The Res'Eau Community Circle[1]

Contents

General Introduction

Strategy is a major preoccupation for many of us. It links us and the ecosystem's concept of supply and demand, and it states where we want to be and how we think we can get there. However, the context of national strategy is shaped by the whys -- whether these policies and programs are justifiable solely to those directly affected, or whether these investments must be defended in terms of their contributions effects on the economy, technology, or another outcome that will benefit the majority. The RES'EAU Community Circle is an innovative method for reconciliation of these two views. It produces new knowledge derived from the interests of the various actors with different levels of cultural sophistication (e.g. urban culture, rural culture, production culture, financial culture, indigenous culture and academic culture). The Community Circle attempts to describe relevant considerations and to pose questions about their relative weight, help decision makers to broaden the range of relevant factors, and make the understanding of such factors deeper and more systematic. Scientific, technological, and academic communities are in a position to further the Community Circle through their unique appeals for public funds, and it is hoped that their important position as special-interest groups will not hinder them from doing so.

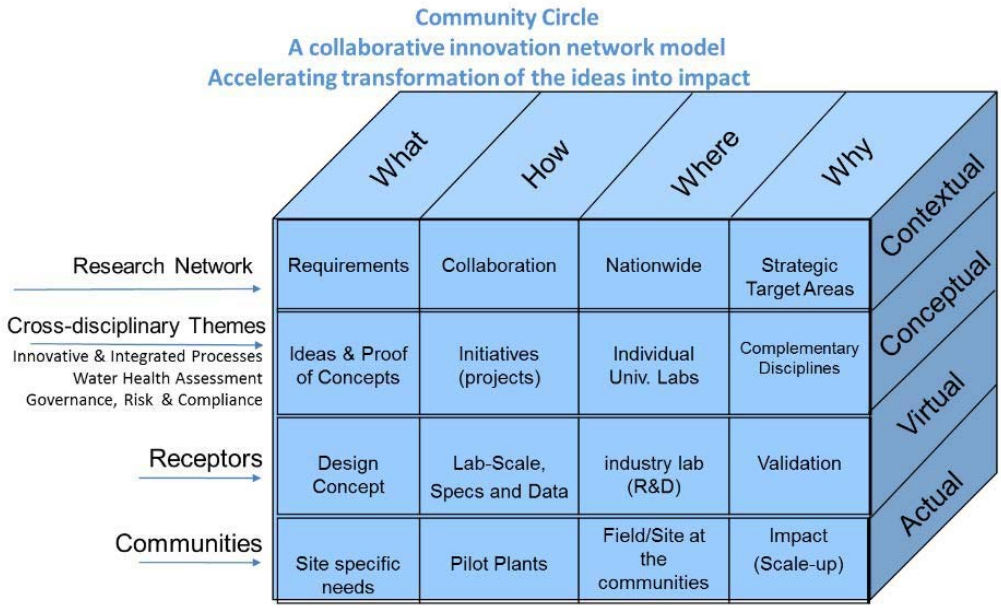
Achieving socially and technologically sustainable outcomes for rural and First Nations water systems has been the primary mandate of RES'EAU-WaterNET. Our achievements through RES'EAU Community Circle:

- Helped to transform the perception of Small and Rural Communities and First Nations' drinking water problems from a poorly understood issue of low national priority to a high priority that is economically viable.
- Streamlined market demand by capturing communities' needs, expectations, preferences and

[1] Extracted from: http://www.reseauwaternet.ca/ , accessed on 3 June 2017 and supplemented with some material from Keyvan Maleki sent in a 9/4/2017 email.

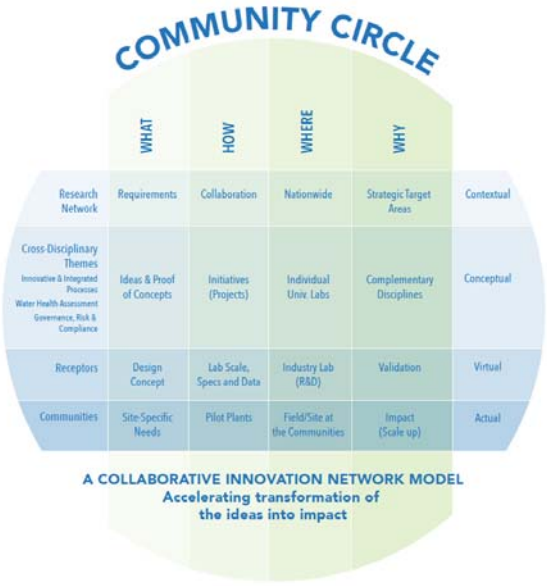
dislikes.

- Positively influenced communities' perceptions about the benefits of collaborating with academia (e.g., community outreach, youth education and engagement programs).
- United communities and operators in the solution development process.
- Built strong partnership with First Nations Operators Water Net of BC and Yukon.
- Performed/performing proof of concept for several innovative treatment methods suitable for small water systems. Three First Nations communities have celebrated the lifting of long standing Boil Water Advisories.
- Encourage better cooperation, communication and collaboration among government departments and agencies (federal and provincial), NGOs, professional associations, communities and academia.
- Provide effective mechanisms to bring researchers and industry together; initiating exchanges between industry professionals and academia; supporting the development of non-technical "innovation skills" involving users and businesses working with engineering and science highly qualified personnel (HQP); develop collaborative proposals and solving significant and complex problems that have important ramifications for Canada.
- Engage all stakeholders, potential collaborators, current and future researchers, community members and others via education and outreach activities (e.g., summer school for Aboriginal youth, workshops for First Nations water operators, professional development for our students); RES'EAU-WaterNET knowledge translation conferences and webinars; panel discussions featuring multi sector experts; fielding speakers and panelists at national and international water events/conferences; participation on national advisory committees; and more. In this manner, we have helped to shape and amplify a national voice and dialogue for small water systems that did not previously exist.
- Working relationship with government agencies and industry include First Nations Operators Water Net of BC and Yukon, First Nations Health Authority, Indigenous and Northern Affairs Canada, Assembly of First Nations, Peter Wall Institute for Advanced Studies, Walkerton Clean Water Centre, Consulting Engineering Firms (Kerr Wood Leidal, Opus International, Urban Systems, Associated Engineering), Trojan Technologies, BI Pure Water, Noram Engineering and Constructors, Tritech, Veolia, professional associations (BCWWA, CWWA), BC Center for Disease Control, Health Canada, BC Ministry of Community, Sport and Cultural Development, and many others.

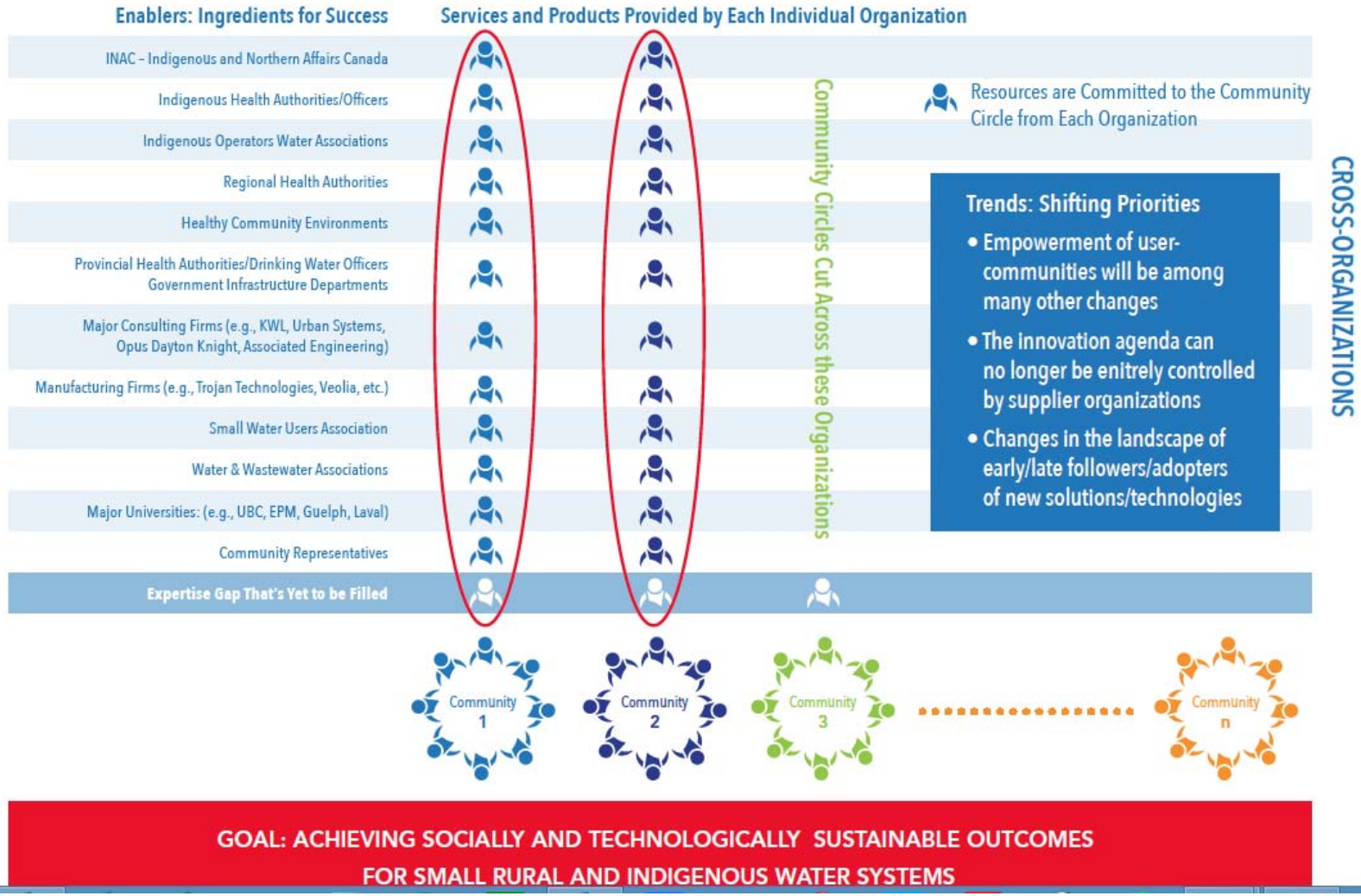


This model takes research program out of the lab and into the real world, incorporating communities, operators, and all stakeholders' expertise and insight at the earliest stages of the problem-solving process. Student/ researchers working closely with communities to understand the limitations and constraints they face. Identify research priorities and design and execute research to produce knowledge and integrated game-changing solutions. These findings are then validated by industry so that they can be readily diffused and adopted. This approach is paving the way in defining a vibrant market space for innovative solutions specific to small and rural water systems. These solutions will be piloted in collaboration with both public and private sector partners and according to guidelines set out by regulatory agencies, either at public sector facilities and/or subsequently in actual communities. Successful solutions will then be scaled up through partnerships with national and international strategic programs, or by industry partners.

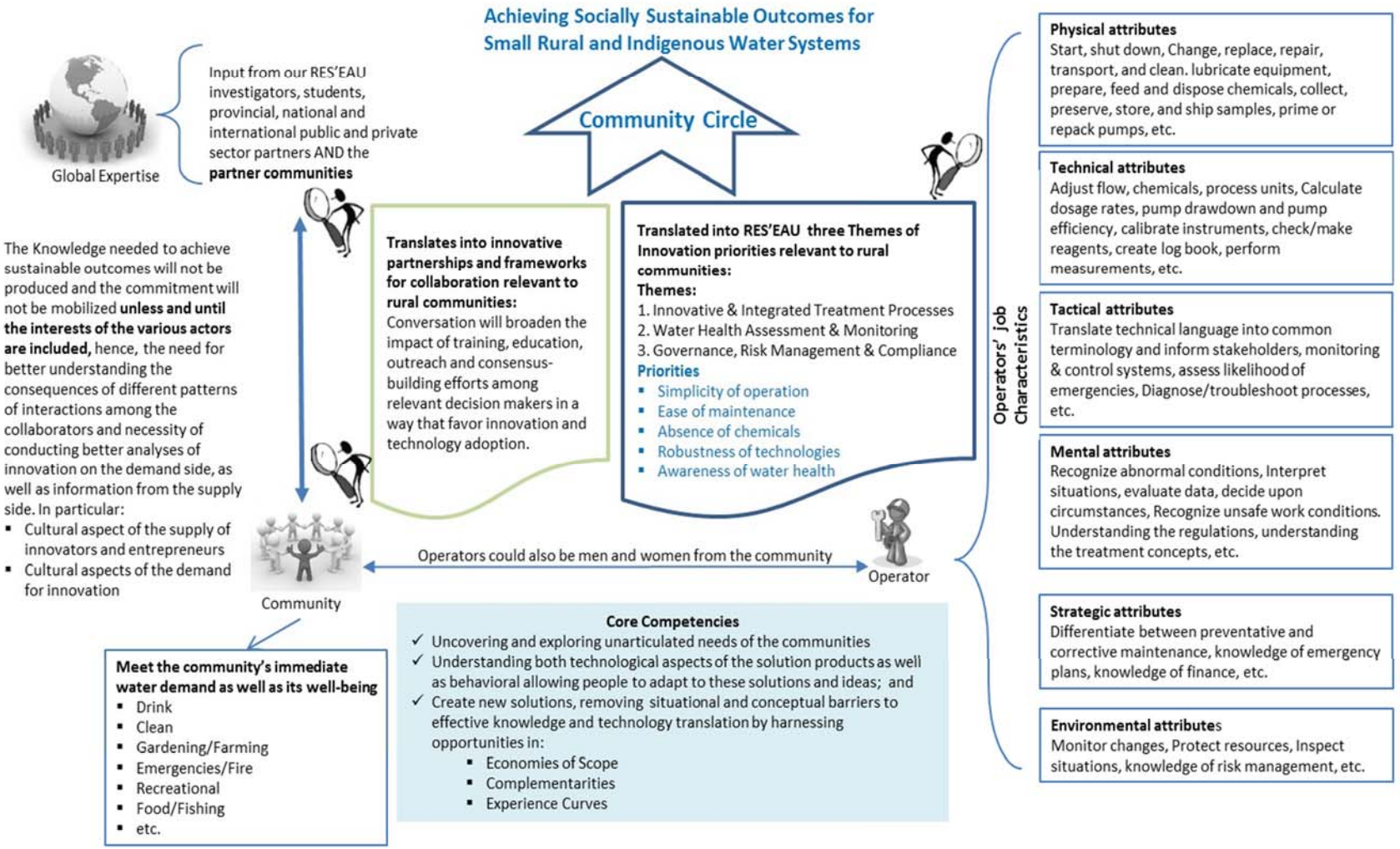
This model allows for participants from every part of the water community to bring their individual concerns and experiences together to explore questions such as: What matters to us as users, operators, engineers, regulators, decision makers, and as a community? And why does it matter? How can we begin to create authentic connections and relationships with others, particularly across the different interests and divisions in the water community? How do we change the water community conversation from one of negotiation to one of dialogue? The aim is to develop new conversations free of the cynicism and resignation inherited from the past and to create new possibilities for a future in which everyone has a place and is valued.

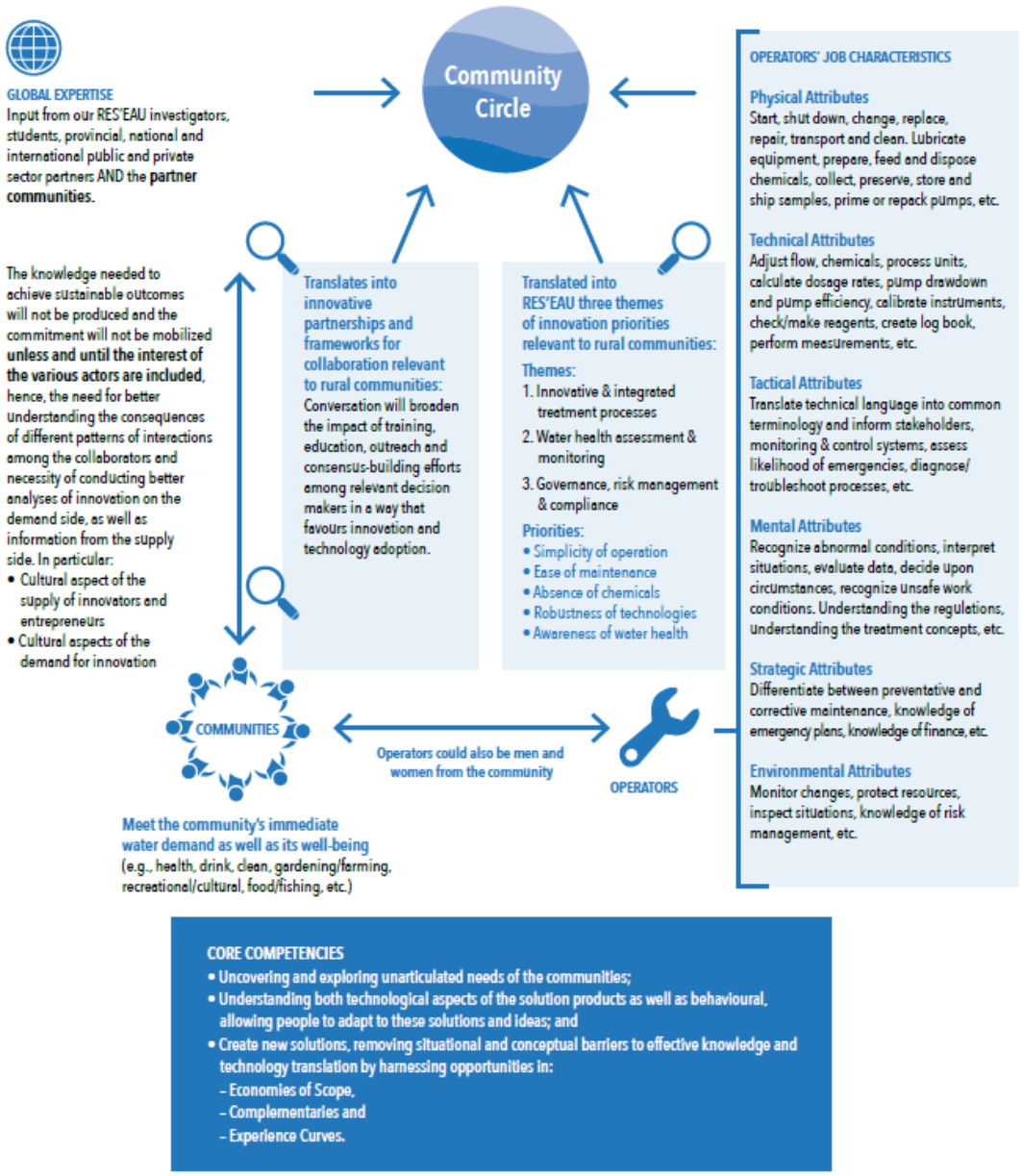

COMMUNITY CIRCLE
WHAT
HOW
WHERE
WHY
Research Network
Requirements
Collaboration
Nationwide
Strategic Target Areas
Contextual
Cross-Disciplinary Themes
Innovative & Integrated Processes
Water Health Assessment
Governance, Risk & Compliance
Ideas & Proof of Concepts
Initiatives (Projects)
Individual Univ. Labs
Complementary Disciplines
Conceptual
Receptors
Design Concept
Lab Scale, Specs and Data
Industry Lab (R&D)
Validation
Virtual
Communities
Site-Specific Needs
Pilot Plants
Field/Site at the Communities
Impact (Scale up)
Actual
A COLLABORATIVE INNOVATION NETWORK MODEL
Accelerating transformation of
the ideas into impact

EXAMPLE OF CONSTRUCTING CROSS-ORGANIZATIONAL INTERACTIONS IN THE COMMUNITY CIRCLE MODEL



Flow of information in the community circle ecosystem





By placing operators at the heart of the innovation cycle and incorporating research insights at the early stages of problem solving, the model cuts across the different challenges specified above.

The figures above outline how operators' six general performance components relate to the network's three research themes. It is virtually impossible to isolate each subcomponent from the others when it comes to operating, diagnosing and solving any problems in water systems. However, separating them for the purpose of providing more details as to how each theme empowers operator performance makes the concept more easily understood. For the sake of simplicity, the timeframes and operators' ability/certification level at which each component becomes seriously stressed have been omitted.

Case Studies

Cowichan Valley Regional District (CVRD) [2013-2015]

Background: CVRD encompasses a large area of 3,475 square kilometres, including four municipalities, nine electoral areas and 34 different utilities. The project focuses on the Shawnigan Lake North Water System, which is used by 2,000 residents (though water is drawn from the lake, which is used by a population of 7,000). The impacts of climate change warms the lake, affecting water quality and increasing demand; population growth and seasonal use also increases demand, which leads to fluctuations in flow and inconsistent chlorine dosing. The formation of disinfection by-products (DBPs) and aesthetic issues are also problems. Current treatment approaches do not adequately address parasite inactivation or removal, and very little space is available to upgrade the treatment facility.

Scope of Work: Our work here involves research on national and international models of devolved water governance, as well as a project seeking to understand climate and watershed land-use impacts on chemical and microbial quality of source water and community vulnerability. We are also evaluating several alternative treatment technologies with the Mobile Water Treatment Research Laboratory (see below) to compare performance, operating costs and practicality. The goal of the project is to determine the most feasible and sustainable water treatment alternatives for Shawnigan Lake and similar communities.

Click here to open a graphic that explains the technical aspects of this project in greater detail.

Progress/Updates: From November 2014 to June 2015, RES'EAU conducted a pilot plant study to evaluate the efficacy and operability of treatment options (nanofiltration, ion exchange and direct filtration) to disinfect and remove organics from the water while improving taste and reducing odour compounds. Results are expected this summer. Community engagement consisted of two public meetings, an open house at the mobile pilot plant and private tours of the plant for local decision makers.

As part of the same Community Circle initiative, RES'EAU participated in a process to improve the governance capacity of small and First Nations communities by developing recommendations for water management in the CVRD region. Prof. Leila Harris of UBC noted that a task force involving 55 local organizations held three workshops as well as other consultations. RES'EAU participated at every level of the consultation process. The task force made several recommendations to the CVRD board:

- Establish a Regional Water Authority
- Transition to the RWA under CVRD leadership
- Provide funding through a CVRD watershed protection service
- Apply watershed-thinking and a risk-based approach

RES'EAU Scientific Director Dr. Madjid Mohseni addresses the community in Shawnigan Lake

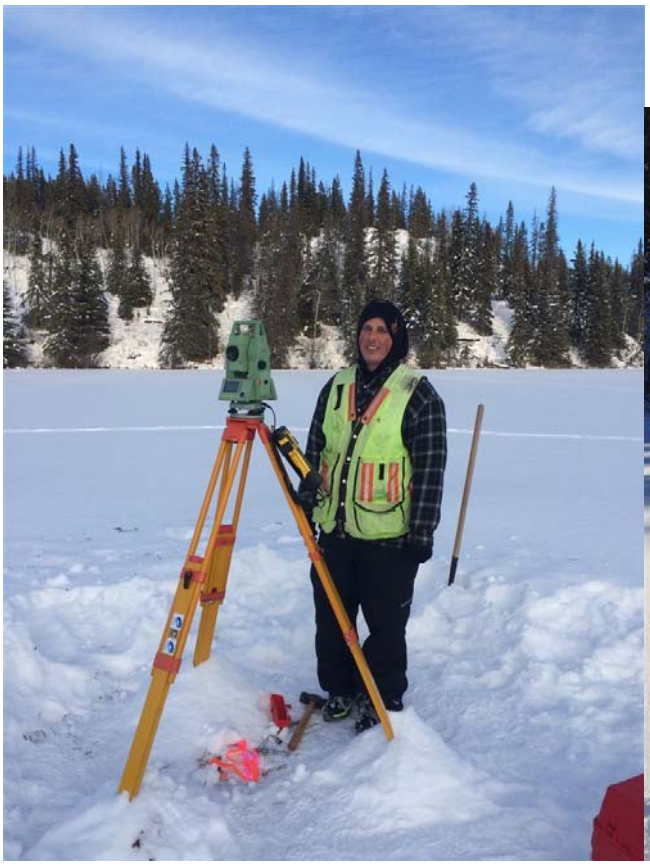
RES'EAU's Mobile Water Treatment Research Laboratory deployed at Shawnigan Lake

Lhoosk'uz Dené Nation (Kluskus First Nations)

Background: A small, rural, and isolated aboriginal community in central British Columbia, the Kluskus Indian Reserve lacks access to potable water meeting the Canadian federal and provincial standards. Two deep, untreated water wells with high iron and manganese levels are the current water source; ;they are also located in close proximity to a failing septic bed.. These heavy metals cannot be removed via boiling. The residents find the colour, taste and residual stains of the water unpleasant and thus rely on bottled water for consumption. Kluskus is in the process of determining the feasibility of an alternative drinking water source. Currently, the community lives under a boil water advisory.

Scope of Work: Our work for 2015-2017 will focus on determining the feasibility of surface and ground water (including Tony's Lake and Kluskus Creek) as drinking water sources. This process will involve developing a comprehensive water quality database for each source, collecting data on their potential to form disinfection by-products, identifying the optimal point to draw water, identifying suitable water well locations, and understanding trends in source water quality to develop a treatment plan.

Project team meeting with Elders and community members of Kluskus IR 1 to discuss drinking water solutions.




Project team conducting a terrestrial survey of Tony's Lake. (January, 2016); Project team measuring the depth and volume of Tony's Lake. (January, 2016)

Project crew working with Kluskus Water Operator to deliver hydrometric equipment to Tony's Lake. (January, 2016)

To date, the residents of Kluskus IR 1 depend on weekly deliveries of 5-gallon water containers for all their drinking and cooking water needs. (January, 2016)

View from the existing water well.

The former septic system.

The community's failing septic field.

RES'EAU's Scientific Director, Dr. Madjid Mohseni, address the community at a gathering to discuss local water requirements.

RES'EAU-WaterNET and Department of Chemical and Biological Engineering at UBC welcomed Chief Liliane Squinas and Lhoosk'uz Dené Nation (Kluskus) for a facility tour and discussion in 2014.

Tony's Lake, one of the two viable options for sourcewater for the community

Kluskus Creek, another potential water source.

The RES'EAU team on a site visit in 2015.

Lytton First Nation IR25 (Nickeyeah)

Background: Lytton First Nation is located in BC on 14,161 acres of land divided into 56 reserves. The reserves are located at the site of the Indian Village of Kumsheen, meaning, "where the rivers cross."

The Lytton First Nation is rich in natural resources. Water availability is perhaps one of the most significant natural resources available to the Nation. The Stein River water system meets the water needs of a large proportion of community members while other community wells provide water to other members. Natural spring waters are available in various areas.

Scope of Work: Here, our partnership focuses on upgrading the water system in Lytton First Nation IR25 (Nickeyeah), which includes improving water intake and treatment as well as the local reservoir. This work requires an understanding of the seasonal variability in source water quality while assessing the feasibility of various technologies for water treatment in the community using our new, state-of-the-art Mobile Water Treatment Pilot Plant (see below).

Progress/Updates: RES'EAU's work focused on engaging band members and local water operators to understand the community's challenges and determine needs for upgrading the local water system. This included improving water intake and treatment as well as the local reservoir. Project partners also included Aboriginal Affairs and Northern Development Canada (AANDC), BI Pure Water, KWL and Lillooet Contracting.

A water sampling program was undertaken to assess water quality and determine seasonal variability. Potential technologies – including bag, cartridge and self-cleaning filters, ion exchange, activated carbon and UV systems – were then tested for three months using the network's state-of-the-art Mobile Water Treatment Pilot Plant. Upgrades were made to the water intake, and the design and construction of a water treatment plant and water storage have been completed. Along the way, local operators were consulted to ensure the end goal was always top of mind.

Click the cover image below to open a PDF summary of the Lytton project to date.

COMPLETING THE CIRCLE

Lytton First Nation and RES'EAU partnership proves communities have a central role to play in problem solving – and that even making mistakes can enable us to achieve positive synergy in the innovation process

RES'EAU-WaterNET's Community Circles initiative places community operators at the heart of the innovation cycle, incorporating their insights at the earliest stages of the problem-solving process. We work with communities to identify the key challenges they face, and to design and execute research to produce knowledge and technologies suited to their individual needs. We then pilot test promising new solutions under real world conditions, and integrate community feedback into our refinement process.

Lytton First Nation has been a great partner for RES'EAU as we work to identify ways to involve small, rural and First Nations communities in research on new, affordable and sustainable water treatment systems. Researchers, students, engineers, and industry partners have been grateful for the opportunity to connect with and learn from the community – it's been an enlightening experience that has informed our overall approach to working with communities across the country.

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The success of the entire process hinged on meaningful community engagement, which included interviewing elders and water operators, holding talking circles and completing questionnaires with stakeholders and organizing a workshop for operators. As you will see by reading on, we didn't execute the community engagement piece quite as well as we had hoped.

"For any project to be successful you really have to have a good team, but you also need to have a good champion from the community or a dedicated group of individuals from the community. [Here], they have a truly dedicated group of individuals who are participating."

– Jim Brown, Level II Operator, Maintenance Manager and Lead Operator, Lytton First Nation, speaking at RES'EAU's 2015 AGM in May

As part of our community engagement activities, we also worked with partners including Nlaka'pamux Nation Tribal Council/ShchEma-mee.tkt Project, Stein Valley Nlakapamux School, Lytton Elementary School and Hannah C/Reel Youth Productions to engage Lytton's youth to learn about their local water situation, the Nickeyeah IR 25 Project and the broader RES'EAU program. After holding an information session and a one-day workshop for youths to learn about their local water situation, youth were given a tour of the local watershed and treatment plant to learn about the challenges of water management and sustainability. They then summarized their experience and learning by creating short videos about water in their community. Click the screen shot below to view one of videos.

RES'EAU personnel and partners meet with community Elders in Lytton, BC.

Validating water treatment technologies tailored to the local needs of small, rural and First Nations communities (SRCs) has gone mobile thanks to a partnership between RES'EAU-WaterNET, UBC, the Peter Wall Institute for Advanced Studies (PWSI), IC-IMPACTS , Trojan Technologies and BI Pure Water.

The Mobile Plant working on site in Lytton.

Partners celebrate the completion of Lytton's new water treatment plant at the BI Pure Water facility in Vancouver.

The new plant is lowered into place.

The interior of the new treatment plant.

A trust circle is held with community members and project partners to mark the completion of the plant installation.

As a result of this work, two First Nations reserves in British Columbia (IR3 Spintlum and IR11 Yawaucht in the Lytton First Nations) celebrated the lifting of long-standing Boil Water Advisories (BWAs) in 2017.

The project united the efforts of several partnering organizations including the First Nations Health Authority, Indigenous and Northern Affairs Canada, the First Nations' Operators Water Net for British Columbia & Yukon Territories and private manufacturing, consulting and contracting firms. They worked closely throughout fourth quarter of 2016 with the Lytton First Nations leadership, dedicated water operators, and residents, to assess the feasibility of point-of-entry (POE) systems to meet site specific needs of individual systems (those serving fewer than five homes).

Specifically, the pilot program sought to determine the circumstances under which a POE approach would be cost effective compared with other alternative treatment options. The team will continue to identify site-specific considerations that could impact the system’s effectiveness, such as water quality variations, water demand, pilot test protocols, public education, technology selection, installation, operations, monitoring plans, liabilities, capital and O&M costs and logistic and administration strategies.

By the end of 2016, new POE systems were in place, and the BWA's were lifted in January 2017. Follow-up work to assess the community's satisfaction and -in collaboration with the residents

and operators- to monitor system performance and operations and maintenance costs are ongoing.

Information and data gathered during this period will help to determine if POE systems are a robust, cost-effective solution for small, remote communities where a centralized water system would be cost prohibitive.

Dzitl'lainli (Middle River) (Tl'azt'en First Nations)

Background: Tl'azt'en First Nation is looking to reintroduce an effective water treatment system for the Middle River community. Located over 110 km from Fort St. James, BC, Middle River currently has five to eight year-round residents, and an additional five to 10 non-permanent residents. Middle River is currently under a boil water advisory. The community has one dedicated water treatment operator. Over the course of two days during the summer of 2015, RES'EAU-WaterNET staff met with several elected counselors from Tl'azt'en First Nation, elders, the chief and several public works staff. There exists significant support from public works employees, elected officials, and band members to implement a new pilot-water treatment plant at its' earliest opportunity.

Scope of Work: The following tasks are proposed to determine the optimal treatment method for Middle River:

Source water quality and seasonal variation monitoring.

Last spring, we developed a water quality database to understand water quality in Middle River as seasons change. Operators collected water samples from different locations (raw water, finished water and tap water) and shipped them to Vancouver for analysis. The laboratory at UBC analyzed the samples for general water quality parameters including, pH, turbidity, dissolved organic carbon, ultraviolet transmittance and anions. The British Columbia Centre for Disease Control then analyzed the water samples for E. coli and total coliforms. Team members from Laval University assessed samples for disinfection by-product formation potential. These parameters were specifically chosen to ensure that the designed water treatment system is able to treat the unique water matrix of the community.

Community engagement: consultations and knowledge transfer activities.

RES'EAU-WaterNET will organize two community workshops and knowledge transfer sessions. Our Community Circle approach will be used to facilitate dialogue with the community about the project and future activities, and it will seek community feedback as we progress.

Technology piloting and evaluation, using RES'EAU-WaterNET mobile pilot system.

From September, 2015 to the end of year, RES'EAU's Mobile Water Treatment Pilot Plant will be on site in Middle River.

Running the pilot through the fall will be important for capturing how the treatment processes perform with deteriorating water conditions, as organics in the water increase. This will also allow sufficient time for running various scenarios of treatment options, ensuring that the most fitting treatment method for Middle River is optimized.

The treatment processes will involve ion exchange, ultraviolet disinfection and filters of various pore sizes. These treatment units have specifically been chosen because of their feasibility for the

community. The units require no chemical dosing, which reduces daily operating and maintenance costs. The units can be easily maintained with little training.

The efficiency of each of the processes will be determined by taking samples of the raw water as well as following each treatment process. The samples will be analyzed for turbidity and pH in the field for real time feedback and to allow for necessary adjustments to be made. The samples will then return to UBC for further in-depth physiochemical analysis.

This will allow removal efficiency of each treatment process to be assessed. The treatment units will be analyzed as stand-alone options and in series with various combinations of units employed.

Once the treatment efficiency of the treatment processes is known, the economics and feasibility of the treatment options can be weighed. This will include the operations and maintenance costs as well as their complexity, and any required training to operate the treatment processes.

Evaluation of alternative source waters (i.e., shallow wells, groundwater).

Here, RES'EAU will:

- Gather all previous reports on possible water sources and reports on environmental issues that could be effecting potential drinking water sources;

- Summarize all reports and determine if there is an alternative water source worth pursuing further; and

- Present results to the community and discuss to gain insight into their thoughts of our findings.

Evaluating the feasibility of decentralized options, such as point-of-entry water treatment.

RES'EAU-WaterNET will work with the community and its water operators toward the development of alternative solutions to the drinking water challenges of reserves that serve a small number of homes. One such option is the use of point-of-entry (POE) treatment systems. If there is support from the residents and the water operators, we believe POEs may offer a viable alternative to an otherwise costly central treatment system.

Detailed feasibility studies and design of a treatment system.

Once the data from the above project milestones has been gathered and consolidated, a detailed feasibility study will be completed. The advantages and disadvantages of each option will be fully investigated. For each viable option, a life cycle cost analysis will be completed. Feedback from the community engagement will be heavily weighted to ensure that the chosen option meets the community's wishes.

Once all of the viable options have been weighed and thoroughly analyzed, the preferred option will be developed and designed. This will include detailed drawings and calculations for the chosen option. A third party consulting firm will be contracted to for the detailed drawings.

Progress/Updates: The RES'EAU Mobile Water Treatment Pilot Plant will be on site in Middle River until the end of the year, conducting technological evaluations. Check back for updates!

An all too common occurrence in small and First Nations communities in Canada.

The Mobile Water Treatment Pilot Plant arrived in Middle River in October, 2015.


RES'EAU
WATERNET
An NSERC Small Water System Strategic Network
UBC

Van Anda Improvement District (VAID)

Our partner consortium here strives to identify, validate and implement sustainable technologies and processes that form a multi-barrier approach to the delivery of safe drinking water.

Background: The Van Anda Improvement District (VAID) is a small community of 550 people located on Texada Island, one of the Gulf Islands off the coast of British Columbia. VAID's drinking water is unique in that water from Priest Lake is high in dissolved organic carbon (organic material that results from the decomposition of plants and animals). While the district has set aside a capital reserve fund for a new water system, pilot testing the many potential new technologies would rapidly deplete the fund.

Click the image below to view a short intro video about VAID and the challenges the community faces.

Click the image below to hear perspectives from members of the community's Board of Trustees.

Videos courtesy of David Sommer, a Ph.D. candidate in the Department of Mechanical Engineering at the University of British Columbia.

Scope of Work: Our partner consortium here strives to identify, validate and implement sustainable technologies and processes that form a multi-barrier approach geared toward VAID's distinct needs. RES'EAU is capable of working with the community to identify goals and then test several prospective solutions simultaneously in our Mobile Water Treatment Pilot Plant at an efficient cost.

The outcome will be a system the community can afford to implement and maintain that will provide quality drinking water and fully protect the health of the community.

Progress/Updates: The RES'EAU Mobile Water Treatment Pilot Plant is on site in the community. Check back for updates on our technology assessments.

Related: The photos below capture the delivery, installation and operation of RES'EAU-WaterNET's Mobile Water Treatment Pilot Plant in VAID during the late summer of 2015.


Mobile Water Treatment Pilot Plant
TROJAN


Well Mate


RES'EAU
WATER
An NSERC Small Water System
UTE FOR ADVANCED STUDIES

White Rock, BC

Background: White Rock, BC is a city of just over 18,000 people. As part of the Greater Vancouver Regional District, it lies on Semiahmoo Bay, surrounded by South Surrey on three sides. Until 2015, the city's drinking water disinfection system was privately run by an Edmonton-based utilities company. Major upgrades to the system were required, and the Fraser Health Authority ordered that chlorination be increased in response to an E. coli outbreak in 2010. White Rock city council voted in mid-July to fund water infrastructure upgrades including two treatment plants capable of reducing naturally occurring manganese and arsenic in their source water.

Scope of Work: The objectives of our piloting activities include the evaluation of several alternative treatment technologies, including technologies already available commercially such as GreenSandPlus, ozonation and membrane filtration. We will then pilot test the most promising technologies to evaluate their viabilities both in terms of performance and economics. The pilot work will be conducted in close collaboration with the City engineers and involves RES'EAU's industry partners who have extensive experience with groundwater treatment and quality.

Progress/Updates: The network's Mobile Water Treatment Pilot Plant will be in White Rock for six months testing various combinations of technologies that will result in a sustainable and affordable system capable of removing natural and man-made contaminants from our groundwater sources. The mobile facilities allow for faster, accurate and more cost-effective assessment of potential technologies than traditional methods. The plant was installed at White Rock in late November, 2016.

Fraser Health Professionals touring the Pilot Plant, May 2017