ALBERTA INNOVATES

FINAL PROJECT REPORT

Reporting Period: 1 April 2017 to 2 March 2018

Project Title: The Future of Water: Engaging Albertans in the Water-Energy-Food Nexus
AI Project Number: AI 2419

Project Leader: Megan Van Ham
Lead Institution: Alberta WaterPortal Society
Project Partners: Alberta Real Estate Foundation, Anonymous Funder

Project Start Date: 1 April 2017
Project End Date: 28 February 2018

Project Budget: $120,000
AI Funding: $60,000

Project Schedule		Cost Status		Milestone Achievements	
	Project on schedule	X	Cost on budget (±10%)	X	All deliverables achieved
	Project delayed		Cost overrun		Partial achievement of deliverables
	Project cancelled		Cost underrun		Major setbacks encountered
X	Project complete				

1. Overall Project Objectives

1.1 Overall scope and objectives of the project.

The Water-Energy-Food Nexus project provided research and shared context for Albertan consumers on how converging water demands can impact new developments, land use decisions, and socio-economic factors related to homes such as energy and food.

Phase I of the project was undertaken from October 2015 to April 2016. This introductory phase included research into the Nexus concept in the Bow River sub-basin, sharing the concept through case studies via the Alberta WaterPortal, and creating a simulator for the public to challenge themselves to manage water trade-offs in the Bow River Basin in 2030. Phase I of the project was made possible through funding from Veolia, Enbridge, and the Alberta Real Estate Foundation.

This project, Phase II, improved upon and further investigated Phase I work through stakeholder input, consumer-centric socio-economic research, and a key workshop featuring representatives from academia, regional development, irrigation and watershed management, government and NGO organizations, and energy companies. Phase II of the project was made possible through funding from Alberta Innovates, the Alberta Real Estate Foundation, and an anonymous donor.

This project had two primary goals:

1. Apply the Nexus concept with research on socio-economic aspects, as a way to connect potential impacts of water management with individuals' lives.
2. Stakeholder input and feedback on the existing simulation, which the WaterPortal will gather, analyze and enact to improve and update the existing Nexus simulator on the WaterPortal.

In addition to the Nexus project, and as part of ongoing engagement and outreach undertaken by the WaterPortal, the Alberta WaterPortal News was supported through this project. Throughout the project delivery, the News leveraged opportunities to build awareness about the Nexus concept from both WaterPortal and third-party sources.

1.2 Changes that have occurred to the original goals and objectives of the project.

There have been no changes to the original goals and objectives.

1.3 Changes to the scope and overall approach for execution of the project.

The project deliverables, tasks, scope and budget remained unchanged from the original plan.

A timeline change was made to move the stakeholder engagement workshop forward. This allowed the project team to gather feedback to inform all areas of the project, rather than just the simulator. The only impact to other tasks in the project from this change was a pause in the social-economic and ethical impact research.

Another change in the project execution was leveraging a summer student with the WaterPortal to help complete the mobile responsive update to the website to accommodate a more accessible simulator. Through another program's funding, the student led updates to the overall website structure and navigation, making it easier for website users to find projects like the Nexus and more effective with funder recognition on the website.

2. Project Relevance and Benefits

2.1 How the project will result in, enable, or lead to water, other environmental, economic, and social benefits in Alberta.

Alberta is projected to add 1.8 million residents by 2040. Over the same time period, climate change is expected to lead to a reduction in available water resources. In this context, an understanding of the converging demands for water from communities, as well as the energy and food production sectors are critical to inform future water management decisions. This project engaged stakeholders and, longer term, the public, to encourage consideration of the water-energy-food nexus (Nexus) and support more holistic water management decision-making in Alberta.

The project researched and shared context for Albertan consumers on how converging water demands can impact new developments, land use decisions, and socio-economic factors related to homes such as energy and food and other costs of living.

Led by the Alberta WaterPortal Society (WaterPortal), the project team leveraged Albertan expertise and collaboration opportunities to build on the interests and experiences of relevant stakeholders. Directed by this, the project team conducted Phase II research, refined the simulation tool (developed in Phase I) and delivered on knowledge sharing opportunities.

Results of this work include:

- Improved awareness of decision making for water management considering competing demands across industries and water applications.
- Access to an Alberta-relevant Nexus concept to all Albertans through the Alberta WaterPortal.
- Funder participation in the research and knowledge sharing process, to include different perspectives and challenge assumptions across industries.
- Informing future, beneficial water management through more holistic water-related planning and education, supported by publicly available tools.
- Addressing critical water and land-use challenges arising due to population growth, greater global food demand, and local energy consumption.

These cumulative results will ultimately impact the sustainability of Alberta's water resources by encouraging the public and decision makers to consider the trade-offs between different water uses, and to encourage new conversations and connections across potentially siloed water management across industry, government, and NGOs.

2.2 How the project will inform or support a provincial strategy, policy, regulation or operational practice.

Per the investment priority outlined in the Alberta Innovates Water Innovation Program for Alberta, Phase II of the Nexus project addresses Theme 1 – Future Water Supply and Watershed Management. Specifically, the Nexus work directly relates to understanding the impacts of food and energy production and climate change on water supply and demand (Water-Energy-Food Climate) Nexus.

This project will inform the Government of Alberta's approach to Integrated Resource Management and Cumulative Effects Management policies. With direct stakeholder input and improvements, the simulator will progress as an interactive and experiential tool for the public to understand the complexity of the Nexus and decision-making across various sectors including; government,

municipalities, agriculture, energy, and other industries who are planning or considering future water management.

2.3 Changes or updates to the anticipated relevance and benefits of the project; why these changes have occurred and the driving forces behind the change.

Hosting the stakeholder workshop earlier in the project timeline and broadening the scope of the feedback collected from participants has resulted in a broader benefit for the project content, and therefore Alberta audiences. Creating an opportunity to bring together people from across industry (food, energy, communities) to discuss water in an interactive and collaborative manner was reported as a useful and beneficial opportunity (see progress and accomplishments).

3. Project Accomplishments

3.1 The following table outlines the tasks completed through the Nexus project

Task #	Task Description	Comments on Tasks and Milestones
Task 1	Phase II kick off meeting and scope confirmation.	Kick off meeting confirmed the scope via a task list, budget and Gantt.
Task 2	Socio-economic research and development of new content for the WaterPortal website.	Research was conducted to gather data and information for the development of three web section that detail how water is used and conserved in the people, energy, and food sectors. This research benefitted from feedback from external stakeholders via the workshop. The research also looked at connections in the Nexus and ethics of trade-offs with practical examples presented in a matrix. A second version of the water use simulator was developed. This effort incorporated an update to make the WaterPortal website mobile responsive and more accessible across various devices. A summer student (funded outside this program) enhanced the mobile responsive migration by updating the navigation and structure of the WaterPortal site. This will make projects like the Nexus easier to find on the site and enhance funder recognition.
Task 3	Plan, prepare and deliver video.	A two-minute video was created to provide a brief and engaging introduction to the concept of the Water Nexus involving people, energy and water. A video format was used in place of a webinar format as it was deemed to be a longer lasting media better suited for this project's purpose.
Task 4	Stakeholder workshop with attendees across government, NGOs,	A successful workshop was hosted on Monday 31 July 2017 at the University of Calgary. It attracted 32 participants and the feedback was positive. Themes from the workshop guided the all of the project work and deliverables.

Task #	Task Description	Comments on Tasks and Milestones
	industry groups and water experts.	A webpage on the WaterPortal was developed to share the insights gathered at the workshop and recognize the inputs of participants.
Task 5	Ongoing project management and communications.	Every two weeks the project team met to address work to date, upcoming work and any obstacles. Financial reporting was maintained on a monthly basis. Phase III scoping was completed and produced three viable and valuable concepts for Phase III of this Nexus work.
Task 6	Evaluation and project close.	The workshop evaluation was incorporated into the interim project evaluation. The number of times the simulator is used and how often the web content is viewed will be tracked.
News	Preparation and e-distribution of bi-weekly Newsletter	Every Tuesday and Thursday from May to October 2017, the e-mail based Alberta WaterPortal newsletter was circulated to over 800 recipients with Alberta Innovates as its banner sponsor.

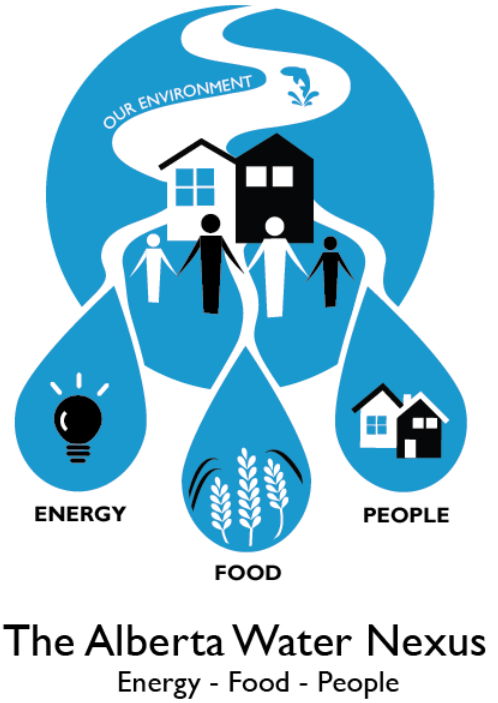
3.2 Examples of the deliverables completed and launched through this project.

Task 4: Photographs of the products developed at the stakeholder workshop

Task 4: Key learnings and feedback captured in the stakeholder workshop:

- Communities are the most important in the Nexus
- Imbalance is always going to happen
- Different stakeholders = different values/perspective/priority
- The Nexus demands a greater scope of data
- Individuals influence all aspects of The Nexus
- The simulator needs to be gamified / other opportunities
- Feedback about the workshop overall

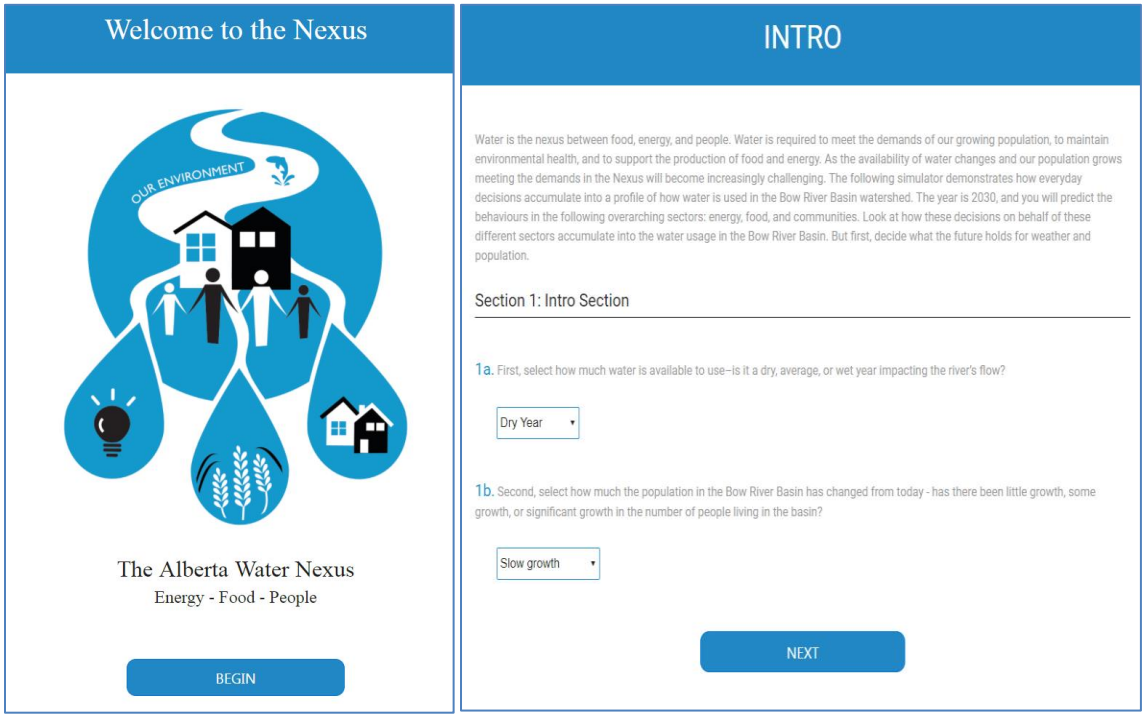
Task 3: The new Water Nexus logo; updated to put people at the centre of the Nexus as per direction received at the stakeholder workshop

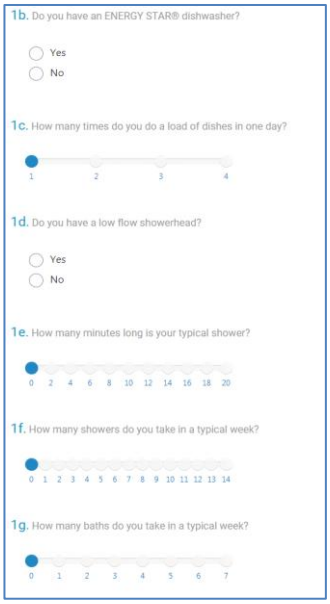


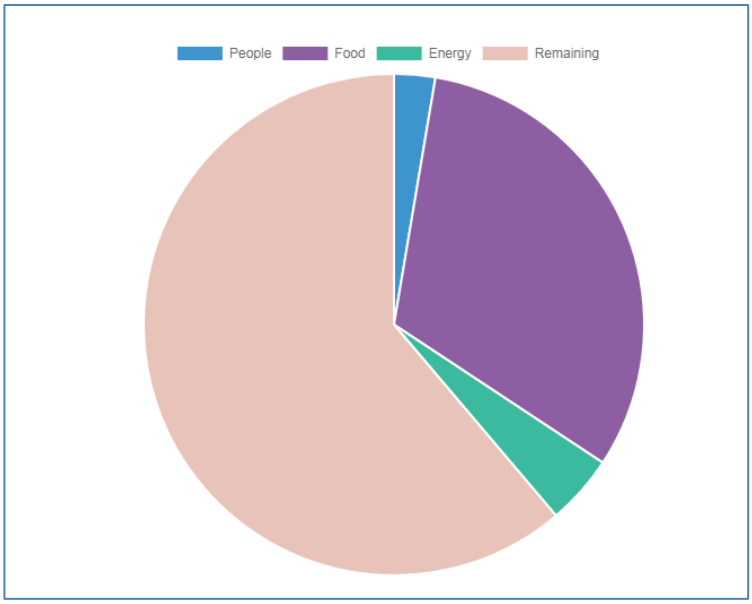
Task 3: A still from the two-minute video; explains the water-food-energy-people Nexus concept for a general audience. The full video can be seen at https://albertawater.com/nexus.

The Alberta Water Nexus: Energy, Food, and People

Task 2: Screenshots from the new Water Nexus simulator; allows visitors to make water decisions.







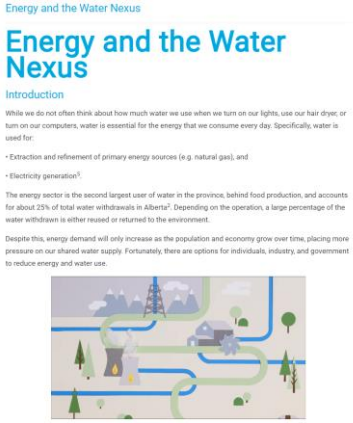
Task 2: Screenshots from the web based information developed to share the research on how water is used and conserved as part of the People, Energy, and Food sectors. This research is partly stand-alone, but also provides supporting information for the simulator.


People and the Water Nexus

People and the Water Nexus

Introduction

People impact the Alberta Water Nexus in many ways. We are directly connected to the Nexus through the taps in our home, the energy we use, and the food we eat. People use water when they take showers, wash dishes and clothes, irrigate lawns, and any other activity that involves a household water supply. Municipalities supply water to most households in Alberta, and have an important role in the Nexus, being the third largest allocation of water in Alberta, behind cooling and irrigation. Municipalities constitute approximately 11% of total water allocation[1].


Energy and the Water Nexus

Energy and the Water Nexus

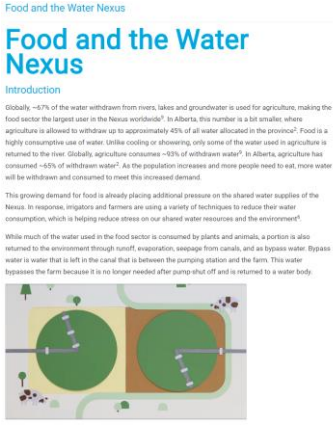
Introduction

While we do not often think about how much water we use when we turn on our lights, use our hair dryer, or turn on our computers, water is essential for the energy that we consume every day. Specifically, water is used for:

- Extraction and refinement of primary energy sources (e.g. natural gas), and
- Electricity generation[3].

The energy sector is the second largest user of water in the province, behind food production, and accounts for about 25% of total water withdrawals in Alberta[2]. Depending on the operation, a large percentage of the water withdrawn is either reused or returned to the environment.

Despite this, energy demand will only increase as the population and economy grow over time, placing more pressure on our shared water supply. Fortunately, there are options for individuals, industry, and government to reduce energy and water use.


Food and the Water Nexus

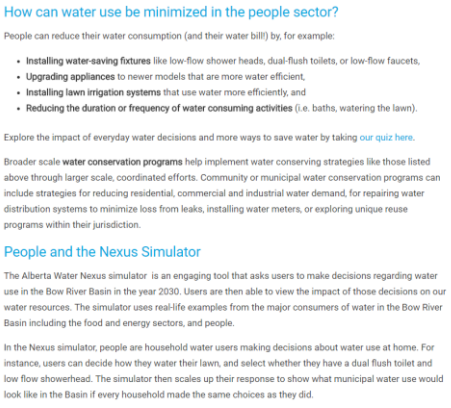
Food and the Water Nexus

Introduction

Globally, ~67% of the water withdrawn from rivers, lakes and groundwater is used for agriculture, making the food sector the largest user in the Nexus worldwide[3]. In Alberta, this number is a bit smaller, where agriculture is allowed to withdraw up to approximately 45% of all water allocated in the province[2]. Food is a highly consumptive use of water. Unlike cooling or showering, only some of the water used in agriculture is returned to the river. Globally, agriculture consumes ~93% of withdrawn water[3]. In Alberta, agriculture has consumed ~65% of withdrawn water[2]. As the population increases and more people need to eat, more water will be withdrawn and consumed to meet this increased demand.

This growing demand for food is already placing additional pressure on the shared water supplies of the Nexus. In response, irrigators and farmers are using a variety of techniques to reduce their water consumption, which is helping reduce stress on our shared water resources and the environment[4].

While much of the water used in the food sector is consumed by plants and animals, a portion is also returned to the environment through runoff, evaporation, seepage from canals, and as bypass water. Bypass water is water that is left in the canal that is between the pumping station and the farm. This water bypasses the farm because it is no longer needed after pump shut off and is returned to a water body.


How can water use be minimized in the people sector?

People can reduce their water consumption (and their water bill!) by, for example:

- **Installing water-saving fixtures** like low-flow shower heads, dual-flush toilets, or low-flow faucets,
- **Upgrading appliances** to newer models that are more water efficient,
- **Installing lawn irrigation systems** that use water more efficiently, and
- **Reducing the duration or frequency of water consuming activities** (i.e. baths, watering the lawn).

Explore the impact of everyday water decisions and more ways to save water by taking our quiz here.

Broader scale **water conservation programs** help implement water conserving strategies like those listed above through larger scale, coordinated efforts. Community or municipal water conservation programs can include strategies for reducing residential, commercial and industrial water demand, for repairing water distribution systems to minimize loss from leaks, installing water meters, or exploring unique reuse programs within their jurisdiction.

People and the Nexus Simulator

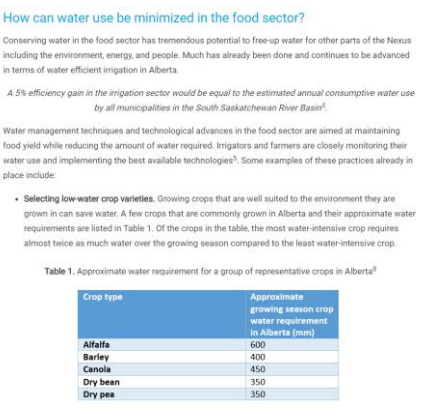
The Alberta Water Nexus simulator is an engaging tool that asks users to make decisions regarding water use in the Bow River Basin in the year 2030. Users are then able to view the impact of those decisions on our water resources. The simulator uses real-life examples from the major consumers of water in the Bow River Basin including the food and energy sectors, and people.

In the Nexus simulator, people are household water users making decisions about water use at home. For instance, users can decide how they water their lawn, and select whether they have a dual flush toilet and low flow showerhead. The simulator then scales up their response to show what municipal water use would look like in the Basin if every household made the same choices as they did.


How can water use be minimized in the energy sector?

The options for reducing water consumption for energy include:

- **Investing in alternative or renewable technologies** such as wind, hydroelectric, and solar, is one way to reduce water use for energy production. Unlike thermoelectric power plants, these energy technologies tend to have fewer impacts on water, as they withdraw and consume very little, if any, water after construction. As such, these technologies may be desirable to reduce the strain on water supplies resulting from a growing population and increased demand for water from people and food sectors. It is important to remember that each technology has its pros and cons, in terms of cost of start-up, use of available space, and environmental impact, and that one type of energy generation will not satisfy the needs of all electrical consumers.
- **Technology to improve water use in existing energy projects.** There are a wide range of technologies that support water efficient energy systems or energy efficient water systems. Options for cooling during the thermoelectric generation process is a strong area of focus for water use efficiency, as this step is the largest user of water[2]. Solutions often seek to reduce cooling requirements by reducing waste heat, using new thermoelectric materials, or using new heat exchanger technologies. Other examples of cooling technology include:
  - efficient air flow designs,
  - water recovery systems,
  - hybrid or dry cooling, or
  - treatment of water used to clean cooling devices (called 'blowdown' water) so that it can be re-used for irrigation or other purposes.
- There are also several technologies that treat non-traditional water sources to allow their safe use in place of fresh water for cooling or other uses[2]. Non-traditional water sources include oil and gas produced waters, saline aquifers, brackish groundwater, brines, seawater, and municipal wastewater. For saline sources, there are a number of water treatment technologies that could permit of the use of saline water in thermoelectric generation.
- **Increasing energy efficiency** to reduce energy consumption, while still maintaining the same level of service. By reducing our energy consumption through energy efficiency, we directly reduce water consumption. There are many ways individuals, business, and government have increased energy efficiency, such as:
  - installation of energy efficient products like LED lightbulbs, new insulation, windows, and smart thermostats[2]; and
  - implementation of municipal and regional energy efficiency education programs that provide resources and information for home and business owners[5].


How can water use be minimized in the food sector?

Conserving water in the food sector has tremendous potential to free-up water for other parts of the Nexus including the environment, energy, and people. Much has already been done and continues to be advanced in terms of water efficient irrigation in Alberta.

A 5% efficiency gain in the irrigation sector would be equal to the estimated annual consumptive water use by all municipalities in the South Saskatchewan River Basin[6].

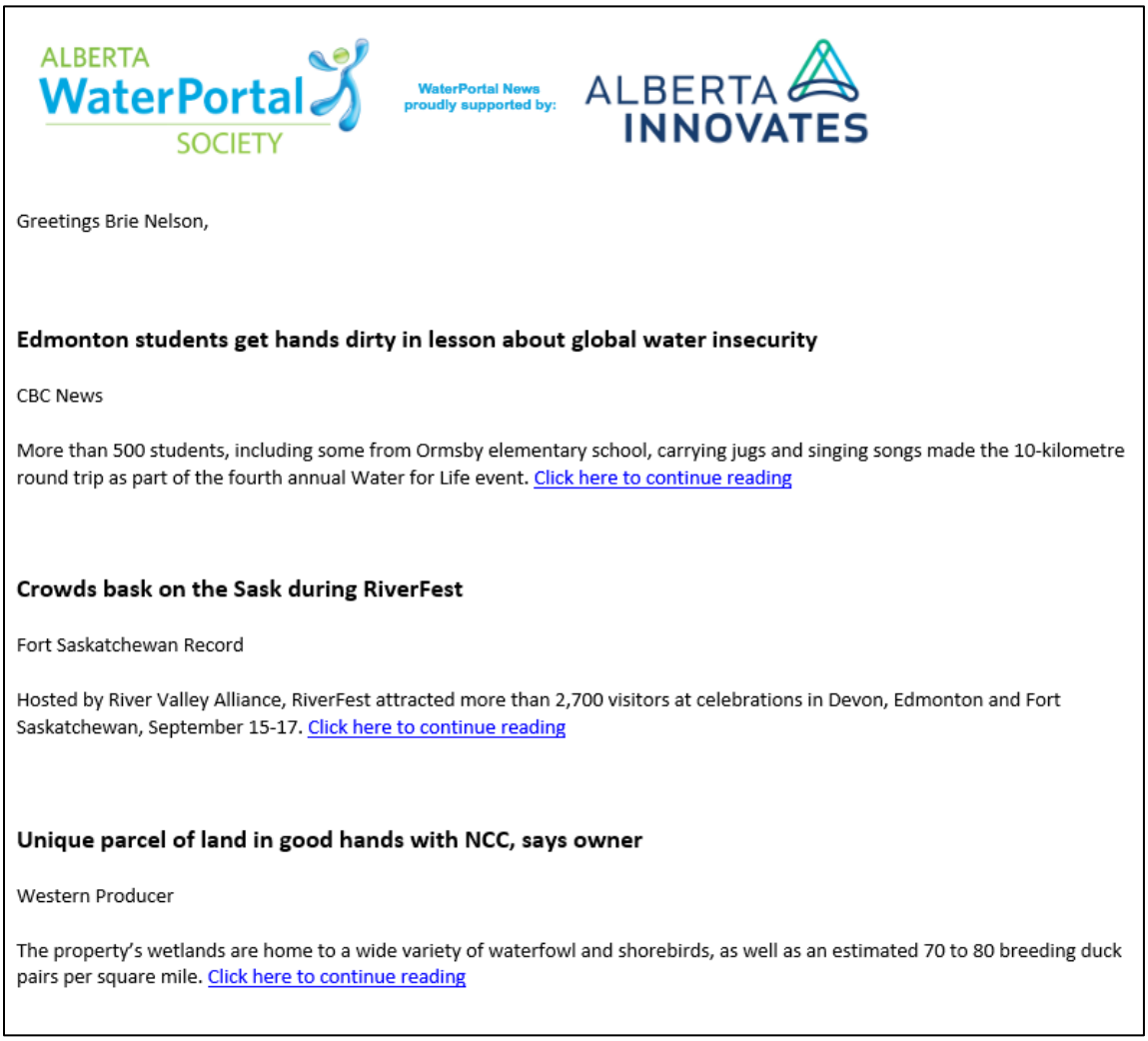
Water management techniques and technological advances in the food sector are aimed at maintaining food yield while reducing the amount of water required. Irrigators and farmers are closely monitoring their water use and implementing the best available technologies[6]. Some examples of these practices already in place include:

- **Selecting low-water crop varieties.** Growing crops that are well suited to the environment they are grown in can save water. A few crops that are commonly grown in Alberta and their approximate water requirements are listed in Table 1. Of the crops in the table, the most water-intensive crop requires almost twice as much water over the growing season compared to the least water-intensive crop.

Table 1. Approximate water requirement for a group of representative crops in Alberta[8]

Crop type	Approximate growing season crop water requirement in Alberta (mm)
Alfalfa	600
Barley	400
Canola	450
Dry bean	350
Dry pea	350

Task News & Events: Sample WaterPortal news & events newsletter prepared and e-distributed every Tuesday and Thursday



ALBERTA WaterPortal SOCIETY

WaterPortal News proudly supported by: ALBERTA INNOVATES

Greetings Brie Nelson,

Edmonton students get hands dirty in lesson about global water insecurity

CBC News

More than 500 students, including some from Ormsby elementary school, carrying jugs and singing songs made the 10-kilometre round trip as part of the fourth annual Water for Life event. Click here to continue reading

Crowds bask on the Sask during RiverFest

Fort Saskatchewan Record

Hosted by River Valley Alliance, RiverFest attracted more than 2,700 visitors at celebrations in Devon, Edmonton and Fort Saskatchewan, September 15-17. Click here to continue reading

Unique parcel of land in good hands with NCC, says owner

Western Producer

The property's wetlands are home to a wide variety of waterfowl and shorebirds, as well as an estimated 70 to 80 breeding duck pairs per square mile. Click here to continue reading

3.3 Update information on metrics of results for your project that relate to tasks and milestones as indicated in the contribution agreement.

The following metrics were collected in the project to date:

Metric	Ideal target	Actual
Stakeholder workshop	30 confirmed attendees across government, NGOs, industry groups and water experts.	32 attendees across government, NGOs, industry groups and water experts.
Stakeholder workshop	80% of respondents increase understanding of the Nexus and felt they had an opportunity to provide input to refine the simulation.	87% of attendees agreed that the workshop increased their understanding of the Nexus.

Metric	Ideal target	Actual
		100% of attendees agreed that they had an opportunity to provide input in the simulator.
Stakeholder workshop	85% of respondents from the workshop now consider other areas e.g. water, agriculture, energy etc. outside their area of focus when considering future water management planning.	71% of attendees agreed that they are more likely to consider other areas outside their area of focus when considering the future of water management.

Online tracking will be maintained to see how often the new web content is viewed and how many times the Simulator 2.0 is used. This will include monitoring of metrics and targets presented in the project workplan:

- 25% increase in overall Nexus page visits, compared to Phase 1 analytics
- 20% increase in social media engagement driven by Nexus content
- At least 100 bitly link clicks in the first two months after publishing of socio-economic content on the WaterPortal.
- 300 video views in the first year of being hosted

4. Project Challenges Encountered and Managed

4.1 Assessment of challenges, difficulties, and learnings to date and steps taken to integrate this knowledge in future implementation

Challenge: Articulating a complex, global challenge in an online format that is locally relevant and understandable.
Steps taken: We use complementary online media to articulate the complex challenge in different ways, each using consistent terminology, references and relatable examples. For this project, we developed a short introductory video, a quiz based experiential simulator, and corresponding online information pages.

Challenge: Avoiding the Water Nexus sounding like a fierce competition for water with no potential for collaboration or success.
Steps taken: We used careful language to explain the Nexus, describing it as the place where differing demands meet and connections are managed thoughtfully and collaboratively to meet multiple interests. This did not diminish the need to make decisions about how to best use a scarce resource but hopefully removed the sense of conflicting demands.

Challenge: Managing workshop participant expectations in terms of what can be done to improve an online simulator with only a limited budget. Our comfort and familiarity with apps and video games raise expectations of the extent to which an online simulator can be “gamified”.
Steps taken: Workshop participant provided invaluable feedback on how to position the Water Nexus for a broad audience and how to make the simulator appealing and interesting. While we could not gamify the simulator within this project’s scope and budget, we applied the participant feedback in many instances throughout the materials developed including putting people at the centre of the Water

Nexus both conceptually and visually, and turning the simulator into a step by step quiz asking the individual to make decisions for themselves and their community.

5. Scientific Achievements/Knowledge Dissemination

5.1 List important meetings, events, presentations and/or distinctions related to project activities.

The Alberta Water Nexus workshop was held in July 2017 to gain feedback for work done as part of Phase II and improve the online simulator from Phase I. Over 30 participants from academia, government, energy and agriculture industries, and non-profit organizations attended the workshop. Beyond gaining insight and ideas from diverse perspectives, the workshop was intended to allow people working in different sectors to hear and understand the perspectives of others.

The workshop gathered insight from participants through three interactive small-group activities. The first was to draw the nexus, the second was to discuss the type of information they would like to find in an online resource about the Nexus, and the third was to explore the current simulation tool and provide feedback on ways to improve it.

5.2 List publications (draft, submitted and published). Include links to published papers where possible.

All of the products developed through this project have been launched on-line on the Alberta WaterPortal, www.albertawater.com.

The specific deliverables from this work can be found at the following links:

https://albertawater.com/nexus

https://albertawater.com/nexus-project-background

https://albertawater.com/nexus-connections

https://albertawater.com/nexus-people

https://albertawater.com/nexus-energy

https://albertawater.com/nexus-food

https://albertawater.com/nexus-simulator

5.3 List students or other highly qualified personnel (HQP) being trained as part of this project.

Name	Level	Period	Focus of work	Status
Therese Baluyot	Bachelors Degree	May to August 2017	Mobile responsive updates to the website Workshop preparation and note taking Visual design	Complete
Courtney Clarkson		October 2017 to February 2018	Design of updated Nexus visual Design of simulator interface	Complete

5.4 Number of jobs created during the project and expected after the project.

# Jobs Created During Project	# Potential Jobs Enabled Post-Project
NA	NA

6. Next Steps

The online content, tools and media developed and published through this project will be profiled and promoted extensively though a scheduled and targeted social media campaign over the coming three months.

The summary messages from the Nexus II project will be captured in a simple, appealing print brochure being developed and produced through separate funding. This brochure will be distributed at public and industry events to further promote discussion and education on the Nexus concept.

The WaterPortal Society will seek funding for a Nexus III project to further advance key aspects of the Water Nexus discussion in Alberta. This may include:

Nexus Connections - demonstrate specific, complex connections experienced in the Water Nexus in Alberta to show:

- decision points where water can be moved to one use or another
- which actors are involved
- how connections are already being managed
- how "you" can get involved in managing the Nexus
- where water quality issues might arise

Nexus in a Changing Climate – demonstrate how climate change and variability might further stress the Water Nexus in Alberta's differing various and different basins, to show:

- what the leading climate models are suggesting for water supply in ~4 of Alberta's basins (Oldman, Bow, Red Deer, Athabasca)
- how a changed climate will change the Water Nexus in that basin
- what can be done to make each basin more resilient

Nexus Education - develop Water Nexus educational materials for youth to instill water management knowledge and commitment in emerging generations, including:

- series of ~5 videos demonstrating specific connections in the Water Nexus
- accompanying worksheets to solidify learning and promote discussion
- project outlines to encourage further investigation into the Water Nexus