2019 CWRA Alberta Branch Conference - Presentation Abstracts (updated 10/04/2019)

Session	Title	Author(s)	Affiliation(s)	Abstract
Keynote 1	Igniting Talent Development in Water Management	Pablo Pina	SAIT	The United Nations estimates that three out of four jobs that make up the global workforce are either heavily or moderately dependent on water. Energy, agriculture, food and beverage, forestry, pulp and paper, manufacturing, health, development, construction, insurance and government are important sectors in which water and jobs are linked at various levels, whether we look at them from an economic, environmental or social perspective. Today, more than ever, individuals, communities and businesses are facing new and different water challenges that have resulted from economic, environmental and technological change. With water being such a vital part of life and a valued resource, individuals, communities and businesses need to work collectively to address both current and emerging challenges. As a leader in applied education, the Southern Alberta Institute of Technology (SAIT) gathers industry leaders to work together on the identification of opportunities in ensuring sustainable water management, which includes not only exploring new water usage technologies and less water-intensive uses, but also talent development. SAIT's new water portfolios aim to enable leaders drew out strategic water challenges that some of Canada's key industries are facing, and identified ways in which students can support industries today and in the near future. This talk will illustrate the value proposition of applied learning in water resources management, including how can students help summarize the challenges, differences, and similarities across sectors while mapping out the opportunities for collectively advancing water management.
Keynote 2	Alberta's Water Innovation Program – Research and Innovation to Support Contemporary and Future Water Management Challenges	John Van Ham	Alberta Innovates	The goals for Alberta's Water for Life Strategy may seem simple: providing Albertans with safe secure drinking water, protecting healthy aquatic ecosystems, and ensuring reliable quality water supplies for a sustainable economy. Achieving these goals is no simple matter. How can Alberta sustainably manage finite water resources with significant population growth, a growing economy that demands water and the need to protect the health of the aquatic ecosystems? Demands for water are further challenged, as future water supplies will become increasingly uncertain and more variable due to climate change. Research and innovation are critical to this strategy and to provide a strong foundation of knowledge and technologies to enable well-informed management decision-making and improve water management practices. To effectively carry out this strategy, Alberta has invested over $55 M in research and innovation to support sustainable water resource management since 2007. The Water Innovation Program (WIP) managed by Alberta Innovates is a flagship program for the Government of Alberta in water innovation. Decisions made about water will play a critical role in shaping Alberta's future. Resolving the challenges related to water; its availability or scarcity, its quality, its impact on the health of Albertans, its use by the energy sector, agriculture and forestry, and its role in sustaining healthy environments will be compelling factors in almost all decisions in the province, as well as the rest of Canada. Alberta Innovates water-related research portfolio supports investments that advance knowledge and technology in 4 key themes: future water supply and watershed management; healthy aquatic ecosystems; water use conservation, efficiency, and productivity; water quality protection. This presentation will use WIP project outcomes to tell a story of building knowledge to support and inform these critical decisions.
Session 1A - Urban Water Management 1	Integrating Waterbodies into Urban Developments	Carly Silver	Stantec	There has been growing momentum to explore options to better integrate natural waterbodies (e.g., wetlands, rivers, drainages) into urban developments. Successfully integrated waterbodies can continue complete important ecological functions while also providing open spaces and educational opportunities for residents. Integrating waterbodies into urban developments requires understanding the current conditions and characteristics of the waterbody, awareness of constraints inherent to the specific site, acknowledgment of decisions for adjacent lands, and consideration of applicable regulations and policies. This presentation will explore the opportunities, challenges, and constraints inherent to integrating waterbodies into urban developments.
Session 1A - Urban Water Management 1	Continuous hydrological simulation of cold region urban wetlands	Faruk Bhuiyan	Independent Consultant	Wetlands in urban or suburban areas serve multiple purposes including stormwater management, ecological enhancement and habitat creation. Wetlands are considered as one of the green infrastructure and climate resilient tools. The hydrology is a dominant factor which controls complex hydrogeochemical processes in wetlands. As a small water body with relatively shallow depths, wetlands are also very sensitive to the variation of local weather and climate parameters. In a cold urban environment, wetlands experience extreme weather of freeze-thaw cycles, vegetation dynamics, and urban-induced hydrometeorological pattern related to precipitation, solar radiation, temperature, wind and humidity. As such planning, designing and assessing the effectiveness of such facilities over long term require continuous hydrological simulation. The current study focuses on detailed modelling of wetlands in an urban watershed. Different hydrological components including snowmelt, evapotranspiration, infiltration and groundwater are included in the model. Field surveys and monitoring of urban wetlands in Alberta provided basic information for model development. The sensitivity of simulated wetland hydrology and water balance with respect to the variability of local climate data and modelling approaches are analyzed. The presentation aims to enhance our understanding regarding cold climate hydrological simulation as a tool for wetland analysis.

2019 CWRA Alberta Branch Conference - Presentation Abstracts (updated 10/04/2019)

Session	Title	Author(s)	Affiliation(s)	Abstract
Session 1A - Urban Water Management 1	"Growing" Infrastructure: Using bioengineering for bank rehabilitation in an historically altered urban creek in Red Deer	Mike Gallant | Kurtis Anketell	Kerr Wood Leidal Associates Ltd. | City of Red Deer Public Works	Waskasoo Creek enters the City of Red Deer from the southwest and flows approximately 9 km through the City to join the Red Deer River east of downtown. The creek has been highly altered over the last century to accommodate the urban development and infrastructure of a growing city. A major alteration of the creek occurred from 1884 to 1890, when Waskasoo was diverted east along present day 43 ST to join Piper Creek across from Rotary Park. Waskasoo Creek now forms an important part of the City's parks system but also is an essential component of the City's drainage infrastructure. In recent years, the historically altered reach of Waskasoo Creek along 43 ST has been subject to excessive erosion, local flooding and sediment deposition, resulting in losses ranging from minor property damage to a major slope failure that was threatening an arterial roadway. The City of Red Deer Public Works and Parks departments initiated the Waskasoo Creek Channel Improvement project with the intent to apply bioengineering approaches to address six (6) areas of concern along this reach. Bioengineering approaches are highly adaptive techniques to manage erosion issues along key riverbank infrastructure because of the ability for vegetation to self propagate and stabilize a riverbank naturally over time. This typically minimizes future interventions and / or maintenance. Bioengineering techniques that were used in Waskasoo Creek included geogrid soil wraps, brush layers, and live staking. Habitat enhancements were also a component of the design and included Newbury riffles, boulder clusters, pools, and root wads. Construction was complete in December 2017. The initial stability of the project was tested over the first winter and spring post-construction by record ice levels due to a watermain break upstream and by spring flooding in April 2018. These events highlight the need to include immediate erosion protection in bioengineering bank stabilization designs to provide stability between construction completion and full vegetation establishment.
Session 1B - Sustainable Agriculture 1	Agriculture's water future - a shared responsibility	Mike Nemeth	WaterSMART Solutions Ltd.	Production pressures and market shifts present an opportunity for Alberta to position itself as an attractive market and global leader in agricultural water stewardship. The Agriculture Water Futures (AWF) project began in 2017 to better define and prove the value of water stewardship across the agri-food supply chain in Alberta. It was sponsored by Nutrient and Alberta Innovates. The overall objective of the project was to help manage risk to the agri-food sector by creating a common dialogue for water stewardship between agri-food and watershed players. The AWF project outlined the roles, actions, and information members of the agri-food supply chain can take to manage water within an operation, steward water beyond an operation and develop a business case for water stewardship. The business case is intended to drive uptake of water stewardship in the agri-food supply chain in Alberta to help manage water-related risk in the supply chain. Funding was received from Nutrien, with matching funds from the Alberta Innovates Water Innovation Program.
Session 1B - Sustainable Agriculture 1	"Big Plant, Big Pipe"	Dale Miller	Wood Environment and Infrastructure Solutions	Doctoral Degree from Western Ontario University, London, Ontario Canada in 2008 in Civil and Environmental Engineering "Water Infrastructure. More than 3 years as a post-doctoral fellow in the University of Manitoba. Worked for Manitoba Water Stewardship as a flood mitigation engineer. Worked for Golder Associates Ltd. as a water resources engineer. Professional engineer license from Ontario, British Colombia and Alberta. Current Position: Water Projects Management Engineer, Environment and Parks, Operations Infrastructure Branch, Water Infrastructure Support. 6 years working for Alberta Environment and Parks, Water Infrastructure Support. Main role: Water infrastructure technical support for the operation and maintenances or construction of any Alberta Environment and Parks water infrastructure in Alberta including irrigation canals, spillways, weirs, culverts, bridges and dams. Secondary role: Managing water infrastructure investigations studies and design of water infrastructures (In-house projects).

2019 CWRA Alberta Branch Conference - Presentation Abstracts (updated 10/04/2019)

Session	Title	Author(s)	Affiliation(s)	Abstract
Session 1B - Sustainable Agriculture 1	Characterizing Drain Water Quality within the Taber Irrigation District	Chris Gallagher	Taber Irrigation District	With increasing attention on the quality of drainage water, Taber Irrigation District (TID), with the support of Alberta Agriculture and Forestry, undertook a systematic approach to investigate the effects of surface and drain water sources on receiving waterbodies. Two methods were used to quantify and assess these effects. For one method, a synoptic study followed a parcel of water as it flowed down a canal and measured when and where water quality changed in the canal relative to drain outfalls. For the other method, a survey of water quality from sub-surface tile drainage systems was undertaken within the district. The information collected was used to inform and develop an approval process for drainage system applications within the district. Synoptic sampling was conducted along Taber Lake Lateral canal during run-off and dry conditions at 500-m intervals and from flowing drains. Total nitrogen (N), nitrate-N, nitrite-N, total phosphorus, total dissolved phosphorus, 2,4-D, and Escherichia coli concentrations were higher during run-off than during dry conditions (p0.90), potassium (r2>0.71), pH (r2>0.76), and sodium absorption ratio (r2>0.72) may be useful in estimating the quality of tile drain outflow. These projects support irrigation managers in the appropriate review and management of drain water and help maintain good water quality in downstream canals for the benefit of water-users and the environment. This study was co-authored with Evan Hillman, Alberta Agriculture and Forestry, with assistance from Fred Williams, Taber Irrigation District
Session 2A - Urban Water Management 2	Flooding, climate change, and the need for a precautionary approach: a case study for Redwood Meadows, AB	Jon Fennell	Integrated Sustainability	In the water-world you will often here practitioners using the term "average" or "mean" to describe annual or seasonal conditions relating to precipitation and attendant river flow conditions or lake level conditions. In the absence of any discussion on degree of variability (i.e. standard deviation or variance), the focus on "average" can be a dangerous deception. Alberta is a province where water conditions change drastically from year to year as influencing climate drivers, like the ENSO and PDO, shift from positive to negative phases - each affecting the intensity and effect of the other. With respect to river flows, influences on the accumulation and melting of annual snow packs, and the timing and intensity of spring-summer rainfall events, can have serious implications when it comes to flooding. Add to this the effects of global warming and shifting seasonal conditions and the risk of flood occurrence may not be what we think it is in the current paradigm. Redwood Meadows is a community located on Tsuu t'ina Nation lands west of the City of Calgary. The Elbow River, a tributary to the Bow River and a large alluvial aquifer system, flows through the area and encroaches on residential development established to the south. To the north are undeveloped lands of significant historical value based on the identification of numerous cultural features of value to the First Nations people and the province. Despite the aesthetic qualities of the Elbow River, it is also poses a threat to human safety, personal property, and infrastructure under extreme flow conditions. The last major flooding event occurred in June 2013, where considerable damage was inflicted on residential properties, much of this a result of groundwater inundation of basements as opposed to overland flow. The river also changed its morphology as a result of the high magnitude flows and associated erosion of lands. Although such flooding events are considered a rare occurrence by many (e.g. 0.5% chance of occurrence any given year, or a 1:200 year event), shifting conditions associated with a variable and changing climate have the potential to increase flood frequency and place infrastructure and cultural heritage at higher risk if not properly acknowledged and accommodated. Despite the uncertainty regarding future river flow conditions in southern Alberta in a warmer world, a precautionary approach to flood mitigation is therefore warranted. This presentation will highlight results of a study assessing future flood risk to the Redwood Meadows development and adjacent lands, including estimates of groundwater flooding damages, under current and future river flow conditions. This work is paving the way to proactively mitigate future flooding events like the one experienced in 2013.
Session 2A - Urban Water Management 2	Improving Flood Resiliency in McDougal Flats	Sean Sullivan	Matrix Solutions Inc.	McDougal Flats is a community near Sundre, Alberta that lies just north and within the floodplain of the Red Deer River. Over the past 30 years, development in McDougal Flats has included a regional airstrip, several subdivisions, secondary roads, and a golf resort that includes mobile homes and RVs. The three largest floods of record at this location on the Red Deer River have occurred since 2005, and these floods have caused widespread damage throughout the community, including its only access roads. This presentation will highlight the challenges with traditional flood mitigation techniques and the unique approach improving flood resiliency within McDougal Flats using the Room for the River approach.

2019 CWRA Alberta Branch Conference - Presentation Abstracts (updated 10/04/2019)

Session	Title	Author(s)	Affiliation(s)	Abstract
Session 2B - Sustainable Agriculture 2	Assessing Water Quality within Alberta's Irrigation Districts	Margo Jarvis Redelback	Alberta Irrigation Projects Association	Alberta has the largest irrigated area in Canada with nearly 680,000 hectares of irrigated land including 13 irrigation districts, 55 reservoirs, and more than 8,000 kilometres of conveyance works. Irrigation infrastructure provides a reliable supply of good quality water for crop and livestock production, rural municipalities, domestic water users, wildlife habitats, and numerous recreational activities including fishing, camping and golfing. This 9-year study (2006, 2007, 2011 to 2017) assessed the quality of irrigation water by comparing it to federal and provincial guidelines for agricultural and aquatic uses. The changes in water quality as it traveled through irrigation infrastructure were also evaluated. Approximately 90 sites within the irrigation districts were sampled four times per year during the irrigation season (May to September). Sites included source water as it entered the districts, irrigation water from mid-district laterals or reservoirs, and unused irrigation water returning to the rivers. These samples were analyzed for more than 155 parameters including nutrients, salinity, pathogens, and pesticides. Indices were calculated for irrigation, livestock watering, protection of aquatic life, and recreational uses. Generally, irrigation water achieved excellent or good water quality index scores. However, water was found to degrade as it moved through irrigation infrastructure, with return water often having poorer water quality than source water. This study provided baseline water quality information for water managers and allows for long-term evaluation of potential change in the quality of Alberta's irrigation water.
Session 2B - Sustainable Agriculture 2	Addressing Increasing Aquatic Weed, Algae and Silt Loading in Irrigation Water	Tony Wikkerink	Taber Irrigation District	Taber Irrigation District (TID) is a medium-sized irrigation district located in the area surrounding Taber, Alberta. TID owns, operates and maintains water delivery infrastructure that supplies water for agricultural, industrial, commercial, municipal and recreational purposes. One of the issues that TID is currently dealing with is increased aquatic weed, algae and sediment loading of water supplied to water users. These contaminants come from a variety of sources, and affect both District and water user operations alike. To address these issues, TID has utilized a variety of technologies including settling ponds, expanded metal screens, gabion wall infiltration systems, gabion fences, debris booms, and several types of mechanical screeners. Through varied applications in TID and surrounding irrigation districts, TID has been able to determine which technologies are likely to be successful and which are likely to fail given site-specific criteria. This presentation will focus on the various technologies employed by TID for aquatic weed, algae and silt removal, including why said debris needs to be removed from irrigation water (the negative effects they have on private and district-owned infrastructure), how suitable technologies are selected for each site, and how TID has collaborated with other irrigation districts and water users to adapt to increased contaminant/debris loading in irrigation water.
Session 3A - Data Collection and Networks	Calgary's Rainfall Measurement Experiences and a Call to Inter-Municipal Collaboration	Dustin Lockwood	City of Calgary	City of Calgary Water Resources Department (The City) has been measuring rainfall at strategic locations throughout the city of Calgary for approximately thirty years. The rainfall data, traditionally collected from May 1 to Sep 30 annually, is required for various storm water and sanitary system studies, Low Impact Development design, disaster resilience and all manner of planning tasks and modelling exercises. The data is also distributed to the University of Calgary, Alberta Environment and Parks , Western Irrigation District and others as needed. As climate change and adaptation analyses are coming online at a municipal scale, and focus on community resilience is increasing, there is more and more interest in higher resolution rainfall data. Currently, The City owns forty tipping bucket rain gauges located in and around Calgary. Four of these tipping buckets have heating elements to melt and measure snow during the winter season. In addition we have recently added four new weigh type rain gauges to capture more information on hail and snow year round. The Calgary rainfall gauge network density is comparable to other large municipalities in Canada and data users are, over time, requesting higher and higher resolution data. Given the hunger for high quality, high resolution datasets The City began looking for affordable and simple ways to meet higher demand. After attending a workshop with The City of Edmonton and Environment Canada in 2016, The City began to explore the use of radar data overlays to fill in the gaps and to give our data users the data they desire. Based on learnings from The City of Edmonton, Calgary has begun piloting radar products with more and more accurate results. Now we are experimenting with some disdrometer devices and precipitation gauges to increase the accuracy of our radar data products. In this presentation I plan to use the example of Edmonton sharing their innovative ideas with Calgary to make the point of fostering collaborative inter-municipal relationships to not only avoid making the same mistakes as your neighbors, but to encourage collaboration and information exchange to build effective municipalities and strengthen environmental decision making within a larger regional framework.

2019 CWRA Alberta Branch Conference - Presentation Abstracts (updated 10/04/2019)

Session	Title	Author(s)	Affiliation(s)	Abstract
Session 3A - Data Collection and Networks	Application and performance of a "Low Power Wide Area Sensor Network" for distributed hydrological measurements in the Stony Mountain Headwater Catchment Observatory	Scott Ketcheson | Vitaly Golubev | David Illing | Sheldon Foisey | Bruce Chambers	Athabasca University | Riot Technology Corp. | Campbell Scientific Canada	Wireless sensor networks (WSN) developed over the proceeding decade have demonstrated capabilities to provide a cost-effective and reliable means to collect spatially representative (distributed) hydrological data in near real time. However, communication distances are greatly limited in settings where vegetation coverage is moderate or dense, and power consumption of some systems can be an issue for deployment in remote environmental settings where portable power supplies are required. This research evaluates the design and performance of a newer, innovative technology called "Low Power Wide Area Sensor Networks" (LPWAN) that is capable of much greater communication distances while consuming less power than traditional WSNs. In partnership with Riot Technology Corp. and Campbell Scientific Canada, a LPWAN was field-deployed in the Stony Mountain Headwater Catchment Observatory ~40 km south of Fort McMurray, as a part of a research project aimed at studying the hydrology and importance of small (<10 km2) headwater catchments for water availability in the Lower Athabasca River Basin. The performance of the Beta LPWAN deployment was evaluated for the impact of vegetation, weather and topography on communication capabilities and power consumption. Results indicate reduced signal strength in topographic valleys, but better actual than modelled data transmission performance. Field and modelling work also indicate that the configuration of antennae combinations at data transmitters and receivers, in combination with data transmitter height above ground, provides the greatest improvement in signal strength and system performance. Optimization of radio parameters, transmission power settings and firmware updates from this research are continually improving system capabilities (e.g., data repeater function) and performance.
Session 3B - Flood Management	Exploring Opportunities for Local Leadership in Flood Risk Management	Andrew Szojka | David Roche	KWL	Since southwestern Alberta's 2013 flood, the provincial Flood Hazard Identification Program (FHIP) has enjoyed a resourcing renaissance. Considerable progress has been made updating inundation maps and flood hazard maps around the province, and Provincial staff are providing a strong leadership role in understanding flood hazards across Alberta. Nonetheless, a provincially-led process like the FHIP must place clearly-defined limits on its achievable scope. For example, FHIP cannot afford to assess the unique consequences of potential dike breaches in its diverse communities; flood hazards in dike-protected areas are instead extrapolated from the confined river cross-section. Perhaps more importantly, the FHIP process generally stops at characterizing the existing hazard under existing development conditions. This leaves an open opportunity for local communities to take a leadership role in taking the next steps: examining how their communities are most affected by flood risk now, how those risks will change in the future, and what the most effective options are for ensuring long-term sustainability. The situation in Alberta clearly contrasts with that of the neighbouring jurisdiction of BC. With an extensive list of dike-protected communities, BC has maintained an active role in dike safety but its leadership role in flood risk management has been limited since 2004. At that time, the Province chose to delegate flood hazard management to local governments, and is now resourced accordingly. Leadership in many aspects of flood risk management comes from forward-thinking communities and non-governmental organizations like the Fraser Basin Council. BC communities like Squamish are rising to this challenge. Squamish is among the first communities to complete an integrated process of scoping risks, analyzing hazards, defining mitigation options that reflect community values, costing and deciding between options that involve trade-offs for stakeholders, and implementing recommendations through an integrated flood risk management plan. These early successes demonstrate how a well-developed, long-term mitigation strategy can help the community make defensible decisions, integrate planning tools into local policy, and pursue cost-sharing opportunities. This presentation will highlight key similarities and differences between the BC and Alberta approaches to flood risk management. Using examples from the Squamish context, it will show how detailed dike breach modelling, integrated planning, and quantitative risk assessment can help communities in both provinces define and achieve long-term sustainability.

2019 CWRA Alberta Branch Conference - Presentation Abstracts (updated 10/04/2019)

Session	Title	Author(s)	Affiliation(s)	Abstract
Session 4A - Fisheries Management	Ladders, live staking and livestock crossings: watershed restoration	Adam Norris	Mighty Peace Watershed Alliance	The Beaverlodge River historically supported multiple uses ranging from municipal drinking water to recreation and high quality fisheries. In 1981, a weir was constructed on the Beaverlodge River to ensure the availability of water for the Town of Beaverlodge to withdraw for municipal uses. The weir created a barrier to fish passage and a Denil type fish ladder was installed in 1983, however this ladder regularly experiences blockages due to accumulated debris. The weir continued to be a seasonal to fish passage because maintenance, that is removing the debris, was challenging and not regularly undertaken. Flow in the Beaverlodge has declined an estimated 13% from 1968 through 2010, which further exacerbated the fish passage issues as well as emerging water quality issues. The primary water quality concern was low and fluctuating dissolved oxygen levels. The driver of this was nutrient enrichment and a lack of thermal buffering. Land use was the cause for both increased nutrient levels in run off and a decrease in thermal buffering. Declining water quality combined with the weir and changes in flow seriously curtailed the opportunities afforded by the Beaverlodge River for many of its prior uses. Beginning in 2013 a group began working on fish habitat restoration, a very complex issue with broad geographical extent. A caveat to any fish habitat restoration was the need to maintain the municipal water supply while improving fisheries, other recreation opportunities and aesthetic values. In the face of changing hydrological patterns and infrastructure challenges, management strategies to identify and implement sustainable and resilient water use were needed. Modifications to land use at the watershed scale were identified as the drivers for improving water quality and mitigating the shifting hydrology. To address the challenges of adapting land use to improve water quality and increase resiliency in the watershed, the Redwillow Watershed Restoration Project was conceived. Not-for-profit organizations, municipal governments and the provincial government all provided members to this team who focused on first understanding the watershed dynamics and the changing conditions. Effort was given to differentiate between ultimate and proximal causes and then strategies were developed to address the ultimate causes. Although efforts were focused on identified hotspots where, the main thrust was improving land use across the watershed thereby assuaging cumulative effects. Riparian restoration was done to improve the filtration of run off and provide thermal buffering. Ghost streams and ephemeral wetlands were sought out and restored, new fish passage was constructed, live staking and erosion control were completed. The challenge remains to continue the knowledge transfer and the fostering of a watershed stewardship ethic allowing a watershed wide improvement. Broadscale, multi-stakeholder watershed planning provides the framework to develop management strategies that support a resilient water resource. - Changes in flood cycles and hydrological patterns - Evolving water policies and management strategies - Sustainable and resilient water use - Water quality, contamination, and consequences - Infrastructure management and adaptability
Session 4A - Fisheries Management	New tools to examine sedimentation pressure in foothills watersheds	Kenneth Jared Fath | Axel Anderson	University of Alberta | Government of Alberta	Fisheries in Alberta are currently in a declining state with many species at historically low levels or functionally extirpated within their native ranges (Alberta Environment and Parks 2018). Threats species face include overfishing, habitat fragmentation due to stream crossing structures (Maitland et al. 2016), and sedimentation from resource roads. During the summers of 2016-2018 we measured road connectivity characteristics, erosion potential, and stream physical habitat attributes in the Simonette watershed in West-central Alberta. The findings of this research are being used to update a cumulative effects model designed by Dan Miller and Lee Benda at Terrainworks. Over the last two and a half years of this study we have made observations on erosion, sediment delivery and impact in watersheds in the Simonette basin in west-central Alberta. Preliminary results indicate that the contributing area of roads and cutslopes drives the lengths of road sediment plumes and the likelihood that they will deliver to nearby waterbodies. Problematic road drainage maintenance leads to roadside gullying which multiplies risks of road sedimentation to streams. When this occurs near road crossings, large amounts of sediment are invariably delivered to streams. Not only have we found strong relationships between road characteristics and sediment delivery potential, but we have done surveys of stream physical habitat and fines intrusion into the streambed gravels and have found a moderate correlation between upstream crossing density and subsurface streambed composition. Our findings indicate that managing stream crossings is an essential part of reducing the impact of unpaved resource roads on the aquatic environment. Tools being developed by Terrainworks, using our data will be used to drive a prediction model which we hope will help land managers identify and remediate problematic road crossings in Alberta's foothills.

2019 CWRA Alberta Branch Conference - Presentation Abstracts (updated 10/04/2019)

Session	Title	Author(s)	Affiliation(s)	Abstract
Session 4B - Framework and Manual Development	Upper Athabasca Region Water Supply and Allocation Study	Natasha Cowie | Ahmad Asnaashari	Hatfield Consultants | Alberta Environment and Parks	Overview Alberta Environment and Parks (AEP) is developing a Surface Water Quantity Management Framework (SWQuanMF) for managing water withdrawals from rivers and lakes in the Upper Athabasca Region (UAR). The Framework will support the provincial Water for Life action plan commissioned in 2018 to promote sustainable, healthy water resources across Alberta over the next decade. In support of the Framework, a Water Supply and Allocation Study (Study) was recently completed by AEP and Hatfield Consultants to provide an assessment of surface water supply, allocated water demands, and water stress (proportion of available surface water allocated) across each of the 19 Water Management Units (WMUs) in the UAR over the last 30 years. The Study also included a statistical analysis of streamflow trends. Methods Water Supply: 30-year continuous hydrographs were estimated at the mouth of each WMU, based on representative Water Survey of Canada (WSC) streamflow data with missing periods infilled using a regression-type (Maintenance of Variance Estimation) approach. From this, runoff statistics (seasonal and annual runoff sums, and annual daily extreme flows) were calculated, then checked for trend direction and significance using a standard Mann-Kendall approach with corrections for temporal autocorrelation. Water Demand: The AEP water allocations database was analyzed, mapped, and converted into cumulative annual water allocations for each WMU and industry type. Water Stress: Annual and 30-year average water stress values were calculated per WMU, as the proportion of cumulative water demand to cumulative water supply. Analyses were completed using R programming, to improve the transparency, reproducibility, and future application by AEP as further data become available. Additional deliverables included an R-Bookdown product to annotate the various data processing steps involved and an interactive website allowing water managers and other authorized users to customize and update water supply, demand, and stress designations across the UAR. Results The streamflow data appear to suggest the following trends during the last 30 years: (1) annual minimum and maximum flows generally increasing in headwaters WMUs and decreasing in the lower portions of the UAR; (2) increasing spring mean flows in most WMUs; and (3) decreasing annual median flows, as well as summer and fall mean flows, in most WMUs. However, these apparent trends were only at statistically significant levels in a minority of the WMUs. The study identified the expected spatial variability in water yield across the UAR (i.e., higher values near the Rocky Mountains, lower values towards the Lesser Slave region). As of 2017, none of the WMUs were experiencing water stress on an annual basis and under average precipitation conditions. Water stress was less than 5% in all WMUs, and only 2% for the entire UAR. However, all WMUs have the potential to exhibit water stress on a shorter time scale (e.g., during the low flow months of the year), locally (e.g., within tributary basins or headwater areas), or during a low flow year.

2019 CWRA Alberta Branch Conference - Presentation Abstracts (updated 10/04/2019)

Session	Title	Author(s)	Affiliation(s)	Abstract
Session 4B - Framework and Manual Development	City of Fort Saskatchewan Surface Drainage Assessment and Operations/Maintenance Plan	Lisa Butler	Associated Engineering	The City of Fort Saskatchewan (the City) operates and maintains a stormwater drainage system comprised of underground storm water drainage networks, stormwater management facilities (SWMFs) and ditches. The City has received complaints from residents concerned about water quality, sediment build-up, erosion, vegetation growth and standing water within SWMFs. In addition, changes in design standards and criteria suggest that the existing infrastructure may no longer be providing adequate capacity to manage surface water runoff. As a result, the City retained Associated Engineering to assess the system to identify defects and provide recommendations for remediation and maintenance. As part of the assessment, visual condition inspections were undertaken on 22 SWMFs during Fall 2017 and Spring 2018. The condition inspections were based on a criterion that included the following defect categories; sediment buildup, vegetation growth, erosion, ponding, obstructions, water quality, high water levels (overtopping), odor and pipe conditions. In addition to the visual inspections, desktop design reviews and functional evaluations were undertaken. These evaluated if the SWMFs had sufficient capacity under current conditions and engineering design standards. To examine the impacts of climate change, two scenarios, Representative Concentration Pathway (RCP) 2.6 and RCP 8.5, were used to estimate the increase in run-off volumes. These pathways estimate the greenhouse gas trajectory under different climate change scenarios. Findings from the visual condition inspections were compared to the design desktop reviews and the functional evaluations to identify any correlations. A qualitative risk-based evaluation was then developed to prioritize deficiencies identified from the condition inspections, design desktop reviews and functional evaluations. For this assessment, risk was defined as the potential for impacts where something of human value (including humans themselves) is at stake and where the consequences are uncertain. Following the risk-based assessment, an Operations and Maintenance (O&M) manual was developed to provide workplans, remediation and maintenance methods. These methods were identified to address the deficiencies found within the stormwater drainage system. High-level cost estimates of the proposed remediation and maintenance works were provided for budgetary purposes. The analysis concluded that some of the SWMFs and ditches inspected were not performing as per the intended design and were under capacity. It was recommended that the City implement the proposed O&M manual and remediation and maintenance works.
Session 5A - Groundwater & Reservoirs	A review of reservoir limnology for water management	Francine Forrest	Integrated Sustainability	Reservoirs often serve multiple uses including: water supply, flood control, power generation, recreation and habitat enhancement. There are over 70 reservoirs in Alberta that have been monitored over the years by several agencies. Most of these reservoirs are located in Southern Alberta. Reservoirs experience similar physical, chemical and biological processes as natural lakes; however, reservoirs do have some differentiating features. This presentation will summarize key similarities and differences of these reservoirs and discuss common water quality issue in reservoirs. The purpose of this presentation is to generally summarize reservoir conditions across Southern Alberta. Summarizing this information is important to understand how to focus monitoring and manage reservoirs in a changing climate for multiple users and cumulative effects.
Session 5A - Groundwater & Reservoirs	Hydrogeologic controls on groundwater discharge to fall and winter streamflow in the Canadian Rocky Mountains	Laura Beamish | Masaki Hayashi	University of Calgary	Mountain headwaters supply essential water resources to downstream communities and ecosystems. Sustainable management of these resources requires an understanding of hydrologic processes in alpine watersheds. Fall and winter streamflows in the Canadian Rocky Mountains are largely sustained by groundwater discharge, but mountain groundwater processes are poorly understood due to the scarcity of studies in these environments. This study investigated regional variability and temporal changes in mountain groundwater processes using two approaches. First, fall and winter streamflow recessions in 19 watersheds in the Canadian Rockies were analyzed. Then, watershed-scale recession behavior was related to conceptual models of groundwater flow using saturated-unsaturated models of hillslope aquifers. In the first phase of the study, most watersheds were observed to have a two-stage recession characterized by fast exponential decay followed by a period of slower exponential decay. Recessions from all watersheds were fit with piecewise functions to determine recession coefficients and the timing of the transitions between the segments. Variability in recession coefficients was found to explain most variability in mean winter baseflow. Results showed that recession coefficients are geologically controlled: slower recessions and higher winter baseflow were associated with younger, more porous bedrock. Rainier, lower elevation watersheds transitioned to the slow recession phase later in the fall, suggesting that the timing of the transition is climatically controlled. Records from the Bow River at Banff showed that the transition point has been shifting to earlier in the fall; this hydrologic change may be a result of climatic change. The second, modelling-based phase of the study was in progress at the time of abstract submission and aims to determine if the two-stage recessions can be explained by layering or bedrock topography in dominant hillslope aquifers. Models will also be used to explore potential causes for the hydrologic changes observed in the Bow River. Results from this work indicate that both geology and climate control the groundwater processes that sustain fall and winter streamflows in mountain environments.

2019 CWRA Alberta Branch Conference - Presentation Abstracts (updated 10/04/2019)

Session	Title	Author(s)	Affiliation(s)	Abstract
Session 5B - Modeling and Forecasting	Reliable Summer Streamflow Forecasting in The Bow River Basin Using Machine Learning Techniques	Amr Gharib | Evan G. R. Davies | Nesa Ilich	University of Alberta | Optimal Solutions Ltd.	Reliable streamflow forecasts are essential for management of water resources, particularly for reservoir operation, water allocation, and hydropower production. They can also improve water use efficiency and help establish early drought and flood warnings. In Alberta, summer season streamflow forecasts are based on antecedent local hydrometeorological conditions, including Rocky Mountain snowpack values which are used as input into standard statistical techniques. However, these forecasts are uncertain. Improving the forecasting skill can reduce the risk for irrigators and other water users. In this study, a combination of local hydrometeorological conditions and global climate indices were used as input into inferential models. We developed backpropagation artificial neural network (ANN) and extreme learning machine (ELM) models to generate summer seasonal and monthly streamflow forecasts with up to three months of lead-time for cordilleran and snowmelt-dominated areas in western Canada, and specifically the Bow River Basin of Alberta. At a local scale, historical records of average monthly precipitation, monthly temperatures and local snow water equivalent data were used, as well as streamflow data for the Upper Bow River watershed in Southern Alberta. The study investigated the predictive value of eleven global climate indices including the Pacific Decadal Oscillation (PDO) and the Atlantic Multidecadal Oscillation (AMO). Three input datasets were prepared for forecasting seasonal runoff: DS1, from 1950 to 2014, with climate indices as predictors only; DS2, from 1970 to 2014, with a combination of local observations and climate indices; and DS3, with data from 1981 to 2014, and more comprehensive and complete SWE records. Input datasets were used in both monthly and seasonal-average forms and were lagged by up to 12 months and four seasons, respectively. For each input dataset, a forward step-wise selection technique was used to select the best combination of predictors, and principal component analysis (PCA) was used to reduce the dimensionality of the modelling problem. To avoid overfitting, we employed a 10-fold cross-validation technique with random sampling of data in each fold. Model performance was tested with 15 years (30%) of the data. Among the three input datasets, DS2 yielded the best summer seasonal and monthly forecast results. In general, ELM forecasts exhibited higher skill for the testing period than ANN forecasts for the monthly and seasonal streamflow; further, coupling PCA with ELM and ANN models improved model handling of the predictors and hence the forecasting skill. Overall, the AMO in November, PDO in December, and measured SWE in April were the three most important predictors of the spring to summer runoff in the Bow River Basin. For seasonal, May, June, and July streamflows, respectively, ELM forecasts over the period from 2000 to 2014 had correlation coefficients of 0.92, 0.87, 0.94, and 0.95 and Nash-Sutcliffe Efficiency had coefficients of 0.79, 0.75, 0.87, and 0.88. In conclusion, reliable seasonal and monthly streamflow forecasts can be obtained for a cordilleran and snowmelt-dominated Bow River Basin using ELM and a combination of local hydrometeorological conditions and large-scale climate indices. ELM forecasts have the potential to support integrated water resources management in Alberta.
Session 5B - Modeling and Forecasting	New Modeling Paradigm for the Assessment of Future Reservoir Storage Requirements: a case study of the Western Irrigation District, Alberta	Amr Gharib | Nesa Ilich | Evan Davies	Optimal Solutions Ltd. | University of Alberta	River basin planning in Alberta has relied on the use of computer modeling since the early 1980s. Modeling is currently used within a single time step framework, where water allocation decisions are made independently, for individual time steps of one week at a time, without taking into account seasonal forecasts or the corresponding demand hedging rules which are often implemented by farming communities. This kind of modeling often leads to premature depletion of storage during dry years, which produces model results that are worse than the actual decisions made by irrigators - who would perform some form of demand hedging. This paper provides a critical review of the current modeling practice, which is primarily based on arbitrarily selected reservoir rule curves, and provides insight into the possible improvements in modeling that result from using multiple time step optimization. These improvements may shed new light on important decisions made in the past, such as those related to the moratorium on issuing new water licenses in some river basins, or others related to the investment in additional infrastructure. Such decisions have often been made in the past on the basis of model results. Our presentation will analyze model results for a case study related to two proposed storage expansions within the Western Irrigation District in Southern Alberta. The existing irrigation failure criteria employed in earlier studies are used as the principal assessment criteria. The study demonstrates significant potential capital cost savings related to future infrastructure development depending on the selected modeling approach, and suggests that investing in forecasting and better reservoir management tools may be more productive than investing in additional infrastructure.

2019 CWRA Alberta Branch Conference - Presentation Abstracts (updated 10/04/2019)

Session	Title	Author(s)	Affiliation(s)	Abstract
WORKSHOP	Opportunities for Water Reuse in Alberta: is it important and how can we do it?	Jacqueline Noga | Dr. Jane Springett | Dr. Nicholas Ashbolt	University of Alberta	Water reuse is the collection of water that comes from alternative sources, such as greywater, rainwater, and stormwater, and subsequent fit-for-purpose treatment for safe use. Infrastructure needs, environmental impacts, ethics, values, economics, and establishment of sustainable, healthy communities are all aspects of water reuse. In Alberta, interest in water reuse is increasing as Southern Alberta faces periods of drought as well as intense rain events, and remote communities face increasing costs to treat all water to a potable standard regardless of intended use. Evolving our water policies and management strategies to reuse water is seen as a likely component to ease stresses on water service provision. We want to explore water reuse with those already engaged in water resources management in Alberta. Our session will start with a presentation from Dr. Nicholas Ashbolt, an expert in water reuse globally, who will provide an overview of water reuse, including why it has been implemented in other parts of the world, the variety of water reuse schemes that exist, and the necessary infrastructure and innovation needed for reuse in its many forms. He will bring the conversation into the Alberta context using examples and discussing the opportunities for future projects, as part of re-envisioning how to develop healthier communities. Throughout the presentation we will encourage questions and check in with participants to ensure the concepts are being understood. After the presentation we will engage participants in a World Cafe to explore their thoughts and ideas about water reuse. One guiding question, how should we implement water reuse in Alberta?, will be discussed at each table and as participants rotate tables they will build on the conversations had previously at the table, as described by the table host. Ideas for potential water reuse projects will be explored and the underlying values and reasons why water reuse might be considered will be discussed. Participants will expand their understanding through conversational learning rooted in real world applications. Our session will end with sharing and discussing outcomes from the World Cafe. Our hope is participants to leave with a foundational understanding of water reuse and the opportunities for it in their work, and with the resources to further their skills and understanding. The overall goal is to engage with participants and develop our combined understanding on what water reuse is and the opportunities for it in Alberta.