# INSTITUTIONAL ADAPTATION TO CLIMATE CHANGE PROJECT

Lethbridge Stakeholder Workshop on Water and Climate

## SUMMARY REPORT

Organized by Prairie Farm Rehabilitation Administration (PFRA)

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Input for presentation summaries provided by presenters

## BACKGROUND INFORMATION

This report summarizes the presentations and focus group discussions from the Institutional Adaptation to Climate Change (IACC) Water and Climate Stakeholder Workshop held at the Lethbridge Lodge in Lethbridge, Alberta on December 1, 2006. The purpose of this workshop was to disseminate information collected by the project thus far, to verify the information is accurate, and to collect data for ongoing and future research projects (See the Agenda in Appendix 2).

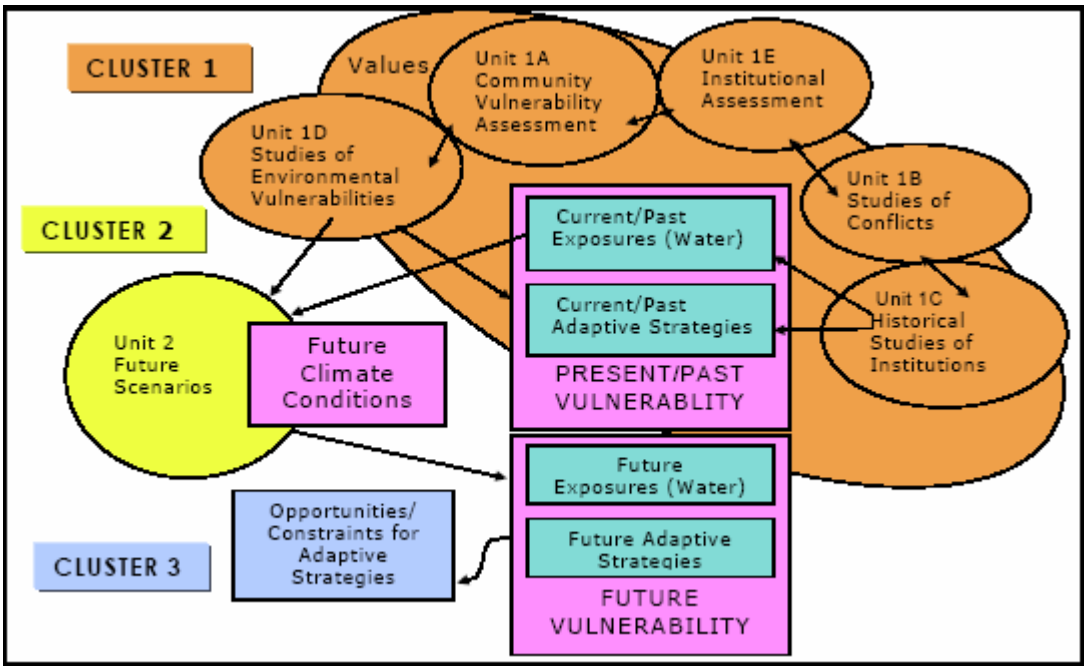


***Figure 1**: The organization of the Institutional Adaptation to Climate Change clusters.*

The Institutional Adaptation to Climate Change (IACC) project is funded by the Social Sciences and Humanities Research Council of Canada (SSHRC) and is administered by the Canadian Plains Research Center (CPRC) of the University of Regina. This project requires the integration of multiple disciplines and involves the collaboration of approximately 30 researchers and a large group of research assistants, all with expertise in their respective discipline. The three objectives of this research project are:

1. To identify the current social and physical vulnerabilities of the rural communities related to water resource scarcity in the two basins;
2. To examine the effects of climate change risks on these vulnerabilities;
3. To assess the technical and social adaptive capacities of the regional institutions to address the vulnerabilities of rural communities to current water scarcity and climate change risks.

The IACC project seeks to understand the adaptive capacities of rural communities and rural households and the roles played by governance institutions in the development of those capacities. In order to achieve this goal a comparative study between two river basins—the South Saskatchewan River Basin in Canada and the Elqui River Basin in

Northern Chile—is being undertaken. The two regions differ in how they are vulnerable to climate change, primarily due to varying social, economic, political and environmental circumstances. However, they are similar in that they are situated in dry climate regions adjacent to a major mountain system, with the agricultural industry predominating in both basins. Furthermore, the basins' supply of water is snow and glacier-melt.

The conceptual model—Figure 1— is the structural framework around which the Institutional Adaptation to Climate Change project's clusters are organized. Presentations from *cluster 1, units 1A, 1B* and *1C* were given at this workshop. Dave Sauchyn's presentation delved into *future climate conditions*. The focus group discussions provided insights into *past/present and future vulnerabilities* and will set the basis for unit 1E. The IACC project adopts a vulnerability assessment approach, where the vulnerability of a system is treated as a function of both its exposure and its adaptive strategies. *Current/past exposures* refer to past or present conditions that affect a particular system. In addition, the nature and specific characteristics of the system are taken into account. *Current adaptive strategies* refer to the ways in which the system has adapted or is adapting to the identified exposures. *Future exposure* refers to the future potential changes in current/past exposures as well as new exposures that may arise under climate change. *Future adaptive strategies* refer to the ways in which the system can adapt to and plan for these future changes. Forces that influence the ability of the system to adapt create *opportunities/constraints for adaptive strategies*.

For the purposes of this workshop, exposures relate to water, and thus adaptive strategies also relate to water. This report is divided into two sections: summary of presentations and focus group findings. The 'Focus Group Findings' section is divided according to the vulnerability approach (i.e. current and future exposures and current and future adaptive strategies). Opportunities and constraints for adaptive strategies are listed under the 'Adaptive Capacity' subsection of this report.

There is significant pressure on Alberta's water resources as documented in the province's Water For Life strategy. Pressures on the water supply stem primarily from population growth, drought and agricultural and industrial development. Presently, the water supply is fluctuating to the point where its unpredictability is affecting communities and their economies. This unpredictability warrants attention since the well-being of Alberta's economy and population depends on a healthy and sustainable water supply.

A variety of water stakeholders were invited to attend the workshop and participate in the focus groups, including representatives from federal, provincial, regional and municipal governments and industry, as well as irrigators, farmers and ranchers. Stakeholders were divided into three focus groups, each with approximately 12 people. The purpose of the focus groups was to initiate discussions among water stakeholders and to provide researchers with a better understanding on the issues stakeholders have with water availability, how these issues are addressed and how these issues can be managed in the future under climate change (Appendix 1 contains the issues discussed during the focus groups). These discussions provide insights into the vulnerabilities and the adaptive capacities of both rural communities and governance institutions, and will set the basis for unit 1E.

## SUMMARY OF PRESENTATIONS

This section summarizes the presentations delivered at this workshop.

### **Water and Climate Scenarios for Alberta's South Saskatchewan River Basin** (Dave Sauchyn, **P**rairie Adaptation Research Collaborative, University of Regina)

Research conducted by Dave Sauchyn, Suzan Lapp and others provides insights to potential changes in Alberta's water resources, with focus on the South Saskatchewan River Basin (SSRB), and Alberta's future climate.

There is consensus among scientists that climate change is a real phenomenon and that the climate is indeed warming. However, what we do not know is just how much warmer the climate will be in the future, or what it will mean for humans and the environment. Climate models are commonly used to simulate future climate conditions, and since the warming climate has been largely attributed to increasing concentrations of greenhouse gases in the atmosphere, these concentrations need to be incorporated into models. Having said that, we cannot know what future greenhouse concentrations will be because we cannot predict what activities humans will engage in that will reduce or increase them.

Future temperature and precipitation scenarios were generated for the City of Lethbridge using numerous climate models and future greenhouse gas emission scenarios, and the results, shown in Figure 2, indicate that by 2050 Lethbridge will experience a 1 to 3.6 degree Celsius increase in temperature as well as an overall increase in precipitation. Models using data from Calgary (baseline 1961-1990) confirm the increasing trends and add that the seasonal distribution of precipitation will also change by 2050. More specifically, as is illustrated in Figure 3, it is expected that there will be more precipitation in winter months and less in summer. Higher temperatures in summer months (see Figure 4) will extend the agricultural growing season, but with a simultaneous decrease in precipitation, there will be less available soil moisture. Similarly, a study by Barrow and Yu in 2005 suggests that, under scenarios of climate change, a new climatic zone will be present in Alberta and that the number of growing degree days above 5 degrees Celsius will significantly increase. In addition, the annual moisture index—heat divided by precipitation—will range from 1 to more than 12 (see Figure 5). This wide range indicates that there could potentially be up to 12 times more heat than moisture in some regions in Alberta.

There is substantial evidence that the warming climate is, and will continue to, affect water resources in Alberta; researchers have already attributed declining river flows to the warming climate. Moreover, the extent of glacier cover in the Rockies is the least it has been in 10,000 years, and the SSRB has already received the bonus melt water from the receding glaciers.

Global circulation models and hydrologic models project that cumulative flows— Figure 6— and the spatial and seasonal response in flows in the Bow River, the South Saskatchewan River and the Oldman River will be significantly affected in the future—

Figure 7. It is difficult to be precise when predicting change in flow, as the future climate is highly dependent on the concentration of greenhouse gases in the atmosphere; for example, the flow in the Oldman could increase by up to 8% or decrease by as much as 13% in the future.

Dramatic increases in temperature are also expected in winter months, where more precipitation will fall in the form of rain. Historically, precipitation has fallen in the form of snow in the mountains, built up, and then melted in the spring. Under climate change, there will be more rain in the winter and it will quickly runoff rather than accumulate. Currently, central North America experiences 30 days without rain every 50 years. By 2070, models suggest that central North America will experience 30 days without rain every 18 years, a substantial increase in the frequency of consecutively dry days.

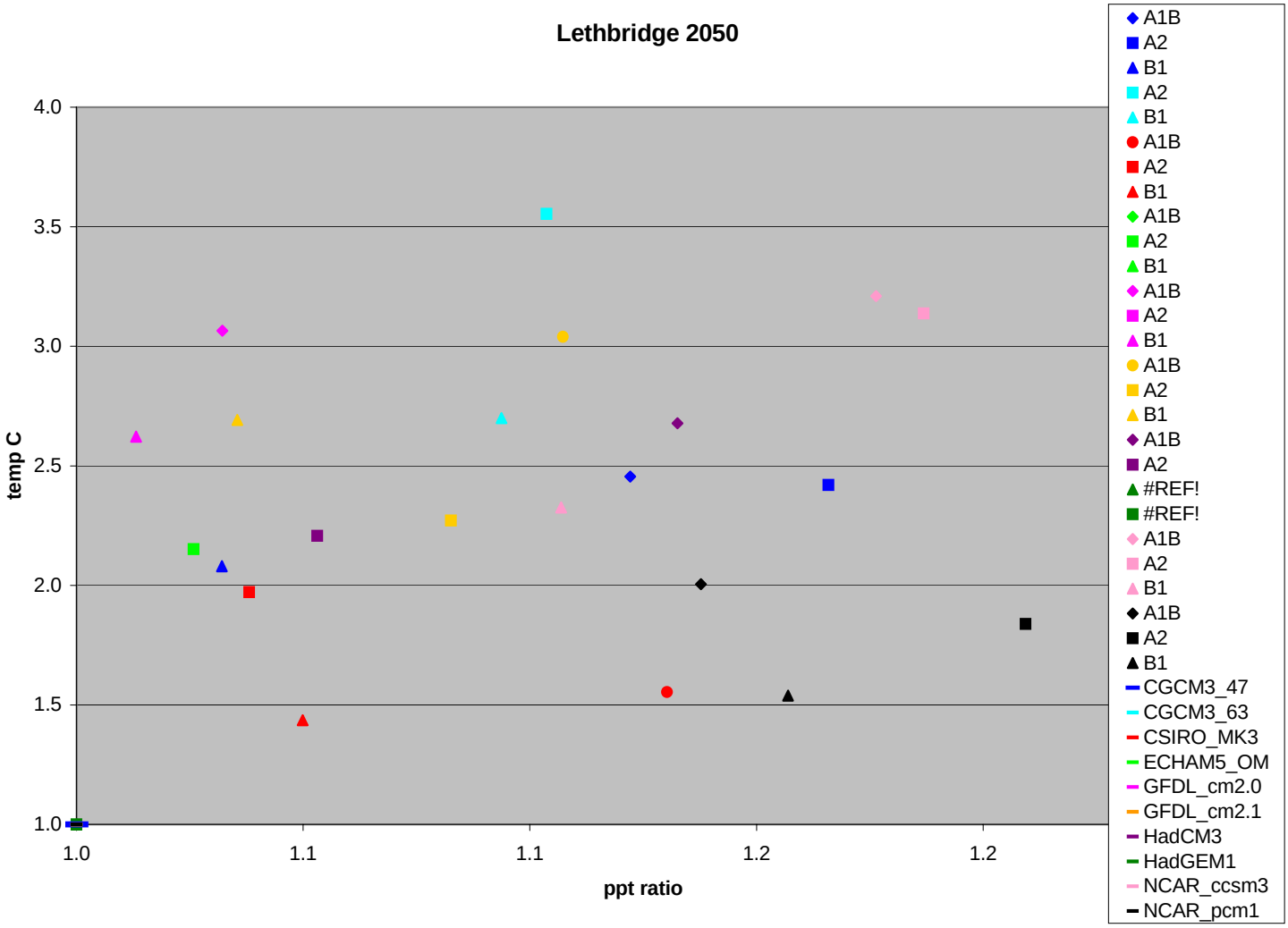


***Figure 2**: Future temperature and precipitation for Lethbridge in 2050.*

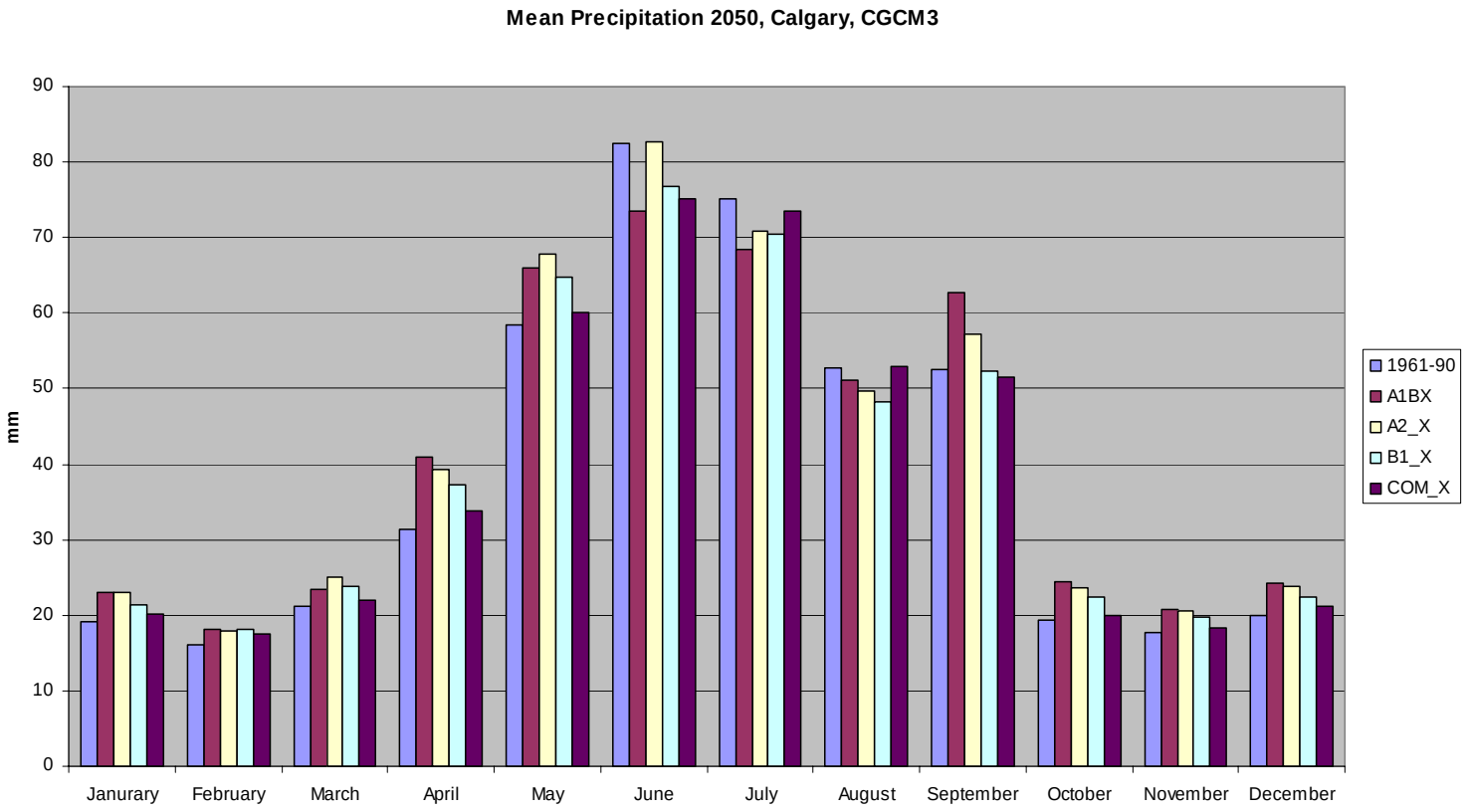


***Figure 3:*** *Average monthly precipitation for Calgary in 2050.*

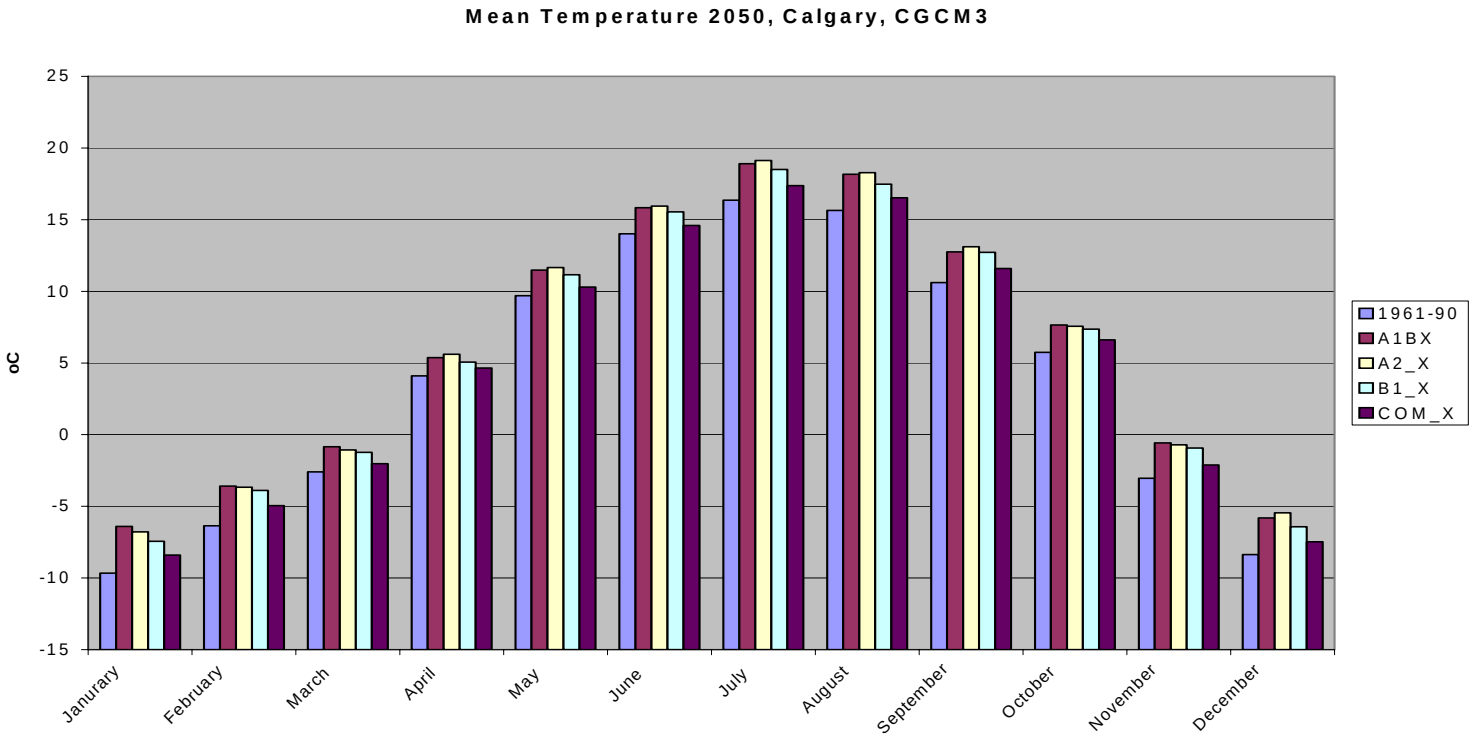


***Figure 4****: Average monthly temperature for Calgary in 2050.*

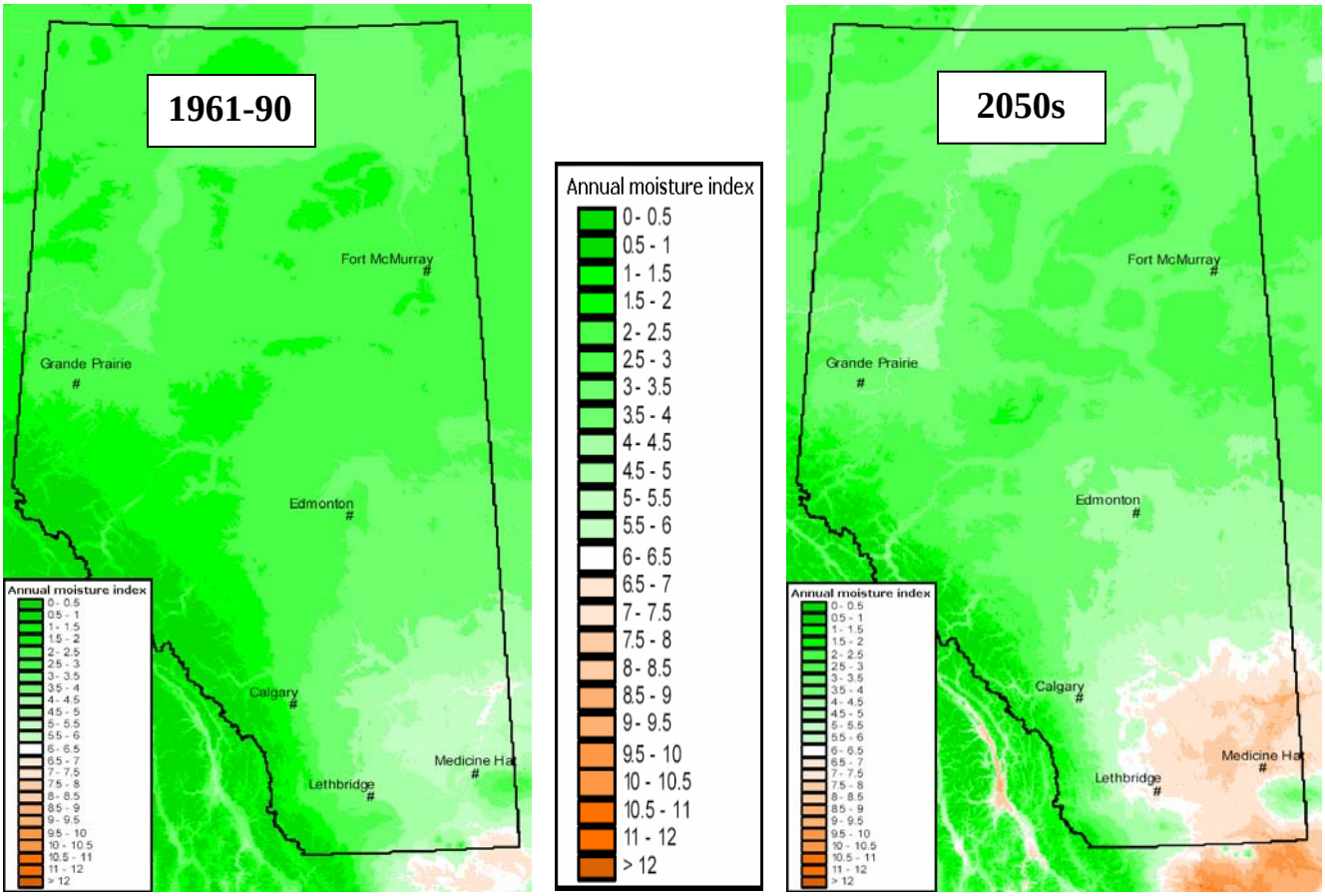


***Figure 5**: Annual Moisture Index for Alberta (Barrow and Yu, 2005).*

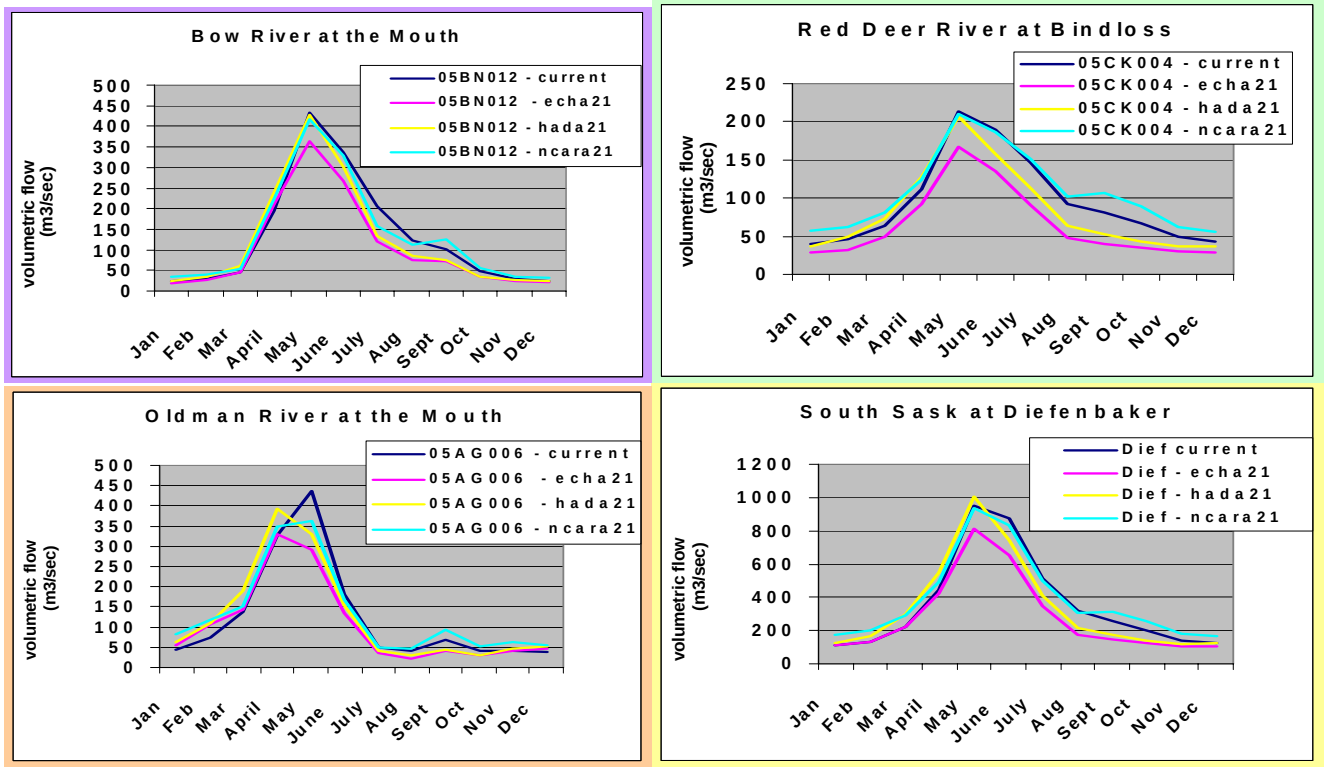


***Figure 6:** GCM scenario results, 2039 – 2070, cumulative flows.*

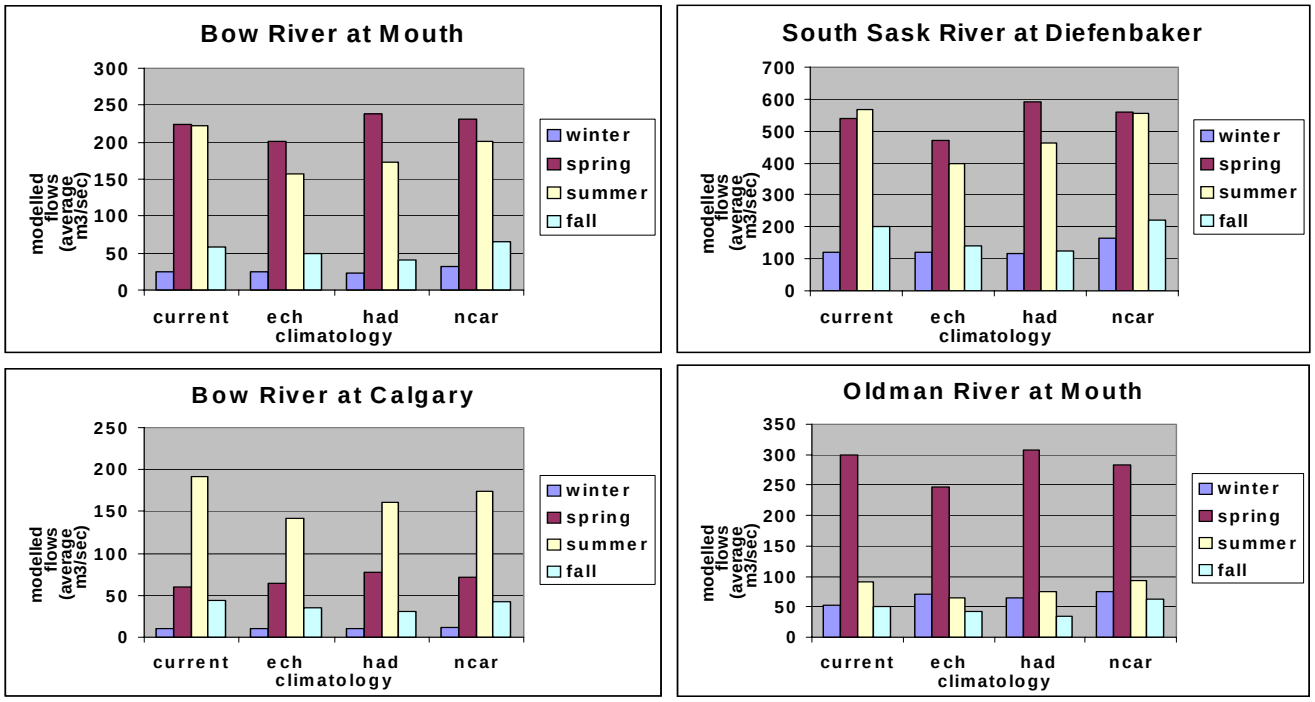


***Figure 7:*** *Spatial and seasonal response in flows, 2039-2070.*

These predictions for Alberta's future climate and water resources have considerable implications for its economic, environmental and social processes. The forces driving the Prairies' climate, its variability and its water resources need to be understood in greater depth for society to be better prepared for the future. In the meantime, we need to be flexible and open-minded so we can avoid the negatives and embrace the positives that climate change bestows upon us.

## **Community Vulnerability in the SSRB: Hanna, Alberta, Preliminary Insights** (Johanna Wandel, University of Guelph)

Hanna, Alberta, located in Special Areas 2, was selected as one of the case study communities for the IACC project. Johanna Wandel and Gwen Young conducted research in the town of Hanna over a five week period, where they gained knowledge with respect to the community's current management of water stress and its ability and the mechanisms available for it to cope with more frequent or more severe stress in the future. Special Areas 2 came out of a history of water stress and is essentially an institutional adaptation to moisture stress.

The way in which Hanna receives potable water is quite complex: water is pumped from the Red Deer River through the ATCO pipeline and into a reservoir, the Henry Kroeger Water Treatment Plant then treats the water and sends it through the Henry Kroeger Treated Water Pipeline to the Town of Hanna and other surrounding communities. The ATCO pipeline supplies the ATCO Power Generation Plant with water for their cooling pond, and via tap-offs and water released by the ATCO plant, it supplies farmers with irrigation water. Those who are not on the pipeline often lack sufficient quality potable water.

***Figure 8**: ATCO pipeline (Source: ATCO)*

Dryland farming still occurs in Hanna but more people are now incorporating ranching into their operations and reducing the amount of land they cultivate, primarily due to the high occurrence of water stress and solonetzic soils in the region. Low soil and subsoil moisture, especially in repeated dry years, limits grass growth and consequently affects grazing. Insufficient precipitation in spring poses serious concerns for farmers as it can significantly affect germination and lower yields. Farmers have adapted to water stress by changing crops and practicing zero or minimum tillage. Many ranchers use their crop for feed in extremely dry years, while others opt for crop and pasture insurance. In addition, ranchers have constructed more and bigger dugouts with the help of PFRA, decrease their herd size and lease additional land to help them cope in dry years. Many farmers and ranchers have also embraced the oil and gas industry or acquired off-farm jobs to supplement their income.

## **Taber Community Assessment, Preliminary Insights** (Susana Prado, University of Regina)

Another Canadian case study community is Taber, Alberta. Agriculture, oil and gas, and the food processing industry drive the economy in Taber, so episodes of drought and flooding, which are common to the area, along with hail, are the key water related exposures in the area. To mitigate the effects of drought, many farmers in the region have adopted irrigation. Other adaptive strategies in times of water shortage include water-rationing, construction of water storage facilities, irrigation just of higher value crops, and the decision by some farmers not to crop. In addition, adaptive strategies such as crop insurance, drainage systems, government financial support in case of flooding, and the adoption of non-drinking water use in some areas of the food processing industry are

other means by which community members adapt to changes in water supply. Dryland farming is also increasingly being mixed with ranching.

Water-use restrictions make people more aware and conscious of the water problem in the region, however future droughts are not a major concern in the community. Community members believe that there will be future inter-provincial and international water conflicts due to projected decreases in supply. The construction of water storage facilities to hold water for future use, such as dams, are frequently mentioned in the challenges for the area and province, however a consensus with respect to this point has not been reached. Technology seems to be the community's key coping mechanism for water scarcity in the future.

## **Water Conflicts and Institutions** (Lorenzo Magzul, University of British Columbia)

***Figure 9****: Oldman dam (Source: Lorenzo Magzul)*

The focus of this research is to investigate the issue of water conflict associated with the Oldman River Dam in the Oldman River Basin and to identify the lessons learned through past conflict so they can be applied to similar future situations. Emphasis is placed on the role of organizations and institutions in mediating conflict, particularly those related to water resources. One of the key underlying issues in Oldman River Basin is that there are different water users and different agreements through which access to water resources is obtained. The decision making process in the management and allocation of water resources can increase the incidence of conflict among community members as the input of some stakeholders is often excluded. Predicted future increases in water scarcity will likely exacerbate conflict situations. One of the most common adaptations to water scarcity in dryland areas such as the Oldman River Basin is the creation of reservoirs. In the case of the Oldman dam, people were unhappy with regards to the actual construction process and felt their objections and/or concerns were not being taken into account in the decision making process. As a result, many people moved away, changing existing human networks.

However, there were some positive outcomes: people recognized the need to be more efficient when they use water and decision-makers acknowledged the need to include all stakeholders in the decision-making process. Also, some stakeholders that were not opposed to the construction did sympathize with those who were (e.g. farmers who benefited from the construction sympathizing with displaced farmers).

**Water Governance and Adaptation to Climate Change: The Cases of Canada and Chile** (Darrell Corkal, Prairie Farm Rehabilitation Administration)

In Canada, water is recognized as a public good. Water management is a provincial government responsibility. Provinces own the water and allocate water rights to users. The federal government works with the provinces. Water management is not defined within the Canadian constitution. However, the Government of Canada could intervene in water management if deemed "in the interest of peace, order and good government" (which is a constitutional role). In reality, there are many federal, provincial and local institutions that are involved in the management of water. Most of the government institutions that deal with water are the departments of environment, health, watershed authorities and/or natural resources. Thus, there are numerous institutions with a vested interest in water management. There are also numerous water stakeholders with a vested interest in water management, and often with a unique perspective of how water should be managed.

Political boundaries have been established for good governance, but water knows no boundaries. The unit of natural movement for surface water is a watershed basin, and for ground water is geology and re-charge zones. Political boundaries do not match the watershed basins or aquifers. Water management is becoming increasingly more difficult for society to manage. The primary concerns with respect to governance in Canada relate to the numerous institutions and water stakeholders, the fragmentation of roles, implementing water management activities when water stakeholders do not always have a common goal or vision, addressing water conflict, and balancing social, economic and environmental interests with timely decision-making. Climate-change and increasing competition for water demands will place increasing challenges on water governance in Canada.

***Figure 10:*** *Agricultural operation in Chile (Source: Darrell Corkal)*

In Chile, the Water Code was established in the constitution. The national government plays a strong role in water management. One of the unique features of the Water Code is that water rights are essentially a commodity, and can be bought, traded or sold. This has increased the role of the private sector in water management. The Water Code was essentially designed to increase irrigated agriculture in Chile. Those with water rights do not own the water but they own the rights to extract it. The national government allocates water rights. When there is a conflict over water rights, the users are expected to address the issue themselves, or resolve the issue in court. Revisions to the Water Code in 2005 gave additional power to the national government to address allocated but unused water rights and to deal with the issue of minimum ecological flows. The commodification of water rights in Chile has given unique powers to the private sector. The private sector has taken advantage of this opportunity, invested heavily in water infrastructure and irrigated agriculture, and is intimately involved in water management. This has significantly advanced the degree of infrastructure development in the country. The agriculture sector consumes 85% of the water in Chile with irrigated agriculture. High-value crops such as grapes, avocadoes, fruit crops dominate the industry, and there is a large value-added food and non-food processing industry. Wine, spirit liquors and food products are sold locally and internationally. Water management issues in Chile relate to sustainability and social equity. Climate-induced reductions in precipitation are expected to affect future available water quantity. The unique arrangement of government-private sector roles in water management has proven to be successful for water development and economic development, but may prove to be a challenge for sustainability and environmental protection.

## Community Vulnerability in the Elqui River Basin, Chile

(Gwen Young, University of Guelph)

South of the driest desert on earth—the Atacama— is the community of Diaguitas, located in the Elqui River Valley. The valley is characterized as semi-arid, receiving approximately 100mm of precipitation yearly. Despite the lack of precipitation, the economy is heavily dependent on agriculture. Potable water in the community is drawn from groundwater and irrigation water is dependent on river flow. Riverflow is dependent on snowmelt from the Andes, and to a lesser degree, glacier melt. Local farmers use flood irrigation whereas large agriculture companies (such as Del Monte)—who are quickly buying up the land and water rights in the region— use very efficient drip irrigation. For the most part, community members have withdrawn from farming all-together due to increasing competition from agricultural companies for water rights and land and lucrative offers from companies for their land and water rights. Those who have left farming seek employment from these companies. Women have also entered the workforce to supplement household income.

***Figure 11****: Canals in Chile (Source: Gwen Young)*

The main climate-related concern in the community is the occurrence of mudslides, as they result in severe damage to infrastructure and human injury. People have taken several precautions to mitigate the effects of mudslides; for example, they reinforce their homes and buy extra food and supplies. The government has invested money in protective structures to divert mudslides away from the community and education programs to inform people of how to better prepare for mudslides. However, residents and engineers are skeptical about the protective structures as they have been poorly constructed and are too small to accommodate the massive amounts of debris flows. Meanwhile education programs through newspapers and radio have been successful in helping people prepare for mudslides.

When the community experiences a water shortage the potable water supply is shut off and irrigation water rationed accordingly. These shortages can occur from increased demand and/or insufficient supply. Government subsidies are available for farmers to improve the efficiency of their irrigation system. However, these subsidies are often inaccessible to the general public—requiring computer skills and time and money to apply. Furthermore, there appears to be lack of coordination and communication among water governance institutions themselves, and between water users and these institutions making it difficult to manage water resource appropriately. Research shows that in the past 100 years average precipitation has decreased 50%, and scenarios indicate a future increase in temperature. The Elqui River Basin may also experience more frequent and prolonged periods of drought. This can be attributed to the likely increase in frequency of El Niño, a consequence of climate change. El Niño is associated with prolonged dry periods followed by heavy rainfall which often instigates mudslides in Diaguitas. Glaciers are predicted to recede in the future, resulting in an increase in short-term river flow, but in the long-term, as snow and glacier reserves diminish and the volume of melt decreases, flows will decrease. However, with warmer temperatures, irrigation demands will increase, causing a potential shortage in water supply.

## FOCUS GROUP FINDINGS

The vulnerability approach emphasizes the need to treat vulnerability as a function of the current and future exposure and the current and future adaptive strategies of the system being considered (e.g. agency, community, individual, etc.). The vulnerability approach differs from many other approaches in that the conditions that give rise to vulnerability are identified by the system. That is, the conditions are not assumed by the researchers.

The purpose of the focus groups was to gain a first-hand understanding of the issues stakeholders see with respect to water availability (i.e. current exposures), how these

issues are currently being addressed (i.e. current adaptive strategies) and how these issues might be managed under future climate change (i.e. future adaptive strategies). Dave Sauchyn's presentation provided information on future climate and water conditions (i.e. future exposures). A list of questions that effectively captures the information sought in the focus groups was developed by the research team (see Focus Group Questions in Appendix 1). The questions were given to each facilitator, whose purpose was to engage participants in discussion and ensure that all questions were addressed.

Workshop organizers realized that there were three general themes that the participating stakeholders could be divided into. Stakeholders were assigned to the focus group that best suited their interests and affiliation. The first group was geared towards stakeholders whose interests or affiliations were municipal or regional in scope; the second towards those provincial or federal in scope; and the third towards industry and irrigators.

This section of the report summarizes the discussions from all three focus groups. Commonalities and differences in the discussions within and among the groups were identified and are discussed in this section. The findings are organized according to the vulnerability approach.

## Current/Past Exposures

Biophysical

Periods of intense rainfall are generally followed by prolonged dry periods. This variability affects stream flow in rivers, which is what many communities depend on for potable and irrigation water. Water quality is often compromised during periods of intense rainfall because there is often a rise in river flow, causing an increase in turbidity, or the concentration of silt present in the water, making it unsuitable for drinking. So even when water is in abundance, it cannot always be utilized. Waters from intense storms can cause damage to infrastructure: sewage systems back up and basements flood. Some regions do not have sufficient infrastructure to sustain the impacts of intense storms, making them more susceptible to storm damage.

High evaporation rates in reservoirs reduce the amount of water available for distribution, as many communities depend on reservoirs to provide them with potable and irrigation water. During droughts, communities often receive less water and therefore less water is available for use, meanwhile, more water is required for irrigation and cropping purposes.

Studies show that all the big, shallow lakes in the prairies are losing water, and that snowpack is no longer accumulating in the mountains and contributing to spring runoff. Thus, there is less water available than there has been in the past.

Livelihoods/occupation

***"The pressures to run more cattle and get more income out of your place…is against what we need to be doing"* – Focus Group Participant**

Agriculture drives the economy in many of the communities represented at this workshop. One fundamental input for the agricultural industry and its success is water. In the past few years precipitation has been especially variable. Extreme fluctuations in precipitation pose serious management challenges for the industry because it is difficult to plan when there is such a high degree of uncertainty. Recent droughts have been particularly problematic for farmers. Droughts can reduce crop quality and lower yields, resulting in lower profits.

Farmers are experiencing difficulties obtaining the water rights required to maintain and/or expand their operations— a barrier that impedes their ability to further develop their operations. Even though water resources are scarce, in order to remain viable, they are feeling pressure to 'go bigger'. Some irrigation districts are fully allocated, limiting how big farmers can actually go.

Environment

***"We have to… balance in the interests of natural systems with economic"* – Focus Group Participant**

Modifications to the landscape, such as infrastructure development in the countryside, are altering ecosystem processes. Fescue grass and cottonwoods are very efficient at storing and retaining soil moisture, and when they are removed from the landscape, runoff rates increase and underground water storage potential decreases.

Institutional

***"It's totally allocated. It's moratorium. There is no water left to be had!"* – Focus Group Participant**

***"There's always guidelines, there's never any legislation"* – Focus Group Participant**

The unpredictable nature of water resources in Alberta makes them extremely difficult to manage.

Water rights and allocations are extremely difficult to come across. Even though more water rights and allocations are sought after, by irrigators in particular, most districts are fully allocated and therefore unable to grant more licenses. There is simply no water left to allocate. Agricultural, industrial and housing developments are limited as a result.

In addition to being scarce, not all licenses are being used to their fullest potential, and some stakeholders feel that water is poorly allocated and/or that allocations are unfairly

distributed. The general feeling is that the agricultural industry has better access to water rights and more rights in total than any other water user.

Alberta is experiencing a development boom. Developments, including casinos, golf courses and homes, are appearing much closer to rivers than they should be, threatening both the natural environment and the water supply. People want to build as much as they

can now because they realize that water allocations will be nearly impossible to come across in the future. More development means more water users, which results in an increase in demand for a resource that is already dwindling.

Guidelines set by the government are simply guidelines, not requirements, and are therefore flexible when decisions need to be made. Developers, for example, are building closer to rivers than is environmentally sustainable because there is nothing in place to prevent them from doing so. Conflicting and contradicting legislations regarding resource use are problematic for decision-makers in that they cannot ever make the "right" decisions.

Social

***"We have almost a full fledge water war brewing on the outskirts of Calgary. It's very controversial, very difficult situation"* – Focus Group Participant**

Demands for water stem from different regions, communities and people. Some feel they deserve to have unlimited access to water resources and are hesitant to change their lifestyle. More water conflicts are arising as a result of conflicting demands.

Many stakeholders refer to an urban-rural disconnect. Urban dwellers generally do not appreciate the resource as much as rural dwellers because they do not realize or understand where it comes from and how scarce it really is. The urban-rural disconnect is not universally applicable: there are both urban and rural stakeholders that do not realize that even though water resources are renewable, they are finite, and this causes tension and conflicts among water users.

## Future Exposures

Biophysical
(See Dave Sauchyn's presentation summary for more details)

Scientists predict that Alberta will experience a 1.5 to 3.6 degree Celsius increase in temperature as well as an overall increase in precipitation, primarily in the form of rainfall. More precipitation is expected in winter months and less in summer when it is desperately needed. The growing season will be longer as a result of rising temperatures, but at the same time, there will be less rain in summer, the outcome being less available soil moisture. These predicted changes in temperature and precipitation will influence snow accumulation in the mountains which feed the rivers that communities are dependent on. In the future snow will accumulate and melt many times throughout the

winter months rather than accumulating over the winter and melting in the spring. Snow melts will generate runoff in the winter, reducing the amount of spring runoff. River flows and volumes will subsequently be affected.

Droughts are expected to become more frequent and prolonged. Models suggest that North America will experience 30 days without rain once every 18 years by 2070.

Livelihoods/occupation

Alberta's economy is heavily dependent on its water resources, so drastic changes to the resource could have severe implications for its economy and its people. Projected decreases in water supply suggest that communities, businesses and industry will have less water to work with in the future. The manufacturing industry will have less water to process products. Even though the growing season will be longer, farmers will require more water to get a good crop when there is less available. The frequency of water related stresses (e.g. droughts) strongly influences the viability of the agricultural industry. Farmers can manage a bad cropping season every 10 years, but one every 3 years is not manageable.

Diminishing flows in rivers means they have less assimilative capacity for waste water flows that go back into it. This compromises water quality and affects everyone that is dependent on the potentially contaminated source of water for drinking and/or irrigation.

Institutional

The large ranges associated with, and the uncertainty surrounding, future predictions makes it difficult for institutions to take concrete actions and make decisions to counter future water stresses. Municipalities' infrastructure is based on old flow regimes, and if flow regimes change, the current infrastructure will be inadequate to sustain the new flows, threatening communities and the environment.

Institutions often act as barriers rather than facilitators in the adaptation process, as they often constrain development. For example, moratoriums on water allocations restrain economic development.

Social

Alberta is a booming province and its population is expected to grow significantly in the future, putting more pressure on its water resources. Demand will grow alongside the population and conflicts over the resource could ensue. Invaluable water rights will be hoarded even though they may not be put to use, and it will be nearly impossible to acquire these rights. Ignorance on behalf of society could further diminish the resource if people continue to use water in an inefficient manner.

## Current/Past Adaptation Strategies

Water use efficiency

When communities experience water shortages various water conservation and rationing strategies are adopted. For example, many municipalities implement and strongly enforce lawn watering restrictions. Irrigators often opt to just water higher value crops. Farmers have installed low pressure irrigation systems to minimize waste water and maximize water use efficiency.

In some regions water is metered, so the more one uses the more one pays. People will likely be motivated to conserve water if they are receiving a bill for the water they consume.

Another measure taken that seeks to conserve Alberta's water resources is the Water For Life strategy. It provides Alberta with a new approach to water management as well as specific conservation guidelines for sustainable use of water resources both now and in the future.

Capturing water

Water scarcity is not uncommon in Alberta. Many communities rely on water storage facilities to satisfy their water needs. Reservoirs and dams have been built to capture and store water that is later supplied to communities. Pipelines and canals are the means by which water is transferred from the reservoirs to the communities. Considerable investment has been made in infrastructure to facilitate the movement of water from one place to another. Dugouts and on-stream storage facilities are examples of other measures taken to capture water for later use.

Technology

Agencies have created websites that the public can access and use to be better informed about the status of water resources. The information provided on these websites allows people to plan for and take the steps necessary to prepare for water related stresses.

Scientists have successfully modified the genes in certain crops to make them more resistant to certain stressful climatic conditions. Genetically modified (GM) crops can be found in many farmers' fields.

Agriculture

More and more dryland farmers are incorporating ranching into their operation because it reduces the economic stress they encounter when they have a bad cropping year. They often use the crop for feed when it is not profitable to sell it on the market.

Farmers have adopted new management practices (e.g. zero till and minimum till) aimed at conserving soil moisture, and irrigation systems have been incorporated into farmers'

operations to mitigate the effects of drought. Farmers are also increasingly seeking off-farm jobs to supplement household income if they are not able to make a satisfactory living off the farm.

Institutional Arrangements

***"Government should only be doing what people can't do for themselves. The solution is not in government. The solution is within the people"*** **– Focus Group Participant**

The water management planning agenda has essentially been handed over to the watershed planning and advisory councils through the Water For Life strategy, which seeks to incorporate the views of all stakeholders in watershed management.

Government has the ultimate control over water resources and the ability to delegate who is granted access to what. However, this power should only be exercised when the people cannot manage, cope with, or resolve a particular problem or issue on their own.

Moratoriums on new water allocations have been imposed in many areas. No new licenses are being distributed given that there is often not enough water available to satisfy the needs of those with existing licenses.

Water stakeholders (e.g. NGOs, government institutions, communities) are collaborating with one another in hopes of better understanding and better managing the water resource. In addition to regular meetings, information sessions and public forums, research studies and collaborations are being used to bring people together to discuss a common goal: maintaining a healthy and sustainable water supply.

Social

***"Don't ever look past yourself, and maybe that's just southern Alberta. If it's gonna be it's up to me! If you don't have that attitude in this country, water to drought, you ain't gonna live here long…that's just how it is"*** **– Focus Group Participant**

Periods of drought and water scarcity affect individuals in very different ways, but everyone in the community pulls together and works together during these difficult times. That is, adaptation becomes a collective effort, even if just for a short while. Essentially there is an unwritten rule in communities that requires everyone to do what they can to conserve water.

## Future Adaptation Strategies (Anticipated)

Water use efficiency

Industry could adopt more efficient manufacturing processes. Water conservation strategies that were adopted during past water shortages could be adopted permanently so that water is constantly being conserved. Demand may be permanently decreased as a result.

Capturing water

***"…we have to be able to store it and then use it when we need it"* – Focus Group Participant**

All three of the focus groups discussed the possibility of developing more water storage to help alleviate the effects of potential water shortages. Types of storage that would be most effective and efficient at capturing the predicted earlier runoff were discussed in detail. The early water can be held in storage for communities to use in the drier months of the year. Future increases in temperature affect the types of storage can be used because evaporation rates will also increase. Depending on how the future climate changes river flows and runoff, both expansion of current storage and construction of additional storage to divert water should be considered.

Bigger and deeper storage was identified as being more effective than shallow storage because more water is lost to evaporation in shallow storage. Underground storage might be more effective than aboveground storage when evaporation rates are factored in because there will always be some water lost in aboveground storage and underground storage may eliminate part of the evaporation factor. Recharging aquifers for use during times of water stress is one option for underground storage. More on-stream storage and bigger, deeper dugouts are other ways in which water can be captured and stored. Heightening of the existing dam would also increase water storage capacity.

It may not be economically feasible to divert large amounts of water into a reservoir—such projects require heavy investment and considerable development of infrastructure.

When considering future water storage we should not limit ourselves to those structures that are made and built by humans, we should also consider storing water in natural systems such as wetland and riparian ecosystems. Restoration of such systems has numerous associated benefits: it maintains the natural landscape, it allows for natural processes to continue taking place, it preserves the environment, and it allows for water to be stored in the soil.

Farmers and Ranchers

***"Expand irrigation, or turn it over to desert!"* – Focus Group Participant**

Farmers have many options to help them cope with future climatic changes. Their operations will have to be modified to accommodate decreases in water supply. Modifications will include adjusting when, where and/or how they crop. The adoption or expansion of irrigation systems is one way to battle droughts and water scarcities and reduce economic losses. Switching to dryland crops, sorghum for example, that do better in drier climates and shifting watering times are adaptation options for farmers to consider. Ranchers will need to reduce the amount of water their operation wastes.

Social

Alberta is not the only place on Earth experiencing water related stresses that will be exacerbated under future climatic change. There are several other countries in the world that are currently experiencing or will experience similar or even worse water related stresses and have taken actions to mitigate the negatives and capitalize on the positives. India has several million acres of farmland under irrigation, and so does the United States. The United States has some very effective models for storage that could be applied in Alberta or modified to meet Alberta's needs. Israel is doing an extensive amount of agricultural research to provide them with ideas as to what crops are the most suitable for cropping in the country. In addition to research, Israel is storing water in their ground water aquifers and using them when needed. They are also mining water at a fast rate. Alberta should be looking to, and learning from, other countries— we are not in this alone.

Awareness building and education were recognized as being mandatory for adaptation to climate change to take place. People have to realize that climate change is already, and will continue to be, a problem, that they are contributing to the problem, and that the decisions they make affect everyone around them. If people were made aware of climate change and its effects on society, and had the information needed to make responsible choices with respect to their lifestyles, they might be more willing to change their practices.

Institutional

***"…look for opportunities to reward or provide incentives to rural producers, rural landowners, land managers who are doing the right thing, that are benefiting society as a whole"* – Focus Group Participant**

Water priorities have to be made in order to effectively manage the water resource. Potable water has to be at the top of the list, followed by both agriculture and industry. These priorities need to be clarified and documented on paper. Once this happens, everyone will be on the same page and arguments over uneven or unfair distribution will hopefully be put to an end.

Saving a percentage of allocations to account for potential decreases in water resources is one way of ensuring that allocations can be satisfied. Decisions are becoming more localized as the WPACs—Watershed Planning and Advisory Councils—take more leadership in setting the water planning agenda in the various basins, which are expected to better represent local interests. Basin decisions will therefore be supported by stakeholders and conflicts minimized.

Those that are unsuccessful in obtaining a license could be using the unused, allocated water, which then brings up issues surrounding conservation: should those attempting to conserve be punished for not using their allocation?

Rather than forming new institutions and agencies and creating new tools to facilitate adaptation, current institutions, agencies and tools can be "tweaked" to incorporate adaptations to climate change.

Industry, businesses, communities and individuals need to be given some incentive for conserving water and becoming more efficient in their water use because there is often an economic sacrifice on behalf of the user. Not everyone is contributing, but society as a whole is benefiting from those that are taking the initiative and becoming more efficient and effective in their water use. This warrants some kind of reward.

## Adaptive Capacity

Focus group discussions revealed numerous constraints and opportunities that influence stakeholders' ability to adapt to changing climatic conditions. This section summarizes both the constraints and the opportunities identified in the focus groups.

Insights on constraints

***"I know where every barrel of oil is in this province but we have no idea where the groundwater is"* – Focus Group Participant**

- Rules and regulations set by government often hinder the ability of people to adapt to the changing climate
- Limited and/or inadequate resources hinder the ability of institutions, agencies and NGOs to effectively carry out their respective duties. Monetary and human resources were identified as being insufficient and the major constraints on the implementation of plans and programs.
- There is an inadequate inventory of Alberta's water resources, and there is inadequate information as to how much of the resource is actually being used. Uncertainties surrounding the quantity and location of water resources make the resource extremely difficult to manage.
- "Knowledge transfer" is a big issue in that information is not shared or passed on to others with vested interests. The information might be there but it is in terms that people do not understand and in places that people cannot easily or readily access.
- Modelers require more precise data to run models. They also need better access to climate change scenarios.
- A better understanding of the ways in which the timing of the water resource will change in the future would allow for better informed decisions to be made.
- Human nature is to worry about oneself first and others later. People are used to a certain lifestyle and they are not always willing to change. Society has to adapt to climate change. It has to be a collective effort, with collective interests in mind.

Insights on opportunities

- The number of growing degree days are projected to increase, along with the range of land that will be suitable for agriculture, providing agricultural opportunities in many regions.

# APPENDIX 1

## Focus Group Questions

1. Outline the day to day management of water (and climate) involved in your organization.
2. What information inputs are used to make decisions? Who makes the decisions?
3. What agencies do you need to collaborate with to make these decisions?
4. What sort of information would improve decision-making? What are the barriers to acquiring this?
5. What sort of actions are done at the institutional level which reduce exposure at the regional/community/individual level?
6. What (if any) planning for future conditions occurs? What are the constraints to future planning?
7. Use the case of 2001-2003: how was the drought felt in your institution? What was done about it? What could have been done better? What changed as a result of this stress? If the same three years happened again now, how would they be handled/what is different now? Were there long-term changes as a result of this dry period?
8. What are the implications of the Sauchyn scenarios for your institution? Are they within the coping range using existing processes? What needs to change?

## APPENDIX 2

## Agenda

*Stakeholder Workshop on Water and Climate*
*Lethbridge Lodge Hotel, Lethbridge AB Friday Dec. 1, 2006*

9:00 **Welcome; Overview of Institutional Adaptation to Climate Change**

- Polo Diaz, Canadian Plains Research Centre, University of Regina

9:15 **Water and Climate Scenarios for Alberta's South Saskatchewan River Basin**

- Dave Sauchyn, Suzan Lapp, University of Regina

10:00 Coffee

10:30 **Breakout Sessions**

- discussion of water issues, institutional needs, etc.

12:00 Lunch, provided

1:00 **Plenary Session**

2:00 **Community Vulnerabilities**

**Canadian Case Studies, SSRB in Alberta**

- **Vulnerability** - Johanna Wandel, University of Guelph
- **Water Conflict** - Lorenzo Magzul, University of British Columbia

**Chilean Case Studies, Rio Elqui, La Serena**

- **Governance** - Darrell Corkal, PFRA
- **Communities** - Gwen Young, University of Guelph

3:15 Coffee

3:45 **Closing Remarks and Thanks**

- follow-up reporting