Watershed Management Plan:

Water Quantity Component

BATTLE RIVER WATERSHED ALLIANCE

Drought Adaptation and Management: **Implementation Guidelines**

Susanna Bruneau

September 2013

Table of Contents

About This Document

The Battle River and Sounding Creek watersheds are prairie fed, and are more susceptible to periodic droughts. Limiting the impact of drought in the region adaptive and ongoing drought management is necessary to protect the social, economic and environmental welfare of the watershed community.

The following document outlines the BRWA's implementation guidelines for drought adaptation and management in the Battle River and Sounding Creek watersheds in Alberta. Drought adaptation and management is one component of the BRWA's watershed management planning process.

This advice was developed with broad input from watershed residents, stakeholders and decision-maker, and is supported by information compiled in the BRWA's *Understanding the Policy Context for Drought Management Battle River and Sounding Creek Watersheds*[i].

Accompanying Policy Advice

This guideline document is accompanied by corresponding policy advice[ii]. Whereas the implementation guidelines outlined below describes options for management strategies to support the implementation of this policy direction, the policy advice document puts forward an overarching policy direction for drought adaptation and management

Guideline Purpose

The purpose of the guideline is to provide information regarding opportunities for drought adaptation and management that contribute to watershed sustainability by addressing the social, economic, and ecological impacts of drought. Policy implementation guidelines are split in two components, (1) drought adaptation and (2) drought management.

- Drought Adaptation: the responses of individuals, groups, and governments, to routine climatic variability in a manner that reduce the occurrence and severity of adverse impacts of drought. Adaptation is employed when drought and its associated impacts are not yet occurring.
- Drought Management: the responses and actions that are employed during times of drought.

Guideline Objective

Overall objectives of the Guideline are:

- **Improved Practices –** to encourage watershed sustainability, water conservation, beneficial land use practices, continuous improvement, shared responsibility, and the use of flexible tools to optimize water use, and increase drought adaptability including actions to:
    - Maintain viability of social and economic institutions while protecting ecological functions to maximize overall watershed sustainability and productivity.
    - Protect the aquatic ecosystem, groundwater resources, and other water users through water conservation, adaptive management and adoption of environmental stewardship measures.
- **Adaptability –** to enable regulatory discretion and adaptation to local and regional circumstances (societal, ecological, and geological variability).
- **Water Conservation –** to minimize the use of water while increasing drought adaptive capacity through:
    - Identifying areas prone to drought and water-shortage events, where the maximum effort must be made to develop and implement drought –adaptive measures.
    - Effective waters use for throughout the Battle River watershed through *periodic re*-evaluation of alternatives and continuous improvement efforts.
- **Regulatory Options –** to provide information to decision-makers, regulators, and the public regarding feasible options and recommended approaches to reducing water use and developing drought management and adaptation.

Guideline Application

This guideline document applies to the Battle River and Sounding Creek watersheds within Alberta. All four orders of government (municipal, provincial, federal and First Nations), urban and rural residents, agricultural producers, business and industry, environmental and community organizations, academia, recreational users, and watershed stewardship groups are encouraged to collaborate with the intent of this policy, and to utilize its guidelines when developing drought policies.

The BRWA's Watershed Management Planning Process is non-regulatory. This means that implementation of policy advice and implementation guidelines developed for each of the 12 watershed management priority areas is dependent on the voluntary actions of watershed

residents, stakeholders and decision-makers. The BRWA will work to support the implementation of policies and management practices that align with the goals and objectives outlined in this document.

Guideline Selection

Adaptation practices are differentiated along several dimensions:

- By spatial scale (local, regional, national);
- By sector (water resources, agriculture, tourism, public health, etc.);
- By type of action (physical, technological, investment, regulatory, market);
- By actor (national, provincial, or local government, private sector, NGOs, local communities and individuals);
- By climatic zone (natural regions, vegetation zones, dryland, floodplains, etc.);
- By baseline income/development level of the systems in which they are implemented (sub-watershed, county, etc.); or
- By some combination of these and other categories[iii].

Selection of appropriate adaptation and management strategies is imperative. Different measures are appropriate in different places. Selecting adaptations to be implemented in the near term (next 10 years) should consider the following criteria[iv]:

- *No regrets* – measures selected should generate other benefits to the economy or the environment and which are justifiable under current conditions;
- *Reversibility* – due to climate and weather uncertainty at the basin or watershed scale, it is not wise to become locked into a course of action that cannot be altered in a decade should new information suggest a more appropriate direction (adaptations should be reversible);
- *Minimize ecological impacts* – adaptation to drought and climate change invariably deals with human activities and human behaviours. A key challenge for the Canadian water sector is ensuring that adaptations do not stress natural systems unnecessarily;
- *Cost effectiveness* – should be inexpensive and the benefits should exceed their costs. Due to increasing climate uncertainty, justifying significant costs for measures that may need to change in the near future may be difficult;
- *Equity* – The distinction between *costs to society* and *costs to individuals* should be recognized. The most appropriate measures are those where beneficiaries accept the costs (the concept of "user pay");
- *Reduce vulnerability* – or at least do not increase it;

- *Ease of implementation (feasibility)* – The most appropriate measure are those that do not require major financial outlays, dramatic changes in institutional arrangements, or immediate radical shifts in behaviour; and
- *Effectiveness* - examine the relative effectiveness of measures after considering the other criteria. There may be limited value in suggesting, highly effective but extremely costly measures, though such measures may be required, especially if they are the ones that best meet criteria such as reducing vulnerability, equity, and reversibility.

These criteria can be used to quickly screen available options and select suitable ones for the near term, without having to make use of in-depth evaluation tools such as cost-benefit analysis.

Another framework commonly used for classifying adaptation measures is based on the study of extreme events such as floods and droughts. This framework places adjustments to extreme events in three main categories[v]:

1. *Accepting losses:* This involves bearing and sharing losses. Loss bearing typically is an individual adaptation. However, it may be pursued by groups or communities that have no other choice, or when the other choices to be too costly. Losses can be shared within wider communities, or via mechanisms such as insurance and public relief.
2. *Preventing effects:* The aim of these adaptations is to prevent the consequences of climate change and drought from occurring. These measures often involve the construction of structural works that will reduce the impacts of climate change. For example reservoirs that store water. Typically, the aim is to allow pre-impact behaviour and activities to continue.
3. *Changing uses and/or locations:* Change in use involves accepting some behaviour and activities can no longer be pursued because they are too risky, too expensive, or simply no longer possible. The adaptation involves switching to a different use strategy. Adaptation strategies that involve a change of location are a more extreme response.

Drought Policy Implementation

The following drought implementation guidelines are recommended to be applied across the watershed.

1. Education & Awareness

   Across the watershed, the recommendation for more education and awareness about causes and total impacts of drought, potential mitigation and adaptation measures, as well as dialogue about trade-offs.

   Engagement with organizational and community members, and other stakeholders is recommended to keep them informed of plans and decisions, involving them in the decision-making process, and empowering residents to make change.

2. Incentives & Rebates

   Incentives and rebate programs are a strategy to begin campaigns, such as water conservation or re-use. Common examples such as rebates on low-flush toilets, rain barrels, composting bins, and energy-efficient retrofit rebates have been practiced throughout Alberta and in communities within the Battle River and Sounding Creek Basins.

   Incentives do not have to be merely money-related. Incentives can include in-kind support as well as provision on materials and personnel to do the work.

   It is important to note that incentive and rebate programs are not meant as long-term solutions. They are a potential quick-fix as a short-term solution or used to motivate the start of a long-term initiative. Use of these programs should be thoughtful and planned well.

3. Develop drought adaptation and management plans at a local and regional level

   Many of the drought management and adaptation guidelines can be implemented voluntarily or independently, or under municipal by-laws. However, development of national, provincial, and municipal drought adaptation and management plans is recommended. These plans allow for adaptive and pro-active measures to be implemented in times when drought is not a concern, allowing for more sustainable and effective measures.

The majority of the following guidelines pertain to particular sectors and those who are involved in those sectors. The sectors identified in the following section relate to policy advice areas discussed in the Drought Adaptation and Management Policy Advice document[vi]. Additional / supplementary documents with information pertinent to each identified sector are also provided (Appendix A).

Adaptation Implementation Guidelines

1 Agriculture

Not all of the following recommendations are suitable on a general basis. It is recommended that an evaluation of current issues, the type of operation, and land characteristics be done before selecting adaptations.

Policy Objective:

Recognize the impact of climate variability and climate change on agricultural operations.

Develop and implement drought adaptation strategies.

In the Battle River and Sounding Creek watersheds, 70% of land use taking place is agriculture-based. Therefore, many of the land management recommendations for drought involve agricultural adaptations.

Implementation Guidelines:

1.1 With respect to farm plans

Guideline	Responsibility
1.1.1: Develop farm drought plans with triggering criteria for implementation.	• Agricultural Producers • Private Land Owners
1.1.2: Develop Environmental Farm and Stewardship plans for land/operations.	• Agricultural Producers • Private Land Owners • Alberta Agriculture and Rural Development • Agriculture & Agri-Food Canada

1.2 With respect to technological developments

Guideline	Responsibility
1.2.1: Develop new crop varieties to increase the tolerance and suitability of plants to temperature, moisture and other drought-related conditions.	• Private Land Owners • Plant Breeding companies • Alberta Agriculture and Rural Development • Natural Resources Conservation Board

1.2.2: Use existing crop types that have greater tolerance and suitability of plants to temperature, moisture and other drought-related conditions.	• Private Land Owners • Alberta Agriculture and Rural Development • Natural Resources Conservation Board
1.2.3: Develop and implement water management innovations to address the risk of moisture deficiencies and increasing frequency of droughts.	• Private Land Owners • Agricultural Producers Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development • Natural Resources Conservation Board
1.2.4: Develop farm-level resource management innovations to address the risk associated with changing temperature, moisture and other drought-related conditions.	• Private Land Owners • Agricultural Producers Alberta Agriculture and Rural Development • Natural Resources Conservation Board

1.3 With respect to farm production practices and land use

Guideline	**Responsibility**
1.3.1: Diversify crop types and varieties, including crop substitution, to address the environmental variations and economic risks associated with drought.	• Private Land Owners • Agricultural Producers • Alberta Agriculture and Rural Development • Natural Resources Conservation Board
1.3.2: Diversify livestock types and varieties to address the environmental variations and economic risks associated with drought.	• Private Land Owners • Agricultural Producers • Alberta Agriculture and Rural Development • Natural Resources Conservation Board
1.3.3: Change the intensification of production to address the environmental variations and economic risks associated with drought. **1.3.4:** Manage grazing rates to match the carrying capacity of the land.	• Private Land Owners • Agricultural Producers • Alberta Agriculture and Rural Development • Natural Resources Conservation Board

1.3.5: Work with municipal agricultural service boards and agricultural producer groups to research and implement BMPs.	• Private Land Owners • Agricultural Producers • Municipalities • Grey Wooded Forage Association • Battle River Research Group (BRRG) • Chinook Applied Research Association (CARA) • Alternative Land Use Services (ALUS)
1.3.6: Change the location of crop and livestock production to address the environmental variations and economic risks associated with drought.	• Private Land Owners • Agricultural Producers • Alberta Agriculture and Rural Development • Natural Resources Conservation Board
1.3.7: Use alternative practices to address drought-related moisture and nutrient deficiencies. For example, move away from monoculture planting where possible.	• Private Land Owners • Agricultural Producers • Alberta Agriculture and Rural Development • Natural Resources Conservation Board
1.3.8: Implement the Wetland Mitigation Decision Framework[vii].	• Private Land Owners • Agricultural Producers • Alberta Agriculture and Rural Development • Natural Resources Conservation Board • Alberta Environment and Sustainable Resource Development
1.3.9: Incorporate wetland and riparian areas management.	• Private Land Owners • Agricultural Producers • Cows and Fish • Alberta Agriculture and Rural Development
1.3.10: Allow/reintroduce beaver activity in wetlands, creeks, and rivers to facilitate riparian and wetland ecosystem services to restore healthy aquatic ecosystems and wildlife corridors.	• Private Land Owners • Agricultural Producers • Drainage Districts

1.3.11: Implement use of off-site watering systems.	• Private Land Owners • Agricultural Producers • Alberta Agriculture and Rural Development • Natural Resources Conservation Board
1.3.12: Implement holistic management and planning grazing.	• Private Land Owners • Agricultural Producers • Cows and Fish • Alberta Agriculture and Rural Development
1.3.13: Two-year storage of seed and/or feed to help alleviate stress, as seen in the Special Areas.	• Private Land Owners • Agricultural Producers • Alberta Special Areas • Alberta Agriculture and Rural Development

1.4 With respect to weather, precipitation, and water level monitoring

Guideline	Responsibility
1.4.1: Increase effectiveness of early warning systems that provide trend data, daily weather predictions, and seasonal forecasts and include links to WPACs (and other watershed agencies).	• Alberta Environment and Sustainable Resource Development Natural Resources Canada • Alberta Agriculture and Rural Development • Environment Canada • Agriculture and Agri-Food Canada
1.4.2: Monitor ground water and stream flows.	• Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development Natural Resources Canada • Environment Canada • Agriculture and Agri-Food Canada

1.5 With respect to farm financial risk management

Guideline	Responsibility
1.5.1: Diversify farm income stream to lessen the risk of drought-related income loss.	• Agricultural Producers • Private Land Owners
1.5.2: Modify crop insurance programs to influence farm-level risk management strategies with respect to climate-related loss of crop yields.	• Agriculture Financial Services Corporation (AFSC) • Alberta Agriculture and Rural Development • Agriculture and Agri-Food Canada
1.5.3: Modify subsidy, support, and incentive programs to influence farm-level production and financial management.	• AFSC • Alberta Agriculture and Rural Development • Agriculture and Agri-Food Canada
1.5.4: Change *ad hoc* compensation and assistance programs to share publicly the risk of farm-level income loss associated with extreme climatic events.	• AFSC • Alberta Agriculture and Rural Development • Agriculture and Agri-Food Canada

2 Individual, Family, and Community Support

Policy Objective:

Recognize the impact of climate variability and climate change on agricultural operations.

Develop and implement drought adaptation strategies to reduce vulnerability and increase resiliency

With adaptations that involve communities and the general public, the first suggested step is assessment of the vulnerabilities and adaptive capacities of different regions, communities, and population groups. The next step would involve identification and selection of the most appropriate response strategies[viii].

Support for the social systems of communities is suggested, as social capital upholds much of the well-being of communities, especially in rural areas[ix].

Implementation Guidelines:

2.1 With respect to social support for individuals, families, and communities

Guideline	Responsibility
2.1.1: Develop funding programs and social supports for children and families affected by drought.	• Local Family and Community Support Services (FCSS) • Other local support organizations • Alberta Agriculture and Rural Development • Alberta Human Services
2.1.2: Increased human support services when planning for drought, must be available and responsive to the needs of farm families and rural people.	• Local FCSS • Other local support organizations • Alberta Agriculture and Rural Development • Alberta Human Services
2.1.3: Supportive community development initiatives to reinforce lasting social changes.	• Local FCSS • Other local support organizations • Alberta Agriculture and Rural Development • Alberta Culture • Alberta Human Services

2.1.4: Incentives to support the development of individual and family well-being plans as part of a shift towards better drought preparedness.	• Local FCSS • Other local support organizations • Alberta Agriculture and Rural Development • Alberta Human Services
2.1.5: Promote policies and strengthen institutional frameworks which develop cooperation and coordination, in a spirit of partnership, between the donor community, governments at all levels, local populations, and community groups.	• Local FCSS • Other local support organizations • Municipalities • Alberta Agriculture and Rural Development • Alberta Human Services
2.1.6: Develop community drought plans.	• Municipalities • Battle River Watershed Alliance

2.2 With respect to mental health

Guideline	**Responsibility**
2.2.1: Implement awareness programs regarding mental health and emotional support services available for local organizations.	• Local FCSS • Municipalities • Other local support organizations • Alberta Health Services • Canadian Mental Health Association • Health Canada
2.2.2: Provide tools for farm families and rural people and enable them to become self-aware of their own physical and mental health needs and to focus on their ongoing well-being at all times.	• Local FCSS • Other local support organizations • Alberta Health Services • Canadian Mental Health Association • Health Canada
2.2.3: Appointment of designated community-based drought mental health workers.	• Local FCSS • Municipalities • Alberta Health Services • Canadian Mental Health Association

2.2.4: Workshops to build on existing mental health promotion interventions to raise confidence and skills in responding to mental health problems **2.2.5:** Facilitate the formation of local networks that would improve mental health care in rural communities.	• Local FCSS • Other local support organizations • Municipalities • Alberta Health Services • Canadian Mental Health Association
2.2.6: Existing mental health services must be easily accessible and responsive to the needs of drought affected families.	• Local FCSS • Other local support organizations • Municipalities • Alberta Health Services • Canadian Mental Health Association

2.3 With respect to physical health

Guideline	**Responsibility**
2.3.1: Dialogue with health professionals and develop a drought plan relating to services needed during a prolonged drought, as well enhance existing strategies for families aimed at reducing barriers to access health services in times of stress.	• Local support organizations Municipalities • Emergency Services • Alberta Health Services • Health Canada
2.3.2: Increase the capacity of the health sector to manage the risks to human health and well-being from drought, particularly for the most vulnerable population groups.	• Local support organizations • Alberta Health Services • Health Canada
2.3.3: Manage population health risks in a systemic and comprehensive manner, so that drought change is integrated into existing frameworks, rather than being addressed as a separate issue. **2.3.4:** Reduce the need for *ad hoc* approaches of bringing in extra health resources during times of drought.	• Alberta Health Services • Health Canada • Municipalities • Local support organizations
2.3.5: Assist people to understand the increase in risk factors determining health during times of drought, and that they have clear access available to obtain appropriate help.	• Local FCSS • Local support organizations • Alberta Health Services • Health Canada

2.3.6: Strengthen healthcare services in rural Alberta to provide health promotion and regular health assessments that include risk factors known to contribute loss of productivity, quality of life, and premature mortality for people in rural communities.	• Local FCSS • Local support organizations • Alberta Health Services • Health Canada
2.3.7: Increase the sustainable capacity of existing primary and allied health care services in rural communities, allowing them to respond to the health and well-being of the community and the impacts of future drought (includes improving access to affordable services)..	• Local FCSS • Local support organizations • Alberta Health Services • Health Canada
2.3.8: Establish public health drought response plans.	• Local support organizations • Alberta Health Services • Health Canada

3 Natural Areas

Policy Objective:

Improve the health of natural areas

Well-managed riparian areas and wetlands buffer the destructive impacts of floods and droughts, especially when efforts are combined on a watershed basis. Shelterbelts and other treed areas help reduce water loss from evaporation, and reduce wind erosion. Riparian areas, wetlands, and shelterbelts also help manage issues of water quality that can occur during and following a drought (high nutrient level concentration, heavy run-off, and nutrient and sediment loading).

Implementation Guidelines:

3.1 With respect to knowledge and understanding of natural areas

Guideline	Responsibility
3.1.1: Education and awareness efforts should focus on the role of natural areas in mitigating the impacts of drought, including desertification, biodiversity maintenance, water attenuation, and potential conflicts with wildlife for water.	• Private Land Owners • Battle River Watershed Alliance Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development • Alberta Tourism, Parks, and Recreation • Natural Resources Conservation Board
3.1.2: Understand traditional ecological knowledge and utilize it in decision making.	• First Nations in the Battle River watershed • Battle River Watershed Alliance • Alberta Environment and Sustainable Resource Development

3.2 With respect to urban environments

Guideline	Responsibility
3.2.1: Incorporate wetland and riparian management for new developments.	• Municipalities • Cows and Fish • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
3.2.2: Incorporate use of native species and natural land cover.	• Municipalities • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

3.3 With respect to riparian areas

Guideline	Responsibility
3.3.1: Improve riparian health.	• Municipalities • Cows and Fish • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
3.3.2: Restrict development in riparian areas.	• Municipalities • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
3.3.3: Assessment of setback and buffer zones for riparian areas.	• Municipalities • Cows and Fish • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

3.3.4: Allow or re-introduce beaver activity in wetlands, creeks, and rivers to facilitate riparian and wetland ecosystem services to maintain healthy aquatic ecosystems and wildlife corridors.	• Municipalities • Post-secondary institutions • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

3.4 With respect to wetland areas

Guideline	Responsibility
3.4.1: Create framework for wetland restoration and other recommendations provided in the Alberta Water Council's Recommendations for a New Wetland Policy[x].	• Ducks Unlimited Canada • Delta Waterfowl • North American Waterfowl Management Plan (NAWMP) • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
3.4.2: Enhance wetland restoration.	• Private Land Owners • Agricultural Producers • Ducks Unlimited Canada • Delta Waterfowl • NAWMP • Municipalities • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
3.4.3: Restrict development around wetlands.	• Municipalities • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

3.4.4: Assessment of setback and buffer zones for wetlands.	• Municipalities • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

3.5 With respect to natural land cover

Description	Responsibility
3.5.1: Limit removal of treed areas/shelterbelts.	• Private Land Owners • Agricultural Producers • Municipalities • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
3.5.2: Develop and implement tree/shelterbelt planting programs.	• Municipalities • ALUS • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
3.5.3: Reintroduce natural land cover and use of native species.	• Private Land Owners • Agricultural Producers • Ducks Unlimited Canada • ALUS • Municipalities • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

3.6 With respect to biodiversity

Guideline	Responsibility
3.6.1: Promote biodiversity and encourage diversity of ecosystems and successional stages to maintain ecosystems functioning within their natural range of variability.	• Battle River Watershed Alliance Alberta Environment and Sustainable Resource Development • Alberta Land Use Framework
3.6.2: Resource conflicts between animals and humans need to be anticipated and legislation, education programs, and processes for minimizing and resolving these conflicts.	• Schools • Municipalities • Battle River Watershed Alliance • Alberta Environment and Sustainable Resource Development
3.6.3: Foster cooperation and consultation between federal, provincial, and local government entities to enhance aquatic species protection, recovery, and re-establishment while protecting rights to water use.	• Municipalities • Alberta Environment and Sustainable Resource Development • Natural Resources Canada • Environment Canada
3.6.4: Develop and implement a water conservation objective and associated plan to effectively manage water for healthy aquatic ecosystems and for other purposes.	• Private Land Owners • Agricultural Producers • Municipalities • Alberta Environment and Sustainable Resource Development • Natural Resources Canada • Environment Canada

3.7 With respect to parks and protected areas

Guideline	Responsibility
3.7.1: Research regarding how drought will impact provincial parks to predict impacts (social, ecological, and economic), and changes in use.	• Local organizations • Post-secondary institutions • Alberta Tourism, Parks, and Recreation

3.7.2: Develop adaptation and management strategies for parks and protected areas.	• Municipalities • Alberta Tourism, Parks, and Recreation

3.8 With respect to land use planning

Guideline	Responsibility
3.8.1: Specify the priority of ecosystem needs relative to other values or interests.	• Private Land Owners • Agricultural Producers • Municipalities • Alberta Environment and Sustainable Resource Development
3.8.2: Develop plans to set out how ecosystem services and values will be protected and managed.	• Private Land Owners • Agricultural Producers • Municipalities • Alberta Environment and Sustainable Resource Development
3.8.3: Under the role of regional planning of the Land Use Framework, ensure 10% of area is designated under protected areas.	• Municipalities • Alberta Environment and Sustainable Resource Development • Alberta Tourism, Parks, and Recreation

4 Water Supply

Water Quantity Policy Objective:

Recognize the impact of water shortage periods on all licence holders.

Develop and implements drought adaptation strategies to maximize water quantity

Access and water supply are key components of the social, environmental, and economic wellbeing of everyone in the watershed. During a drought there is potential that new water licence holders will not be able to access and utilize the water resource.

Water Quantity Implementation Guidelines:

4.1 With respect to community engagement and education

Guideline	Responsibility
4.1.1: Foster the emergence of a water-saving culture.	• Schools • All watershed stakeholders and residents • Post-secondary institutions • Municipalities • Battle River Watershed Alliance
4.1.2: Foster the emergence of water efficient or waterless technologies and practices.	• Municipalities • Battle River Watershed Alliance
4.1.3: Provide opportunities for community and stakeholder engagement regarding input and feedback on plans, and incorporating this input into drought adaptation and management plans.	• Municipalities • Battle River Watershed Alliance • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
4.1.4: Provide access by local populations to appropriate information and technology (i.e. composting toilets, low-water appliances, etc.).	• Municipalities • Battle River Watershed Alliance • Alberta Environment and Sustainable Resource Development • Alberta Infrastructure • Alberta Municipal Affairs

4.1.5: Facilitate dissemination of drought awareness, knowledge, and adaptation through workshops.	• Municipalities • Battle River Watershed Alliance
4.1.6: Communicate and work with the public to establish comprehensive water supply plans, local drought adaptation and preparedness plans, and emergency drought action plans.	• Municipalities • Battle River Watershed Alliance
4.1.7: Encourage water conservation, stewardship and education through local media.	• Municipalities • Battle River Watershed Alliance • Media organizations

4.2 With respect to decision-maker education

Guideline	**Responsibility**
4.2.1: Provide education and training about climate change, drought impacts, and adaptation for decision-makers.	• Municipalities • Battle River Watershed Alliance
4.2.2: Increase the use of decision-making processes or tools (e.g., software, drought simulations) that include drought impacts and adaptations.	• Municipalities • Battle River Watershed Alliance
4.2.3: Increase the informational exchange through workshops and other communication exchange vehicles so municipalities can share their adaptation strategies' knowledge.	• Municipalities • Battle River Watershed Alliance
4.2.4: Collaborate in the creation of an interprovincial drought collaborative to facilitate communication and drought information resources technology.	• Agriculture & Agri-Food Canada • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

4.3 With respect to community planning

Guideline	Responsibility
4.3.1: Develop, refine, and maintain hydrological hazard and risk models to guide community planning.	• Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
4.3.2: Work with communities to ensure that they have the necessary information to respond when droughts are forecast.	• Municipalities • Battle River Watershed Alliance • Alberta Rural Development Network • Municipal Affairs • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development • Agriculture & Agri-Food Canada
4.3.3: Provide local governments and water suppliers with planning tools to adapt to and prepare for drought.	• Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development • Municipal Affairs • Natural Resources Canada • Environment Canada • Agriculture & Agri-Food Canada
4.3.4: Create and implement ongoing water conservation plans.	• Municipalities
4.3.5: Update and practice implementation of plans regularly/annually.	• Municipalities
4.3.6: Implement a municipal drought adaptation plan	• Municipalities

4.4 With respect to community water sources

Guideline	Responsibility
4.4.1: Evaluate population growth initiatives in relation to available water.	• Municipalities
4.4.2: Ensure water can be stored for water deficit periods.	• Agricultural Producers • Private Land Owners • Municipalities
4.4.3: Ensure source water protection.	• Agricultural Producers • Private Land Owners • Municipalities
4.4.4: Consider alternate water source development.	• Agricultural Producers • Private Land Owners • Municipalities
4.4.5: Work with water distributors to ensure that they have the necessary information to respond when droughts are forecast.	• Municipalities • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
4.4.6: Develop bylaws for water conservation, drought management, and emergency drought preparedness to respond to diminishing streamflow and water storage conditions.	• Municipalities
4.4.7: Gather available information for the community on historic droughts, water supply and climate conditions.	• Municipalities • Battle River Watershed Alliance

4.5 With respect to water allocation and management

Guideline	Responsibility
4.5.1: Refer to the draft Approved Water Management Plan for the Battle River Basin[xi] in regards to development plans.	• Private land owners • Agricultural Producers • Municipalities • Alberta Environment and Sustainable Resource Development

4.6 With respect to groundwater

Guideline	Responsibility
4.6.1: Establish groundwater monitoring and modeling for quantity.	• Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
4.6.2: Increase knowledge and care surrounding groundwater resources and source water protection.	• Battle River Watershed Alliance • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
4.6.3: Assessment of groundwater potential under normal and drought conditions.	• Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
4.6.4: Groundwater Atlas expansion with implications and applications or research.	• Alberta Environment and Sustainable Resource Development • Natural Resources Canada
4.6.5: Promote groundwater conservation methods.	• Battle River Watershed Alliance • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

4.7 With respect to water conservation and efficiency

Guideline	Responsibility
4.7.1: Research to develop or improve decision-making tools that include drought information appropriate to adaptation. Such research should be developed and undertaken jointly by impact climatologists and watershed decision-makers.	• Municipalities • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development • Environment Canada • Agriculture and Agri-Food Canada • Natural Resources Canada
4.7.2: Develop new policies and programs to encourage the recovery, recycle, and reuse of water and reclaimed/grey water for industrial, municipal and agricultural use. Examples would include changes to Alberta's building codes.	• Municipalities • Alberta Infrastructure • Alberta Environment and Sustainable Resource Development • Alberta Municipal Affairs
4.7.3: Incentive programs and rebates i.e. rain barrels, dual flush toilets, compost toilets, grey water systems.	• All watershed residents and stakeholders • Municipalities
4.7.4: Continuous rural and urban water conservation and re-use year-round to reduce extraction from water sources.	• All watershed residents and stakeholders • Municipalities
4.7.5: Revisit established water conservation strategies and reduction targets.	• Municipalities
4.7.6: Continuously improve community water use efficiency.	• All watershed residents and stakeholders • Municipalities
4.7.7: Regulatory initiatives such as increasing the unit price of water for excessive use, and relating residential wastewater charges to water use	• Municipalities
4.7.8: Incorporate water conservation into planning and daily operations.	• All watershed residents and stakeholders • Municipalities
4.7.9: Establish water conservation strategies and water use reduction targets.	• Municipalities

4.8 With respect to infrastructure and design

Guideline	Responsibility
4.8.1: Change building regulations to allow permaculture and grey water systems to reduce need for water withdrawal.	• Municipalities • Alberta Infrastructure • Alberta Environment and Sustainable Resource Development • Alberta Municipal Affairs
4.8.2: Improvement of community infrastructure (i.e. water delivery systems, low impact developments).	• Municipalities • Alberta Infrastructure • Alberta Environment and Sustainable Resource Development • Alberta Municipal Affairs

4.9 With respect to industry

Guideline	Responsibility
4.9.1: Develop drought adaptation strategies and plans for industries that require water for operation and production.	• Industry
4.9.2: Change policies regarding down hole disposal of oilfield wastewater.	• Industry • Energy Resources Control Board (ERCB) • Alberta Environment and Sustainable Resource Development
4.9.3: Encourage utility providers, developers, and water users to partner together on managing and optimizing water flows and reservoir storage across the region.	• Municipalities • Industry • ERCB
4.9.4: Introduce new financial and tax-based capital cost incentives to encourage the upgrades, and associated value added industries to work collaboratively on the development of regional water and wastewater treatment facilities.	• Industry • Financial institutions • Economic organizations • ERCB • Alberta Environment and Sustainable Resource Development

4.9.5: Work to implement low-water and no-water technologies.	• Industry • Financial institutions • Economic organizations • ERCB • Alberta Environment and Sustainable Resource Development

4.10 With respect to business

Guideline	Responsibility
4.10.1: Establish drought adaptation strategies for businesses that require water for operation and are directly or indirectly rely on agriculture, or recreation/tourism.	• Businesses • Financial institutions • Economic organizations
4.10.2: Develop appropriate performance indicators focused on water risks as part as part of the annual reporting.	• Businesses • Financial institutions • Economic organizations
4.10.3: Encourage project developers to make comprehensive and holistic water assessments and risk management in project planning decisions, business projections, and business opportunity due diligence. Some of the tools at the project level include value chain and supply chain analysis, water resources economic/vulnerability analysis.	• Businesses • Municipalities • Financial institutions • Economic organizations
4.10.4: Work to implement low-water and no-water technologies.	• Businesses • Financial institutions • Economic organizations • Municipalities
4.10.5: Involvement of local financial institutions (local farm insurance agencies, banks) in understanding and education the impacts of drought.	• Businesses • Financial institutions • Economic organizations

Water Quality Policy Objective:

Recognize the reduced ability of receiving waters to assimilate contaminants

Drought adaptation strategies should seek to minimize contaminants entering the aquatic environment.

During low flow periods, the ability of receiving waters to assimilate contaminants (i.e. nutrients, bacteria, metals) is minimized, lowering water quality.

Water Quality Implementation Guidelines:

4.11 With respect to non-point source

Guideline	Responsibility
4.11.1: Address issues of non-point source pollution as per the BRWA nutrient-management[xii] policy advice and guidelines.	• Private Land Owners • Agricultural Producers • Municipalities • Alberta Environment and Sustainable Resource Development

4.12 With respect to infrastructure and design

Guideline	Responsibility
4.12.1: Introduce soft infrastructure (infrastructure with opportunity for some permeability and filtration).	• Municipalities • Alberta Infrastructure
4.12.2: Bio-swails to slow storm water and provide filtration.	• Municipalities
4.12.3: For communities that access surface water for potable use, improved technologies for water treatment may be required during prolonged drought periods that may affect water quality.	• Municipalities • Alberta Environment and Sustainable Resource Development • Alberta Infrastructure
4.12.4: Improvement of water filtration and wastewater management to improve quality of effluent.	• Municipalities • Alberta Environment and Sustainable Resource Development

4.12.5: Water quality guidelines of effluent from municipalities should be based on low-flow conditions.	• Municipalities • Alberta Environment and Sustainable Resource Development

4.13 With respect to groundwater

Guideline	Responsibility
4.13.1: Increase knowledge and care surrounding water quality of groundwater resources and source water protection to address water security and groundwater protection.	• Municipalities • Battle River Watershed Alliance • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
4.13.2: Inventory of groundwater vulnerability to pollution.	• Alberta Environment and Sustainable Resource Development • Natural Resources Canada
4.13.3: Predictions concerning the impact of groundwater management strategies on the environment, including other water bodies, changes in groundwater quality, cost of water, and social acceptance of low quality water.	• Alberta Environment and Sustainable Resource Development • Natural Resources Canada
4.13.4: Implement *Working Well* guidelines.	• All watershed residents and stakeholders who utilize well water
4.13.5: Establish long-term groundwater quality and quantity monitoring networks.	• Alberta Environment and Sustainable Resource Development • Natural Resources Canada

4.14 With respect to industry

Guideline	Responsibility
4.14.1: Establish cumulative effects planning on water sources.	• Industry • ERCB • Alberta Environment and Sustainable Resource Development
4.14.2: Establish hydraulic fracturing policy to ensure safety of aquifers.	• Alberta Environment and Sustainable Resource Development • ERCB

Management Implementation Guidelines

1 Agriculture

Policy Objective:

Implementation of drought management plans.

Implementation Guidelines:

1.6 With respect to farm production practices and land use

Guideline	Responsibility
1.6.1: Develop and implement policies and programs to influence farm-level land and water resource use and management practices in light of changing climate conditions.	• Municipalities • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development • Agriculture and Agri-Food Canada
1.6.2: Implement drought management strategies.	• Agricultural Producers • Private Land Owners • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

1.7 With respect to weather, precipitation, and water level monitoring

Guideline	Responsibility
1.7.1: Incorporate early warning and monitoring information as part of drought management strategies	• Agricultural Producers • Private Land Owners • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

2 Individual, Family, and Community Support

Policy Objective:

Implement drought management strategies to address social and health impacts.

Implementation Guidelines:

2.4 With respect to social support for individuals, families, and communities

Guideline	Responsibility
2.4.1: Implement funding programs and social supports for children and families affected by drought.	• Local FCSS • Local support organizations • Municipalities
2.4.2: Develop, refine, and maintain hydrological hazard and risk models to guide community emergency response.	• Alberta Emergency Management Agency • Public Safety Canada
2.4.3: Facilitate dissemination of drought management information.	• Local FCSS • Local support organizations • Schools • Municipalities • Battle River Watershed Alliance

2.5 With respect to mental health

Guideline	Responsibility
2.5.1: People who are employed in drought support roles be required to possess mental health literacy, referral, and first aid skills.	• Local FCSS • Other local support organizations • Alberta Health Services • Alberta Agriculture and Rural Development • Canadian Mental Health Association • Health Canada

2.5.2: Primary and secondary school mental health initiatives be extended to schools in drought affected communities, particularly those rural schools without existing counselling support.	• Local FCSS • Other local support organizations • Schools • Battle River School Division • Alberta Health Services • Canadian Mental Health Association • Health Canada
2.5.3: Existing mental health services must be easily accessible and responsive to the needs of drought affected families.	• Local FCSS • Other local support organizations • Alberta Health Services • Canadian Mental Health Association • Health Canada

2.6 With respect to physical health

Guideline	**Responsibility**
2.6.1: Existing physical health services must be easily accessible and responsive to the needs of drought affected families.	• Local support organizations • Alberta Health Services • Health Canada
2.6.2: Drought health response plans should be implemented.	• Local support organizations • Alberta Health Services • Health Canada
2.6.2: Health providers should assist in monitoring surface and groundwater for water quality assurance during prolonged drought periods.	• Local support organizations • Alberta Health Services

3 Natural Areas

Policy Objective:

Maintain the health of natural areas.

Well-managed riparian areas and wetlands buffer the destructive impacts of floods and droughts, especially when efforts are combined on a watershed basis.

Implementation Guidelines:

3.9 With respect to urban areas

Guideline	Responsibility
3.9.1: Maintain natural corridors.	• Private Land Owners • Agricultural Producers • Land developers • Municipalities • ALUS • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
3.9.2: Maintain wetlands as per the Alberta Wetland Policy[xiii].	• Private Land Owners • Agricultural Producers • Land developers • Municipalities • Ducks Unlimited Canada • Delta Waterfowl • NAWMP • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
3.9.3: Maintain riparian areas.	• Private Land Owners • Agricultural Producers • Land developers • Municipalities • Cows and Fish • Alberta Agriculture and Rural Development

	• Alberta Environment and Sustainable Resource Development
3.9.4: Maintain natural cover.	• Private Land Owners • Agricultural Producers • Land developers • Municipalities • ALUS • Ducks Unlimited Canada • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

3.10 With respect to parks and protected areas

Guideline	Responsibility
3.10.1: Implement drought management strategies.	• Municipalities • Alberta Tourism, Parks, and Recreation
3.10.2: Educate park visitors about the impact of drought on parks and protected areas, and what visitors can do to limit their impact.	• Municipalities • Alberta Tourism, Parks, and Recreation

3.11 With respect to wetlands

Guideline	Responsibility
3.11.1: Follow the Wetland Mitigation Decision Framework[xiv] and Alberta Wetland Policy.	• Private Land Owners • Agricultural Producers • Municipalities • ALUS • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
3.11.2: Enhance wetland awareness, highlighting the economic, social, and ecological functions of wetlands.	• Municipalities • Battle River Watershed Alliance • Ducks Unlimited

	• Delta Waterfowl • NAWMP • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
3.11.3: Maintain wetland areas as per the Alberta Wetland Policy.	• Private Land Owners • Agricultural Producers • Land developers • Municipalities • Battle River Watershed Alliance • ALUS • Ducks Unlimited Canada • Delta Waterfowl • NAWMP • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

3.12 With respect to riparian areas

Guideline	**Responsibility**
3.12.1: Enhance riparian and awareness, highlighting the economic, social, and ecological functions of wetlands.	• Municipalities • Battle River Watershed Alliance • Ducks Unlimited • Delta Waterfowl • NAWMP • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

3.12.2: Maintain riparian areas.	• Private Land Owners • Agricultural Producers • Municipalities • Battle River Watershed Alliance • Cows and Fish • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development

4 Water Supply

Water Quantity Policy Objective:

Implement drought management strategies

Water Quantity Implementation Guidelines:

4.15 With respect to community water supply

Guideline	Responsibility
4.15.1: Develop and implement drought management plans complete with triggering criteria (for examples, see Appendix B).	• Municipalities • All stakeholders • Alberta Agriculture and Rural Development • Alberta Environment and Sustainable Resource Development
4.15.2: Collaboration between water licence holders in development of water sharing agreements.	• All water licence holders
4.15.3: Manage community water supplies.	• Municipalities • All stakeholders
4.15.4: Enforce water restrictions.	• Municipalities

4.16 With respect to industry

Guideline	Responsibility
4.16.1: Establish drought management strategies for industries that require water for operation and production.	• Industry • ERCB
4.16.2: Change policies regarding down hole disposal of oilfield wastewater.	• Industry • ERCB

4.17 With respect to business

Description	Responsibility
4.17.1: Establish drought management strategies for businesses that directly or indirectly rely on agriculture, or recreation/tourism.	• Businesses • Financial institutions • Economic organizations

Water Quality Policy Objective:

Drought management strategies should be implanted to minimize contaminants entering the aquatic environment through improved management of both point and non-point sources.

Water Quality Implementation Guidelines:

4.18 With respect to monitoring

Guideline	Responsibility
4.18.1: Water quality monitoring for water-borne diseases and bacteria during prolonged drought periods.	• Alberta Environment and Sustainable Resource Development • Alberta Health Services

4.19 With respect to non-point source pollution

Guideline	Responsibility
4.19.1: Address issues of non-point source pollution as per the non-point source pollution policy advice and guidelines[xv].	• Agricultural Producers • Private Land Owners • Municipalities • All stakeholders

4.20 With respect to industry

Guideline	Responsibility
4.20.1: Establish drought management strategies for industries that require water for operation and production.	• Industry • ERCB
4.20.2: Change policies regarding down hole disposal of oilfield wastewater.	• Industry • ERCB

Appendix A

Implementation guidelines and resources for more information

Guidelines	Resources		
	Provincial	National	International
General	Cow and Fish	Agriculture & Agri-Food Canada Invitational Drought Tournament	International Association for Public Participation Drought-Ready Communities: A Guide to Community Drought Preparedness
Agriculture	Agricultural Drought Risk Management Plan and Agriculture and Rural Development		Holistic Management – Savory Institute Holistic Management International Managing Drought on the Ranch
Community Support			It's About People: Changing Perspective. A Report to Government by an Expert Social Panel on Dryness Weathering Climate Risks
Mental Health	Alberta Mental Health & Wellness		New South Wales, AU, Health
Physical Health		Human Health in a Changing Climate - Health Canada	When Every Drop Counts - CDC
Natural Areas	Ecosystem Services Approach Pilot on Wetlands		
Water Supply	Town of Okotoks – Sustainable Okotoks	Moose Jaw River Watershed Drought and Excessive Moisture Preparedness Plan	Municipal Drought Management Plan Guidance Document

Appendix B

Example drought plans

Moose Jaw River Watershed Drought and Excessive Moisture Preparedness Plan

Murray-Darling Basin Authority, Australia - Basin Plan

Drought Plan Directory for the United States

Kansas Municipal Drought Plans and Templates

Ontario Low Water Response

About the Battle River Watershed Alliance

The Battle River Watershed Alliance (BRWA) was created in 2006 as a non-profit society. Shortly after its formation, the BRWA was selected by Alberta Environment, under *Water for Life: Alberta's Strategy for Sustainability*[xvi], as the designated Watershed Planning and Advisory Council (WPAC) for the Battle River and Sounding Creek watersheds within Alberta.

Under Alberta's *Water for Life* strategy, WPACs have a role to report on the state of the watershed, lead in watershed planning, develop best management practices, educate users of the water resource and foster stewardship activities within the watershed.

The BRWA works in partnership with communities, individual watershed residents, watershed stewardship groups, all four orders of government (municipal, provincial, federal and First Nations), industry, academia, and environmental organizations to promote the health and sustainable management of the land and water resources of the Battle River and Sounding Creek watersheds using the best science and social science available.

We exist to have a watershed that sustains all life by using sound knowledge, wisdom, and wise actions to preserve our watershed for future generations.

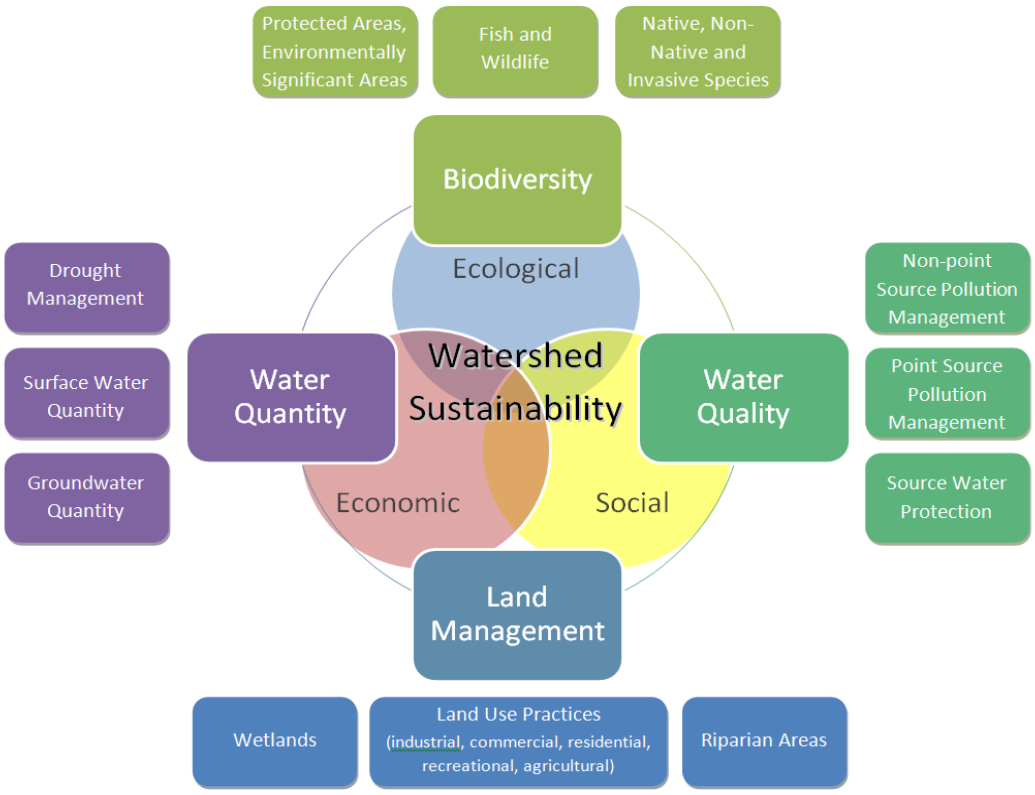
About BRWA's Watershed Management Planning Process

As the provincially designated Watershed Planning and Advisory Council (WPAC) for the Battle River and Sounding Creek watersheds within Alberta, the BRWA has a role to lead in watershed planning.

The BRWA's Watershed Management Planning Process was initiated in 2011. This planning process will ultimately result in a comprehensive Watershed Management Plan for the Battle River and Sounding Creek watersheds in Alberta, and is guided by the *Battle River Watershed Management Planning Process Phase Two Terms of Reference*[xvii].

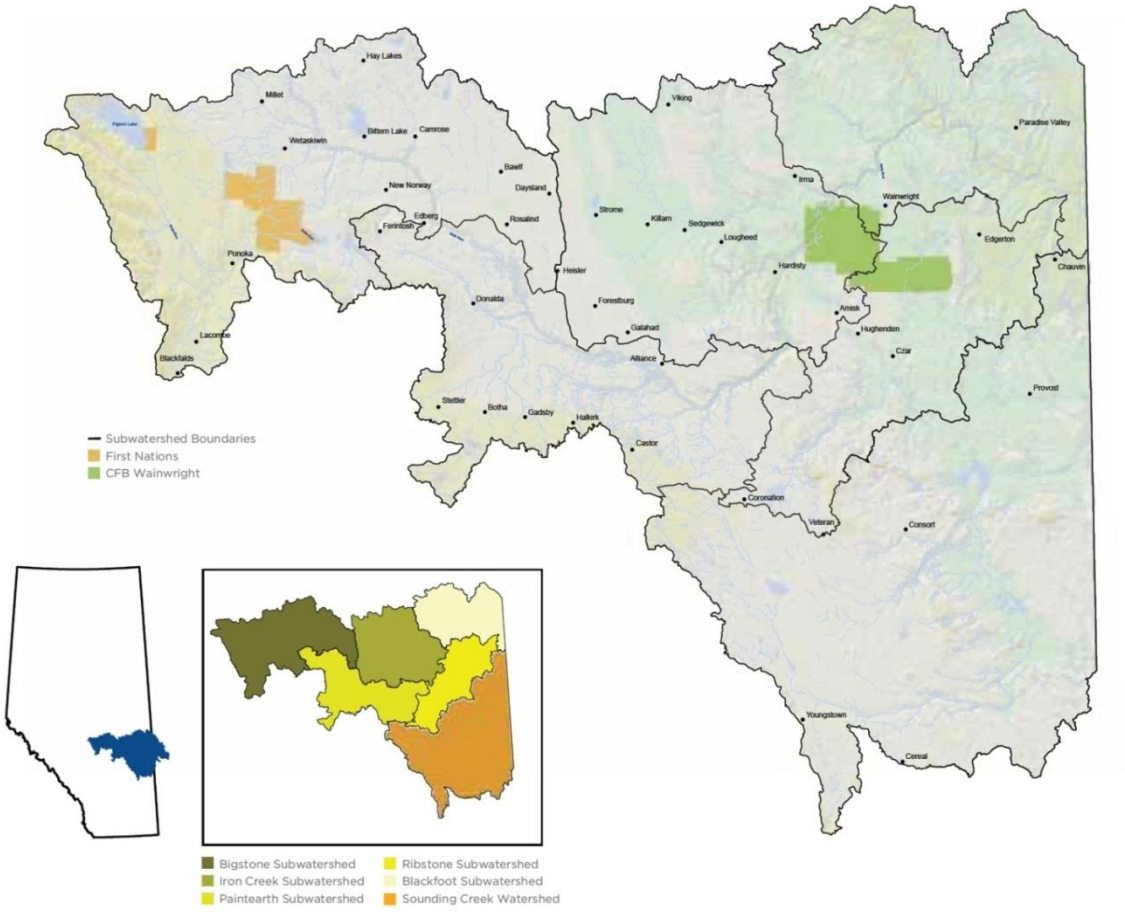
The Watershed Management Planning Process will address a number of watershed management priorities that have been identified through the BRWA's 2011 State of the Watershed Report[xviii] and extensive public engagement. These priorities are outlined in the figure below.

Policy advice and implementation guidelines will be developed for each of these priority areas. These documents will comprise the Watershed Management Plan for the Battle River and Sounding Creek watersheds in Alberta.



Key components of the BRWA's Watershed Management Planning Process

Battle River and Sounding Creek Watersheds within Alberta



[i] Bruneau, S. (2012). *Understanding the Policy Context for Drought Management Battle River and Sounding Creek Watersheds.* BRWA Watershed Planning Document. Available from http://www.battleriverwatershed.ca/publications/232/view

[ii] Bruneau, S. (2013). *Drought Adaptation and Management: Policy Advice.* Battle River Watershed Alliance Watershed Management Planning Report (Publication No. BRWA_PAR_2013_01).

[iii] Adger, W.N., S. Agrawala, M.M.Q. Mirza, C. Conde, K. O'Brien, J. Pulhin, R. Pulwarty, B. Smit and K. Takahashi, 2007: Assessment of adaptation practices, options, constraints and capacity. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 717-743. Available at http://www.ipcc.ch/publications_and_data/ar4/wg2/en/contents.html

[iv] de Loe, R., Kreutzwiser, R, & Moraru, L. (2001). Adaptation options for the near term: Climate change and the Canadian water sector. *Global Environmental Change* 11, 231-245.

[v] Ibid.

[vi] Bruneau, S. (2013). *Drought Adaptation and Management: Policy Advice*.

[vii] Alberta Water Council. (2008). *Recommendations for a new Alberta wetland policy*. Retrieved from http://www.albertawatercouncil.ca/Portals/0/pdfs/WPPT%20Policy%20web.pdf

[viii] Lemmen, D.S. and Warren, F.J., editors (2004): Climate Change Impacts and Adaptation: A Canadian Perspective; Government of Canada, Ottawa, ON, 174 p. Retrieved from http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca.earth-sciences/files/pdf/perspective/pdf/report_e.pdf

[ix] Drought Policy Review Expert Social Panel 2008, *It's About People: Changing Perspective. A Report to Government by an Expert Social Panel on Dryness*, Report to the Minister for Agriculture, Fisheries and Forestry, Canberra, September. Available from http://www.daff.gov.au/__data/assets/pdf_file/0008/889946/dryness_report.pdf

[x] Alberta Water Council. (2008).

[xi] Nelson, G. (2012). *Approved Water Management Plan for the Battle River Basin (Alberta): Draft for Discussion.* Alberta Environment and Sustainable Resource Development Planning Report.

[xii] Skinner, S. 2013. *Non-point Source Pollution Management: Policy Advice (Nutrient Management Focus)*. BRWA Watershed Planning Document.

[xiii] Alberta Environment and Sustainable Resource Development. (2013). Alberta wetland policy. Government of Alberta. Available from http://www.waterforlife.alberta.ca/01533.html

[xiv] Alberta Water Council. (2008).

[xv] Skinner, S. (2013). *Non-point Source Pollution Management: Policy Advice.*

[xvi] Government of Alberta. (2003). *Water for Life: Alberta's Strategy for Sustainability*. Available from http://www.waterforlife.alberta.ca/

[xvii] Battle River Watershed Alliance (BRWA). (2012). *Battle River Watershed Management Planning Process Phase Two Terms of Reference*. Battle River Watershed Alliance Watershed Planning Report. Available from http://www.battleriverwatershed.ca/publications/161/view

[xviii] Battle River Watershed Alliance (BRWA). (2011). *State of the Battle River and Sounding Creek Watersheds Report 2011*. Battle River Watershed Alliance. Available from http://www.battleriverwatershed.ca/content/state-watershed-report