

Proposed Action Plan Approach for Local Adaptation to Climate Change in Alberta

March 2013

Prepared by Guy Greenaway, Tracy Lee, Greg Chernoff and Ken Sanderson



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INSTITUTE



Prepared for:

The Biodiversity Management and Climate Change Adaptation Project

Proposed Action Plan Approach for Local Adaptation to Climate Change in Alberta

Communications Strategy for the Local Adaptations Sub-project
March 2013

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This report was produced as part of the Biodiversity Management and Climate Change Adaptation Project. This project is led by the Alberta Biodiversity Monitoring Institute, with collaborators from the University of Alberta and the Miistakis Institute. The project receives its core funding from the Climate Change and Emissions Management (CCEMC) Corporation.



Executive Summary

In April 2012, the Miistakis Institute undertook the *Local adaptations for biodiversity-related ecosystem services* sub-project of the ABMI-led *Biodiversity Management and Climate Change Adaptation* project. The Miistakis initiative is exploring how local communities can understand and make informed decisions about climate-related risks and adaptations in the context of ecosystem services and biodiversity.

The Miistakis team's first report, *Review of Possible Tools for Local Adaptation to Climate Change in Alberta* (Miistakis Institute 2012) described several cases and examples, seeking to identify the key considerations for the development of such an approach. The authors concluded the sub-project should use the development of Climate Change Adaptation Action Plans as an entry point to incorporating biodiversity management, that 'community' be defined geographically around a rural municipality, that a mapping 'toolkit' be developed rather than a single all-purpose tool, and that ecosystem services be explored as the method to connect biodiversity and local decision making.

Since the first report, the authors' views on the topics reviewed within that report evolved, leading to a refinement of the objectives (though an affirmation of the goals and outcomes), most notably a focus on CCA Action Planning, expansion of the original map-based tool concept, deferral of the community engagement to Year Two, and integration with other Alberta-based CCA efforts. This second report – aimed chiefly at the broader project team, Steering Committee, and potential partners – was developed to update progress on the research, identify the refinements, and mark the end of the "design" phase and launch of the "implementation phase."

Climate change adaptation action planning has emerged as the operational focus of the sub-project, as this approach helps communities become more climate resilient and better able to respond to environmental changes exacerbated by climate change through attention to biodiversity and ecosystem services. Generically the steps involve: 1. Initiate; 2. Learn about climate change; 3. Identify impacts to the community; 4. Address vulnerability and risk; 5. Develop adaptation strategies and actions; and 6. Implement and monitor plans.

CCA Action Planning is uncommon in Alberta, however two entities currently have plans to support Alberta municipalities in this: C3 (formerly Climate Change Central) and the Municipal Climate Change Action Centre (MCCAC). However, climate change adaptation is not currently on the radar for many rural municipalities, largely due to a limited interpretation of the science.

To better understand the development of CCA Action Plans at a local government level, the authors reviewed several CCA action planning processes and case, selecting three for formal review: the *Columbian Basin Trust: Communities Adapting to Climate Change Initiatives* (CACCI), ICLEI's (Local Governments for Sustainability) *Climate Resilient Communities*TM (CRC), and the Geos Institute's *ClimateWise*. Key findings were identified for each, with the authors ultimately concluding: there is no need for a 'new' process for Alberta; all CCA Action Planning process

have common components; and two CCA Action Plan components are most critical for Alberta (compiling climate change science, and devising means by which to make it matter locally). These are envisioned to be the focus of implementation in Years Two and Three.

A review was undertaken of the mapping tools associated with these CCA Action Planning processes, concluding that process-specific mapping tools are largely unused in the reviewed processes, most map products are acquired with the data collection, the idea of expanding the use of tools for visualization and mapping is being discussed, and mapping tools could play an important information role in action plan implementation.

For the purpose of this project, a distinction is made between *mapping* and *visualization* tools; mapping tools making use of GIS and spatial data to create maps, and visualization tools presenting generalized/simplified landscapes or information sets to highlight specific aspects. The review revealed few effective examples of mapping or visualization tools that aid the climate change adaptation action planning process, representing a substantial gap and a significant opportunity given the need to articulate locally-relevant potential impacts of climate change.

While climate change mitigation must be considered at a global scale, climate change adaptation must be understood at a local scale. The Miistakis team will work with a “local community” on this project, which has been operationally defined as a rural municipality with a predominantly agriculture-based economy, situated within the Grassland Natural Region of Alberta. In December 2012, Miistakis conducted a preliminary survey of the 21 municipalities, generating little response. Based on survey responses, review of CCA Action Planning, and conversations with implementation partners, the authors concluded that engaging a community will require 1) greater clarity on which aspect(s) of the CCA action planning process the municipality would engage in, 2) preliminary engagement of the potential implementation partners, and 3) clarity on the costs to a municipality of participation.

Ultimately, the authors believe CCA Action Plans represent the best option for managing climate-affected biodiversity by building climate resilient communities; ecosystem services represent the ideal framework for understanding biodiversity’s role in adapting to climate change; climate change adaptation is inherently local; municipalities represent the ideal scale for climate change adaptation; and the critical Action Planning steps for Alberta are compiling relevant climate change science, and making climate change impacts relevant to local communities.

The research and case reviews conducted in Year One have, as intended, served to inform the activity of Years Two and Three, the implementation phase. The work of the next two years can be described in terms of the following four tasks: 1. Articulate a climate change adaptation action plan approach; 2. Develop materials that articulate impact changing climate has on Alberta communities; 3. Develop toolkit to support CCA Action Planning; and 4. Identify and incorporate the data and modeling sources.

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INTRODUCTION

In April 2012, the Miistakis Institute became involved in a three-year project led by the Alberta Biodiversity Monitoring Institute (ABMI) to help Alberta effectively manage its biodiversity under a changing climatic regime through successful adaptation. The Miistakis Institute's role in this partnership project is to explore how local communities can better understand climate-related risks and adaptations in the context of ecosystem services and biodiversity, and create a decision support system (DSS) to raise awareness of the biodiversity-related ecosystem services relied upon by the community, represent how those services would be affected by climate change, and characterize potential adaptation strategies that satisfy community goals in a manner beneficial to biodiversity.

This is the *Local adaptations for biodiversity-related ecosystem services* sub-project.

At the end of the research conducted in the first half of Year One, the Miistakis team concluded that the existing Climate Change Adaptation Action Planning processes provided the best framework for achieving this goal (Miistakis Institute 2012). During the second half of Year One, the Miistakis team concluded their research and case reviews, conducting a full assessment of several Climate Change Adaptation Action Planning approaches, identifying the needs and gaps inherent in those approaches, making initial contact with the partners who will need to be involved in implementation, clarifying the need and role for supporting tools, describing how a partner community will need to be engaged, and defining the most appropriate role for the Miistakis team over Years Two and Three.

This report has prepared to summarize that final stage of research, and to set the stage for moving into the implementation phase.

PROJECT REVIEW AND MANAGEMENT

Project background

'BIODIVERSITY AND CLIMATE CHANGE ADAPTATION' PROJECT OVERVIEW

The *Biodiversity and Climate Change Adaptation Project* was conceived by the Alberta Biodiversity Monitoring Institute (ABMI) in response to the need to define the scope of change required to effectively manage biodiversity under a changing climatic regime, and to support Alberta's biodiversity management system with essential knowledge and tools for successful adaptation to a changing future climate.

The rationale for this initiative rests on the importance of biodiversity to Albertans, and the complex relationship between climate and biodiversity. Biodiversity, which includes species and their ecosystems, supports the delivery of numerous ecosystem services. These include provisioning services (e.g., food, fibre, fuel, water), regulating services (e.g. water and air filtration, flood regulation), cultural services (e.g., nature recreation, wildlife viewing) and supporting services such as soil formation and wildlife habitat. Because these biodiversity-related services are impacted by a changing climate, and because the relationship between climate and biodiversity is uncertain, knowledge gaps constrain effective adaptation. Proactive investments in the knowledge and tools for effective biodiversity management under a changing climate regime will deliver significant benefits to people and avoid crisis-driven interventions that are by their nature reactive, costly and often ineffective.

The project consists of **five integrated sub-projects** divided into **two parts**:

- Part One: Assess the change required to effectively manage biodiversity in a changing climate
 1. Vulnerability assessment and action plan
- Part Two: Knowledge and tools for adaptation
 2. Management systems for biodiversity in a changing climate
 3. Local adaptations for biodiversity-related ecosystem services
 4. Invasive species control in a changing climate
 5. Species at risk considerations for climate change adaptation

The project has been framed as a three-year project. Year One (2012-2013) draws to a close March 31, 2013. Years Two and Three will go from 2013-2014 and 2014-2015 respectively. All deliverables will be complete by March 31, 2015.

'LOCAL ADAPTATIONS' SUB-PROJECT OVERVIEW

The Miistakis Institute is taking the lead on sub-project #3: *Local adaptations for biodiversity-related ecosystem services* (concisely, the *Local Adaptations* sub-project).

The goal of this sub-project is to support Alberta communities by developing a map-based decision support system (DSS) to better understand climate-related risks and adaptations in the context of ecosystem services and biodiversity. The role of this DSS is to raise awareness of the biodiversity-related ecosystem services relied upon by the community, represent how those services would be affected by climate change, and characterize potential adaptation strategies that satisfy community goals in a manner beneficial to biodiversity. The form of the DSS is envisioned to be a map-based interactive tool.

The central challenge of this sub-project has been to connect the vast realm of biodiversity and climate change data to the everyday world of a local community decision-maker. The approach is intended to be pragmatic, seeking a rigorous method while recognizing limits in relevant data and

the needs of affected communities, thus ensuring that databases and information are accessible to local decision makers.

This sub-project is conceived in two parts, one which takes place in Year One, the remaining one to take place over Years Two and Three. The first year's tasks are marked by two milestone reports, and represent the *design* phase of the sub-project; the *implementation* phase will take place over Years Two and Three. The Implementation phase will be based on *Next Steps* identified at the end of this report .

Summary of Report One: *Review of Possible Tools for Local Adaptation to Climate Change in Alberta*

INTRODUCTION

At the outset of the *Biodiversity and Climate Change Adaptation Project* the goal of the *Local adaptations for biodiversity-related ecosystem services* sub-project is to support Alberta communities by developing a map-based decision support system (DSS) to better understand climate-related risks and adaptations in the context of ecosystem services and biodiversity (see *Refinement of Goals and Deliverables*, below for an update). Report One (*Review of Possible Tools for Local Adaptation to Climate Change in Alberta*, Miistakis Institute 2012) summarized the information gathered over the first half of Year One in the *Local Adaptations* sub-project.

This report described several cases and examples, and in doing so attempted to identify the key considerations for the development of such a tool / approach. The report was divided into four sections: Exploring Community Approaches for Addressing Climate Change Adaptation, Approaches to Mapping Ecosystem Services and Climate Change Adaptation, Review of Data Sources that are Potential Tool Inputs, and Conclusions.

A number of conceptual bases which underlay the report, and the sub-project, were identified explicitly (climate change adaptation, decision suites, ecosystem services, local community, natural capital, resilience, and others), and a conceptual model was developed for the integration of biodiversity and climate change in the context of ecosystem services and local communities.

REVIEW OF LOCAL CLIMATE CHANGE ADAPTATION INITIATIVES

Report One (Miistakis Institute 2012) reviewed examples of how communities are addressing climate change adaptation and, more specifically, how biodiversity is considered in relation to climate change adaptation. Case studies found to be informative to the development of a community climate change adaptation project were reviewed base on applicability to Alberta communities, consideration of biodiversity, solution/action oriented, useful functionality, and user friendliness.

Overall, the authors found an increasing number of articles linking climate change adaptation (CCA) and biodiversity management, few suggestions around a process for developing climate change adaptation plans, an emphasis on mitigation rather than adaptation, a need for CCA tools and resources at all levels, a need to integrate biodiversity management and CCA in land use and policy, and that many recommended biodiversity management strategies in relation to CCA are already ‘in the toolbox.’

Within Alberta, several Government of Alberta ministries were found to be undertaking targeted CCA strategies, tools, or related programs, but facing the challenges of cross-ministry coordination, lack of staff, and competition with other Government of Alberta goals. A review of efforts by Alberta municipalities to address climate change *adaptation* produced very few results.

DECISION SUPPORT TOOLS

Outside of Alberta, a number of provincial, state and municipal governments were found to have developed climate change adaptation plans. These typically assess vulnerabilities and risks of climate change and lead to the development of strategies or actions needed to enable a community to respond to climate change impacts. The restoration, maintenance and management of biodiversity are not comprehensive within most CCA plans, although many of the strategies complement this goal.

Potentially applicable decision support tools were reviewed and categorized as analytical tools, educational tools, and process oriented tools. A plethora of tools were found, and priority was given to those focused on climate change adaptation or sector-specific approaches which could inform development of CCA and biodiversity decision support tools.

MAPPING TOOLS AND DATA NEEDS

Mapping ecosystem services (ES), climate change adaptation (CCA), and biodiversity was found to be an important step in visualizing, analyzing and identifying knowledge gaps of both current and projected landscapes. The use of mapping tools was reviewed to determine current activity, lessons to be learned, and limitations. A significant issue identified with providing tools to a large user group is dealing with the different (and often low) levels of capacity.

Specific data sets were not identified as the tools/processes they inform had not been ascertained. However, some initial conclusions were drawn about types of data required, and associated challenges. Data will be needed that characterizes present conditions (land cover, land use and biodiversity) and future conditions (climate change, population growth and natural ecological change). Eventual tool development and associated data scoping will have to consider that access to spatial data for Alberta is generally less accessible and more expensive than in

other jurisdictions, potential tools are often developed in regions with higher-quality data than Canada, and the quality and availability of data is not uniform across the province.

CONCLUSIONS AND NEXT STEPS

The authors concluded that the *Local adaptations* sub-project should use the development of community-based climate change adaptation action plans as an entry point to incorporating biodiversity management, that ‘community’ be defined geographically around a rural municipality, that a mapping ‘toolkit’ be developed rather than a single all-purpose tool, and that ecosystem services be actively explored as the most viable way to connect biodiversity and local decision making.

Based on the research in the first report, and the feedback from the project team, the Miistakis team committed to proposing a tool architecture and supporting approach to be pursued during years two and three of the project. The identified next steps leading to the release of this report (Report Two) focus around immediate steps in designing a community-based climate change adaptation approach, matching mapping toolkit needs to the process steps, and clarifying the linkages between the Government of Alberta policies and local community CCA plan.

Evolutions Since Report One

Even as Report One was released, the authors’ views on the topics reviewed within that report was evolving. That was intentional, as Report One was framed as a ‘summary thus far,’ and Year One was framed as a foundational year, determining the most effective approach to helping local communities incorporate biodiversity-relevant climate change adaptation into their decision making. Years Two and Three are framed as the ‘implementation’ years; creating the tools, and connecting to the communities.

This section reviews the most significant refinements and changes since the release of Report One, and also since this sub-project was conceived.

It is important to also state what has *not* changed. The overall goal of this sub-project remains the same, as does its role within the larger project: to support Alberta communities by developing a “decision support system (DSS) to better understand climate-related risks and adaptations in the context of ecosystem services and biodiversity.” (ABMI et al 2012)

The approach remains fundamentally the same: “The role of this DSS is to raise awareness of the biodiversity-related ecosystem services relied upon by the community, represent how those services would be affected by climate change, and characterize potential adaptation strategies that satisfy community goals in a manner beneficial to biodiversity” (ABMI et al 2012).

REFINEMENT OF OBJECTIVES AND DELIVERABLES

Though the overall objectives are fundamentally the same, there have been significant refinements to this sub-project's goals and deliverables for Years Two and Three as a result of the research undertaken in Year One (articulated in Report One and the continued summary of research included in this report).

Focus on Climate Change Adaptation Action Planning

The original conception of the *Local Adaptations* sub-project was to start with the creation of an interactive, map-based tool to show local changes in biodiversity-based ecosystem services. ***That has changed to a focus on the development of Climate Change Adaptation Action Plans for local communities.*** This change reflects a recognition that, as with building a house, tools without a plan are of limited use. This has been borne out by the research (see Report One) which indicated the most effective approaches to infusing local decision making with biodiversity-based considerations focused on adapting existing community plans, made clear connections to the climate change-initiated issues, included local assessments, and engaged the community in all of the above.

Though the map-based interactive tool is no longer the most *immediate* goal, it will continue to be an important component of the project deliverables, and will in fact be the focus of an evolved conception, as well (see Expansion of Map-Based Decision Support Tool Concept, below).

Expansion of Map-Based Decision Support Tool Concept

As described above, the primary deliverable of this sub-project has thus far been simply described as a *map-based interactive tool*. This description has largely been a 'placeholder' as the sub-project matured, indicating the desire for a visual, tangible tool for decision support, while the decision-support mechanism was yet to be defined.

Now that the decision support system has been identified (climate change adaptation action planning), work has begun on identifying the appropriate form of the map-based interactive tool. Report One identified that a tool "kit" was more likely to be effective than a single tool, and that these tools may already be in existence. As a second step, the conception of that tool has been expanded to be *visualization tools* that support CCA Action Planning. These may be spatially-explicit, but have a broader goal of helping local decision makers visualize the climate change adaptation and biodiversity issues, rather than simply mapping them, with limited consideration to their impact and use.

Deferral of Community Identification

Originally, the authors had intended to identify a partner municipality in the latter half of Year One. As a result of the conclusions drawn around Climate Change Adaptation Action Planning, this has been deferred to Year Two. This is more fully explained below, under *Local Community Selection*.

In brief, as the Climate Change Adaptation Action Plan process arose as the most desirable route to achieving this sub-project's goals, the role that a municipality was going to be asked to play evolved. Recognition that the Miistakis team would not be undertaking an Action Planning process alone meant recruiting a partner community became a question for multiple implementation partners. The role that Miistakis would play in promoting the CCA Action Plan approach, and therefore the aspects of a CCA Action Plan for which a municipality is being asked to partner, has focused on Steps 2 and 3 of the Action Planning process, meaning the details are as yet unclear. Clarity will be achieved in Year Two, and a partner community will be engaged then.

Integration with other Alberta-based Climate Change Adaptation Efforts

At the same time as the Climate Change Adaptation Action Planning approach has been explored, the Miistakis team has been investigating which organizations are, or could be, working to help local communities address climate change adaptation in Alberta. This approach is based on the recognition that implementing CCA Action Plans requires multiple entities, and that the Miistakis Institute's resources within this project are limited.

The key players that have arisen thus far are C3 (formerly Climate Change Central), the Municipal Climate Change Action Centre (MCCAC), Alberta Environment and Sustainable Resource Development (AESRD), and the Alberta Association of Municipal districts and Counties (AAMDC). The roles each of these is or could play is described throughout this report. In the context of the refinement of the goals and objectives of this project, the key point is that integration with these partners was not conceived of at the beginning of the Local adaptations sub-project. However, it has become increasingly important that this happen, and will become a greater focus of activity for the Miistakis team in Years Two and Three.

Change in Report Two Working Title

As a result of the evolutions described above, the original working title of Report Two, *Proposed Tool Structure for Local Adaptation for Climate Change in Alberta*, was deemed to no longer be appropriate. A new title was developed, as shown above: *Proposed Action Plan Approach for Local Adaptation to Climate Change in Alberta*.

WHAT SUCCESS LOOKS LIKE

As originally described in Report One, success for this sub-project can be measured in terms of the *desired output* and the *desired outcome*. The refinements above have led to small changes in the description of the desired output, and clearer connections (though no changes) to the desired outcome.

Originally, the ultimate product (*output*) of this sub-project was envisioned solely as a map-based, interactive decision-support system usable by southern Alberta communities (see *Refinement of Goals and Deliverables*). As described above, that output has been modified, but the originally-stated intent of the output has not changed; namely, to assist the local community decision-maker in:

- Seeing the impact a climate-modified landscape has on their decisions;
- Seeing how their decision process can respond to the climate-changed landscape; and
- Readily visualizing and wielding information in support of their decisions.

Success of the *output* will continue to be measured against these criteria.

The desired *outcome* of this project continues to be to help the identified local decision makers better understand climate-related risks and adaptations in the context of ecosystem services and biodiversity by:

- Raising awareness of the biodiversity-related ecosystem services relied upon by the community;
- Representing how those services would be affected by climate change; and
- Characterizing potential adaptation strategies that satisfy community goals in a manner beneficial to biodiversity.

Success of the *outcome* will continue to be measured against these criteria.

YEAR ONE TASK REVIEW

Year One of the *Local Adaptations* sub-project was structured to involve a series of tasks undertaken and reported on in two discrete blocks, but collectively addressing the same list of tasks. Table 1 is a summary of the completion status of the Year One tasks.

Table 1: Review of Year One Task Completion

Task	Status	Comments
Review		
• <i>Similar approaches / tools</i> – Alberta is not the first to explore climate change adaptation at the local level, so there will be much to learn from other initiatives.	Complete	Reviewed climate change adaptation approaches, identifying CCA Action Planning as ideal approach.
• <i>Potential data inputs</i> – <i>To a large</i>	Complete	Although an on-going task, preliminary

degree, the tool will be defined by data and information inputs that are available and accessible.

data scoping was completed.

Understand

- *Role of map-based tool* – Before conceiving the structure of the tool, it will be critical to understand its intended role.
- *Sub-project integration* – How this sub-project integrates with the other sub-projects and co-projects will be explored in an on-going fashion.

Complete

Assessed existing map-based tools and potential mapping tools, ultimately expanding concept to visualization and mapping tools which will assist Steps 2 and 3 of the CCA Action Planning process.

Complete

Identified connection points to other sub-projects for Report One, but will continue to refine how modeling, CCVI, and other project products can inform this sub-project.

Determine

- *Local community(s)* – Conception of “local community” that makes sense for this project will be based on the other sub-projects and a pragmatic assessment of potential communities.
- *Decision suites to be supported* – A useful decision support system (DSS) supports the decisions people are actually making; those must be identified.
- *Biodiversity / ES features to map* – As not all biodiversity / ecosystem service features are mappable, those suitable for this project will be determined for the project.

Complete

Clarified focus for local community (rural municipality, with a predominantly agriculture-based economy, situated within the Grassland Natural Region of Alberta).

Complete

CCA Action Plan approach will be used, which specifically identifies the local community decisions which are affected by climate change.

Modified

Identified preliminary data sets which would lend themselves to mapping biodiversity / ES features. However, identified CCA Action Planning background information collection methods as key route to determining which features to map.

Conceive

- *Level of functionality for Tool V.1* – As a starting point, an outline of what base functionality is for Version 1 of the DSS tool is required.
- *Data integration* – How data and information from a variety of sources is integrated and incorporated into the

Modified

The review of key functionality led to 1) an expansion of the concept to include visualizations as well, and 2) a focus on the identification of insertion points in the CCA Action Planning process which are genuinely augmented by visualization and/or mapping tools.

Modified

The scan of available tools and the preliminary data scoping led to a conclusion that multiple tools would be needed, that these would need to

tool is a key consideration.

- *Accessibility* – The physical and conceptual user interface will dictate if the tool truly supports the local adaptation decisions being made.

Modified

coordinate with the CCA Action Plan approach, and that Steps 2 and 3 of the process were the key steps for Alberta. This dictated a need to defer specific data integration considerations until the CCA Action Plan framework was developed and the needs for Steps 2 and 3 identified. The review of tool interfaces led to a consideration of open source vs. proprietary software, costs of small municipalities, and web-based vs. software-specific. Ultimately, it was recognized that 1) the variety of existing tools dictated a need for a tool 'kit', and 2) this was dependent on the CCA Action Plan approach to be chosen.

Report Two / Milestone Two

PURPOSE OF REPORT TWO

There are four purposes the report is intended to serve.

First, this report (Report Two) updates the progress and final research/review undertaken in the Year One design phase. Taken together with Report One it represents both a summary and an archive of critical information gathered to support the implementation phase of Years Two and Three.

Second, the report identifies evolutions since the outset of the project and since the release of Report One (see Miistakis 2012). As would be expected, there are several refinements in the goals and objectives for this sub-project, though the overarching goal and approach has remained fundamentally unchanged.

Third, the completion of this report formally marks the end of the first "design" phase, and the launch into the second "implementation" phase for this sub-project. As such, it further explains Climate Change Adaptation Action Planning and why it will be the framework for implementation, the role that the Miistakis team will be playing in this approach, the role that other partners would play, the revamped function for visualization and mapping tools, and how a local community will be engaged in the implementation phase.

Finally, this report is the second milestone for the *Local adaptations* sub-project's contributions to the greater project.

AUDIENCE FOR REPORT TWO

As described in Report One, ultimately, the audience for this research and tool development will be local community decision-makers, and the policy makers who guide them. However, that is not the most immediate audience for this report. There are four key audiences for this report.

The first is the *Biodiversity Management and Climate Change Adaptation* project team, informing them about the progress undertaken within this sub-project, and hopefully clarifying where the Miistakis Institute team will be seeking their input and advice. The second key audience is the project Steering Committee, with a similar information and consultation intent.

A new audience for this report arose as a result of the new focus on Climate Change Adaptation Action Planning, and the recognition that other partners will need to be involved. This document will serve to inform those existing and potential implementation partners in Alberta as to the intent and approach of the Miistakis team in this sub-project.

Finally, this report is intended to be an enduring resource to any other individuals or organizations seeking to help local communities achieve climate resiliency, especially through maintenance of biodiversity and attention to ecosystem services.

REPORT FORMAT AND APPROACH

This report is divided into five principal sections:

- **Climate Change Adaptation Action Planning:** Presents the final research on Climate Change Adaptation Action Planning, the basis for this sub-project's approach to helping local communities address climate change adaptation through climate resiliency
- **Mapping Tools in Climate Change Adaptation Action Planning:** Reviews the existing and potential uses of mapping tools in Climate Change Adaptation Action Planning applications;
- **Potential for Mapping and Visualization Tools:** Assesses the potential for an expanded concept of support for climate change adaptation through more broadly-conceived, but more targeted use of tools;
- **Local Community Selection:** Summarizes the research undertaken in Year One to identify a partner municipality, as well as the necessary changes in approach indicated; and
- **Observations and Next Steps:** Summarizes the conclusions drawn by the authors overall as well as in each of the key report sections, then describes the steps the four steps that will form the basis of the second phase – implementation.

The authors recognize that for many this is a resource document, and will in those cases rarely be read from front to back. For that reason, there are numerous cross-references, and some repetition such that a person landing on a section mid-way should be able to knowledgeably navigate that section without having read from the beginning.

CLIMATE CHANGE ADAPTATION ACTION PLANNING

Building Climate Change Resiliency

The stated goal of the *Local adaptations* sub-project is to “support Alberta communities by developing a decision support system (DSS) to better understand climate-related risks and adaptations in the context of ecosystem services and biodiversity” (ABMI et al 2012).

Operationalizing that goal has evolved to mean helping local Alberta communities become more climate resilient through consideration of climate change adaptation with a special emphasis on protecting, maintaining and restoring biodiversity. Biodiversity and its role in ecosystem functions and processes play a key role in building ecosystem resilience, and therefore represent an important consideration when developing adaptation strategies. A resilient ecosystem is better able to respond to environmental changes exacerbated by climate change, and therefore exhibits less stress and offers greater protection for human well-being.

Building a climate resilient community at a local municipal level is important because local land use decisions and best management practices can have profound impacts on ecosystems resilience and therefore the ecosystems ability to respond to climate change. For example a local municipal government has the ability to conserve sites of ecological significance such as wetlands, native range or areas of high biodiversity, all which provide essential ecosystem services.

A climate resilient community is one that is able to adapt to a changing local climate by such means as encouraging responsive land use practices, proactively designing and building infrastructure, fostering climate-resilient industry, taking advantage of new opportunities brought on by a changing climate, and protecting ecosystem services that minimize the negative impacts of climate change.

Climate Change Adaptation Action Planning

A Climate Change Adaptation (CCA) Action Planning process is a tool used to help a local community takes steps toward becoming climate resilient. The Miistakis team concluded from the research and case reviews done at the outset of the *Local adaptations* sub-project that such a process held the most promise for achieving the project goal (Miistakis Institute 2012).

CCA Action Plans enable a community to better understand the risks and opportunities associated with climate change and to develop appropriate response strategies. Globally, there are numerous examples of climate change adaptation action processes and case studies to

guide a local municipal government on how to address climate change adaptation. Most of these processes consist of a series of steps to walk a community toward resiliency through the development of a Climate Change Adaptation (CCA) Action Plan. Generically the steps involve:

1. Initiate: Establish a local coordinator and steering committee, develop objectives and outcomes relating to climate change adaptation;
2. Learn about climate change: Communicate the science in a meaningful way;
3. Identify impacts to the community: Determine what the changes in climate variables mean to a local community in terms of impacts (e.g., increase in wildfires or reduced water supply);
4. Address vulnerability and risk: Estimate how sensitive or susceptible a system is, and identify the priority opportunities and risks;
5. Develop adaptation strategies and actions: Identify goals, objectives and strategies/actions; and
6. Implement and monitor plans: Determine how the strategies can be implemented into existing planning processes, and develop metrics for measuring success.

In Alberta, only two large urban centers have undertaken a CCA action planning process, Calgary and Red Deer. The authors were unable to find a rural municipality currently considering the development of a CCA Action Plan. There are however two entities who have plans to support municipalities in CCA Action planning in Alberta;

- C3 (formerly Climate Change Central) has developed a concept to help municipalities undergo a rapid CCA Action planning process using methods developed by the Columbia Basin Trust and tested in Southeastern B.C. (Jeff Zukiwsky, pers. comm.)
- Municipal Climate Change Action Centre (MCCAC) has expressed interest in helping Alberta municipalities undergo the ICLEI CCA Action Planning process (Bob Hawkesworth, pers. comm.). Both Calgary and Red Deer have used this process.

Despite these interests, it appears that climate change adaptation is not currently on the radar for many rural municipalities in Alberta. One of the main reasons is the interpretation of the science is limited and key messages have not been developed and shared. These efforts would include determining and communicating how to reduce risks and vulnerability, the costs of inaction, and the biodiversity's importance underpinning ecosystem services.

To better understand the development of CCA Action Plans at a local government level the authors sought and reviewed several CCA action planning processes and case studies to review. Three were selected for a more formal review. These were rated against a set of developed criteria to better understand the process and how biodiversity is considered within it. A summary of the key findings is provided with consideration of a CCA action planning process occurring at a municipal level in Alberta.

CCA Action Planning Process Selection

The Miistakis team reviewed CCA Action Planning processes and associated case studies undertaken in North America with an emphasis on Canadian examples. Each CCA action planning process was briefly reviewed with a goal of selecting three processes for a more in-depth review. The criteria used to select the CCA planning process included:

- Applicable to Canadian municipality (rural emphasis);
- Has been used in Alberta or is being considered for use by others in Alberta;
- Process is well documented;
- Availability of process case studies;
- Process has been being replicated;
- Includes decision support tools ; and
- Process includes biodiversity considerations.

Table 2: CCA Action Planning processes identified

Process	Case Study	Considered for use in Alberta	Replicated	Tool Kit	Biodiversity
Columbia Basin Trust: Communities Adapting to Climate Change Initiatives (CACCI)	Elkford, BC	C3, currently in concept	Six times in SE BC	Yes	Mentioned in science summary but not integral to process
ICLEI's Local governments for Sustainability, Climate Resilient Communities™ (CRC) Program	Vancouver, BC	MCCAC	Many times, mostly large urban centres	Yes	Have another process called <i>Local Action for Biodiversity (LAB) Program</i> ; recently released a document highlighting the cross over between the CCA and Biodiversity programming (Livingston and Marzok 2012)
ClimateWise	Missoula, MT	No	California and Oregon	No	Excellent incorporation of biodiversity into process
Corporation of the District of Sannich Climate Change Adaptation Plan Report developed in partnership with Stantec Inc.	District of Sannich, BC	No	No	No	Used a sector review approach, biodiversity strategies incorporated into Ecosystems, Urban forests and Parks sector but not in others.
Ontario Regional Adaptation Collaborative (ORAC)	Lake Simcoe Case Study (ON)	No	Unknown (likely)*	No	Excellent incorporation of biodiversity into process
Climate Change Adaptation Planning: A Handbook for Small Canadian Communities.	Dawson Creek	No	Unknown (likely)*	No	

* Indications are that the process has been replicated though not under the same name, so specific replications were not found.

Based on the criteria listed above, three case studies were selected and reviewed along with relevant documentation, these include;

1. *Columbia Basin Trust: Communities Adapting to Climate Change Initiatives* (CACCI)
 - a. Dialogue to Action Final Report- Overview of Initiative
 - b. Adaptation Resource Toolkit: <http://adaptationresourcekit.squarespace.com/six-step-planning-process/>
 - c. Elkford District Case Study (Gorecki et al. 2008)
2. ICLEI's (Local Governments for Sustainability), *Climate Resilient Communities*TM (CRC) Program
 - a. Adaptation Database and Planning Tool (ADAPT) - The Adaptation Tool has been designed to assist local governments with climate change adaptation planning. This interactive web-based tool takes users through the Five Milestone process outlined in the ICLEI Canada Changing Climate, Changing Communities: Guide and Workbook for Municipal Climate Adaptation.
 - b. ADAPT tool: <http://www.icleicanada.org/component/adaptationtool/?Itemid=104>
 - c. City of Vancouver case study (City of Vancouver 2012).
3. *ClimateWise*
 - a. *The people, economy, land, and resources of Missoula County and Potential Vulnerabilities to Climate Change* (Headwaters Economics 2011)
 - b. *Missoula County Climate Action: Creating a resilient and sustainable community* (ClimateWise 2011)
 - c. Process description:
http://www.geosinstitute.org/images/stories/pdfs/Publications/ForestManagement/Icaruspaper_final2011May16th.pdf

CCA Action Plans and Process Review

The three processes and case studies selected above were then reviewed in greater depth using the following criteria:

- *Process*: Is there a well-developed process description and has it been replicated;
- *Resource Requirements*: How do technical and municipal staff participate in process (including time required, and other resources needed);
- *Context setting*: What climate modeling and reporting is used to set the context of climate change impacts on a community; how is the science presented to the local community;

- *Biodiversity*: How is biodiversity addressed within the process and do the case studies have strategies focused explicitly on biodiversity; if not, could biodiversity be incorporated into the process;
- *Ecosystem Services (ES)*: Is the process explicitly framed in a ES framework, if not are ecosystem services alluded to or could they be incorporated;
- *Decision Support tools*: What decision support tools are used; what decisions do they support; and
- *Mapping tool potential*: Is there a mapping tool, how easily could one be incorporated, where it could be incorporated, what objective it could fill.

Each process is described below with consideration to the above criteria, and key findings are highlighted. Because the mapping tool potential is a particular consideration of this project, those considerations and conclusions are summarized under *Mapping Tools In Climate Change Adaptation Action Planning*, in the next section.

COLUMBIA BASIN TRUST

The Columbia Basin Trust's (CBT) program *Communities Adapting to Climate Change Initiatives* (CACCI) was designed to help communities in the Columbia Basin of British Columbia (e.g., Castlegar, District of Elkford) become more resilient to climate change. The program is supported by a technical team, made up of academics, government officials and first nations as well as community development practitioners. This process has been well documented but is adapted as community development practitioners learn from each experience. A climate change adaptation (CCA) program liaison commented that no two processes (six have been completed) have ever been the same (Jeff Zukiwsky, pers. comm.). Currently the CBT has shifted to undertaking rapid action scanning and planning assessments, which reduces the process to a one day workshop where a community is encouraged to focus on one of the priority risks (e.g., wildfire). A community is then encouraged to address additional priority concerns through participation in another CCA rapid assessment process. This approach was taken due to time and fiscal constraints of local governments. The downside is communities may only be developing climate change adaptation strategies for one priority concern.

The CBT has developed a number of resources to help local communities better understand the impacts of climate change on the environment. Climate modeling projections from the Pacific Climate Impacts Consortium (PCIC) provides an understanding of key changes in temperature and moisture. A CBT *Dialogue to Action* report summarizes anticipated key changes to the environment based on climate modeling projections. CBT does a good job of summarizing environmental impact, and changes to biodiversity is identified as a risk. However, within this process, strategies are developed for the top one to three concerns. In all cases reviewed, biodiversity did not make the top three community concerns. In addition, our review indicates strategies focused on promoting ecosystem resilience were not common, reducing the possibility of protecting, maintaining or restoring biodiversity through this process.

The CBT process is largely driven by the local community, and although impacts are assessed directly as they relate to human well-being, an ecosystem services framework is not fully utilized. This may have resulted in a lack of understanding of the impacts changes to biodiversity have on ecosystem function, structure and process that are valuable to human well-being.

The CBT has developed a web-based adaptation tool kit to help local communities better understand climate change adaptation. As well as outlining the steps involved in a CCA action planning process, this decision support tool highlights expected changes due to climate change, thought such mechanisms as modeling of anticipated future climatic conditions (e.g., annual/seasonal precipitation, mean temperature, growing degree days, etc.), and representing changes to ecology and landscape (e.g., changes to biota, water temperature, wildfire, habitat, distribution of invasive/native species, etc.). Lastly, the toolkit identifies impacts from a community perspective, such as changes to infrastructure, agriculture and food, recreation and tourism, forestry and mining, flooding and storm water, and water quality.

The end goal of this process is to incorporate CCA Action Plan strategies into existing municipal planning documents. Identifying this point of insertion is an important step in the CCA action planning process as it helps to foster implementation of strategies that fit into existing frameworks.

Table 3: Summary of Key findings of CBT’s Communities Adapting to Climate Change Initiatives (CACCI) process

<p>Key Findings:</p> <p>Columbia Basin Trust’s <i>Communities Adapting to Climate Change Initiatives (CACCI)</i> process</p> <ul style="list-style-type: none"> • Adaptable process, driven by local community and focused on top concerns. • Use of local knowledge in the initial stages of process, whereby practitioners are encouraged to share their local experience of changes in the region due to climate change. • Decision support tool, Adaptation toolkit is well developed and user friendly • Check list to highlight strategies the municipality is already doing to promote climate resiliency. • Strategies to address protection, maintenance and restoration of biodiversity are uncommon, likely due to priority impacts a community selects.
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ICLEI'S LOCAL GOVERNMENTS FOR SUSTAINABILITY, CLIMATE RESILIENT COMMUNITIES™ (CRC) PROGRAM

ICLEI Canada's *Climate Resilient Communities* program was developed to foster communities to become climate resilient through climate change adaptation planning. ICLEI supports municipalities in climate change adaptation planning by providing technical support, resources, tools and workbooks.

ICLEI's methodology provides a straightforward five-milestone framework which allows municipalities to investigate climate change impacts at a general level, and devise strategies to address them. This structured approach assists local governments with the creation of an Adaptation Plan to tackle relevant climate change impacts in the community.

The process has been used in Alberta for two large urban centers, Calgary and Red Deer. It is estimated to take two years and is driven by the municipality with support from ICLEI Canada. Decision support tools include an on-line, five-milestone workbook (in Microsoft Excel) to help a community work through CCA Action framework.

The process relies on local climate change data and reports to communicate the climate change science. The authors reviewed a case study of the City of Vancouver, B.C. because Red Deer and Calgary are in process. Like the Columbia Basin Trust examples, the City of Vancouver commissioned the Pacific Climate Impacts Consortium at the University of Victoria to identify anticipated regional climate changes. Similar to the CBT process, the impacts from these anticipated changes on infrastructure, water and other important municipal variables were then identified.

ICLEI has developed three independent programs which help a community become climate resilient: their adaptation initiative, *Mitigation: Partners for Climate Protection* and *Local Action for Biodiversity* (LAB). Although biodiversity is addressed in the adaptation initiative, many urban municipalities have taken part in the LAB program and therefore have developed separate biodiversity plans. In a recent series of publications called *Finding the Nexus* (Livingstone and Marzok 2012), ICLEI highlights how integrated action on climate change can address multiple challenges facing local governments. In one issue they focus on how biodiversity management can contribute to climate change adaptation, and show examples where efforts to conserve biodiversity help the ecosystem to respond to climate change (e.g., enhanced biodiversity will maximize resilience against new pests and disease expected because of climate change). In addition the report highlights the importance of using an ES framework to identify actions which benefit both biodiversity and climate change adaptation by focusing on the ecosystem service. For example, insects and birds pollinate local food crops (an ecosystem service). Developing public engagement initiatives to increase awareness of the value of pollinators (promoting pollinator friendly gardening, reducing pesticide use, etc.) benefits biodiversity by maintaining genetic diversity of vegetation, birds and insects, but also supports adaptation as conserving pollinators will buffer uncertainty of species range shifts.

The end result is a series of actions to address key climate change impacts facing the municipality. For each action, the action plan outlines funding source, timeline, accountability (assigning a lead agency within municipality) and effort.

Table 4: Summary of Key findings of ICLEI’s Climate Resilient Communities (CRC) program

<p>Key Findings:</p> <p>ICLEI’s Climate Resilient Communities (CRC) program</p> <ul style="list-style-type: none"> • A good policy of “No Regret Actions¹” • Includes development of actions for all high risk impacts; • Focuses on large urban municipalities, geared toward municipal staff; • Two year process, heavily dependent on municipal staff time; • Requires access to climate change science to outline local impacts of climate change; • Focuses on finding the nexus between adaption, mitigation and biodiversity, recognizing integrated strategies can serve multiple issues facing a local government; identification of where biodiversity and adaptation strategies are mutually beneficial; and • Suggests focusing on delivery of an ecosystem service to ensure support and win-win actions. [citation ???]

CLIMATE WISE

ClimateWise® was developed by the Geos Institute based in Ashland, Oregon and specializes in helping communities and other groups to understand the local impacts of climate change, and develop actions to minimize and prepare for the impacts. ClimateWise has been replicated in Montana, Oregon and California and the usual scale is at a county level. This process is not specifically focused on municipal governments and strategies are not exclusive to local governments but may be relevant to multiple levels of government or stakeholders within the region.

The process includes development of two key documents, usually by consultants:

¹ Whereby, regardless of the unpredictability of climate change impacts on natural capital and human well-being, the actions are beneficial to ecosystem health and human well-being. In other words, even if climate change impacts are minimal relative to modeling, the actions are still beneficial.

1. The *Socioeconomic Report* provides information on economic drivers, water and energy supply, health and emergency response issues, cultural issues, local infrastructure, and many other locally-relevant details.
2. The *Projections Report* explains climate models, their output, their utility for local planning, and summarizes supporting scientific literature that further elucidates how the region and its resources are expected to change in the future.

Information for the projections report is obtained from USDA Pacific Northwest Research Station who model climate projections at locally-relevant scales (8km). One of the important roles of Geos Institute is the translation of the climate projections and science for a local community audience.

Once these reports are developed a workshop is organized where local participants are asked to focus on one area of interest, such as forestry, agriculture, business, human health, emergency response, infrastructure, environmental justice issues, terrestrial ecosystems or aquatic ecosystems. Focus groups are asked to discuss exposure, sensitivity and adaptive capacity for each sector. Participants are asked to rank risks for each sector and then strategies are developed to address high-priority risks.

<p>Key Findings:</p> <p><i>ClimateWise</i> program</p> <ul style="list-style-type: none"> • Lead organizations can be either municipality, NGO or state government; • Identification of conflicts and barriers for each strategy helps to understand the challenges need to be overcome; • Integration points are identified for each strategy outlining initiatives already going on which contribute positively to the strategy; • Biodiversity is well integrated into process; strategies developed to specifically address species and habitat; • Ecosystem services framework is used and ecosystem resilience is an important consideration in strategy development; and • Holistic approach is used, incorporating many different stakeholders; makes implementation more difficult as no attachment to specific level of government or stakeholder.
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Table 5: Summary of Key findings of ClimateWise program

Biodiversity is well represented within this process, as strategies focused on building ecosystem resilience are emphasized. One of the key messages during this process is that if natural systems are resilient in the face of change, the impacts to human communities will be less severe. An ES

framework is used, as ClimateWise states “healthy ecosystems will filter the effects of climate change, resulting in less stress and continued benefits for people” (Koopman et al. 2012). The process therefore results in strategies to maintain key ecological services.

The end result is a final Climate Change Adaptation report which is composed of the initial projections, the identified impacts and risks, and the recommended strategies and actions for addressing these at many different levels.

Conclusions

Numerous approaches to the development of climate-adaptive or climate-resilient communities already exist. The authors reviewed several of these approaches, and have arrived at three important conclusions.

THERE IS NO NEED FOR A “NEW” PROCESS

There is no need to create a new process “from scratch” for building climate resilience in Alberta. By employing an existing approach directly, or by taking the best components of proven approaches and adapting them to the Alberta context, the authors believe that a suitable approach can be identified.

ALL CCA ACTION PLANNING PROCESS HAVE COMMON COMPONENTS

Among all the approaches reviewed, the authors identified the following common and unifying components:

Climate Change Science: Modeling of anticipated future climatic conditions (e.g. annual/seasonal precipitation, mean temperature, growing degree days, etc.), and modeling of ensuing changes to ecology and landscape (e.g. changes to biota, habitat, distribution of invasive/native species, etc.)

Interpretation of Science: This step brings the climate change science to bear on local communities, by describing anticipated changes in terms of things that matter to local communities – essentially it provides community-level answers to the “So what?” questions around climate change. It explains how climate change might impact local economy, culture, infrastructure, and biodiversity, and why this matters. Here the authors suggest approaching CCA and biodiversity by developing a decision support tool that enables a community to understand the ecosystem services being impacted with a priority on actions that mutually benefit biodiversity and climate adaptation.

Climate Change Action Plan: Once the local impacts of climate change are understood, this understanding is used to create a Climate Change Action Plan. This is a strategic-level document that describes:

- The anticipated local impacts of climate change.
- An explanation of why climate change will matter locally, typically using a service oriented lens.
- Identification of opportunities for the community to become more resilient to climate change, including new actions and strategies as well as things the community may already be doing to foster resilience.
- Identification of “points of insertion” for climate change resilience strategies. An exploration of where opportunities for applying strategies are within the municipal decision-making and administrative process.

Implementation: Acting on the strategies described in the Climate Change Action Plan. This could include changes to municipal policies, community outreach, creation of incentive programs, etc.

Evaluation: Monitoring and measurement of the performance of implemented actions over time, and a commitment to revisit and make changes to the Climate Change Action Plan as required.

TWO CCA ACTION PLAN COMPONENTS ARE MOST CRITICAL FOR ALBERTA

Through conversations with AESRD staff, practitioners whom have being involved in CCA action planning processes and the Municipal Climate Change Action Centre (Kendra Issac, pers. comm., Jeff Zukiwsky, pers. comm.), the authors identified the most foundational and immediate need in Alberta is a process that will fulfill the first two components described above: creating, compiling, and sharing climate change science; and devising means (i.e., process/workshops series) by which to make this science matter to local communities.

In addition, the authors suggest framing “why it matters” information in an ecosystem services framework so communities can relate and better understand why action is important and what is the true cost of inaction.

Regardless of whether an existing CCA action planning approach is chosen, or a new “made in Alberta” approach is developed, or even if nothing happens beyond increasing our knowledge of climate change and of why it matters at a local level, there is inherent and essential value in delivering on these first two components.

MAPPING TOOLS IN CLIMATE CHANGE ADAPTATION ACTION PLANNING

Introduction

In Report One (Miistakis Institute, 2012) the use of mapping tools in the areas of climate change, ecosystem services and biodiversity were reviewed. It was determined that mapping tools could be clumped into the three major areas of use: 1) process, 2) analysis and 3) education and delivery. Overlap exists across these areas, but in general most mapping tools fit within these uses. It was also found there were two major types of tools: online tools (those used largely through a web browser), and GIS tools (those used either stand alone or through a GIS software application).

As outlined in *Climate Change Adaptation Action Planning*, above, Miistakis reviewed Climate Change Adaptation (CCA) action planning processes and their perspective case studies undertaken in North America with an emphasis on Canadian examples. Each CCA action planning process was briefly reviewed with a goal of selecting three processes for a more in-depth review.

This section will explore the use of mapping tools by the three processes selected for in-depth review: Columbia Basin Trust: Communities Adapting to Climate Change Initiatives (CACCI), ICLEI's Local governments for Sustainability, Climate Resilient Communities™ (CRC) Program, and ClimateWise.

Mapping Tools Review Methods

Each of the selected CCA action planning processes were described to varying degrees of detail with online documentation. While extremely detailed for describing the process itself, the documentation did not give significant technical detail regarding how information was being obtained or used in workshops, meetings and the generation of reports. The documentation also did not answer important questions about what is missing and what is needed in relation to their respective processes.

To augment the online documentation, phone interviews were conducted with key representatives of each of the three processes. While questions were asked exploring a variety of aspects of each CCA action planning process, two questions were asked specifically with regard to mapping tools:

- What mapping tools are currently used in the process?
- Was there any specific mapping tools or resources missing, that would have made the process easier?

A summary of the answers is included below.

COLUMBIA BASIN TRUST: COMMUNITIES ADAPTING TO CLIMATE CHANGE INITIATIVES

What mapping tools are currently used in the process?

Several communities in the Columbia Basin underwent the climate change adaptation action planning process. Some of the resulting reports include maps depicting aspects of climate change. However, the process itself does not currently use any mapping tools.

In the cases where maps were used to depict climate change information, these maps were generally provided by the people / organizations providing the source climate change information (using a variety of tools as outlined in Report One, Miistakis 2012). Maps were generally not generated by the climate change adaptation action planning process itself. (Jeff Zukiwsky, pers. comm.)

Was there any specific mapping tools or resources missing, that would have made the process easier?

Contacts at the Columbia Basin Trust reported that their process currently runs fairly well and while available maps are used at times during the workshops, they are generally hung on the wall so that people can look at them on breaks. While there is no immediate defined need, the use of maps and mapping tools has been discussed to assist with local knowledge transfer using community based mapping techniques and in the visualization of information such as impacts, hazards and risks (Jeff Zukiwsky, pers. comm.).

ICLEI'S LOCAL GOVERNMENTS FOR SUSTAINABILITY, CLIMATE RESILIENT COMMUNITIES

What mapping tools are currently used in the process?

Similar to the Columbia Basin Trust process, the ICLEI process provides some limited mapping to depict climate change information, as provided by the source of the climate change information, and not generated by the process itself. While no formal use of mapping tools exists, some of the community workshops have used informal community-based mapping techniques by providing paper maps and having participants highlight assets and risks. This data is then used to inform the discussion during the workshop. (Leya Barry, pers. comm.)

Was there any specific mapping tools or resources missing, that would have made the process easier?

Contacts at ICLEI Canada report the process currently runs well with the limited use of maps during workshops and the occasional informal community-based mapping exercise. While there is no immediate defined need, the use of visualization to highlight data and actions has been discussed. Several visualization projects have been looked at, including University of British Columbia's *Collaborative for Advanced Landscape Planning* section. (Leya Barry, pers. comm.) Currently, climate data availability is inconsistent and varies by region and province. While the information is available, a consistent national dataset of downscaled climate data would be a useful resource for municipalities.

CLIMATEWISE

What mapping tools are currently used in the process?

ClimateWise uses maps in its reports and to depict climate data far more than the other two processes. Maps are generated using in-house GIS software with data gathered from a variety of sources including LiDAR. These maps are used to depict information and inform the discussions at the workshop and in the final report. No mapping tools are used during the workshop process. (Keith Henty, pers. comm.)

Was there any specific mapping tools or resources missing, that would have made the process easier?

Initial conversations with ClimateWise personnel indicated no immediate need for specific mapping tools had been identified. However, it was also suggested that other people at ClimateWise could have more in-depth opinions on the topic (Keith Henty, pers. comm.), but were unable to be reached. Also, ClimateWise engages partners (such as Headwaters Economics) who play community-engagement roles and who may have useful views on this topic. Further investigation of this question specific to the ClimateWise process is warranted.

Conclusions

Process-specific mapping tools are largely unused in the three CCA action planning processes reviewed. While maps are used for depicting climate change information, they are generally created outside of the process using GIS, and arrive “pre-packaged” as part of information inputs.

While no immediate need was identified in any of these processes, the idea of expanding the use of tools for visualization and community-based mapping is being discussed and is on the radar of two of the three reviewed processes.

It is also important to note that community engagement is not necessarily a major component in the implementation phases of these action planning processes, as they mostly focused on a subset of “priority” results as determined by the community. Broader scale community engagement is important in the long term acceptance of a community’s entire climate change adaptation action plan. This is therefore an area where mapping tools could play an important role in the delivery of information and education, leading to broader implementation of the action plan.

POTENTIAL FOR MAPPING AND VISUALIZATION TOOLS

Mapping Tools Versus Visualization Tools

For the purpose of this project, there is an important distinction between *mapping* and *visualization* tools. Mapping tools make use of GIS and spatial data to create static or dynamic maps of a landscape. These may show the outputs of climate models, past, present, or anticipated ranges of species, etc. They may also allow access to the data that is presented by the tool.

Visualization tools are more illustrative, presenting an intentionally generalized/simplified representation of the landscape to highlight a specific aspect. Examples could include displaying what possible future climate change scenarios, environmental impacts, or local changes might look like. With visualization tools, the user can be presented with a picture of an “every-landscape”, an archetypical generalization of the landscape rather than a precise location or area (which may carry certain emotional attachment or prejudice). The user can also be presented with a plausible depiction of a specific landscape, highlighting potential changes in a visual, graphic or intuitive fashion (e.g., photo mock-ups); with interactive mind maps graphically depicting various elements needed to inform decision trees (e.g., strategy maps); and/or with graphic representations of the economic impacts of strategies/inaction (e.g., financial info-graphics, demographic models).

Mapping versus visualization tools are presented here as a choice between two discrete options. In actuality they are extremes at either end of a continuum, with many possible hybrid options in between.

Employing Mapping and Visualization Tools

The applications developed for this project may fall at different points along the above-described spectrum. Miistakis will explore various options for the creation of meaningful and accessible mapping and/or visualization tools in support of the goals and objectives described in the Year Two work plan (see ABMI et al 2012). The most beneficial and meaningful tools will be identified through facilitated discussion and needs assessment with the partner municipality (see *Local Community Selection*, below), and through continued discussion with the developers of the established CCA action plan processes (see *Climate Change Adaptation Action Planning*, above).

To help build awareness of the local impacts of climate change, and to facilitate the process of building climate-resilient communities, the authors envision a suite of tools that will:

- Present climate change science (anticipated changes/trends) on a continental or national scale (e.g., change in mean annual temperature, precipitation, etc.);
- Describe relevant environmental impacts on a regional or provincial scale (e.g., change in habitat/species assemblages, spread of invasive plant species, frequency of wildfires, etc.); and
- Illustrate the projected results - both opportunities and challenges - of climate-induced changes to the local landscape (e.g., increased/decreased viability of agricultural crops, impacts of flooding or severe weather events, susceptibility to fire, etc.).

Focus will be on the last two bullets above (local scale tools), with the first two intended mostly to frame local issues in a wider context.

As the spatial extent of these tools gets smaller, visualization tools will become more appropriate than mapping tools. This reflects not only movement along the continuum described above, but also limitations of available spatial data. Any climate change modeling or associated analysis that has been done in Alberta will not be of sufficient resolution to be meaningful at a local level (e.g., quarter-section or section), nor is this data designed to be interpreted at a site-specific scale. It may, therefore, become more pragmatic to illustrate the type of change that might be expected, using a representative rather than an actual physical landscape.

Mapping Tool Options:

There are many options for the creation of tools that allow the user to view, interact with, and analyse spatial data. Miistakis prefers to build such applications on free and open-source platforms, as those tend to have similar functionality as proprietary software, but are accessible to small organizations (such as rural municipalities) with limited budgets.

The necessary spatial data will come from a variety of sources. Spatial data created and compiled through the larger *Biodiversity Monitoring and Climate Change Adaptation* project is the most obvious source, and Miistakis will make use of this data wherever it is appropriate to do so. For example, data from climate change modeling, vulnerability assessment, invasive species, or

biodiversity research may all be of use to this sub-project. The Miistakis team will also seek to make use of data products from ABMI (e.g., <http://www.abmi.ca/abmi/rawdata/rawdataselection.jsp>).

The InVEST toolkit (<http://www.naturalcapitalproject.org/InVEST.html>) presents an accessible, proven, and well-documented way to potentially describe local or regional impacts of climate change from an ecosystem service (ES) perspective. InVEST allows for the valuation and mapping of ES, and is scalable to different ES focal areas as well as varying quality and resolution of input spatial data. It is free to download and use, and operates either as a stand-alone application or as an extension to ESRI ArcGIS software. Miistakis is currently exploring opportunities to use InVEST to improve the spatial data and mapping and visualization tools developed through this project.

Visualization Tool Options:

Through preliminary investigation of options for developing visualization tools, a number of promising alternatives are evident, including:

- “Traditional” Illustration: This would involve engaging a graphic designer or artist to work on developing material that would illustrate the local impacts of climate change. The results could be presented as static (hard copy or digital) images, animations, or physical objects. These products, though simple and intuitive, would not allow for interaction on the part of the user.
- NetLogo: NetLogo (<http://ccl.northwestern.edu/netlogo/>) is a free software application that allows for the creation and animation of agent-based change models. Users are able to create new models “from scratch”, or choose from a vast array of prescribed models and alter them to better reflect the process being described. Models can be constructed that allow the user to interact with them by changing individual parameters; this could be applied to a climate change illustrative tool by creating buttons or sliders that would allow the user to change different aspects of local land use (e.g., cropland conversion, timber harvest rates, herbicide application, etc.) and observe the resulting changes on a representative landscape.
- Grasshopper: Grasshopper (<http://www.grasshopper3d.com/>) is a free extension to the proprietary Rhino 3D modeling software. Initially designed for engineers and architects, Grasshopper is now used in a widening range of applications from interior design to conservation planning. Grasshopper is similar to NetLogo in that both enable the creation and illustration of dynamic agent-based models, but with two main advantages: it models in three dimensions, and it has the capacity to read, understand, and output spatially referenced data.
- Strategy maps: Headwaters Economics produced a series of graphic ‘strategy maps’ for Missoula County’s ClimateWise workshops, identifying prioritization and intensity of impacts for the variety of strategies developed by the community (<http://headwaterseconomics.org/interactive/climatewise-missoula-strategy>)

Conclusions

The review of existing approaches to building community climate adaptation and resilience revealed very few effective examples of mapping or visualization tools that aid the climate change adaptation action planning process. The authors see this as a substantial gap and a significant opportunity to improve on existing approaches. Discussion with developers of some of the proven approaches supports the assertions that there are numerous points in each process where mapping and visualization might prove beneficial (see *Mapping Tools In Climate Change Adaptation Action Planning*, above).

The authors feel it is important to expand the original consideration of the support tools envisioned in this sub-project from simply web-delivered maps to more broadly include visualization tools. The differences and implications are describe below, however the rationale for the expansion is based on a deeper consideration of the climate change adaptation (CCA) action planning process and the needs of local community decision makers.

Regardless of the CCA action planning process (Columbia Basin Trust, ICLEI, or ClimateWise), the ability to articulate, in a locally-relevant way, the potential impacts of climate change on the resources important to the community was a critical step. Depending on the level of engagement (existing or desired) on the part of the community, map-based representations may or may not provide the compelling messages required to catalyze action.

LOCAL COMMUNITY SELECTION

Miistakis is committed to work with a “local community” on this project, to build tools that advance their understanding of the local impacts of climate change, and inform their future discussions around climate adaptation and resilience.

Defining ‘Local Community’

As discussed in Report One (Miistakis Institute 2012), the definition of “local community” is subjective; it can relate to shared geography or geopolitical boundaries, to shared land use or industry, or to a shared ideology. The operational definition chosen has significant bearing on determining who exactly comprises a local community: local landowners or residents, elected government officials, public servants, concerned citizens, or other stakeholders.

The authors determined the municipality chosen “should be considered jurisdictionally first (i.e., County X), but also geographically (i.e., the diverse community that lives within the county

boundary)” (Miistakis Institute 2012, p.57). This recommendation was based on the conclusions in Report One that:

- Community selection should be geographic in scope as many community associations (watershed groups, agriculture, energy industry) are already exploring climate change adaptation;
- The results of CCA plans for different sectors will be important resources for developing small scale community CCA plans;
- Rural municipalities represent a very important player in the successful implementation of climate change adaptation strategies on the ground, because they are responsible for land use planning and policy decisions at a local level; and
- There are gaps in Alberta at the rural municipal level, because land use planning decisions and policy at the scale of municipality are currently not considering climate change adaptation in Alberta.

For the purpose of this project, the authors have operationally focused “local community” to a rural municipality, with a predominantly agriculture-based economy, situated within the Grassland Natural Region of Alberta.

A Question of Scale

All efforts to understand or address climate change eventually become questions of scale. More often, they become questions of reconciling competing scales: climate change is a planetary phenomenon caused by collective individual actions.

Considerations of the causes of climate change and mitigation of climate change necessarily scale up: one tail pipe is not the issue, and understanding its impact and the responsibility of its owner requires scaling up to a global picture.

However, while climate change mitigation must be considered at a global scale, climate change adaptation must be understood at a local scale. Considerations of adaptation must necessarily be scaled down. The form of adaptation is very different depending if one lives on a flood-prone coastline, or depends on water from a glacier, or lives in a fire-prone forest; etc.

For this reason, when developing a climate change adaptation action planning process (and associated mapping or visualization tools) to help a community deal effectively with the local impacts of climate change, there is no “one size fits all” methodology that would work equally well for any community in Alberta. However one chooses to define them, local communities are unique, with specific natural and cultural physiographies. There are initiatives underway at global, national, and provincial scales that explain climate change in that geographic context, but there is a dearth of efforts to bring climate change to bear on the everyday lives of individuals. In order to make climate change impacts matter locally, one first needs to understand nature, culture, politics and economy at the local level.

Choosing a Local Community

Communities of any type could arguably benefit from climate change adaptation action planning. The operational focus for a 'local community' described above narrows the scope to local communities where CCA action planning could be most impactful, and allows the authors to test an approach and prove concepts that may form a foundation for replicating this work in other local communities. Our intent is to build tools and processes that are well-documented, tailored to specific local objectives, but adaptable to other communities.

Even within this narrowly defined scope, some effort is required to choose an appropriate local community. There are 22 rural municipalities located within the Grassland Natural Region of Alberta, 21 of which list Agriculture as their primary industry. There are also 3 Special Areas (Special Areas 2, 3, and 4), which will not be considered as candidate local communities due to our lack of familiarity with these jurisdictions. Figure 1 is a map showing the candidate local communities for this project.

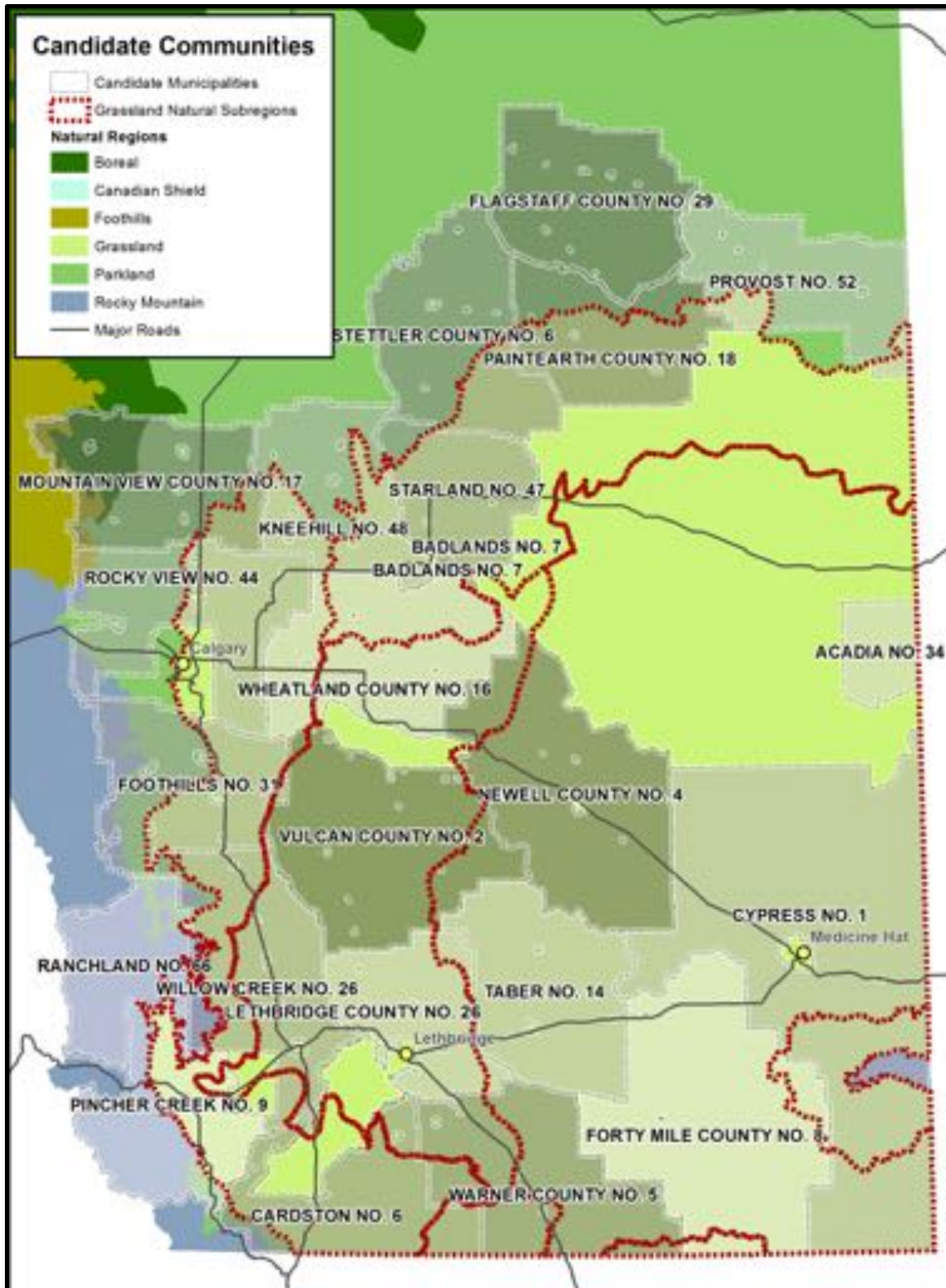


Figure 1: Candidate local communities for Local Adaptations sub-project

In December 2012, Miistakis conducted a preliminary survey of the 21 municipalities that meet the initial selection criteria listed above. The survey was conducted via email, and was aimed at introducing the project concept and gaging general interest. The email included four questions:

1. Does your municipality your municipality have any policy, strategy, or official position related to climate change?
2. Does your municipality have an agriculture strategy?
3. Does your municipality your municipality have any policy, strategy, or official position related to biodiversity?
4. If the answer to any of the above questions is “no”, is there interest within your municipality in developing such strategies?

As of February 2013, this survey has generated three responses. One respondent answered “no” to all four questions. The other two indicated initial general interest in the concept, and considered these important strategic objectives for their respective municipalities, but both were concerned about the staff and resource requirements in order to undertake this work, and neither felt as though they had enough information to make any commitment beyond general interest. It is likely that others who received the survey may have been similarly curious, but lacking sufficient information or authority to respond.

Conclusions

The emphasis on climate change adaptation (CCA) *action planning* has clarified many aspects of the Miistakis Team’s approach within the *Local adaptations* sub-project. However, it has also complicated other aspects, the selection of a partner community perhaps foremost in that category. Originally, a community partnership was envisioned as a bilateral relationship with the Miistakis Institute (representing the *Biodiversity Management and Climate Change Adaptation* project), one where Miistakis would comprehensively develop a targeted decision-support tool for that community. Through our case reviews, the concepts of both a decision support tool and an effective partnership model have evolved considerably.

This has led to the following key conclusions regarding selecting a partner community. The key inputs to these conclusions were the:

- Survey of municipalities;
- Deeper review of the CCA action planning processes; and
- Evolving conversations with organizations likely to play a significant role.

PARTNERING ON WHAT

As described in *Climate Change Adaptation Action Planning*, above, the climate change adaptation action planning process has several components. Engaging a partner municipality could involve working through an entire action plan, developing a framework, undertaking a rapid

assessment, or developing key materials that link communities and local climate change impacts. One thing that is clear is, within the bounds of this project, the Miistakis Institute cannot provide all of these to a partner community. Engaging a community will require clarity on which aspect of CCA action planning would be the basis of the partnership with Miistakis.

PARTNERING WITH WHOM

Linked to the reality that the Miistakis Institute (and this project in general) likely cannot provide all aspects of a CCA action plan to a partner municipality, is the reality that this might not even be appropriate. Given the capable organizations in existence that could play an important role in supporting municipalities with their climate change adaptation goals, it would be at best inefficient not to include them in this discussion. At this point, those organizations the authors consider critical to involve are C3 (formerly Climate Change Central), the Municipal Climate Change Action Centre (MCCAC), the Alberta Association of Municipal Districts and Counties (AAMDC), and Alberta Environment and Sustainable Resource Development (AESRD) climate change adaptation personnel.

Although this streamlines the ultimate implementation, it complicates the step of choosing a partner municipality, as the number of organizations that might partner with has increased. These organizations need to play a significant role in the selection of the community, thus the first step in selecting a partner community is exploring and establishing partnerships with these organizations.

COSTS OF PARTNERING

The initial conversations made it clear that for a municipality considering being a partner in this project, costs are top of mind. Even before any information was sought about the actual costs and the potential benefits, those municipalities who replied to the survey and informal inquiries indicated this would be a critical barrier to participation. The authors believe that a full representation of costs (including the costs of climate change adaptation *inaction*, and the ability to integrate strategies into existing plans) will create a compelling case for participation. However, the signal has been provided loud and clear that without this step having been completed, successful recruitment of a partner municipality is unlikely to happen.

OBSERVATIONS

Within each section of this report, representing distinct areas of research and review, a number of conclusions were listed. The following section identifies several overarching conclusions, then summarizes the previously-listed conclusions.

Principal

There are four primary conclusions that the authors have drawn, which will directly inform activity in Years Two and Three.

- Climate Change Adaptation Action Plans continue to represent the best option for managing climate-affected biodiversity by building climate resilient communities;
- Ecosystem services represent a framework for understanding biodiversity's role in adapting to climate change;
- Climate change mitigation is inherently global, and thus hard to scale down; climate change adaptation is inherently local, and this hard to scale up; municipalities represent the ideal scale for climate change adaptation; and
- The critical Action Planning steps for Alberta are compiling relevant climate change science, and making climate change impacts relevant to local communities.

Climate Change Adaptation Action Planning

- There is no need to create a new process "from scratch" for building climate resilience in Alberta.
- All CCA Action Planning process have the same basic components: Climate Change Science, Interpretation of Science, Climate Change Action Plan, Implementation, and Evaluation.
- The first two CCA Action Plan components are most critical for Alberta: creating, compiling, and sharing climate change science; and devising means to make this science matter to local communities.
- Framing why CCA information in an ecosystem services framework helps communities better understand why action is important and inaction is costly.

Mapping Tools In Climate Change Adaptation Action Planning

- Process-specific mapping tools are largely unused in the CCA Action Planning processes reviewed;
- Maps depicting climate change information are generally created outside of the process, and arrive as information inputs;
- The use of tools for visualization and community-based mapping is being discussed by two of the three reviewed processes; and
- Mapping tools could play an important education role in the implementation phases of the CCA action plans.

Potential for Mapping and Visualization

- There are numerous points in each CCA Action Planning process where mapping and visualization might prove beneficial;
- Map-based representations may or may not provide the compelling messages required to catalyze action; and
- It is important to expand the consideration of support tools envisioned from simply web-delivered maps to more broadly include visualization tools.

Local Community Selection

- Through the case reviews, the concepts of a decision support tool and an effective partnership model have both evolved considerably.
- Engaging a community will require clarity on which aspect of CCA action planning would be the basis of the partnership with Miistakis.
- The first step in selecting a partner community is exploring and establishing partnerships with organizations already seeking to support municipalities with their climate change adaptation goals; and
- For a municipality considering being a partner in this project, costs are top of mind; the authors believe that a full representation of costs will create a compelling case for participation.

NEXT STEPS

The research and case reviews conducted in Year One have, as intended, served to inform the activity of Years Two and Three, the implementation phase. The work of the next two years can be described in terms of the following four tasks. Although there is some obvious staging, these tasks will overlap and be undertaken concurrently to some degree.

1. Articulate a climate change adaptation action plan approach

“Articulate a climate change adaptation action plan approach that incorporates biodiversity management considerations into Alberta municipalities’ planning and adaptation frameworks.”

Several Climate Change Adaptation Action Plan processes exist, a handful of which the authors have reviewed in detail. Each has facets to recommend them, and each accommodates the goals of this project to differing degrees. Organizations have been identified who are or could play a

role in CCA Action Planning in Alberta. Over Year Two, a CCA Action Plan process will be articulated, This articulation will balance the best of the reviewed models, integrate with existing efforts, clearly indicate the points where climate science interpretation is needed, and identify the role which Miistakis in particular, and the Biodiversity Management and Climate Change Adaptation project in general, will play. A key component of this task is partnership development, working with the Alberta-based organizations already considering climate change adaptation, and with a partner municipality for implementation.

2. Develop materials that articulate impact changing climate has on Alberta communities

“Develop a mechanism and draft materials that articulate, in an ecosystem service context, the impact a changing climate has on Alberta communities’ economies, infrastructure, and natural systems (identified as the largest gap in applying CCA action plans in Alberta), applying that to the circumstances of a particular partner municipality.”

This task, representing the bulk of the work in Years Two and Three, focuses on communicating the local impacts of climate change in terms of “what matters” locally: local land use priorities, and elements of biodiversity and/or ecosystem services of local significance. The intent is to build a high-quality resource for a specific local community, and a methodological template that is robust and replicable to other communities in Alberta. The result will be tangible, targeted materials and tools. Identification of “what matters” locally will require engagement of a specific community in order to identify local social, economic, and environmental priorities. This will focus the role of Miistakis on interpreting science and process for working with local community to develop decision support tools that integrate biodiversity and adaptation (referred to as Steps 2 and 3 in the Climate Change Adaptation Action Plan process, above, in *Climate Change Adaptation Action Planning*). Year Two will involve framing the mechanism, outlining materials, and engaging the partner municipality; Year Three will involve finalizing the mechanism, the resource materials, and associated tools.

3. Develop toolkit to support CCA Action Planning

“Develop a spatially-explicit toolkit to support climate change adaptation action planning in the Alberta context based on representing that relationship between climate-modified systems and community resources.”

A key part of the “what matters” materials will be the supporting tools. Mapping and visualization tools can be used to show the impact of a changing climate on many if not all local priorities. Developing tools in support of Steps 2 and 3 of the CCA Action Planning processes will involve identifying the insertion points (points where visualization tools can make a demonstrable

contribution to supporting decisions), creating a tool “kit” to the greatest degree possible, and looking first and foremost to tools that are already in existence. Year Two activities will parallel the articulation of the CCA Action Planning process, identifying the visualization toolkit components and the logical insertion points. These will support the development of the materials described in the task above. Year Three will involve integrating the visualization toolkit into CCA Action Plan process.

4. Identify and incorporate the data and modeling sources

“Identify and incorporate the data and modeling sources needed to support representing the ‘Local Implications’ relationships, especially within a biodiversity management and ecosystem services context.”

The CCA Action Plan processes, and in particular the targeted Steps 2 and 3, are very dependent on data and information inputs. Data and information that can, and should, be used to inform the development of the local implications materials will be identified. This will include climate science models and reports that inform understanding climate variables and environmental changes in southern Alberta. These data and modeling will then be incorporated into the tool kit. This work, map based and otherwise, will make the best use of data and resources created by other sub-projects, and from other associated sources (e.g., ABMI data). Detailed accomplishment of this task necessarily requires other sub-project decisions being made first; however, leaving data and information considerations to the latter stages confounds fundamental design questions, so this task will involve an on-going review exercise throughout the project. Having said that, Year Two will largely involve identifying required data and modeling sources, and Year Three will involve incorporating data and modeling into the local implications materials and associated spatially-explicit toolkit.

CONCLUSION

“Although most countries refer to communication of climate impacts and vulnerabilities as one of the most important strategies to increase public awareness and encourage adaptation action, as yet there seems to be little progress on such strategies within governments. These strategies, however, could play a valuable role in the way adaptation policy is communicated and eventually implemented.”

- Partnership for European Environmental Research (PEER), *Europe Adapts to Climate Change: Comparing National Adaptation Strategies*, p.90

This second report from the Miistakis Institute in support of the Biodiversity Management and Climate Change Adaptation project represents the completion of the first phase of the *Local adaptations* sub-project, and sets the stage for moving into Years Two and Three – the implementation phase.

The overarching goal of this sub-project continues to be to develop a “decision support system (DSS) to better understand climate-related risks and adaptations in the context of ecosystem services and biodiversity. The role of this DSS is to raise awareness of the biodiversity-related ecosystem services relied upon by the community, represent how those services would be affected by climate change, and characterize potential adaptation strategies that satisfy community goals in a manner beneficial to biodiversity” (ABMI et al 2012).

This report completes the review of the climate change adaptation action planning, the associated mapping tools, the potential for visualization and mapping tools, and the process for engaging a partner community. The principal conclusions of this report continue to support the assertion that Climate Change Adaptation Action Plans represent the best option for managing climate-affected biodiversity by building climate resilient communities, and that ecosystem services represent the best framework for understanding biodiversity’s role in adapting to climate change. Operationally, the greatest needs for applying climate change adaptation action planning in Alberta are compiling relevant climate change science, and making climate change impacts relevant to local communities (characterized in this report as Steps 2 and 3 of the Climate Change Adaptation Action Planning process). In short, the authors found the same circumstance in Alberta as those referenced in the quotation above.

The next steps, and the work of the Miistakis team in Years Two and Three are to articulate a climate change adaptation action plan approach, develop materials that articulate the impact a changing climate has on Alberta communities, and develop a toolkit to support CCA Action Planning.

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