

Adaptive Policy Analysis of Saskatchewan's 25-Year Water Security Plan

Prepared by:

International Institute for Sustainable Development

Prepared for:

Water Security Agency, Government of Saskatchewan



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2013 ADAPTTool Application Adaptive Policy Analysis of Saskatchewan's 25-Year Water Security Plan

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With support from Natural Resources Canada through the Adaptation Platform



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2013 ADAPTTool APPLICATION

Adaptive Policy Analysis of Saskatchewan's 25-Year Water Security Plan

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Executive Summary

Introduction

Public policy operates in a dynamic and complex environment. As conditions change, policies and programs may become less effective or even counterproductive. Adaptive policies and programs help avoid these kinds of failures. While policies aim to achieve certain objectives—for example, improve water quality or regulate forest harvesting—they also should avoid policy failures and unintended consequences as conditions change (Walker et al., 2002). Swanson et al. (2009) describe such policies as designed to function more effectively in complex, dynamic and uncertain conditions. Swanson and Bhadwal (2009) describe seven key guidelines for adaptive policies, based on observations of policies that perform well in the face of change and on insights from the recent policy literature dealing with complex systems. These guidelines are summarized below.

Policy-makers and the public are increasingly aware of potential impacts of climate change, increasing vulnerability to climate change and adaptation needs. *Adaptation* is defined as an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, in order to reduce harm or take advantage of opportunities (Intergovernmental Panel on Climate Change, 2007). There is also a growing body of literature on the role of policies and strategies in adapting to climate change, including assessing current policies for their ability to address adaptation.

The ADAPTTool was developed by the International Institute for Sustainable Development (IISD) with support from Adaptive Resource Management Ltd, Novel Futures Corporation and The Energy and Resources Institute (TERI) and with financial and in-kind support from the International Development Research Centre, Natural Resources Canada's (NRCan) Prairie Regional Adaptation Collaborative, Manitoba Conservation and Water Stewardship, Manitoba Agriculture, Food and Rural Initiatives and the Saskatchewan Water Security Agency. The ADAPTTool is based on the 2009 book *Creating Adaptive Policies* (Swanson & Bhadwal, 2009).

In 2013 Saskatchewan's Water Security Agency (WSA) led a collaborative project with IISD and three other provinces with support from NRCan to analyze diverse sectorial policies using the ADAPTTool. This analysis aimed to assess the ability of these policies to contribute to the planned and autonomous adaptability to anticipated and unanticipated uncertainties. The analysis was performed by IISD with inputs and feedback from WSA personnel and other stakeholders in Saskatchewan Environment.

The objective of the analysis was to provide the government with a systematic assessment and understanding of the potential for its policies and programs to support climate change adaptation in key aspects of environmental management and to raise awareness and "mainstream" consideration of adaptation, as well as assess the policies themselves against elements of adaptive policy-making identified by IISD's prior research and application of the ADAPTTool.

Policy Analysis

Saskatchewan's WSA partnered with IISD under the scope of this analysis to determine if the seven goals under its 25-year plan were contributing to adaptation needs for key sectors in the province, and if the goals and plans developed under this plan were themselves adaptive and flexible in light of uncertainty and change. This study was initiated by Tom Harrison, the Director of the Saskatchewan WSA and colleagues, including Benjamin Brodie. Terry Hanley subsequently replaced Tom towards the end of the project.

The first steps of the analysis involve defining the geographic scope, stressors and the policies to be analyzed. In the case of Saskatchewan, the geographic scope selected was the entire province. Based on a review of literature, a climate scenario was presented that could be summarized as more frequent and severe floods, droughts, and severe storms in the future.

Analysts from the WSA and IISD selected policies for inclusion in this analysis based on their relevance to the chosen climate stressor, and whether there were “champions” willing to participate in the analysis. It was decided the 25-year water security plan (WSP) for the province would be analyzed with the ADAPTool and its seven goals as though they were existing policies/programs.

The seven goals of the WSP are:

- **Sustainable Supplies:** Ensure the sustainability of our surface and ground water supplies.
- **Safe Drinking Water:** Ensure our drinking water is safe by protecting supplies from source to the tap.
- **Protection of Water Resources:** Ensure water quality and ecosystem functions are sustained
- **Safe Dams:** Ensure dams safely meet water supply and management needs.
- **Flood and Drought Damage Reduction:** Ensure measures are in place to effectively respond to floods and drought.
- **Adequate Data, Information and Knowledge:** Ensure adequate water data, information and knowledge are available to support decision making.
- **Effective Governance and Engagement:** Ensure water management and decision-making processes are coordinated, comprehensive and collaborative.

Key Findings

A key finding through this pilot application of the ADAPTool *for existing policies* was that this tool is not well suited to a plan that has not yet been implemented. Most of the questions within this tool explore the inclusion of specific adaptive policy elements in policy implementation. Since the selected goals (policies) in this case were prospective, these questions were not clearly answered and the comments and scoring was based on “possible inclusion” based on the language of the goal (policy) rather than “actual inclusion.” This in turn meant that the goals (policies) all scored moderately based on possible incorporation of adaptive policy elements. Please note that at the time of this research, the project team was also developing and pilot testing a version of the ADAPTool *for new policies*. However, that version is intended to help write brand new policies and would not also have applied to this prospective but fully developed plan. Essentially this application provided lessons about the limitations of the tool. However, the project team believes that applying the tool on this plan does provide insights on how the tool can provide support for sector-specific adaptation needed as well as some recommendations on how the specific goals can incorporate adaptive policy elements in their future implementation.

Based on our analysis, all goals or policies within the scope of the analysis (and comprising the 25-year plan) provided indirect support to various sectors in Saskatchewan facing increasing climate change impacts requiring adaptation actions. The adaptation analysis worksheet showed that 133 out of the total 198 adaptation actions have no direct program support. Of the 198 total adaptation actions, 65 are supported (directly or indirectly) by one of more of the policies.

An overview of the scoring of the analyzed policies is presented in Box 1. Many of the analyzed policies are themselves vulnerable to the stressor due to the close relationship between temperature changes and the hydrologic cycle and natural water systems. For the rest of the adaptive policy analysis, most policies scored moderately well.

Finally, we identified additional adaptation needs, additional support for specific capacities and overall more diversity in the types of policies, such as economic, institutional and expenditures, to create a robust set of policies capturing diverse adaptation stakeholders’ needs. It is recommended that the adaptation needs that were not supported by the policies assessed be scrutinized for their implications and that responses be developed accordingly.

BOX 1. OVERVIEW OF THE OVERALL SCORING ACROSS THE SEVEN GOALS UNDER THE WSP

Adaptive Policy Questions	Overall synthesis	Sust. supplies	Safe drinking water	Protection of water resources	Safe dams	Flood and drought damage reduc	Adequate data, info and knowledge	Effective gov. and engage.
Ability to Support Anticipated Adaptation Needs (score out of 10)	5	4	3	4	4	3	5	5
Are anticipated adaptation actions supported by the policies?	1	1	1	1	1	1	1	1
Is the policy itself vulnerable to the stressor?	1	0	0	0	0	0	2	2
Can the existing suite of policies enhance the capacity of actors within each sector to undertake the anticipated adaptation actions?	1	1	1	1	1	1	1	1
Were foresight methods and multistakeholder deliberation used in the design of the policies?	1	1	0	1	1	1	0	1
Program’s Ability to Respond to Unanticipated Events (score out of 10)	6	4	4	5	4	4	5	4
Are foresight methods and multistakeholder deliberation used in the implementation of the policy?	1	1	1	1	1	1	1	1
Does the policy enable self-organization and social networking?	1	0	0	1	0	1	1	1
Is decision making for policy implementation adequately decentralized?	1	1	1	1	1	1	1	1
Is there adequate variety in the suite of policies and programs directed at the policy issue?	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Do the policies have a regular formal policy review?	1	1	1	1	1	0	1	0
Overall Adaptive Policy	1	1	1	1	1	1	1	1

Key Conclusions and Recommendations

The overall conclusions and recommendations of the adaptive policy analysis for the suite of policies considered include:

- **Support to Anticipated Adaptation Needs** (planned adaptability). From the identified 198 adaptation actions, 65 were supported either directly or indirectly. The remaining 133 have no direct program support amongst the analyzed policies. *For next steps it would be beneficial to scrutinize the unsupported adaptation actions to see if any of them are provincial priorities and if any other policies not included in this review might be providing appropriate support.*
- **Policy Stress** (planned adaptability). Five of the seven policies reviewed are vulnerable to climate change impacts since climate change has significant impacts on the hydrologic system. *Incorporating scenario processes and including climate projections explicitly in policy design and implementation is a mitigation factor. In the future, more effort would need to be devoted to explore feasible levels of water withdrawals under diverse climate change scenarios to reduce the vulnerability of the policies and managed water resources.*
- **Support to Stakeholder Adaptive Capacity** (planned adaptability). Of the six determinants of adaptive capacity (access to economic resources, technology, infrastructure, information/skills, institutions/networks and equitable access to resources), the analyzed policies provided the most support for access to relevant information and skills. The policies fall short in supporting other capacities such as access to infrastructure, technology and broad-based financial resources.
- **Use of Multistakeholder Deliberation** (planned and autonomous adaptability). The policies performed relatively well in terms of ensuring foresight methods and stakeholders involvement during the planning and implementation phases. In terms of implementation, there is appropriate language built in to enable some deliberative and analytical processes, but these have not yet been implemented. *Creating formalized procedures and guidelines on consultation and use of future scenario processes are recommended for implementation.*
- **Enabling Self-Organization and Networking** (autonomous adaptability). Four of the seven policies perform moderately in this aspect while three do not have explicit instruments for this purpose. *Building forums for sharing best practice, resources for enabling self-organization, and other such elements of enabling self-organization will ensure adaptability to unexpected climate-related challenges in the future.*
- **Decentralization** (autonomous adaptability). As the suite of policies analyzed is not yet implemented, this analysis relies on the wording used in the prospective 25-year plan. The policies within the plan seem moderately decentralized and do devolve authority to watershed groups, regional partners, municipalities etc. as appropriate. To strengthen this aspect, *policies being implemented should ensure that along with devolution of responsibilities to appropriate levels, resources, capacity and accountability are devolved as well to help improve decentralization for adaptive policies.*
- **Variation in Policy Instruments Employed** (autonomous adaptability). The policy instruments suggested in the 25-year water security plan include a range of different kinds of policies, including expenditure, economic, institutional and regulatory. *A key aspect of improving implementation would be to build in review mechanisms to check which instruments are working well and to enhance those that are helping the most in achieving policy objectives.*
- **Formal policy review and improvement** (planned and autonomous adaptability). There seems to be a plan to review the overall, 25-year plan every five years. In addition, five of the seven policies have some explicit mention of review mechanisms. *It is important for the overall functioning of the plan and its components that formal review mechanisms are built in for the plan as a whole and for the seven sub-components, and that specific deliberative and analytical approaches are used for such reviews.*

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1.0 What Is Adaptive Policy/Programming?

Note: In this context, the term “policies” may refer also to programs, legislation, regulation and other policy instruments.

Over the past several decades, there has been recognition that public policies and programs intended to achieve stated objectives can, even if well-designed, lead to unintended consequences as conditions change. Public policy operates in a dynamic and complex environment. Actors in the policy domain interact with new external factors, changing economic and market conditions, new information, changing technology and evolving networks of exchange. With increased global interconnection, dynamic economic conditions, shifting climate and rapid changes in technologies, the resulting complexity and pace of change make outcomes difficult to predict. As conditions change, policies and programs may become less effective or even counterproductive. The idea of adaptive policies is to design policies and programs to increase their adaptability and help avoid these kinds of failures.

IISD collaborated with The Energy Research Institute (TERI) in India over a four-year research project to explore case studies of policies in the agriculture and natural resource management sectors in both countries and identify characteristics of adaptive policies based on evidence of their actual performance. The results are described in the 2009 book *Creating Adaptive Policies: A Guide for Policy-Making in an Uncertain World* (Swanson & Bhadwal, 2009).

- This research identified seven characteristics of policies that were adaptable to changing conditions. Some of these characteristics were designed to build in adaptability to anticipated change and projected future conditions (autonomous adaptability).
- The ADAPTTool version used in this project is structured around these seven characteristics. Different questions in the tool are used to assess and score policies in relation to these factors.

The characteristics of adaptive policies/programs are: 1) integrated and forward-looking analysis; 2) multistakeholder deliberation; 3) automatic policy adjustment; 4) self-organization and social networking; 5) decentralization of decision making; 6) promoting variation; and 7) formal policy review and continuous learning.

These characteristics of adaptive policies/programs are summarized below, and described in more detail, with case studies, in the book.

1.1 Integrated and Forward-Looking Analysis

Integrated and forward-looking analysis can identify key factors that affect policy/program performance and scenarios for how these factors might evolve in the future, so that policies and programs can be made robust to a range of anticipated conditions. These tools can also be used to develop indicators that will trigger adjustments when needed. Modelling tools of varying sophistication can be used to support this kind of analysis, which is often integrated through scenario planning.

1.2 Multistakeholder Deliberation

Multistakeholder deliberation is a collective and collaborative public effort to examine an issue from different points of view as part of a decision-making process. Deliberative processes strengthen policy and program design by building recognition of common values, shared commitment and emerging issues, and by providing a comprehensive understanding of causal relationships. The key aspects of this process are that it involves participants in sharing multiple perspectives in an attempt to reach consensus on a relevant decision. This approach goes beyond stakeholder consultation.

1.3 Automatic Policy Adjustment

Automatic adjustment mechanisms can speed up the process of response to conditions that are more or less anticipated. They can be used in complicated policy/programmatic environments by separating the various issues into units in which the understanding of the system is high, allowing for fine-tuning of the system and making adjustments that help reduce risks and maintain performance. Automatic adjustment can be both fully and semi-automatic.

1.4 Enabling Self-Organization and Social Networking

The intent of this characteristic is to ensure that policies do not undermine existing social capital, but instead create forums that enable social networking, facilitate the sharing of good practices and remove barriers to local self-organization. Local responses, self-organization and shared learning all strengthen the ability of stakeholders to respond to unanticipated events through innovation.

These practices take advantage of the capacity of complex adaptive systems to generate solutions without external input or formally organized interventions. The ability of individuals and groups to self-organize in response to stresses, crises or unexpected problems is well documented in social and ecological literature, and a key aspect of healthy adaptation. For policy-makers and program managers, the idea is to foster self-organized responses to unexpected conditions by enabling and supporting interaction, learning and networking, without trying to control or dictate outcomes. This includes facilitating sharing and copying of best practices, providing resources to reduce barriers to self-organization, and creating spaces for adaptive collaboration.

1.5 Decentralization of Decision Making

In governance terms, the principle of “subsidiarity” means decentralizing decision making to the lowest effective and accountable unit of governance. This has adaptive advantages because there are better opportunities for feedback and information sharing to ensure that decision-makers are aware of unexpected problems and effects of proposed interventions, as well as the nature of different interests. For policies/programs directly concerning natural resources and ecosystems, field staff typically notice significant change earlier, and can mobilize affected local interests to address these changes more simply. Because local conditions vary widely, decentralization provides a way to implement policies and programs more flexibly, to ensure effectiveness and adaptation to change. The potential for decentralization in any particular policy or program area will depend on the scale of intervention needed, the extent of local knowledge and capacity, and the structure of governance mechanisms for accountability and coordination.

1.6 Promoting Variation

Given the complexity of most policy settings, implementing a variety of policies to address the same issue increases the likelihood of achieving desired outcomes. Diversity of responses also forms a common risk-management approach, facilitating the ability to perform efficiently in the face of unanticipated conditions. Variation may be actively designed, as when a range of alternative options is provided to meet the diverse needs of different stakeholders. This can be facilitated by:

- Using a mix of policy instruments
- Exploring synergies with other policies
- Providing opportunities for risk-spreading

Another approach is to use policy tools to facilitate variation by removing barriers to alternative solutions and providing information to support exploration of options.

1.7 Formal Policy Review and Continuous Learning

Regular review, even when the policy or program is performing well, and the use of well-designed pilots throughout the life of the policy/program to test assumptions related to performance can help address emerging issues and trigger value-added policy adjustments. Formal review is different than automatic adjustment, where triggers and responses may be determined in advance. Formal review is a mechanism for identifying and responding to unanticipated circumstances and emerging issues. This assessment process can be very useful in detecting emerging issues that can affect the policy's performance. A formal review mechanism includes triggers for the review, definition of the nature of the review and a learning process that includes who needs to be involved in the review, who will take action on the results and what kinds of actions are to be considered.

Together, these seven characteristics of adaptive policies are relevant in the planning and design of policies and programs, as well as in their implementation and evaluation. The ADAPTtool is intended to encourage assessment and discussion of these characteristics in various phases of the policy cycle.

2.0 The Adaptive Design & Assessment Policy Tool (ADAPTool)

The Adaptive Design and Assessment Policy Tool (ADAPTool) is a Microsoft Excel-based workbook designed to evaluate a suite of public policies and/or programs for their ability to contribute to the capacity of key economic sectors (e.g., mining, agriculture, forestry) to adapt to a specific socioeconomic or ecologic stress, such as climate change or market price volatility. A policy's ability to help stakeholders adapt to the stress and the policy's ability to adapt itself to the stress is assessed by answering 15 questions across three worksheets, with a fourth worksheet aggregating results. The ADAPTool is based on the book *Creating Adaptive Policies: A Guide for Policy-Making in an Uncertain World* (Swanson & Bhadwal, 2009).

The workbook serves as the basis for scoring each of the programs in response to the assessment questions identified below in Box 2. The questions cover both planned adaptability (i.e., how well the policy or program anticipates the likely impacts of the stressor) and autonomous adaptability (or adaptability to unanticipated impacts of the stressor).

BOX 2. ADAPTOOL QUESTIONS AND WORKSHEET STRUCTURE

I. Scope of Evaluation Worksheet:

- 1) What is the geographic scope of the analysis (e.g., watershed, conservation district, municipality, region, province)?
- 2) What is the stressor of concern (i.e., climate change, market price instability)?
- 3) What are the policies/programs to be assessed?

II. Vulnerability & Adaptation Analysis Worksheet (for planned adaptability):

- 4) What are the main sectors active in the geographic area?
- 5) In what ways are the sectors vulnerable to the stressor?
- 6) What adaptation actions might be necessary if this stressor becomes more severe in the future?
- 7) Are the identified adaptation actions supported by the policies/programs?

III. Adaptive Capacity Analysis Worksheet (for both planned and autonomous adaptability):

- 8) Is the policy itself vulnerable to the stressor identified?
- 9) Does the policy enhance the capacity of actors within each sector to adapt (with respect to access to finances, technology, infrastructure, information and skills, institutions and networks and equitable access)?¹
- 10) Were foresight methods and multistakeholder deliberation used in the scoping and design of the policy?
- 11) Are foresight methods and multistakeholder deliberation used in the implementation of the policy?
- 12) Does the policy enable self-organization and social networking among affected stakeholders? (Does the policy provide mechanisms for the sharing and copying of best practices and lessons learned?)
- 13) Is decision making for policy implementation adequately decentralized?
- 14) Is there adequate variety in the suite of policies and programs directed at the policy issue (e.g., economic, regulatory, expenditure, institutional policy instruments)?
- 15) Does the policy have a regular formal review process in place that can detect emerging issues?

IV. Synthesis Worksheet

An aggregate ranking of planned adaptability and autonomous adaptability is provided for the overall suite of policies, as well as for each individual policy.

¹ Based on Smit & Pilofosova (2001).

3.0 Policy Analyses

3.1 NRCan Project Process Overview

The Province of Saskatchewan has been working on adaptation-related issues actively through its provincial processes and its involvement with the Prairies Regional Adaptation Collaborative (PRAC). Adaptation is being actively considered in sectors such as agriculture and water resource management where climate change impacts are expected to affect decision making, management and planning.

Saskatchewan's water resources are critical and foundational elements of the province's performance and success in most economic and human development sectors. However, climate change impacts such as changes in temperature, precipitation and runoff regimes affect the quantity, quality and availability of water in lakes, wetlands, reservoirs and watersheds in general. Early in the course of this project, it was decided that the ADAPTTool would be used to analyze water-related policies in the province in relation to key economic sectors such as agriculture, hydroelectricity and mining.

Partly in response to climate change needs and for long-term planning of water resources management, the Saskatchewan's WSA created a 25-year water security (WSP) plan to project future water demands and stresses and provide a long-term framework for all aspects of water management provincially.²

Analysts from the WSA and the IISD selected policies for inclusion in this analysis based on their relevance to the chosen climate stressor, and whether there were "champions" willing to participate in the analysis. After a number of face-to-face and email discussions with key WSA staff, it was decided the 25-year water security plan for the province, which is intended to replace a number of older or absent/unwritten policies or strategies on water management would be analyzed using the ADAPTTool. The seven goals within the 25-year plan would be analyzed as provincial policies, and their contribution to provincial adaptation needs and their adaptive capacity would be determined using the ADAPTTool.

This ADAPTTool analysis involved several steps, described in more detail in subsequent sections of this report: initial project scoping and selection of water sector policies to be assessed, staff training in the use of the ADAPTTool, adaptability assessment of selected policies and reporting. The scoping process involved determining which climate change stressors to focus on, sectorial and subsectorial vulnerabilities to climate change, and potential adaptation actions in response to these vulnerabilities. The scoping of vulnerabilities, adaptation actions and programs/policies to assess was an iterative process that occurred through in-person meetings, phone and email interactions.

For the Saskatchewan project, the assessment was conducted by Dimple Roy from IISD with inputs from Darren Swanson, also associated with IISD. Government of Saskatchewan analysts provided inputs and feedback and included Tom Harrison and Benjamin Brodie.

² <https://www.wsask.ca/About-WSA/25-Year-Water-Security-Plan/>

In order to apply the ADAPTTool analysis to the 25-year WSP, the following specific steps were used:

- One-on-one capacity building on adaptive policies and the ADAPTTool for Saskatchewan project lead, Benjamin Brodie. This session focussed on the foundations and elements of adaptive policies, an overview of the ADAPTTool, its key elements and experiences with applications and its use for the Saskatchewan analysis.
- Meetings with WSA staff to determine the most appropriate water-related policies to assess and provide feedback on the 25-year WSP as an appropriate candidate for the analysis.
- Phone and email conversations with Saskatchewan analysts on the priority sectors relevant to water security, their vulnerabilities to climate change and necessary adaptation actions.
- Review of goals in Saskatchewan’s 25-year WSP using the worksheets in the ADAPTTool for planned and autonomous adaptability of the seven goals under the 25-year WSP. This was sent for review by Saskatchewan analysts.
- The ADAPTTool assessments for each policy/program were then consolidated into a master workbook synthesizing results and a final report written on the results and further recommendations.

3.2 Policy Selection

The primary stressor of interest in this analysis is climate change. More specifically, our study of literature presented climate change in Saskatchewan to be manifested as increased incidents and severity of drought, excess moisture and storms. The geographic scope of this policy analysis is the Province of Saskatchewan. In the application of the ADAPT tool in Saskatchewan, the focus was on the Saskatchewan 25-year WSP comprising seven goals that acted as seven distinct provincial programs relating to water security. The seven goals under the 25-year WSP include:

- **Sustainable Supplies:** This goal focuses on “ensuring the sustainability of our surface and ground water supplies” (4). It includes actions areas for: efficient use of water, new water supply infrastructure, water allocation systems, irrigation, climate change adaptation and water availability study.
- **Safe Drinking Water:** This goal focuses on “ensuring our drinking water is safe by protecting supplies from the source to the tap.” It includes actions areas for: municipal systems, semi-public systems and private systems.
- **Protection of Water Resources:** This goal focuses on “ensuring water quality and ecosystem functions are sustained.” It includes action areas for: water quality, wetland conservation, ecosystem health and biodiversity protection, and source water protection planning.
- **Safe Dams:** This goal focuses on “ensuring dams meet water supply and management needs.” It includes action areas for: dam safety and maintenance, and dam benefits and sustainable operation.
- **Flood and Drought Damage Reduction:** This goal focuses on “ensuring measures are in place to effectively respond to floods and droughts.” It includes action areas for: flood damage prevention and emergency response in developed areas, agricultural drainage and flooding, and drought response.
- **Adequate Data, Information and Knowledge:** This goal focuses on “ensuring adequate water data information and knowledge is available to support decision making.” It includes action areas for: data collection and management, communication and information, and research partnerships.

- **Effective Governance and Engagement:** This goal focuses on “ensuring water management and decision making processes are coordinated, comprehensive and collaborative.” It includes action areas for: modernizing legislation, engagement and consultation with First Nations and Métis communities, provincial water council, inter-jurisdictional water management and comprehensive planning to enhance decision making.

Together, these form Saskatchewan’s 25-year WSP aimed at long-term management of water resources.

3.3 Identification of Vulnerabilities and Adaptation Actions

For the purposes of listing the key vulnerabilities, key economic sectors dependent on or limited by water resources management were selected as the target sectors. These were: mining, municipal, hydroelectricity and agriculture. The mining sector was divided into subsectors based on phases of mining, including mining exploration and siting, mining development (construction of infrastructure), mining operations (processing and waste management, extractions, etc.), mining closure and remediation. The agricultural sector comprised agricultural subsectors including cattle, grain and perennial pasture-unimproved.

Based on our analyses, a series of 97 vulnerabilities and 198 relevant adaptation actions were identified for the sectors and subsectors identified by the analysis team. Since these were identified independently of the analysis of the water security plan, vulnerabilities and adaptations to issues related to the sector were identified and were not limited to water issues. A few previous analyses, including an ADAPTtool analysis relating to the North American Waterfowl Management Plan in Saskatchewan, were used to develop the list of vulnerabilities and adaptation actions.

The list of references used for this part of the analysis includes:

- ADAPTtool analysis of the NAWMP, Saskatchewan (Swanson & Roy, 2011)
- *HEAT: Hands-on Energy Adaptation Toolkit* (Energy Sector Management Assistance Program, 2010)
- *Climate Impacts on Energy Systems: Key Issues for Energy Sector Adaptation* (Sector Management Assistance Program, 2011)
- *Hydropower Vulnerability and Climate Change: A Framework for Modelling the Future of Global Hydroelectric Resources* (Blackshear et. al., 2011)
- *Adapting to Climate Change: An Introduction for Canadian Municipalities* (Richardson, 2010)
- *Adapting to Climate Change: Implications for the Mining and Metals Industry* (International Council on Mining and Metals, 2013)
- *Climate Change 2007: Impacts, Adaptation and Vulnerability* (Intergovernmental Panel on Climate Change, 2007)
- *Climate Change and Canadian Mining* (Pearce et. al., 2009).
- *Canadian Communities’ Guidebook for Adaptation to Climate Change* (Bizikova, Neale & Burton, 2008)
- *A Feasibility Assessment to Study Societal Adaptation and Human-Health Impacts Under Various Future Climate Scenarios Anticipated in the Canadian Prairies* (Klaver, 2001)

3.4 Analysis Process

Once the vulnerabilities and potential adaptation actions were identified, the project team proceeded to review each of the seven “programs” under the water security plan using the ADAPTtool workbook. This review was then shared with representatives from the Saskatchewan government who are well versed in the development and implementation of the program and can provide feedback on the analysis. Unfortunately, due to provincial flux and change, this review was never done and as a result, this analysis is reflective only of IISD analysts’ inputs and not based on inputs and feedback from policy experts.

3.4.1 Assessing the Ability of Policies to Address Adaptation Needs

When assessing the ability of policies to address adaptation needs, we ranked the levels of support that policy provides for the adaptation and we indicated cases in which the adaptation need is not applicable to the scope of the specific policy. An overview of the vulnerabilities, adaptations and their relevance for the studied policies is presented in Appendix A; a summary of the findings is presented in Figure 1.

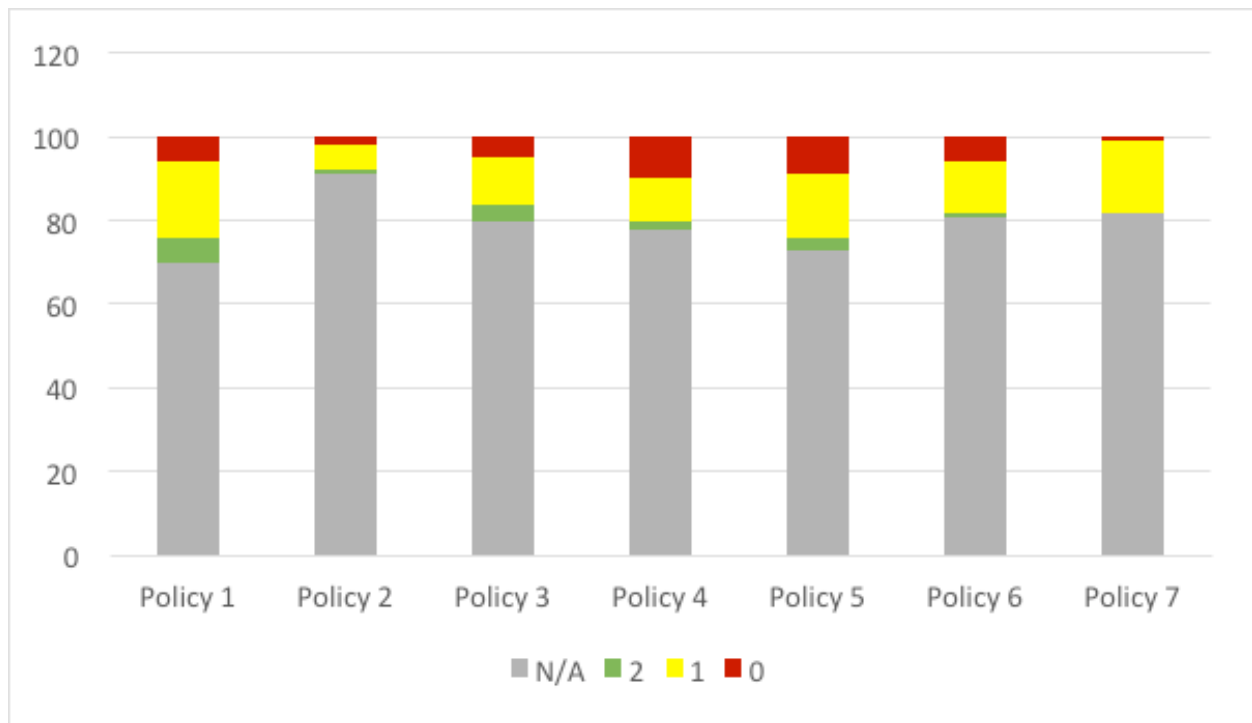


FIGURE 1. OVERVIEW OF THE OUTCOMES OF VULNERABILITY ANALYSES FOR THE SEVEN ANALYZED PROGRAMS

(as a % from n; n= 198 identified adaptation options)

NOTE: Policy 1= Sustainable Supplies; Policy 2= Safe Drinking Water; Policy 3= Protection of Water Resources; Policy 4= Safe Dams; Policy 5= Flood and Drought Damage Reduction; Policy 6= Adequate Data, Information and Knowledge; Policy 7= Effective Governance and Engagement

Our analysis showed that 133 out of the total 198 adaptation actions have no direct program support. Of the 198 total adaptation actions, 65 are supported (directly or indirectly) by one or more of the policies.

3.4.2 Assessing the Ability of Policies to Support Unanticipated Adaptations

Overall, the seven assessed policies performed very well in the series of questions on adaptive capacity. The policies performed well in multistakeholder deliberation during policy development and implementation, in promoting self-organization and social networking, and in promoting a suite of instruments to achieve the policy goals.

The analyzed policies, however, presented only a narrow spectrum of potential instruments mostly focused on regulation, which made it challenging to ensure diversity in terms of supported actors' capacities. Actors' capacities that were focused on economic resources, technology and infrastructure were not well captured and thus for the future we would recommend considering a broader and more diverse set of policies.

The policies on guides were less successful in integrating the impacts of climate change on water in the guides, which could make the policies vulnerable to climate change impacts.

Finally, for all the analyzed policies there are good practices emerging in terms of stakeholder consultations, informal reviews and approaches to decentralization; however, many of these processes, even when applied successfully, are not well documented. This limits their ability to be taken up by other policies and plans in the province and elsewhere. We would recommend developing standardized guidelines on these processes and, if needed, formalizing the procedures so they can be applied and results reviewed regardless of staff movement, or structural and organizational changes.

4.0 Adaptive Policy Conclusions and Recommendations

The overall conclusions and recommendations of the adaptive policy analysis for this suite of policies considered are outlined in the table below. An overview of the analyses and specific conclusions and recommendations for each policy are provided in Appendix B.

Adaptive Policy Questions	Overall Synthesis	Sust. Supplies	Safe Drinking Water	Prot. of water res.	Safe dams	Flood and drought damage reduc	Adequate data, info and knowledge	Effective gov. and engage.
Ability to Support Anticipated Adaptation Needs (score out of 10)	5	4	3	4	4	3	5	5
Are anticipated adaptation actions supported by the policies?	1	1	1	1	1	1	1	1
Is the policy itself vulnerable to the stressor?	1	0	0	0	0	0	2	2
Can the existing suite of policies enhance the capacity of actors within each sector to undertake the anticipated adaptation actions?	1	1	1	1	1	1	1	1
Were foresight methods and multistakeholder deliberation used in the design of the policies?	1	1	0	1	1	1	0	1
Program's Ability to Respond to Unanticipated Events (score out of 10)	6	4	4	5	4	4	5	4
Are foresight methods and multistakeholder deliberation used in the implementation of the policy?	1	1	1	1	1	1	1	1
Does the policy enable self-organization and social networking?	1	0	0	1	0	1	1	1
Is decision making for policy implementation adequately decentralized?	1	1	1	1	1	1	1	1
Is there adequate variety in the suite of policies and programs directed at the policy issue?	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Do the policies have a regular formal policy review?	1	1	1	1	1	0	1	0
Overall Adaptive Policy	1	1	1	1	1	1	1	1

A few key trends are described below:

- The sectors most supported by the 25-year WSP are municipal and hydroelectricity. The least supported sector is the mining sector, specifically the subsectors relating to operations (processing and waste management, extraction, etc.) and closure and remediation.
- A number of sectoral adaptation actions were unsupported by any of the policies selected for this analysis. Examples of such unsupported adaptation actions included those relating to: mining exploration and siting, such as the need for appropriate transportation; others relating to mining operations, such as need for alternative technologies to deal with increased evapotranspiration from waste piles and tailing; increased need for energy

efficiency to cope with increased energy demands in municipalities; health assistance for those affected by impacts of climate stressors, such as West Nile virus; contingency planning, such as insurance backup or regional trading for a decline in hydroelectric power in the short/medium term; and issues such as improved feedlot design for agriculture-cattle to cope with a shortage of feed and feed quality issues.

The overall conclusions and recommendations of the adaptive policy analysis for the suite of policies considered include:

- **Support to Anticipated Adaptation Needs** (planned adaptability). From the identified 198 adaptation actions, 65 were supported either directly or indirectly. The remaining 133 have no direct program support among the analyzed policies. *For next steps it would be beneficial to scrutinize the unsupported adaptation actions to see if any of them are provincial priorities and if any other policies not included in this review might be providing appropriate support.*
- **Policy Stress** (planned adaptability). Five of the seven policies reviewed are vulnerable to climate change impacts since climate change has significant impacts on the hydrologic system. *Incorporating scenario processes and including climate projections explicitly in policy design and implementation is a mitigation factor. In the future, more effort would need to be devoted to exploring feasible levels of water withdrawals under diverse climate change scenarios to reduce the vulnerability of the policies and managed water resources.*
- **Support to Stakeholder Adaptive Capacity** (planned adaptability). Of the six determinants of adaptive capacity (access to economic resources, technology, infrastructure, information/skills, institutions/networks and equitable access to resources), the analyzed policies provided the most support for access to relevant information and skills. The policies fall short in supporting other capacities such as access to infrastructure, technology and broad-based financial resources.
- **Use of Multistakeholder Deliberation** (planned and autonomous adaptability). The policies performed relatively well in terms of ensuring foresight methods and stakeholders' involvement during the planning and implementation phases. In terms of implementation, there is appropriate language built in to enable some deliberative and analytical processes, but these have not yet been implemented. *Creating formalized procedures and guidelines on consultation and use of future scenario processes are recommended for implementation.*
- **Enabling Self-Organization and Networking** (autonomous adaptability). Four of the seven policies perform moderately in this aspect, while three do not have explicit instruments for this purpose. *Building forums for sharing best practice, resources for enabling self-organization and other such elements of enabling self-organization will ensure adaptability to unexpected climate-related challenges in the future.*
- **Decentralization** (autonomous adaptability). As the suite of policies analyzed is not yet implemented, this analysis relies on the wording used in the prospective 25-year plan. The policies within the plan seem moderately decentralized and do devolve authority to watershed groups, regional partners, municipalities etc. as appropriate. To strengthen this aspect, *policies being implemented should ensure that along with devolution of responsibilities to appropriate levels, that resources, capacity and accountability are devolved as well to help improve decentralization for adaptive policies.*
- **Variation in Policy Instruments Employed** (autonomous adaptability). The policy instruments suggested in the 25-year WSP include a range of different kinds of policies, including expenditure, economic, institutional and regulatory. *A key aspect of improving implementation would be to build in review mechanisms to check which instruments are working well and to enhance those that are helping the most in achieving policy objectives.*

- **Formal Policy Review and Improvement** (planned and autonomous adaptability). There seems to be a plan to review the overall, 25-year plan every five years. In addition, five of the seven policies have some explicit mention of review mechanisms. *It is important for the overall functioning of the plan and its components that formal review mechanisms are built in for the plan as a whole and for the seven sub-components and that specific deliberative and analytical approaches are used for such reviews.*

5.0 Lessons Learned

The ADAPTool application in Saskatchewan provided a few important lessons for the adaptive policy analysis process and results:

- Water security was deemed a provincial priority and an appropriate sector for the use of the ADAPTool analysis. During the ADAPTool project implementation, water policies and water management institutions in Saskatchewan were in a state of flux. The 25-year WSP was selected as a viable project focus as an alternative to analyzing existing water management policies and to test the utility of the ADAPTool for analyzing new plans. The 25-year WSP is prospective and includes goals, targets and action items for seven areas of work over the next few years. In practice, the plan was new enough that specific implementation policies and programs were not yet identified—making it more difficult to analyze with the ADAPTool version for existing policies, as many questions focussed on the nature of policy implementation. However, the plan was not a “new policy” just being designed, which would have made it applicable for the ADAPTool for new policies version that was being developed under the NRCan-funded project. In retrospect, the WSP that was selected for analysis was in between being “existing” and “new,” and as a result, the ADAPTool analysis results were deemed unhelpful and untimely by the Saskatchewan government. The important lesson from this experience is that the ADAPTool is not applicable to policies, plans or programs that have already been designed but not yet implemented.
- Provincial representation and involvement in the project and analysis changed during the course of the project. As a result, the analysis did not benefit from the level of involvement realized in previous ADAPTool applications in the province, including review and feedback from provincial experts, which is necessary to produce comprehensive analysis and recommendations from the ADAPTool analysis.
- Despite these shortfalls, the analysis team sees value in using the ADAPTool to more clearly articulate key components of a prospective plan both around sector-specific adaptation needs and policy adaptability. However, for this to be successful, it needs the same collaborative process between tool experts and policy experts that is usually prescribed for the ADAPTool analysis.

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Appendix A: Results of Vulnerability and Adaptation Action Analysis

The seven goals of the water security plan (WSP) are:

- **Policy 1: Sustainable Supplies:** Ensures the sustainability of our surface and ground water supplies
- **Policy 2: Safe Drinking Water:** Ensures our drinking water is safe by protecting supplies from source to the tap.
- **Policy 3: Protection of Water Resources:** Ensures water quality and ecosystem functions are sustained.
- **Policy 4: Safe Dams:** Ensures dam safely meets water supply and management needs.
- **Policy 5: Flood and Drought Damage Reduction:** Ensures measures are in place to effectively respond to floods and drought.
- **Policy 6: Adequate Data, Information and Knowledge:** Ensures adequate water data, information and knowledge are available to support decision making.
- **Policy 7: Effective Governance and Engagement:** Ensures water management and decision-making processes are coordinated, comprehensive and collaborative.

Sector/Subsector	Identified Vulnerabilities	Adaptation Needs	Policy							
			1	2	3	4	5	6	7	
Mining: Exploration and Siting	Roads (permanent and winter): energy drilling on ice cover, wet and fire season issues	Roads: Need to fly in equipment (potential show stopper for projects)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Drilling on ice barges (also potential show stoppers)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Increase in wetlands due to more precipitation: could affect location of exploration and increase regulation	TBD	n/a	n/a	1	n/a	1	1	n/a	
	Increased forest fires: smoke could affect location of exploration	TBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Mining: Development (Construction of Infrastructure)	Roads (access to site transportation of materials): excess water inhibiting access to site	Divert water around new site	1	n/a	n/a	n/a	1	n/a	n/a	
	Water availability and siting: impacts on development location	Preferential sourcing of large water bodies that are unlikely to dry up	1	n/a	1	n/a	1	1	n/a	
		Maximize water recycling	2	n/a	n/a	n/a	1	1	n/a	
		More dry processes	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
		Increased use of ground water	2	n/a	n/a	n/a	n/a	1	n/a	
	Foundation: permafrost (discontinued); identifying permafrost pocket melt; risk of sinking slopes can degrade foundations fails as permafrost degrades; problems with infrastructure	Avoiding water winter roads	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
		Airships	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Climate change impacts on policy regulation: changes to building codes for increased windstorm activity	TBD	n/a	n/a	n/a	n/a	1	n/a	n/a		

Mining: Operations (Processing and Waste Management, Extraction, etc.)	Adequate amount of water for brining: lack of or excess water can delay the process affect recovery periods and increase amount of energy required to bring brine to adequate concentrations (non-metal - sodium sulphate)	Diversion of rivers	1	n/a	1	n/a	n/a	n/a	n/a
		Build storage unit to control water flow from rivers to lakes	1	n/a	n/a	n/a	1	n/a	n/a
		Use dikes to divert water to sections of lake	1	n/a	n/a	n/a	n/a	n/a	n/a
	Passive contaminant reduction systems (e.g. wetland filtration): increased temperatures particularly during the summers can dry up water, re-exposing metals and contaminating ground below (metal)	Built backup systems	n/a	n/a	n/a	n/a	1	n/a	n/a
	Invasive species passive filtration system: more use of natural bogs affecting water management plan; significant drying can lead to erosion; drought increased risk of fires	Built backup systems	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Waste piles and tailing: for water cover (tailing or pit); rise in evapotranspiration and mean annual precipitation can increase, which in turn may reduce risk of drought effects but also increase risk of emergency discharge. In some regions where more seasonal drought is projected increased risk of exposure of tailing to air (metal-Acid Rock Drainage [mARD])	Use alternative cover technology where more negative water balance is projected	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Water treatment: failure and underperformance of other components can be caused by an increase in hydraulic (precipitation sensitive) or chemical loading (temperature sensitive) (mARD)	Hydraulic: increase mine water treatment system capacity (e.g., holding pond flow)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Chemical process modifications: increase use of reagents	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Open pits: increase in extreme precipitation can lead to a rise in flooding of pit and need for pumping treatment or emergency release; changes in chemical loading to pit water (mARD)	Plan for increased use of pits as storage ponds for extreme events; increase treatment of pit water or enhance other diversion structures and storage options	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Underground workings: rise in extreme precipitation can increase flooding of underground can intensify use of pumping and treatment (mARD)	Plan for increased management of mine water (pumping and treatment) or enhance other and water storage options	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Other hydraulic structures (ditches diversions holding ponds): with increase in extreme precipitation, current diversion ditches and channels are undersized, resulting in more infiltration into or contact with acid generating material (mARD)	Increase capacity of diversion and storage structures	1	n/a	n/a	n/a	0	n/a	n/a
	Dams: increase in permafrost degradation and in annual and extreme precipitation can escalate the amount of seepage in the foundation (mARD)	Design for stability in frozen and unfrozen state	n/a	n/a	n/a	0	n/a	n/a	n/a
		Design for no pond at closure (i.e., dry tailings)	n/a	n/a	n/a	0	n/a	n/a	n/a
	Dams: increase in extreme precipitation can cause overtopping in freeboard spillway (mARD)	Provide additional freeboard design with option to increase spillway capacity	n/a	n/a	n/a	0	n/a	n/a	n/a
Heating system: higher temperatures during the winter lowers the cost for operational heating (m)	Use alternative heating system (cost savings)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Cooling system: higher temperatures in the summer could increase operating costs if cooling systems are required	Take longer breaks	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Drink water	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Install cooling system units	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Water intake capacity for mineral processing: changes in regional temperatures and precipitation will affect the amount of water runoff collected in basins or rivers needed for mineral processing	Incorporate climate change models within engineering designs (currently in need of detailed local-level projections as most climate change models are generalized)	1	n/a	n/a	n/a	1	1		n/a
Transportation: road and rail networks are sensitive to extreme weather and changes in temperature and precipitation (e.g., road-related drainage infrastructure and the winter road system)	Flood winter roads to thicken structure	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Monitor ice-sheet thickness with ground penetrating radar	n/a	n/a	n/a	n/a	n/a	1		n/a
	Plow snow off the road to enhance freezing effect	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Restrict hauling to hours of darkness towards the end of the season when the ice sheet is stronger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Transportation: spring flooding can affect transportation of product from mines and access to mine sites	Flooding winter roads to thicken structure	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Monitor ice sheet thickness with ground-penetrating radar	n/a	n/a	n/a	n/a	n/a	1		n/a
	Plow snow off the road to enhance freezing effect	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Restrict hauling to hours of darkness towards the end of the season when the ice sheet is stronger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Buildings: infrastructure built on or near steep slopes are at risk of slopes slumping and sliding as underlying frozen material loses cohesion due to melt as extreme flooding, ice storms, and wind events are projected to increase in some regions	TBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Buildings: buildings erected on thaw-sensitive land could see their foundations settle and shift, and in worst case collapse as permafrost melts increasing maintenance expenditures and causing potential operational delays	Use thermosyphon technology to help keep permafrost cool; ultimately will help maintain structural integrity during permafrost degrading conditions	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Raw tailings: increased temperatures can lead to increased evapotranspiration from tailing ponds potentially exposing raw tailings to subaerial weathering (m)	TBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Potash separation processes: increased temperature can disrupt potassium-sodium separation process	Would require engineered cooling system	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Potash separation processes: increase in precipitation can create an increase in surface runoff and affects self-contained tailing ponds making them less effective (lowers crystallization process)	Include in the design divisions dams to control runoff	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Energy-intensive technology	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Brine injection wells: Process can be impacted by extreme temperature 30 degrees Celsius.	Technology design	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Northern mines: Sensitive to increased forest fire activity and associated smoke.	TBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mining: Closure and remediation	Waste piles and tailing: change in mean annual and extreme precipitation can affect storage and release cover leading to an increase in percolation, erosion or metal uptake; erode the cover. In turn, it affects surrounding vegetation trying to adapt properly (and with increase in temperature, vegetation runs higher risk of forest fires)(mARD)	Increase vegetation (more or new)	1	n/a	1	n/a	n/a	n/a	n/a
		Increase thickness/capacity of storage layer	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Increase erosion resistance	1	n/a	n/a	n/a	n/a	n/a	n/a
	Waste piles and tailing: soil infiltration barrier can be affected by eroded cover and increase percolation caused by increase in mean annual and extreme precipitation (mARD)	TBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Waste piles and tailing: when the protection layer is eroded due to increased precipitation (mean annual and extreme), the synthetic infiltration barrier runs the risk of being damaged (mARD)	Increase erosion resistance of protection layer where required	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Waste piles and tailing: higher permafrost degradation can lead to increased percolation (mARD)	Rock cover thickness or use of alternative cover technology can be increased	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Waste piles and tailing: for water cover (tailing or pit) rise in evapotranspiration and mean annual precipitation can increase MAP, which in turn may reduce risk of drought effects but also increase risk of emergency discharge. In some regions where more seasonal drought is projected increased, there is a risk of exposing tailing to air (mARD)	Use alternative cover technology where more negative water balance is projected	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Waste piles and tailing: higher temperatures can create less entrained ice and less settlement of future reclaimed surface positively affecting the tailings storage	Construct a smaller dam if needed	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Water treatment: failure and underperformance of other components can be caused by an increase in hydraulic (precipitation sensitive) or chemical loading (temperature sensitive) (mARD)	Hydraulic: increase mine water treatment system capacity (e.g., holding pond flow)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Chemical process modifications increase use of reagents	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Open pits: increase in extreme precipitation can lead to a rise in flooding of pit and need for pumping treatment or emergency release; changes in chemical loading to pit water (mARD)	Plan for increased use of pits as storage ponds for extreme events increased treatment of pit water or enhance other diversion structures and storage options	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Underground workings: rise in extreme precipitation can increased flooding of underground can intensify use of pumping and treatment (mARD)	Plan for increased management of mine water (pumping and treatment) or enhance other and water storage options	n/a	n/a	n/a	n/a	n/a	n/a	n/a
ARD biochemical process (i.e., sulphide oxidation rate): increase in rate of sulphide oxidation process due to higher average temperature (other factors considered constant) (mARD)	Implement water treatment or make process modifications to existing water treatment to address increased chemical loading (e.g., increased use of reagents)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

	Native species: Changing climate could affect the types of native species that can be planted and survive on reclaimed land.	Adjust what is considered native to shifting bio regions	1	n/a	1	n/a	n/a	n/a	n/a
	Dams: increase in permafrost degradation and in annual and extreme precipitation can escalate the amount of seepage in the foundation (mARD)	Design for stability in frozen and unfrozen state	n/a	n/a	n/a	0	n/a	n/a	n/a
		Design for no pond at closure (i.e., dry tailings)	n/a	n/a	n/a	0	n/a	n/a	n/a
	Dams: rise in precipitation (mean annual and extreme) can slope foundation due to rising phreatic surface (mARD)	Flatter slop ore buttress required	n/a	n/a	n/a	0	n/a	n/a	n/a
	Dams: increase in extreme precipitation can cause overtopping in freeboard spillway (mARD)	Provide additional freeboard design with option to increase spillway capacity	n/a	n/a	n/a	0	n/a	n/a	n/a
	Dams: change in permafrost degradation can affect settlement of foundation	Provide additional freeboard	n/a	n/a	n/a	0	n/a	n/a	n/a
Municipal	Water shortages (pressure on potable water)	Increased efficiency reduced demand (e.g., through xeriscaping)	2	n/a	0	n/a	n/a	1	1
		Improved infrastructure	2	n/a	0	1	n/a	n/a	1
		New infrastructure to bring in water	2	n/a	0	n/a	n/a	n/a	1
	Water quality	Improved infrastructure	0	2	2	1	n/a	n/a	1
	Flooding	Improved infrastructure (e.g., sewers and culverts dikes)	1	n/a	2	0	2	n/a	1
		Integrated stormwater management plans	0	n/a	1	n/a	1	0	1
		Relocate homes from flood zones	0	n/a	0	n/a	0	n/a	1
		High-resolution mapping of possible future flood levels	1	n/a	0	0	2	2	1
	Infrastructure damage	Improved infrastructure	1	1	2	1	0	n/a	1
	Economic impacts on community (e.g., reduced agricultural income)	TBD	n/a	1	n/a	n/a	1	n/a	1
	Economic impacts of disaster mitigation and response	TBD	n/a	1	n/a	n/a	n/a	n/a	1
	Damage to habitat for vulnerable species affecting the local economy and traditional ways of life in some communities	Habitat protection	1	0	2	n/a	1	0	1
		Diversify livelihoods	1	0	1	n/a	0	0	1
		Education	n/a	0	1	n/a	0	1	1
	Loss of biodiversity as invasive species replace native species	Programs to counter-invasive species	n/a	0	2	n/a	0	0	1
	Increased demand for electricity (due to heat waves)	Renewable energies	1	n/a	n/a	n/a	n/a	n/a	n/a
		Increase efficiency reduce demand	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Improved infrastructure	n/a	n/a	n/a	1	n/a	n/a	n/a
	Health impacts (e.g. West Nile)	Health education	n/a	n/a	n/a	n/a	0	0	n/a
		Health assistance for those in need	n/a	n/a	n/a	n/a	0	n/a	n/a
Distribution of water		1	n/a	n/a	1	1	n/a	1	
Establishing cooling centres at public locations					1	1	n/a	1	
Air quality and other pollutants	TBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Snow load	Revised building codes	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

	Increased snow removal	TBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Increased risk from wildfires	Forest fuel management plan	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Wildfire mitigation requirements for approval of new developments	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Increased urban forest tree losses	Increase tree planting	n/a	n/a	0	n/a	n/a	n/a	n/a
		Change selection of tree species planted	n/a	n/a	0	n/a	n/a	n/a	n/a
	Increased frequency of heat waves and smog episodes	Green planning	n/a	n/a	0	n/a	n/a	n/a	n/a
		Adequate water supply	2	n/a	0	1	1	n/a	1
	Accessibility to roads	TBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hydroelectricity	Decline in hydroelectric power in short to medium term	Changes to hydroelectric power generating facilities	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Create new upstream storage reservoirs	0	n/a	n/a	n/a	0	n/a	1
		Increase capacity of spillway and other structural adaptations	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Optimize current water and power generation management system	0	n/a	n/a	1	n/a	n/a	n/a
		Diversify power generation	0	n/a	n/a	n/a	n/a	n/a	n/a
		Contingency planning such as insurance backup and/or regional trading	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Risk of damage to hydropower operations	Implement engineering adaptations as part of dam rehabilitation	n/a	n/a	n/a	2	n/a	n/a	n/a
		Amend and implement design standards to take account of climate change	1	n/a	n/a	2	n/a	n/a	n/a
	Increased long-term hydropower production	Changes to hydroelectric power generating facilities	n/a	n/a	n/a	2	n/a	n/a	0
	Increased demands for hydro	Improved energy conservation (demand-side management)	n/a	n/a	n/a	0	n/a	n/a	n/a
		Expansion of hydropower facilities	n/a	n/a	n/a	1	n/a	n/a	n/a
		Develop shared understanding of region-wide climate risks to energy security	1	n/a	n/a	0	n/a	1	n/a
		Diversify assets and regional interconnections; explore potential financial risk management products	n/a	n/a	n/a	n/a	n/a	n/a	1
	Increased uncertainty of access to hydro facilities	More reliance on air access	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Investment in alternative means of access (all-weather roads etc.)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Lower water availability	Flexibility in operations and water transportation	1	n/a	n/a	n/a	1	n/a	0
		Structural adaptations	n/a	n/a	n/a	1	1	n/a	n/a

	Hydromet data needs	Collect and analyze hydromet data for existing and potential basins	0	n/a	n/a	0	1	1	n/a
		Require climate change aspects to be considered in designs and upgrades of new and existing facilities	0	n/a	n/a	0	1	n/a	n/a
		Work with other users (particularly in the agriculture sector) to reduce potential future competition for water resources	2	n/a	n/a	0	1	0	1
		Consider insurance upgrade in existing facilities to optimize generation	n/a	n/a	n/a	1	n/a	n/a	n/a
	Competing hydro needs	Collect and analyze hydromet data for existing and potential basins	0	n/a	1	0	1	1	1
		Require climate change aspects to be considered in designs and upgrades of new and existing facilities	1	n/a	1	0	1	n/a	n/a
		Work with other users (particularly in the agriculture sector) to reduce potential future competition for water resources	2	n/a	0	0	1	0	1
		Consider insurance	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Upgrade existing facilities to optimize generation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Collect and analyze data on competing water uses	2	n/a	n/a	n/a	1	1	1
		Identify other users	2	n/a	n/a	n/a	0	0	1
		Raise awareness of competing interests	1	n/a	n/a	n/a	0	1	1
		Work together, particularly with agricultural water users	1	n/a	n/a	n/a	1	0	1
Increased regulatory requirements	Monitor river flows and emissions to ensure abstractions and discharge; do not damage river; avoid negative impacts by considering impact of climate change in design of future assets	2	1	1	0	1	1	1	

	Increased sedimentation and reduced outputs	Monitor and assess sedimentation risk	0	1	1	0	1	0	1
		Rehabilitate existing assets	n/a	n/a	1	1	0	n/a	n/a
		Implement sediment control	n/a	1	1	n/a	0	n/a	n/a
		Work with other stakeholders to manage future risks	1	1	n/a	1	1	n/a	1
		Build desilting gates	n/a	1	n/a	1	n/a	n/a	n/a
		Increase dam heights	n/a	n/a	n/a	1	n/a	n/a	n/a
		Construct smaller dams in upper basins	1	n/a	n/a	1	n/a	0	1
		Adapt capacity to flow regimes (if increased); changes in water reserves and reservoir management	2	n/a	n/a	1	0	1	n/a
		(Re)locate based on changes in flow regime	n/a	n/a	n/a	1	0	2	n/a
	Higher costs of maintaining dam operations security	Monitor impact of climate change on dam security	0	n/a	n/a	0	0	1	n/a
		Consider financial risk management products to spread the risk	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Transmission disruption	Reduce existing technical losses (e.g., insulation of cables)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Underground critical cables	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Amend and implement design standards to take account of climate change for new upgraded infrastructure	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Reduced investment in hydropower	Diversify assets	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Regional interconnections and explore potential financial risk management products		n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Agriculture: Cattle	Shortage of feed; feed quality	Feed storage	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Alternative feed sources (e.g., grain pellets, drought-tolerant crops, shade transition to different livestock types, Texas types of cattle, elk, llamas, bison)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Improve feed quality and efficiency	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Rotational grazing to maintain ground cover (conservation tillage)	n/a	n/a	1	n/a	n/a	n/a	n/a
	Cattle health concerns (e.g., foot rot, heat stress, pregnancy loss, calf loss)	Raising the feedlot design and location	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Prevention	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Maintain feed and water quality	n/a	1	n/a	n/a	n/a	1	n/a
		Pest management	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Drinking water quality	Nutrient management Best Management Practices(BMPs) - riparian fencing	n/a	1	2	n/a	n/a	n/a	n/a
	Water availability	Water storage systems	1	n/a	1	1	2	1	n/a
Length of growing season	Feed and water storage	1	n/a	1	1	1	1	n/a	
	Natural shelter diminished	Shelter design	n/a	n/a	n/a	n/a	n/a	n/a	
		Drought-tolerant vegetation to provide shade	n/a	n/a	n/a	n/a	n/a	n/a	
	Pests	Pest management	n/a	n/a	n/a	n/a	n/a	n/a	
	General	For several of the above, support government policies and regulations or incentives that help facilitate these actions	n/a	n/a	n/a	n/a	n/a	n/a	1
		For several of the above, carry out education to help facilitate these actions (e.g., adoption of BMPs ensuring water quality)	n/a	1	n/a	n/a	n/a	1	n/a

Agriculture: Grain	Access to land (seeding and harvesting)	Grow winter wheat to minimize access issues in the spring	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Water runoff and storage design	1	n/a	1	1	2	n/a	n/a
		Farm machinery design	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Crops for shorter growing season	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Decreased yields	TBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Decreased quality	TBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Disease	Develop disease-resistant crops	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Genetic variety	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Pests (e.g. grasshoppers) and weeds	Integrated pest management	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Research	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Weed control	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Soil quality; soil loss (e.g. erosion salinity compaction)	Implement BMPs to prevent erosion	n/a	1	1	n/a	n/a	n/a	n/a
		Lighter farm equipment for compaction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Equipment modifications	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Maintain ground cover	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Conservation tillage	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Diversity of crops	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Increase rotations	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Multi-year crop loss	Improve insurance mechanisms	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Income diversification	n/a	n/a	n/a	n/a	0	n/a	n/a
	Increase in unseeded acres	TBD	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Length of growing season	Flexibility in operations and water transportation	n/a	n/a	n/a	n/a	1	n/a	n/a
		Equipment to support decisions based on conditions	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Improved insurance mechanisms	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Moisture-tolerant crops	n/a	n/a	n/a	n/a	1	0	n/a
	Reduced bee pollination due to excess moisture	Alternative pollination methods	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Heat stress	Heat tolerant-methods	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Agriculture: Perennial Pasture- unimproved	Access to land	Improved drainage and storage	1	n/a	2	n/a	2	1	n/a
	Loss of vegetation	Prevent overgrazing	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Rotational grazing	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Increase usage of native species (e.g., bison)	n/a	n/a	n/a	n/a	n/a	n/a	1
		Improve pasture management (e.g., controlled burns)	n/a	n/a	n/a	n/a	n/a	n/a	1
	Increased weeds	Weed management including natural control	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Fire	Fire breaks	n/a	n/a	1	n/a	n/a	n/a	n/a
		Stored water	1	n/a	1	1	2	1	n/a
		Community preparedness and fire management plans	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Controlled fires to reduce excess thatch	n/a	n/a	n/a	n/a	n/a	n/a	n/a

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Appendix B: Conclusions and Recommendations for Specific Policies

	1. Sustainable Supplies	
Adaptive Policy Questions	Score	Recommendation
Program's Ability to Support Anticipated Adaptation Needs (Planned Adaptability, score out of 10)	4	
Are anticipated adaptation actions supported by the policies?	1	<p>This goal focuses on "ensuring the sustainability of our surface and groundwater supplies" (Water Security Agency, 2012, p. 4). It includes action areas for: efficient use of water; new water supply infrastructure; water allocation systems; irrigation; climate change adaptation; and water availability study.</p> <p>Of a total of 58 relevant adaptation actions, 60 per cent are indirectly supported by this goal, and 21 per cent are directly supported. The adaptation actions it most directly supports relate to water availability/allocation for mining, municipal, hydroelectricity and agriculture; increased municipal water efficiency and supply; competing water needs related to hydro and other uses; and water availability studies to inform better water supply management.</p> <p>This goal can potentially indirectly support a range of adaptation needs, and these could be examined and enhanced in the development of programs and plans under these goals. These adaptation needs include water for fire management and for brining and cooling in mining; water storage facilities for mining operations; improving infrastructure; maintaining hydropower; managing distribution of water for municipalities; improving flexibility in water supplies, etc. This goal can more actively enable co-benefits related to water quality (relating to water supply management), integrated storm water management planning, relocation from flood-prone areas, placement of hydro reservoirs, optimizing current water and power management systems and ensuring that climate change is actively considered in hydro facility development and management.</p>
Is the policy itself vulnerable to the stressor?	0	Water supplies will be vulnerable with future climate scenarios of floods, droughts and severe storms. A robust water supply management plan with clear indications of competing water users, and strong decisions based on a clear understanding of long-term synergies and trade-offs will be beneficial. Applying scenarios and other foresighting processes to sustainable supply planning can ensure that decisions are made keeping in mind the best science and stakeholder perspectives.
Can the existing suite of programs enhance the capacity of actors within each sector to undertake the anticipated adaptation actions?	1	The sustainable supplies goal provides access to relevant information, skills and institutions/networks, and gives equitable access to resources. However, there is no explicit mention of financial resources, technology and infrastructure access to help meet the needs of this goal. These aspects of adaptive capacity could be enhanced through the development of specific policies and programs under this goal.
Were foresight methods and multistakeholder deliberation used in the design of the policies?	1	It seems that long-term studies and projections are a strong component of this goal. However, these need to be combined with multi-perspective deliberation to ensure that competing users, needs etc. are also adequately reflected.
Program's Ability to Enable Sector Responses to Unanticipated Events (Autonomous Adaptability, score out of 10)	4	
Are foresight methods and multistakeholder deliberation used in the implementation of the policy?	1	All goals seem to propose either foresighting or deliberative processes for implementation. Due to the prospective nature of the plan, the actual implementation of these components is difficult to gauge. A combined and deliberate use of both analytical and deliberative process will benefit the long-term sustainability and impact of the goals and this plan.
Does the policy enable self-organization and social networking?	0	While promotion of best practices is included, ensuring that stakeholders are able to do and learn from it by incorporating mechanisms for peer-to-peer learning, enabling them with financial and other resources could help with unanticipated uncertainties associated with climate change.
Is decision making for policy implementation adequately decentralized?	1	Enhance the coordination with watershed groups, water users and other groups to ensure that implementation is decentralized to the most appropriate level.
Is there adequate variety in the suite of policies and programs directed at the policy issue?	n/a	

Do the policies have a regular formal policy review?	1	There is mention of reviewing specific sub-components, such as existing water use licenses and assessing current water use. All aspects should be formally reviewed either periodically or triggered through performance and indicators and using analytical and deliberative processes.
Overall Adaptive Policy	1	
2. Safe Drinking Water		
Adaptive Policy Questions	Score	Recommendation
Program's Ability to Support Anticipated Adaptation Needs (Planned Adaptability, score out of 10)	3	
Are anticipated adaptation actions supported by the policies?	1	<p>This goal focuses on "ensuring our drinking water is safe by protecting supplies from the source to the tap" (Water Security Agency, 2012, p. 4). It includes actions areas for municipal systems, semi-public systems and private systems.</p> <p>Of a total of 17 relevant adaptation actions, it indirectly supports 71 per cent and directly supports 6 per cent of these actions.</p> <p>The adaptation actions that it most directly supports relate to improved infrastructure for water quality in municipalities.</p> <p>It indirectly supports or enables a number of actions and these could be examined further and enhanced through the development of plans and programs under this goal. These include: improved infrastructure to prevent infrastructure damage and can improve the risks of flooding in municipalities; potentially improved development and maintenance of hydropower facilities; water quality and sedimentation control issues affecting hydro generation, water storage requirements for agricultural water availability and agricultural BMPs for erosion. The goal does not address habitat protection (water quality for environmental needs), diversification of livelihoods and education around water quality. These should be examined in the context of the whole plan in order to ensure that they are addressed through one or more goals.</p>
Is the policy itself vulnerable to the stressor?	0	<p>Drinking water supplies are clearly vulnerable to flooding, resulting nutrient loading and water shortages from droughts. Applying scenarios and other foresighting processes to inform decision-making can ensure the incorporation of science, knowledge and stakeholder perspectives into any decision making. The approach of an integrated, systems approach to safe drinking water planning, including infrastructure management, aquifer protection, and incorporating public, private and semi-private systems is a robust one.</p>
Can the existing suite of programs enhance the capacity of actors within each sector to undertake the anticipated adaptation actions?	1	The safe drinking water goal provides direct or indirect access to all components of adaptive capacity, including access to financial resources, information, skills, infrastructure, and institutions/networks, and gives equitable access to resources.
Were foresight methods and multistakeholder deliberation used in the design of the policies?	0	There is no explicit mention of foresighting processes or multi-perspective deliberations and inputs in this goal. Incorporating foresighting and deliberative processes in the development of component policies and programs will be important for the successful development of this goal.
Program's Ability to Enable Sector Responses to Unanticipated Events (Autonomous Adaptability, score out of 10)	4	
Are foresight methods and multi-stakeholder deliberation used in the implementation of the policy?	1	Implement by using analytical foresight and appropriate multiperspective deliberations processes.
Does the policy enable self-organization and social networking?	0	This critical aspect of coping with unanticipated uncertainty should be incorporated by providing access to sharing resources, financial resources, information for emulating best practices, etc. Specific areas for this could be in the management of private water supplies, by focusing such networking and facilitation to at-risk areas, enabling sharing of best practices among private water supplies, regionally posting test results, etc.
Is decision making for policy implementation adequately decentralized?	1	Enhance the coordination with watershed groups, water users and other groups to ensure that implementation is decentralized to the most appropriate level.
Is there adequate variety in the suite of policies and programs directed at the policy issue?	n/a	

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Do the policies have a regular formal policy review?	1	There is mention of reviewing specific sub-components, such as the current safe water drinking strategy from 2002 and the regulatory regime applying to semi-public systems. All aspects should be formally reviewed either periodically or triggered through performance and indicators and using analytical and deliberative processes.
Overall Adaptive Policy	1	

3. Protection of Water Resources		
Adaptive Policy Questions	Score	Recommendation
Program's Ability to Support Anticipated Adaptation Needs (Planned Adaptability, score out of 10)	4	
Are anticipated adaptation actions supported by the policies?	1	This goal focuses on "ensuring water quality and ecosystem functions are sustained" (Water Security Agency, 2012, p. 4). It includes action areas for: water quality, wetland conservation, ecosystem health and biodiversity protection, and source water protection planning. The adaptation actions most directly supported by this goal include improved infrastructure needs for water quality and flooding vulnerabilities in municipalities, habitat protection and invasive species management in municipalities, nutrient management BMPs in the agricultural sector for drinking water quality management and improved water drainage and storage on agricultural lands through wetland management. This goal partially enables mining exploration vulnerabilities due to increased wetlands, adequate amounts of water for mining processes such as brining, ecosystem management for mining rehabilitation, improved ecosystem health to mitigate shifting vegetation patterns on previously mined lands, integrated stormwater management planning, diversification of livelihoods, and public education around habitats and ecosystem management in municipal regions and data needs relating to competing water uses in hydro development. In the case of hydro development, adaptation actions include: monitoring water extractions and emissions to ensure the maintenance of environmental flows, implementing sediment control and rehabilitating existing assets. In agriculture, they include: improving rotational ground cover, nutrient management BMPs, water storage systems, water runoff design, erosion control and weed control. The goal does not address some municipal needs, including water demand management, improved municipal infrastructure, relocation of homes from flood-prone areas, high resolution mapping of future flood levels, urban fire management and urban water needs for heat waves and smog episodes. For hydro adaptation needs, this goal does not support the need to reconcile competing water needs.
Is the policy itself vulnerable to the stressor?	0	Water quality and ecosystem functions will be affected by floods, droughts and severe storms in our climate change scenario. Applying scenarios and other foresighting processes to inform decision making can ensure the incorporation of science, knowledge and stakeholder perspectives into any decision-making. In addition, ensuring that synergies between this goal and all other ones within this water security plan is important to maximize benefits with the most resource efficiency. Incorporating robust monitoring, reporting and adaptive management systems will be critical to ensuring that ecosystems and biodiversity are protected for long-term sustainability.
Can the existing suite of programs enhance the capacity of actors within each sector to undertake the anticipated adaptation actions?	1	The protection of drinking water goal provides access to financial resources, relevant information and skills, institutions and networks, and gives equitable access to these resources. However, access to relevant technology and infrastructure needs to be enhanced through specific policies and programs developed under this goal.
Were foresight methods and multistakeholder deliberation used in the design of the policies?	1	While multistakeholder deliberation seems to be a part of the source water protection plans, there is no evidence of foresighting methods being used. Using quantitative and qualitative scenarios with inputs from relevant stakeholders would improve the design, impact and sustainability of this goal.
Program's Ability to Enable Sector Responses to Unanticipated Events (Autonomous Adaptability, score out of 10)	5	
Are foresight methods and multi-stakeholder deliberation used in the implementation of the policy?	1	Implement by using analytical foresight and appropriate multi-perspective deliberations processes.
Does the policy enable self-organization and social networking?	1	This goal provides access to information, targets and priorities that can in turn can motivate self-organization. Explicitly targeting self-organization can enhance the use of this tool.
Is decision making for policy implementation adequately decentralized?	1	While Saskatchewan watershed groups are explicitly mentioned for the development of source water protection plans, other agencies could be more actively involved in managing wetlands, biodiversity and other critical aspects of protecting of water resources.

Is there adequate variety in the suite of policies and programs directed at the policy issue?	n/a	
Do the policies have a regular formal policy review?	1	There is mention of reviewing specific sub-components, source water protection plans. All aspects should be formally reviewed either periodically or triggered through performance and indicators and using analytical and deliberative processes.
Overall Adaptive Policy	1	

4. Safe Dams		
Adaptive Policy Questions	Score	Recommendation
Program's Ability to Support Anticipated Adaptation Needs (Planned Adaptability, score out of 10)	4	
Are anticipated adaptation actions supported by the policies?	1	<p>This goal focuses on "ensuring dams meet water supply and management needs." (Water Security Agency, 2012, p. 4). It includes action areas for: dam safety and maintenance, dam benefits and sustainable operation.</p> <p>Of the 45 relevant adaptation actions, this goal indirectly addresses 47 per cent and directly support 7 per cent of these actions.</p> <p>The actions directly supported by this goal include implementing engineering adaptations for rehabilitating dams and improving dam safety and longevity.</p> <p>This goal indirectly addressed a number of adaptation actions and these can be examined further to enhance through plans and programs developed under this goal. These include: including dams explicitly under needs for improved infrastructure for municipal water supply and quality, using safe dams more explicitly to improve power generation management, expanding hydropower facilities, structural adaptations in hydropower generation, rehabilitating existing assets, and explicitly addressing the need for working with other stakeholders and issues related to the risk of increased sedimentation and reduced outputs from hydro facilities. This goal can address agricultural adaptation needs more explicitly by using dams for enhancing water storage.</p> <p>This goal does not address adaptation needs around dam safety relating to damage from permafrost and extreme precipitation in the mining sector, and is not addressed in infrastructure damage mitigation or high resolution mapping of future flood needs in the municipal sector.</p>
Is the policy itself vulnerable to the stressor?	0	The safety, need and effectiveness of dams will be affected by more floods, droughts and more severe storms. Applying appropriate scenarios and other foresighting processes to inform decision making can ensure the incorporation of science, knowledge and stakeholder perspectives into any decision making. Also, synergies between this goal and the others in this long-term water security plan are critical to ensure that trade-offs between energy production and other aspects of ecosystem management and sustainable water management are not compromised.
Can the existing suite of programs enhance the capacity of actors within each sector to undertake the anticipated adaptation actions?	1	The "safe dams" goal provides some access to financial resources, relevant information and skills, relevant infrastructure, and institutions/networks. However, equitable access to these resources needs to be enhanced to ensure that these benefit all the relevant stakeholders or are targeting the most vulnerable sectors.
Were foresight methods and multi-stakeholder deliberation used in the design of the policies?	1	The Saskatchewan 10-year infrastructure plan mentioned in this goal implies long-term thinking and the use of foresighting methods. Combining these with multi-perspective deliberations and inputs would enhance the long-term sustainability of this goal and its component strategies and policies.
Program's Ability to Enable Sector Responses to Unanticipated Events (Autonomous Adaptability, score out of 10)	4	
Are foresight methods and multi-stakeholder deliberation used in the implementation of the policy?	1	Implement by using analytical foresight and appropriate multi-perspective deliberations processes.

Does the policy enable self-organization and social networking?	0	This goal can improve the enabling of self-organization amongst stakeholders by promoting best practices (say through Water Security Agency dams) to follow. Also, sharing the requirements of the Canadian Dam Association can serve as a means to enable self-organization for sharing of best practices.
Is decision making for policy implementation adequately decentralized?	1	While adopting some federal responsibility at the provincial level is mentioned as appropriate, there is little mention of decentralizing some responsibility to municipalities or other jurisdictions if appropriate. Explore regional institutions and decentralize to ensure most appropriate and adaptive management.
Is there adequate variety in the suite of policies and programs directed at the policy issue?	n/a	
Do the policies have a regular formal policy review?	1	There is mention of reviewing a specific sub-component—existing reservoir operating plans—although this should be formalized through time or triggers. All aspects should be formally reviewed either periodically or triggered through performance and indicators and using analytical and deliberative processes.
Overall Adaptive Policy	1	

5. Flood and Drought Damage Reduction		
Adaptive Policy Questions	Score	Recommendation
Program's Ability to Support Anticipated Adaptation Needs (Planned Adaptability, score out of 10)	3	
Are anticipated adaptation actions supported by the policies?	1	<p>This goal focuses on “ensuring that measures are in place to effectively respond to floods and droughts.” It includes action areas for: flood damage prevention and emergency response in developed areas, agricultural drainage, and flooding and drought response.</p> <p>Of the 52 relevant adaptation actions, this goal indirectly supported 56 per cent of the actions and directly supported 12 per cent of the actions.</p> <p>The actions directly supported by the goal include improved municipal infrastructure for flood mitigation and high-resolution flood mapping for forecasting. As well, this goal addresses agricultural adaptation needs by enabling water drainage and storage and improving agricultural access, water availability and water storage for fire.</p> <p>This goal does not support drainage and storage specifically for mining operations. Nor does it explicitly address relocation of homes from flood-prone areas, habitat protection, improvements in infrastructure and education related to municipal flooding and extreme events. Finally, it does not support income diversification from municipal and agricultural issues related to floods, droughts and extreme storms.</p>
Is the policy itself vulnerable to the stressor?	0	The need for flood and drought damage reduction will clearly be more in a future with increased floods, droughts and severe storms. Applying scenarios and other foresighting processes to inform decision making can ensure the incorporation of science, knowledge and stakeholder perspectives into any decision-making.
Can the existing suite of programs enhance the capacity of actors within each sector to undertake the anticipated adaptation actions?	1	The flood and drought damage reduction goal provides some access to financial resources, access to relevant technology, access to relevant information and skills, access to institutions/networks, and gives equitable access to these resources. However, access to relevant infrastructure could be enhanced through policies and programs developed under this goal.
Were foresight methods and multi-stakeholder deliberation used in the design of the policies?	1	There is some mention of long-term studies informing the development of this goal. Explicit use of foresighting methods, combined with stakeholder engagement process focussed on multistakeholder inputs would improve the long-term performance and sustainability of this goal.
Program's Ability to Enable Sector Responses to Unanticipated Events (Autonomous Adaptability, score out of 10)	4	
Are foresight methods and multistakeholder deliberation used in the implementation of the policy?	1	Implement by using analytical foresight and appropriate multi-perspective deliberations processes.

Does the policy enable self-organization and social networking?	1	This goal does provide priorities and targets for stakeholders to self-organize around. Ensuring that information around flood-prone zones and their implications are shared with communities can also enable self-organization. Also, regulations on water allocation to help manage water shortages during droughts may enable water trading or other forms of self-organization.
Is decision making for policy implementation adequately decentralized?	1	Since floods and droughts affect communities, municipalities, farmers and small watersheds, this goal should explicitly seek decentralized institutions that can provide the most relevant feedback on what's working and what's not and help with the development of programs and plans that are effective and impactful.
Is there adequate variety in the suite of policies and programs directed at the policy issue?	n/a	
Do the policies have a regular formal policy review?	0	There is no specific mention of components or goal review. All aspects should be formally reviewed either periodically or triggered through performance and indicators and using analytical and deliberative processes.
Overall Adaptive Policy	1	

6. Adequate Data, Information and Knowledge		
Adaptive Policy Questions	Score	Recommendation
Program's Ability to Support Anticipated Adaptation Needs (Planned Adaptability, score out of 10)	5	
Are anticipated adaptation actions supported by the policies?	1	<p>This goal focusses on "ensuring adequate water data, information and knowledge are available to support decision making." (Water Security Agency, 2012, p. 4).It includes action areas for: data collection and management, communication and information, and research partnerships.</p> <p>Of 17 relevant adaptation actions, this goal indirectly supports 62 per cent and directly supports 5 per cent of these actions.</p> <p>The actions directly supported by this goal include the need for high-resolution mapping of predicted future floods and (re)locating hydro based on state of watershed assessments and reporting.</p> <p>The actions that are indirectly supported by this goal should be examined more closely and enhanced through policies and programs developed under this goal. These actions include: using the wetland inventory to help site mining operations, improving water supply and recycling in mining and enabling increased use of groundwater for mining operations. This goal could also help more actively with water conservation goals and actions in the municipal sector and with education around damage to habitat for vulnerable species. In the hydro sector, this goal can help with improving broad-based understanding of region-wide climate risks to energy security, help collect and report on hydromet data for existing and potential basins, collect and inform competing water uses, report on water systems to minimize environmental damage, help adapt reservoir capacity to changed flow regimes and monitor the impact of climate change on dam security. In agriculture, this goal can more explicitly address the need for maintaining water quality for cattle through monitoring and reporting on water quality, improving general agricultural resilience through public education and helping with water storage opportunities.</p>
Is the policy itself vulnerable to the stressor?	2	While this goal is not directly vulnerable to the stressor, data, information and knowledge can help mitigate and adapt to the anticipated and unanticipated impacts of climate and help with all other goals in this long-term water security plan. This should remain a strong focus of this plan and should be used to draw synergies between the various goals under this plan.
Can the existing suite of programs enhance the capacity of actors within each sector to undertake the anticipated adaptation actions?	1	The goal on adequate data, information and knowledge is largely focussed on access to information and most directly supports this aspect of adaptive capacity. It also enables access to relevant technology and institutions/networks and gives equitable access to these resources.
Were foresight methods and multistakeholder deliberation used in the design of the policies?	0	Neither foresighting processes, not multistakeholder perspectives are indicated in the development of this goal. Using a combination of analytical and deliberative processes will significantly improve the long-term sustainability and impact of this goal.

Program's Ability to Enable Sector Responses to Unanticipated Events (Autonomous Adaptability, score out of 10)	5	
Are foresight methods and multistakeholder deliberation used in the implementation of the policy?	1	Implement by using analytical foresight and appropriate multi-perspective deliberations processes.
Does the policy enable self-organization and social networking?	1	The development of a geographically referenced database to provide government and public access to water-based information, a water information portal and state of watershed reporting will be invaluable tools in highlighting issues for people to self-organize around and should be designed to explicitly facilitate this.
Is decision making for policy implementation adequately decentralized?	1	The collection, reporting and use of data, information and knowledge is inherently a decentralized process and needs to be shared to ensure that data and information is disseminated and used by a broad audience for a range of different purposes. This will improve the long-term sustainability of the goal.
Is there adequate variety in the suite of policies and programs directed at the policy issue?	n/a	
Do the policies have a regular formal policy review?	1	There is mention of developing and publishing regular "state of the watershed report cards" every five years. In addition, other aspects of the goal should be formally reviewed, either periodically or triggered through performance indicators using analytical and deliberative processes.
Overall Adaptive Policy	1	

7. Effective Governance and Engagement		
Adaptive Policy Questions	Score	Recommendation
Program's Ability to Support Anticipated Adaptation Needs (Planned Adaptability, score out of 10)	5	
Are anticipated adaptation actions supported by the policies?	1	<p>This goal focuses on "ensuring water management and decision making processes are coordinated, comprehensive and collaborative" (Water Security Agency, 2014, p. 4). It includes action areas for: modernizing legislation, engagement and consultation with First Nations and Métis communities, provincial water council, inter-jurisdictional water management and comprehensive planning to enhance decision making.</p> <p>Of the 35 relevant adaptation actions, this goal indirectly addresses 94 per cent, and directly addresses 0 per cent.</p> <p>The actions indirectly supported by this goal should be examined and more closely addressed through the programs and policies developed under this goal. These actions in the municipal sector include addressing issues of water shortages, quality, flooding, infrastructure damage, economic impacts, habitat and biodiversity impacts, distribution and supply of water. In the hydroelectric sector, these actions include the need to enhance upstream water storage reservoirs, the need for increased regional interconnections and risk management for increasing hydro needs, working with other water users (particularly agriculture) to deal with competition, the need to collect and analyze hydromet data for existing and potential basins. In the agricultural sector, actions include the need for improving general agricultural resilience by developing appropriate government regulations or incentives to help facilitate these actions, enhanced by inter-jurisdictional and collaborative approaches. The actions not supported by this goal include the need for increased long-term hydro generation and resulting changes to hydro-generating facilities and the need for flexibility in hydro operations due to lower water availability.</p>
Is the policy itself vulnerable to the stressor?	2	While this goal is not directly vulnerable to the stressor, effective governance, partnerships and collaborative approaches can help mitigate and adapt to the anticipated and unanticipated impacts of climate and help with all other goals in this long-term water security plan. This should remain a strong focus of this plan and should be used to draw synergies between the various goals under this plan and partnership-based implementation.
Can the existing suite of programs enhance the capacity of actors within each sector to undertake the anticipated adaptation actions?	1	The "effective governance and engagement" goal is focused on access to institutions/networks aspect of adaptive capacity and supports this well.
Were foresight methods and multistakeholder deliberation used in the design of the policies?	1	While ongoing collaborative processes are explicitly enhanced through this goal, there is no explicit mention of foresighting methods. A deliberate, combined use of both in the design and development of component policies would improve their long-term sustainability and impact.

2013 ADAPTtool APPLICATION

Adaptive Policy Analysis of Saskatchewan's 25-Year Water Security Plan

Program's Ability to Enable Sector Responses to Unanticipated Events (Autonomous Adaptability, score out of 10)	4	
Are foresight methods and multi-stakeholder deliberation used in the implementation of the policy?	1	Implement by using analytical foresight and appropriate multi-perspective deliberations processes.
Does the policy enable self-organization and social networking?	1	This goal explicitly focuses on networks and partnerships and can facilitate self-organization by broadly sharing the decisions, priorities and other results of these forums.
Is decision making for policy implementation adequately decentralized?	1	This goal focusses on networking and collaborative forums and can lend itself very well to informing the most appropriate means of decentralizing the other goals. Identifying the right level of decentralizing should be focussed on ensuring that the feedback mechanisms are robust and can effectively inform design and implementation of the goals.
Is there adequate variety in the suite of policies and programs directed at the policy issue?	n/a	
Do the policies have a regular formal policy review?	0	There is no specific mention of components or goal review. All aspects should be formally reviewed either periodically or triggered through performance and indicators and using analytical and deliberative processes.
Overall Adaptive Policy	1	

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