

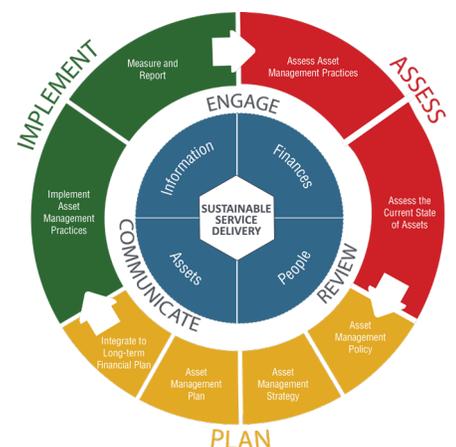
Climate Change and Asset Management



A Sustainable Service Delivery Primer

2019

A companion document to Asset Management for Sustainable Service Delivery: A BC Framework



Climate Change and Asset Management is one of a series of primers developed to expand upon concepts in Asset Management for Sustainable Service Delivery: A BC Framework. Other primers, and the BC Framework are available on the Asset Management BC website: www.assetmanagementbc.ca.

Acknowledgments

The development of this primer was funded by the BC Ministry of Municipal Affairs and Housing. This primer was developed in partnership with the Union of BC Municipalities, Asset Management BC, and the BC Ministry of Municipal Affairs and Housing, and was supported through consulting services provided by Urban Systems Ltd. Special thanks to the following individuals for their guidance and input:

- **Glen Brown**, General Manager, Victoria Operations, UBCM
- **Brian Bedford**, BC Ministry of Municipal Affairs and Housing
- **Cathy LeBlanc**, BC Ministry of Municipal Affairs and Housing
- **Angela Danyluk**, City of Vancouver
- **Emanuel Machado**, Town of Gibsons
- **Mark Boysen**, District of Ucluelet
- **Krista Daniszewski**, Township of Langley
- **Megan Chorlton**, Municipal Insurance Association of British Columbia
- **Dustin Carey**, Federation of Canadian Municipalities

Asset Management Framework and Primers

This primer is one of a series of primers that are provided to expand upon concepts in Asset Management for Sustainable Service Delivery: A BC Framework. While the content in this primer can be used alone, we recommend reading it in conjunction with the Framework. The other primers can also provide additional context and insight into the asset management process.

Primers in this Series

- Climate Change and Asset Management
- Integrating Natural Assets into Asset Management
- The Role of Operations and Maintenance in Asset Management
- Land Use Planning and Asset Management

Who Should Read This?

The Asset Management Framework and Primer series are designed for local government staff. Asset management is an inherently multidisciplinary process. This content is relevant for all departments / disciplines involved in asset management.

Introduction

The 2016 Canadian Infrastructure Report Card found that only 19% of responding local governments formally incorporate climate change adaptation into decision-making. Asset management provides an opportunity to effectively and efficiently respond to climate change through adaptation and mitigation, in the context of sustainable service delivery.

In a 2018 Auditor General report on managing climate change risks, the Provincial government concluded that “climate change is the greatest challenge of our generation.” In British Columbia, climate change means changes in precipitation patterns, temperature, sea levels, and the frequency and intensity of extreme events. These changes are expected to (and in some cases, already have) result in more severe forest fires, floods, and droughts – all of which threatens our communities’ ability to deliver sustainable services.

For many asset intensive services, climate change makes it more difficult to deliver desired levels of service. It amplifies risk and increases costs required to manage these risks. The greatest impacts are to transportation systems, buildings, water management systems, and marine infrastructure. These assets represent the majority of local government infrastructure assets.

Climate change will also impact natural assets, which play a critical role in service delivery for all communities. Wetlands, creeks, deltas, foreshore areas, forests, groundwater aquifers, and other natural assets are all vulnerable to the effects of climate change. However, these natural assets can also provide opportunities to increase community resilience to the impacts of climate change and carbon storage to mitigate changing climate.

Local governments are uniquely positioned to respond to climate change through mitigation and adaptation measures. The BC Climate Action Charter was developed in 2007 and is focused on climate change mitigation. Since then, 186 of 189 local governments have signed on, committing to take action to mitigate climate change and 45 of the signatories have transitioned to carbon neutral operations. This demonstrates that local governments recognize the importance of the issue and need for action; however, the Charter does not comprehensively address adaptation. In addition, local governments face the ongoing challenge of allocating limited resources in the face of many priorities. Asset management provides a systematic approach for evaluating trade-offs between service, cost, and risk for built and natural assets. Integrating climate change mitigation and adaptation into asset management is a very effective and cost-efficient way to implement climate change response. It makes use of existing processes and helps local governments to balance investments, working toward the goal of sustainable service delivery.

Purpose of this Primer

This primer has been written for staff of local governments. It introduces an approach for integrating climate change considerations throughout the asset management process. It provides an overview of the following topics:

- Key concepts
- Why integrate climate change response with asset management
- How to integrate climate change response throughout the AM process

This primer is a companion document to Asset Management for Sustainable Service Delivery, A BC Framework (the Framework) and builds on concepts from the Framework.

Key Concepts

Climate Change

Climate change is a change in global or regional weather patterns that persists for an extended period, usually decades or longer. In the context of mitigation and adaptation planning, climate change typically refers to changes that are attributed to human activity that are in addition to natural climate variability observed over comparable periods of time.

Climatic changes will vary from region to region, but general trends in BC are:

- Hotter, drier summers;
- Warmer winters with increased precipitation;
- Increasing frequency and intensity of storms;
- Increasing intensity of extreme winds; and
- Sea level rise.

These changes create the conditions for increased drought, flooding, forest fires, among other challenges for communities in BC.

Information about climate change impacts for regions throughout BC is available through the Pacific Climate Impacts Consortium.

Impacts of Climate Change on Local Government Infrastructure Systems

Drinking Water

- Drought leading to loss of reliable water sources
- Reduced source water quality and loss of potable water
- Increased water demands leading to system capacity issues and stress on water sources
- Infrastructure damage from fires and flooding
- Water-borne health effects from increased flooding
- Summer taste/odour problems in potable water supply
- Reservoir dam failures

Buildings

- Damage due to forest fires
- Damaged or flooded structures
- Increased indoor air temperature and reliance on cooling systems, increased energy use
- Reduced service life and functionality of components and systems

Land Transportation

- Soil instability, ground movement, and slope instability, leading to road damage from erosion, landslides, and embankment failure
- Increased frequency/severity of thermal cracking, rutting, frost heave, and thaw weakening
- Capacity of culverts and storm sewer systems more frequently exceeded, leading to road washout
- Causeways, bridges, and low-lying roads have a high risk of being inundated or damaged

Wastewater

- Increased inflow and infiltration leading to system capacity more frequently exceeded (leading to surface surcharging and basement flooding)
- Changes to wastewater effluent characteristics
- Buildings, tankage, housed process equipment affected by flooding

Drainage and Flood Protection

- System capacity more frequently exceeded
- System failure (drainage systems and dikes) causing damage to property and other infrastructure systems
- Increased energy costs due to increased pumping

Parks

- Drought leading to increased stress on vegetation and potential water restrictions for built water features
- Loss of trees due to drought and windstorms
- Increased temperatures leading to increased demand on parks with water features (natural or constructed)
- Changes to water quality of adjacent lakes or rivers impacting recreational use
- Increased erosion and decreased slope stability

Solid Waste Management

- Increased odour and pests during warmer summers and winters
- Increased landfill leachate during winter months
- Increased risk of flood to critical infrastructure or collection routes
- Reduced water available during summer months for wet site management practices

Cascading Impacts

The table on the previous page summarizes potential impacts to major infrastructure systems due to climate change. While these impacts alone can be significant to a community, infrastructure systems are interconnected and interdependent. This means that impacts to one system may impact the ability of another system to perform. Cascading impacts will often involve multiple infrastructure-owning organizations (local governments, provincial government, power and gas utilities, First Nations, etc.), further complicating efforts in emergency planning or response. Some examples of cascading failures are:

- Reservoir dam failure, leading to loss of a community's drinking water source, damage to downstream land and infrastructure (bridges, trails, pipes, etc.).
- Storms causing power outages, leading to loss of communication and control systems and malfunction of other infrastructure systems. May lead to impacts like flooding and further damages, resulting in disruption of business continuity and reputational damage.
- Drought leading to reduced capacity of water sources, limiting water available for fire suppression during heightened risk of wildfire.
- Flooding or washout of a major highway servicing a community restricts the transportation of water treatment chemicals into the community.

Climate Change Response

Climate change mitigation strategies are those that reduce the magnitude and rate of climate change, typically by reducing greenhouse gas emissions.

Climate change adaptation strategies are those that increase the resilience of a community to the impacts of climate change.

Recovery strategies are those that wait for the impacts of climate change to happen, and then react. These actions typically involve remediation of damages or moving towards lower levels of service as a choice.

EVALUATING THE COSTS OF ACTION

"...it would cost approximately \$9.5 billion to address sea level rise and seismic upgrades to dikes along the Metro Vancouver shoreline and the Fraser River shore. In comparison, a major Fraser River flood could cost between \$19.3 and \$22.9 billion"

Managing Climate Change Risks: An Independent Audit, BC Auditor General, 2018

Local government climate change response should include a combination of these three approaches. Asset management processes can help to develop an effective response by evaluating impacts on services, risks, and costs and the trade-offs inherent in different response options.

Assessing Vulnerability and Risk

Assessing vulnerability of infrastructure is an important step in planning for adaptation and there are tools available to support this process. These tools and processes commonly use some key terms:

- **EXPOSURE** refers to whether infrastructure systems will be impacted in some way by a climatic change.
- **SENSITIVITY** is an evaluation of how much the climatic change will impact the functionality of the infrastructure system.
- **ADAPTIVE CAPACITY** is the ability of the infrastructure system to adjust to the impacts of the climatic change.
- **VULNERABILITY** of infrastructure and natural assets that are exposed to climate change is the product of both sensitivity and the adaptive capacity of the system.
- **RISK** is the product of the likelihood of an impact occurring (related to the vulnerability of a system) and the consequence of that impact on service delivery.

Why Integrate Climate Change In Asset Management?

1. The purpose of asset management is sustainable service delivery, and climate change is a threat to sustainable service delivery.

The purpose of asset management is sustainable service delivery: the ability to deliver services to the current community in a way that does not compromise the needs of future generations. Sustainable service delivery requires continuously balancing trade-offs between service, risk and cost. Climate change introduces impacts that may:

- Amplify the risk of asset failure and reduce asset service life through added and/or compounding stress on existing infrastructure or cascading impacts of other infrastructure systems.
- Reduce the level of service existing infrastructure systems can provide.
- Increase the cost of managing risks and delivering the same level of service.

2. Asset management practices can increase a community's resilience to the impacts of changing climate *and* improve response to natural disasters.

Proactive risk management, adequate maintenance of engineered and natural assets, and timely asset improvements or renewal can improve the overall resilience of asset systems to impacts of climate change, whereas not keeping up with these requirements can make systems more vulnerable to climate change. Identifying and assessing the services provided by natural assets can improve understanding of how these natural assets will perform under climate change scenarios – often providing greater adaptive capacity than engineered assets.

CHANGING DESIGN CONDITIONS

It is not uncommon for critical infrastructure components to have expected lifespans of 50, 80, or even 100 years. Impacts of climate change are observable today and will continue to increase as years pass—adding up to substantial changes throughout the life of an asset. If communities do not consider climate change when designing new or renewed assets, they are essentially reducing the expected life of the asset right from the beginning. Considering changing climate in the design of new or renewed infrastructure protects the investments that communities are making by enabling future generations to use the full design life of the asset.

Asset management practices also help local governments to have current and accessible information about assets and services. This information is critical in times of emergency and can improve the timeliness and effectiveness of responses to any natural disaster or extreme weather event, not just those caused by changing climate.

3. Asset management decisions will impact climate change.

The decisions about the way assets are planned, designed, constructed, operated, maintained, and decommissioned represent some of the most substantial opportunities a local government has to reduce greenhouse gas emissions, mitigate climate change, and meet Climate Action Charter commitments. The most obvious opportunities to reduce emissions are during the planning and design stages of new or renewed assets (including up front at land use planning stages), although there are also opportunities for reducing emissions throughout the rest of the asset lifecycle.

4. Asset management helps local governments make decisions about climate change response in the broader context of local government service delivery and other priorities.

To address impacts to sustainable service delivery, important decisions will need to be made to respond to climate change:

- Where should we invest in adaptation? How does the current state of our assets affect climate risk? Where is it worthwhile to make capital or operational investments to manage risk and increase resilience? Where should we accept changes to levels of service?
- When is the right time to invest in adaptation? How can we minimize investment costs while maintaining levels of service and managing risk, especially when balancing many priorities? How do climate risks compare to other risks, and are there cost-effective ways we can address both?
- How do we act to mitigate climate change? When considering asset investments, what investments will our organization make to reduce greenhouse gas emissions? What other benefits can we realize from these investments?

These decisions can't be made in isolation; they need to consider the broader context, goals, and priorities of the community. Some actions may increase a community's resilience to climate change, but they may impact other service delivery goals. Asset management is a process of making decisions about infrastructure and natural assets, including decisions about climate change response, that considers the broader context and priorities of the community.

5. Integrating climate change response into asset management is a practical approach to managing liability risks.

The impacts of changing climate are leading to potential increases in the exposure of local governments to liability risk, particularly due to flooding from increasing precipitation and frequency of extreme weather events. Asset management helps to manage liability risks in a few ways:

- Establishing clear, documented, approved, and published levels of service can provide a policy defense to local governments. Policy defense can protect against negligence claims (not nuisance claims).
- Having and following an inspection and maintenance program that considers response in extreme weather events is part of demonstrating a reasonable standard of care to protect against negligence claims.
- Asset management information and processes support the evaluation of trade-offs between the costs of providing a higher level of service (i.e. system with greater capacity) and the risks (i.e. increases in flood damages and claims).

Asset management is a process of continuous improvement—so is building resilience to changing climate. Asset management practices do not need to be sophisticated to begin to incorporate climate change considerations.

UNDERSTANDING FLOOD LIABILITY

The two main bases for local government liability due to flooding are **nuisance** and **negligence**.

Nuisance refers to unreasonable interference with property rights. If stormwater being collected in a drainage system owned by the local government escapes the system and enters private property, the local government may be exposed to a nuisance claim. If the flood arises from breakdown or malfunction of the sewer or drainage system, BC local governments have statutory immunity to nuisance claims. However, the inundation of a system beyond its design capacity does not constitute a breakdown or malfunction, and in this situation, local government may still be liable for flood damages.

Negligence is failing to take a reasonable standard of care, including correcting known problems, planning for future development, adequately maintaining the system, and providing a system with adequate design capacity. While the standard of care applicable to the design of infrastructure is likely to be the standard of care at the time of the design, there is a possibility that claim decisions may include considerations about changing climate.

How to Integrate Climate Change Response in Asset Management

Where to start

The following pages outline how to integrate climate change response throughout the process of asset management, however, there are two foundational elements that should be in place before you begin:

- 1. A basic asset inventory.** This inventory will be valuable for screening climate vulnerabilities and identifying approaches to adaptation. The inventory does not need to be complete or fully accurate to be useful. It should list the assets that are most critical to core service delivery (or, in other words, the assets that would have the biggest impact on service delivery if they failed), their approximate age, estimated remaining life, and location (ideally in a mapped form). Anecdotal information about asset condition and age is sufficient for getting started.
- 2. A basic understanding of anticipated climatic changes** in your community, including changes to temperature, precipitation, and sea level rise. The Pacific Climate Impacts Consortium (PCIC) has several tools and resources available that are excellent sources of information about regional climate impacts. The Plan2Adapt tool is a useful place to start.

Integrating climate change response with the BC Asset Management Framework



ASSET MANAGEMENT PRACTICES

Assess AM practices to identify the current level of integration, gaps, and opportunities for increasing climate change integration throughout the AM Process.

ASSETS

Assess the vulnerability of assets to climate change and lifecycle emissions of assets.

ASSET MANAGEMENT POLICY

Formalize the organization's commitment to integrating climate change response and AM in the AM policy.

ASSET MANAGEMENT STRATEGY

Identify the approach the organization is taking to integrate climate change mitigation, adaptation, and asset management.

ASSET MANAGEMENT PLAN

Identify specific impacts to levels of service, service delivery risks, actions for managing risks (capital and operational), and costs. Include considerations for adaptation and mitigation.

LONG TERM FINANCIAL PLAN

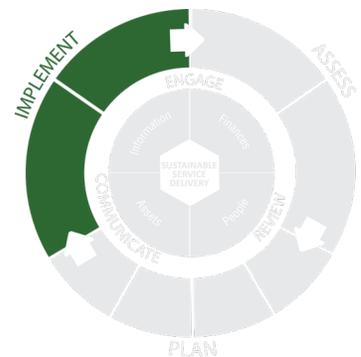
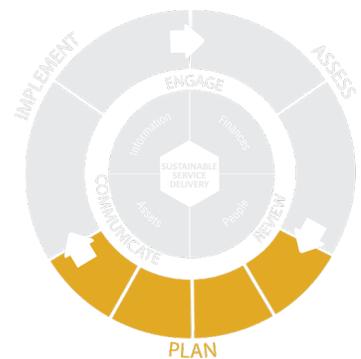
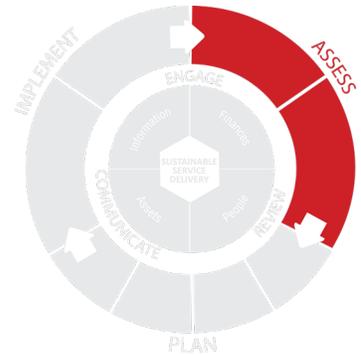
Update the long term financial plan to include considerations of climate change mitigation and adaptation. Include funding strategies and potential risks to funding strategies.

IMPLEMENT ASSET MANAGEMENT PRACTICES

Implement AM practices with integrated climate change response.

MEASURE AND REPORT

Measure the resilience of the organization and services to changing climate. Reporting to staff, council, and the public.



ASSESS

ASSESS ASSET MANAGEMENT PRACTICES

Assess AM practices to identify the current level of integration, gaps, and opportunities for increasing climate change response integration throughout the AM Process.

As signatories to the Climate Action Charter, most local governments in BC are taking actions to mitigate climate change. Additionally, some local governments have begun to plan for climate change adaptation. Assessing asset management practices with a climate response lens highlights how well these actions are integrated with ongoing asset management practices and identifies gaps for improvement.

Activities

AssetSMART 2.0 is a tool for a self-assessment of an organization's general AM practices under the four core elements of asset management: people, assets, information, and finances. One of the 21 assessment categories is related to climate change. This assessment category can be used to identify high-level gaps in integrating climate change and asset management. A more detailed assessment can be conducted by applying a climate lens to the full AssetSMART 2.0 assessment tool (or other asset management process assessment tool).

ASSESS THE CURRENT STATE OF ASSETS

Assess the vulnerability of assets to climate change and lifecycle emissions of assets.

The purpose of assessing the vulnerability of assets is to identify how climate change will impact level of service, risk, and cost. Doing detailed assessments may require technical analysis and more data about assets and climatic changes than is initially available. Starting with a high-level assessment or screening will add value to decision-making. The level of detail can be increased over time as needed to inform specific decisions.

BUILDING AWARENESS ABOUT THE IMPACTS OF CLIMATE CHANGE

Staff, council, and members of the public may not be aware of various ways climate change could impact the local government's ability to deliver services. Engaging staff to assess the current state of AM practices and the current state of assets can be a very effective way of raising awareness, while adding a lot of valuable information to the process of identifying vulnerabilities and improving asset management practices.

Information about vulnerabilities should be shared with council or the board and the public, and they should be engaged in evaluating the trade-offs that are inherent to the possible ways the local government can adapt.

The process of engaging staff, council or the board, and the public will require building basic awareness of climatic changes and the impacts of these changes on the community. This will take time but will result results that are understood and can be effectively acted upon.

Activities

- Identify the expected climatic changes for the community.
- Identify the potential impacts of these climatic changes to the community (e.g. decrease in summer precipitation and longer dry spells may cause drought).
- Assemble an interdisciplinary team to conduct the vulnerability assessment. The size and membership of the team will vary by organization, but it should have people who understand asset operations, asset planning and engineering, finance, and environment.
- Identify which asset systems will be exposed to the various climatic changes.
- Identify asset vulnerabilities to climatic changes by assessing asset system sensitivity and adaptive capacity. To do this, consider the current level of service of the asset system, how the level of service would change if the climatic impact occurred, and what would be required to respond to the impact if it happened.
- Conduct an emissions inventory to identify annual emissions of existing assets.

PLAN

ASSET MANAGEMENT POLICY

Formalize the organization's commitment to integrating climate change response and AM in the AM policy.

An asset management policy can direct staff to integrate asset management with climate change response considerations. The policy may generally identify where climate change response and asset management should be integrated throughout the asset lifecycle. Specific details of how climate change response and asset management are integrated will be in the AM strategy or plan, not the AM policy.

Activities

Review and update the Asset Management Policy to integrate climate change mitigation and adaptation.

ASSET MANAGEMENT STRATEGY

Identify the approach the organization is taking to integrate climate change mitigation, adaptation, and asset management.

Strategies can establish the context of why climate change needs to be considered by identifying the impacts of changing climate on sustainable service delivery and assets by service area (including natural assets). Asset management strategies should identify specific objectives and goals related to increasing community resilience to climate change through asset management, and the approach to meeting those goals.

Activities

- Identify expected local climatic changes and how these changes will impact asset systems and sustainable service delivery (at a high-level).
- Identify links between planning, land use decisions, asset management, and climate change mitigation and adaptation.
- Define goals and objectives for improving community resilience to climate change through asset management.

EXAMPLE CLIMATE CHANGE RESPONSE STRATEGIES

Climate change response strategies should be incorporated throughout the asset lifecycle, through integration with bylaws, policies, planning, standards and guidelines, design, asset lifecycle planning, operations and maintenance planning, and emergency planning. Below are example climate change response strategies that can be implemented through asset management. These strategies may be referenced in the policy and then identified at appropriate levels of detail throughout the strategy and plans.

CLIMATE CHANGE MITIGATION

- Considering lifecycle emissions during asset procurement (i.e. emissions released throughout the lifecycle of the asset through manufacturing, transportation, construction, operations and maintenance, decommissioning, and disposal)
- Supporting low-emissions fleet and transportation options
- Improving energy efficiency of new facilities by optimizing building orientation and design
- Improving energy efficiency of existing facilities by retrofitting infrastructure components as they are scheduled for renewal
- Protecting and/or enhancing natural assets through planning and land policies and bylaws

CLIMATE CHANGE ADAPTATION

- Increasing capacity of infrastructure to accommodate changes in demand patterns (e.g. increasing capacity of drainage conveyance systems, increasing drinking water storage capacity, reducing inflow and infiltration in sanitary sewer systems, etc.)
- Increasing system redundancy for system resilience (e.g. providing backup access roads, water sources, etc.)
- Adapting operations and maintenance practices to improve resilience (e.g. changes to timing and frequency of culvert and pipe cleaning, removing silt from retention structures, keep trees trimmed to reduce risk to overhead power lines and above ground infrastructure)
- Updating risk assessments and long-term capital plans for asset replacement to include asset capacity and vulnerability, not just asset age or condition
- Incorporating natural assets in asset management processes to understand the interactions between built and natural assets, and how climate change will impact the interacting systems
- Designing and managing community infrastructure to be multi-purpose (e.g. parks that can hold flood water, roads that act as flood barriers)

- Outline desired approaches for integrating climate change response into asset management practices, plans, and decisions.

E.g. consider lifecycle emissions in the design of new assets or complete a climate risk assessment for all major service areas.

- Outline approaches for integrating climate change response with risk management, levels of service, and financial planning.

E.g. the organization's risk management framework should identify how climate vulnerabilities and risks will be assessed and prioritized along with risks to assets and services caused by other hazards.

- If required, identify strategies to improve understanding of expected local climatic changes and the impacts of these changes on assets and services.

ASSET MANAGEMENT PLAN

Identify specific impacts to levels of service, service delivery risks, actions for managing risks (capital and operational), and costs. Include considerations for adaptation and mitigation.

Asset management plans document the activities required to deliver the desired levels of service, manage risks, and contain costs over time. These plans provide an opportunity to consider climate change impacts in the context of other asset risks, costs, and service objectives, and develop an integrated and cost-effective set of actions.

REALIZING CO-BENEFITS

Mitigation and adaptation strategies may have other benefits beyond the reduction of greenhouse gases and improved community resilience:

- Energy efficient designs can lead to decreased energy costs and increased resilience to future changes in energy costs.
- The protection and enhancement of natural assets for adaptation may also provide climate change mitigation benefits and lead to improved aesthetics and recreation opportunities.
- Retrofitting facilities to be energy efficient can improve the quality of the indoor environment for users.

All the benefits of a potential mitigation or adaptation strategy should be considered when deciding to implement the strategy.

Activities

- Clarify desired levels of service. Using identified asset vulnerabilities, categorize how climatic changes will impact the ability to deliver levels of service. Some potential impacts include:
 - Decreased asset condition due to increased wear and tear
 - Assets reaching capacity before the end of design life
 - New hazards introduced by other asset systems failing
 - Increased maintenance requirements
 - Increased system stresses or loads due to extremes in temperature, precipitation, or wind
 - Increased risk of fire or flooding
 - Increased risk of power outages
- Identify opportunities to manage climate risk through other asset management activities (e.g. when replacing an asset due to poor condition or capacity, design the replacement to reduce climate risk).
- Evaluate the costs and benefits of available adaptation approaches. For adaptation approaches that have impacts on the community or other stakeholders, this stage will require public engagement. Time and resources should be allocated to effectively and meaningfully engage stakeholders.
- Select the desired approaches and levels of service. Note that adaptation and mitigation actions can have other benefits. Approaches should be designed to maximize benefits, and this should be considered when evaluating costs and benefits.
- Identify opportunities for reducing emissions through other asset management activities (e.g. choosing energy efficient or low emissions models when replacing assets).
- Identify operating and maintenance activities that will be implemented to reduce climate risk and mitigate climate change.

LONG-TERM FINANCIAL PLAN

Update the long-term financial plan to include considerations of climate change mitigation and adaptation. Include funding strategies and potential risks to funding strategies.

When incorporating adaptation and mitigation actions it is important to recognize where climatic changes may impact costs of service delivery and the approaches to funding those costs.

Activities

- Evaluate the costs of delivering current levels of service and managing risks without investments in adaptation. Use these costs to evaluate and prioritize adaptation actions.
- Identify the overall increased cost of responding to changing climate, and ways to minimize and manage these costs (mitigation, collaboration with other local, provincial, federal, or First Nation governments, partnerships with other organizations, etc.).
- Identify sources of revenue and funding.
- Identify strategic level risks to funding related to climate change (e.g. areas that rely on agriculture for tax base may see some instability, areas with water-intensive industries may see instability, etc.).

IMPLEMENT

IMPLEMENT ASSET MANAGEMENT PRACTICES

Implement AM practices with integrated climate change response.

This is about putting plans into action. Appropriate communication and engagement with key stakeholders, such as staff, council or board, and the public, through the earlier stages will help with successful implementation.

Activities

- Update capital plans to align with asset management plans.
- Update operations and maintenance plans to align with asset management plans.
- Develop an approach to building the desired skills and knowledge within the organization to improve integration of climate change and asset management.
- Improve information about assets and climatic impacts where appropriate, to inform decision-making.

MEASURE AND REPORT

Measure the resilience of the organization and services to changing climate. Report to staff, council or the board, and the public.

Measuring and reporting on successes and challenges is critical to learning and maintaining momentum with climate change adaptation and mitigation. Measures related to climate change response can be integrated with other reports related to sustainable service delivery. Examples of platforms for sustainable service delivery reporting include annual reports, asset management maturity and progress reports, service delivery or infrastructure report cards or dashboards.

Activities

- Include indicators related to climate change resilience in overall set of progress measures.
- Evaluate progress against actions identified in AM Strategy and AM Plan.
- Track changes in AM practices using an assessment tool like AssetSMART 2.0.
- Track changes in overall service sustainability using a tool like Sustainable Service Assessment Tool.
- Communicate results with staff and council or the board.
- Communicate messages about the community's climate resilience to the public through tools such as the annual report. Leverage other engagement opportunities to include resilience messages.

COMMUNICATE, ENGAGE, REVIEW

The importance of continuous communication, engagement, and review cannot be overstated. Communication and engagement about the integration of climate change and asset management is critical to raising awareness with decision-makers and asset operators to understand climate change, impacts to sustainable service delivery, and what can be done to effectively and efficiently manage these impacts. Key stakeholders (staff, council or board, and the public) can also provide important information about asset operations and other risks, organizational priorities, community values, and willingness to pay.

Many organizations and communities have people who are knowledgeable about climate change and passionate about mitigation and adaptation. Integrating climate change with asset management may bring these people in as new champions who support asset management, further benefiting the development of asset management practices.

Helpful Resources

Asset Management for Sustainable Service Delivery, A BC Framework

Developed by UBCM, the framework for asset management is a guide through the circular process model for service, asset, and financial sustainability. The framework is scalable to any community size and capacity with a focus on desired outcomes and reflecting current best practices rather than specific methodologies.

<https://www.assetmanagementbc.ca/framework/>

Auditor General Report

The Managing Climate Change Risks: An Independent Audit (February 2018) takes a comprehensive look the government's management of risks associated with climate change and takes a deeper look into the impacts of climate change within the British Columbian context.

<http://www.bcauditor.com/pubs/2018/managing-climate-change-risks-independent-audit>

Climate Atlas of Canada

The Climate Atlas of Canada is a resource to better understand and learn about climate change through a combination of climate science, mapping and storytelling that localizes the global issue of climate change through a multimedia and interactive website.

<https://climateatlas.ca/>

Engineers and Geoscientists British Columbia (EGBC) - Climate Change Information Portal

The EGBC Climate Change Information Portal provides adaptation tools and resources to support Engineers and Geoscientists in British Columbia integrate climate change considerations into their practice. The resource covers flood hydrology, introductions to climate change (and adaptation), collaboration networks, guidelines, adaption case studies, and more.

<https://www.egbc.ca/Practice-Resources/Climate/Climate-Change-Information-Portal>

Local Governments for Sustainability (ICLEI) – Building Adaptive and Resilient Communities (BARC)

The BARC program is a comprehensive and collaborative means to develop and implement an adaptation plan for the protection of local communities. For local governments, the program offers an ICLEI liaison, research assistance, expert input, planning guidance, implementation assistance, progress reports, stakeholder outreach, public recognition, and more to help respond to the impacts of climate change.

<http://www.icleicanada.org/programs/adaptation/barc>

Pacific Climate Impacts Consortium (PCIC)

The Pacific Climate Impacts Consortium (PCIC) provides information on the physical impacts of climate variability and change in the Pacific and Yukon Region of Canada. The PCIC provides data portals, analysis tools (e.g. Plan2Adapt, regional analysis tools, and seasonal anomaly maps), and other resources that include courses called Climate Insights 101, various publications and software.

<https://www.pacificclimate.org/>

Public Infrastructure Engineering Vulnerability Committee (PIEVC)

The PIEVC provides a protocol for informed engineering judgements on the threat of climate change to public infrastructure. The PIEVC Engineering Protocol reviews historic climate information to help predict the nature, severity, and probability of climate changes and events in conjunction with an individual infrastructures design, operation and maintenance to establish the adaptive capacity and illustrate any needed adjustments.

<https://pievc.ca/about-pievc>

References

BC Auditor General, "Managing climate change risks: an independent audit," Office of the Auditor General of British Columbia, Victoria, BC, Canada. February 2018. Accessed on: August 13, 2018.

<http://www.bcauditor.com/pubs/2018/managing-climate-change-risks-independent-audit>

"Preparing for climate change: an implementation guide for local governments in British Columbia," D. Carlson, West Coast Environmental Law, Vancouver, British Columbia, Canada. ISBN 978-0-919365-32-2, October, 2012. Accessed on: August 13, 2018.

https://www.wcel.org/sites/default/files/publications/WCEL_climate_change_FINAL.pdf

"Informing the future: Canadian infrastructure report card," Canadian Infrastructure, 2016. Accessed on August 13, 2018.

<http://canadianinfrastructure.ca/en/index.html>

"Climate change adaptation and canadian infrastructure: a review of the literature," J. Boyle, M. Cunningham, & J. Dekens, International Institute for Sustainable Development (iisd), Winnipeg, Manitoba, Canada. November, 2013.

"Asset management for sustainable service delivery: a BC framework" Union of British Columbia Municipalities. Canada. Accessed on: August 13, 2018.

<https://www.assetmanagementbc.ca/framework/>

"Pan-Canadian framework on clean growth and climate change: Canada's plan to address climate change and grow the economy," Department of Environment and Climate Change Canada. 978-0-660-07023-0 ISBN, 2016. Accessed on: August 13, 2018.

<http://publications.gc.ca/site/eng/9.828774/publication.html>

"B.C. Climate Action Charter," Province of British Columbia, Union of British Columbia Municipalities, & Signatory Local Governments, Government of British Columbia, 2007. Canada. Accessed on: August 13, 2018.

<https://www2.gov.bc.ca/gov/content/governments/local-governments/climate-action/climate-action-charter>

"Climate change 2014: synthesis report," R.K. Pachauri, & L.A. Meyer (eds.), Intergovernmental Panel on Climate Change (IPCC) with contribution from Working Groups I, II, and III to the Fifth Assessment Report. Geneva, Switzerland. 2014. Accessed on: August 13, 2018.

<https://www.ipcc.ch/report/ar5/syr/>

"Status of asset management in British Columbia: Results from the 2016 gas tax fund asset management baseline survey," Union of British Columbia Municipalities (UBCM). October, 2017. Accessed on: August 13, 2018.

https://www.assetmanagementbc.ca/wp-content/uploads/UBCM_2016_AssetManagementReport_FINAL.pdf

"Reducing liability exposure for local governments," T. W. Barnes, & M. Z. Sherkat, Municipal Insurance Association of British Columbia (MIABC). September, 2016. Accessed on: August 13, 2018.

http://www.ubcm.ca/assets/Convention/2016/2016~Documents/Tue-OakBay_2-Reducing%20Liability%20Exposure.pdf