FINAL

# Climate Change Adaptation Tools and Resources Training Program Options

Submitted to:

**Government of Newfoundland and Labrador**
**Office of Climate Change and Energy Efficiency**

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## EXECUTIVE SUMMARY

Between December 2015 and February 2016, Amec Foster Wheeler met with stakeholders to discuss usage of climate change adaptation tools and resources made available by the Province of Newfoundland and Labrador. As part of this engagement process, stakeholders were asked for recommendations for a training program aimed at increasing the uptake of the tools and resources. This report synthesises that stakeholder input and presents options for a potential training program.

A four component training program designed to meet the needs of a broad range of stakeholders is recommended. After advertising through existing channels the training would begin with a series of General Awareness Sessions offered at different locations across the province. These relatively short sessions would provide a general overview of the tools that are available and would discuss situations in which they should be used. Partnering with professional associations and industry groups in a lunch and learn type format is recommended. Each of these sessions would present identical content to ensure all stakeholders in attendance receive a consistent message. It is recommended that the need for additional, more detailed training be evaluated at these sessions, by means of a participant survey. Development of the remainder of the training program would be guided by the results of this survey.

The remaining three types of training sessions each target a specific participant. Vulnerability Assessment Sessions are an hour and a half in length and are designed to meet the needs of asset managers and planners and undertake the initial steps towards increasing a community's resiliency. Engineers and technical specialists would also benefit from these sessions. Engineers are the intended participants of the Technical Sessions, which focus on making design decisions under the uncertainty of climate change projections. These sessions introduce the sources of climate projection uncertainty and highlight the importance of considering the distribution of future climate scenarios. The final session is designed for municipal leaders. These one-hour sessions discuss the impacts of climate change on the day-to-day operations of a municipality, the benefits of implementing adaptation measures and the roles that elected and non-elected officials play in the process.

Regardless of the format of the training sessions (online or in person) it is recommended that recordings be made available for those who were unable to attend and ongoing support be provided by the Office of Climate Change and Energy Efficiency.

## Acronyms and Abbreviations

API: Atlantic Planners Institute

CCEE: Office of Climate Change and Energy Efficiency

CENL: Consulting Engineers of Newfoundland and Labrador

CPWA: Canadian Public Works Association

Coastal Zone Management (CZM)

DJ-FES: Department of Justice and Public Safety, Fire and Emergency Services

DMA: Department of Municipal Affairs

ICLEI: International Council for Local Environmental Initiatives

IDF: Intensity Duration Frequency

MNL: Municipalities Newfoundland and Labrador

MUN: Memorial University of Newfoundland

NEIA: Newfoundland and Labrador Environmental Industry Association

NLCA: Newfoundland and Labrador Construction Association

NOAA: United States National Oceanic and Atmospheric Administration

NRCan: Natural Resources Canada

OCCIAR: Ontario Centre for Climate Impacts and Adaptation Resources

PEGNL: Professional Engineers and Geoscientists Newfoundland and Labrador

PIEVC: Public Infrastructure Engineering Vulnerability Committee

PMANL: Professional Municipal Administrators Newfoundland and Labrador

TAC: Transportation Association of Canada

USEPA: United States Environmental Protection Agency

UWO: University of Western Ontario

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## 1.0 INTRODUCTION

In its 2011 Climate Change Action Plan, the Government of Newfoundland and Labrador stated that "climate change is one of the most pressing issues facing Newfoundland and Labrador". Government anticipates that climate change will affect the Province in a variety of ways, including more extreme weather, increased temperatures, increased precipitation, higher sea-level and storm surges. Depending on the location, this could result in more flooding in already flood prone areas, flooding in new areas, greater coastal erosion, reduced sea ice conditions and unstable / thawing permafrost.

Government has developed various tools and resources aimed at stakeholders such as municipalities, Provincial departments responsible for infrastructure and planning, private sector companies and industry associations. The goal is that the agencies would improve their capability to incorporate climate change into decision-making processes with a view to mitigating risks to infrastructure, economic activity and communities as much as possible and enhancing resilience to adverse climate change effects.

As the maximum benefit of these tools and resources rests with their widespread use by decision-makers, it was important to assess the extent to which they are used, understand any barriers to their utilization, determine ways to increase uptake, identify any gaps in provision of tools and resources and to assess how best to raise awareness and build capacity among key stakeholders. To gain a higher level of understanding of usage and provide insight into training opportunities, the Office of Climate Change and Energy Efficiency (CCEE) issued a “Request for Proposals: Climate Change Adaptation Tools and Resources” on 8 September 2015.

In October 2015, Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler) was engaged to consult with stakeholders on the tools and resources that have been developed to assist with climate change adaptation. The goal of the stakeholder engagement program has been to understand use of the climate change adaptation information products and tools made available by CCEE while identifying gaps in stakeholder needs. The results of the stakeholder engagement process are outlined in a report: “Climate Change Adaptation Tools and Resources Stakeholder Engagement Report”, which describes the stakeholder consultation process and the results of discussions about relevant tools and resources: usage, awareness, access, application, availability, reliability, direction, collaboration and conflict as well as recommendations on enhancing uptake, improving accessibility and addressing climate change adaptation information gaps.

Stakeholder engagement was also intended to gain insight into the training needs and requirements of identified stakeholders. This second report was prepared to provide recommendations on awareness and training that would enhance stakeholder capacity to better understand and adapt to climate change. The report provides a detailed syllabus of the content, duration and structure of a proposed training program.

## 1.1 Scope

As per the initial RFP:

Develop a comprehensive approach for training for identified stakeholders, and other professionals, on the use of climate change adaptation information products and tools as it relates to infrastructure, land use planning and development decision making processes. This approach will be informed by stakeholder engagement as described in Section 4.0, item 2.b (of the RFP). This will include:

a. Preparing detailed options for content, duration and structure to be reviewed and approved by CCEE. The options will address the following points, as a minimum:

    i. The number of modules in the training program,

    ii. The topics for each module,

    iii. Examples of materials that can be used for each module, and

    iv. The format of training (e.g. webinars, classroom, etc.); and

b. Recommendations for training roll-out.

## 2.0 STAKEHOLDER RECOMMENDATIONS

This section provides a summary of recommendations with regard to climate change adaptation awareness and training, provided by the three stakeholder groups described in Section 3.0 of the Stakeholder Engagement Report (SER). This includes a discussion of who should attend training followed by recommendations related to training content and format. In addition, other comments on logistics that were contributed by participants are provided.

While the development of a training program was highlighted as one of the key recommendations in the SER, a number of respondents stated that awareness needs to be increased before training is offered. Others added that education is not the issue and that a level playing field needs to be created for all municipalities and consulting firms (i.e. standards and regulations). Both of these recommendations are covered in the SER.

Not all of the participants were in favour of a training program. One consultant felt that workshops are a "costly waste," stating that many engineers would find a way to learn how to use the tools once they knew they were available and were given direction to apply them in their work. Another consultant highlighted that if the tools were easy to use then they may not need additional training.

### 2.1 Training Program Attendees

Several participants noted that only certain groups of people need technical training and that the level of detail would vary depending on the audience (e.g. targeted session versus conference presentation). Training requirements for municipal officials would depend on the community and the division of labour and resources within the organization. Those who should consider attending include town managers, public works directors and outside supervisors. Many people mentioned that municipalities and non-technical professionals need only general information. It was suggested that they need to know what issues are occurring and what tools and resources are available to address them so that they may give direction to consultants. Some municipal officials stated that hands on training would be useful but the priority is to learn what is available and how to find it.

Most participants from all three stakeholder groups agreed that highly technical training should be targeted at consulting firms and select municipal or Provincial employees. Consulting firms are interested in learning how to apply climate change adaptation tools and resources if they are asked to use them on a project. Several engineering consultants mentioned that this training would help to fulfill continuous professional learning requirements established by Professional Engineers and Geoscientists Newfoundland and Labrador (PEGNL).

The Provincial Government has a large number of employees in a wide variety of roles in a range of departments and agencies. Participants recommended training be offered to employees of particular agencies and departments such as Fire and Emergency Services (FES), Transportation and Works and Municipal Affairs that work with communities and consultants in infrastructure development /

maintenance and emergency response. It was noted that some Provincial staff need to be aware of climate change adaptation tools and resources so they can share the information with appropriate business clients that may use it. Others felt that high-level training should be compulsory for management, while some felt it sufficient to train employees who could then give policy advice and background information to managers and politicians. It was suggested that as part of this training, CCEE should provide information on where to get advice and teach professionals what to ask the experts.

## 2.2 Training Program Content

An introductory session was a common suggestion among all three stakeholder groups. Recommendations for introductory content included an overview of climate change impacts on the province and a high level summary of the various tools and resources available, where one can find them and examples of how the tools can be used. One engineer suggested to initially offer a lunch-and-learn format (similar to those offered regularly by PEGNL) where the overview and details of future in depth-training would be provided. That way attendees would have a better idea of whether or not they should attend further training and CCEE would be able to gauge interest before expending a large amount of effort developing detailed sessions. Another recommendation for a general high-level session was to bring all key stakeholders together (consulting firms, municipalities and provincial government departments) to ensure everyone has the same information and understands who should use the tools and resources.

Municipal officials recommended walking through what is available on the web portal (once one has been created). Many municipalities suggested specific training for IDF curves. Several said the focus should be on practical issues and cover content such as the climate change issues that need to be considered.

Some participants noted that any tools that are to be used by municipalities will require introductory discussion and context for their implementation. Participants also mentioned that they would need support for using tools in local context, with the option to telephone someone within CCEE for assistance.

Several consultants and municipal officials said that interactive workshops where participants were guided through the use of the tools and resources by working on appropriate case studies would be valuable. Specific topics recommended include the use of IDF curves, storm water management design, erosion control, flood control, flood risk mapping and storm surge prediction (to assess the level and timing for design use). One suggestion was to provide information on how to supplement CCEE's information with other tools and resources that are available. Multiple consultants also suggested guidance on designing under the uncertainty of climate change.

## 2.3 Training Program Format

A wide variety of training formats and lengths were recommended by stakeholders, ranging from technical guidance documentation to multi-day interactive workshops. Partnering with professional and industry associations such as PEGNL, Consulting Engineers Newfoundland and Labrador (CENL), Newfoundland and Labrador Construction Association (NLCA), Atlantic Planners Institute (API) etc., as well as Municipalities Newfoundland and Labrador (MNL), was a common suggestion. Most stakeholders said that following an introductory session, they might participate in a half-day to full-day workshop. Some expressed interest in longer programs and others said that multi-day training would be too long. Several respondents noted that workbooks and guides would be beneficial, in addition to training modules. One recommendation was an approach similar to CCEE's 2012 Guide to Building Energy Efficient Homes, which reflected recent changes to the National Building Code and was found to be helpful for municipalities.

There was a divide between those stakeholders who preferred webinars or in-person sessions. For a variety of reasons, Provincial Government employees tended to recommend webinars, while municipal employees generally favoured face-to-face training. Many consultants suggested in-person sessions but said that webinars were also a good approach because of saving time and expenses for attending. One engineer pointed out that online modular sessions could be recorded for future training purposes (e.g. new personnel and those who missed initial offerings).

All of the stakeholders who were located outside of the Avalon Peninsula strongly emphasized that any in-person sessions had to be held in a variety of locations around the province and not just St. John's. The general recommendation was a location on the Avalon, in central and on the west coast of the island, though some thought more local sessions were required (including in St. John's, Clarenville, Gander or Grand Falls-Windsor, Deer Lake or Stephenville, and in Labrador). It was noted that those in St. John's have more opportunities for in-person professional education than in other areas and one respondent was concerned that consultants in various regions should be offered in-person training as local consultants are often preferred by municipalities.

Government has travel restrictions and good technical resources so webinars can be used but participants felt that modules should be available on an ongoing basis so staff can take them at their own pace and review and refresh as required. Computers and possibly headsets and cameras would be required for full participation in live interactive courses. The Centre for Learning Development provides training for Provincial employees and Government uses Microsoft Lync and Adobe Connect to deliver short courses. It was noted that it is difficult to assemble groups from diverse Provincial Government departments, necessitating multiple training opportunities.

## 2.4 Other Training Program Considerations

Various recommendations were made with regard to the timing of a training program. One consulting firm mentioned that the slowest time of year, with regard to client projects, was from January to mid-

March, making it an ideal time for training. This is before infrastructure contracts are let for the construction season which does not end until late fall. However, the Department of Municipal Affairs is busy in the late winter and early spring with municipal infrastructure funding requests. One municipality suggested June was a good time for workshops, and that the information could then be presented at the Canadian Construction Association meeting, which is held each November. For some Provincial Government employees, March is generally the slowest month. There is likely no good time for everyone which makes self-paced online programs with on-going access attractive. Alternatively, if in-person training sessions are offered, they could be distributed throughout the year (as well as geographically).

Participants were interested in continuous updating of information and skills. Some respondents suggested that along with providing updates on new data, tools and information, regular refresher courses would also be beneficial should the tools prove to be widely used. One municipal official recommended a continuing education program providing, for example, two workshops per year.

Potential trainees were concerned about the costs of participation. For consultants, training time and expenses (including potential travel costs) contributes to overhead costs and results in loss of productivity. Provincial employees have travel restrictions and municipalities have limited budgets. It was mentioned by many that there should be no participant fees associated with any programs offered.

Stakeholders were interested in having input into training. One municipal employee suggested that the Provincial Government assemble the “mid- to large-sized municipalities” to discuss the questions that need to be answered in a training program for climate change adaption tools and resources. One municipal participant suggested that municipalities could form a working group, which would provide the opportunity to informally discuss municipal climate change adaptation approaches to inform training needs. One official strongly encouraged funding for northern regions to determine what specific training would be most suitable for its communities.

Another participant suggested using an incentive program, like Tidy Towns. Municipalities could get a climate change adaptation rating (e.g. series of stars) that they could achieve for participating in activities such as attending an awareness session and/or training, applying the tools and resources, incorporating climate change into the municipal plan and taking various climate change adaptation measures for infrastructure. Recognition could be provided by an organization such as MNL.

# 3.0 AMEC FOSTER WHEELER TRAINING PROGRAM RECOMMENDATIONS

This section provides training program recommendations for increasing capacity to address climate change adaptation in Newfoundland and Labrador. Each section covers one of the four training modules and provides an overview of the respective sessions, intended participants, duration, potential partner host/facilitator, curriculum details, required materials and expected outcomes. Additional resources that may be useful are presented in Section 3.5.

## 3.1 General Awareness Sessions

The proposed training program would begin with short General Awareness Sessions that can be organized with various professional groups and other associations throughout the province to provide multiple opportunities for a large number of people to learn about the tools and resources. Some organizations (e.g. API and PEGNL) would offer these sessions as part of their continuing professional learning programs potentially in a lunch and learn format. Associations, such as CENL or NLCA, with individual, corporate or municipal members that are part of the target audiences would use a similar format or offer sessions at regular luncheons or annual conferences. The content of all of the General Awareness Sessions would be consistent so that professionals, technical staff and officials in any role could attend and receive suitable information.

### 3.1.1 Curriculum

The General Awareness Sessions would provide an overview of the available tools and resources and show real examples of how these can be used to enhance adaptation.

**Participants**: Any Stakeholder

**Duration**: 1 hour

**Potential Partner Host/Facilitator**:

Including, but not limited to:

- API
- PEGNL
- CENL
- NLCA
- MNL
- Canadian Public Works Association (CPWA)
- Newfoundland and Labrador Environmental Industry Association (NEIA)
- Professional Municipal Administrators Newfoundland and Labrador (PMANL)

**Section Details**:

1. Introduction of CCEE
2. Overview of observed climate trends and projected climate change impacts in NL
    a. Variability
    b. Extremes
3. Discussion of short-term and long-term financial and human resource benefits of incorporating climate change adaptation in land use planning and infrastructure design in the context of:
    a. Emergency response
    b. Public health and safety
    c. Public / private property damage
    d. Insurance costs
    e. Infrastructure replacement
4. Discussion of tools available from Provincial Government
    a. Climate Data Information Portal
    b. Intensity-Duration-Frequency (IDF) Curves (2015 update)
    c. Projected Impacts of Climate Change for the Province of Newfoundland and Labrador
    d. Flood Risk Mapping
    e. Hurricane Season Flood Alert System & Flood Forecasting Flood Alerts
    f. Coastal Erosion Monitoring
    g. Sea-Level Rise Report
5. Showcase various vulnerability assessment tools

**Materials**: A short survey to explore need for additional training should be distributed at the end of each session.

### 3.1.2 Outcomes

Following these sessions, participants would be able to use their knowledge in a variety of ways depending on their role. Municipalities and Provincial agencies who are not intended to be hands-on users of the tools and resources could use the information to give direction to consulting planners and engineers who work on their behalf. The review of vulnerability assessment tools will provide participants a starting point for climate change adaptation in their communities. Consultants who currently have appropriate skills, and access to relevant technology, could use these sessions to simply learn about the tools and how to access them and may not require additional training. These sessions could also be used to explore the need for additional training.

## 3.2 Vulnerability Assessment Sessions

While many municipal and provincial officials are not directly responsible for any technical analysis required for implementing adaptation measures, their knowledge of the assets is invaluable. This knowledge can be well utilized to identify key systems and infrastructure as well as any corresponding

vulnerabilities. By introducing them to this assessment process, asset managers will be able to develop a more thorough understanding of adaptation requirements that can be accounted for in any RFPs relating to corresponding systems and infrastructure. It will also help officials ensure that steps toward increased climate change resiliency are appropriately prioritized.

The primary objective of these sessions is to help municipal and Provincial asset managers understand the vulnerability assessment process so they are able to work through the process with their colleagues. Once they have completed the session, they will be able to conduct full assessments to identify key infrastructure and systems and determine action items that would lead to increased resiliency to impacts of climate change.

### 3.2.1 Curriculum

The session should begin by introducing and defining key terms that will be used during the session. These include:

- Climate change
- Vulnerability and resiliency
- Key infrastructure and systems

Any of the three vulnerability assessment tools identified and promoted by CCEE could be presented in these sessions. Each has well developed curriculum and supporting materials. Descriptions of these assessment tools are found below.

1. “7 Steps to Assess Climate Change Vulnerability in Your Community”
    a. Overview: This comprehensive tool can help municipalities plan for climate and extreme weather related issues and assist in the development of strategies to deal with those issues. It is currently being redeveloped into an interactive and user-friendly website by MNL.
    b. Participants: Municipal stakeholders, including staff and key community members
    c. Potential Partner Host/Facilitator: MNL
2. “Managing Municipal Infrastructure in a Changing Climate”
    a. Overview: This workbook, which is intended to complement the 7 Steps assessment process, uses a combination of case studies and breakout session exercises.
    b. Participants: Municipal officials and staff
    c. Potential Partner Host/Facilitator: MNL
3. PIEVC Protocol
    a. Overview: Used to analyze the engineering vulnerability of an individual system or infrastructure. Most effective once critical components have been identified but the identification process can be included in the beginning of these sessions. Detailed procedure and worksheets are available through a license agreement with Engineers Canada at no charge.

b. Participants: Provincial or municipal asset managers and consulting firms
c. Potential Partner Host/Facilitator: Engineers Canada

The following table outlines the general steps involved in each of the assessment processes.

| 7 Steps Assessment | Managing Municipal Infrastructure | PIEVC Protocol |
|---|---|---|
| 1. Identify relevant climate and extreme weather-related issues<br>2. Locate where these issues have occurred or could occur<br>3. Assess what infrastructure has been or will be impacted<br>4. Identify residents who have been or will be most affected as well as those who can provide assistance in the community<br>5. Assess which economic sectors have been or will be most impacted by the issues<br>6. Identify how the natural environment has been or will be affected<br>7. Determine the best ways to address the issues identified | 1. Discuss how municipal infrastructure is planned, constructed and maintained<br>2. Consider how your community is affected by changes in local weather patterns<br>3. Discuss what can be done to manage ad protect municipal infrastructure to increase climate change resiliency | 1. Project definition<br>2. Data gathering and sufficiency<br>3. Risk assessment<br>4. Engineering analysis (optional)<br>5. Conclusions and recommendations |

**Duration:** Typically, sessions where participants conduct full vulnerability assessments take either a half-day or a full-day. By focusing on ensuring participants understand the process (but not complete all of the steps), these sessions will be 1.5 hours.

**Materials:** Supporting materials (workbooks, etc.) for whichever of the three assessment tools is used should be provided by the host/facilitator. Summary information from “Projected Impacts of Climate Change for the Province of Newfoundland and Labrador” should also be provided for relevant regions of the province.

### 3.2.2 Outcomes

Participants should leave with an understanding of the process of assessing risks introduced by climate change. They should be able to take this understanding and develop a detailed vulnerability assessment leading to a clear path forward to increase resiliency for key infrastructure and systems in their communities. It is the intention that this understanding would be incorporated into regular planning activities and the RFP development process.

## 3.3 Technical Training – Dealing with Uncertainty

Before expending resources to develop and offer Technical Training Sessions, the need should be further evaluated, as discussed in Section 3.6: Roll-out. While several stakeholders mentioned they would like to see technical sessions offered, consulting firms, who would be doing the bulk of the technical analysis, do not need training in fundamental engineering principles (e.g. how to use an IDF curve) and may find the content of the general awareness sessions sufficient (e.g. where to find IDF curves that incorporate climate change projections). However, as discussed below, dealing with uncertainty and choosing between datasets may be a valuable component of technical case studies.

If required, technical training could be made available to those professionals who will be most likely to use the climate change adaptation tools and resources. Some of the content (e.g. general awareness) of the first two types of sessions would be summarized and presented with the knowledge that participants would be familiar with the tools and resources and possibly have attended previous sessions.

Engineers are typically accustomed to designing according to specific values based on historical information (e.g. a location-specific 50-year storm event). The uncertainties associated with climate change mean that there could be several projections for the future, each with an equal probability. Uncertainty also arises where climate datasets are incomplete or insufficient. Engineers and technical professionals need to account for this uncertainty and to be able to explain and justify increasing the cost of infrastructure as recommended.

As such, the objective of this technical workshop is for participants to understand how to make design decisions based on uncertain future conditions.

### 3.3.1 Curriculum

This session begins with an overview of the sources of climate change projection uncertainty, which then leads to selecting a dataset and analysis technique appropriate for the location of interest. Following this is a discussion of the common ways climate model projection uncertainty is represented and how a range of values can be incorporated into technical designs. A case study highlighting situations where consideration of more than just the projection mean or median is important. The final topic covered will be how to communicate uncertainty to asset managers and decisions makers.

**Participants**: Engineers and Technical Specialists

**Duration**: Two hours

**Potential Partner Host/Facilitator**: Technical Expert

**Section Details:**

1. **Uncertainty:** Sources of uncertainty in climate projections are caused by our inability to predict the path of society, the complex nature of the climate system, the choice of climate models and analysis techniques, as well as the way in which the climate projections are used. The primary sources of uncertainty include:
    a. IPCC emissions pathways (RCP 2.6, 4.5, 6.0, 8.5)
    b. Global Climate Models (GCMs)
    c. Downscaling and Regional Climate Models (RCMs)
    d. Impact models (e.g. hydrologic models)
2. **Selecting Datasets and Analysis Techniques**: Selecting which datasets and analysis techniques to use can have a significant impact on the outcome of the project. Considerations include:
    a. Benefits of using ensembles versus the dangers of single projection values
    b. How to get site specific information
        i. Using pre-downscaled data (e.g. "Projected Impacts of Climate Change for the Province of Newfoundland and Labrador")
        ii. Datasets and resources that can be used to supplement those provided by CCEE (examples provided in Materials below). (As the Province's tools and resources may not cover a specific location or there may be preferred datasets for specific situations and locations.)
3. **Representing Uncertainty**: There are a variety of ways in which uncertainty can be represented. The size of the ensemble (i.e. number of climate models used) and the end use of the data will help determine which methods may be appropriate. Common examples include:
    a. List of individual outcomes, which would include spaghetti plots for time series (i.e. all timelines on one plot)
    b. Summary statistics (e.g. mean, median, percentiles), including best and worst case scenarios
    c. Probability distributions
4. **Designing Based on a Distribution**: Professional judgement is required when using uncertainty ranges or distributions for design.
    a. The section includes examples of when it may be appropriate to use, for example, the 25$^{th}$ percentile, the 50$^{th}$ percentile or the 95$^{th}$ percentile projection values.
    b. There will always be some assumed risk in any decisions and the consequences of under design versus the costs of over design should be balanced.
5. **Communicating Uncertainty and Risk** to decision makers is important to ensure the reasoning behind design decisions is understood, including the costs and benefits of consideration situations more involved that the mean/median values.

**Materials**: In addition to the Province's published climate projections (e.g. "Projected Impacts of Climate Change for the Province of Newfoundland and Labrador" and "Intensity-Duration-Frequency Curve

update for Newfoundland and Labrador"), information about outside resources should also be provided. Some useful Canadian examples are listed below and discussed further in Section 3.5.

- University of Western Ontario's (UWO) Climate Change IDF Tool (http://www.idf-cc-uwo.ca/)
- The Pacific Climate Impacts Consortium's (PCIC) statistically downscaled climate scenarios (https://www.pacificclimate.org/data/statistically-downscaled-climate-scenarios)
- The Government of Canada's Canadian Climate Data and Scenarios (http://ccds-dscc.ec.gc.ca/)

### 3.3.2 Outcomes

Engineers and technical specialists who attend this session should gain an understanding of the uncertainty of climate change projections and how technical decisions can be made based on a range of values.

## 3.4 Municipal Leaders Sessions

In order to ensure a consistent and effective message is received by all stakeholders, the training program should include all those involved in the decision making process, including elected officials and non-elected municipal leadership. This is important as the continuity of elected officials' roles is limited compared to those of municipal staff and they likely do not have the same understanding of the community's systems and infrastructure and their corresponding vulnerabilities. Municipal efforts toward addressing asset management challenges that have to be approved by elected officials often focus on near-term reactionary measures and in isolation of the system as a whole. By taking a broader view at the root causes of these challenges (e.g. increased extreme precipitation frequency trends), preventative planning and maintenance measures are more likely to be implemented.

### 3.4.1 Curriculum

These short sessions will begin with a high level overview of how climate change will impact Newfoundland and Labrador. Common vulnerabilities of municipalities will be discussed along with an outline of how to identify vulnerability and risks. This will be followed by actions that can be taken to increase resiliency of communities. The session will conclude with an overview of tools, resources and support available from the Province.

The curriculum for this session was modified from the United States Environmental Protection Agency (USEPA) online training module "Local Government Climate Change Adaptation Training" (see Section 3.5.5 for more details).

**Participants**: Municipal councillors and mayors as well as non-elected municipal leaders (e.g. town clerks and managers)

**Duration**: 1 hour

**Potential Partner Host/Facilitator**: MNL

**Section Details**:

1. Climate change Basics
    a. Observed trends and changes
        i. How climate change impacts day-to-day municipal operations
    b. "Projected Impacts of Climate Change for the Province of Newfoundland and Labrador"
        i. Discussion on intense precipitation
    c. Sea level rise and coastal erosion
2. Vulnerabilities of Local Communities
    a. Examples of recent extreme events
    b. Identifying Vulnerability and Risk
        i. Introduce the three vulnerability assessment tools
        ii. Focus on storm water infrastructure but include discussion of other examples (e.g. coastal infrastructure, transportation infrastructure)
        iii. Emphasize how climate change and extreme weather can impact day-to-day operations
3. Developing a plan for action and their role in increasing resiliency
    a. Engage municipal staff and community members
    b. Use vulnerability assessment tools to identify priority areas
    c. Incorporate adaptive measures into RFPs, Asset Management Plans and Municipal Plans
        i. Request consultants to include considerations for climate change adaptation
    d. Monitor progress and make corrections as required
    e. Share experiences with the Province and other municipalities
4. Overview of available tools, resources and support

**Materials**: No special materials are required for this session.

### 3.4.2 Outcomes

The primary objective of this session is to inform elected and non-elected municipal leaders about the needs and benefits of climate change adaptation as well as highlight their role in the process. Officials who have attended this session should have developed an understanding of how climate change impacts the day-to-day operations of a municipality as well as their role in increasing community resiliency.

## 3.5 Additional Resources

This section provides information on selected Canadian and American resources for various types of climate change adaptation awareness and training programs. These are delivered through online resources and through in-person workshops and conferences. This material is not presented to make

specific recommendations on training programs but rather to provide representative examples of existing materials and organisations engaged in climate change adaptation. This demonstrates that there are many existing resources that could be used as content models for local training programs. There are a number of local subject matter experts with the Provincial Government, Memorial University of Newfoundland and the consulting community that could be engaged in development of training materials.

### 3.5.1 Engineers Canada Public Infrastructure Engineering Vulnerability Committee

The Engineers Canada Public Infrastructure Engineering Vulnerability Committee (PIEVC) was formed to assess the vulnerability of Canada's public infrastructure to the impacts of climate change. The committee facilitates initiatives that provide climate change adaptation guidance for the design, construction, maintenance and regulation of safe, reliable and financially sustainable public infrastructure in Canada. PIEVC workshops have been delivered and well-received in the province. Engineers Canada is also in the process of developing online training modules. The PIEVC protocol is one of the three methods recommended for the Vulnerability Assessment Sessions.

http://www.pievc.ca/

### 3.5.2 Natural Resources Canada

Natural Resources Canada (NRCan) has developed a science assessment report “From Impacts to Adaptation: Canada in a Changing Climate” to update a previous report with new information on current research and practical experience in climate change impacts and adaptation in Canada. The report includes the work of more than 90 authors and 115 expert reviewers, and synthesized over 1500 publications. Some of this content could be used for local training and awareness programs and one section focuses specifically on infrastructure.

This report provides examples of vulnerabilities and adaptation measures for various infrastructure components, such as storm water management (Section 2.3) and coastal infrastructure (Section 3.3).The key findings highlight the importance of well-maintained infrastructure in climate change resiliency and cites it as an important part of adaptive asset management. Examples can be pulled from this report for use in the Vulnerability Assessment Sessions and Municipal Leaders Sessions.

http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2014/pdf/Chapter8-Infrastructure_Eng.pdf

NRCan has also developed “Canada’s Adaptation Platform”, which is a group of key stakeholders from government, industry and professional organizations collaborating on adaptation. This organization assembles knowledge, capacity and financial resources to work on adaptation, and ensures that information, tools and recommendations are shared with target audiences. Webinars are provided through the “Adaptation Platform”.

http://www.nrcan.gc.ca/environment/impacts-adaptation/adaptation-platform/10027#webinars

### 3.5.3 University of Western Ontario's Climate Change IDF Tool

The University of Western Ontario (UWO) has developed an automated tool for developing IDF curves under climate change, for a wide variety of locations across Canada, including 30 locations in NL. The tool is user friendly, relatively customizable and free of charge, though registration is required. This resource would be useful as a supplemental data source discussed in the Technical Training Sessions.

http://www.idf-cc-uwo.ca/

### 3.5.4 Pacific Climate Impacts Consortium's Statistically Downscaled Climate Scenarios

The British Columbia based Pacific Climate Impacts Consortium (PCIC), offers climate model output downscaled to nationwide 10 kilometre grid. Three variables (minimum temperature, maximum temperature, and precipitation) are available for a selection of climate models and are accessible through an interactive map. This resource would be useful as a supplemental data source discussed in the Technical Training Sessions.

https://www.pacificclimate.org/data/statistically-downscaled-climate-scenarios

### 3.5.5 The Government of Canada's Canadian Climate Data and Scenarios

The Canadian Climate Data and Scenarios (CCDS) is an interface for distributing climate change information relevant to Canada. Precipitation and temperature output from the ensemble of models on which the most recent IPCC reports were based (including the Third, Fourth and Firth Assessment Reports) are made available through CCDS. This resource would be useful as a supplemental data source discussed in the Technical Training Sessions.

http://ccds-dscc.ec.gc.ca/

### 3.5.6 United States Environmental Protection Agency Local Government Advisory Committee

The United States Environmental Protection Agency (USEPA) and its Local Government Advisory Committee has developed the "Local Government Climate Change Adaptation Training" online training module for local governments to learn about climate change adaptation. This type of program content would be suitable for Municipal Leaders Sessions as discussed in Section 3.4.

http://www.epa.gov/communityhealth/local-government-climate-adaptation-training

### 3.5.7 United States National Oceanic and Atmospheric Administration

The United States National Oceanic and Atmospheric Administration (NOAA) develops a variety of resources for decision makers including resources for climate change adaptation. The "Decision Maker's Toolbox" includes a variety of resources that discuss relevant materials. Examples of coastal adaptation actions from the United States can be found on their website (e.g. updating building codes and developing related coastal regulations to address rising sea levels). These examples can be referred to when discussing costal resiliency in the General Awareness Sessions and Municipal Leaders Sessions.

https://www.climate.gov/news-features/decision-makers-toolbox/planning-climate-change-adaptation

### 3.5.8 Massachusetts Office of Coastal Zone Management

The Massachusetts Office of Coastal Zone Management (CZM) developed the StormSmart Communities program to help local government officials prepare for and protect communities from coastal storms and flooding for current conditions and potential sea-level rise. Pilot projects from the website can supplement those examples from Section 3.5.7 when discussing sea-level rise, coastal erosion and storm surges.

http://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/stormsmart-communities/

### 3.5.9 Federation of Canadian Municipalities Climate Change Adaptation

The Federation of Canadian Municipalities (FCM) has a large selection of adaptation resources available through their website. Of particular use for the Technical Training sessions described above are the case studies from locations across Canada. These case studies could be used as examples of the adaptation process in the Vulnerability Assessment Sessions and Municipal Leaders Sessions.

http://www.fcm.ca/home/policy-and-advocacy/climate-change-and-resiliency/climate-change-adaptation.htm

### 3.5.10 Various Resources

A large number of climate change adaptation resources are available online. The following sources are a selection of these and are provided for the interest of reader.

**Canadian Standards Association (CSA)**

http://www.csagroup.org/global/en/home

**The One UN Climate Change Learning Partnership**

http://unccelearn.org/

**International Council for Local Environmental Initiatives (ICLEI) Canada's Adaptation Library**

http://www.adaptationlibrary.com/

**Adaptation to Climate Change Team (ACT) at Simon Fraser University**

http://act-adapt.org/

**Institute for Catastrophic Loss Reduction (ICLR)**

http://www.iclr.org/

**Ontario Centre for Climate Impacts and Adaptation Resources**

http://climateontario.ca/

**Transportation Association of Canada Climate Change Adaptation and Mitigation Webinars**

http://tac-atc.ca/en/events-and-learning/webinars/climate-change-adaptation-and-mitigation

### 3.6 Format

Various organizations have ongoing continuous professional learning events and regular conferences. These opportunities can be used for the proposed General Awareness Sessions. This would be low cost and minimal effort for the CCEE aside from preparation of content and presenting. Presentations could be placed online following sessions so that those who could not attend can view and learn about the climate change tools and resources and where to find them.

Several of the sessions can be held as webinars with online presentations for those who have available technology and also presented as seminars at regional conferences for those who do not have adequate technology resources. Webinar content could remain online following sessions so that those who could not attend can view and learn about the climate change tools and resources for adaptation in land use planning and infrastructure applications.

It may be most cost effective to hire content / curriculum specialists to develop the training and a local agency to organize the events and manage relevant matters such as registration.

Some participants stated that training should be free of charge. This was an especial concern for those not located on the Northeast Avalon. However, charging a nominal fee (e.g. $25) is required upon registration for an in-person event, would likely result in fewer initial registrants but also fewer no-shows than a session that is free of charge. If a webinar format is chosen, it may be possible to find a service provider that can deliver the sessions and maintain the practice exercises online on an ongoing basis.

### 3.6.1 In-Person Versus Online Sessions

Many participants felt that in-person training has advantages due to having access to specialists and interaction with other professionals. However, a number expressed concerns about costs of travel and downtime to participate in training and stated that online training is more cost effective. Online sessions are advantageous as preparatory work is limited to development of content, interface design and delivery of a program online. Online training puts all users at a fair advantage as sessions can be offered on multiple occasions with equal costs for participants no matter where they are located. A number of participants, generally with Provincial Government agencies and large consulting firms, appeared to have available technology for online courses. Smaller municipalities and consulting firms may not have access to similar resources. In some areas of the province, access to high speed Internet may have limitations. The locations of in-person sessions would likely depend on any partnering agency, though hotel conference centers, Provincial Government facilities, or college and university campuses are all viable options.

## 3.7 Roll-out

Roll-out of the training program would likely be undertaken in several stages, beginning with raising awareness, and continuing on with sessions of an increasingly technical nature.

The first stage of rolling out any training program is to spread the word among the target audience. One avenue for this would be via existing list-serves of professional and industry organizations, of which many of the identified stakeholders are members. Making personal phone calls to targeted stakeholders within municipalities and Provincial Government departments and agencies would be an effective way to ensure that an email was not overlooked. Raising awareness of the training opportunity would be undertaken several weeks in advance of the first session to ensure that information is emailed out via list-serves in a timely manner. This would also give those interested in attending time to fit it into their schedules. Contact information of attendees should also be collected to facilitate direct contact about subsequent sessions.

The second stage of rollout is the General Awareness Sessions, described in Section 3.1. It would be advantageous to hold these sessions well in advance of the rest of the training program. It would provide CCEE the opportunity to gauge the interest in and need of additional, more detailed sessions. A short survey that participants fill out at the end of an awareness session could advise CCEE on the interest and need of additional training sessions. Sample survey questions are listed below.

- In which industry do you work?
    - Select one: Private Industry; Provincial Government; Municipal Government; Not-for-Profit; Other (Please Specify)
- What is your role?
    - Select all that apply: Engineering or Technical Specialist; Planner; Manager or Administrator; Elected Official; Other (Please Specify)

- On a scale of one to five, rate the usefulness of this session (five being very useful)
- Do you have any recommendations on how to improve this session?
- Would you be interested in attending training on any of the following topics?
    - Vulnerability and Risks Assessment of Key Systems and Infrastructure
    - Making Design Decisions Based on an Uncertain Future Climate Scenarios
    - Day-to-day Impacts of Climate Change and the Benefits of Adaptation
    - Other? Please specify.
- General Comments

Depending on the interest shown, the remaining sessions should be offered within a couple of months of the awareness sessions. This time period is long enough to customize or edit training materials and short enough that the topic is still on peoples' radars (particularly those who may not deal with the issue of climate change adaptation on a regular basis). It is good timing for a reminder. All subsequent training sessions should be preceded with additional awareness raising, as discussed above.

As mentioned earlier, any online training (or even in-person presentations) could be recorded and made available for those who were unable to attend a relevant session. This would also facilitate the training of any new employees at stakeholder organizations and allow for self-guided learning.

General refresher sessions (via webinar) could also be held annually, or as needed. This would be an avenue to discuss any updates on the tools and resources and also provide examples of recent applications of climate change adaptation in the province or similar regions.

## 4.0 SUMMARY AND CONCLUSIONS

This report provides options for a four component training program, which would begin with General Awareness Sessions then proceed with more targeted training. Additional periodic refresher sessions are also discussed.

The priority should be on offering General Awareness Sessions throughout the province (Section 3.1). These sessions would provide a general overview of the available tools and resources and show real examples of how these can be used to enhance adaptation. Partnering with professional and industry organizations would be a resource-effective way of delivering these sessions while reaching the intended audience. In addition to the delivery of content, these initial sessions can provide the opportunity to further evaluate the need for subsequent training and they also contribute to increasing awareness of CCEE's climate change adaptation tools and resources, as recommended in the Stakeholder Engagement Report. General Awareness Sessions would be offered well in advance of the rest of the training program. Resources required for these sessions would be minimal and more detailed training need not be developed until these sessions have been completed and the need for further training is evaluated.

The other three types of training sessions each target a specific participant: asset managers and planners, engineers and technical specialists and municipal leaders (elected and non-elected). Vulnerability Assessment Sessions are an hour and a half in length and are designed to meet the needs of asset managers and planners and provide the initial steps towards a community's resiliency. Engineers and technical specialists would also benefit from these sessions.

Engineers are the intended participants of the technical sessions, which focusing on making design decisions under the uncertainty of climate change projections. These two-hour sessions introduce the sources of climate projection uncertainty and highlight the importance of considering the distribution of future scenarios.

The final session is designed for municipal leadership. These one-hour sessions discuss the impacts of climate change on the day-to-day operations of a municipality, the benefits of implementing adaptation measures and the roles that elected and non-elected officials play in the process.

New information and updated tools and resources will continue to be developed by CCEE and other organizations. Periodic refresher sessions would provide the opportunity to discuss any updates and provide examples of recent examples of climate change adaptation. Examples of such training materials from a variety of online sources are presented in Section 3.4.

As discussed in Section 3.7, many of these sessions could either be conducted in person or via webinar. The advantages of in-person sessions include a more interactive environment and stakeholder network building, while the advantages of webinars include low costs of delivery, especially for presenters and participants travel time and expenses, and ease of recording for future use. Various conferences and

lunch and learns both provide useful avenues for the non-technical sessions, while remaining cost effective methods of personal interaction.

## 5.0 CLOSURE

This report has been prepared for the exclusive use of the Office of Climate Change and Energy Efficiency. The study was conducted in accordance with the terms of reference and verbal and written requests from the client. The conclusions presented herein are based solely upon the scope of services and time and budgetary limitations described in our proposal.

We trust that this report meets your needs and are available to discuss upon request.

Yours sincerely,

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