

“WHAT EVERY COASTAL COMMUNITY SHOULD KNOW ABOUT STORM SURGE: PRESENT AND FUTURE”



CLIMATE CHANGE ADAPTATION FUND FINAL PROJECT REPORT

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Introduction/Project Description

This project was designed to connect people developing and ultimately implementing Municipal Climate Change Action Plans (MCCAP) with information on how to **correctly interpret a present-day and projected storm surge** when assessing flood risk. This audience includes but is not limited to: land use/community planners, emergency management coordinators, consultants, and public works engineers. Coherent explanations about how to *apply* this information is important during immediate impact mitigation (i.e., emergency response) and for long-term land use planning and development control.

Many municipal units have not been accurately interpreting storm surge warnings during weather events. It is not for lack of ability, but simply lack of information. Water level components such as waves, wind run up and tidal changes are important elements of storm surge/flood warnings, though *not included* in storm surge warnings. As well, there has been little effort to integrate storm surge warnings with mapping. In part because of a disconnect between municipal emergency management personnel and municipal staff with GIS (geographic information systems) skills, as well as omnipresent confusion over the difference between Chart Datum and Canadian Geodetic Vertical Datum: the vertical reference systems used for nautical and terrain maps, respectively.

This project involved the development and implementation of a live presentation and recorded webinar that provides municipal units with an explanation of how to account for storm surge in the context of MCCAPs, while simultaneously building emergency management capacity. A summary informational pamphlet and a data collection template were also developed and distributed. The data collection template was designed to engage municipalities in updating community narratives used by the Atlantic Storm Prediction Centre (the Centre) to determine flood-warning stages. By updating the Centre's narratives which describe local flood impact severity according to impact consequences, the accuracy and local applicability of the warning system across the Province will improve.

Deliverables/Method of Achievement

In the early stages of this project, Heather and Anne approached Bob Robichaud for guidance. As the Warning Preparedness Meteorologist, Canadian Hurricane Centre, Environment Canada, Bob Robichaud generates weather warning briefings that are circulated through the Emergency Management Organization Nova Scotia, to Municipal level Emergency Managers during the warning phase of potential weather events.

Not only was Bob willing to help, he was excited to be able to work on this project as it gave him a previously unavailable avenue to be able to provide emergency planners with weather interpretation skills. As well, Bob viewed this project as a chance to improve the predictability accuracy of his data in

future through the feedback he will receive on completed templates. This project helped fulfill a mandate to share information in a meaningful way and receive local impact information for future prediction. This high level contribution from Environment Canada greatly improved not only the quality of the final products, but the reception of these products at the local municipal level, particularly with Emergency Managers.

The four products created as part of this project include:

1. A brochure was developed to explain how a simple formula could be used to consider both tide levels and predicted storm surge to create numbers that could be mapped to identify areas of impact and municipal concern (Appendix A).
2. A Post Storm Analysis Template was created for storm data collection with the request any completed templates be passed on to Environment Canada to enhance predictions and identify Stage 1, 2 and 3 flood levels in various parts of the province. This Template also includes a “Storm Surge Decision Tree for Emergency Managers”. This provides a flow chart they can follow in the warning phase of potential storm surge to better assess data and take appropriate action (Appendix B).
3. A PowerPoint presentation was developed and used for the live presentation and the webinar recording. This presentation outlines how the MCCAP process highlighted the need to share information between emergency responders and municipal planners. It also provided information to clarify the variety of weather information sources and the tools that could be used to accurately define impacts and take action. (Appendix C Part 1 & 2)
4. A 1 hour 2 minute webinar was created based on the PowerPoint presentation: <https://gts-ee.webex.com/gts-ee/ldr.php?AT=pb&SP=MC&rID=33531&rKey=c00dcbf90fba5f9f>
This recording walks the viewer through the challenges that weather information and storm surge predictions present for Emergency Managers. The audience receives information on how a real life example of the struggle to make sense of multiple information sources, led to the development of a formula that can be used throughout the province to provide planning and response data. MCCAP action items that include linking map data with emergency responders are encouraged. The audience is provided with multiple sources of weather information and the tools to interpret that information to local areas and specific situations.

Short-term objectives (prior to MCCAP submission—before end of 2013):

1. Build municipal organizational adaptive capacity by demystifying the relationships between sea level rise, storm surge and flood risk probabilities, and how to include considerations of waves, wind run-up and tidal changes.
2. Build municipal organizational adaptive capacity by teaching planning and emergency management professionals how to interpret present-day storm surge predictions *correctly* and prepare and respond accordingly to ensure citizen safety and the protection of built assets (e.g., critical infrastructure).
3. Provide template MCCAP action items that are measurable and will improve the accuracy of localized flood warnings.
4. Provide sea level rise, storm surge and tidal information that is directly applicable to water level estimates being used in MCCAP development to assess coastal flood risk vulnerability.
5. Create framework/system for an ongoing information exchange between Nova Scotian Municipalities and the Atlantic Storm Prediction Centre, Environment Canada that will help to update and keep current, Stage One, Stage Two, and Stage Three flood warnings.

Long-term objectives (2014 forward):

1. The resulting template MCCAP action items are identified as priorities in MCCAP submissions, and municipalities feel confident they have the knowledge and financial capacity to implement them, as well as an appreciation for their importance to the protection of the community's socio-economic well-being.
2. Communication and data sharing is improved between planning departments and emergency management coordinators.
3. Municipal professionals throughout the province are using a shared, consistent, and informed approach when interpreting the storm surge component of water levels in climate change scenarios.
4. Vertical allowances are considered as an adaption option within MCCAP submissions.
5. Informed interpretations of water level scenarios are used to (re)assess environmental considerations—Step 5c as laid out in the MCCAP Guidebook.
6. Human safety is improved and damage to the built environment is mitigated given an improved understanding of water level scenarios.

Product Distribution

The information compiled was distributed in three ways. First, in November 2013, the PowerPoint presentation which later became the recorded webinar, was presented to all Nova Scotia Emergency Management Coordinators (EMCs) and Nova Scotia Emergency Management Organization staff, approximately 40 people, present at the Red Cross Disaster Conference. Participants were also given hard copies of the brochure and the Post Storm Analysis Template and assured they would receive the longer recorded webinar via email. The presentation was well received. The Environment Canada Meteorologist fielded questions and comments for 45 minutes after the formal session from interested EMCs and throughout the three-day conference.

Secondly, the recorded webinar, the brochure and data template were distributed via email to the four Nova Scotia Emergency Management Planning Officers. These officers, each responsible for a zoned geographical area of the province, maintain communication links between provincial emergency management preparedness, planning, response and recovery and emergency actions undertaken at the municipal level. These officers forwarded the webinar to all Emergency Management Coordinators and Regional Emergency Management Coordinators within all municipalities throughout the province. Anyone receiving the webinar was encouraged to further distribute within their planning groups as appropriate.

Lastly, with support from Jeff Merrill, Director Planning and Development Services Municipality of the District of Lunenburg, the recorded webinar, brochure and Template were distributed via email to:

- All Planning Director's in NS,
- The Planning and Development Officers list server,
- LPPANS membership (Licensed Professional Planners Association of NS), and
- AMA (Association of Municipal Administrators) with the request the email be distributed to the UNSM (Union of NS Municipalities) and to all CAO's and Mayors.

As a result of these mailings, planning staff throughout the province have been getting in touch with Heather Mackenzie-Carey and Anne Warburton to ensure their understanding of webinar content, and ask points of clarification. This is a positive sign that the webinar has been viewed and is instigating the intended conversations and learning.

Ties to Municipal Climate Change Action Plans

Presentations and products developed for this grant project encouraged municipal planners and emergency management coordinators to harmonize efforts in four key ways: all of which were recommended as MCCAP action items.

First, it was encourage that emergency responders become aware of the map data and mapping capabilities that exist within their municipal jurisdiction, and that the municipality create a seamless way making this data—and capable GIS personnel—accessible to not only planning staff, but also emergency management staff. The MCCAP process has revealed that in many cases EMO staff is simply not aware of the information available, such as population density mapping. Even if imperfect (which they often are), population density maps can be useful tools when evaluating risk and planning staged evacuations.

Secondly, municipalities were encouraged to evaluate their *real-time* mapping capabilities within Emergency Operation Centres and list identified needs for improvement as MCCAP action items. For example, one municipality on the Minas Basin shoreline included the MCCAP action items:

- Build mapping capabilities (staff and technology) and create redundancy for Emergency Preparedness Planning and use in the Emergency Operations Centre (EOC) in collaboration with all REMO members.
- Collaborate with REMO members to provide a computer with appropriate mapping software in the EOC and alternate EOC with access to appropriate municipal databases/GIS data and a plotter.

What the above action items set out to do, is to ensure that when a storm surge warning is received and an EOC is activated, that emergency staff have access to a map that shows what parts of the coast will be inundated with water or potential affected by waves, and thus *who* is vulnerable due to exposure. This visual analysis will aid in risk mitigation efforts.

Third, municipalities were encouraged to make completing the Post-Storm Analysis Template a standard practice/procedure after any storm surge event, and then to send one copy of the Template to the Atlantic Storm Prediction Centre, and keep one for their records. As explained previously, by sharing information on *what exactly* was effected (e.g., what infrastructure, neighbourhoods, roads) and *where* during a surge event, the Centre can begin to better understand the local context of their storm surge warnings, and can thus update the narratives that define Flood Stages accordingly. As it stand, some narratives are decades old. This creates a situation where local impacts could be *worse* than presumed by the Centre due to the fact that the coastal area in question may now host more development than what was present when the Centre's narratives were originally written. The concern is that the Stage warning given may not be severe enough if it does not reflect actual development. Essentially, the Centre's understanding and local understanding of water level impacts need to be more in synch. The suggested MCCAP action item reads: "Establish a joint municipal and REMO protocol to conduct post-storm analysis using a template provided by NS EMO (via this grant project)

and the Atlantic Storm Prediction Centre, and have REMO keep one copy for their records and send one copy to the Atlantic Storm Prediction Centre, care of the Weather Preparedness Meteorologist.”

The reason one copy of the Template needs to be kept at the municipality is that this record will create a log of historical impacts. It was discovered during the MCCAP process that municipalities have little to no record of expenses incurred and/or damages experienced due to severe weather. While the Template only captures coastal flood impacts—and thus municipalities need to instigate another means of capturing non-storm surge related costs and damages—it does offer a reference tool for emergency planners and land use planners when trying to mitigate future flood risk. For example, by reviewing what was experienced historically and where, emergency personnel and land use planners can work collaboratively to ensure that there are development controls in place to mitigate future risk. This may include tactics such as not allowing new builds in highly susceptible areas, or encouraging vertical or horizontal setbacks or flood proofing.

Lessons Learned

The relationship between land use and risk (due to threat exposure) has been underappreciated, and the potential role of emergency professionals as a collaborative partner in making land use planning and development decisions that mitigate risk has not been capitalized on to its fullest potential. The tradition within municipalities has been to seek EMO development approval/comment in regards to fire concerns only. However, the tide may be changing. For example, a municipality on the South Shore included the MCCAP action item, “Develop a process / mechanism by which a REMO representative has input on planning departments recommendations to Council.”

People don’t know what they don’t know. The old adage continues to ring true. In the context of the MCCAP process and this simultaneous grant project, there was an obvious void in the understanding of multiple factors at play when dealing with storm surge, including but not limited to:

- Chart datum versus Canadian Geodetic Vertical Datum and the fact that the water level scenarios provided by William Richards and Réal Daigle in the ACAS report, *Scenarios and Guidance for Adaptation to Climate Change and Sea-Level* were in Chart Datum and needed to be converted
- The conversion factors needed to turn Chart datum into Canadian Geodetic Vertical Datum: municipalities have no idea how to find these numbers, nor are they easily accessible if you do have an idea of where to look

- Wave action is *not* included in the storm surge warning, and yet is of serious concern due to the damage and risk to public safety that waves can cause. And how do you account for waves when identifying areas of high risk during an event? This was touched upon during the presentation and webinar.
- Although the Atlantic Storm Prediction Centre has been using the language of Flood Stages and there is a general sense that the higher the stage the more severe the event, what do those Stages really mean in terms of localized impacts?
- There is inconsistency across the province on whether or not storm briefs (a service offered by Environment Canada's Atlantic Storm Prediction Centre with EMCs province-wide) are shared with Community Planners. In fact, there is an overall void of communication and understanding of each others roles and responsibilities. As well, Planners are generally unaware of the NS EMO structure, the NS EMO relationship to local EMCs, and how this system functions. This may be, in large part, the reason that Planners and EMCs have not been benefiting from each other's knowledge and expertise.
- The culture of EMCs has exacerbated the above-mentioned situation, in that EMCs across the province have traditionally been focused on response. The paradigm shift that the MCCAP process and this grant project may help to inspire is one where emergency management embraces the risk mitigation component of their mandate.
- Even in municipalities with Planning Technicians capable of manipulating spatial data and creating maps, there has not been a practice of using these experts within the EOC for situations in real-time. In cases where the ECO *does* include a Planning/GIS Technician, the Technician may be limited in their knowledge of the available software (i.e., more training is needed), or limited by out-dated software. As well, it was identified that redundancy is problem, meaning that there is often one person who could assist with mapping during a weather event, and if that person is unavailable (or can not get to the EOC) there is no back up.
- Land Use Planners, Planning Technicians, and many EMCs *want* practical information such as was provided by this grant. They also want and need support (i.e., financial support for training, offerings of subject-specific training) so that they can begin to update their practices and procedures in a climate-wise and meaningful way.

Suggested Follow-Up Actions

1. It would behove the Climate Change Unit to include a link to this grant's webinar on their website, as well as the pamphlet and the Post-Storm Analysis Template. It would

also be useful to include (reiterate) the conversion factors for Chart Datum to Canadian Geodetic Vertical Datum.

2. The link to the webinar and accompanying products should be redistributed at the beginning of every hurricane season.
3. In a year, conduct a survey to see how many municipalities completed a Post-Storm Analysis Template after an event. If the number is low, redistribute the Template in conjunction with the webinar and associated products.
4. Environment Canada, through Bob Robichaud , the Warning Preparedness Meteorologist will continue to use this Storm Surge Presentation during an expanded course for Emergency Planners on overall weather interpretation. This course will now be available through Emergency Management Organization Nova Scotia beginning in January 2014 and will be conducted throughout provincial municipalities.
5. During UNSM training of newly elected Councilors, include a review of the roles and responsibilities of EMCs, as well as the system through which they are briefed on severe weather, and the importance of reviewing and updating emergency preparedness plans and contingency plans. As well, explain the link between land use planning and development and risk mitigation, and the benefit of a collaborative approach that more fully involves EMCs and public works, while led by Planners.
6. Collect case studies across the province of municipal processes, procedures or land use decisions that addressed storm surge in a manner that is evidence-based, scientifically valid, and collaborative across municipal departments.

Conclusions

This project highlighted the interest both Emergency Managers and Municipal Planners have in receiving applicable data that can help determine present and future impacts of storm surge on a very practical level.

The presentation and webinar appears to have initiated increased communication between Emergency Managers and Municipal Planners. Such communication has opened the doors to an increased sharing of knowledge and information between these groups. To have both groups involved in climate change adaptation allows for increased efficiency during emergency events and greater understanding of long term impacts and mitigation efforts.

Ultimately, this project has helped bridge a gap between the knowledge held by climate change experts such as meteorologists, planners, and GIS professionals and those first responders and

emergency coordinators that are required to provide emergency assistance to the public when impacts are experienced.