Using an EMO-Based Hazard Risk Vulnerability Assessment Process for Municipal Climate Change Action Plan Development

Town of Truro and County of Colchester

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For:
Town of Truro & County of Colchester
HRVA-MCCAP Core Working Group

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EXECUTIVE SUMMARY

The Nova Scotia Climate Change Directorate's Climate Change Adaptation Fund awarded funding to the Town of Truro and County of Colchester to explore the benefits and limitations of using an emergency management based risk assessment process during municipal climate change action planning. This report:

- reviews the approach taken to infuse an emergency management process into municipal climate change action plan (MCCAP) development,
- summarizes the strengths and limitations that were revealed during the process,
- discusses ways in which municipal and emergency management perspectives converge and diverge in the context of climate change action planning, and
- provides recommendations for other municipalities or organizations interested in using an emergency management based hazard risk vulnerability assessment (HRVA) for informing climate adaptation priorities and actions.

The project was premised on the hypothesis that using the HRVA tool, which is a collaborative planning process, would improve the thoroughness and accuracy of both HRVA *and* MCCAP content while simultaneously fostering improved communication / data sharing between municipal planners and EMO professionals. The central major finding of the project was a confirmation of this hypothesis, with the added realization that the process improved qualities of organizational adaptive capacity.

Another significant finding of this project was that in the absence of the HRVA-MCCAP process, prioritization of emergency management plans for natural disasters would have continued to be based—like most municipal plans—on historical trends and experiences. The HRVA-MCCAP collaboration shifted both municipal and EMO perspectives away from planning based on historical events, to forward looking considerations of climate trends and projections.

The project revealed the extent to which EMO and non-EMO municipal governance assess the potential severity of a threat (i.e., natural disaster) differently. In the context of climate exacerbated natural hazards, EMO is a dynamic response mechanism where the rest of the corporate structure is more static and mitigation oriented. Where EMO is concerned primarily with citizen safety, the municipality as a whole casts a much wider net when assessing a threat (e.g., the potential interruption of municipal services, impacts to the local and regional economy, municipal liability, credibility and confidence of the voting public).

The project grappled with the influence of estimated changes in storm return periods—interpreted as probabilities—on the prioritization of natural hazards warranting emergency plans or municipal adaptation actions. It was discovered that neither EMO or the municipalities were inclined to plan for the worst case scenario, but instead struggled with the question of *which* probability it made the most sense to plan for. The HRVA turned out to *not be* the platform for addressing this question so the MCCAP will have to

explore the subject of matching storm/event probabilities to sensible land uses and development control, as well as adaptation investments.

The HRVA template is based on the definition of a trigger(s): the circumstance or point at which emergency personnel are brought to attention / activated. A major finding of this project was that defining this trigger as explicitly and thoughtfully as possible is critical to validity of the assessment. A key element of the trigger's definition is a climatologically accurate (to the extent possible using latest scientific research) description of the event. A benefit of the MCCAP process was the introduction of localized climate projections into HRVA triggers.

A limitation of the HRVA in the framework of MCCAP development is the fact that economic impacts and impacts to socially valued assets are outside the scope of HRVAs. As well, EMO does not typically consider potential municipal costs associated with preventing or mitigating impacts from a weather event, where this information *is* of interest to a MCCAP designed to ultimately determine which adaptation options to invest in. It was also noted that the ranking of natural hazards requiring adaptive action may be *higher* in the MCCAP than the HRVA due to public pressure / low risk tolerance. For similar reasons, a municipality may be concerned about or addressing a climate trend or weather event *before* it triggers an EMO response.

This report outlines thirteen recommendations for municipalities or organizations that are interested in infusing an HRVA process into climate-wise long term planning.

1. The core working group (assessment and planning team) and those whose support for the process is needed should be briefed on planning requirements, climate projections, and the synchronicities and divergences between corporate planning and EMO planning.
2. Members of the core working group and stakeholders invited to partake in the HRVA process should be briefed on EMO structure and responsibilities (municipal and provincial) before engaging in the collaborative completion of HRVAs.
3. Consideration should be given to what kind of expertise would be valuable to have 'at the table' for each threat to be addressed via an HRVA.
4. Have commitment from the core working group to see the whole process through, and engage stakeholders as needed in a consistent and controlled manner.
5. Engage the core working group in preparing for the HRVA by gathering pertinent information.
6. If an MCCAP team uses the HRVA impact severity narrative (the Overall Impact Score) and 5-tiered ranking system for non-emergency based climate impacts, the narrative should be modified.
7. The numbers of the HRVA's 5-point likert scales for Overall Impact Score and for the Probabilities Score should be reversed.
8. The HRVA's should be used to develop or revise EMO Contingency Plans for the hazards as analyzed in priority sequence.

9. All items identified as White Flags, Red Stops and Green Stops (follow up items) should be passed on to appropriate parties for consideration and attention.
10. HRVA results can be inputted directly into a hazard impact matrix within a climate change action plan. However, priority rankings may need to be reconsidered and take into account the extent to which the economy is impacted, socially valued assets could be negatively affected, and the natural landscape and it's ecosystem services altered.
11. The costing column in the HRVA should be expanded to better achieve its original intent of highlighting the cost of mitigation versus cost of response and recovery.
12. HRVA content should be reflected in the MCCAP's hazard impact matrix and HRVAs should be included as an Appendix to the MCCAP.

PROJECT BACKGROUND

The federal government has committed to transfer funds equivalent to a portion of the federal excise tax on gasoline to municipalities. The federal government and Nova Scotia entered into a Municipal Funding Agreement that set out the terms and conditions of the program. As a requirement for this funding, municipalities prepared and submitted Integrated Community Sustainability Plans (ICSP) in 2010. Currently, municipalities are to develop MCCAPs as an amendment to the ICSP by end of 2013, again, as a requirement for continued funding. This requirement stems in part from the fact that when ICSPs were submitted in 2010 the majority of municipalities identified climate change as a challenge to maintaining infrastructure and overall financial health.

In 2012, Service Nova Scotia and Municipal Relations released a Guidebook outlining a suggested framework for the development of the MCCAPs. The Guidebook presents a 6-step framework with questions nested in each step. The intent of MCCAP process to be undertaken by municipalities in 2013 is the identification of priority areas for adaptive action. In other words, municipalities are determining what the most important things to address are to make sure people, property, special places and essential services aren't compromised by natural hazards exacerbated or introduced by climate change.

Consulting land use planner, Anne Warburton, and Heather MacKenzie-Carey, a Regional Emergency Management Coordinator and emergency management consultant (HMC/EMC Inc.), suggested to the Town of Truro and the County of Colchester that they submit a grant proposal to the Climate Adaptation Fund provided by Nova Scotia Department of Environment's Climate Change Directorate. The Climate Change Adaptation Fund is a pool of funding available to "assist with the identification and assessment of the threats and opportunities related to climate change in Nova Scotia and build Nova Scotia's capacity to become better suited to new and different climatic conditions." The project was undertaken to determine whether or not concentrated effort to complete Hazard Analysis for emergency management purposes using an HRVA Model adapted from NS-EMO would provide each municipality with information that could be extrapolated from the HRVAs directly into their MCCAP.

The HRVA is a tool that Heather was hired to design for the NS-EMO office. The purpose of the tool is to prioritize hazards to direct emergency management planning efforts. Heather and Anne quickly recognized synchronicity between the HRVA and the MCCAP process. They believed the data required to complete the MCCAP would be similar to information gathered to complete HRVAs within the emergency management community. Emergency managers use hazard analysis to assess the impacts of identified threats and direct emergency planning efforts at all levels of mitigation, preparedness, response and recovery.

The grant proposal was premised on the following hypothesis. Using the HRVA tool, which is a collaborative planning process:

- improves thoroughness and accuracy of HRVA content,
- improves thoroughness and accuracy of MCCAP content, and
- fosters improved communication / data sharing between municipal planners and EMO professionals.

The Town of Truro and County of Colchester were successful with their grant application, so released a request for proposals for facilitation of the grant project. Anne Warburton and Heather MacKenzie-Carey submitted the successful bid for the work.

The project's accepted workplan was structured around one initial workshop followed by three working sessions. The initial workshop was to kick the project off and provided a wide audience (e.g., municipal staff and Council, key stakeholders) with base knowledge of the MCCAP requirement, climate trends and projections, and design of the HRVA. This workshop built support for the HRVA-MCCAP process, as well as helped select staff prepare for the following working sessions. The second and third working sessions involved a pre-selected core working group. Collaboratively, this core working group completed HRVAs for six natural hazards that Heather and Anne had identified as hazards most directly affected by changes in climate. The fourth working session offered an opportunity to:

- review HRVA results,
- discuss the strengths and limitations of using the HRVA template during MCCAP development,
- garner tips that may be applicable to other municipalities / groups interested in addressing EMO and climate change action planning simultaneously,
- collaboratively identify any opportunities or needed actions that could simultaneously benefit both municipal planning and emergency management, and
- review next steps for MCCAP development

This report fulfills three project objectives: 1) it summarizes the HRVA process and synthesizes the results of the HRVA working sessions, 2) it evaluates the strengths and limitations of the HRVA tool itself, and 3) it catalyzes a discussion about the intersection

and divergence of emergency planning and municipal adaptation planning. The structure of this report mirrors these three objectives.

HRVA WORK SESSIONS

Six threats (natural hazards) identified as being influenced by changes to climate, and with the potential to require emergency planning were assessed through the HRVA model in workshop format. The six hazards of focus were:

1. Coastal Flooding
2. Drought
3. Forest Fire/Wildland Fire
4. Hurricane
5. Inland Flooding
6. Winter Storm/Blizzard

The goal of the HRVA work sessions was to complete a Regional HRVA for each of the six threats. Each HRVA was to take climate change projections into consideration and assign a ranking number that indicated priority for emergency planning. The overall format of the work sessions for each of the six threats was:

1. Review basic impact of each threat with consideration for Climate Change projections.
2. Review critical infrastructure and vulnerabilities for each threat.
3. Complete any information gaps for each HRVA required for overall analysis.
4. Assign overall regional ranking of threat by group consensus.

It was understood that the collaborative analysis of risk would likely identify issues of concern in all (EMO) areas of prevention, mitigation, adaptation, preparedness, response and recovery. It was recognized these issues might be specific to a particular unit or regional in scope. In order to remain focused on analysis only without losing valuable information for later use, a flagging system was utilized during the workshop.

Issues outside the scope of analysis, as well as issues, questions or concerns that could not be answered during the workshop with the gathered resources and personnel were documented and organized under three categories:

1. White flag of surrender: any item that was a long-standing issue, considered political in nature, or involved personnel not within the committee or unit jurisdictions (e.g., provincial, or municipal leadership), or specific to the HRVA model being used
2. Red Stop for Emergency Management: any item that should be addressed by Emergency Management during response, future planning or analysis
3. Green Go to MCCAP: any item that should be addressed through further MCCAP work.

Appendix B lists all items documented using the categories above. It should be noted that some questions listed as 'Green Go to MCCAP' items during the first HRVA work session were indeed answered before the second HRVA work session. For example, during the first work session the question arose as to how many days of water supply the Town of Truro's reservoir could provide if the reservoir's supply had been eliminated: a question pertinent to the conversation about drought. By the next HRVA work session, the Town's engineer was able to provide this estimate. The point being, this process worked very well. The group was able to record and organize issues and questions as they arose in a manner that did not diminish the importance of the issue or question, and this helped the group maintain momentum and not get bogged down when uncertainty surfaced.

One of the ideas being tested within the HRVA-MCCAP grant project was the replicability of this process by other municipal jurisdictions. Heather, a long-time emergency management professional, had guided the group through the first two HRVAs (inland flooding and blizzard) in plenary, achieving consensus along the way. At the second work session, the group split in two and each completed an HRVA. Once both groups had completed their HRVA, they vetted their decisions with the other group. The purpose of this shift in format was to 'test' the degree to which a group could guide themselves through the HRVA. Three lessons were learned from this experiment in facilitation:

1. While a group *can* work through the HRVA—it is straightforward enough to do so—having the guidance of a professional emergency management professional does make a difference in the quality and relevance of information recorded.
2. Third-party facilitation—with a relevant professional background—helps to ensure that the HRVA questions are understood, keeps the group on track, and facilitates the consensus process.
3. The right people need to be at the table for each threat being considered. For example, the group that worked on the HRVA for coastal flooding during the second work session had the benefit of being joined by a provincial employee of the Department of Agriculture responsible for dyke management and maintenance. Her knowledge was critical to process. She offered practical insight that helped the group begin to understand the threat accurately. In fact, had she not been there, a crucial impact would not have been listed simply because group members were unaware of the issue: the siltation of aboiteauxs as a cause for or aggravation of flooding.

HRVA RESULTS SUMMARY

By the end of the grant project's third workshop, the core working group had completed six HRVAs as intended. The completed HRVAs can be found in Appendix A. Final scores and hazard ranking are as per Table 1.1 below.

Table 1.1. HRVA/MCCAP Threat Assessment Summary

Threat	Hazard Risk Vulnerability Ranking	Hazard Risk Vulnerability Actual Rating Score (1-25)
Flood Inland	**High**	**15 (requires more analysis due to low risk tolerance)**
Hurricane	**High**	**15**
Winter Storm/Blizzard	**High**	**15**
Wildland Fire	**Medium**	**8**
Drought	**Medium**	**6**
Coastal Flooding	**Low**	**5 (required more analysis due to low risk tolerance)**

Of the six threats assessed, Flood Inland, Hurricane, and Winter Storm/Blizzard ranked highest with a score of 15 out of 25 identified for each of these three threats. Of these three, it was further assessed that Flood Inland was a high priority due to past events and a low risk tolerance among the general public and media. For each of these threats a trigger point, which would bring the impact from an 'every day first responder' emergency to an event involving municipal resources and beyond, was identified as a disruption in transportation.

Wildland Fire was scored as an 8 out of 25 or a medium priority for planning. This HRVA was completed with particular focus on a fire within Victoria Park having the greatest potential to impact the municipality and require resources beyond Department of Natural Resources.

Drought was scored as a 6 out of 25 or a medium priority for planning. Analysis revealed the current reservoir can handle extensive drought conditions but dry wells (particularly dug wells) could become cause for concern at a threshold level of 60% of the population.

Coastal (storm surge) flooding was scored as a 5 or low priority for emergency planning. This threat scored very low (rare chance of occurrence; once every 100 years or more) in *probability* but received the highest impact score (5) considered catastrophic if it did occur.

STRENGHTS AND LIMITATIONS OF THE HRVA TOOL FOR MCCAP DEVELOPMENT

This project marked the second time that HRVAs had been explored as a means of MCCAP development. The first time revealed an opportunity to refine the HRVA tool so that references to climatic changes and probability scales better aligned with terminology

and probabilities provided to Nova Scotian municipalities for climate change action plan development: specifically, the Atlantic Canada Adaptation Solutions research, *Scenarios and Guidance for Adaptation to Climate Change and Sea-Level Rise – NS and PEI Municipalities* by William Richards and Réal Daigle. As well, discussions with non-EMO municipal staff brought to light some uncertainty about the *extent* to which the HRVA process could underpin MCCAP development, as well as the practical influence of the exercise on daily municipal or EMO operations. The Town of Truro and County of Colchester's HRVA-MCCAP project explored these two questions explicitly.

At the fourth work session, Heather MacKenzie-Carey and Anne Warburton led a discussion with the municipal HRVA-MCCAP core working group exploring the strengths and limitations of the HRVA process as a means of MCCAP development.

The core working group confirmed the hypothesis that the HRVA-MCCAP grant was premised on: using the HRVA tool, which is a collaborative planning process improved thoroughness and accuracy of HRVA content, improved thoroughness and accuracy of MCCAP content, and fostered improved communication / data sharing between municipal planners and EMO professionals.

It is important to explicitly recognize key ways in which thoroughness and accuracy of the HRVAs and the MCCAP were improved. First and foremost, HRVAs—not unlike other municipal planning practices—were predicated on historical events. Bringing HRVAs into the MCCAP process shifted the focus to what is likely to happen based on climate projections compared to what is likely to happen based on previous experience.

Municipal staff noted that the MCCAP process "would have missed (many) impacts on the community if the EMO perspective had not been accounted for." Entering MCCAP development through the EMO door brought a human element to the process—an emphasis on citizen safety—that might have otherwise been inadvertently diminished. As well, this emphasis reconnected municipal staff with ideas about how land use and infrastructure play a role in aggravating or mitigating hazard vulnerability.

In terms of fostering improved communication and data sharing between municipal planners and EMO professionals, the core working group agreed whole-heartedly that the process did in fact increase awareness of what the other does and reveal resources that are mutually beneficial or needed. For example, the Town and County's REMO Coordinator was pleased to learn of the population density map for use during emergency planning and response. As well, municipal staff and EMO were able to compare perceptions of what by laws could and could not be reasonably enforced—such as fire bans—and why. Such conversations are essential to ensuring that MCCAP action items are truly implementable.

In addition to these fundamental strengths, the core working group also agreed that using the HRVA process as a base of MCCAP development:

- revealed potential resources (e.g., population density mapping) that could be used for both municipal planning and during an emergency event,
- revealed significant gaps in knowledge at the organizational level (e.g., no one has information on the location or type of hazardous materials, where it might have been assumed that emergency management professionals had this information),
- brought knowledge partners to the table who might otherwise not have been present (e.g., Department of Community Health and Wellness, Public Health, NS Department of Agriculture), and
- served as a reminder of a municipality's (non-EMO) role in citizen protection and disaster mitigation via land use.

While it was understood at the onset that the HRVA was not designed to fulfill the scope of a climate change action plan, the grant project wanted to define the HRVA's limitations within the role it does play. The core working group agreed that these limitations included:

- the HRVA trigger was framed purely from the EMO perspective,
- there are hazard-impacts that an HRVA won't capture because they don't warrant an EMO response, but are of importance to a municipality (e.g., alternating wet/dry climate triggering mobility of arsenic, coastal erosion),
- an EMO based priority ranking may be different than the final MCCAP ranking in that it doesn't include consideration of public risk tolerance, or non-emergency but equally important impacts, and
- the costing question within the HRVA was intended to illustrate the cost of mitigation versus the cost of emergency response, but instead was a point of confusion.

THE RELATIONSHIP BETWEEN EMERGENCY PLANNING AND MUNICIPAL ADAPTATION PLANNING

In addition to talking about the strengths and weaknesses at the fourth work session, the municipal HRVA-MCCAP core working group also reflected on ways in which corporate (municipal) and EMO perspectives converged or diverged in the context of addressing climate change, and why. Discussing points of divergence was particularly useful in that it revealed issues not captured within the collaborative HRVA process that the municipality (Town or County) would need to follow up on in order to complete the MCCAP.

Key points of convergence included:

- all hazards and impacts listed in HRVA *are* a concern to both EMO and municipal governance,
- the narrative used to define and rank severity of impact speaks to both municipal and EMO concerns,

- there was agreement from both the municipal and EMO perspectives on the priority rankings of the natural hazards warranting emergency plans,
- it was agreed that if the municipality does well mitigating impacts through an adaptation strategy the chance of an EMO response being activated lessens, and
- certain resources and spatial data are of use to both land use and emergency planning.

The core working group agreed that there were three key areas of divergence. First, and most fundamentally, **the perspectives from which a municipality and EMO *assess* a threat are different**. EMO is concerned with people's safety first and foremost. That concern is immediate in nature, meaning that the EMO perspective is inclined to focus on the *most probable in the near term*. It has not been the practice of EMO to consider how climatic changes may alter the frequency or magnitude of response in the future. It was recognized, however, that there is value in taking a long-term planning view within EMO in order to adequately address a changing need for resource allocation and response preparation.

Historically, land use planning *arose* from the need to protect the safety of citizens. It was from this historical intent that separation of land uses became so commonplace. Municipal responsibility for safety has not diminished over time, but like other corporate cultures, that role has been largely allocated to EMO (and its predecessors) and increasingly 'softened' within the rest of the local governance structure. The HRVA-MCCAP process served as a reminder of the connections between land uses, municipal services, and citizen safety. It also pointed out that while emergency plans are designed to protect citizens from the threat of highly probable near term events, municipalities have a wider view of 'threat'. Municipalities consider anything that poses a potential interruption of services (e.g., ability to distribute an adequate supply of potable water, ability to manage and treat wastewater, ability to ensure accessible transportation networks) to be a threat. As well, from a municipal perspective, a natural disaster or climatic change is a threat if it has the potential to cause local job loss. And to a lesser degree, events for which a municipality cannot adequately respond (in the eyes of the public) are considered 'threatening' because of the potential for diminished trust in or credibility of elected officials. In light of these perspectives of threat, **municipalities are concerned not just with the most probable in the near term, but also with varying probabilities over the long term**. This is understandable given the static nature of many municipal decisions, such as infrastructure investments and creation of planning strategies and land use by laws. When asked if they wanted to address the most probable, or the worst case scenarios, the municipalities responded that they wanted to 'see both'. EMO said they plan for the most probable scenario (not the worst case scenario).

In addition to divergent perspectives when defining a 'threat', a few other points of divergence emerged during the HRVA-MCCAP process.

- The point at which a weather event triggers municipal concern and response may be different from the point at which EMO is triggered into action. In other words, **a municipality may be involved in non-emergency mode before it reaches a**

critical EMO trigger point. The MCCAP can capture this, but the HRVA cannot.

- The HRVA is concerned with public safety and critical infrastructure. **Economic impacts and impacts to socially valued assets** (high valued places that are not considered to be critical infrastructure) **are not captured in the HRVA process** when assigning a rank for severity of impact.
- Although there was agreement from both the municipal and EMO perspectives on the priority rankings of the natural hazards warranting emergency plans, the **ranking of natural hazards requiring adaptive action may be *higher* in the MCCAP due to public pressure / low risk tolerance**. Case in point, coastal flooding received a surprisingly low rank on the EMO priority scale due to a perceived low probability of occurrence despite high impact severity if/when it does happen. The municipality will likely increase this ranking in their MCCAP due to recent attention around flooding issues.
- **EMO does not typically consider potential municipal costs associated with preventing or mitigating impacts from a weather event**. EMO is simply ready to respond given current circumstances. A municipality, in comparison, *is* interested in comparing costs of mitigation to costs of response and rebuilding within a given timeframe (probability of occurrence). In essence, the perspective of EMO is response based, where the perspective of a municipality is largely mitigation based.

KEY LESSONS

When an HRVA is filled out, the group collaboratively defines trigger points: events or situations that would bring EMO to the table—instigate a state of response readiness. These trigger points are the basis from which the HRVA is completed. For example, in the coastal flooding HRVA, the trigger point was defined as, "Warning of Storm Surge potential above 2 feet occurring at High Tide." This trigger dictates how the group then assesses impacts: what areas, people and infrastructure would be affected when the water is *this* high?

One of the key lessons from this project was the critical importance of spending time on defining and understanding the 'trigger'. It is now understood that **this is where the value of climate projections comes into play**, as the trigger must be climate-wise given the most recent projections available.

A related lesson was how difficult it is to ensure understanding of and reach consensus on the *probability* of an event, especially in the context of a collaborative municipal-EMO process. Said another way, it is hard to understand what probability to plan for. Neither the municipality or EMO are planning for the worst case scenario, and planning for the 100 year storm as defined by historical events is no longer indicative of what to expect in the future. Again, this revealed a key lesson about the value of incorporating climate change projections. The lesson being, **climate projections should be used to define a weather event's magnitude**. In other words, probabilities should be based on climate projections (e.g., design rainfall events based on downscaled

projections) instead of historical data. This notion *is acceptable* to both EMO and municipalities. Therefore, MCCAP teams desire clear definitions of what the new 1:100 year event means, as well as other return periods. As well, it is useful to have projected water levels given in Canadian Geodetic Datum 28 and broken into constituent parts (e.g., total sea level, storm surge, higher high water large tide), and estimated rainfall amounts and anticipated drought lengths to the extent possible. Lastly, this information needs to be communicated in a manner that is easily interpreted for multiple return storm periods. *This* was the main role of Anne Warburton's contribution as a consultant: simply assisting with the *interpretation* of climate projections and connecting the municipality with whomever has the expertise to aid in the appropriate understanding and application of that information.

Another key lesson emerged gradually throughout the HRVA process, and that was that **we often do not know *who* holds *what* information**. As the group began to understand what kinds of questions they needed to be asking in order to assess the threat of a particular disaster, they were often surprised at what kind of information other groups had access to, as well as what information *no one* seemed to have. For example, a professional from Capital Health who attended the project kick off workshop made sure that appropriate representatives attended HRVA work sessions. One such professional brought to a HRVA work session a risk assessment they had just completed which was interesting to see and provided information pertinent to assessing social vulnerabilities. The same person was able to—with one phone call—answer questions about vulnerable populations due to particular drug dependencies. While location of these people is unknown and ever changing, having an estimated number for such populations informs an emergency plan on what to be prepared for, and to what extent. As well, having stakeholders from health sector offered valuable insight on the concept of 'vulnerability' and which populations may truly warrant specific attention. They also have practical knowledge about who 'vulnerable' groups turn to when in need of help. For example, elderly will turn to the people they already have relationships with, such as home health care assistants. They will *not* likely call emergency services.

On the flip side of learning who had valuable information to share, was the lesson that sometimes the information does not exist. For example, it was assumed that fire services possessed information about the location and type of hazardous materials. This proved to be erroneous. Similarly, it was assumed that the Department of Agriculture would have GIS data on the location and types of agricultural operations. They do not, although they are working toward that. It was also assumed that federal and provincial departments would provide any and all data relevant to threat assessments, but this has also proved untrue. Case in point, the Canadian Hydrographic Service is reluctant to share data needed for individual tide gauge sites to assist in the conversion of Chart Datum to Canadian Geodetic Vertical Datum 28. Similarly, the Nova Scotia Department of Natural Resources is trying to figure out the best way to share information about saltwater intrusion and other geohazards. Meanwhile, the information is not readily available.

The good news is that all HRVA-MCCAP questions for which information was not available, led to creative ways to get the information (i.e., forging new relationships with

people that *could* provide access to information) or were considered fodder for MCCAP action items (e.g., follow up with Department of Agriculture to track their progress in compiling their information into GIS layers).

RECOMMENDATIONS FOR HRVA USE FOR MCCAP DEVELOPMENT

The following recommendations stem from the insights of the core MCCAP working group for the Town of Truro and the County of Colchester, as well as the experiences of Heather MacKenize-Carey and Anne Warburton who have been involved in the use of HRVAs in two regional MCCAP processes.

13. If completing HRVAs in the context of municipal climate adaptation planning, involved parties and those whose support for the process is needed, should be briefed on MCCAP requirements, climate projections, and the synchronicities and divergences between questions posed in the Provincial MCCAP Guidebook and the HRVA template.

    The HRVA process has been used within this grant project as the initial base for MCCAP development. The purpose of reviewing the MCCAP requirements, climate projections and similarities and differences between the MCCAP and the HRVA is to build and understanding of and support for the *entire* MCCAP process. For that reason, it is important to have Council members present as well as stakeholders who may, at some point, be asked to contribute knowledge and effort to MCCAP development. As well, it is a means by which to begin introducing the concept of mainstreaming climate-wise long-term planning and language around qualities of social vulnerability, adaptive capacity and resilience.

14. Members of the core working group and stakeholders invited to partake in the HRVA process should be briefed on EMO structure and responsibilities (municipal and provincial) before engaging in the collaborative completion of HRVAs.

    During the process of working through HRVAs, there were moments where it became clear that stakeholders invited to the table did not understand the EMO structure and responsibilities of NS EMO versus local REMO or EMO staff. This lack of knowledge underpinned some misguided assumptions and misunderstandings about who is responsible for what. The flagging process mitigated the situation, as white flags were used to capture concerns about perceived inefficiencies. However, it was noted that time spent at the forefront explaining the EMO structure would build organizational capacity (i.e., redundancy, expertise, flexibility) and improve the quality of suggestions regarding emergency *and municipal* planning efforts at all levels of mitigation, preparedness, response and recovery disaster preparation.

15. Consideration should be given to what kind of expertise would be valuable to have 'at the table' for each threat to be addressed via an HRVA.

    Have the *right* 'knowledge partners' at the table, but don't have too many people involved. A working group of 10-15 maximum is suggested. Members of the core working group are told to bring information with them that is pertinent to the natural disaster being discussed, and are encouraged to phone colleagues or stakeholders when/if information is needed from someone outside of the room. This 'life line' approach worked well *when* it was known *who* to call, but as noted in Key Lessons Learned, the fact that the team didn't always know who to call was a lesson in and of itself. Similarly, much was learned about what information is and is not available. The core working group believed, in hindsight, that it would have been quite valuable to have someone from the DNR's environmental services program as part of the working group to help connect to existing spatial resources, forthcoming resources, and other Departmental expertise vital to emergency mitigation, preparedness, response and recovery (i.e., fire crews, erosion site assessments, slope stability assessments, salt water intrusion data, spatial information pertinent to arsenic, etc.).

16. Have commitment from the core working group.

    Consistency in and commitment from the core working group from start to finish is critical: starting with the project kick off meeting where members are introduced to the process and its requirements, through to completion of not only the HRVAs but also follow up work as defined in the flagging system. There are team qualities that develop during the process that are not to be underestimated. Being engaged from start to finish is essential to building organizational capacity. As well, it hastens the process and improves the quality of the results in that members quickly become familiar with the process and the strengths that fellow team members bring to the table.

    While members are encouraged to reach out when specific information or expertise is needed, the engagement of stakeholders needs to be controlled and expected. Meaning, if it is noted that an HRVA for a particular natural disaster would benefit from a select stakeholder, then it should be known by the group that that stakeholder will be present at the HRVA work session and for what purpose. What should be avoided is an open-ended invitation to a stakeholder (e.g., Department of Community Health and Wellness or Public Health) without a commitment from that stakeholder to be at every HRVA session. The reason being, involvement in a few HRVAs but not all HRVAs may introduce some inconsistencies in the thoroughness with which certain topics/issues are addressed. While it is unlikely this lack of consistency would significantly alter the final priority ranking, the ranking process would be better served in general if all HRVAs had similar levels of expert input.

17. Engage the core working group in preparing for the HRVA by gathering pertinent information.

    One of the success factors in the HRVA process is letting members of the core working group know what to expect of the process (i.e., how it will run) and what kind of information might be useful to have / know in order to answer questions posed during the process. In preparation for the first HRVA work session, Heather MacKenzie-Carey explained the process to members of the core working group and the group members self-assigned who would gather what information. There was a great deal of uncertainty about *what* kind of information was needed exactly, but Heather assured the group that the flagging process was defined to address uncertainties and until actually engaged in the process, it is difficult to foretell all information that will be desired. However, 'homework' done ahead of time not only contributed to the HRVA completion but also initiated some momentum and investment in the process. For example, on member of the core working group volunteered to reach out to the Red Cross and other organizations to see how had what information about vulnerable populations. As well, the GIS technician prepared and brought to the HRVA work sessions maps such as population density, existing flood risk delineations, and location of critical infrastructure and public institutions. These maps were posted around the room and members of the core working group were encouraged to get up and refer to the maps when collaboratively answering questions about areas, infrastructure and populations potentially impacted by a particular threat.

18. If an MCCAP team uses the HRVA impact severity narrative (the Overall Impact Score) and 5-tiered ranking system for non-emergency based climate impacts, they may want to modify the narrative.

    In discussion with the core working group after the HRVAs were completed, municipal staff commented that references to fatalities threw them off a bit because there can be 'catastrophic' impacts to a municipality that do *not* entail loss of life or injury. For example, a highly probably situation of significant damage to key critical infrastructure that the municipality could not readily afford to fix may be ranked as a high priority, irrespective of citizen safety. While consideration of fatalities and injuries is inherent to the EMO threat assessment, when this impact severity scale is adopted for climate impacts that *don't* trigger an emergency response, slight alterations will make it more municipally oriented. In addition to removing references to fatalities, the Town of Truro and County of Colchester suggested *adding* sentences that reference a measure of economic impact, the degree to which socially-valued (though non-critical) assets are impacted, and the community's ability to respond to an event before outside (provincial) resources are called upon.

19. The numbers of the HRVA's 5-point likert scale for Overall Impact Score should be reversed. The same reversal would be required for Probability Score.

Currently, a 5 is catastrophic while a 1 is insignificant. It has been suggested that flipping this scale around (though no need to change the narrative) would better align the HRVA with the Incident Command System currently being put into place by the NS EMO office. This flip would mean that a ranking of 1 is of greatest concern, and a 5 would be 'insignificant'.

The same switch would be required in the Probability Score. Currently a Highly Probably event is given a 5, while a rare chance event is given a 1. The flip would mean a ranking of 1 is of greatest likelihood, while a 5 is rare.

With this reversal, the final Hazard Risk Vulnerability Rating would be assigned a 1 for a high priority planning and a 25 for the low priority for planning.

20. EMO should use the HRVA's to develop or revise existing Contingency Plans for the hazards as analyzed in priority sequence.

    The completion or revision of Contingency Plans for the hazards analyzed during the HRVA process in the order in which they were prioritized respects not only the wisdom of the process but also more importantly the wisdom of the group that completed the ranking. This recommendation is related to the confirmed hypothesis that using HRVAs during MCCAP development improves the thoroughness and accuracy of HRVA content. Having thoroughly analyzed the impacts in the HRVA process, Contingency plans can be developed to plan for a more effective response.

21. All items identified as White Flags, Red Stops and Green Stops should be passed on to appropriate parties for consideration and attention.

    HRVAs, like the MCCAP, should be considered 'living' documents. They are containers of knowledge that need tending and updating in order to be of use. Following up with flagged items is part of that 'tending'. If an item or an issue was important enough to be flagged, then not following up with that item would leave a hole in the container. The thoroughness of the HRVA and/or MCCAP relies on this follow-up.

22. HRVA results can be inputted directly into a MCCAP hazard impact matrix. However, priority rankings may need to be reconsidered and take into account the extent to which the economy is impacted, socially valued assets could be negatively affected, and the natural landscape and it's ecosystem services altered.

    These elements of step 5 in the MCCAP Guidebook are outside the scope of the HRVA. HRVA rankings should be considered a first (and thorough) step at assessing priority areas for adaptive action. The second step would be to evaluate if and how a impact severity ranking should be changed based on social, economic and environmental considerations.

23. The costing column in the HRVA should be expanded to better achieve its original intent of highlighting the cost of mitigation versus cost of response and recovery.

    The cost column of the HRVA was a point of confusion when used on the South Shore. This column was modified for the Town of Truro and County of Colchester, but still proved difficult to handle. It was decided by the core working group that another modification was needed. They suggested dealing with the cost in three tiers:

    - Estimated municipal cost to mitigate: high, medium, low (defined by pre-selected dollar amounts)
    - Estimated municipal cost for response: high, medium, low (defined by pre-selected dollar amounts)
    - Estimated collective cost to residents for recovery: high, medium, low (defined by pre-selected dollar amounts)

24. HRVA content should be reflected in the MCCAP's hazard impact matrix and HRVAs should be included as an Appendix to the MCCAP.

    This recommendation reflects the core working groups belief that despite the limited role HRVAs play in MCCAP development, they *do* play an important and pivotal role. As well, despite natural divergence of the municipal and EMO perspectives, the collaborative effort was a resounding success in that it did improve organizational capacity. Lastly, including HRVAs as an appendix to the MCCAP solidifies the critical nature of the EMO perspective in climate change action planning. Via that connection, updates to the MCCAP should stimulate simultaneous updates to the HRVAs and vice versa.

APPENDIX A: COMPLETED HAZARD RISK VULNERABILITY ASSESSMENTS

Hazard Risk Vulnerability Model
Revised From: Nova Scotia Emergency Management Organization HRVA Model

Inland Flooding

Background Information

Analysis Completed For: Town of Truro & County of Colchester
Analysis Completed By: MCCAP/HRVA Team
Date of Last Review/Update: January 2013

Category of Hazard

X	Natural
	Technological
	Industrial
	Human-Induced

Definition of Specific Hazard

A Flood can be defined as "an overflow or inundation that comes from a river or other body of water and causes or threatens damage".

This may occur as a result of weather phenomena and events that deliver more precipitation to a drainage basin than can be readily absorbed or stored within the basin over time or as a Flash Flood, the result of heavy or excessive amounts of rainfall within a short period of time, usually less than 6 hours, causing water to rise and fall quite rapidly.

*Historically a 100-year flood occurs **on average** once every 100 years and thus has a 1-percent chance of occurring in a given year. (Williams & Daigle)*

Related Notes or Hazard Triggers (specific to Hazard Definitions for area)

Environment Canada predicting Heavy Rainfall; Spring thaw after a winter of heavy snowfall where temperature stays above freezing overnight; rising water levels causing traffic disruption/closures; evacuations required for low-lying (residents & business)

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
Yarmouth/Halifax November 2012	None noted	Nov 7-Dec. 15- high winds & heavy rains over a one month period; Nov. 7 215mm rain fell in Yarmouth, 172mm Halifax. 120 homes evacuated in Yarmouth, roads & bridges washed out, homes damaged, 46,000 homes without power,
September 2012	Installed permanent gate on Park Street; 1 Business moved locations; province and county fixed North River Berm; upgraded Berm at Holy Well Park;	Heavy rainfall during high tide; 6 homes evacuated; large media influence; berms were damaged along North River; roadways shut down; private home basement flooding Eddygroup flooded; erosion on properties
Meat Cove August 2010	None noted	Flash flood, five bridges swept into sea; 35 residences isolated;
Bridgewater 2005	None noted	383 mm rain over 3 day period, overland flooding of Fancy Lake (watershed area), 100 evacuated Est. Cost of $1,447,904

Predicted Events without Historical Evidence

Predicting Authority	Predicted timeframe	Mitigation Strategies	Comments
Environment Canada	5		Flooding situation likely to continue and increase due to increased building and rising sea and water levels
Climate Scenario Development for Communities in Nova Scotia, ACAS 2011 (the Williams and Daigle report(http://atlanticadaptation.ca/acasa/node/181	By 2050	" "	Amount of rain to fall during rainfall events expected to increase (Daigle Report Table A-18). Water deficits predicted, meaning that conditions will generally alternate between too wet and too dry, to a greater extent than experienced currently.
Bedford Institute of Oceanography	decadal and 50 year timeframes		High uncertainty related to rainfall predictions, especially at local level. However, findings do not counter the Williams and Daigle study mentioned above.

IMPACTS

Identify most likely Impact Area

Flood Plain Mapping has been done available through municipal offices

Identify Population number in Impact Area

Direct population (1,200-1,500 properties) affected by flooding

Larger population (25,000-30,000) impacted by road closure/disruption caused by flooding

Identify numbers of Susceptible Persons in Impact Area

Group	Estimated Numbers
Property owners	1,200-1,500
Persons with mobility issues	Unknown
Farm/livestock owners	Horses from Racetrack (Dept. of Ag)
Homeless	None known
Pet owners (evacuation)	Approx. 764 companion pets *
Drug-dependent individuals	Unknown
Medical equipment dependent individuals	Unknown
Residents without 72 hour preparedness ability or plans	Unknown
School (CEC)	1700
Colchester Stadium (if occupied)	1000 (potential)

* estimated from U.S. Pet formula (1500 households) https://www.avma.org/KB/Resources/Statistics/Pages/US-pet-ownership-calculator.aspx?PF=1

Identify critical Infrastructure in Impact Area

Sites	Identify Owner (Private; Municipal; Prov. Fed)
Roads	Provincial, municipal, private
Bridges (Millbrook)	Provincial, municipal
Dams/Berms/Dykes	Provincial, municipal, private
Culverts	Provincial, municipal, private
Cemeteries (Robie St. Cemeteries)	Private
On site septic & wells	Private
Industrial & Agricultural Sites with potential hazardous goods	Unknown
CN Rail Line; Cape Breton Rail	Private

Identify Severity of Impacts and Resources Required

Typical Impacts (Table 1)	Estimated # Affected (People/Structures)	Resources required to respond	Estimated Cost Ranking For Response			Comments
			High	Med.	Low	
Fatalities and injuries	Less than 10	First Responders			X	Everyday emergency
Displacement	Approx. 50	REMO/Red Cross			X	2 apartment buildings
Isolation	Less than 10	First Responders			X	History of one dwelling on private road isolated
Water contamination	100 Homes (County)	Water testing kits; potable water			X	100 home owners on private wells; potentially high cost for home owner if contaminated
Community Lifeline damage – Roads & bridges	51,000	No resources available other than redirection/detour			X	First Responders would have longer response times (significantly increased)
Erosion	51,000	First Responders/REMO	X			Erosion to berms occurred in past; difficult to predict what might erode & when; could involve sudden road failure/collapse
Transportation disruption	51,000	First Responders/REMO			X	As per lifeline damage & erosion
Property Damage	1,200-1,500	Building Inspector; Homeowners			X	High cost potentially for homeowners, low cost for municipal

High Cost = 500,000 & above
Medium Cost = 75,000- 500,000
Low Cost = 75,000 & below

HAZARD RISK VULNERABILITY RATING

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

X	5	Highly Probable : once every 5 years or less
	4	Likely to occur once every 10 years
	3	Might occur once every 20 -30 years
	2	Not expected; could occur once every 50 years
	1	Rare chance of occurrence; once every 100 or more years

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard)

	5	**Catastrophic**, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
	4	**Significant;** 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
X	3	**Moderate**; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
	2	**Minor;** less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours
	1	**Insignificant;** no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

(Probability score) __5__ X (Overall Impact Score) __3__ = Number assigned to this Hazard _15___(1-25)

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public			X
Media			X
Other (Identify)			

Final Hazard Assignment, in consideration of Risk Tolerance for Priority Planning

	1-5	Low
	6-10	Medium
X	11-25	High
X		Requires further analysis/planning due to Risk tolerance rating

Hazard Risk Vulnerability Model
Revised From: Nova Scotia Emergency Management Organization HRVA Model

HURRICANE

Background Information

Analysis Completed For: Town of Truro & County of Colchester
Analysis Completed By: MCCAP/HRVA Team
Date of Last Review/Update: January 2013

Category of Hazard

X	Natural
	Technological
	Industrial
	Human-Induced

Definition of Specific Hazard

When disorganized clusters of showers and thunderstorms become organized so that a definite rotation develops and winds become strong, the system is upgraded to a tropical depression. If winds continue to increase to 63 kilometres per hour the system becomes a tropical storm and is given a name. The system becomes more organized and the circulation around the center of the storm intensifies. As surface pressures continue to drop, the storm becomes a hurricane when wind speed reaches 118 kilometres per hour. An eye develops near the center of the storm, with spiral rain bands rotating around it.

Once a tropical cyclone reaches hurricane strength it is given a rating from 1 to 5 on the Saffir-Simpson Hurricane Intensity Scale. A category 1 storm has the lowest wind speeds, while a Category 5 has the highest.

Category 1= minimal damage; primarily to shrubs, foliage and unanchored homes or structures

Category 2- moderate damage; damaged to exposed mobile homes; poorly constructed signs; some roofing; window and door damage; rising water in roads 2-3 hours before arrival of the center; marinas flooded; small craft torn from moorings; **Evacuation of some shoreline residences and low-lying areas required**. Hurricane Juan made landfall as a Category 2.

Category 3- extensive damage; large trees blown down; signs, roofing, window and door damage; structural damage to small buildings; mobile homes destroyed; serious flooding at coast; larger structures near coast damaged by waves and debris; low lying escape routes flooded with water 3-5 hours before hurricane arrives; flat terrain of 1.5 metres or less above sea level flooded inland 1.3km or more. **Evacuation of low-lying residences within shoreline area required**.

Category 4- extreme; trees, signs blown down; extensive damage to residences; complete destruction of mobile homes; flat terrain of 3 metres or less above sea level flooded inland as far as 9.5km.Low-lying escape routes cut by

rising water 3 to 5 hours before hurricane center arrives. **Major evacuation required of all residences within 50 metres of shore and single-story residences within 3km of shore likely required**.

Category 5- catastrophic; unlikely in Canada

Related Notes or Hazard Triggers (specific to Hazard Definitions for area)

Warning (Environment Canada or NS-EMO) of Category 1 or above entering Canadian waters with potential to make landfall within Atlantic region

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
Aug. 28-30, 2011	No changes	Multiple warnings and "near misses" during very active 2011 season; Irene downgraded to extratropical when landfall; Hurricane Maria landfall in Nfld.; Ophelia landfall in Nfld. 300 people evacuated in Quebec (Irene); 2 fatalities; 1,169,000 lost power
Sept. 21, 2010	No Changes	Warnings in place for Hurricane Igor, landfall occurred as Cat. 1 in NFld. –extensive damage to roads/infrastructure in Nfld (300 people evacuated, 1 fatality; $16,000,000 damage)
Sept. 3, 2010	No changes	Hurricane Earl made landfall at Western Head Nov Scotia
Aug. 23, 2009	No changes	Hurricane Bill made landfall at Western Head; power outages
November 3, 2007		Storm Noel. Heaviest impact in Halifax & Lunenburg. $2,772,554 total damage recorded provincially.
2003 Hurricane Juan	Warning Systems more advanced; greater public awareness of probability, impact and need to prepare	Although predicted to hit the South Shore, Juan veered off course and made landfall between Shad Bay and Prospect as a Category 2 hurricane. Storm surge in Halifax was 1.63m. Rainfall was approx. 40mm, storm surge in Mahone Bay was 1.0m, Longest power outages were 2 weeks. 8 deaths
1996	Changes to public awareness, warnings, information	Hurricane Hortense hit Mahone Bay. Storm surge measured approximately 1 meter in height. Surge in Halifax 1.63 m(Dalhousie Mahone bay Sea-Level Rise Final Report 2011)
October 25, 1991		"Halloween Storm" of 1991, preceded by two hurricanes: Grace and an unnamed storm off the north Atlantic; highest wave in the world ever recorded by an instrument was measured as 30.7metres on the Scotian Slope
1953		Hurricane Edna through New Brunswick
August 1, 1950		Hurricane-like storm hit Nova Scotia and caused flooding throughout the province
Oct 4, 1869		Saxby Gale typically used as historical event that could be repeated in worst case scenarios; 2 metre storm surge at high tide with Cat. 2 hurricane

Predicted Events without Historical Evidence

Predicting Authority	Predicted timeframe	Mitigation Strategies	Comments
Environment Canada	5	Warning Systems (responders and public); 72 hour Preparedness Program;	Hurricane season predictions made every year for June- November season; number and impact of hurricanes predicted to continue to increase
Canada- Nova Scotia Infrastructure Secretariat "Municipal Climate Change Action Plan Guidebook" 2011	5	Increased public warning for predicted storms via Environment Canada	"Research indicates the Atlantic Region will experience an increase in extreme weather events and all climate models suggest that storm activity will worsen". (pg. 6)
Intergovernmental Panel on Climate Change (IPCC) 2007	5	As above	Globally there has been a 75% increase in the number of Category 4 or 5 hurricanes since 1970; Warmer climates are experiencing more frequent and intense storms
Bedford Institute of Oceanography	50 year timeframe		More research is needed on shifting storm tracks. Scientists caution that the Canadian Regional Climate Model, and possibly other models "*underestimate the track density over the northwest Atlantic area* (Guo et al. 2012). That being said, current data does not indicate more frequent hurricanes. What will make hurricanes more intense, is increased sea level—thus storm surges have more water to move ashore.

IMPACTS

Identify most likely Impact Area

See map reference for coastal surge/flooding

Identify Population number in Impact Area

52,000

Identify numbers of Susceptible Persons in Impact Area

Group	Estimated Numbers
Residents	52,000
Mobility issues	Would be available through public health
Farm/livestock owners	Numbers may be available through Dept. of Agr. Unknown at present
Drug/medical dependent	Some numbers available through Public Health
Tourists	Unknown (Central Nova Tourist Association)
Campground residents	Scotia Pines; Hidden Hilltop; Five Islands; Sunrise Campground
Mobile Home Parks	2 in Town of Truro; multiple in County (mapping required)
Summer camps (ex. Boy Scouts/ Girl Guides etc.)	Tim Hortons; unknown
Homeless	minimal
Pet Owners	Approx. 764 companion pets for 1500 households

** estimated from U.S. Pet formula (1500 households) https://www.avma.org/KB/Resources/Statistics/Pages/US-pet-ownership-calculator.aspx?PF=1

Identify critical Infrastructure in Impact Area

Sites	Identify Owner (Private; Municipal; Prov. Fed)
Roadways	Private/municipal/provincial
Wharves	Community owned
Electrical substations & transmission lines	Private
Water & waste treatment facilities	Municipal
Telecommunications (towers, switching stations, radio communications)	Private
Dams, berms, dykes	Private/Municipal/Provincial
Emergency Infrastructure	Municipal/Provincial
Wind Farms	Private

Identify Severity of Impacts and Resources Required

Typical Impacts (Table 1)	Estimated # Affected (People/Structures)	Resources required to respond	Estimated Cost Ranking For Response			Comments
			High	Med.	Low	
Fatalities/Injuries	Less than 10	First Responders			X	
Displacement	Less than 100	First Responders/Red Cross			X	
Property Damage	52,000	First Responders/ Homeowners			X	
Power disruption	52,000	First Responders/ NSP			X	
Telecommunication Disruption	52,000	Private companies				Unknown costs
Transportation disruption	52,000	First Responders/TIR/ Public Works/Private companies	X			Costs to clean-up debris, cut trees, restore roadways
Food & Fuel Shortages	52,000	First Responders/ REMO/municipal/Provincial			X	Unknown impacts
Inland Flooding	As per Flooding HRVA	As per Flooding HRVA				

High = 500,000 and above
Medium = 75,000-500,000
Low = 75,000 and below

HAZARD RISK VULNERABILITY RATING

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

X	5	Highly Probable : once every 5 years or less
	4	Likely to occur once every 10 years
	3	Might occur once every 20 -30 years
	2	Not expected; could occur once every 50 years
	1	Rare chance of occurrence; once every 100 or more years

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard)

	5	**Catastrophic**, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
	4	**Significant;** 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
X	3	**Moderate**; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
	2	**Minor;** less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours
	1	**Insignificant;** no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

(Probability score) __5__ X (Overall Impact Score) __3__ = Number assigned to this Hazard __15__(1-25)

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public	X		
Media	X		
Other (Identify)			

Final Hazard Assignment, in consideration of Risk Tolerance for Priority Planning

	1-5	Low
	6-10	Medium
X	11-25	High
		Requires further analysis/planning due to Risk tolerance rating

Hazard Risk Vulnerability Model
Revised From: Nova Scotia Emergency Management Organization HRVA Model

Winter Storm/Blizzard/Ice Storm

Background Information

Analysis Completed For: Town of Truro & County of Colchester
Analysis Completed By: MCCAP/HRVA Team
Date of Last Review/Update: January 2013

Category of Hazard

X	Natural
	Technological
	Industrial
	Human-Induced

Definition of Specific Hazard

A Blizzard is "a severe weather condition characterized by reduced visibility from falling and/or blowing snow and strong winds that may be accompanied by low temperatures."

Blizzard warnings are issued by Environment Canada's Meteorological Service (MSC) for hazardous weather conditions characterized by high winds, and a widespread reduction in visibility due to falling and/or blowing snow.

Blizzard conditions may persist for a period of time on their own, or be part of an intense winter storm in which case a blizzard warning is issued instead of a winter storm or snowfall warning. Blizzard conditions may be accompanied by a severe wind chill making it even more dangerous.

from Environment Canada's Glossary

Related Notes or Hazard Triggers (specific to Hazard Definitions for area)

Power outages over 8 hours to large residential (100people) or commercial
RCMP recommends no travel on major highways or TIR closes major roads (Cobequid Pass alone is trigger point)
Widespread failure (50%) of public utility services (water, communications, sewer)

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
November 2008	Notification; protocols; increased methods to close roadway/lifeline; REMO will be notified if GTA impacted (people stranded in area)	Cobequid pass incident; hundreds of motorists stranded overnight on the highway
December 4, 2007	Increased public awareness of 72-hour preparedness	40cm wet, heavy snow knocked out power to approx. 50,000 people across 4 Atlantic provinces
February 18-19, 2004	Warnings systems via environment Canada, NS Power and NS-EMO established	"White Juan" 4 day Provincial State of Emergency; storm surges caused flooding in NB & Nfld; 50-70 cm snow; winds 60-80km/hr with gusts up to 120km/hr **$5,600,000 provincial cost**
January 17-22 2000	None: Dairy operations increased capacity to operate with power loss and transport product	Storm lasted for 6 days; 70cm snow, temperatures dropped to minus 40 C with the windchill; 216 people evacuated in NS **$6, 621,462 provincial cost**
March 15, 1993	Changes to emergency management structures federally & provincially	Caused by mid-latitude cyclone; 3 million people without electricity at one point; Liberian freighter left Halifax despite warnings of hurricane winds and sank 200km off Cape Sable Island in waves up to 20m. Crew of 33- no survivors **$19,866, 000 Eastern Canada costs**

Predicted Events without Historical Evidence

Predicting Authority	Predicted timeframe	Mitigation Strategies	Comments
Intergovernmental Panel on Climate Change 2007 www.ipcc.ch	By 2050	Municipal Climate Change Adaptation Plans to be created by December 31, 2013	Future warming of 1.5 to 6 degree Celsius is predicted to occur over the next century. (*Table SPM.1*) Although this may decrease the amount of local snow fall, NS may experience more freezing rain and rain-snow mix events.
Climate Scenario Development for Communities in Nova Scotia, ACAS 2011 http://atlanticadaptation.ca/acasa/node/181	By 2050	" "	Scenario Model predicts an increase in precipitation in winter season over next century; coupled with warmer weather - can lead to possible mix of blizzard / rain-snow conditions. (*Table A18*)

Bedford Institute of Oceanography	decadal and 50 year timeframes		Warmer/wetter winters may lead to fewer heavy rainfalls, and/or more ice conditions/events.

IMPACTS

Identify most likely Impact Area (ex. geographical; map reference)

Debert through Cobequid Mountains are snow belts/areas of concern (population density map reference)

Identify Population number in Impact Area

Advance road warnings may decrease population numbers travelling in concern impact areas

12,500 Truro; 38,500 Colchester County

Identify numbers of Susceptible Persons in Impact Area

Group	Estimated Numbers
Homeowners in coastal areas	Not significant for Blizzard
Persons with mobility issues	7500 estimated from Stats Canada (15% adult population)
Farm/livestock owners	Unknown
Homeless	Minimal (concentrated within town)
Pet owners (evacuation)	unknown
Drug-dependent individuals	Unknown (approx. 100 prescribed methadone)*
Medical equipment dependent individuals	Unknown (approx. 120 on home oxygen)*
Residents without 72 hour preparedness ability or plans	Unknown
Mobile home residents (flat roof snow load & winds)	Not applicable

* numbers dynamic, available through CEHHA Emergency Planner

Identify critical Infrastructure in Impact Area

Sites	Identify Owner (Private; Municipal; Prov. Fed)
CEHHC (hospital & facilities)	Prov.
Emergency Infrastructure (EHS, Fire Dept.; Police Station, EOC)	Municipal, Provincial
Seniors & long Term Care Facilities	Provincial/private
Roads	Provincial, municipal, private
Bridges	Provincial (1 municipal bridge Millbrook First Nations)
Dam/Berms/Dykes	Municipal/Provincial/private
Power dependent facilities/business without generator back-up	Private/Municipal
Facilities/Businesses dependent on transportation for critical supplies (i.e. food gas)	Private/Municipal/Province
Cell Towers	Private
Utilities (sewage plants; water plants; pumping station towers;)	Municipal
NS Power (substations, lines, poles)	Private
Schools	School Board
Prison	Federal
Youth Detention Treatment	Provincial
Public Works Building	Municipal

Identify Severity of Impacts and Resources Required

Typical Impacts (Table 1)	Estimated # Affected (People/Structures)	Resources required to respond	Estimated Cost Ranking For Response			Comments
			High	Med.	Low	
Fatalities/injuries	less than 10	EHS; Police; Fire			X	May require coordination with road clearing for response; #'s could increase with MVC's;
Displacement	Less than 10	EMO, Red Cross			X	Very few areas that could be cut off and unable to supply essential services
Prolonged Isolation	Less than 10	DCS/Red Cross			X	
Property damage	Minimal	Building Inspectors			X	Unlikely cost unless Ice-storm
Crop/Livestock damage	Unknown	Unknown				Unknown
Power/Utility Disruption	51,000	NS Power; Red Cross; REMO		X		Pre-deployment; critical areas identified;
Transportation Disruption	51,000	TIR; Municipal Works	X			
Supply Shortage	51,000	Need additional resources after 72 hours (prov./fed)	X			Will require provincial support if major arteries (102, 104, 101) cut off more than 72 hours or if NB border cut off
Community Lifeline/Emergency Infrastructure Damage	51,000	Need additional resources after 72 hours (prov./fed)	X			Hospital and First Responders on decreased capacity to respond; REOC limited; Supply lines unable to provide after 72 hours

High Cost = 500,000 & above
Medium Cost =75,000-500,000
Low Cost= 75,000 & below

HAZARD RISK VULNERABILITY RATING

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

X	5	Highly Probable : once every 5 years or less
	4	Likely to occur once every 10 years
	3	Might occur once every 20 -30 years
	2	Not expected; could occur once every 50 years
	1	Rare chance of occurrence; once every 100 or more years

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard)

	5	**Catastrophic**, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
	4	**Significant;** 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
X	3	**Moderate**; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
	2	**Minor;** less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours
	1	**Insignificant;** no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

(Probability score) __5__ X (Overall Impact Score) __3__ = Number assigned to this Hazard __15__(1-25)

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public	X		
Media		X(non-local would focus on Cobequid Pass area)	
Other (Identify)			

Final Hazard Assignment, in consideration of Risk Tolerance for Priority Planning

	1-5	Low
	6-10	Medium
X	11-25	High
		Requires further analysis/planning due to Risk tolerance rating

Hazard Risk Vulnerability Model
Revised From: Nova Scotia Emergency Management Organization HRVA Model

Forest Fire/Wildfire

Background Information

Analysis Completed For: Town of Truro & County of Colchester
Analysis Completed By: MCCAP/HRVA Team
Date of Last Review/Update: January 2013

Category of Hazard

X	Natural
	Technological
	Industrial
	Human-Induced

Definition of Specific Hazard

Forest Fire — Any wildfire that is burning in forested areas, grass or barren. **The main types of forest fire are:**

Ground Fire: A fire that burns in the ground fuel layer.
Surface Fire: A fire that burns in the surface fuel layer, excluding the crowns of trees, as either a head fire, flank fire, or backfire.
Crown Fire: A fire that advances through the crown fuel layer, usually in conjunction with a surface fire.
http://www.gov.ns.ca/natr/forestprotection/wildfire/media-guide/glossary.asp

"In many provinces a large number of forest fires are caused by lightning. In Nova Scotia only an average 3 % of fires start this way. The remaining 97% are caused by the activities of people, mostly accidental but sometimes deliberate. About one-third of person-caused fires are classed as "residential". These fires are caused by people engaged in activities- like debris and grass burning- on and around their property. Another major cause is arson, which accounts for about one quarter of the person-caused fires in this province in an average year. "(DNR; Media Guide to Forest Fires May 2009 pg.2

Related Notes or Hazard Triggers (specific to Hazard Definitions for area)

Raises awareness - fire ban raises red flags for risk of forest fire; municipal fire services unable to respond and require DNR to take over
Incident Commander (DNR) orders evacuation of more than 10 units or 25 people due to smoke or fire hazard
Major transportation route shut down at request of Incident Commander
Request for provincial resources beyond mutual aid agreements

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
Heat Wave March 20-22, 2012	None known	Record temperatures and official heat wave (28degree weather) created grass and wood fires throughout the region; no evacuations or property damage noted. DNR crews not on standby until April 1, could create lack of resources
Slave Lake Alberta May 1, 2011	None Known	Towns of Slave Lake, High Prairie, Little Buffalo, Lesser Slave Lake, and multiple municipal districts affected. 12055 evacuated (1300 under immediate, emergency conditions including hospital and town services) Oil drilling in region halted; CN rail halted Estimated Cost = $700, 000,000
B.C 2009	None Known	Fire Season 2009 had 3049 fires, 213 were wildland-urban interface fires. Increased lightning storms, record high temp. and decreased precipitation were factors. 100 notable fires causing 27 evacuation orders, 20, 000 people evacuated in total. One fatality (within fire service personnel) Estimated Cost = $ 75,000,000
Halifax May 2009	None Known	Purcells Cove Halifax, brush fire spread quickly due to wind gusts & dry debris as a result of previous hurricane (Juan 2003) 1200 people evacuated from 427 homes. 10 homes damaged, 2 homes destroyed
Halifax June 13, 2008	Fire hydrants installed in Victoria Park	Brush fire in wooded area east of Halifax (Lake Echo & Porter's Lake). Fire destroyed 2 homes, 5000 residents evacuated
Eastern Passage/Cole Harbour May 16, 2003	None Known	Started in a bog near Cole Harbour; high winds and dry conditions helped spread fire burning 240 hectares; 240 homes evacuated. 500 people also evacuated near Eastern Passage in NE Halifax.
Porcupine Lake Trafalgar, Guysborough Co. June 4, 1976	None Known	13000 ha burned; fire burned for six days; boy scout troop in area was protected by water bomber drops until evacuation could occur

Predicted Events without Historical Evidence

Predicting Authority	Predicted timeframe	Mitigation Strategies	Comments
Environment Canada	5	None	Climate Change Predictions indicate increased temperatures; hotter summers; less snowfall; incidence of greater variance in rainfall (drought followed by heavy rain); increased hurricanes leaving deadfall; all these factors increasing the risk of wildfires (MCCAP Guidebook)
DNR	Issued on an annual basis, no projected forecast	Public warnings issued via media & bans throughout parks ; permits required for residents during fire season (April-Oct.) Fire Behavior is predicted according to the Canadian Forest Fire Danger Rating System Fire Behaviour Prediction model on any given outbreak to help guide evacuation response Nova Scotia has a relatively wet climate, thus the number of fires that typically occur in an average season is low compared to drier provinces (NS Wildfire Science)	DNR issues Fire Index and puts out fire bans and alerts based on successive days of increased risk. Tracked from April 1-Oct. 15th DNR crews on stand-by for provincial response from April 1 to Oct. 15th only
Climate Scenario Development for Communities in Nova Scotia, ACAS 2011 (the Williams and Daigle report(http://atlanticadaptation.ca/acasa/node/181 Table A-18	Steady increase in water deficit through to 2015		Predicts precipitation patterns to shift to more rain in winter, and perhaps also (but less volume) in spring, but **water deficits in summer** and autumn.

IMPACTS

Identify most likely Impact Area

County, outlying areas of the Town, Victoria park. Areas where residential land use is adjacent to forested areas. Remote or isolated areas are also at risk for fire spreading before being noticed.

Identify Population number in Impact Area

Number of households around Victoria Park, risk for evacuation is 400 households. Depending on time of day and year, between 100 and 1000s of users in the park at any time. In case of a fire, population of Truro (12,000) would be impacted by smoke.
38,000 people in County. Points of increased risk are sparsely populated.

Identify numbers of Susceptible Persons in Impact Area

Group	Estimated Numbers
Persons with Respiratory Conditions	Unavailable
Mobility Issues	Unavailable
Farm/Livestock owners	10-20
Pet Owners	Approx. 764 companion pets*
School populations (including day cares)	Truro Junior
Tourists	Depending on events – a few or very many
Campground/seasonal residents/cottage developments	Hilden campground
Summer Camps	Tim Hortons in Tatam
Long term care facilities	On young Shannex and Mira

** estimated from U.S. Pet formula (1500 households) https://www.avma.org/KB/Resources/Statistics/Pages/US-pet-ownership-calculator.aspx?PF=1

Identify critical Infrastructure in Impact Area

Sites	Identify Owner (Private; Municipal; Prov. Fed)
Hospital	Provincial
Municipal Water Supply	Municipal
Roads	Municipal/provincial
NSP transmission lines and substations	Private
Schools	School Board
Water & waste water treatment plants	Municipal
Emergency Infrastructure	Municipal/provincial

Identify Severity of Impacts and Resources Required

Typical Impacts (Table 1)	Estimated # Affected (People/Structures)	Resources required to respond	Estimated Cost Ranking For Response			Comments
			High	Med.	Low	
Fatalities & Injuries	Less than 5	First responders			X	Big public event could escalate panic.
Displacement (evacuation)	5000 people, 400 structures	First responders, Red Cross, evacuation facility		X		
Private Property Damage	Up to 400	First responders, home owner insurance			X	
Public Property Damage	Reservoir contamination; 20,000 people	Public Works (Town and County), TIR, Dept of Enviro.	X			
Long-term Environmental Impacts	As above					
Air Pollution	12,000 to 25,000	First responders, media			X	
Long term economic impacts	unavailable	Unknown		X		Impact to tourism
Long term community impacts	50,000	Municipal – creation of new park facilities	X			Sense of community and opportunity for recreation

High = 500,000 and above
Medium = 75,000- 500,000
Low = 75,000 and below

HAZARD RISK VULNERABILITY RATING

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

	5	Highly Probable : once every 5 years or less
	4	Likely to occur once every 10 years
	3	Might occur once every 20 -30 years
X	2	Not expected; could occur once every 50 years
	1	Rare chance of occurrence; once every 100 or more years

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard)

	5	**Catastrophic**, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
X	4	**Significant;** 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
	3	**Moderate**; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
	2	**Minor;** less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours
	1	**Insignificant;** no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

(Probability score) ___2_ X (Overall Impact Score) _4___ = Number assigned to this Hazard __8_(1-25)

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public			X
Media			X
Other (Identify)			

Final Hazard Assignment, in consideration of Risk Tolerance for Priority Planning

	1-5	Low
X	6-10	Medium
	11-25	High
		Requires further analysis/planning due to Risk tolerance rating

Hazard Risk Vulnerability Model
Revised From: Nova Scotia Emergency Management Organization HRVA Model

DROUGHT

Background Information

Analysis Completed For: Town of Truro & County of Colchester
Analysis Completed By: MCCAP/HRVA Team
Date of Last Review/Update: January 2013

Category of Hazard

X	Natural
	Technological
	Industrial
	Human-Induced

Definition of Specific Hazard

"Droughts are complex phenomena with no standard definition. Simply stated, drought is a prolonged period of abnormally dry weather that depletes water resources for human and environmental needs" (AES Drought Study Group, 1986). Environment Canada- Science & Technology

May be a regional prediction for what atmospheric conditions will constitute a drought situation.

May be correlation with increased hot days HRVA/plans

Related Notes or Hazard Triggers (specific to Hazard Definitions for area)

__60_% of population with dry wells in one community (duration and percentage of population are important considerations)

Current reservoir can handle extensive period of drought. (Considered built for 1:100 year scenario)

At any time there is only three months volume in the reservoir then rationing to major industry would be considered. Reviewing projected rainfalls against consumption rates etc.

Shortage of water for agriculture production – water for dairy, water for irrigation for veggies and fruit (permitted by monitored by NSE) Severe conditions could impact job loss and industry.

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
2009	None	Saskatchewan & Alberta. A dozen counties and municipal districts declared a state of drought emergency or disaster
2002-2001	Agriculture & Agri-Food Canada (AAFC) expanded Drought Watch to monitor status of drought over all major agricultural regions of the country.	Canada-wide drought from Spring 2001 to Fall 2002. Repercussions included agricultural production, employment, crop and livestock production, and the Gross Domestic Product. Atlantic Canada sought advice from Prairie Farm Rehabilitation Administration (PFRA) on procedures to augment on-site water supplies for agricultural communities.
1989-1993; 1996	None	Drought events recorded through Prairie provinces

Predicted Events without Historical Evidence

Predicting Authority	Predicted timeframe	Mitigation Strategies	Comments
Nova Scotia Department of Agriculture & Fisheries	100	None	Droughts in Atlantic Provinces occur rarely but reduced occurrence results in lower adaptive capacity making the region more susceptible to drought impacts.
Environment Canada-Science & Technology	100	None	All Global Climate Models project future increases in summer continental interior drying and associated risk of droughts due to increased temperature and evaporation not balanced by precipitation. Uncertainly exists on a regional basis of any impacts to Atlantic region.
Climate Scenario Development for Communities in Nova Scotia, ACAS 2011 (the Williams and Daigle report(http://atlanticadaptation.ca/acasa/node/181	50	None	Predicts precipitation patterns to shift to more rain in winter, and perhaps also (but less volume) in spring, but **water deficits in summer** and autumn.
DNR	0n-going	None	DNR measures and releases daily during fire season, a Provincial Drought (DC) on a range of 0-unlimited. Measures dryness of the largest sized surface fuels and deep duff layers (10+cm depth) Derived from the previous (day before) DC, the local noon temperature, and 24 hour precipitation. Coded as Low, Moderate, High and Extreme

IMPACTS

Identify most likely Impact Area

Rural areas un-serviced by drilled wells; Dug wells will have greatest impact.

Identify Population number in Impact Area

Unknown at this time.

Identify numbers of Susceptible Persons in Impact Area (Refer to Appendix A & B)

Group	Estimated Numbers
Residents on well systems	Follow up required
Farm Owners (crops & livestock)	Follow up required

Identify critical Infrastructure in Impact Area

Sites	Identify Owner (Private; Municipal; Prov. Fed)
Municipal water supplies	Private
Industry dependent on water supply	Private
Schools	School Board
Rural Fire Departments – using ponds and dug well	Various communities
Various Aboiteaux – silting up	Prov

Identify Severity of Impacts and Resources Required

Typical Impacts (Table 1)	Estimated # Affected (People/Structures)	Resources required to respond	Estimated Cost Ranking For Response			Comments
			High	Med.	Low	
Decreased water supply /watershed	16,000 homes using reservoir in Truro, 720 in Tatama, 500 in Debert	Personnel to implement and promote a rationing program			x	
Decreased water supply wells	TBD	REMO and Prov EMO			x	
Crop damage	TBD	Dept of Ag to respond			x	
Pest infestation		Dept of Ag to respond			x	
Animal (wildlife) disease/death	Unknown	DNR			x	
Increased Wildland Fires	Everyone 52,000	REMO, DNR	X			
Increased demands on Health care system	Increased numbers of sanitary driven diseases and dehydration	EHS and Emergency Dept – Provincial			x	
Decreased resources for Fire Suppression	Various municipalities	Moving water from longer distance			x	
Animal disease/death (farm)		Dept of Ag			x	
Blocked aboiteaux	TBD	Dept of Ag, REM, NSE			x	

High = 500,000 and above
Medium = 75,000-500,000
Low = 75,000 and below

HAZARD RISK VULNERABILITY RATING

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

	5	Highly Probable : once every 5 years or less
	4	Likely to occur once every 10 years
	3	Might occur once every 20 -30 years
X	2	Not expected; could occur once every 50 years
	1	Rare chance of occurrence; once every 100 or more years

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard)

	5	**Catastrophic**, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
	4	**Significant;** 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
X	3	**Moderate**; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
	2	**Minor;** less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours
	1	**Insignificant;** no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

(Probability score) __2__ X (Overall Impact Score) _3___ = Number assigned to this Hazard __6__(1-25)

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public	x		
Media	x		
Other (Identify) N/A			

Final Hazard Assignment, in consideration of Risk Tolerance for Priority Planning

	1-5	Low
X	6-10	Medium
	11-25	High
		Requires further analysis/planning due to Risk tolerance rating

Hazard Risk Vulnerability Model
Revised From: Nova Scotia Emergency Management Organization HRVA Model

COASTAL FLOODING

Background Information

Analysis Completed For: Town of Truro & County of Colchester
Analysis Completed By: MCCAP/HRVA Team
Date of Last Review/Update: January 2013

Category of Hazard

X	Natural
	Technological
	Industrial
	Human-Induced

Definition of Specific Hazard

Coastal flooding occurs when sea water inundates coastal land forms. This can be influenced by sea level rise, storm surge, wind, waves, and tidal variations.
Storm surge = temporary increase at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place. Negative storm surges also occur and can present significant problems for navigation. (MCCAP guidebook pg. 4)

The two main atmospheric components that contribute to a storm surge are air pressure and wind. Deep low pressure systems can create a dome of water under the storm (much like the low pressure in a vacuum on a carpet). High winds, lunar influences and sea level rise along a coastline can also elevate the water levels at the shore, depending on the direction of the wind with respect to the coast. (Environment Canada)

Related Notes or Hazard Triggers (specific to Hazard Definitions for area)

Warning of Storm Surge potential above 2 feet occurring at High Tide

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
October 30, 2011	On-going maintenance to maintain constructed elevation 260km of dyke system	Nor'easter occurred causing Storm Surge to reach levels only 15cm less than the storm surge of Hurricane Juan
January 2-3 2010	unknown	Baie-Verte and Port Elgin NB Peak water levels lasted for approx. 2 hours, no gauges to identify height but greater than recorded 5 feet at closest gauge; winter storm event; $627,673 damage costs
October 29, 2009	unknown	Eastern and Northern Coastline NB Severe storm surge with winds in excess of 130km/hr. Private property, businesses & public infrastructure damaged. Emergency shellfish aquaculture industry (mussels, oysters & clams) was greatly affected.
December 27, 2004	unknown	Kings County PE Winter storm, winds & surge. Person rescue by firefighters from flooded residence
September 2003		Hurricane Juan 1.63M surge at Halifax
January 21, 2000	unknown	1.36 m surge occurred as intense storm passed 55km east of Charlottetown bringing 70km/h sustained winds. Peak surge coincided with high tide resulting in water level of 4.23m above chart datum. 460 properties inundated including gas stations, power generating plant and damaging wharves
1996		Hurricane Hortense- 1M storm surge
October 25, 1983	unknown	Cape Breton Island Eastern shores of Cape Breton Island; water levels rose to 0.761.5m above normal high water mark. Flood highways and destroyed 30 fishing boats and thousands of lobster traps.
February 2, 1975	unknown	Western, Central and Northern NS & Saint John NB "Groundhog Day Storm", produced 188km/h winds & 12m waves with swells 10m high. NB- $8,005,500 damage; transportation & utilities stopped for a week, 550m sea wall caved in; damaged docks, buildings, boats, mobile homes, lobster traps & nets; hydro poles & trees NS- $ 4,137,800 damage; roofs, windows, trees,

		power and telephone lines, sea wall damage; biggest impacts due to storm surge; fishing industry greatly affected by damage to shoreline as a result of extremely high tides
Oct 4, 1869		Saxby Gale typically used as historical event that could be repeated in worse case scenarios; 2 metre storm surge at high tide with Cat. 2 hurricane

Predicted Events without Historical Evidence

Predicting Authority	Predicted timeframe	Mitigation Strategies	Comments
Intergovernmental Climate Change Panel 2007	50	Climate Change Adaptation Plans to be created by December 31, 2013.	ICCP reports projects increase in global average surface temperatures will result in global sea level rise of a meter or more by the end of this century. This will occur due to thermal expansion of seawater and melting glaciers and ice caps. Predictions suggest with climate change, Halifax could experience an increase in sea level by 80cm by the year 2100. (MCCAP guidebook pg. 7) As sea level rises, the risk of storm surge inundation increases. "Increased erosion and flooding will likely mean significant impacts on coastal communities with damage to houses, buildings, roads, bridges and other types of infrastructure, as well as the risk of contamination to fresh water supplies, damage to drainage systems and sewage treatment facilities. " (Guidebook pg.7)
Climate Scenario Development for Communities in Nova Scotia, ACAS 2011 (the Williams and Daigle report(http://atlanticadaptation.ca/acasa/node/181	By 2050		Relative to chart datum at Burncoat Head, the projected water level for a 100-year return period storm is 17.88 ± 0.23 (the sum of: statistically derived storm surge, global mean sea level for the 30 year period ending 2040, plus highest tide level). If building infrastructure today that will still be around in 2100, and if that infrastructure should, at that time, be able to withstand a 100-year return period storm, it will need to accommodate a water level of 18.78 ± 0.68
Bedford Institute of Oceanography	decadal and 50 year timeframes		Research coming out of BIO generally aligns with the Williams and Daigle report – predicting only slightly higher water levels (approximately 7 centimetres by 2085). Mean sea level rise in the Atlantic Basin is projected to be higher than global estimates (Yin et al. 2009, Xu et al. 2011) On the 100-year time scale, relative sea leave rise in

			the Atlantic Basin is projected to range from 0.9-1.6m (DFO 2012).

IMPACTS

Identify most likely Impact Area (Flood Plain Map available)

As per Flood Plain map (areas involved include Marshland Drive; Robie Street; Main St. Bible Hill; Park St. & surrounding neighborhood; Lower Truro marshes/Lower Truro Road; West Prince)

Identify Population number in Impact Area

Approx. 1000 buildings

Identify numbers of Susceptible Persons in Impact Area

Group	Estimated Numbers
Residents in coastal dwellings/areas	2400
Persons with mobility issues	Available through health
Farm/livestock owners	Available through Department of Agriculture; largely farm/crop area; some NSAC land
Pet owners	Approx. 764 companion pets*
Drug/medical dependent	Available through health
Tourists	2 hotels (Comfort Inn; Barry's Motel)
Golf Course	18 hole ; country club
Businesses	Multiple restaurants; mall; retail

**estimated from U.S. Pet formula (1500 households) https://www.avma.org/KB/Resources/Statistics/Pages/US-pet-ownership-calculator.aspx?PF=1

Identify critical Infrastructure in Impact Area

Sites	Identify Owner (Private; Municipal; Prov. Fed)
Industrial sites	Stella Jones (treated lumber) Private
Water treatment/sewer infrastructure	2 pumping stations; sewage treatment plant access; - municipal
Roadways	Robie St, Marshland Drive; Park St.; Main St. ; West Prince (Municipal/Provincial)
Dams, berms, dykes	No Dams; or Berms; approx. 30 Dykes (private owned provincially maintained)
Wells (salt water intrusion)	Private (lower Truro; Bible Hill)
Business sites	As above
School	CEC (could be isolated)

Identify Severity of Impacts and Resources Required

Typical Impacts (Table 1)	Estimated # Affected (People/Structures)	Resources required to respond	Estimated Cost Ranking For Response			Comments
			High	Med.	Low	
Fatalities/injuries	Less than 10	First Responders			X	
Displacement	28 apartment units	First Responders/Red Cross/EMO			X	
Erosion (land)	Culvert; 3000 dwellings along Northumberland strait/cobequid Bay potential well contamination	Public works			X	Insurance unavailable, high cost to owners
Road/infrastructure erosion	Re-routing required	First Responders/barricades			X	
Water Contamination (increased salinity)	3000 dwellings along Northumberland strait/cobequid Bay potential well contamination	Homeowner			X	Insurance unavailable, high cost to owners potentially for wells, property costs, well testing; sewage systems etc.
Utility disruptions	Unknown	Unknown			X	Potential in rural areas
Economic impacts (ex. Farmland; Business disruption)	Unknown	Unknown			X	Crop/farm damage possible insurance; Multiple businesses may be temporarily shut-down, clean-up repair costs
Dyke Erosion	2400 residents within flood plane				X	Dyke breach could flood entire area Low cost to municipality but high cost to government & private
Dyke Overtopping/Breach	2400 residents	Rapid First Response might be required, beyond immediate resources & protocols	X			Dyke breach could cause rapid problems(30 minutes or less)and increase immediate problems to catastrophic events

High = 500,000 and above
Medium =75,000-500,000
Low = 75,000 and below

HAZARD RISK VULNERABILITY RATING

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

	5	Highly Probable : once every 5 years or less
	4	Likely to occur once every 10 years
	3	Might occur once every 20 -30 years
	2	Not expected; could occur once every 50 years
X	1	Rare chance of occurrence; once every 100 or more years

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard)

X	5	**Catastrophic**, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
	4	**Significant;** 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
	3	**Moderate**; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
	2	**Minor;** less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours
	1	**Insignificant;** no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

(Probability score) _1_ X (Overall Impact Score) __5__ = Number assigned to this Hazard __5__(1-25)

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public			X
Media			X
Other (Identify)			

Final Hazard Assignment, in consideration of Risk Tolerance for Priority Planning

X	1-5	Low
	6-10	Medium
	11-25	High
X		Requires further analysis/planning due to Risk tolerance rating*

* general public will have low tolerance of any flooding issues, especially around breach or failure of systems in place

APPENDIX B: WHITE FLAGS, RED STOPS, GREEN STOPS

The following includes all items documented during the workshop process that were deemed outside the scope of the workshop but pertinent for future consideration and effort.

White Flags (surrender)

- Process issue: If marked low cost in HRVA, worried low cost ranking will lead to issue not being taken seriously. "If we don't have to pay for it (dykes) we don't need to deal with it."

Red Stops (Items for REMO)

- EMO Public Health may not be communicating effectively
- TIR – How many people use Cob quid Pass typically (daily). Appreciating warning system now in place, still looking for a general range of people that might get stuck.
- EMO to connect with Agriculture to determine location and types of farm operations
- How many tourists around during hurricane season? (including campgrounds)
- Mobile homes – where are they? How many? (In and out of mobile home parks)
- Storm Surge plan should deal with wells (salt water intrusion) as public information to be disseminated

Green Stops (Items for MCCAP)

- Map beams – horizontal and vertical
- Floodplain mapping needs updating (inland flooding)
- Size and location and vulnerability (e.g., power loss): applicable to 5b
- Learn about NSE permitting for irrigation and agriculture production – what volume triggers permitting? To what extent does NSE monitor consumption, and then ration? What triggers rationing?
- Town of Truro looking into supply volume (total versus monthly demand) – pertinent to drought
- Get mapping layer for dug vs. drilled wells – though not all dug reported!
- Broaden fire bans to include backyard smokers and 'fire pots' (might be white flag issue—cause who declares fire bans?) Or is this just an MCCAP education issue?
- Useful to both Planning and EMO: Modeling and forecasting for storm surge or breach of dykes; planning for evacuation, sirens, staging evacuation, forecasting
- Compare Crawford's layer of dyke with what Darryl H. has.
- Tease apart extreme TSL – interpret without high tide?
- Treat coastal flooding in two parts: one for coastal and one for rural Colchester