Atlantic Climate Adaptation Solutions Association
Solutions d'adaptation aux changements climatiques pour l'Atlantique

Tantramar Dyke Risk Project : The Use of Visualizations to Inspire Action

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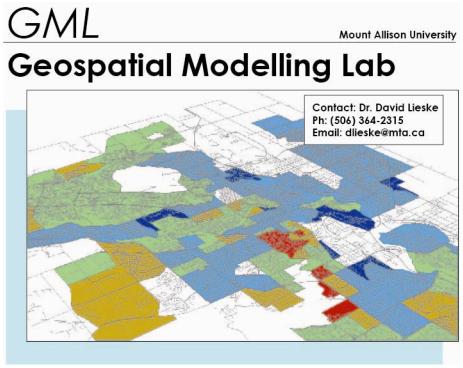

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This report is also available for download from the ACASA website at:
www.atlanticadaptation.ca

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Executive Summary

Introduction and Background

This research report is a follow up to an earlier study that involved creating flood scenarios using GIS software to help members of the public visualize the extent of a number of flood scenarios (funded by the Atlantic Climate Change Adaptation Solutions organization, SSHRC, and Mount Allison University (Mount A REB 2011-042 "Is geovisualization an effective tool for public communication of climate threats?")).

Project Components

This study involves several components. First, a literature review was conducted that focused on the communication of flood risk and adaptation with a particular focus on fostering action as a result of climate change-induced flooding from sea level rise, where possible. The second component of this study involved conducting interviews based on a purposive sample of regional experts who have previous experience (or interest) in communicating flood risk and/or extensive involvement with the development of adaptation plans for the Tantramar Region. The third component is an inventory of climate change visualization communication tools that that could be drawn on to further communicate flood risk. The fourth and final component of this project is a proposed list of contents for a toolkit about climate change.

Literature Review

The literature review identified numerous elements that should be considered when communicating about climate change (in particular, flood risk, in the case of the focus of this research) to the public. Additionally, the literature review brought to the fore the numerous barriers and challenges that climate change communicators face when communicating about climate change.

In the literature there was also discussion about the potential benefits of visualizations. Benefits all pointed to how visualizations could convey the complex messages of climate change in an accessible way. At the same time, some caution about using visualizations was expressed and ethical considerations were put forth in order to ensure that visualizations are used to build public confidence and not cause panic.

The literature continually referenced the need to understand the impact of visualizations on changing behaviour. However, there was little reported research about this area pointing to the need for more research about how to use visualizations to promote attitudinal changes and adaptive behaviour, particularly at the individual level. Change at the local level on a broad scale will have global impacts. But only if individuals are equipped with the knowledge and

tools to do so and only if the policy environment is such that it supports adaptation education and activities.

Interview Results

Though not a representative sample, the key informant interviews nonetheless confirmed the results of the literature review and also brought to light several key local issues that impact communications about flood risk.

Though the sample of interviewees was small, the range of experience within that small group was considerable. From academics to government personnel to those working within the field of climate change mitigation, the sample proved to have a broad set of experience related to communicating about flood risk. At the same time, because the sample was not representative, it is difficult to know whether the views and opinions expressed during this interview process represent the views and opinions of the Tantramar community at large. Overall, however, the need to increase mitigation measures to protect the Tantramar region was echoed by all respondents. All recognized that the current dyke structure in the region is currently insufficient to protect the region, particularly the Town of Sackville, and that considerable more effort must be made in order to ready the region for a major flood event that was viewed to be 'just a matter of time'.

Interview informants felt that visualizations were an effective tool to communicate because visual imagery can convey a considerable amount of information at a glance. At the same time, and like what was reported in the literature, caution was raised about using visualizations alone without contextual information. Informants cautioned that discussing flood risk and the potential solutions to flood risk impact people considerably and that extra care should be taken to ensure that panic, fear, depression, and a sense of helplessness do not ensue. Visualizations should accompany adaptation solutions to help people deal with the implications of flooding (or whatever you are communicating). They should also be personalized so that the impacts on the individual are clear. Visualizations should also respond to the issues that are important to the public.

Informants felt that word of the Tantramar Regional Adaptation Strategies Assessment Project is spreading. As a result, there seemed to be consensus that the flood scenarios should be made public. It was felt that people should be encouraged to learn about the increase in storm frequency. People have to be made aware that an increase in storm frequency equates to a higher flood risk and associated consequences. For example, several interviewees mentioned that people are still considering Lorne Street in Sackville as a site of future development. Yet, Lorne Street is in a low-lying area and floods almost annually (usually because of fresh water flooding) but it is also vulnerable to flooding due to sea level rise. Thus, while the flooding of Lorne Street seems to be widely known, the connection between the street flooding and the wider flood risk in the Tantramar Region does not appear to be. It was also felt that greater education should occur and that information should be integrated into workshops and public information materials to maximize awareness. Though, there was concern that the information should be released with contextual information so people can make informed decisions without being overtaken by fear. Information should be conveyed in such a way that people

understand what they mean on an individual level and how much one will lose specifically. Concrete, localized, and personal examples should be used to engage the average person. Particular caution should be taken when going into areas that are going to be especially hard hit by a flood event.

At the same time, just because one relays the message of flood risk does not necessarily mean that people are going to use that information and stop building along the coastline or in flood plain areas. It was also noted that public meetings are not necessarily well attended; this impacts who learns about potential issues.

The other critical piece that was raised was the dykes. Every year the dykes erode. One interviewee noted that two years ago, on December 6, 2010, there was a bad storm and the dykes came within two inches of being breached. The sense was that, while not the complete answer, reinforcing the dykes was nonetheless important. Yet, recently, funding to maintain the dykes was cut at the provincial level. This suggests that at that level, the value of the dykes is not fully appreciated.

It was noted that Sackville has a sophisticated set of mapping tools while other communities do not. At the same time, there appears to be little understanding among the layperson (including municipal leaders, employees, etc.) of what this data actually means and what one can do with it.

Regardless of the tools that are available, there is a possibility of misuse or abuse. People who are communicating the message of flood risk need to be cautious about 'crying wolf' all the time. Otherwise, the community will be numb and will not want to hear about the issue anymore.

To overcome communication challenges, it is necessary to deliver in information in such a way so as to clearly explain what the probability of an event happening is and what the impacts will be. Moreover, information should be conveyed in terms that people can relate to. Scenarios should be localized and personal so that people can place themselves within them and see the impact on them directly.

A website may be a good place to convey information. It can contain a range of information and resources and can respond to specific questions. In terms of who might be responsible for such a webpage, it could be a joint undertaking among partners, spearheaded by the municipal government.

Local government was identified as the key driver of change. It was felt overall that local government is the entity to spearhead communications with the public and lobby on behalf of the community, particularly with other levels of government. It was also felt that local government bears the responsibility to explore, not only flood mitigation measures, but adaptation measures as well. The key informants expressed a desire for local government to formulate an adaptation plan and be proactive about dealing with flood risk in the Tantramar Region instead of waiting until a flood emergency occurs. It is important for municipal councils to organize and be proactive and to begin to lobby on behalf of the community. It is also

imperative for the public to lobby decision-makers at all levels to come up with short, medium, and long terms actions and solutions that will begin to address the issues that communities are facing.

Yet, politically, there was a sense that there were constraints to how far one can talk about flood risk. For example, though information about flood risk had been communicated to town council, the issue of flood mitigation/adaptation did not become a public campaign issue. This suggests that people in the region are not particularly concerned about flood risk or potential emergencies or damages. However, it has yet to be determined whether or not this lack of concern is because people know about flood risk and are not worried about it or whether it is because people do not know enough about flood risk to be concerned about it. Anecdotal experience suggests the latter to be the case.

It was also felt that if municipal staff is evaluating infrastructure and know the infrastructure in flood risk areas, they should be fixing the infrastructure or redoing it in those areas. It was felt that staff needs to take it more seriously than they have. At the same time, policy must be established to allow them to do that and funding must be available as well. Staff (and government) seems to have the information about flood risk but does not appear to have made any decisions based on that information yet. Additionally, it was felt that the town requires at least a part time public outreach officer (perhaps as part of the emergency measures office) who is aware of flood risk and who can facilitate and coordinate information dissemination.

It was noted that supportive ways of working with people need to be developed. The community, as a whole, should reject the institutions and processes that are not currently working and replace them with new ones that will work. Then, we as a community need to focus on 'the saving work' and need to be 'actively engaged in our own solution making. We need to re-think the notion of community and undertake actions that support people as the infrastructure is reinforced. We need to undertake a collective response instead of letting people deal with situations on their own. The Tantramar Planning District Commission was identified as playing a role.

Interestingly, it was also suggested that to an intentional adult education approach is required. Information must be presented in variety of forms, such as in visual and auditory forms. One should also involve a strategic process that allows people to express themselves and work through their feelings and which provides people with a way forward. Thereafter, it will be incumbent on decision makers to take all that and move forward.

Some people do not have access to the Internet so alternative ways of communicating with people are required. Moreover, if the electricity goes out, people will not have access to the Internet so the Internet cannot be relied in an emergency per se.

It was also suggested that one should determine through dialogue with target audiences what people know and what they should know. Then, one can determine how to communicate with them and design visualizations around how people prefer to be communicated with. If visualizations are used well, one can check the audiences' pulse on whether they are engaged

and what impacts the visualizations are having. In other words, allow for feedback on the visualizations as one works with target audiences.

This research has also revealed that there are many positive activities that are being undertaken currently. For example, current local research has reached valuable results around the use of visualizations to communicate flood risk communication. The Town of Sackville operations department is acutely aware of where the town sits in the flood zone and recognizes in principle the need to proactively plan so that it can undertake emergency measures swiftly and effectively. The Tantramar Planning District Commission also has a good understanding of the flood risk and has been effectively involved in the Tantramar Dyke Risk Project. Its past track record on numerous issues demonstrates that the Tantramar Planning District Commission is a valuable tool in organizing public meetings and informing the public.

Inventory of Climate Change Visualization Communication Tools

Visualizations appear to fall into two general categories: mathematical/scientific based visualizations, such as graphs and charts and maps, to name a few, or more popular media, such as video games, virtual world simulations, and photography. The way in which each type could be used, the content they could contain and the scenarios they could apply to are endless. How visualizations can be used is limited only by the bounds of one's imagination.

The inventory includes:

1. 3-D models
2. 3-D photorealistic renderings of terrain and objects
3. Animations
4. Art exhibits
5. Before and after images
6. Cause and effect diagrams
7. Collaboration cards
8. Colouring books
9. Comics
10. Compound visualizations
11. Concept visualizations
12. Data cubes
13. Data visualizations
14. Educational resources
15. Exhibits
16. Film/Video
17. Fridge magnets
18. Hydrological models
19. Information visualizations
20. Inundation models
21. Maps
22. Metaphor visualizations
23. Photography

24. Posters
25. PowerPoint slides
26. Public exhibitions
27. Risk dashboard
28. Risk ruler
29. Shockwave tools
30. Simulations
31. Stereographic visualizations
32. Storyboards
33. Storytelling
34. Strategy visualizations
35. Television commercials
36. Terrain (elevation) models
37. Theatre
38. Timelines
39. Time-sequenced animations
40. Video games
41. Vignettes
42. Virtual reality models

Proposed Contents for a Toolkit about Climate Change

This section provides a listing of recommended contents a toolkit on flood risk communication may contain. This toolkit may be available in a variety of formats including on a website (including downloadable information), as a resource binder, CD-ROM, fridge magnets, posters, or as summary leaflets. The toolkit could be linked to other media, such as YouTube, Facebook, Twitter, and other forms of social media. Information in a toolkit could also be integrated with various visualizations (see section 6). This section of the report is termed in terms of a homeowner but could conceivably apply to businesses as well.

The toolkit should be presented along with a message of uncertainty. In other words, the toolkit is probabilistic and offers the best resources available at the time.

In addition to content, one should also consider the aesthetics of the toolkit. Pictures can convey 'a million words' and can demonstrate concepts quickly and effectively, such as how to properly build a proper sandbag bank.

A municipality could also use an online toolkit as an opportunity to promote its own adaptation activities. It might be a place where the municipality can demonstrate that it is taking the issue of flood risk seriously and that it is being proactive.

Potential content may include the following sections:

1. Background
2. Am I at Risk
3. Protection
4. Preparing for a Flood
5. Your Family Flood Plan

6. Advice for the Elderly or People with Disabilities
7. Keeping Your Pet Safe
8. How to Know if a Flood is Coming
9. What to do in the Event of a Flood
10. Safety
11. After the flood
12. Emotional Responses to a Flood
13. Repair and Restoration
14. Insurance
15. Maps and Visualizations
16. Checklists
17. Terminology and Facts
18. Research
19. Emergency Measures
20. Farming
21. Flood Mitigation and Adaptation
22. Renovating a Home in a Flood Zone
23. Current Events and News
24. Contacts
25. Resources for Teachers

Each of the aforementioned sections could also contain a frequently asked questions (FAQs) section, contain checklists, direct people to additional sources of information.

Final Thoughts

The mandated focus for this research project was to investigate how visualizations can be used to encourage people to undertake climate change adaptations, particularly in relation to flood risk. A literature review was completed as were a set of interviews. An inventory of visualization ideas was compiled and the contents of a toolkit were proposed.

Visualizations are no doubt important and have, both in the literature review and as a result of the interviews, been confirmed as an indispensable tool for communicating flood risk. The impacts of an image should not be underestimated.

At the same time, focusing on visualizations alone would be too myopic. Visualizations are but one piece of the puzzle. Mitigating and adapting to flood risk requires a more wholistic approach. A 'big picture' focus would also consider where the issue of flood risk sits within the larger region geographically but also within the social, economic, and collective psyche of the community. It would consider how flood risk will impact and is interconnected with broader sustainability issues. There needs to be a broader understanding of what it means to be self-reliant and resilient. To that end, this research report concludes with a number of recommendations, as follows:

1. **Proactive local government** – Local government needs to be proactive in spearheading a flood risk adaptation strategy. This strategy should focus on the short and long term and should be carried over from administration to administration to ensure consistency in application.
2. **Local focus** – By taking a local focus, visualizations and other forms of communication along with strategic planning will have a greater likelihood of success of conveying messaging and accomplishing long term flood risk mitigation and adaptation.
3. **Strategic plan** – A definitive strategic adaptation plan that incorporates long and short term measures should be developed immediately and put into place so that the municipal government can begin to take proactive steps to communicate about and mitigate flood risk so that the community as a whole can begin to adapt collectively and individually.

4. **Communications strategy** – As part of the overall strategic plan, a communications strategy is integral to ensuring clear, consistent messaging and to making the best use of communications resources. Communications activities could include a range of undertakings, including a website, toolkit, making use of local radio, emergency preparedness, door-to-door campaigns, etc.
5. **Monitoring plan** – A monitoring plan should be established to analyze processes and activities as they proceed towards the goal of improving efficiency and effectiveness.
6. **Evaluation plan** – Each activity and process should be evaluated in terms of the strategic plan, goals and objectives, and deliverables.
7. **Emergency preparedness** – Emergency preparedness obviously requires having an emergency preparedness plan for the entire community. But it also means ensuring that individuals and families are prepared in the event of a flood event (or other emergency). The local government could facilitate this by spearheading the development, implementation and promotion of the emergency preparedness plan. The municipal government could also bulk purchase flood mitigation and emergency preparedness items that it could then sell to the public at cost. Bulk buying would lower the cost to individual citizens and increase the municipality's buying power. Items that could be purchased in bulk could include floodboards, hydrabarriers, first aid items, thermal blankets, crank radios, and so forth.
8. **Education** – An education campaign should be undertaken to ensure that everyone understands the flood risk. In the Tantramar Region, for example, people need to understand the history of the dykes and how the Tantramar Region is situated within them. People who live in town need to understand how their homes and businesses will be affected in the event of a flood. They need to have information so they can make educated decisions about relocating or about making their dwellings and businesses as flood proof as possible. Most importantly, they also need to know about the flood risk so that they can stay safe and healthy. Loss of life must be avoided at all costs. An education campaign should begin at the local governmental level so that the municipal council fully appreciates the flood risk and then takes a proactive approach to strategically addressing the flood risk as much as possible.
9. **Meaningful engagement** – The public should be meaningfully involved in all facets of communicating flood risk. One should determine through dialogue with target audiences what people know and what they should know. Then, one can determine how to communicate with them and design visualizations around how people prefer to be communicated with. Throughout the process, one should check the audiences' pulse on whether they are engaged and what impacts the visualizations and other communications materials are having. Numerous strategies for engaging the public could be employed, from enlisting their participation on committees to asking individuals to facilitate kitchen chats.
10. **Community building** – Communities should develop a broader sense of the collective. Artificial divisions within communities that should be overcome so that they better see themselves as a network, an interconnected web.
11. **Personal Support** – People will need support and psychological and emotional resources should be available to them. There are also numerous low cost options as well. For example, locally, neighbourhoods could be encouraged to organize and hold block discussions so people can seek support among people in the same neighbourhood and talk amongst themselves and formulate plans. A buddy system could be organized where

people living in the low areas are partnered with people in the high areas so they have somewhere to go if they need to evacuate.

12. **Community support** – On a larger scale, support may be found in other communities that are facing similar circumstances. Perhaps there is an opportunity to establish a 'twin community' project that pairs communities with similar challenges so they can share their knowledge and resources towards globalizing opportunities and solutions.
13. **Incentives** – People should be provided with incentives to act.

With efforts to ensure that a community is safe, by setting the bar to challenge communities to succeed, and with the support and information to enable proactive preparation and mitigation and adaptation measures, members of a community can work individually and collectively to look beyond the short term towards long term flood risk mitigation and adaptation solutions that benefit us all.

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1. Introduction and Purpose

This research report is a follow up to an earlier study that involved creating flood scenarios using GIS software to help members of the public visualize the extent of a number of flood scenarios (funded by the Atlantic Climate Change Adaptation Solutions organization, SSHRC, and Mount Allison University (Mount A REB 2011-042 "Is geovisualization an effective tool for public communication of climate threats?")).

2. Project Components

This study involves several components. First, a literature review was conducted that focused on the communication of flood risk and adaptation with a particular focus on fostering action as a result of climate change-induced flooding from sea level rise, where possible. The second component of this study involved conducting interviews based on a purposive sample of regional experts who have previous experience (or interest) in communicating flood risk and/or extensive involvement with the development of adaptation plans for the Tantramar Region. The third component is an inventory of climate change visualization communication options that that could be drawn on to further communicate flood risk. The fourth and final component of this project is a proposed contents for a toolkit about climate change (see Appendix 1 for a list of interview questions).

3. Overview of the Tantramar Region

The Tantramar Region is situated in southeastern New Brunswick. It is governed by four municipal governments,[1] one First Nation[2] and nine local service districts.[3] The maps[4] below depict the region, in terms of the municipalities and the larger region. The region is characterized by both French and English communities though English is more predominant.

As of April 2011, the key demographic characteristics of the Tantramar Region are:

- A population of 14,545
- A median age of 42.
- A well educated population: 14% of the population has a university certificate, diploma or degree, 12% has an apprenticeship or trades certificate or diploma, and 18% has a college, CEGEP or other non-university certificate or diploma.
- The median income in the region is $23,272 per annum.

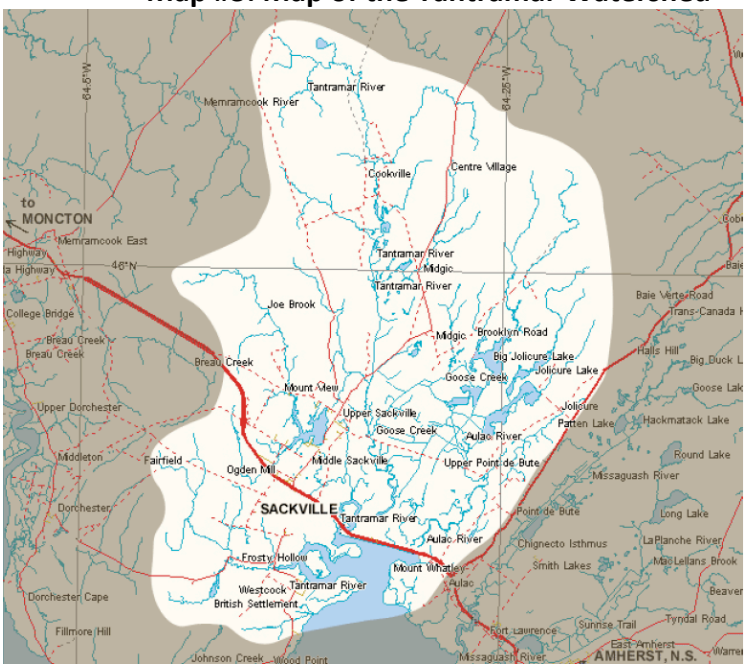
[1] The four municipalities are: Town of Sackville, Village of Dorchester, Village of Memramcook, and Village of Port Elgin.
[2] Fort Folly First Nation.
[3] The nine local service districts are Baie Verte, Bayfield, Botsford, Cape Tormentine, Dorchester, Murray Corner, Pointe de Bute, Sackville, and Westmorland.
[4] Tantramar 2040 Project. *Tantramar 2040: Regional Profile*, Sackville: Unknown, 2011, p. 3 and Tantramar 2040 Project. *Tantramar 2040 Sustainability Plan*, Sackville: Unknown, 2011, p. 3.

- 72% of people are employed in the service sector.
- 82% of residents own their own homes.
- The labour force participation rate is 64.6% and the employment rate is 58.7%. Conversely, the unemployment rate for the region is 9.1%.[5]

Map #1 and #2: Maps of the Tantramar Region

The region is also characterized by an extensive watershed. Map #3[6] below depicts the Tantramar watershed. It shows where water in the region, be it from rain or show, drains into rivers, lakes, and the sea.

Map #3: Map of the Tantramar Watershed



[5] Tantramar 2040 Project. *Tantramar 2040: Regional Profile*, Sackville: Unknown, 2011, pp. 5-7; 11-12; 17.
[6] Ibid., pp. 25-26.

4. Literature Review

4.1 Introduction

Climate change is a hotly debated issue. Some argue that the extent of climate change is grossly exaggerated while others maintain that climate change has had a profound impact on the state of the environment and that the situation will only worsen unless people across the globe make lifestyle changes and feel motivated to change their behaviour. This paper takes the latter position and will focus on the use of visualizations to foster behavioural change. To do that, the paper is organized into a number of subcomponents:

1. (Risk) Communication
2. Behavioural Change and Adaptation
3. Barriers to Action/Adaptation
4. Communicating for Action
5. Defining a Visualization
6. The Benefits of Visualization
7. The Use of Visualizations to Promote (or Inhibit) Action
8. Ethical Considerations
9. Notable Lessons from the Literature
10. Concluding Thoughts

4.2 (Risk) Communication

Traditionally, communicating to the public was generally considered to be a passive process where information was essentially transferred from an authoritative source, such as a government, scientist, academic, or private industry, to a passive, ignorant public. Now, however, the more common view is that the public is much more discerning in what information it accepts and processes. (Risk) communication tends to be regarded more as an exchange of information among a variety of stakeholders, including risk assessors and managers, consumers, community, academia, industry, etc.[7]

There are a multitude of factors that determine whether the public becomes concerned about an issue and/or accepts a message. For example, Sandman[8] maintains that the perceived characteristics of a hazard will influence whether people are concerned about it or not, adding that individual characteristics shape our responses to risk and therefore influence how information should be communicated.

Siegrist et al.[9] found that the public tends to trust experts that they identify with and with whom they believe they share personal and social values. As a result, the public will be more willing to align their risk perception with experts they trust.

[7] McCarthy, Mary and Brennan, Mary. "Food risk communication: Some of the problems and issues faced by communicators on the Island of Ireland" in *Food Policy*, volume 34, 2009, p. 550.
[8] 2006 as cited in ibid., p. 555.
[9] 2000 as cited in ibid., p. 550.

Vulnerability seems to also be an issue. Chowdhury and Haque consider risk communication around the issue of climate change-induced heat waves (e.g., knowledge gaps between experts and laypeople, public perceptions of the issue, and gaps in understanding between experts and the public on how best to communicate risk) in Winnipeg, Manitoba. They found that people's knowledge and perception around climate change and the negative effects of climate change are similar to that of experts. The elderly were found to be the most knowledgeable but they were also the least interested in taking mitigation measures (to reduce the effects of heat waves, in the case of this study). Low-income participants in their study were also found to be more reluctant to take precautionary or corrective measures to reduce the impact of a heat wave. Thus, it appears that risk communications are less effective with vulnerable groups. Chowdhury and Haque therefore suggest that risk communication strategies should consider social, economic, demographic, ethno-cultural factors into account in order to maximize their effectiveness.[10]

Brunsting, et al. apply a communication–persuasion matrix to the issue of communicating about carbon capture and storage and note that the source of a message, the actual message, the way the message is distributed (the channel) and the characteristics of the receiver of the message influence the outcomes of a communication.[11]

Whether an individual or a corporation, the source of the message can also influence how a message is perceived. Source factors include source attractiveness, i.e., physical appearance (vocal pleasantness, facial expressiveness, or physical appearance); level of familiarity to the audience; the similarity between the source of the information and the audience vis a vis demographics, educational background, appearance, etc., and; the extent to which the source of information appears to be trustworthy. [12]

When considering the message itself, one must not only consider the content of the message but also the objectives of the message (i.e., whether the message is intended to raise awareness, inform, instruct, persuade or mobilize), where change is required (i.e., in what segment of the population change is aimed at), how people can benefit (i.e., costs and benefits), how the message is framed and how often the message is repeated. [13]

The way a message is distributed considers the opportunity and ability people have to process information. Channels of communication include conventional media approaches, such as television, newspapers, brochures, the Internet as well as public meetings, or education programs, etc. Opportunity refers to the exposure people have to a message and whether information is made available when people can access it. For example, if an information session is held during the workday when the majority of people are not available, the information presented at that meeting is not

[10] Chowdhury, Parnali D. and Haque, C. Emdad. "Knowledge of the environmental risk and communication gaps between experts and the public: the case of climate change-induced heat waves in Winnipeg" in *Prairie Perspectives*, volume 11, 2008, pp. 114-115.
[11] Brunsting, S., Upham, P., Dütschke, E., De Best Waldhober, M., Oltra, C., Desbarats, J., Riesch, H., and Reiner, D. "Communicating CCS: Applying communications theory to public perceptions of carbon capture and storage" in *International Journal of Greenhouse Gas Control*, volume 5, 2011, p. 1653.
[12] Ibid., pp. 1658-1659.
[13] Ibid., pp. 1659-1660.

considered to be very accessible. Ability refers to someone's capacity to process information. Complexity can influence one's ability to process. [14]

Characteristics of the receiver that can influence how a message is perceived can include the receiver's self-perceived involvement in an issue. Involvement can either be categorized as outcome relevant involvement where the receiver perceives an outcome to be directly and personally relevant or value-relevant involvement where an issue is not directly related to the receiver physically but are relevant to the receiver's personal values on a subject, and the level of involvement. [15] Patt and Dessai underscore the importance of the target audience and suggest that one undertakes a number of strategies in communicating uncertainty to the public. Because communication around climate change may be directed to multiple audiences, a pluralistic approach is necessary. Moreover, terminology should be clear and used consistently. They also suggest that it may be helpful to depict the probability of different risks by ranking them and using a visual to display them, such as a table, in order to make the idea less abstract.[16]

Rabinovich, Morton, and Birney explore how the perceived goals of communicators may influence how the public responds to science communication and engages with messages. Their first study demonstrated that the people tend to trust scientists that they perceive as informing them about climate change rather than persuading them to act in a certain way. When people believe scientists are informing, not persuading, they tend to exhibit a stronger willingness to act in an environmentally-friendly way. Their second study demonstrated that this effect was influenced by the style of the message. People who expected scientists to persuade them were more open to persuasive messaging. Conversely, people who expected scientists to inform them were more receptive to informative messaging. As such, the researchers conclude that an important component to communicating about climate change is ensuring that delivering messages should be consistent with the public's or audience's expectations and that the motives of the communicator may be important to engaging the public as well. The authors go on to recommend that it is therefore important to manage an audience's expectations.[17]

L'Orange Seigo, et al. comment on the amount of information presented. They conducted an online experiment to evaluate the influence of information about monitoring at CO2 storage sites on people's perceptions of carbon capture and storage. One group received basic information about carbon capture and storage and the second group received extra information about monitoring measures being used at storage sites. The researchers found that men who had received the additional information exhibited greater negative effects than men who only read the basic information. The men who were exposed to the additional information demonstrated more risk perception, lower acceptance, and perceived fewer benefits than those who reviewed the basic text. Women's perceptions did not seem to change from one group to the next. Their findings suggest that more information does not necessarily lead to more balanced views or more informed people. In fact,

[14] Ibid., pp. 1658; 1661.
[15] Ibid., p. 1657.
[16] Patt, Anthony and Dessai, Suraje. "Communicating uncertainty: lessons learned and suggestions for climate change assessment" in *Comptes Rendus Geosciences*, volume 337, 2005, pp. 437-438.
[17] Rabinovich, Anna, Morton, Thomas A., and Birney, Megan E. "Communicating climate science: The role of perceived communicator's motives" in *Journal of Environmental Psychology*, volume 32, 2012, pp. 11; 16-17.

more information may have the opposite effect than what is intended. [18]

L'Orange Seigo et al. also caution that it is also critical to consider content, context and how the information being provided. Women and men do not necessarily react to messaging in the same way so communicators should attend to gender differences and how to communicate with them.

The way a message is framed appears to influence an audience's receptivity to it. Spence and Pidgeon found that framing messages in terms of gains as opposed to losses increased participants' openness to taking mitigative action. When messages were framed in terms of losses, they were found to produce higher levels of fear responses. In turn, this produced greater perceptions of the severity of climate change impacts. When the impacts of climate change were framed as distant, they were perceived as being more severe. Participants' attitudes were more receptive to mitigation when they were asked to consider the social aspects of climate change as opposed to personal ones. Thus, the study suggests that framing climate change in terms of how it is personally relevant to an audience may help localize climate change with people's own lives, it may also decrease how severe the impacts are perceived and therefore reduce the likely of action to mitigate the effects of climate change. The study also indicates that it may be important to highlight the distant effects of climate change because they are perceived to be more severe than local ones and to highlight the social benefits of climate change because they are perceived to be greater than the personal benefits.[19]

In the same vein, Morton, Rabinovich, Marshall, and Bretschneider found that messages that conveyed greater uncertainty about climate change and which emphasized potential losses due to climate change (as opposed to gains) increased participants' levels of uncertainty and decreased their intentions to behave in a more environmentally favourable way. In other words, uncertainty about negative impacts reduced environmentally responsible action (i.e., risk), whereas uncertainty about the possibilities of a more positive outcome seemed to increase such action (i.e., caution). However, when a message of greater uncertainty was framed in a positive way and focused on the possibility of losses not occurring, participants' were found to be more likely to act. This implies that a message framed positively is more likely to foster action than one that is framed negatively. This study builds on past research that finds that people participants tend to be uncertainty averse; as uncertainty increases, people tend to be less responsive. This study implies that emphasizing the potential negative potential effects of climate change may in fact not shock people into action mainly because that future is uncertain and people are less likely to act in the face of uncertainty. However, if a message were re-framed more positively, that is to say in terms of what losses may not occur, people may be motivated to act in a way to avoid negative future. It appears that people are more responsive to uncertain optimism than uncertain pessimism.[20]

Joint communications among competing stakeholders seems to influence the perceived balance of a message. Ter Mors, Weenig, Ellemers, and Daamen found that when dissimilar stakeholders come

[18] L'Orange Seigo, Selma, Wallquist, Lasse, Dohle, Simone, and Siegrist, Michael. "Communication of CCS monitoring activities may not have a reassuring effect on the public" in *International Journal of Greenhouse Gas Control*, volume 5, 2011, pp-1676-1679.

[19] Spence, Alexa and Pidgeon, Nick. "Framing and communicating climate change: The effects of distance and outcome frame manipulations" in *Global Environmental Change*, volume 20, 2010, pp. 662-663.

[20] Morton, Thomas, A., Rabinovich, Anna, Marshall, Dan, and Bretschneider, Pamela. "The future that may (or may not) come: How framing changes responses to uncertainty in climate change communications" in *Global Environmental Change*, volume 21, 2011, pp. 101-108.

together to communicate with the public, people expect the information they present to be more balanced than if the stakeholders communicated individually. The public also expects the information to represent more divergent opinions and therefore to be higher in quality. Ter Mors et al. also found that when similar stakeholders unite to convey a message, the public does not expect the information to convey a range of perspectives and be more balanced. Collaborative communications were found to be more effective only when stakeholders are perceived to represent different perspectives.[21]

In speaking directly about the media, Abroms and Maibach suggest that mass media interventions that seek to influence people directly by directly targeting people, such as those that have a health problem, are less effective than mass media interventions that attempt to influence people indirectly by, for example, creating beneficial changes in the places where people live and work. They hypothesize that individual-focused campaigns may not be as effective because while they encourage changes in individual behaviour, they neglect to consider that the context in which people operate (e.g., social networks, place where people live and work, etc.) do not change.[22]

Shaw et al. comment on stakeholder participation and the need to ensure that key stakeholder are involved meaningfully. This includes traditionally excluded people, such as Aboriginal communities. Innovative ways to engage such communities and the public in general will have to be taken.[23] Morgan et al. agrees and comments on the cost of excluding stakeholders in not only communication processes but in designing communication processes as well:

> Rather than conduct a systematic analysis of what the public believes and what information they need to make the decisions they face, communicators typically ask technical experts what they think people should be told … Those passing judgment may know very little about either the knowledge or the needs of the intended audience. Under such conditions, it is not surprising that audiences often miss the point and become confused, annoyed, or disinterested. If the communicators feel that they have done everything that is expected of them, they may conclude that their audience was responsible for the communications failure. [24]

Regarding strategies for effective risk communications, the OECD Guidance Document for Communicating Chemical Risk promotes a number of steps for effective risk communication that have a high level of public concern. These steps include: issuing a statement of commitment for

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[21] Ter Mors, Emma, Weenig, Mieneke W.H., Ellemers, Naomi, Daamen, Dancker D.L. "Effective communication about complex environmental issues: Perceived quality of information about carbon dioxide capture and storage (CCS) depends on stakeholder collaboration" in *Journal of Environmental Psychology*, volume 30, 2010, pp. 255-256.

[22] Abroms, Lorien C. and Maibach, Edward W. "The Effectiveness of Mass Communication to Change Public Behavior" in *Annual Review of Public Health*, volume 29, 2008, pp. 219-228.

[23] Shaw, Alison, Sheppard, Stephen, Burch, Sarah, Flanders, David, Wiek, Arnim, Carmichael, Jeff, Robinson, Joh, and Cohen, Stewart. "Making local futures tangible—Synthesizing, downscaling, and visualizing climate change scenarios for participatory capacity building" in *Global Environmental Change*, volume 19, 2009, p. 461.

[24] Morgan M.G., Fischhoff, B., Bostrom, A., Atman, C. *Risk Communication: A mental models approach*. New York: Cambridge University Press, 2002, p. 19.

communicating information that is relevant to the public; making clear distinctions between hazards (i.e., types of potential harms) and risk (i.e., the likelihood people may suffer from those harms); being aware of and acknowledging the heightened sense of fear or dread that people may be feeling; being clear about what is known and who may be likely to be exposed to dangers; indicating the level of knowledge that is already known and how knowledge will be improved or expanded; describing what is not known in the knowledge one already has and when gaps in knowledge may be filled; describing quantitatively and quantitatively what estimates of probability have been made or when they might be expected; justifying what is thought to be an acceptable level of risk; providing clear justification for the action that is being undertaken, and; providing contact information where questions may be directed.[25]

4.3 Behavioural Change and Adaptation

Kollmuss and Agyeman comment that environmental psychology has attempted to answer why people act or do not act environmentally and what the barriers to positive environmental action might be. They note that numerous frameworks have been developed, such as early US linear progression models, altruism, empathy and pro-social behavior models, sociological models, economic models, psychological models, social marketing models and deliberative and inclusionary processes or procedures. These frameworks attempt to explain the gap between one's environmental awareness and displaying what the authors term as pro-environmental behaviour, i.e., "behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world".[26] They note that hundreds of studies have been conducted and no answers have been found.

Nonetheless, adaptation as a response to climate change can reduce people's vulnerability to the impacts of climate change and therefore reduce costs and loss associated with it. Adger states that adaptation can take place at any scale, from local to global. [27]

Risbey et al. proposes that a public adaptation process contains four stages: (1) signal detection, where one decides on what to adapt and what to ignore; (2) evaluation, where one interprets a signal and evaluates potential consequences; (3) decision and response, where there is a notable change in the behaviour, and; (4) feedback, where one monitors behaviours and outcomes. [28] In a similar manner, Klein et al. asserts that there are four stages in planned adaptation: (1) information collecting and awareness building; (2) planning and design; (3) implementation, and; (4) monitoring and evaluation.[29]

Social marketing is "the systematic application of marketing concepts and techniques to achieve specific behavioural goals relevant to the social good".[30] McKenzie-Mohr advocates using

[25] Organisation for Economic Development, Environment Directorate. *OECD Guidance Document on Risk Communication for Chemicals Risk Management*, 2002, p. 23

[26] Kollmuss, Anja & Agyeman, Julian, "Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior?" in *Environmental Education Research*, volume 8, number 3, 2002, p. 240.

[27] 2001 as cited in Grothmann, Torsten, and Patt, Anthony. "Adaptive capacity and human cognition: The process of individual adaptation to climate change" in *Global Environmental Change*, volume 15, 2005, p. 201.

[28] 1999 as cited in ibid.

[29] 1999 as cited in ibid.

[30] Corner, Adam and Randall, Alex. "Selling climate change? The limitations of social marketing as a strategy for climate change public engagement" in *Global Environmental Change*, volume 21, 2011, p. 1006.

community-based social marketing founded on psychological processes to foster sustainable behavior. Once barriers to behaviour are identified, McKenzie-Mohr proposes a four-step approach involving (1) selecting which behaviours to promote; (2) developing a program to overcome the selected behaviours; (3) testing the program through a pilot, and; (4) evaluating the approach upon implementation.[31] Kollmuss and Agyeman also comment that social marketing techniques seems to show promise in encouraging behavioural change.[32]

Corner and Randall find that using social marketing as the sole way to engage the public on climate change is not effective and may even be counterproductive. The authors suggest a number of communication and engagement strategies that one can use to either compliment social marketing or to be used instead. These are: environmental education, value-based engagement, and the enhancement of social capital and citizenship. They suggest that the characteristics of the audience and the social context determine the approach that should be used. Drawing on the work of Crompton[33], Corner and Randall suggest that messages should engage the public on 'bigger than self' issues and that messages should focus on larger values, rather than solely self-interest. Furthermore, social networks may be important to encouraging change because they develop norms for collective rather than individual interest and behaviour. Finally, Corner and Randall emphasize that education, whether formal or informal, is crucial in forming attitudes, values, and behaviours, particularly among children which they will then carry with them throughout their lives. Learning about environmental issues as children creates agency as adults. Education can also help people find their place and their role.[34]

Grothmann and Patt apply the lessons from microeconomics to adaptation, noting that people tend to underestimate large probabilities and overestimate small ones. Therefore, in designing effective public policy, one requires an understanding of how individuals make decisions. [35] Adger[36] argues that individuals' capacity to adapt to climate change is determined by their access to resources. Others, like Patt and Gwata, question the importance of resources alone. [37]

There seems to be a connection between cognitive factors and adaptation. For example, Weber[38] found that perception and expectation of climate change are important factors. Viscusi and Chesson[39] identify fear and hope as relevant factors when studying how managers and business owners respond to risks of storm damage in coastal North Carolina. Linneweber et. al. [40] and Harmuth[41] consider the influence of people's positions in society on coastal zone protection. Grothmann and Patt also argue that models of adaptation/adaptive capacity should consider socio-cognitive variables. Their case study analysis of 157 randomly chosen residents living within flood-prone areas of Cologne, Germany

[31] McKenzie-Mohr, Doug "Promoting Sustainable Behavior: An Introduction to Community-Based Social Marketing" in *Journal of Social Issues*, volume 56, number, 2000, pp. 543–549.
[32] Kollmuss and Agyeman, pp. 239-240.
[33] 2010 as cited in Corner and Randall, p. 1010.
[34] Corner, and Randall, pp. 1006-1012.
[35] Grothmann and Patt, p. 202.
[36] 2003 as cited in ibid.
[37] 2002 as cited in ibid.
[38] 1997 as cited in ibid.
[39] 1999 as cited in ibid.
[40] 2002 as cited in ibid.
[41] 2002 as cited in ibid.

and Zimbabwean farmers' proactive adaptation to the risk of drought revealed that it was more effective to explain adaptive behaviour using socio-cognitive factors like risk perception and perceived adaptive capacity than by using socio-economic factors like home ownership and income.[42]

To explain why some people show adaptive behaviour while others do not, Grothmann and Patt developed a process model of private proactive adaptation to climate change founded on Protection Motivation Theory. Protection Motivation Theory differentiates between risk appraisal, i.e., a person's assessment of the probability of a threat and the potential of damage to items she or he values with no change to her or his behaviour, and adaptation appraisal where a person evaluates one's ability to avoid being harmed by a threat and the costs of taking that action. Risk appraisal has two aspects: perceived probability and perceived severity. Perceived probability is one's expectancy of being exposed to a threat. Perceived severity is one's evaluation of how harmful the threat would be to the things one values of that threat were to actually come to pass. The greater the difference is between what one wants to happen, or not happen, as the case may be, and what one actually expects to happen, the more motivation one has to adapt.

Adaptation appraisal begins after risk perception and only starts after a minimum threshold of threat appraisal is surpassed. Adaptation appraisal has three aspects: (1) perceived adaptation efficacy or the belief that adaptive responses/actions are effective in protecting oneself or others from being harmed by a threat; (2) perceived efficacy or one's perceived ability to pursue an adaptive response, and; (3) perceived adaptation costs or the cost associated with making the adaptive response, be they monetary, personal, effort, time, etc. Adaptive responses are those that are taken that avoid or prevent damage and maladaptive responses encompass avoidant reactions, such as denial, fatalism, wishful thinking, and those that actually increase damage, whether intended or not.[43] Grothmann and Patt focus only on avoidant maladaptive responses; they find that one makes such a response if their risk perception is high but their perceived adaptive capacity is low. Grothmann and Patt also distinguish between adaptation intention, i.e., having the intention to change, and behavioural adaptation, i.e., actually changing one's behaviour.[44] Grothmann and Patt maintain that cognitive biases and 'judgment heuristics' not only affect people's perceived adaptive capacity irrationally but also influence risk perception. Errors of judgment are often most serious when uncertainty is high, despite the fact that this is exactly when adaptation should occur. One such bias is the 'optimistic bias' or 'unrealistic optimism' where people perceive their risk of being harmed as being smaller than the average risk. Another bias is the 'availability heuristic' where people estimate potential risks by referring back to their memories for examples of such a risk actually occurring. This, in turn, can lead to additional biases. For example, events that are more recent are judged to be more likely to occur again and events that create vivid memories are also judged to be more likely.[45] It is possible to overestimate or underestimate one's ability to adapt. With regards to climate change, Grothmann and Patt[46] postulate that there may be a tendency to underestimate one's adaptive capacity largely because, as Gardner and Stern[47] suggest, people feel that they are unable to solve large-scale environmental issues.

[42] Grothmann and Patt, p. 209.
[43] Ibid., pp. 203-204.
[44] Ibid., pp. 204-205.
[45] Ibid., p. 205.
[46] Ibid., pp. 202-203.
[47] 1996 as cited in ibid.

In their study of people's acceptance of low emission energy technologies, Ashworth et al. found that attitudinal changes will be impacted by the strengths of an individual's beliefs or attitudes about the technology and whether they are presented with information that are in accordance with or at odds with them.[48]

Lorenzoni, Nicholson-Cole, and Whitemarsh discuss the issue of engagement on climate change in terms of a personal state of connection with the issue, not in terms of a public participation process (in policy making).[49] They regard engagement as comprising cognitive, affective and behavioural aspects; these aspects are not related in a linear way and are a product of social and institutional contexts. They maintain that engagement goes beyond people knowing about climate change to people caring about it, and being motivated and able to act on it. Lorenzoni et al. draw on psychology that discusses the range of factors that influence people's attitudes and behaviours regarding environmental issues, such as past behaviour, knowledge, experiences, feelings, social networks, institutional trust and demographic characteristics.[50] When contemplating what motivates people to act, Lorenzoni, et al. present the Theory of Planned Behaviour, which postulates that beliefs about a certain behaviour, norms and "perceived behavioural control"[51] determine an intention to act. However, the authors point out that this theory has been criticized for being too individualistic and does not contemplate context enough.

De Hoog, Stroebe, and de Wit considered the processing and acting of a recommendation in terms of the impact of vulnerability (to a severe health risk), the quality of the arguments, and the source of the recommendation. They found that the quality of the argument affects the attitudes towards the recommendations and that when conditions are severe, an action recommendation is processed based on the contents of the information rather than on 'shallow' heuristics. They also found that the extent to which someone feels vulnerable influenced their decision to act, but did not necessarily affect their attitude. However, De Hoog, Stroebe, and de Wit did find that as one moves from attitudes to intentions and behaviours, vulnerability becomes important. They found that respondents in their study displayed a greater intention to act when they felt more vulnerable and regardless of the quality of the argument being put forth. Vulnerable respondents also acted more positively and with fewer negative thoughts than those who were less vulnerable. They also asked for more information. This suggests that vulnerability can be a defense motivation. Vulnerable people also perceived consequences as more threatening. The authors considered whether individuals under threat are more likely to take protective action and conclude that the perceived effectiveness of an action still plays a significant decision in one's decision to act.[52]

Agyeman, Doppelt, Lynn, and Hatic consider how risk communication may be used among low income or minority communities. They note a number of factors that should be borne in mind. People in low income or minority communities tend to be wary of people and programs from outside their

[48] Ashworth, Peta, Carr-Cornish, Simone, Boughen, Naomi, and Thambimuthu, Kelly. "Engaging the public on Carbon Dioxide Capture and Storage: Does a large group process work?" in *Energy Procedia*, volume 1, 2009, pp. 4771-4772.
[49] Lorenzoni, Irene, Nicholson-Cole, Sophie, and Whitmarsh, Lorraine. "Barriers perceived to engaging with climate change among the UK public and their policy implications" in *Global Environmental Change*, volume 17, 2007, p. 446.
[50] Ibid.
[51] Ibid.
[52] de Hoog, Natascha, Stroebe, Wolfgang, and Wit, John B. F. "The Impact of Fear Appeals on Processing and Acceptance of Action Recommendations" in *Personal Social Psychology Bullet*, volume 31, 2005, pp. 30-32.

communities. They tend to focus on fulfilling the basics of life (e.g., feeding their families). Therefore, communicators will have to build credibility and trust. This can be done in a variety of ways. As examples, Agyeman, Doppelt, Lynn, and Hatic suggest partnering with local, credible organizations and by citing issues that are meaningful to the community. Spokespeople should also understand the socio-cultural context of the community. Messages should not monger fear but be honest, jargon-free, and reassuring. Finally, an asset-based approach, rather than a problem-based approach, should be adopted. In other words, the issue should be framed in a way that recognizes people in community have the skills, assets, and talents to be part of the solution. [53]

Gifford and Comeau consider whether a message is framed in motivational or sacrificial way leads to one's perceived ability to act. They found that people who were exposed to motivational messages saw themselves as more competent and engaged in climate change as compared to those who were exposed to messages that focused on sacrifice. Gender also seemed to be the most important demographic factor. Women reported having greater perceived competence to engage with and mitigate climate change and they expressed more concern with the state of the environment. [54] Kollmuss and Agyeman also report that gender and education seem to influence environmental attitude and pro-environmental behavior. Women tend to have less environmental knowledge than men but are more willing to change, are more emotionally engaged, and are more concerned about the negative impacts of environmental degradation. Though, Kollmuss and Agyeman observed that having more education does not necessarily lead to more pro-environmental behaviour. [55]

In Gifford and Comeau's study, older participants reported having greater intentions to act but felt less competent to do so. The researchers suggest that if messages are directed to the public in general, they should be motivational rather than sacrificial. However, if one can focus one's message on a particular segment of the population, then using one type of message may be more effective than using another type. For example, men and women appear to be more receptive to different types of messages therefore whether one is communicating with a group of men over women may mean that a different approach to messaging would be used.[56]

Similarly, Pelletier and Sharp consider how message tailoring and message framing can foster a change in behaviour. They maintain that in order to change behaviour, three types of messages should be conveyed. The first type of message should be geared towards education people that a particular problem or issue exists, that is the 'detection phase'. Messages here would help people determine that the problem or issue is important and is the rationale for future information. The second type of message should relay important actions that could be undertaken to reduce risks, that is the 'decision phase'. The point here is to convey information about behaviours that could meet the challenges identified during the first phase. In other words, messaging should tell people what they can do and how a situation will improve as a result of their undertaking action. The third type of message is explaining the specifics of how a behaviour should be undertaken so people can

[53] Agyeman, Julian, Dopplet, Bob, Lynn, Kathy, Hatic, Halida. "The climate-justice link: communicating risk with low-income and minority audiences" in Moser, Susanne C. and Dilling, Lisa, eds. *Creating a Climate for Change. Communicating Climate Change and Facilitating Social Change*, Cambridge: Cambridge University Press, 2007, pp. 133-136.
[54] Gifford, Robert and Comeau, Louise A. "Message framing influences perceived climate change competence, engagement, and behavioral intentions" in *Global Environmental Change*, volume 21, 2011, pp. 1305–1306.
[55] Kollmuss and Agyeman, p. 248.
[56] Gifford and Comeau, pp. 1305–1306.

understand how they can translate their intention to act into action itself.[57]

Additionally, Pelletier and Sharp assert that it is important to consider the intrinsic and extrinsic values, costs or gains that are promoted or emphasized when trying to cause behavioural change. An intrinsic value, cost or gain relate to personal well-being, such as health and personal grown whereas extrinsic ones pertain to elements such as face, money, and physical attractiveness. They maintain that intrinsic motivations are more likely to underpin pro-environmental behaviour than extrinsic values.[58]

Pro-environmental behaviours also seem to be influenced by the availability of resources to implement them. Kollmuss and Agyeman contemplate external and internal factors. In terms of external factors that may influence positive behaviours, the researchers point to the availability of institutional factors, such as good public transportation, economic incentives, and socio-cultural factors. Internal factors may include the level of one's environmental knowledge and awareness, values, attitudes, emotional involvement, the belief as to whether one believes one's behaviour can bring about change, personal responsibilities and priorities, motivation but they caution that motives like altruism and social values can be inhibited by motives that are more grounded in one's own needs like comfort, money, and time. Each factor, however, also has its limitations and can also stymy behaviour or contribute to inaction.[59]

Tribbia summarizes the internal and external forces that motivate or constrain individual action as falling into 5 categories. First is the concept of inclination. Socioeconomic status, ethnicity, gender, age, values, attitudes, and beliefs can all influence inclination. For example, socioeconomic status can influence whether people can afford to purchase greener items, which tend to be more expensive. Concern about the environment manifests itself in different ways among ethnic minorities than among people with a Euro-North American background. Men and women tend to act differently to environmental issues with women being more incline to adopt environmentally-friendly behaviour. Younger people tend to be more environmentally concerned than older people. People's values, attitudes, and beliefs also impact one's priorities and impact one's decisions to act.[60]

Motivation is the second category. Motivators include knowledge and information (including solutions), emotions, being consistent with one's identity and sense of self, desires, and needs. Chess and Johnson caution though that factual information alone is not enough to motivate behaviour.[61]

The third category is information processing and behavioural intent. Experiences, surroundings, and values influence how a person processes information. And, how a person processes information affects what kind of behavioural intentions (i.e., intent to act) they form.[62]

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[57] Pelletier, Luc G., and Sharp, Elizabeth. "Persuasive Communication and Proenvironmental Behaviours: How Message Tailoring and Message Framing Can Improve the Integration of Behaviours Through Self-Determined Motivation" in *Canadian Psychology*, volume 49, issue 3, 2008, pp. 213-214.
[58] Ibid., pp. 214-215.
[59] Kollmuss and Agyeman, pp. 249-256.
[60] Tribbia, John. "Stuck in the slow lane of behavior change? A not-so-superhuman perspective on getting out of our cars" in Moser and Dilling, 2007, pp. 238-241.
[61] Chess, Caron and Johnson, Branden B. "Information is not enough" in Moser and Dilling, 2007, p. 228.
[62] Tribbia, pp. 244-245.

Ability and skill comprise the fourth category. This refers to whether one has the talent or skill, financial means, technical expertise, or information to translate an intention to act into an action. A sense of self-efficacy, or personal sense of ability, is also important here.[63] The final category is external support, which can come from peer or social groups, institutions, laws and regulations, and infrastructure.[64]

As a result of these five categories, Tribbia maintains that attempts to enable environmental behavioural change should adopt a diverse, multi-pronged strategy.[65] Tribbia references Malcom Gladwell's *The Tipping Point* in which Gladwell discusses small ideas making a big difference after spreading widely. Three principles help something move to the 'tipping point' or the threshold at which they become popular: (1) the 'law of the few' which states that ideas are spread by a few individuals who have an extensive network, by experts, and by people who are influential and persuasive; (2) the 'stickiness factor' that involve making messages memorable, and; (3) the 'power of context' that draws on using people's personal context to convince people to change.[66] Tibbia maintains Gladwell's principles can be applied to promoting environmentally responsible behaviour.

Though a considerable amount of the literature on climate change focuses on the individual, Arroyo and Preston remind us that the business sector plays a considerable role in mitigating and adapting to climate change. Businesses can respond to scientific information, often participate in policy dialogue, and develop replacements or alternatives for environmentally unfriendly products.[67]

4.4 Barriers to Action/Adaptation

There are numerous roadblocks that prevent the public from changing their behaviour in response to climate change. Nicholson-Cole, for example, notes that the concept of climate change is quite abstract. Therefore, it is difficult for people to relate to it and see how their small, personal changes can affect such a massive issue. There is also conflict about the validity of climate change and how to address it among politicians, causing confusion and uncertainty at the constituent level. There are few drivers for change at the local level. It is seemingly easier to continue with 'business as usual'; changes to behaviour seem daunting and implausible. Nicoleson-Cole found that participants were often more affected by national and local imagery about climate changes because it was easier for them to relate to. She also found that participants used their own personal experience from the past to imagine the future. The participants in Nicoleson-Cole's study felt that it was everyone's responsibilities to do something about climate change but that the government should lead initiatives and make it easier for people to do something. Many participants felt that the problem of climate change was too big and that individuals could not make a difference. Some participants expressed the feeling that it was not worth doing anything when so many others were not changing their ways. Others said that they did not see the effects of climate change and therefore should not be obligated react behaviourally. In other words, climate change is seen as a distant issue and not one that has to be acted on until the effects of climate change are felt directly. At the same time, the participants in

[63] Ibid., p. 245.
[64] Ibid., pp. 245-246.
[65] Ibid., p. 247.
[66] Gladwell, 2002 as cited in ibid.
[67] Arroyo, Vicki and Preston, Benjamin. "Change in the marketplace: business leadership and communication" in Moser and Dilling, 2007, p. 321-322.

Nicoleson-Cole's study reported that they would be more inclined to act if they understood what the impact would be on them, what they could actually do and if they could be reminded regularly to act or behave differently by the media, by government, and by other regular sources of information. She also notes that people are often concerned about compromising their standard of living or quality of life. [68] As a result of their research of communication activities around carbon capture and storage, Ashworth, Boughen, Mayhew, and Millar found that once people form their opinions, it is difficult to change them. [69]

Sterman and Booth Sweeney discuss public complacency towards climate change. They postulate that perhaps the public is inadequately informed about climate change and will not act on something they do not know about. [70] Rogers[71] notes that adopting a new approach is more likely when supporting policies are easy to assess, straight forward, are clearly advantageous, and where costs and benefits are obvious.

Maiteny finds that people can become overwhelmed by sustaining environmental behaviour because of the enormity of it and the sense that one's small behaviours are ultimately futile. At the same time, he finds that actions that are localized and which can be done 'at home' can be more helpful and can reduce anxiety and promote action.[72] Maiteny also found that participants in his study who undertook pro-environmental behaviour also experienced a greater sense of well-being. The less the individual is connected with the environment, the less likely one is to change one's behaviour.[73]

Lorenzoni, Nicholson-Cole, and Whitemarsh analyze three studies completed in the United Kingdom to further explore the range of perceived barriers to public engagement in the climate change (in the United Kingdom). They classify barriers into two categories: individual and social. [74] In terms of individual barriers, Lorenzoni, Nicholson-Cole, and Whitemarsh found that people seem to have a lack of basic understanding about climate change causes, impacts and solutions that contributes to a general uncertainty about climate change. And, while information is available, it is not translated into action. Reasons include not knowing where to find information, a lack of interest in getting information, information overload, confusion caused by conflicting information, a lack of understanding over how information is relevant to one's local situation, information that is not perceived as being trustworthy or credible, inaccessible formats of information, and a disconnect between information and solutions. The authors found that climate change is often lumped in under the broader issue of environmental issues and is not necessarily regarded as being distinct. [75]

Lowe et al. also commented on information deficits in his assessment of the impact of the film *The*

[68] Nicholson-Cole, Sophie A. "Representing climate change futures: a critique on the use of images for visual communication" in *Computers, Environment and Urban Systems*, volume 29, 2005, pp. 258; 264-266.
[69] Ashworth, Peta, Boughen, Naomi, Mayhew, Melissa, and Millar, Frances. "An integrated roadmap of communication activities around carbon capture and storage in Australia and beyond" in *Energy Procedia*, volume 1, 2009, pp. 4754-4755.
[70] Sterman, John D., and Booth Sweeney, Linda. "Understanding public complacency about climate change: adults' mental models of climate change violate conservation of matter" in *Climatic Change*, volume 80, 2007, p. 235.
[71] Rogers 2003 as cited in ibid., 2007, p. 235.
[72] Maiteny, Paul T. "Mind in the Gap: Summary of research exploring 'inner' influences on pro-sustainability learning and behaviour" in *Environmental Education Research*, volume 8, number 3, 2002, p. 301.
[73] Ibid., pp. 303-304.
[74] As cited in Lorenzoni, Nicholson-Cole, and Whitmarsh, p. 448.
[75] As cited in Ibid, p. 451.

Day After Tomorrow, a film about the earth's catastrophic shift into a new ice age, on the perception of climate change. Lowe et al. considered four issues: the likelihood of an event; concern about climate change; motivation to act; and who has the responsibility for the climate change. They found that as a result of seeing the film, moviegoers did demonstrate a shift in attitude and their concerns about climate change increased. At the same time, anxiety about environmental problems increased and viewers had difficulty differentiating between fact and fiction and their belief of the likelihood of extreme events decreased. Viewers also expressed a strong motivation to act after the move but the study also revealed that people lack information on how to act.[76]

Lorenzoni, Nicholson-Cole, and Whitemarsh observe that the media often relays scientific and political disagreement about the issue and does not consistently pay attention to climate change. The leads people to question the seriousness or validity of climate change. In turn, this influences how information is reacted to. If information is in conflict with our values or experiences, that information will be ignored.

Lorenzoni, Nicholson-Cole, and Whitemarsh also found that fatalism can also be a barrier to engagement. If a problem, such as climate change is so far gone, no human action may be able to reverse it so no action on their part is necessary. Another barrier to engagement is trust in the sources of information. Media was perceived as biased and much of the information presented by industry was regarded as marketing tactics. Some people believe that the responsibility for responding to climate change likes with other people, governments, business, industry, or even other countries or that certain technological solutions may save the day. The researchers found that denying personal responsibility and shifting the blame were significant barriers. Lorenzoni, Nicholson-Cole, and Whitemarsh also noted that some of their participants had trouble visualizing the consequences of their activities and the connection between their behaviour and climate change. Participants often felt that individual action has very little effect on climate change as compared to larger scale actions and therefore taking individual action was just not worthwhile since it would have such little effect. Participants were also concerned about the effect that taking action on climate change would have on one's lifestyle or quality of life. Many were convinced that taking action would lead to discomfort or sacrifice. [77]

Lorenzoni, Nicholson-Cole, and Whitemarsh identified numerous additional social barriers to action: (1) a perception that local, national and international governments were taking limited political action; (2) a lack of action by private business and industry; (3) inaction by others; (4) a lack of infrastructure to support change; (5) lifestyles, such as driving to work, road trips, and the focus on consumption, and; (6) denial as a reaction to fear of the threat of climate change. [78] Lorenzoni, Nicholson-Cole, and Whitemarsh also caution that the public is heterogeneous and therefore, a strategy to promote action should bear this in mind. [79]

In their study of the acceptance of carbon capture and storage, Terwel, Harinck, Ellemers, and

[76] Lowe, Thomas, Brown, Katrina, Dessai, Suraje, de França Doria, Miguel, Haynes, Kat and Vincent, Katharine. "Does tomorrow ever come? Disaster narrative and public perceptions of climate change" in *Public Understanding of Science*, volume 15, 2006, pp. 451-454.
[77] Lorenzoni, Nicholson-Cole, and Whitmarsh, pp. 452-453.
[78] Ibid., p. 453.
[79] Ibid., p. 454.

Daamen found that the public's trust of stakeholders, not solely the properties of carbon capture and storage, affect public acceptance of it. In other words, the researchers found that (1) the level of competence stakeholders in an issue (in their case, carbon capture and storage) are perceived to have affect how people perceive information; (2) people who perceive more benefits than risks tend to be more positive about the technology; (3) if people do not view a communicating organization as being open, honest, and sincerely concerned with public interests, people will take positions that are opposite to those taken by the communicators; (4) people tend to believe environmental NGOs over industry suggesting that perceived motives might be important; (5) trust is fostered when there is a congruence between perceived motives and the who the communicator is perceived to be (e.g., the public trusts industrial communicator less when it discusses environmental benefits rather than economic benefits), and; (6) people are more likely to accept policy decisions if they trust the policy-makers.[80]

In considering what prevents municipalities from taking action against climate change, Burch asserts that capacity is critical, be it financial, human, or social.[81] She does on to identify four types of barriers that local governments face: structural/operational, regulatory/legislative, cultural/behavioural, and contextual factors. Structural/operational barriers refer to an organization's structures and procedures that shape daily municipal activities and long-term policy. Participants in her study identify numerous structural/operational barriers, including: excessive transparency prevents councilors from learning about new issues in a non-threatening environment; term limits prevent long-term decision making; a lack of a long-term strategic sustainability plan; few opportunities for institutional learning; a tendency to have to create recommendations that are consistent with past policies; having no incentives for innovation; cumbersome community consultation processes that can hinder efficient decision-making; planning cycles that are based on short, budgetary cycles not long-term planning; a party system that inhibits collaborative planning; neighbourhood divisions that inhibit municipal-wide planning; redundancies in job descriptions and job responsibilities; differing and sometimes divergent departmental mandates; a rigid hierarchical system; isolating environment and climate change within certain departments limits widespread buy-in from all departments; job descriptions that do not embed climate change into daily responsibilities; inability of individuals to see linkages between departments; engrained decision-making processes, and the size of governments can stymy effective and efficient communication. [82]

Regulatory/legislative barriers include policy tools and relationships between different levels of government. Burch identified several such barriers including: conflicts between municipal building by-laws and the provincial building code; a lack of local control over the main producers of emissions; limitations on regional planning because power resides with local and provincial governments only; a lack of harmonized industrial emissions in all parts of a region; the failure of provincial supports to communities to materialize; provincial policies that contradict with regional growth strategies; a lack of a long-term sustainability strategy leading to inconsistencies between departmental goals and approaches; a lack of integration of new information about climate change causes and impacts; no

[80] Terwel, Bart W., Harinck, Fieke, Ellemers, Naomi, and Daamen, Dancker D.L.. "Going beyond the properties of CO2 capture and storage (CCS) technology: How trust in stakeholders affects public acceptance of CCS" in *International Journal of Greenhouse Gas Control*, volume 5, 2011, p. 187–188.

[81] Burch, Sara. "In pursuit of resilient, low carbon communities: An examination of barriers to action in three Canadian cities" in *Energy Policy*, volume 38, issue 12, 2010, p. 7576.

[82] Ibid., pp. 7578-7579.

policy to ensure developers adopt green approaches; abstract policy frameworks; a lack of common understanding of sustainability; a lack of implementation, monitoring and evaluation plans and mechanisms; weak mayoral powers; ad hoc environmental committees with no formal mandate or authority, and; constrained action because of having to work within existing program structures. [83]

Cultural/behavioural, and contextual factors embody culture, personality, values, and beliefs. Burch identified several such barriers including: the cultural climate of the organization; conflict and competition between municipalities and transit authorities prevent transportation planning; formal approaches to policy and procedural development that emphasizes educational and cultural differences between groups in a municipality; isolation between planning and operations and animosity between them; operational staff being wary of initiatives that stem from planning departments; desire to be re-elected inhibits transformative, long term decision making; a lack of federal or provincial leadership; decision-making processes that may be at odds with the status quo; the mayor and council being partial to special interests; animosity between Council and the planning function; physical separation between operational and planning staff so are little opportunities to work together; reluctance to try anything that has not already been proven elsewhere, and; penalizing managers for violating new by-laws. [84]

Finally, contextual barriers, such as the environment in which governments operate and public values, interests, and priorities, can either facilitate or prevent action. Participants in Burch's study identified several contextual barriers: climate change may force adaptation, not mitigation, and may focus only on short term planning; there are few opportunities to transform a(n urban) landscape in older, developed communities; competing priorities might limit commitment to climate change action; communities may be resistant to change; demonstrable impacts from climate change are first required in order to get politicians to act. [85]

Burch find that barriers tend to be deeply engrained and may reinforce each other, preventing movement or progress. Burch concludes by suggesting that if this inertia is to be overcome, these barriers must be transformed into enablers of action. [86]

Moser and Dilling identify a number of barriers regarding communicating about climate change. They note that climate change is complex and uncertain. The complexity is difficult for the average person to comprehend. The results of climate change are long term and can be slow to onset. Day to day impacts or changes are difficult to detect. The impacts of today's emissions on the climate are long term and therefore difficult to perceive. Moreover, people who live in regions of the globe that are already experiencing the effects of climate change live a part from the people who live in areas that are the major sources or creators of emissions. It is also difficult to comprehend that one's local actions have global impacts. The pressures of daily living limits most of us to focusing on immediate concerns. Therefore, preventative or remedial action is difficult to encourage. [87]

[83] Ibid., p. 7580.
[84] Ibid.
[85] Ibid., p. 7581.
[86] Ibid., p. 7584.
[87] Moser, Susanne C. and Dilling, Lisa. "Making Climate Hot: Communicating the Urgency and Challenge of Global Climate Change" in *Environment*, volume 46, number 10, 2004, pp. 32-46.

Moser and Dilling also point to the failure on the part of communicators to communicate effectively with the public. The media portrays global warming and climate change as being uncertain and one where the debate is fraught with inconsistencies and disagreements. This confuses the public. There is also a failure (or reluctance) to understand the anthropogenic causes of climate change and therefore a failure to see how we as people can play a role in the solution. As a result, people have no idea what they can do to avert a disaster that has been conveyed to some degree as being inevitable. The public also tends to equate climate change with a change in the weather. In turn, weather is regarded as a natural phenomenon that humans cannot control. Therefore, people tend to conclude that climate change (or changes in the weather) is not caused by and cannot be solved by people. There are many organizations both in acceptance and in denial of climate change which polarized the issue and results in a public that 'tunes out'. [88]

4.5 Communicating for Action

Through their literature review, Sheppard et al. extract a set of criteria in building awareness and capacity for acting to undertake climate change solutions in communities. This includes providing clear, understandable, and salient information and providing information that people can connect with and that reflects what they care about. At the same time, it is important not to overwhelm one's audience with problems and negative information. Agency is more likely if the impending risks are presented along with positive messaging around what people can do to prepare and adapt and reduce the threat. Sheppard et al. integrate these criteria into three requirements: (1) localizing the issue of climate change and involving local stakeholders; (2) using holistic scenarios, not partial or sectoral ones, which combine multiple aspects of climate change (or whatever issue is at play), such as scenario drivers, impacts, responses, adaptation strategies, and mitigation strategies, and; (3) using visualizations to foster interest and engagement, educate the public and engage the public in the development of plans and solutions. [89]

Sheppard et al. also lay out some conceptual needs that are required when designing scenarios to motivate the general public, planners, and policy makers. One should consider a range of scenarios that reflect different action possibilities; a variety of adaptation and mitigation options; project well into the future so that one can see the effects over time; ensure scenarios are phrased such that they are easy to understand and not overly complex; portray situations and conditions that are meaningful and concrete to the audience, and; which build on information and systems that are already in place and/or which are familiar.[90]

McCarthy and Brennan[91] sought to understand why people in possession of knowledge (about food safety, in the case of their study) are not always motivated to act on this knowledge and make use of what they know. It was found that individual differences are significant. As a result, they recommend that risk communicators should consider the heterogeneity of their audience(s). They also recommend that risk communicators understand what their audience(s) know about the risk and why

[88] Ibid.
[89] Sheppard, Stephen, R.J., Shaw, Allison, Flanders, David, Burch, Sarah, Wiek, Arnim, Carmichael, Jeff, Robinson, John, and Cohen, Stewart Cohen. "Future visioning of local climate change: A framework for community engagement and planning with scenarios and visualization" in *Futures*, volume 43, 2011, p. 402.
[90] Ibid.
[91] McCarthy and Brennan, pp. 550; 255.

they believe what they do in order to communicate effectively with them. The authors explain that this is because when there is anecdotal evidence that contradicts a behaviour the risk communicator is trying to communicate or which indicates that the behaviour the risk communicator is trying to encourage is not necessary, the credibility of the communicator is diminished overall. McCarthy and Brennan also suggest that messages with high visual impact that focus on solutions may be the most effective in changing behaviour as may messages that contain facts, real life stories that people can relate to, and which show the consequences of poor behaviour as well as solutions.

Ashworth, Boughen, Mayhew, and Millar find that context is important. They suggest that communication activities should address stakeholder concerns but focusing on one technology or element of an issue is less likely to cause public acceptance. Ashworth et al. make a number of recommendations regarding how to communicate with the public. These include: (1) proactively communicating to stakeholders by fostering dialogue and discussion; (2) partnering with credible environmental organizations and other organizations that the public trusts; (3) developing educational materials that not only addresses the issues but also solutions; (4) engaging high profile personalities in one's communications to raise an issue's positive profile; (5) testing communication materials first to determine their applicability; (6) using a range of mediums to communicate, such as the Internet, print, television and radio, and; (7) identify resources that will facilitate and support action.[92]

4.6 Defining a Visualization

Different terms are used to describe the use of images to convey landscape simulations or scenarios, including landscape visualization, visual simulation or landscape modeling. Lewis and Sheppard note that a visualization "… attempts to represent actual places and on-the-ground conditions in 3D perspective views with varying degrees of realism … [and] simulates the experience of standing in the landscape and viewing the surrounding environment … "what if" visualization exercises can represent to the user an environment with which they are familiar but showing what a future resource development plan might look like".[93]

Brown et al. define visualization as "a computer-generated image providing an enhanced visual representation of a physical space or environment, with the intention of facilitating interpretation".[94] MacEachern et al. describe visualizations as "an act of cognition, a human ability to develop mental representations that allow us to identify patterns and create or impose order".[95] In other words, a visualization is a tool that allows us to convey information in a visual way.

[92] Ashworth, Boughen, Mayhew, and Millar, pp. 4754-4755.
[93] Lewis, John L. and Sheppard, Stephen, R.J. "Culture and communication: Can landscape visualization improve forest management consultation with indigenous communities?" in *Landscape and Urban Planning*, volume 77, 2006, p. 293.
[94] Brown, Iaian, Jude, Simon, Koukoulas, Sotiris, Nicholls, Robert, Dickson, Mark and Walkden, Mike. "Dynamic simulation and visualization of coastal erosion" in *Computers, Environment and Urban Systems*, volume 30, 2006, p. 843.
[95] 1992 as cited in Schroth, Olaf, Lange, Eckart, and Schmid, Willy A. "From Information to Participation – Applying Interactive Features in Landscape Visualizations" in E. Buhmann, P. Paar, I. Bishop & E. Lange (Eds.). *Trends in real-time landscape visualization and participation*. Heidelberg: Wichmann, page unknown.

4.7 The Benefits of Visualization

There are numerous benefits to using visualizations to communicate with the public and engage them particularly because, as Robins[96] noted, we are currently in the midst of an 'image revolution' because of the proliferation of visual media. Nicholson-Cole adds that visualizations provide a visual way to convey strong messages, make information have more impact and be easier to remember. Visualizations can simplify and condense (new) information, and communicate multiple ideas in an instant.[97] Visualizations also allow people to learn about an issue without having direct experience with it.[98] Visualizations may also increase 'spatial memory' enabling people who have seen visualizations to draw on that memory during an emergency, such as drawing on the memory of a visualization to recall which streets should be avoided during a natural disaster.[99]

Sheppard et al. note that the benefits of visualizations include: bridging the gap between the formal, analytical approach of scientists and the layperson;[100] helping people to envision future scenarios, thereby making the future seem more 'real';[101] helping people to envision potential solutions;[102] increasing engagement and support for climate change policy; enhancing learning; strengthening conceptualization of even complex environmental issue; localizing the scale of climate change so people can connect to place, community identity, values, and their overall quality of life; evaluating the social impacts of, acceptance of, or opposition to mitigation and adaptation policies or approaches.[103] Visualizations can also help demonstrate the potential effects of different responses to climate change and foster a greater understanding of the cause and effect between local actions and their larger consequences.[104] Sheppard adds that by using visualizations, one has the capacity to present different scenarios side by side, and the flexibility to customize details.[105] Finally, Sheppard et al. remark that visualizations are novel, dynamic and interactive, can provide meaningful socio-cultural contexts; allow for the comparison of different possible scenarios, and, are adaptable. Visualizations can be modified, simplified, or made more complex.[106]

Jude considered the role of landscape visualizations in participatory coastal management. Respondents in his study identified a number of benefits of visualizations: (1) images may offer a way to have open dialogue about people's perceptions and consequences of change and ensure that people are all on the 'same page' in terms of what is being talked about; (2) traditional maps are hard for the average layperson to understand; visualizations were perceived to be much easier to

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[96] 1996 as cited in Nicholson-Cole, pp. 258-259.
[97] Nicholson-Cole, pp. 258-259.
[98] Lieske, David J. "Towards a Framework for Designing Spatial and Non-Spatial Visualizations for Communicating Climate Change Risks" in *Geomatica*, volume 66, number 1, 2012, p. 259.
[99] Cockburn and McKenzie, 2002 as cited in ibid.
[100] Sheppard et al., 2011, p. 401.
[101] Ibid.
[102] Ibid.
[103] Ibid., pp. 403; 409.
[104] Ibid., p. 409.
[105] Sheppard, Stephen R.J. "Landscape visualization and climate change: the potential for influencing perceptions and behaviour" in *Environmental Science & Policy*, volume 8, 2005, p. 640.
[106] Sheppard, S.R.J., A. Shaw, D. Flanders, & S. Burch. 2008. "Can Visualisation Save the World? Lessons for Landscape Architects from Visualizing Local Climate Change." In *Procs. Digital Design in Landscape Architecture 2008, 9th International Conference on IT in Landscape Architecture*. Dessau/Bernburg, Germany: Anhalt University of Applied Sciences, May 29-31 2008, p. 3

understand; (3) visualizations allow one to consider multiple options, and; (4) visualizations can be displayed in a variety of formats.[107]

Visualizations can also be a uniting force. They can bring different stakeholders together and different communicators together, such as scientists, climate change experts, and local and community stakeholders. In fact, Jude et al. found that visualization techniques can be used to facilitate dialogue between conflicting organizations. Visualizations can also be useful in order to show how various management approaches may change an area (like a landscape).[108]

Tress and Tress note that visualizations of changes in the landscape can help planners, decision-makers, policy makers, the academic community, and even laypeople conceive of the potential impacts of development (or a climatic event). However, they caution that visualizations alone are descriptive; they are not evaluative.[109]

By building greater local awareness, capacity, and agency, visualizations can support better governance.[110] Sheppard and Shaw believe visualizations can foster community engagement and awareness around the impacts of climate change and note that visualizations can create realistic scenarios that integrates impacts, adaptation and mitigation and which can be used locally by municipal governments, decision makers and stakeholders. They can also be used to test the social impact of policies, and assist in fostering an understanding for the need for new policies to address climate change.[111]

4.8 The Use of Visualizations to Promote (or Inhibit) Action

Psychological research, such as that of Slovic et al.[112] postulate that the interplay between cognition, affect, and behaviour may help understand visual stimuli of behavioural responses. They suggest that visual material that is perceived to have personal implications, instead of solely cognitive information, may provide the impetus to change one's behaviour.

Stern asserts that altruistic or self-transcendent values may lead people to have the tendency to act in a pro-environmental way. Drawing on value-belief-norm theory, Stern postulates that a person is motivated to act when whatever that person values is threatened or at risk. Therefore, people who value other species and the environment will be more likely to be concerned when they perceive them to be threatened. Conversely, other characteristics may inhibit pro-environmental behaviour,

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[107] Jude, Simon. "Investigating the Potential Role of Visualization Techniques in Participatory Coastal Management" in *Coastal Management*, volume 36, number 4, 2008, pp. 339-340; 344.

[108] Jude, S., Jones, A.P., Andrews, J.E., and Bateman, I.J. "Visualisation for Participatory Coastal Zone Management: A Case Study of the Norfolk Coast, England" in *Journal of Coastal Research*, 2006, volume 22, number 6, p. 1535.

[109] Tress, Bärbel, and Tress, Gunther. "Scenario visualization for participatory landscape planning—a study from Denmark" in *Landscape and Urban Planning*, volume 64, 2003, p. 173.

[110] Sheppard et al., 2011, p. 409.

[111] Sheppard S.R.J, Shaw A. *Future Visioning of Local Climate Change Scenarios: Connecting the Dots and Painting Pictures to Aid Earth System Governance*. Paper presented at the 2007 Amsterdam Conference on the Human Dimensions of Global Environmental Change: Earth System Governance: Theories and Strategies for Sustainability. Amsterdam: Vrije Universiteit; May 24-26, 2007.

[112] Slovic, P., Finucane, M., Peters, E., MacGregor, D.G. "The affect heuristic" in Gilovich, T., Griffin, D., Kahneman, D. (Eds.), *Heuristics and Biases: The Psychology of Intuitive Judgement*. New York: Cambridge University Press, 2002, pp. 397–420.

such as self-enhancement or egoistic values, obedience, self-discipline, and family security. Accordingly, promotional material that highlights certain values may inspire people who hold those same values to act or not to act, whatever the case may be.[113]

Stern maintains that there are four types of causal variables that affect behaviour. The first variable is attitudinal factors, including norms, values, and beliefs. Attitudinal factors may be environmental in nature (e.g., perceived costs and benefits, and personal commitment) and non-environmental attitudes, such as speed, power, frugality, luxury, family). The second variable is contextual forces, which encompass interpersonal influences like persuasion or modeling, community expectations, advertizing, government regulations, other legal and institutional factors, monetary incentives and costs, physical limitations (both human and the built environment), public policies, and socioeconomic factors, such as interest rates or the price of fuel. The third variable is personal capabilities, which include individual knowledge and skills, sociodemographic factors, and the availability of time and resources like money, social status, and power. The final causal variable is habit or routine. Changing one's behaviour often requires one to change one's habits and establishing new ones. Different behaviours may be influenced by different causal variables. For example, activities that require a significant amount of resources may be influenced by one's ability to afford the activity. Moreover, causal variables work differently to influence behaviour. At the same time, Stern asserts that behaviour is determined by multiple variables and they way they interact with each other. In other words, people are encouraged act in a more environmentally positive way, not because of any one particular motivation, but because of several factors. The interplay of variables can encourage positive behaviour, on the one hand, or discourage it. Therefore, to encourage people to act in a more environmentally positive way, Stern recommends first identifying behaviours that have significant environmental impact, analyze the behaviours to determine contributing actors and actions, consider the causal variables that contribute to that behaviour, and then formulate intervention strategies. [114]

Sheppard summarizes that there appears to be visualizations may be able to affect behaviour if the images portray a future that is meaningful and perceptible. Sheppard notes that the behavioural implications of visualizations need to be tested. At the same time, he cautions that an assessment of the impacts of visualization on behaviour should not only consider the images themselves but also factors such as the purpose, the context (socio-cultural, environmental, economic, etc.), the audience, and other types/forms of information. There are also ethical questions of whether visualizations should be used to persuade or whether it should be used only to inform.[115] Sheppard adds that what causes behaviour is extremely complex and not well understood and that various factors must be considered, not only one (such as visualizations). [116]

O'Neill and Nicholson-Cole found that fear is an ineffective tool to use to engage people. It is more effective to use non-threatening imagery and connect to people's emotions and concerns. Moreover, they found that images that can evoke strong feelings did not necessarily make participants feel equipped to act. In fact, in some cases, they found that the reverse was true. Despite images building climate change as an important issue, participants in O'Neill and Nicholson-Cole's study said at the

[113] Stern, Paul C. "Toward a Coherent Theory of Environmentally Significant Behavior" in *Journal of Social Issues*, Volume 56, Number 3, 2000, pp. 413-414.
[114] Ibid., pp. 416-420.
[115] Sheppard, Stephen R.J., 2005, p. 647.
[116] Ibid., p. 641.

same time, these images made them feel powerless, overwhelmed, scared, emotional, and depressed. Participants in their study also felt that some of the images were remote from their personal experiences and therefore were easily forgotten. On the other hand, participants indicated that the images that were the most empowering were the ones that showed clearly what people can do on a local, personal level because they gave them clear ideas of how to act. Images that depicted local impacts also seemed to be the most effective in inspiring personal efficacy.[117]

Moser echoes the caution against using fear appeals as a stimulus to constructive action. She maintains that fear appeals may only be successful when people feel personally vulnerable, have specific information about precautions they can take, feel confident in their own ability to take action, feel that their action will solve the problem, believe that the cost of action is low compared to the benefit, view the repercussions for not taking action as unacceptable or unappealing, and cognitively process information (not emotionally).[118] Guilt appeals can propel people who feel guilty to want to atone for their perceived sins but do not lead to action per se because people tend to resent being manipulated.[119] Moser maintains that the presence or absence of "concurrent supportive, enabling conditions"[120] underpins whether or not fear or guilt cause action. The desired action must coincide with one's self-identity. This, coupled with the fact that fear and guilt are emotional responses and emotional responses are difficult to control, Moser maintains that positive motivation may be more effective in encouraging action.[121] Similarly, Lieske asserts that visualizations are most effective when supported by risk perception research and when presented so as to not overwhelm or cause feelings of helplessness.[122]

The issue of stakeholder participation is discussed briefly by Tress and Tress who suggest that greater stakeholder participation may foster greater buy-in into planning processes.[123] One could postulate that this may, in turn, foster a greater potential for action.

Sheppard et al. found that visual imagery can dramatically affect awareness and affective response, which are two important drivers for change. They found that using visualizations extensively generated a high degree of engagement in the public participants.[124] Participants in their study who were planning and engineering professionals demonstrated an increase in urgency to responding to climate change after seeing the visualization scenarios. Situating the visualizations of future scenarios at local and familiar sites also increased the public's awareness of the potential effects climate change may have on their communities. The visualizations in places that were 'close to home' and known to the participants seemed to make the impacts of global warming more real and tangible.[125]

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[117] O'Neill, Saffron and Nicholson-Cole, Sophie. ""Fear Won't Do It" Promoting Positive Engagement With Climate Change Through Visual and Iconic Representations" in *Science Communication*, volume 30, number 3, March 2009, pp. 355; 373-374.

[118] Moser, Susanne C. "More bad news: the risk of neglecting emotional responses to climate change information" in Moser and Dilling, 2007, p. 70.

[119] O'Keefe, 2002 as cited in ibid., p. 71.

[120] Eagly and Kulesa, 1997 as cited in ibid., p. 71.

[121] Moser in Moser and Dilling, 2007, pp. 70-71.

[122] Lieske, pp. 256-257.

[123] Tress and Tress, p. 174.

[124] Sheppard, et al., 2008, p. 11.

[125] Ibid., p. 14.

Sheppard et al.'s research also revealed a significant increase in the number of study participants that intended to act on climate change after seeing a visualization scenario. Intended actions centred on personal use, such as using the car less, using public transportation, carpooling, making energy efficient choices in one's home, etc. instead of collective responses like voting for candidates that have a climate change platform or getting involved in the community around issues pertaining to climate change. Some also expressed a willingness to support climate change policies at the local level. [126]

Sheppard et al.'s study thus seems to support the use of visualizations to generate cognitive and behavioural responses and certainly demonstrate an intention to act. However, as noted by the researchers, Sheppard et al.'s study did not measure behavioural change. [127]

Nicoleson-Cole deduced that people's beliefs and attitudes about climate change are related to visual imagery they are exposed to and their personal experience. She notes that if visualizations are going to grab people's attention, be memorable, and incite people to act and change their behaviour, they need to be: (1) relatable, realistic, applicable, present rather than future oriented, and local and familiar; (2) based in science, as certain as possible, and from a source that is trusted by the audience; (3) instructive, containing a clear message that individuals can make a significant difference, and that change is easy to do and feasible; (4) attention grabbing, and; (5) tailored specifically to the target audience. Nicoleson-Cole adds that one image alone will not likely lead people to take action but that sets of appropriate images are more likely to be more powerful and effective.[128]

Nicoleson-Cole concludes by saying that visualizations alone will not motivate people to act on climate change. Visualizations must be coupled with other strategies. The participants in her study proposed a number of suggestions that would make the issue of climate change easier to understand. They include feeling the impacts of climate change themselves, greater community involvement, more education, greater governmental commitment to providing people with easy and doable examples of what they can do at home to make a difference, paying greater attention to the news, and a greater consistency in messaging.[129]

Jude et al. assert that visualizations will only be effective if they are actually used by managers and integrated into the planning process. And, the planning process should be open to the public to foster their participation in it. This in turn, would foster dialogue and identify solutions. [130]
At the same time, visualizations are also very expensive to create and involve a significant number of resources. [131]
Sheppard suggests that future research around visualizations might include considering researching the psychological link between perceptions of climate change and behaviour, ethical issues of using visualizations, and tracking current projects that use visualizations to assess the impacts of them on

[126] Sheppard, et al., 2008, p. 14.
[127] Sheppard, et al., 2008, p. 15.
[128] Nicholson-Cole, pp. 267-268.
[129] Ibid., p. 268.
[130] Jude, et al., p. 1537.
[131] Lieske, p. 259.

learning and behaviour. Such research, Sheppard theorizes, might help identify some of the causes of behavioural or attitudinal behaviour. [132]

4.9 Ethical Considerations

Nicholson-Cole cautions that when using computer-generated visualizations, one should be aware of ethical and methodological issues, including how viewers may interpret the visualizations differently, the subjectivity inherent in the selection of images, and assumptions made in creating the visualizations. How people react to visualizations is influenced by their prior perceptions, experiences, attitudes, social background, culture, emotions, and behavioural tendencies. Accordingly, audiences are heterogeneous and therefore, their reactions will be heterogeneous and therefore, when using visualizations it is necessary to consider the characteristics of a target audience and how they might react (i.e., the range of interpretations). [133] The choice of which images to include in a visualization is subjective and this subjectivity can also influence how visualizations are perceived. Images may reflect the communicator's own bias, point of view, or attitude and can affect the receiver's interpretations of the image.[134]

Nicoleson-Cole suggests that visualizations can cause people to react emotionally and therefore may motivate people to act. At the same time, she cautions that disturbing or misleading images can arouse fear or unease, discomfort or feelings of powerlessness. Over-stimulation can also de-sensitize one's audience and give people a feeling that there is nothing t hey can do, reducing the likelihood that they will take any action. [135]

Participants in Jude et al.'s study noted that one danger with visualizations is that they convey a sense of certainty when actually, there is much uncertainty. Caution should therefore be taken to avoid presenting visualizations as definite or certain. In fact, a concerted effort should be made to convey the uncertainty in the visualizations. [136]

In their consideration of the use of visualizations to depict coastal erosion, Brown et al. found that abstract visualizations that convey complex scientific data may be appropriate for data specialists. Others, such as planners and decision-makers seem to prefer visualizations that are more realistic. Participants in their study, who were coastal managers, appreciated the high degree of realism conveyed in the visualizations and the ability to navigate to different viewpoints within the images. It was felt that the visualizations could convey more than more conventional maps. While this realism was noted to be potentially useful in engaging the broader public in broader environmental issues, there was some concern that the level of realism could cause the public to react with fear or a high degree of emotion because of perceiving personal loss implied by some of the visualizations.[137]

Nicoleson-Cole also notes that it is also important to remember that visualizations are virtual and not real. Accordingly, they are often a simplification of what may potentially happen. Visualizations

[132] Sheppard, Stephen R.J., pp. 651-652.
[133] Nicholson-Cole, pp. 256-260.
[134] Ibid., p. 261.
[135] Ibid., p. 260.
[136] Jude, et al., p. 1536.
[137] Brown, et al., pp. 854-856.

should be kept as realistic as possible.[138]

Despite the value of using visualizations, Dockerty et al. caution that visualizations are only potential representations of the future and should not be interpreted too literally. They suggest that the frameworks and methods for assessing the impacts of climate change and conveying them to the public should be improved. This might include the way uncertainty is represented in spatial data. For example, in a visualization, a boundary zone may be clear and defined but in actuality, boundaries are often unclear. Likewise, a visualization may present features of a landscape as equally definitive but in a future scenario, some features of a landscape may be more likely, such as buildings and land boundaries as opposed to particular crops being grown in a field. They also suggest that more interactive landscape displays like ones that allow someone to navigate through a virtual landscape or which allow users to move or change landscapes, might enhance the ability to ask what the impacts might be if a certain event occurred. They also note that more research is required to understand how the public is impacted by visualizations, particularly those that are more 'realistic'.[139]

Jude also identified a number of potential problems or concerns with visualizations. First, if visualizations are rigid and cannot be used to integrate other people's ideas, they may not be effective. Second, technologically, limitations in current technology may prevent depicting an entire area. For example, visualizing an entire coastline may not be technologically feasible and this would limit a coastline planning process. Third, visualizations are time consuming to create. Fourth, visualizations must be adjusted easily to be able to consider real-time changes, alternative scenarios, or the dynamic nature of a landscape. Fifth, visualizations should not be presented in isolation but should be contextualized and presented along with other explanatory information. Sixth, visualizations can be expensive to produce. [140]

Tress and Tress remark that visualizations that people tend to use their imaginations to fill in gaps left by abstract scenarios. They caution that this could lead to misinterpretations, exaggerations, or underestimations.[141]

Visualizations are not without their bias. Appleton and Lovett note that the perspectives, affiliations and intentions of the people who request the visualization or the people who create it may be reflected in the visualization, however unintentionally. This can, in turn, affect detail, accuracy, supplementary information, and/or the audience. The audience itself may also affect the choice of viewpoints depicted in the images, the method used to present the visualization, and the way additional or contextual information is supplied. [142]

Appleton and Lovett also comment on the realistic potential of visualizations, noting that realism can affect the certainty with which a viewer regards a visualization and can influence what a viewer focuses on. They caution that the level of realism that is taken with a visualization should be

[138] Nicholson-Cole, pp. 261-262.
[139] Dockerty, Trudie, Lovett, Andrew, Sünnenberg, Gilla, Appleton, Katy, and Parry, Martin. "Visualising the potential impacts of climate change on rural landscapes" in *Computers, Environment and Urban Systems*, volume 29, 2005, pp. 316-317).
[140] Jude, pp. 342-345.
[141] Tress and Tress, p. 174.
[142] Appleton, Katy and Lovett, Andrew. "GIS-based visualisation of development proposals: reactions from planning and related professionals" in *Computers, Environment and Urban Systems*, volume 29, 2005, p. 337.

considered carefully because excessively realistic images may have negative consequences. They recommend that the level of data should be tied to actual data and be purposive. The level of realism should be considered along with the choice of viewpoints, the method used to present the information, and contextual information that is presented as well. The conclude by cautioning that new technology should not be used carte blanche but that it should be carefully assessed.[143]

Sheppard also discusses the ethical questions of using visualizations for persuasion, rather than simply to inform. He proposes a Code of Ethics for using landscape visualizations that would include several principles including accuracy, representativeness, clarity, viewer engagement, legitimacy, accountability and transparency, and accessibility. [144]

Sheppard discusses the need to develop an ethical framework to guide the creation and use of visualizations. He argues that such a framework is required because visualizations can be powerful and are used to shape planning decisions. There is the potential for misuse, whether deliberate or not. For example, the technology that is available now enables designers to create highly realistic visualizations but the data on which the visualizations are based may not be reliable, accurate, or of a high quality. Therefore, predictive simulations may not be driven by actual (and accurate) data. Data can also be presented in a variety of formats, which raises validity and reliability issues. Different formats can also affect an audience's perception (of risk) as can the context in which visualizations are presented. Visualizations are also often used to persuade and are therefore not value-neutral. Daniel and Meitner also note that "Environmental visualizations may be completely accurate with respect to their portrayal of relevant and accurately projected bi-physical conditions, but still produce perceptions, interpretations, and value judgments that are not consistent with those that would be produced by actual encounters with the environments represented". [145] This can result in poor or inappropriate planning decision. A formal framework on use can also help minimize debates over the veracity of visualizations and maintain the integrity of the designers. A code of ethics would establish a clear framework on how to prepare and present visualizations and would provide a mechanism with which to evaluate whether a visualization has met this framework. A framework also sets out a minimum standard of practice that practitioners should aspire to and should be held accountable for.[146] Sheppard then goes on to present an itemized list of what a code of ethics might contain.

Sheppard also notes that the documented evidence of how visualizations affect planning decisions is limited. [147] He cites Zube et al. who stated: "[i] t is clear, in spite of the absolute dependency of designers on simulations as a means of communication, that very little is known about the communication effectiveness of these media". [148]

[143] Ibid.
[144] 2001 as cited in Sheppard, et al., 2008, p. 6.
[145] Daniel and Meitner, 2000, as cited in Sheppard, Stephen R.J. "Guidance for crystal ball gazers: developing a code of ethics for landscape visualization" in *Landscape and Urban Planning*, volume 54, issues 1–4, 2001, p. 188.
[146] Sheppard, 2001, pp. 186-193.
[147] Ibid., p. 187.
[148] Zube et al., 1987, as cited in Sheppard, 2001, p. 187.

4.10 Notable Lessons from the Literature

Moser and Dilling propose seven strategies to improve communications around climate change to encourage adaptive, rather than maladaptive behaviours. First, one should determine who one's audience is, consider how to frame one's message, and select the right messenger that is perceived to have legitimacy and credibility. Second, focus on empowerment and send a calm, but pressing message. Limit the use of fear as a motivator. Successes should be promoted and action should be rewarded and acknowledged. Be explicit about what people can do and prompt people to remember what to do and to take action. Third, make the messages more persuasive. Repeat messages often. Fourth, employ credible and legitimate messengers. Bring experts together to communicate about climate change. Consider socio-cultural-demographic factors in determining who the best communicator might be. Fifth, take advantage of opportunities to communicate. Sixth, tap into people's motivation and desire to act. Frame issues/solutions/actions such that they reflect cultural values and beliefs. If messages match one's cultural values and beliefs, one will be more likely to act. Finally, unite rather than divide/isolate individuals, communities, and issues. Avoid compartmentalization. The solutions to climate change are also solutions to other problems. For example, reducing the number of cars on the road reduces emissions but it also reduces the traffic and the time one has to spend commuting. Thus, solving climate change problems will also help alleviate others. Engaging people will also reduce isolationism and make people feel like they are part of a larger community. Unification will also promote the cumulative impacts of action. [149]

Additional notable lessons for supporting greater action in response to climate change that stem from this literature review are noted below.

1. All stakeholders (i.e., government, business, the nonprofit sector, the public, etc.) should be involved in developing solutions. [150]
2. The public will be more effectively engaged if they are meaningfully involved consistently. [151]
3. Basic information is required along with the implications of climate change. [152]
4. Information should be communicated transparently by channels that are regarded as credible by the various audiences. [153]
5. Communication should be consistent and regular and relayed in its scientific context. [154]
6. Younger people in particular should be educated on how to undertake environmental action. [155]
7. The issue of climate change should be localized to the audience's local environment and concerns. Likewise, examples used to communicate climate change should be local. [156]
8. The personal benefits of changing ones behaviour should be emphasized.
9. Supportive institutions and infrastructure must be in place for effective action to occur and support must be sustained. [157]

[149] Moser and Dilling, 2004, pp. 32-46.
[150] Lorenzoni, Nicholson-Cole, and Whitmarsh, p. 454.
[151] Ibid.
[152] Ibid.
[153] Ibid.
[154] Ibid., pp. 454-455.
[155] Ibid., p. 455.
[156] Ibid.; Sheppard et al., 2011, p. 410.
[157] Lorenzoni, Nicholson-Cole, and Whitmarsh, p. 455.

10. A stronger regulatory and fiscal framework can initiate mitigative responses. [158]
11. Education can change behaviour over time. [159]
12. There needs to be a greater understanding of different audiences' comprehension of climate change and these perspectives should be integrated into the policy process.[160]
13. Communications should be undertaken by a team that represents social scientists, scientists, risk communication professionals, and communications experts and which is engaged throughout a process, rather than at the end of it. Such collaboration would overcome the silos that prevent effective communication.[161]
14. Reports and other communications should be written in jargon-free, plain language so that people understand the message and know what to do.[162]
15. Data should be related to amounts, measures, and quantities that people are familiar with.
16. Information should disclose the 'scientific' in a clear and accessible way and should be as realistic as possible.[163]
17. Visualizations should be designed to attract and maintain interest and be founded on solid data and methods. [164]
18. Climate change scenarios need to be framed so that there are clear options for action.[165]
19. Climate change scenarios should be designed with local input as well as scientific input in order to foster greater buy-in on the part of the public. [166]

Sheppard et al. also provide an outline of the features that visualizations pertaining to climate change might have. These include being founded on scientific data so that the visualizations are perceived as being credible, being developed and presented by a trusted source (though caution must be taken as well because the public also tends to believe trusted sources, sometimes too easily), visualizations must also accompany standards of delivery so that there isn't excessive drama and potential pitfalls are avoided. Sheppard et al. suggest employing stakeholders in developing rules for using visualization scenarios, involving stakeholders in generating the visualizations themselves, and let skeptics freely use the visualizations. [167]

Appleton and Lovett also found that a high degree of detail in visualizations helps people relate to the images better and help them imagine themselves in the landscape. What constitutes the 'right' level of realism though has not been determined.[168]

[158] Ibid.
[159] Ibid.
[160] Ibid.
[161] Sterman, John D. "Communicating climate change risks in a skeptical world" in *Climatic Change*, volume 108, 2011, p. 820.
[162] Ibid.
[163] Sheppard et al., 2011, p. 410.
[164] Ibid.
[165] Ibid., p. 410.
[166] Ibid., p. 411.
[167] Sheppard, et al., 2008, pp. 16-17.
[168] Appleton and Lovett, p. 130.

Eppler and Aeschimann formulate a preliminary set of guidelines for creating and evaluating risk visualizations:

1. **Time of use of visualizations** – Once something is presented as an image, it is difficult to conceive of that topic or issue in any other way. Therefore, consider how the topic/issue will be depicted and also when the image will be use.
2. **Think about the context** – Not every situation allows for the use of visualization. The use of visualizations can be constrained by the audience itself (i.e., its receptivity) or the lack of time, tools or space. One should consider these contextual factors in determining whether to use visualizations. Visualizations should augment what the presenter is saying and not distract from the main message.
3. **Create images that follow standard graphic design principles and expectations (what the authors call gestalt laws of visual perception)** – For example, bigger elements of an image are perceived by the audience as being more important and items in the centre of a graphic are considered to be more important than those on the periphery. Visualizations should be 'uncluttered' and decorative elements should be kept to a minimum because they are distracting.
4. **Consider the process** – The process of creating a visualization is just as important, if not more important, the final product. This is particularly the case if the drafting process involves multiple parties and is intended to be collaborative and unifying.
5. **Pilot test the visualization** – Test the visualization and get feedback on it before using it in a broad way so that you can tweak it so its effect can be maximized.[169]

This literature review did not contemplate the form of the content in visualizations but there is some research that indicates that visualizations are perceived to be more effective if certain aspects of them are more realistic. For example, Bishop and Rohrmann note that audiences may respond better to visualizations if vegetation were more realistic. They also note that the colours of objects may have to be more realistically presented as well.[170] The results of Appleton and Lovett's research also seems to indicate that colour choice, shadowing, and visual depth and perception can also impact how an image is perceived.[171]

4.11 Concluding Thoughts

At the onset, the focus of this exercise was to uncover how visualizations can foster action. This review has found that while there is considerable discussion about the use of visualizations in the landscape planning literature and numerous studies that reference the barriers to action, there is a paucity of research that focuses on the effect of using visualizations to inspire action. Sheppard and Sheppard et al. too noted that are very few studies that have examined the behavioural (action) impacts of visualizations.[172] Chess and Johnson also note that more information is needed about

[169] Eppler, Martin J. and Aeschimann, Markus. "A systematic framework for risk visualization in risk management and communication" in *Risk Management*, volume 11, number 2, 2009, pp. 85-86.
[170] Bishop, I.D., and Rohrmann, B. "Subjective responses to simulated and real environments: a comparison" in *Landscape and Urban Planning*, volume 65, 2003, p. 275.
[171] Appleton and Lovett, pp. 127-129.
[172] Sheppard, et al., 2008, p. 3.

what initiates people to act and what information is helpful to people who are already motivated to act.[173] This is, therefore, a gap that could be addressed by future research.

Beyond the field of geography, environmental studies, and visualization and landscape planning, a considerable amount of work has been done in trying to understand human behaviour. Theories such as persuasion theory, rational choice theory, integrative models of consumer behaviour, reasoned action theory, expectancy-value theory, and social learning theory may ultimately provide insight into understanding the role of visualizations in encouraging action and adaptation. Likewise, an exploration of various fields, such as marketing (e.g., Doug McKenzie-Mohr's community-based social marketing), anthropology (e.g., Gregory Bateson), and education (e.g., transformational learning approach) may be helpful. Certainly, each theory has its proponents and opponents but, together, they may shed light on what influences behaviour and motivates action. Thus, there may be transferable lessons in other fields of inquiry that may expand the knowledge-base and understanding around how to use visualizations of climate change, particularly flood risk, to motivate people into acting and adapting.

5. Interview Results

Ten interviews were conducted with regional experts who have previous experience (or interest) in communicating flood risk and/or extensive involvement with the development of adaptation plans for the Tantramar Region. Interviewees included the lead researcher of the Tantramar Regional Adaptation Strategies Assessment Project, Town of Sackville councillors, Town of Sackville employees, community planners, provincial government personnel, and local academics and environmental activists who have a particular interest in flood risk adaptation and climate change.

As noted above in section two, the purpose of the interviews was to determine interviewees' perceptions of the effectiveness of communication strategies about flood risk as well as to assess the utility of the visualizations developed as part of the earlier study. The research questions revolved around the following issues: the interviewee's personal experience with communicating about flood risk, communication successes and challenges, audience, who should be communicating about flood risk, visualizations, the Tantramar Regional Adaptation Strategies Assessment Project specifically, and recommended contents of a potential toolkit. The interview questions can be found in Appendix 1.

Because the interview component of this project involved interviewing a purposive sample and not a representative sample, the results of the interviews are presented as general trends or notable comments rather than in terms of frequency.

Each section below corresponds with a question in the interview questionnaire. There is, however, one exception: interviewee responses regarding what should be included in a toolkit about flood risk and adaptation activities is integrated into section seven.

[173] Chess, Caron and Johnson, Branden B. "Information is not enough" in Moser and Dilling, 2007, p. 228.

5.1 Experience Communicating with the Public about Flood Risk

Participants were asked to describe what their personal experience was in talking to the general public about the risks associated with climate change-induced flooding from sea level rise. Experienced ranged. Some respondents acted as coordinators, researchers, or as workshop facilitators for the Regional Adaptation Collaborative while others were participants in workshops that were conducted as part of the Tantramar Regional Adaptation Strategies Assessment Project. Still others were involved in maintaining the dykes or worked at the governmental level, implementing policy related to the environment.

Participant experience with communicating about flood risk involved coordinating workshops, facilitating workshops and focus groups, organizing information sessions, participating in working groups, presenting research results, giving lectures, and one on one or small group communications.

5.2 Audiences Have Had Experience With Communicating with about Flood Risk

Interview participants were asked to describe the audiences that they have had contact with and the specific ways in which they communicated with them (e.g., writing a pamphlet, organizing a workshop).

As a result, participants have experience speaking to a range of audiences about flood risk. Audiences include people directly affected by floods and storm surges; land owners and those with coastal properties; emergency measure personnel; working groups; focus groups made up of community members, members of the academic and research community, social and non profit organizations, and seniors; professional personnel, such as engineers; municipal councils and other elected officials; municipal and provincial governmental employees/departmental representatives; the Tantramar District Planning Commission, insurance industry representatives; youth; family; friends; high school and university students; the Regional Adaptation Collaborative, and; the general public. One interviewee noted that audiences s/he spoke to seemed to be affluent and well-educated.

Interviewees used a variety of communication tools, including face-to-face communications, PowerPoint, newspaper articles focusing on sea level rise or the Regional Adaptation Collaborative, and bringing in guest speakers, such as scientists, and recognized experts.

Some interviewees had used visualizations in particular. These included graphics, animations, two-dimensional maps (paper and computer based), puddle maps, computer maps with zoom features, interactive maps, tables and charts, pictures of flood risk relative to a person's body or a recognized landmark,

5.3 Aspects of Communicating about Flood Risk that Appeared to Work Well

Interview informants were also asked about what aspects of communicating flood risk worked well. They were asked to identify what tools or messages appeared to successfully transfer knowledge and aid in the understanding about the problem, and encourage people to take action in some way.

Ultimately, the message is key. That said, without hesitation, most respondents indicated that maps were invaluable. Regardless of the format used, maps were seen as being able to demonstrate the potential breadth of a flood event. Ultimately, when informing people about flood risk, one wants to convey that the water has gotten or will get to a certain level, has cause or will cause damage, and what the impacts are or will be. It was felt that images (including maps) convey that information best. People also want to know if they will be personally affected by a flood event. Maps, particularly interactive ones, allow one to zoom in on particular areas and get people involved and interested. Maps can help people relax but only if people learn that they will not be directly impacted.
But it was noted that maps (and visualizations in general) support the information.

Some respondents had also used animations that showed various elements like maximum sea level height over time or how a downtown are would be affected.

Historic trends were also identified as useful. By seeing the progression or incidence of flood events or water height from one time period to another, one can then see the dramatic differences occurring in a tangible way.

In terms of encouraging action, one interviewee noted that the tools used to incite action depend on who one is talking to. Engineers or scientists may very well understand maps or raw scientific data whereas the average layperson may not.

A distinction was also made between professionals working in the field of flood risk mitigation/adaptation and non-professionals. The public was regarded as either not understanding the situation or as being in a fear state. Therefore, it was felt that the immediate focus was to provide educational information to inform the public and that once that basic foundation was there, solutions or adaptive options could be provided. At this time, professionals (e.g., those already working in the field) were regarded as being more likely use data.

Topics to encourage action would include discussing what the potential or what is the probability of a flood happening, what areas would be affected by a flood and what are the potential impacts. This would help generate greater understanding.

It was also noted that if one was talking about flood risk in an area where there had not been a major storm, it was more difficult to convince people about the flood risk. However, if you were talking to people who live in an area that had already been flooded, people seem to understand the issue better, had seen the affects, or had been directly impacted. Therefore, encouraging action in an area already affected by risk was easier; you do not have to convince them of the possibility of a flood because they already know one is possible. Unfortunately, with the increase in flood events, such as those in Perth Andover and Port Elgin in New Brunswick and in Louisiana, it is becoming progressively easier to relay flood risk messaging.

Another interviewee commented that most tools are effective with people who already understand the issue, like researchers, municipal council or staff or environmental activists. They already have information that informs them about the real issue that needs to be addressed.

Conveying information about insurance and the lack of flood damage coverage in Canada is very poignant for people.

If people can picture themselves in the flood zone (aided by a map or another type of visualization), then they can listen and ask what they can do.

5.4 Aspects of Communicating about Flood Risk that Did Not Appear to Work Well

Informants were asked what aspects of communicating flood risk did not appear to work well, in their experience.

Maps are acknowledged as being effective but only if one can read them. However, if one cannot read and understand the maps, they are useless. Mapping is also limited in situations where there is no public engagement from the start of a process because maps can be difficult for the average layperson to understand. By involving stakeholders in a process from the beginning, one will be more likely to foster buy-in, participation, and understanding. One will also build map reading skills and one's understanding of flood data. Thus, the public engagement piece is crucial.

People who are not well informed already or who are not open to hearing about flood risk, are not absorbing information. It was theorized that this was because giving people terrible news without giving them something to work with (e.g., safety and support) will not result in proactive behaviour and will not be successful in having them move toward action and in feeling hopeful. So if one just shows a focus group a map without any other information about what people can do with that information, it is like 'dropping a bomb'. There is uncertainty in the information on maps and on their own, they can be scary or tell the wrong message. Maps without support will only cause panic.

People are not currently being told what infrastructure will be threatened. They also do not necessarily understand the extent of the flooding. For example, some people believe that they are prepared for a flood because they have a sump pump. But, they do not seem to understand that the flood potential here in the Tantramar will extend beyond some water in basements. It will cut off access to hospitals, gas stations, highways, and the rail system. The sewage ponds will be the first to flood. They are built below sea level and in Sackville, one wall of the sewage pond is the dyke wall.

Many people who attend public information events or who some of the interviewees talk to about flood risk are already interested in the issue. It was noted that it is imperative to reach more people, notably those that one does not speak to regularly or who you call your friends.

Many people do not seem to understand or appreciate that the Tantramar Region and Sackville in particular is a dyked community. Some streets in town, like Lorne Street, are below sea level and will be flooded considerably. The pumping station will be under water as will the CN rail line. The sewer system and electricity will be affected. If there is a flood of great magnitude, the focus will be on saving lives, not on water in a basement or an overflowing pond; those concerns will be secondary.

Similarly, many people do not seem to understand the urgency of the situation. People have an 'it won't happen to me' attitude. The concept of flood risk is still abstract. People also tend to be very individualistic in their own thinking. It is important to teach people to think on a different level. With

mitigating and adapting to flood risk, the focus should be on working as a whole community rather than dealing with one basement.

The science is not accessible to the layperson especially if the person conveying the scientific information speaks like a scientist. It is hard to wade through scientific data and extract the core message so data has to be balanced with history and recent realities, e.g., the frequency of storm surges in the last 20 years, the number of events in the last 20 years as opposed to the number of events in the last 100 years, etc. One should focus on the recent past to have the most impact.

Statistics and probabilities are difficult to understand and to convey. People cannot conceive of what the numbers mean. Moreover, there is disagreement among scientists regarding the probability of events and how to calculate probabilities so one can have a wide range of opinions which can be confusing.

Some people are fixed in their ways and in traditional thinking and they do not believe that a flood will ever happen. We also have a culture of doing nothing that is difficult to overcome.

There are not enough credible voices reinforcing the message that there is a critical issue to deal with. Moreover, merely presenting information without solutions or support is like 'dropping a bomb'. It can be devastating and disempowering, leaving people sad, dejected, and depressed.

Municipal governments are often at a loss as to what to do. There is little support in addressing flood risk and it is such a pessimistic topic that no one wants his or her political career resting on such a negative issue.

The cost of a flood event is not well understood. There is research currently underway that will assess the cost of doing nothing, the cost of increasing the height of the dykes, and the cost of relocating people or re-establishing the salt marshes to create a bigger buffer zone.

Presenting information verbally at meetings without maps or other visualizations did not appear to work well.

One interviewee expressed disappointment that under the Regional Adaptation Collaborative process, the public engagement piece was missing. Because of a lack of community engagement, some of the tools that were developed are staying with the professionals. Had the public been engaged from the start, they could have provided input into the development of the tools. Moreover, this process would have fostered greater buy-in and understanding of flood risk. In turn, the maps that the public itself participated in developing could have then be used to show the public how to act and move forward.

With the RAC process, there were to tools to measure what worked well and what did not work well. The focus seemed to be on educating, not engaging.

It is important to get the message out but there is a risk of bombarding people with too many details that ultimately leads to losing the message. At the same time, some people want to know the details. Striking a balance is challenging.

A number of activities have to be undertaken to mitigate flood risk in this region. For example, the dykes should be raised and maintained well. Pumping stations are required that are well above sea level. Streets in low lying areas need to be addressed. All such activities cost a significant amount of money. No one embraces the idea of spending more money or raising money. Likewise, there is no implementation plan at this time which hinders action.

While communicating flood risk, the audiences seemed to want to know what the implications were for them and what they could do. Answering them was difficult.

5.5 Main Challenges to Communicating about Flood Risk

Interviewees were asked what they felt were the main challenges or barriers to communicating flood risk to the general public. They responded as follows.

1. Scenarios are based on assumptions and speculation.
2. A large number of people do not believe that a major flood will happen because one has not happened yet.
3. The effects of a flood are hard to quantify.
4. The discussion of flood risk thus far has focused on salt water flooding but there area also risks associated with fresh water flooding that is not thoroughly studied or conveyed thus far.
5. There are a lot of unknowns, like how long it will take for areas to flood once the dykes are breached, how long the water will stay, and how long will it take the water to dissipate.
6. The piece about what the public can do about flood risk is missing. The public needs that information so they can be more proactive. People need information so they can make decisions.
7. It can be challenging to educate communities about what they can do with bylaws. Municipal governments are often unaware of the range of options that are available to them. For example, with regards to by-laws, one could make a by-law that closes off an area in a flood zone from development, dictates how high up a building has to be (e.g., building on stilts or prohibiting basements in certain areas, or requiring houses to have backflow valves).
8. Encouraging people to take the next steps with regards to flood risk is a major challenge.
9. Not being prepared to give people ideas about what they can do is a challenge.
10. There are a lot of unknowns in terms of probability, size of the incident, and what is the actual impact.
11. The tools used to measure probability, potential size of an incident or the extent of impact are not accurate and there is disagreement among experts about them.
12. There are currently no public processes, systems or programs to support people as they absorb information.
13. We collectively lack confidence that there is something we can do about flood risk.
14. The biggest loss people fear right now is financial. Yet, government is saying that there is no money at any level so there this is an added level of anxiety that has to be addressed.
15. The public does not want to hear messages that will affect the value of their property so there is a strong reluctance to listen.
16. For the average person (not directly affected by flood risk), an issue remains current only for as long as the media covers it. Once coverage ends, there tends to be an overall lack of

interest over the long term. In other words, once something is no longer being covered by the media, people lose interest.
17. The issues are complex.
18. Money is a challenge on a number of fronts. The moment one starts to discuss costs, people are threatened. Or, they are concerned about tax hikes. The availability of resources also impacts your options in taking adaptive measures (i.e., in terms of being able to afford adaptive measures), whether you can afford to leave or pay for alternative accommodations during a flood event, or whether you can afford repairs after a flood
19. Uneducated people, i.e., people with no knowledge about the state of the dykes or the flood risk are a challenge.
20. Educating children and youth is challenging. They are often an audience that is difficult to access.
21. People are stuck in their own 'comfort zone' and tend to focus on their own individual situation without seeing context or having a sense of community responsibility.
22. Doubters. A serious event has not happened since 1962. Some people believe that a serious flood event will not happen in their lifetime.
23. People are diverse. Having limited time to talk to the broadest swath of people is a challenge.
24. Visualizations do not communicate solutions, they only communicate information.

5.6 The Aspects of Communicating Flood Risk that are the Most Confusing

Interviewees are asked what aspects of communicating flood risk are the most confusing. They identified the following elements:

1. The idea of risk and vulnerability;
2. The risk of a flood event happening;
3. Terms like a 1 in 10 year flood, a 1 in 20 year flood, etc.;
4. The sheer amount of information is difficult to boil down into a sound byte;
5. How to calculate risk and how people can calculate the personal risk they are willing to take;
6. The fact that the insurance industry does not currently offer flood insurance;
7. The time span; a lot of flood information is presented in terms of decades but the average person does not look that far ahead;
8. The concept of a return period (i.e., the estimated interval of time between events);
9. Probability and statistics;
10. The certainty with which a flood event will actually occur;
11. What government is doing about flood risk;
12. What is a flood going to cost to individuals;
13. When is a flood going to happen;
14. What will the extent of a flood be;
15. How much water are we looking at and the degree to which areas are going be flooded;
16. How much time will there be to respond once the dykes are breached;
17. How much can be done to actually prevent a flood;
18. How long will the water stay;
19. Scientific jargon is hard to understand;
20. Contradictory scientific data; even scientists disagree and sometimes there is the perception that scientists can manipulate the numbers into anything they want;

21. The lack of prevention activities and why most activity focuses on responding to a disaster instead of preventing one (why a reactive rather than a proactive approach is taken);
22. People are overwhelmed;
23. The media showers us with blockbuster headlines;
24. People are numb and do not want to hear about climate change and related issues;
25. The reality of a flood;
26. That a significant part of Sackville will be affected;
27. That they dykes do not actually protect us;
28. Uncertainty is hard to communicate;
29. The language of climate change science;
30. Not providing people with any ideas on what they can do; the solutions are not clear;
31. How to minimize flood risk;
32. The sequence of events is not well understood; there are many sequences that might cause flooding and methods to prevent or minimize impacts are different;
33. What is practical and what is not;
34. The difference between theory and practice (i.e., what happens in 'real life' is often different)
35. There are a lot of unknowns, like what is the order of operations, what is the timeframe, what will happen from the beginning of an event to the time the water recedes, etc.);
36. The fact that there is no one approach that will necessarily work, and;
37. When the dykes will be breached.

5.7 Tools that Would Have Assisted with Communications

Interview participants were also asked whether there were any tools or materials that they wish they had to assist them in communicating about the problem of flood risk due to climate change. Caution was expressed that any information or visualizations that are developed must be simple so a wide range of audiences can understand them. The respondents suggested a range of options, as follows:

1. A tool that would allow one to simulate water flow, wind speed, etc.
2. Maps that covered all corners of the province and which were accessible online (i.e., highly accessible);
3. High quality LiDAR maps;
4. Wet area mapping with puddle maps that are based on LiDAR mapping;
5. The integration of maps into systems that are already available, like GeoNB;
6. Posters that can be posted to demonstrate what things will look like if there is a flood;
7. Brochures or information that is portable and which people could access at a glance; they could be presented as a series and could cover a range of topics, such as what to do if there is a flood;
8. A repertoire of pictures that can be integrated into PowerPoint and adaptation options;
9. An inventory of adaptation solutions; examples of what other people have done and the cost of undertaking such options locally;
10. Accurate data on elevations;
11. Accurate data on the risk of storms;
12. The complexity of a flood;
13. Maps that are easily accessible;

14. Query types of tools that searches are more interactive and so that it would be possible to bring up information for a particular zone;
15. Information that quantifies the impacts; for example, what does it mean when X number of houses are in the flood plain, how much money will it cost, what number of people will be affected, etc.;
16. An assessment of consequences and impacts;
17. Data about how fast sea level is rising and what the projections are;
18. Up to date and current information;
19. Access to storm surge models, such as the one available from the US National Weather Service, National Hurricane Center at http://www.nhc.noaa.gov/ssurge/ssurge_slosh.shtml;
20. Fresh water flood models;
21. Models in general; Environment Canada does some of this modeling but it is difficult to access. One model that is available is American but is not available for non-Americans (see the US Federal Emergency Management Agency http://www.fema.gov/plan/prevent/hazus/).
22. Models that can be manipulated by the user instead of having the user ask someone else to generate a report;
23. More current information (some of the maps that are easily accessible are dated);
24. Data on how deep the water will be in different places;
25. Data and maps on where the water will extend onto the land;
26. An inventory of solutions that people could be presented with, and;
27. More refined animations that are clear and which contain recognizable landmarks so that there is an increase in their appeal and the emotive aspect of the animation.

One interviewee also expressed a desire to gain access to the schools and talk to the students about flood risk.

5.8 Issues that Cause Discomfort or Concern

Respondents were asked whether there were any aspects of communicating flood risk to the general public that make them uncomfortable or which caused them concern.

Respondents were extremely sensitive to the fact that in communicating flood risk, one is also conveying negative or scary information that has a lot of potentially negative consequences. People will experience significant water damage to their homes and businesses, the cost of repair and recovery will be high, insurance companies do not offer flood insurance, infrastructure will be impacted significantly, and potentially, lives will be lost.

There is an element of the public that believes that those with an element of authority, such as municipal politicians, policy makers, or community planners can simply ban development. Yet, it is not possible to unilaterally infringe one people's rights to do what they want on their own land. Moreover, unilateral decisions would create a huge political backlash on municipal (and other) governments.

If flood risk is mapped out clearly, there will be negative impacts on the value of land and property. A huge question then arises in terms of how people will be compensated.

Communities face a massive risk. To make things more manageable, people seem to focus on the smaller, more manageable things that can be done immediately or which appear to be more tangible. It is sometimes difficult to guide people to look at the bigger picture particularly because climate change and flood adaptation is also tied to lifestyle changes and people are not generally ready to undertake such a shift.

Presenting information without providing options and support is uncomfortable and emotional.

Discussion relocation makes one respondent particularly uncomfortable.

Decision makers do not communicate with each other and this impedes progress. It is also difficult to incite confidence in the public if levels of government are not seen as cooperating and collaborating.

Audiences sometimes react aggressively. Sometimes government or scientists are accused of exaggerating information. People are resistant to the idea of relocation in particular. They maintain that they have a right to be where they are and resent being told they have to leave.

Talking about the impacts of flood risk is personal. People can react negatively and with a range of emotion. People will be affected personally, be it in terms of their property or their well-being.

There does not seem to be much we can do about flood risk. This is disheartening and difficult to convey. People will get cut off and will be at risk.

People do not understand the uncertainty of the map. One interviewee expressed concern that the public might use a map as evidence and then try to pursue legal action, e.g., sue the town to try and recover the loss of value of their house. A solution is required, not a class action, anti-social response.

Climate change is a global problem. It is difficult to convey that at the local level. It is also difficult to express that the entire community will have to participate in the solution.

Another concern is that people would find themselves on the map and determine whether they were in the flood plain or not. If they were out of the range of danger, they might then say that flood risk is not their problem. But, even if their house is not directly affected, their quality of life would still be affected; the plumbing will not work, getting around town will be severely constrained, you might not have access to food and water, etc.

Some people in government are not well informed.

Elected officials are challenged in that they try to make decisions based on what they think the public wants but at the same time, it is difficult to explain how much money should be spent to adapt to climate change, what are the best benefit to cost ratios to reach a certain level of minimizing the impacts of flood risk, and where funding will come from.

The cost of maintaining infrastructure is cheaper than waiting until it degrades. Yet, politicians are usually in office for the short term. They tend to focus on the duration of their term which precludes long term planning.

5.9 Who Messages about Flood Risk should be Directed To

Respondents were asked who messages about flood risk should be directed to. The first reaction of several interviewees was 'everybody'. In other words, everyone should be informed about flood risk and how they may be impacted, be it directly or indirectly. The general public should be informed because addressing flood risk involved the public purse.

More specifically, the following target audiences were identified:

1. People that live in vulnerable areas; land and home owners;
2. People who will be directly impacted;
3. Municipal government and staff, particularly the municipal council and staff, like the engineer, emergency measures staff;
4. The planning commission;
5. Vulnerable populations, like the elderly;
6. Provincially elected officials;
7. Provincial bureaucrats, and;
8. Youth.

In identifying target audiences, it was also noted that the people who attend meetings are the ones who are interested, concerned, directly impacted, or socially active. But there are a significant element of the population that is not engaged and therefore who are missed.

5.10 The Most Vulnerable Audience(s)

Respondents were asked who they perceived as being the most vulnerable audience. The most common response was people living in vulnerable areas, i.e., people living in low lying areas or the flood plain that will experience flooding most directly. If mitigation activities are not undertaken, their lives and property will be most directly affected. However, additional audiences were identified. One respondent described some of these audiences as disempowered or challenged. They included:

a. Senior citizens – People who are elderly are more likely to experience mobility issues. They also are more likely to live in poverty than other people.
b. People who live in poverty – People who are middle class tend to be able to afford to undertake activities to mitigate flood risk but if one does not have money for such things, adapting becomes more difficult. They do not have the financial means to change their situation.
c. People who have limited mobility or who are ill – People with mobility challenges or people who are ill or who experience chronic diseases may be physically unable to relocate or evacuate.
d. Single parents – Single mothers were identified in particular. They also may experience poverty, which in turn, makes it more challenging to undertake adaptive behaviour.
e. Parents who are home alone with their children – Being alone with children, particularly young children makes moving around (quickly) more difficult.

f. Immigrants – People from non-English/non-French speaking countries may have difficulty because of a language barrier.
g. People who are isolated – This may include people who are socially isolated and lack a social network but also those that live on higher ground and who may not experience direct flooding but who may still become isolated and become difficult to evacuate.
h. People who are uneducated – People who are uneducated may not know where to seek information.

It was expressed that people who are vulnerable may also have trouble perceiving risk because of a lack of access to information because they either lack access to the Internet and other technology that would facilitate their access to information or because they have a small social network.

5.11 How to Reach the Most Vulnerable Audience(s)

Respondents suggested a number of ways that the above named audiences may be reached. Tactics may include:

- Letters
- Communiqués
- Public/town hall meetings
- Small group meetings
- Kitchen chats
- Media (television, radio, newspaper)
- Community evening/meetings/workshops
- Door to door
- Units with students in school and through them, workshops with their parents/caretakers
- Information booths
- Videos

One respondent suggested working with each audience and involving them in determining how they wish to be communicated with. Other recommendations included engaging students from Mount Allison University (the local university) to assist in reaching vulnerable audiences and shuttling people who have limited mobility or who lack transportation to and from meetings to enable them to participate.

It was also suggested that a registry of vulnerable people be created, such as the Sault Ste. Marie Vulnerable Persons Registry Pilot (in Ontario) (see https://www.soovpr.com/). Perhaps the Emergency Measures Officer could take on the task of developing and maintaining this registry.

All respondents agreed that an attempt has to be made to reach the wider mass of people. It was felt that once a critical mass of people was reached, they themselves would start to talk to each other on their own. But, a significant amount of work has to happen in advance for this to happen. Information and supporting material has to be gathered and/or prepared. A communication strategy was recommended to ensure that a coordinated approach to communications is undertaken. Those communicating the message of flood risk should be trained. The message has to be clear;

communicators need to know what to say to people who might be impacted and how to say it. Moreover, financial resources have to be in place to undertake communications activities.

5.12 Who Should be Communicating about Flood Risk

Interviewees were asked who they thought should be delivering the message about flood risk to each of the target audiences identified.

Several interviewees expressed uncertainty about who should be communicating the message about flood risk. Some interviewees indicated that some people thought the Tantramar District Planning Commission should be the main communicator. Some also remarked that the public sometimes perceives nonprofit (environmental) organizations as having a vested interest in the issue of climate change/flood risk and therefore are not perceived as being truthful.

Regardless of who the main communicator is, it was felt that the municipal government (town council) should be at the helm. The municipal government has the potential to unite us all into a single community so that there is a sense of support and so that people do not feel so alone. At the same time, other levels of government have a role to play as well.

It was suggested that the communicator might change depending on the target audience. Perhaps if one were trying to reach a particular audience, such as youth, one might employ a member of that target audience, i.e., another youth to help communicate the message.

One respondent indicated that communicators should be those who can say what is being done to mitigate or adapt to the risk. They should be able to explain what is being done about the issue of flood risk. Scientists are not often involved in solutions on the ground. Communicators should be people who have some ability to protect, work with and support others in the community. Communicators should also be known and respected in the community. Sometimes people respond better to people they know.

Another suggested that various communicators should be used at various times. Politicians have the responsibility for the public purse. Scientists have the data and knowledge. It is advised that representatives from different organizations speak at different times. Or alternatively, come together to jointly present a message. A communicator does not always have to be one specific party.

'Experts' may have the knowledge but they are not necessarily the ones that have the best social or public speaking skills. As a result, it was also felt that communicators should also be people with exceptional public speaking abilities. They should be dynamic but at the same time, they should possess a good understanding of the scientific data and social skills and a sense of humour.

5.13 The Best Equipped to Communicate

Interviewees were asked who they thought would be the best equipped to talk to each target audience identified. Some respondents were not sure. Others cautioned relying on Mount Allison University. Because of the 'town and gown' struggle, it was felt that any message led by Mount Allison

University may wrongfully imply that an issue (or solution) was a university initiative and therefore has the potential of discouraging some from becoming active or in listening to the message.

On several occasions, respondents indicated that the message about flood risk should come from the municipal council. A variety of communicators could be employed but ultimately, the council was regarded as the one who should facilitate or spearhead any communication activity.

Another expressed doubt about whether there is one particular individual who could best communicate flood risk. Instead, it was suggested that a multi-disciplinary group be responsible for communicating flood risk messaging. This group could consist of various entities, such as representatives from the municipal, provincial and federal governments, the planning commission, etc.

People with technical expertise could be used to convey details about the data.

Regardless of the approach taken, leadership on this issue is required. And, regardless of the technique used, one should consider using different tactics to communicate with different audiences and that formal and informal approaches be utilized. Communicators should be able to relate to the audience and be able to 'think on their feet'.

5.14 Advice to People Responsible for Communicating Flood Risk

Respondents provided advice to those responsible for flood risk communications:

1. **A question of balance** – it is important to balance presenting the results of research with avoiding to scare people. At the same time, one should present enough information to strong encourage people to act but not to the point where people are petrified or are scared to the point of denial or inaction or catatonia.
2. **A plan is required** – Talking to people has to be planned and there needs to be follow up so the public can be kept informed on what progress is being made or what the state of affairs is. Be prepared – One should be prepared so that one can demonstrate one's credibility. If the aim is to mobilize the public, one has to give the public the impression that the issue is serious and legitimate. Make sure one has a thorough understanding of the area and the flood history of the area in addition to understanding the scientific data. Be armed with options/ideas of what people can do or respond to or prepare for a flood.
3. **The issue needs a face** – People like to speak to someone they know and they trust, someone with credibility.
4. **Use visuals** – Visualizations can convey idea and information in a way that people remember.
5. **Employ a member of the target audience** – Partner with someone from the target audience to facilitate access to that group. For example, if one is going to speak to farmers, connect with someone who works with farmers. People tend to listen better if they are being spoken to by people in their field or people they know.
6. **Listen** – Listen and learn as much as possible from the people being spoken to.
7. **Make sure the message is clear** – The audience has to understand what the major issue is and what the message is.
8. **Present realistic options** – Ensure that options are realistic and attainable.

9. **Be supportive** – People may feel scared and upset. Present information in a meaningful way. Communicate a message of support in addition to information. Do not be trite.
10. **Involve the audience** – Engage the audience in identifying what they perceive the risk to be and then respond to the audience.
11. **Don't be alarmist** – Ensure that practice, realistic options are provided so that people feel empowered, not alarmed.
12. **Time the use of maps** – Consideration should be given as to when to use visualizations. For example, one respondent preferred to use maps at the end of his/her presentation because s/he found that showing a visualization too soon led people to focus on the picture, not the information.
13. **Avoid cheap journalism** – Sensationalism and platitudes about climate change should be avoided. Focus on being technical and informative.
14. **Keep things fresh** - Too much repetition can close and numb people.
15. **Keep things simple** – People will tune out if information gets too technical or too complicated.
16. **Focus on the community** – Focus on the community, not on any one individual's properties because doing so will fragment the community into two groups: those who are and who are not affected. Then the community would be polarized and cooperation and support would be stymied.
17. **Emphasize community** – Emphasize the cost we are all bearing and the impacts a flood will have on the quality of life and the shared infrastructure. Flood risk has implications for everyone, not just those living in the vulnerable areas.
18. **See communication as an open dialogue** – Communication is a two way street; people will ask you questions and they will also suggest solutions. See communication as facilitating a dialogue, not just presenting information.
19. **Put yourself in the audience's shoes** – Appreciate where the audience may be coming from. Ask oneself what one would like to know if one were in the audience's shoes.
20. **Be prepared for people's emotions** – People may get very emotional as they learn about how flood risk may affect them.
21. **Use the numbers to come up with answers but the answers should not have numbers** – Information and recommendations should be grounded in science but data can be confusing and exclusionary. Instead, put the numbers in words that anyone can understand.

5.15 Advice to Government about Communicating Flood Risk

Interview participants were asked what they would advise government in particular about communicating about climate change. Government was urged to listen to the science.

It was maintained that the role of government in general is to complete solid, unbiased research/information and provide infrastructure and resources and it should communicate better with the public in this regard. Yet, the bulk of communications about climate change should come from nonprofit organizations and universities. It was maintained that because of its bureaucratic role, government does not believe in real engagement and does not really know how to communicate. Government should only communicate to the point of providing information. Communication should be engaging and action oriented, not alarmist and should be provided it in a format that everyone can understand. Communications should involve informing people who are at risk and telling people what they can/should do, i.e., not to move into or build new structures on the flood plain in the future.

Government has to be honest with the public about what can occur and where it can occur so that people can make decisions and take care of themselves. Government should provide infrastructure but the public has to take responsibility for its property and itself. Government should convey this message. People should be empowered with information and not expect the government to save them. But they do need information and tools so they can ensure they are safe.

Government also has a responsibility to plan for the future. It should be proactive and undertake preventative measures. If a problem can be prevented and mitigated, then catastrophe can hopefully be removed from the equation. Moreover, the public expects government to provide services and maintenance to prevent flooding and in the event of a flood, constituents expect you to respond effectively. The better it can respond to this expectation, the less ire it will face when it does not meet the needs of the public.

Another notion that was put forth was that the municipal government should be open and forthcoming and needs to be an advocate for the community. It should lobby at the provincial and federal level for interim and long term support to build up and repair the dykes and for other resources.

The municipal government should provide information-based programs and initiate workshops. It should formulate an emergency plan and inform the public that there is one. It should engage in outreach.

The province needs to issue provincial planning statements about public safety and health. It also needs to enable planners by establishing provincial policies and regulations about coastal issues so municipalities have a framework in which to work.

Flood risk should be depicted on the maps available through Service New Brunswick and included in Service New Brunswick data so that home buyers and land developers have access to this information.

The federal government also has a responsibility and should finance adaptations. It is not possible to leave the communities with the brunt of the responsibility because quite simply, there is no money at the community level to finance all the activities that are required. Government should provide funding and communities should do the work. Work should be community based because each communities faces different coastal situations, issues and threats.

5.16 Effectiveness of Visualization Techniques

With regards to the effectiveness of visualization techniques as a way to inform the public about flood risk, all interviewees felt that visualization techniques were significantly more effective in conveying messages than words or numbers alone. People can relate to visualizations particularly if they are contextualized and local.

Visualizations can play a significant role in building awareness quickly. But different visualizations can be used for different purposes. For example, it was suggested that video clips could be used to build awareness but that maps could be used to foster a more engaged discussion.

Visualizations can also range in complexity. Simpler visualizations, like a simple, two dimensional map, could be used at the starting stages of engagement while more complex maps could be used as target audiences become more engaged.

Visualizations can help tell the story. They can cut across barriers and can provide examples of what is being discussed. Yet, they should be complimentary to the main education and awareness activities being undertaken and not be the sole information medium. Context is still required in order for visualizations to be powerful. Using visualizations alone will only create panic and chaos because they do not communicate everything. Not all visualizations, such as maps, are comprehensible to everyone.

Visualizations also help make complex information accessible. For example, data can be presented in numerical format but if that data were converted into something more entertaining, like an animation the message of the data may be more compelling and visually exciting and will attract more attention. Quite simply, if one can get people's attention, one is more likely to get the message across.

5.17 Role Visualizations can Play in Addressing Barriers

Respondents were asked to describe the role that visualizations in general can play in addressing hurdles or barriers previously discussed. As already mentioned, visualizations were regarded as being helpful in terms of providing information in an accessible way. Visualizations can reduce some of the challenges of communication by visually demonstrating the point one is trying to make. They can also spark interest or dispel denial. Visualizations cut through and show the extent of the problem without verbal commentary. But respondents cautioned that visualizations should not be used without explanation. They require interpretation. Not all visualizations, such as maps, are accessible to the layperson. Without context and additional information, people will be left on their own to draw conclusions and sometimes, these conclusions may not be accurate. In other words, visualizations support the message, they are not the message in and of themselves.

5.18 Problems Visualizations can Solve

Similarly, respondents were asked to comment on the types of problems that visualizations cans solve. They can:

- Show people visually what the issues are.
- Give perspective.
- Communicate problems and potential solutions.
- Convey information quickly.
- Be adapted to local contexts and different needs and circumstances.
- Catch people's attention.
- Make information accessible.
- Translate scientific information into a format everyone can appreciate.

- Help in dispelling denial.
- Put a problem in perspective.
- Bring back to memory what has happened in the past.
- Cement the message one is trying to convey.
- Relay vulnerabilities.
- Cut across social barriers, such as age, language, education, financial status, etc.
- Show how people will be affected by a flood event.
- Give one a sense of how to respond to a flood event or how to plan for one.

5.19 Problems Visualizations Cannot Solve

Notwithstanding their benefits, visualizations are not a panacea. Respondents maintained that the visualizations cannot:

1. Solve blocks in people. People will ultimately believe what they want to. Some people will always deny the data there will be nothing that can be done to change their minds.
2. Answer the question of time. They cannot indicate when a flood event will occur.
3. Eliminate the negative message. There are not a lot of soft edges to flood risk information. Regardless of how one paints the picture, news about flood risk is not good.
4. Incite action on their own. There is a numbness between the time one gets information and the time one acts. Visualizations cannot fill this void.
5. Answer every question. They will likely engender a lot more questions in fact that will require resource people to answer.
6. Convey the social, psychological or emotional impacts one may experience.
7. Convey personal stories. Visualizations do not report on the vulnerability of a community or how to address social concerns, how to allocate resources or how to acquire resources.
8. Be organic. They are snapshots in time; they are static. Therefore, people need to interact with them. People are still required to work out what the impacts may be, who will be impacted, what resources will be required, what problems will be solved, etc.
9. Show people how to respond. They cannot compel people to make personal adaptations.
10. Make people understand risk. Concepts like a one in fifty year storm are not well understood by laypeople and many people are unconcerned either because they do not believe that one is possible or because they will not be around anyway so it is not their concern.

5.20 Recommendations for Additional Visualizations

When asked what other kinds of visualizations could be used to communicate flood risk, interviewees suggested:

- Using visual arts or theatre.
- Creating an animation of a car driving through a familiar area and showing where the water line may be.
- Creating a video of the dykes. Many people do not realize the Tantramar Region is a dyked community. A video of the dykes can show people what a dyke is, how it works, and where it is in relation to town.
- Building street visualizations that depict one's actual town with recognizable landmarks.

- Using animations. Animations can show the extent to which the water can extend and how high it may get.
- Depicting water marks on known buildings and how it would affect men, women, and children. For example, one could depict a family walking along a town street and show where the water line would come up to on a man, woman and child of average size.
- Creating three dimensional models.
- Using a photograph of one's downtown and superimposing a water line on it.
- Holding workshops.
- Creating maps.
- Creating graphs and other animations.
- Acquiring a television station and using the local news to update and inform.
- Using celebrities to endorse key messages. Celebrities involve people that are known and respected in one's community.
- Interviewing individuals and creating documentaries or short films about their personal experiences.
- Using humour, e.g., comedians, to convey somber messages.
- Making use of social media sites, such as Facebook.
- Organizing flash mobs.[174]

Regardless of the approach, visualizations should have a local perspective. If one's real town is used, people will already be familiar with the place. They will see a picture of a street in their town and they will immediately know where they are.

Visualizations should be simple and straight forward. At the same time, they should be creative and should present creative solutions so that they can inspire people to act instead of depressing them.

One respondent noted that one should be wary of making visualizations too polished or 'high tech' because people may make assumptions, such as that a lot of money was spent on making a visualization rather than on assisting people directly.

5.21 Specific Visualizations for Specific Audiences

Informants were asked if particular visualizations should be used with certain audiences and not others. Overall, most respondents said that most visualizations could be used with most audiences though they may have to be adjusted depending on one's target. It was felt that any visualizations could be used and that it was the process that was most significant. The real issue is supporting people through the challenging times. The real question is how to get through this as a community. There are a multitude of options for how to do that. Visualizations are just informational tools; they themselves are not going to do the work.

Regardless, it was suggested that a combination of visualizations should be utilized so that information can be shown in a variety of ways. Moreover, messages were believed to have more impact if people receive them three or four times.

[174] Although seemingly spontaneous, a flashmob is a collective of individuals that come together suddenly for a short time to perform a certain activity and then disperse.

It was suggested that more 'entertaining' approaches be used, such as storytelling or theatre, if one were communicating information in a more relaxed atmosphere rather than a more formal atmosphere, such as during a town hall meeting or workshop.

Detailed visualizations could be used to convey information to those who will be directly impacted. They may need to know the specifics of an escape route or where they should live. Conversely, the general public may only need the bigger picture so a more general visualization may be more appropriate for that audience.

It was also suggested that one should determine through dialogue with target audiences what people know and what they should know. Then, one can determine how to communicate with them and design visualizations around how people prefer to be communicated with. If visualizations are used well, one can check the audiences' pulse on whether they are engaged and what impacts the visualizations are having. In other words, allow for feedback on the visualizations as one works with target audiences.

More technically adept audiences, such as planners, engineers, and scientists, may appreciate data visualizations more, such as more detailed maps, graphs, statistics, and probabilities. The average layperson, however, may only want to use a map, for example, to see where s/he is located and to see the extent to which s/he will be directly affected. However, one still needs some sort of spatial representation so that people will know where the exit routes are, for example, and what places to avoid.

In terms of maps specifically, it was suggested that they be general and not depict with certainty where the water may go. Maps should show relative risk only. There is a concern that people do not understand the nature of the data and are likely to misinterpret it. Crisp lines may give the false impression that it is known with certainty where the water will go and the extent of the flooding. While the data indicates that there is a strong flood risk, the specifics of when, how much water, and the extent of flooding are not known exactly. Depicting such information with certainty would be misleading and if something does not happen as forecasted, people may lose trust.

It was also suggested that visualizations should be used with caution with some audiences. For example, graphic visualizations that show serious flooding should not be used with children. They should not be scared. However, the issues should still be addressed with such audiences but in a more benign, empowering way.

Of course, visualizations should be used to show the public what may happen. But they should also be used to demonstrate what will happen if we as a community do nothing. In other words, visualizations should be used to show the consequences of doing nothing. Yet, if people are prepared, they can overcome their fears and the severity of the event may be reduced.

5.22 How the Tantramar Dyke Risk Project Addressed Concerns about Communicating Flood Risk

Interviewees were asked to comment on how well they thought the Tantramar Dyke Risk Project addressed the hurdles and/or concerns about communicating about flood risk. Many could not comment because they did not participate in the project or observe focus group sessions that the project team spoke to. Others noted that more will be known once the results of the project's focus groups are tabulated. Nonetheless, it was noted that the focus groups provided a strong starting point for understanding how the visualizations work so that a broader approach can be developed in order to communicate with the public as a whole.

It was noted that there are several excellent maps and other visualizations and that a consultant was hired to calculate the cost of flooding. At the same time, communicating about flood risk and encouraging adaptation is only at the initial phases in the Tantramar Region and a considerable amount of work remains. The current information needs to be conveyed to the public in a constructive and action-oriented way.

5.23 Positive Aspects of the Visualizations Used in the Tantramar Dyke Risk Project

Various project strengths were identified by those interviewees who were able to comment on the specifics of the Tantramar Dyke Risk Project.

- Focus groups were used to test the visualization tools that were developed.
- The project team worked with local organizations, like the Rotary Club of Sackville, to organize focus groups.
- The project team was very responsive to ideas and good to work with. For example, at the outset, the team realized that an understanding of the economic repercussions of flood risk was missing. As a result, funding was secured and a study is underway that is assessing the cost of doing nothing versus the cost of undertaking several remedial actions and adaptations.
- Stakeholders or focus group participants were informed of the flood potential.
- The project showed that individuals were quite aware of the problem and open to talking about it in a mature and rational way.
- The research suggested that animations were worth pursuing. There appears to be value in animations and they warrant more investigation. Such visualizations could become pivotal to convincing people of action they need to take in the long term.
- It was a good overview of what immediate risk is and what should be done first.
- Learned more about the specific impacts on the public works infrastructure and the potential impact on the community when infrastructure is affected.
- The project brought together people from different agencies, such as Sackville Town Council, the Tantramar District Planning Commission, Mount Allison University, Government of New Brunswick Department of the Environment (put full name), and the Regional Adaptation Collaborative (RAC).

In terms of the visualizations specifically, interviewees:

- Commented on the map, noting that they 'loved' them; they really show where the flood risk is and how areas may be affected by flooding in the future.
- Appreciated seeing the details on the map, like sewer and hydro lines.
- Noted that the visualizations made information more accessible to the layperson.
- The animation of the man walking down the street was particularly effective. It helped people to see the impact of a flood in terms that were more real. Animations made the information seem more real.
- Appreciated the interactive visualizations where one could zoom in and see more detail.
- Felt the visualizations, particularly the maps, could become invaluable tools for emergency medical service officers in preparing for a flood emergency.
- Also felt the tools could be invaluable for land use planning.
- Expressed interest in the way visualizations helped them to pay attention to the shape of the land and the elevation of the land.
- The visualizations worked well when placed in context.

5.24 Negative Aspects of the Visualizations Used in the Tantramar Dyke Risk Project

Notwithstanding the strengths of the Tantramar Dyke Risk Project, it was felt that improvements could be made in the following areas:

- More could be done in terms of conveying how infrastructure works.
- More information should be presented that explains the extent to which the flooding will affect each neighbourhood and the projected depth of the water.
- The data charts and graphs would only be of interest to a small subset of the population. For the layperson, these were tedious and confusing. Information should be presented in a way that the average person can grasp it. Couple the data charts and graphs with visuals and more appealing forms of information.
- More visualizations could be utilized.
- The project team did not interact with people about their experiences.
- Government was not engaged about what it perceives the problem to be.
- The focus groups focused on presenting data but it seemed that participants left wondering what they should do and how much it will cost. This gap in the research should be filled.
- The project also focused on the infrastructure of the dykes and the town infrastructure but not on freshwater flooding.
- The animation of the man walking downtown was basic. The images where blocky and the downtown was not recognizable as Sackville.

Challenges still exist, such as:

- How to disseminate the information results from this project out to the public.
- Developing tools for general public use.
- Engaging funders and decision makers, i.e., those with power and authority.
- Engaging people and encouraging them to make adaptations. Some people want to act but do not know how.
- Having a communications plan.

- Communicating with different segments of the population. The people within the Town of Sackville will be affected by a flood event more so than those living outside of town. Thus, there are two groups that will experience the flood differently: those that live inside the town and who may experience significant personal loss and those that live outside of it who may be isolated for a finite period of time.
- How to infuse visualizations with the 'human element' and make them more personal and therefore more relatable.

One respondent emphasized that one should bear in mind that the concept of communication is more than merely giving information. It is about safety, challenge and support. If these three elements are not addressed in a concerted fashion, a flood event and preparing for one will be harder than it needs to be on people and responses may not be as effective or as strategic.

5.25 Visualizations that Should Have Been Part of the Tantramar Dyke Risk Project

Interviewees were asked whether there were any visualizations that should have been used in the Tantramar Dyke Risk Project. Respondents expressed interest in having the following:

1. **High resolution aerial imagery** – Though, there are technical limitations to using the, such as huge file sizes).
2. **Layered visuals** – For example, inserting a line on a graph, and then another one and then layer in an animation so that the end result is a multi-layered visual that allows viewers to perceive and process each element of the visual in an incremental way.
3. **Fresh water flooding** – The region is also vulnerable to fresh water flooding so visualizations could have integrated fresh water and sea water scenarios.
4. **A creeping water line** – Though there was some hesitation with this suggestion because there is still not enough information about how the flood water may move.
5. **A depth map** – Visualizations should include information on how deep flood water could get. This information should not necessarily be available to everyone. For example, depth maps could be made available to those who are preparing for a disaster response but not necessarily available during a preliminary information session.
6. **A variety of scenarios** – Additional scenarios could be presented along with solutions.

5.26 Information that Should Have Been Covered by the Tantramar Dyke Risk Project

Interview informants were also asked if there was any information that should have been covered by the Tantramar Dyke Risk Project. Again, a number of respondents could not comment because there were not familiar with the details of the project. However, those who could comment on the content of the project suggested that the following topics be considered:

- How long it would take the water to reach a certain point – Such information would help with disaster response.
- The impacts of a flood on the town – The impacts may be extensive and knowing potential impacts may help in disaster planning.
- Information about fresh water flooding – This information should be coupled with information about flooding due to sea level rise to present as complete a picture as possible.

- A social profile of the residents – Emergency response and others require a better idea of who lives in the most vulnerable, high risk areas. Information could include the number of people in the dwelling/family, health or mobility issues, date of birth and age, language spoken, etc.
- An update on what is currently being done and direction on what individual people could do to take action – The project was conceived as one that would centre on testing visualizations. However, the end result was that the project became one that actually communicated to the public. Because of this, it would have been preferable to provide project participants with information about what is being done and what they could do.
- Methods, approaches, or policies on how to minimize risk impacts – Methods will illustrate ways to accomplish mitigation and adaptation tasks and assist various employees to do their jobs better.
- Presentations – Results of the project should be presented and used as a basis of further action.

5.27 Other Things the Public Should Know about Flood Risk

Informants suggested that the public in the Tantramar region needs the following information about flood risk:

- Maps – It was felt that the public needs to see the maps. However, as mentioned above, the maps need to be embedded in constructive information.
- Messaging – Messaging needs to be formulated and needs to be part of a larger communications plan.
- Understanding of risk – The public needs to understand that there is a risk of flooding in this area, where the risk stems from, what can cause flooding, the likelihood if a flood, who is dealing with it, who should be dealing wit it, etc.
- Lines of authority – There needs to be a greater understanding of who is responsible for what.
- Roles – There needs to be a greater promotion of what municipal, provincial, and federal governments and other agencies are doing about flood risk.
- Collaboration – The public needs to understand how different governments and agencies are working together on the issue of flood risk.
- Insurance – Canada is the only country in the G8 where flood insurance is not available. Many people do not know that flood insurance is not available to them and that current insurance policies will likely not cover damages caused by a flood.
- Infrastructure – Community members need to better understand that a community is a network, a web, and is therefore interconnected. So, even if one's house is not in a low lying area and therefore not immediately vulnerable to water, one will still be affected by a flood event. For example, homes will be isolated and cut off from grocery stores and hospitals, transportation will be limited, and sewer and electrical services will likely not be available.
- Dykes – There should be a greater awareness about the dykes in terms of what they are, what they were built for, what they are expected to do now, and the state of affairs. There also needs to be a greater understanding of the importance of the dykes to the Tantramar Region.
- Land use – People have to know what land on the flood plain could be used for.
- Costs – People need to know the financial, personal, and emotional costs of a flood event.

- Assistance – People need to know what assistance will be available to help them undertake adaptation activities, who will support them in the event of a flood, and what type of support will be available.
- Options – People need to know what the options are in terms of dealing with flood risk, how to prepare for a flood event, and so forth. This could be housed in a toolkit.
- Dialogue – The public should be extended an invitation to participate in a dialogue to discuss adaptation strategies so that moves can be made towards community empowerment.
- The plan – A plan needs to be in place for dealing with flood risk and the public needs to know the details of it and have the opportunity to provide input into it.
- Support – People need a support group, a network; they need to know where they can find information, like a website, and they need to know who they can talk to so they know they are not alone.

One major concern that was expressed was that people might panic and communicators should be aware of this and be prepared to deal with it. Moreover, information should be organized and presented bearing this possibility in mind.

5.28 How to Inspire People to Act Positively

Interview respondents were asked how they might inspire people to act positively about flood risk without becoming fearful about it. In many instances, respondents were at a loss and stated that this was the key that they were collectively working towards. Nonetheless, several ideas were put forth:

- Provide information and provide alternatives.
- Use zoning bylaws (and policies) to shape future development.
- Provide specific options on what can be done to reduce impacts, such as installing a backflow valve.
- By being honest.
- By providing leadership and setting an example.
- By being supportive. Demonstrate that people are not alone.
- By being interactive and engaging.
- By being inclusive.
- By being positive and inspiring in your messaging.
- By being action oriented. Describe what people can do.
- By focusing on things that people can actually do and manage.
- Be credible.
- By building community connections.
- By educating people so they are ready and not cut off guard.
- By voting for political representatives that prioritize climate change and the environment.

Action was regarded as the only way forward. Not ding anything is no longer an option.

5.29 Additional Comments

Finally, respondents were asked if they had any additional comments. They noted that there are many issues that need to be addressed, such as:

- The waste pond no longer meets federal standards. This is important because one of the walls is actually the dyke wall.
- In the short term, the dykes need to be reinforced.
- New areas for housing need to be identified.

The tax system should change. One should consider a different tax structure in vulnerable areas so people can save money every year so they can make plans and take adaptation measures. In some countries in Europe, for example, citizens are charged an environmental tax. This would allow the municipality to generate funds to address mitigation and adaptation.

Flood risk and the potential of flooding represent a collective loss to the community. As such, people need to work collectively and we need to have mutual understanding of how people are feeling.

Messaging should be inspiring, not discouraging. Great care should be taken in terms of how messages are communicated. Real options must be available along with a common sense approach.

One respondent observed that there appears to be a culture of crisis in the Maritimes. People have been lost at sea and in mining disasters. The people who have lived here for generations are part of this culture. There is a certain acceptance of living in a precarious place because we know tomorrow someone can be lost at sea or lost in the mine. This changes the potential of how you see things in the future.

Understanding flood risk also need to encompass the fact that it is not only the Town of Sackville that is vulnerable but the New Brunswick/Nova Scotia gateway. Other players (such as the provincial and federal governments, CN Rail, and private enterprise) will ultimately have to weigh in on the issue because a flood will affect them as well as well as the transportation of millions of dollars of goods.

No individual has the capacity to deal with the issue of flood risk alone. This is a community issue. Likewise, people are not alone. Addressing the problem requires the cooperation and collaboration of many players, a significant amount of resources, both financial and human, and the community coming together.

6. Inventory of Climate Change Visualization Communication Tools

There are numerous types of visualizations that can be used to communicate climate change. The focus of this inventory will attempt to inventory a broad range of visualization communication tools, particularly those that can be used to communicate flood risk. The inventory is a combination of academic and popular ideas.

The inventory is presented in alphabetical order and is a presentation of options only. An assessment was not made on any of these applications. Each application could be used in a simple or complex

manner, could be used for a multitude of purposes and in a range of applications. The inventory includes:

1. **3-D models** – Participatory 3-D models are manufactured based on the merger of traditional spatial information (elevation contours) and peoples' spatial knowledge (cognitive maps). Elevation contours are used as templates for cutting out sheets of carton board of a given thickness (e.g., expressing the vertical scale). Cut-out sheets are progressively superimposed to build the relief. Models could be a scaled model of an actual parcel. Relief models provide stakeholders and local authorities with a powerful medium for easing communication and creating common grounds for discussion. They can be used to effective in overcoming logistical and practical constraints of transporting many people to a site and still ensure public participation in land/resource use planning and management.
2. **3-D photorealistic renderings of terrain and objects** – These visualizations can be used for educational purposes and to show research results.
3. **Animations** – Animations could be used for representing geospatial data using a range of technology.
4. **Art exhibits** – Art exhibitions could be used to showcase art objects related to flood. Art could be combined with educational material to convey chosen messages. Art can span a variety of media, including pictures, drawings, video, sound, installation, performance, sculpture, pottery, fabric, etc. Art can be showcased in a variety of locations, such as art galleries, coffeehouses, social clubs, and outdoor spaces.
5. **Before and after images** – Such images, be they maps, satellite imagery, streetscapes or landscapes can provide an understanding of an area before and after a flood.
6. **Cause and effect diagrams** – Cause and effect diagrams can graphically depict a range of actions and their associated effects.[175]
7. **Collaboration cards** – Collaboration cards are used particularly for fostering collaboration planning and information sharing.
8. **Colouring books** – Colouring books could be directed towards younger audiences to make learning about flood risk information and fun.
9. **Comics** – Comic strips and books can be used to convey information in a fun, non-threatening manner. They are also excellent ways to communicate with youth and children.
10. **Compound visualizations** – Compound visualizations involve meshing together different graphics to present information. They include graphic facilitation, cartoons, rich pictures, knowledge maps, learning maps, and infomurals. [176]
11. **Concept visualizations** – These are used to elaborate on qualitative ideas, plans, and analyses and include mindmaps, layer charts, soft system modeling, squares of oppositions, minto pyramid technique, synergy maps, concentric circles, cause-effect chains, force field diagrams, argument slides, toulmin maps, ibis argumentation maps, meeting traces, communication diagrams, swim lane diagrams, decision trees, process event chains, flight plans, gantt charts, critical paths, pert charts, concept skeletons, perspectives diagrams, concept fans, evocative knowledge or asset maps, dilemma diagrams, concept maps, and vee diagrams. [177]

[175] Eppler and Aeschimann, p. 80.
[176] Lengler R., Eppler M. "Towards A Periodic Table of Visualization Methods for Management" in IASTED Proceedings of the Conference on Graphics and Visualization in Engineering, 2007, Clearwater, Florida, USA, page unknown.
[177] Ibid.

12. **Data cubes** – Built like a Rubik's Cube, a data cube is a three dimensional array of values. It enables one to explore information from multiple perspectives and in different combinations.
13. **Data visualizations** – Data visualizations are particular useful for visually representing quantitative data in a schematic way. Examples include continuum diagrams, tables, Cartesian coordinates, pie charts, line charts, bar charts, area charts, histograms, scatterplots, tukey box plot, and spectrograms.[178]
14. **Educational resources** – Educational resources could be used for school applications and accompanied by teacher's notes. One such example is Floods Explorer (http://education.melbournewater.com.au/content/rivers_and_drainage/our_drainage_system/floods_explorer/floods_explorer.asp#).
15. **Exhibits** – Museum-type of exhibits could be used to educate and inform the public and visitors/tourists about flood risk and climate change.
16. **Film/Video** – Films can be used to educate about flooding, flood risk, and adaptation. Innumerable topics could be covered, such as impacts on victims, relief efforts, damage, good Samaritans, demonstration (e.g., to demonstrate how to properly build a sandbag bank), and overall education. Films can be presented in person, at a public showing, or posted on YouTube.
17. **Fridge magnets** – Fridge magnets and other such items could be used as helpful, at-a-glance and accessible tools to convey key points of information quickly. They can also be used as a source of information, such as by listing key phone numbers.
18. **Hydrological models** – Hydrological models can be constructed using different types of software to model and simulate flood events. Such models can be used to communicate flood risk to a variety of audiences, such as water management authorities, government, or emergency response staff, as well as the public.
19. **Information visualizations** – Here, data is transformed into an image. Examples of information visualizations include radar chart cobwebs, sankey diagrams, data maps, parallel coordinates, information lenses, treemaps, hyperbolic trees, entity relationship diagrams, cone trees, cycle diagrams, petri nets, system dynamic simulation, timelines, flow charts, data flow diagrams, venn diagrams, clustering, and semantic networks. [179]
20. **Inundation models** – Various technologies can be used, such as geographic information system (GIS) technology, to demonstrate forecasted minimum and maximum water inundation in a particular area, causes of inundation, at risk asset mapping, emergency planning, etc.
21. **Maps** – Maps can be used to convey an array of information, such as extreme flood maps between a particular period of time, flood hazards, flood risk, etc. They can be presented in paper or digital formats and can be static or animated, can be interactive and can be presented in one, two or three-dimensional formats.
22. **Metaphor visualizations** – Metaphor visualizations present information within a graphic to convey information. The type of visual metaphor in which the data is presented also helps convey information as well. Examples of metaphor visualizations include metro maps, temples, story templates, trees, bridges, funnels, parameter rules, icebergs, and heaven 'n hell charts. [180]
23. **Photography** – Photographic imagery (land or aerial) could be used to convey a variety of flood messages and be used to emphasize the human element of flood risk. Photographic

[178] Ibid.
[179] Ibid.
[180] Ibid.

montage is one avenue for the use of photographs; it refers to the process of making a composite photograph by cutting and joining numerous photographs. Photographic imagery can also involve three-dimensional panoramic imagery.

24. **Posters** – Posters can be eye-catching, used for a multitude of purposes, can convey an array of information and can be posted in a variety of settings.
25. **PowerPoint slides** – A slideshow of images can be used for a range of purposes, such as updating an audience on research or activities undertaken, fostering discussion, or presenting options or simulations.
26. **Public exhibitions** – Similar to the 'art show' concept, public exhibitions could be used to inform or solicit public input.
27. **Risk dashboard** – A risk dashboard is an at-a-glance tool visualization that is meant to provide a quick overview of the status or level of risk. Typically, a risk dashboard incorporates gauges, diagrams, and tables to present the risk situation.[181]
28. **Risk ruler** – A risk ruler is a graphic template that represents the risk rating of a particular event and is sometimes accompanied by risk assessment criteria. It can be used to represent or determine risk.[182]
29. **Shockwave tools** – Shockwave, an Adobe Flash file format, can be used for multimedia, vector graphics, and ActionScript (used for Adobe Flash Player); Shockwave files can contain animations or applets and can be used to build interactive applications. Using such technology, animations, text and simulations can be combined to teach about floods. Various topics can be addressed such as the shape of drainage basis, water discharge rates, water deposition, runoff, frequency of flooding, projected flood paths, to name a few. The tool can also be used to generate a flood and assess different flood control techniques in order to assess how a range of conditions can affect flooding.
30. **Simulations** – Simulations could be used to inform various audiences about flood paths, projected water levels, escape routes, personal impacts, etc.
31. **Stereographic visualizations** – Traditionally, stereographic visualizations contained two almost identical images with minor differences in perspective that when merging together, can simulate a tactile quality. Such visualizations can be used to present images with depth.
32. **Storyboards** – Storyboards are illustrations or images that are arranged in a sequence. Originally developed for the purpose of pre-visualizing a film, television or animation, storyboards could be used to convey a sequence of flood events (pre-, during, or post-flood).
33. **Storytelling** – While not visual per se, storytelling can be used through theatre or other means to convey a flood risk/mitigation/adaptation message in a non-threatening, constructive manner to inspire listeners.
34. **Strategy visualizations** – Strategy visualizations involve "the systematic use of complementary visual representations in the analysis, development, formulation, communication, and implementation of strategies in organizations. They include supply and demand curves, Edgeworth boxes, performance charting, portfolio diagrams, strategy maps, strategic game boards, organization charts, Mintzberg's organigraphs, house of quality, Zwicky's morphological boxes, feedback diagrams, affinity diagrams, failure trees, decision discover diagrams, magic quadrants, BCG matrices, life cycle diagrams, strategy canvas, Porter's five

[181] Eppler and Aeschimann, p. 83
[182] Ibid., p. 78.

forces, value chains, s-cycles, hype-cycles, stakeholder maps, stakeholder rating maps, ishikawa (fishbone) diagrams, taps, technology roadmaps, and spray diagrams. [183]

35. **Television commercials** – In addition to showing commercials or advertisement on local television, for example, they could also be shown at local theatres, before the feature film.
36. **Terrain (elevation) models** – Such models are digital renditions of a terrain. They are often in 3-D format. Models of terrain could be designed to demonstrate a range of information, such as flood paths, projected water levels, environmental impacts, escape routes, etc.
37. **Theatre** – Theatre can be an impactful way to convey a message in a relaxed atmosphere.
38. **Timelines** – Timelines could be used to convey information about a sequence of events or an anticipated/forecasted chronology.
39. **Time-sequenced animations** – Animations can be presented in time sequence. In an animation, various types of information can be laid over each other. For example, a map that shows a continuous animation may be overlain with text boxes and water depth markers.
40. **Video games** – Animated video games could be tailored to one specific region and integrated with positive messaging to promote good flood sense, particularly among youth. Stop Disasters! (http://www.stopdisastersgame.org/en/home.html) is one such example. The game could be available in various levels of difficulty.
41. **Vignettes** – 2-3 minute short films of people who have experienced a flood and who are talking about their experiences could convey the personal side of flood risk. Vignettes could also be provided in other formats as well.
42. **Virtual reality models** – Also referred to computer-simulated environments or virtual worlds, virtual reality models can create a lifelike experience and simulate one's physical presence in the simulated world. Virtual reality models can be presented on a computer screen, by using stereoscopic displays, tactile tools, or though sound speakers/headphones.

There are innumerable instances of using visualizations to communicate with the public. Though not explicitly the focus of this research, a short listing of projects that could be used a starting point for a survey of the use of visualizations to communicate flood risk is included here:

1. Coastal Erosion on the Great Lakes (Wisconsin, USA) – The coastal erosion on the Great Lakes project is intended to lessen the gap between scientific understanding and public perception regarding coastal erosion. See http://www.geography.wisc.edu/coastal/ for more information.
2. Collaborative for Advanced Landscape Planning (CALP) (British Columbia, Canada) – CALP uses modeling and visualization along with workshop processes, charrettes, and planning exercises to consider how citizens, stakeholders, decision-makers and others address sustainability and climate change issues. See http://www.calp.forestry.ubc.ca/ for more information.
3. CRUE ERA-NET (Europe) – CRUE ERA-NET aims to integrate research regarding flooding within Europe to generate a greater understanding of flood risk and to foster greater flood management. See http://www.crue-eranet.net/ for more information.
4. Flood Risk Management Research Consortium (Great Britain) – Operating between 2004 and 2012, the Consortium was the largest consortium of British universities and other organizations conducting flood risk research. See http://www.floodrisk.org.uk/.

[183] Lengler and Eppler, page unknown.

5. Floodsite (European Union) – Floodsite is a consortium of 37 European institutes and universities. Projects cover the physical, environmental, ecological and socio-economic facets of floods. See http://www.floodsite.net/ for more information.
6. Province of Zeeland (Netherlands) – The province of Zeeland piloted an interactive 3D flood visualization. See http://www.flood-aware.com/newsletter/newsletter1/3D for more information.
7. Influenced by a case study of visualization in Goderich, Ontario on Lake Huron (Schwartz et al. 2004)

Visualizations can be stand-alone objects or can be used to enhance other items, such as pamphlets, etc.[184] Regardless of the technique being used, when producing visualizations, numerous considerations should be borne in mind, including cost, software access, portability, audience, whether visualizations can be modified, interactivity, etc.[185] Functionality, ease of use, and interface capabilities with a range of systems should also be considered.

Considering the media that one can use to create and present one's visualization is but one aspect of the puzzle of using visualizations to convey flood risk. Other elements which should be considered in more detail when developing and using visualizations (but which are outside of the scope of this project) include:

- Ethics;
- Techniques and how to actually present the visualizations, e.g., using split screens or using virtual reality theatres, etc.;
- The type of training required for presenters of visualizations;
- The setting (in other words, consideration should be given to the setting the visualization is being used or presented in and how that setting is arranged, including physical elements like seating);
- How the visualization workshop/presentation is organized;
- Who the audiences are and which visualizations to use as a result
- How to engage stakeholders in collaborative planning of the visualizations/presentation materials;
- How spatial and temporal elements of the visualizations will be conveyed;
- Credibility of the visualizations and the people who are presenting them (this is tied to trust the audience feels in the data and in the presenters);
- Types and levels of interaction that is desired from various audiences;
- Desired outcomes or actions, and;
- Transparency (i.e., how information will be conveyed and whether the information and sources are transparent and perceived to be legitimate and honest).

[184] Jude, pp. 340-341.

[185] Appleton, K., Lovett, A., Dockerty, T., Sünnenberg, G. *Representing Uncertainty in Visualizations of Future Landscapes*. Unknown: Zuckerman Institute for Connective Environmental Research, School of Environmental Sciences, University of East Anglia, date unknown, p. unknown.

All the above elements will contribute to whether the context for delivery is conducive to the goal that the researcher has in terms of what s/he wants to convey with the visualizations and what his/her planned outcomes are.

7. Proposed Contents for a Toolkit about Climate Change

This section provides a listing of recommended contents a toolkit on flood risk communication may contain. This toolkit may be available in a variety of formats including on a website (including downloadable information), as a resource binder, CD-ROM, fridge magnets, posters, or as summary leaflets. The toolkit could be linked to other media, such as YouTube, Facebook, Twitter, and other forms of social media. Information in a toolkit could also be integrated with various visualizations (see section 6). This section of the report is termed in terms of a homeowner but could conceivably apply to businesses as well.

The toolkit should be presented along with a message of uncertainty. In other words, it should be made clear that the information contained in the toolkit is based on the best science available at the time of development but that there are many unknowns associated with climate change and flood risk and it is impossible to anticipate everything. As a result, the toolkit is probabilistic and offers the best resources available at the time and will be updated continually as new information becomes available.

In addition to content, one should also consider the aesthetics of the toolkit. Pictures can convey 'a million words' and can demonstrate concepts quickly and effectively, such as how to properly build a proper sandbag bank. Font can be used to emphasize or draw the reader's attention to particular information or entice the reader to delve deeper into the content.

The toolkit should be kept current and up to date. As such, it should be updated annually and time stamped so that users know that they are have access to the most up to date information available. It could also contain a decision making tree to assist people in selecting options for action and making decision.

It might also be useful to have a search tool if the toolkit is available electronically so that people can find information quickly and efficiently. An online resource may also be a site for updates, testimonials, meeting notices, blogs, and discussion groups.

A municipality could also use an online toolkit as an opportunity to promote its own adaptation activities. It might be a place where the municipality can demonstrate that it is taking the issue of flood risk seriously and that it is being proactive.

When building a toolkit about flood risk, prevention and adaptation strategies, and post-flood recovery, consider the following content:

1. **Section: Background** – This section would provide an overview of climate change and flood risk. Contents may include:
    a. What is climate change?

b. Flooding – What is flooding and what are the causes of flooding? What is the flood risk in this area?
c. Information about the dykes – What is a dyke? What are they for? What is the condition of the dykes? Why are the dykes important for this region?
d. Regional overview
e. The cost of doing nothing versus the cost of adaptation

2. **Section: Am I at Risk** – This section would cover issues to help people determine whether they are at risk for flooding and/or whether or not they live in a high, medium, or low flood risk area. Content may include:
    a. How to assess flood risk
    b. What is the flood risk in this area?
    c. How does water get into the house?
    d. How will my property and belongings be affected, like items most at risk
    e. How will a flood affect me, like emotional and psychological impacts, financial impacts, the costs of flooding, repairs, restoration and clean up
    f. Where to go for answers and help
3. **Section: Protection** – This section would assist home owners in protecting their property to reduce damage in the event of a flood. Content of this section may include:
    a. Information about flood proofing your walls and the types of products available, like liquid membranes, polymer/cement coatings, asphalt or sheet membranes
    b. Information about how to improve the flood resistance of your windows and doors, like ensuring the seal is tight, dealing with cracks
    c. Information about temporary defenses that can be used to protect your house, like sandbags, floodboards, house wrapping, and other flood barriers for domestic doors, vents, etc.
    d. Issues to consider if you are building a new house or an extension
    e. Ensuring the land around your house slopes down and away from your house
    f. Positioning eave troughs and downspouts
    g. Materials to have on hand so you are ready for a flood, like plywood, plastic sheeting, sandbags, sand, nails, hammer, shovel, bricks, blocks of wood, a saw
    h. Regular maintenance checklist
    i. Where to store valuable and sentimental items
4. **Section: Preparing for a Flood** – This section would cover topics to help people take preventative/protective measures to protect their home against flooding. Contents may include:
    a. How to prepare your house and improve the flood resistance of your house
    b. Temporary defenses
    c. How to flood proof if you are building a new home or an extension
    d. Materials to have in your home so you are prepared if flooding begins
    e. The need for regularly inspecting your home
    f. Where to store valuables
    g. How to prepare you refrigerator before a weather emergency, like freezing containers with water, transferring food from the fridge to the freezer to keep them safe longer, grouping food so it stays colder longer
    h. How to deal with food after a weather emergency

5. **Section: Your Family Flood Plan** – This section would cover what to do in case of a flood emergency. Contents may include:
    a. What type of emergency numbers you should have on hand, like friends and family, doctors, hospital, insurance company
    b. Contents of a flood kit, like a flashlight, warm and waterproof clothes, a battery or wind-up radio, rubber gloves, rubber boots, a first aid kit, multipurpose tool, whistle, copies of personal documents (e.g., insurance policies, identification, bank account information, stored in a waterproof container), keys, rain gear, and blankets or sleeping bags, dust masks, towelettes, garbage bags and plastic ties for sanitation
    c. Emergency supplies to have on hand, like a 3-day supply of water and non-perishable food, can opener, a cell phone with a charger, whistle, cash, medication, glasses, infant formula and diapers, bleach (to be used as a disinfectant with water and a medicine dropper), fire extinguisher, matches in a waterproof container, feminine and personal hygiene products, paper cups, plates and plastic utensils, towels, paper and pencil, books and games
    d. A list of essentials you will have to bring if you are evacuated, such as medication, baby food, diapers, a favourite toy, a change of clothes, etc.
    e. A list of special or sentimental items and where they are so you can move them to safety if there is a flood
    f. A list of gas and electricity shut offs and when to turn them off
    g. A prearranged place to meet
    h. How to get people out safely (including the elderly, young children, and people with disabilities)
    i. Practicing your flood plan
    j. Social insurance numbers, health card numbers
    k. In and out of town contact names and numbers
    l. Template for developing your own family flood plan
6. **Section: Advice for the Elderly or People with Disabilities** – This section would cover issues pertaining to ensuring the safety of the elderly or people with disabilities. Content may include:
    a. Pre-arranging accommodations for the elderly or people with disabilities in cases of emergency
    b. An escape plan and route
    c. A list of useful phone numbers, such as doctors, hospitals, special care services, a list of family and friends
7. **Section: Keeping Your Pet Safe** – This section would address how to ensure the safety of your pets in a flood situation. Contents may include:
    a. Ensuring a durable name tag with your name and phone number
    b. Supplies to have on hand in case of evacuation, such as a carrier, leash or harness, non-spill bowls, litter, food, medication.
8. **Section: How to Know if a Flood is Coming** – This section would help people learn if a flood is likely and how to act quickly and safely.
    a. Sources of weather reports
    b. Current weather information
    c. Sources of local water levels
    d. Tidal charts

9. **Section: What to do in the Event of a Flood** – This section would cover the actions that should be undertaken if flooding occurs. Contents may include:
    a. A reminder to check the family flood plan
    b. What should be done inside the house, like: moving valuable and other items to safety, rolling up carpets, moving furniture or emptying furniture that can't be moved, raising furniture on blocks, removing curtains, securing doors and cabinet doors, disconnecting electrical appliances, moving electrical appliances to safety
    c. Food and water supplies that you should have
    d. Getting ready to leave the house, e.g., warm clothes, rubber boots, and life jackets ready
    e. What to take with you, like warm clothes, rubber boots, life jackets, health cards, medication, cell phone, emergency phone numbers, flashlight
    f. What should be done outside your home, like: moving your car to higher ground, if possible, moving items outside to higher ground, moving chemicals/fuel to higher ground so they don't cause damage, weighing down manhole covers so they don't come lose, closing off flow valves from propane tanks, etc., unplugging outdoor electrical equipment, turning off external water supply taps, anchoring plants and trees, emptying gas powered lawn mowers, sandbagging sheds, harvesting ripened crops
10. **Section: Safety** – This section would cover safety measures to be taken if a flood occurs. Content may occur:
    a. How to move to safety and when to avoid using your car
    b. Where it is and is not safe to walk
    c. How to walk through shallow water and avoiding manhole covers and other places that can become dislodged
    d. Avoiding contact with flood water and sewage
    e. When to turn back
    f. Avoiding low spots
    g. Issues of contamination, like protective clothing that you may need, cleaning and protecting cuts and other wounds, what to do in case of injury
    h. Protecting people who are vulnerable, like women who are pregnant, children, the elderly, people with disabilities or people who are ill
    i. How to drive to safety
11. **Section: After the flood** – This section would cover what to do after a flood in terms of re-entry and immediate clean up. Contents may include:
    a. Health and safety risks in a post-flood environment (in your home/business or outside of your home/business)
    b. Basic health safety steps
    c. When you can re-occupy your house
    d. Protective gear to use
    e. Precautions to take when re-entering a property after a flood, including checking the power to ensure it is off, checking for gas or noxious fumes, ensuring the integrity of walls and ceilings, how to move heavy objects and debris, how to move around your property (and inside your home too), watching for animals, vermin, and vermin urine and feces, ensuring there is adequate ventilation
    f. When and how to remove items from standing water, how to drain water in stages

g. When and how to remove sediment, mud, and debris
h. When to pump your basement and how to ensure the ground is not oversaturated
i. How to disinfect after dealing with contaminated water and items
j. Recording the damage, including documenting with a camera and/or video camera, marking water levels on walls for reference
k. Getting the rest, nutrition, and support required to undertake cleanup
l. Documenting damage, in writing and with pictures, including times and dates
m. What you will need, a camera and/or video camera, tarps, hand sanitizer, tools (e.g., hammer, nails, a screwdriver, etc.), brooms, mops, scrub brushes and buckets, disinfectant, rubber boots, gloves, protective clothing, shovels, heaters, fans, dehumidifier, heavy duty garbage bags
n. How to remove standing water, like engaging a company or the fire department to pump out water, draining water
o. Maximum and minimum temperatures at which to heat/cool your home
p. How to clean and disinfect your home, like the type of detergent to use, how to clean hard to reach places, cleaning soft furnishings, how to clean and disinfect food preparation surfaces
q. How to dry out your property, like dos and don'ts, how to dry out your building, how to speed up the drying process, moving moisture trapping barriers, getting started early, how to increase air circulation, how to ensure good ventilation
r. Security issues, like closing windows and doors, locking your home when you are not there, covering broken windows or damaged doors
s. The lawn and garden, like how to salvage plants, rejuvenating the pond, aerating your lawn, dealing with vegetables and fruit
t. Dealing with mould
u. Dealing with sewage problems
v. Dealing with your septic system
w. Using bleach

12. **Section: Emotional Responses to a Flood** – This section might provide an overview of the psychological and emotional responses to a flood and how or where to seek house. Content may include:
    a. An overview of what you may experience
    b. Intrusive reactions
    c. Avoidance and withdrawal reactions
    d. Physical arousal reactions
    e. Reactions to trauma and loss reminders
    f. What helps
    g. What doesn’t help
    h. When to know if you need professional help
    i. Helping children after a flood
    j. Sources of assistance
13. **Section: Repair and Restoration** – This section might cover issues to consider when repairing damage from flooding and restoring service to your home. Content may include:
    a. Assessing damage, like noticing cracks, salty residue, checking walls, ceilings, and floor joists, removing flooring, swelling, testing for moisture
    b. Getting approval to proceed from your insurance company

c. Hiring a reputable contractor, like getting several quotes and asking for references
d. Cleaning glass, windows, locks and hinges
e. Checking insulation, determining if it should be removed and how to remove it safely
f. Preparing for redecorating, like removing wallpaper and other wall coverings, when to re-paint, replacing drywall
g. Checking for structural damage and noticing things like changes in the roof line, wall buckling, cracks, bulging
h. Keeping receipts
i. Ensuring your insurance company has approved of work
j. Restoration services, like getting an electrician to check your electrical panel, wiring, sockets, etc., checking appliances and fuel lines, how to flush the water lines and taps, and dealing with plumbing (toilet) blockages

14. **Section: Insurance** – This section might cover the insurance sector in general, and what to do regarding insurance in the event of a flood. Potential contents may include:
    a. Examining your insurance coverage
    b. Determining what insurance coverage is available
    c. Sources of flood insurance
    d. Insurance coverage dos and don'ts
    e. How flood insurance works
    f. A flood insurance claims handbook
    g. How to begin the insurance claim process
    h. Contacting your insurance company and filing your insurance claim
    i. Steps to undertake once you have reported your loss
    j. What to do before the adjuster arrives
    k. Appealing your flood insurance claim
    l. Managing your flood insurance claim
    m. What to keep until you get approval from your insurance company to get rid of refuse
15. **Section: Maps and Visualizations** – This section might include various maps and visualizations that would help homeowners. Perhaps these visualizations could also have a zoom feature so people could zoom in and see specific areas and see their properties and how they may be impacted. Potential content may include:
    a. Floodplain/flood zone maps
    b. Exit/escape routes
    c. A map of the dykes around the region
    d. Risks associated with the dykes
    e. Living behind the dykes
    f. 'How to' videos that could be used to inform and educate and even demonstrate the usage of emergency equipment such as a mask or fire extinguisher.
16. **Section: Checklists** – This section might include various checklists that could be printed off and used in family flood planning, during a flood emergency and in the post-flood recovery period. Potential content may include:
    a. Flood risk assessment checklist
    b. Flood protection checklist
    c. List of materials to have in your home in case of flooding
    d. Emergency and important phone numbers sheet
    e. Checklist of items that should be contained in a flood kit

f. Checklist of essential items to bring with you if evacuated
g. Checklist of the location of key points in your home like gas and electrical shut off points
h. Checklist of actions to be taken in the event of a flood for inside your home
i. Checklist of actions to be taken in the event of a flood for outside your home
j. Post flood damage documentation sheets
k. Questions to ask a contractor

17. **Section: Terminology and Facts** – This section might include various terminology, like:
    a. An explanation of what a floodplain is and other terminology
    b. What is meant by a 1 in 100 year flood, i.e., that it is a flood that has a 1% chance of happening in any given year; it is not a flood that will happen once in one hundred years
    c. Flood facts, i.e., facts can be used to poignantly emphasize certain concepts, types and causes of flooding, impacts of floods
    d. Information about the dykes, such as what is a dyke, how does a dyke work, what was the original purpose of the dykes, what the dykes are used for now
18. **Section: Research** – This section might include flood risk prevention, mitigation and adaptation efforts being undertaken in the region. Content may include:
    a. Recent research reports
    b. Statistics and scientific data
19. **Section: Emergency Measures** – This section might include information about the municipalities emergency measures protocol. Contents may include:
    a. The emergency measures policy.
    b. How the municipality will communicate with its citizens in times of emergencies.
20. **Section: Farming** – This section might include information particular to farmers. Content may include:
    a. Tagging of livestock
    b. Important phone numbers, such as veterinarians, animal care and control, department of agriculture contacts
    c. Ensuring animals have access to high areas
    d. Performing regular safety checks around the farm
    e. Removing barriers like fences
    f. Installing a hand pump and other measures to ensure your livestock has access to fresh water
    g. Identifying alternative power and water sources
    h. Securing items that can become floating projectiles
    i. Labeling and dealing with hazardous material
    j. What to do in the case of a flood, like dealing with machinery and equipment, moving livestock, securing buildings, tying down loose equipment or material, protecting your well
    k. What to do after a flood, such as dealing with dead animals, and how to protect yourself
    l. Rights and responsibilities of riparian landowners
21. **Section: Flood Mitigation and Adaptation** – This section might address what government at all levels as well as other entities like planning commissions are doing to address, mitigate and adapt to flood risk. Content may include:

    a. Government policies
    b. Planning principles
    c. Strategic plans
    d. Government contacts
    e. Zoning and by-laws
22. **Section: Renovating a Home in a Flood Zone** – This section could contain information for home owners who wish to renovate or build additions to houses situated in flood risk area. Content could include:
    a. Building code
    b. Permit requirements and procedures
    c. Restrictions
    d. FAQs
    e. Forms
    f. Links
23. **Section: Current Events and News** – This section could contain up to date information about the state of affairs or emergency situation. Content could include:
    a. News bulletins
    b. Evacuation orders
    c. Newsletters
    d. Questions and answers
24. **Section: Contacts** – This section could contain contact information for a variety of services, including:
    a. Municipal government contacts
    b. Provincial departments, such as at Agriculture, Aquaculture and Fisheries, Emergency Measures Organization, Environment and Local Government, Health, Office of the Premier, the Office of the Member of the Legislative Assembly for your area, Public Safety, Transportation and Infrastructure
    c. Federal departments, such as Agriculture and Agri-Food Canada, Environment Canada, Fisheries and Oceans Canada, Health Canada, Public Health Agency of Canada, Transport Canada
25. **Resources for Teachers** – This section would include pedagogical information that teachers could use to teach students about climate change and flood risks. This section could be tailored to different grade levels. Content could include:
    a. Lesson Plans
    b. Methods of assessments, such as tests and quizzes
    c. Assignment ideas
    d. Answer keys

Each of the aforementioned sections could also contain a frequently asked questions (FAQs) section, contain checklists, direct people to additional sources of information.

8. Summary Thoughts and Conclusions

8.1 The Literature Review

The literature review identified numerous elements that should be considered when communicating about climate change (in particular, flood risk, in the case of the focus of this research) to the public. Additionally, the literature review brought to the fore the numerous barriers and challenges that climate change communicators face when communicating about climate change.

In the literature there was also discussion about the potential benefits of visualizations. Benefits all pointed to how visualizations could convey the complex messages of climate change in an accessible way. At the same time, some caution about using visualizations was expressed and ethical considerations were put forth in order to ensure that visualizations are used to build public confidence and not cause panic.

The literature continually referenced the need to understand the impact of visualizations on changing behaviour. However, there was little reported research about this area pointing to the need for more research about how to use visualizations to promote attitudinal changes and adaptive behaviour, particularly at the individual level. Change at the local level on a broad scale will have global impacts. But only if individuals are equipped with the knowledge and tools to do so and only if the policy environment is such that it supports adaptation education and activities.

8.2 The Interview Results

Though not a representative sample, the key informant interviews nonetheless confirmed the results of the literature review and also brought to light several key local issues that impact communications about flood risk.

Though the sample of interviewees was small, the range of experience within that small group was considerable. From academics to government personnel to those working within the field of climate change mitigation, the sample proved to have a broad set of experience related to communicating about flood risk. At the same time, because the sample was not representative, it is difficult to know whether the views and opinions expressed during this interview process represent the views and opinions of the Tantramar community at large. Overall, however, the need to increase mitigation measures to protect the Tantramar region was echoed by all respondents. All recognized that the current dyke structure in the region is currently insufficient to protect the region, particularly the Town of Sackville, and that considerable more effort must be made in order to ready the region for a major flood event that was viewed to be 'just a matter of time'.

Interview informants felt that visualizations were an effective tool to communicate because visual imagery can convey a considerable amount of information at a glance. At the same time, and like what was reported in the literature, caution was raised about using visualizations alone without contextual information. Informants cautioned that discussing flood risk and the potential solutions to flood risk impact people considerably and that extra care should be taken to ensure that panic, fear, depression, and a sense of helplessness do not ensue. Visualizations should accompany adaptation solutions to help people deal with the implications of flooding (or whatever you are communicating).

They should also be personalized so that the impacts on the individual are clear. Visualizations should also respond to the issues that are important to the public.

Informants felt that word of the Tantramar Regional Adaptation Strategies Assessment Project is spreading. As a result, there seemed to be consensus that the flood scenarios should be made public. It was felt that people should be encouraged to learn about the increase in storm frequency. People have to be made aware that an increase in storm frequency equates to a higher flood risk and associated consequences. For example, several interviewees mentioned that people are still considering Lorne Street in Sackville as a site of future development. Yet, Lorne Street is in a low-lying area and floods almost annually (usually because of fresh water flooding) but it is also vulnerable to flooding due to sea level rise. Thus, while the flooding of Lorne Street seems to be widely known, the connection between the street flooding and the wider flood risk in the Tantramar Region does not appear to be. It was also felt that greater education should occur and that information should be integrated into workshops and public information materials to maximize awareness. Though, there was concern that the information should be released with contextual information so people can make informed decisions without being overtaken by fear. Information should be conveyed in such a way that people understand what they mean on an individual level and how much one will lose specifically. Concrete, localized, and personal examples should be used to engage the average person. Particular caution should be taken when going into areas that are going to be especially hard hit by a flood event.

At the same time, just because one relays the message of flood risk does not necessarily mean that people are going to use that information and stop building along the coastline or in flood plain areas. It was also noted that public meetings are not necessarily well attended; this impacts who learns about potential issues.

The other critical piece that was raised was the dykes. Every year the dykes erode. One interviewee noted that two years ago, on December 6, 2010, there was a bad storm and the dykes came within two inches of being breached. The sense was that, while not the complete answer, reinforcing the dykes was nonetheless important. Yet, recently, funding to maintain the dykes was cut at the provincial level. This suggests that at that level, the value of the dykes is not fully appreciated.

It was noted that Sackville has a sophisticated set of mapping tools while other communities do not. At the same time, there appears to be little understanding among the layperson (including municipal leaders, employees, etc.) of what this data actually means and what one can do with it.

Regardless of the tools that are available, there is a possibility of misuse or abuse. People who are communicating the message of flood risk need to be cautious about 'crying wolf' all the time. Otherwise, the community will be numb and will not want to hear about the issue anymore.

To overcome communication challenges, it is necessary to deliver in information in such a way so as to clearly explain what the probability of an event happening is and what the impacts will be. Moreover, information should be conveyed in terms that people can relate to. Scenarios should be localized and personal so that people can place themselves within them and see the impact on them directly.

A website may be a good place to convey information. It can contain a range of information and resources and can respond to specific questions. In terms of who might be responsible for such a webpage, it could be a joint undertaking among partners, spearheaded by the municipal government.

Local government was identified as the key driver of change. It was felt overall that local government is the entity to spearhead communications with the public and lobby on behalf of the community, particularly with other levels of government. It was also felt that local government bears the responsibility to explore, not only flood mitigation measures, but adaptation measures as well. The key informants expressed a desire for local government to formulate an adaptation plan and be proactive about dealing with flood risk in the Tantramar Region instead of waiting until a flood emergency occurs. It is important for municipal councils to organize and be proactive and to begin to lobby on behalf of the community. It is also imperative for the public to lobby decision-makers at all levels to come up with short, medium, and long terms actions and solutions that will begin to address the issues that communities are facing.

Yet, politically, there was a sense that there were constraints to how far one can talk about flood risk. For example, though information about flood risk had been communicated to town council, the issue of flood mitigation/adaptation did not become a public campaign issue. This suggests that people in the region are not particularly concerned about flood risk or potential emergencies or damages. However, it has yet to be determined whether or not this lack of concern is because people know about flood risk and are not worried about it or whether it is because people do not know enough about flood risk to be concerned about it. Anecdotal experience suggests the latter to be the case.

It was also felt that if municipal staff is evaluating infrastructure and know the infrastructure in flood risk areas, they should be fixing the infrastructure or redoing it in those areas. It was felt that staff needs to take it more seriously than they have. At the same time, policy must be established to allow them to do that and funding must be available as well. Staff (and government) seems to have the information about flood risk but does not appear to have made any decisions based on that information yet. Additionally, it was felt that the town requires at least a part time public outreach officer (perhaps as part of the emergency measures office) who is aware of flood risk and who can facilitate and coordinate information dissemination.

It was noted that supportive ways of working with people need to be developed. The community, as a whole, should reject the institutions and processes that are not currently working and replace them with new ones that will work. Then, we as a community need to focus on 'the saving work' and need to be 'actively engaged in our own solution making. We need to re-think the notion of community and undertake actions that support people as the infrastructure is reinforced. We need to undertake a collective response instead of letting people deal with situations on their own. The Tantramar Planning District Commission was identified as playing a role.

Interestingly, it was also suggested that to an intentional adult education approach is required. Information must be presented in variety of forms, such as in visual and auditory forms. One should also involve a strategic process that allows people to express themselves and work through their feelings and which provides people with a way forward. Thereafter, it will be incumbent on decision makers to take all that and move forward.

Some people do not have access to the Internet so alternative ways of communicating with people are required. Moreover, if the electricity goes out, people will not have access to the Internet so the Internet cannot be relied in an emergency per se.

It was also suggested that one should determine through dialogue with target audiences what people know and what they should know. Then, one can determine how to communicate with them and design visualizations around how people prefer to be communicated with. If visualizations are used well, one can check the audiences' pulse on whether they are engaged and what impacts the visualizations are having. In other words, allow for feedback on the visualizations as one works with target audiences.

This research has also revealed that there are many positive activities that are being undertaken currently. For example, current local research has reached valuable results around the use of visualizations to communicate flood risk communication. The Town of Sackville operations department is acutely aware of where the town sits in the flood zone and recognizes in principle the need to proactively plan so that it can undertake emergency measures swiftly and effectively. The Tantramar Planning District Commission also has a good understanding of the flood risk and has been effectively involved in the Tantramar Dyke Risk Project. Its past track record on numerous issues demonstrates that the Tantramar Planning District Commission is a valuable tool in organizing public meetings and informing the public.

8.3 Inventory of Climate Change Visualization Communication Tools

Visualizations appear to fall into two general categories: mathematical/scientific based visualizations, such as graphs and charts and maps, to name a few, or more popular media, such as video games, virtual world simulations, and photography. The way in which each type could be used, the content they could contain and the scenarios they could apply to are endless. How visualizations can be used is limited only by the bounds of one's imagination.

8.4 Toolkit Contents

The process of compiling the potential contents of a toolkit revealed that other jurisdictions have considerable experience dealing with floods and have produced numerous and excellent resources. These could be accessed in preparing for a flood and adapted to meet the needs of a particular region. Most notable resources are:

- Federal Emergency Management Agency (FEMA) (USA) (see disasters and maps section) (www.fema.gov)
- Office of Public Works (Ireland) (see flood risk management section) (www.opw.ie/en/)
- National Flood Insurance Program (USA) (www.floodsmart.gov/floodsmart/)

It would be beneficial to draw on what has already been accomplished and the lessons learned in other jurisdictions when developing a toolkit and/or any information pertaining to communicating to the public about flood risk.

8.5 Final Thoughts

The mandated focus for this research project was to investigate how visualizations can be used to encourage people to undertake climate change adaptations, particularly in relation to flood risk. A literature review was completed as were a set of interviews. An inventory of visualization ideas was compiled and the contents of a toolkit were proposed.

Visualizations are no doubt important and have, both in the literature review and as a result of the interviews, been confirmed as an indispensable tool for communicating flood risk. The impacts of an image should not be underestimated.

At the same time, focusing on visualizations alone would be too myopic. Visualizations are but one piece of the puzzle. Mitigating and adapting to flood risk requires a more wholistic approach. A 'big picture' focus would also consider where the issue of flood risk sits within the larger region geographically but also within the social, economic, and collective psyche of the community. It would consider how flood risk will impact and is interconnected with broader sustainability issues. There needs to be a broader understanding of what it means to be self-reliant and resilient. To that end, this research report concludes with a number of recommendations, as follows:

1. **Proactive local government** – Local government needs to be proactive in spearheading a flood risk adaptation strategy. This strategy should focus on the short and long term and should be carried over from administration to administration to ensure consistency in application.
2. **Local focus** – By taking a local focus, visualizations and other forms of communication along with strategic planning will have a greater likelihood of success of conveying messaging and accomplishing long term flood risk mitigation and adaptation.
3. **Strategic plan** – A definitive strategic adaptation plan that incorporates long and short term measures should be developed immediately and put into place so that the municipal government can begin to take proactive steps to communicate about and mitigate flood risk so that the community as a whole can begin to adapt collectively and individually.
4. **Communications strategy** – As part of the overall strategic plan, a communications strategy is integral to ensuring clear, consistent messaging and to making the best use of communications resources. Communications activities could include a range of undertakings, including a website, toolkit, making use of local radio, emergency preparedness, door-to-door campaigns, etc.
5. **Monitoring plan** – A monitoring plan should be established to analyze processes and activities as they proceed towards the goal of improving efficiency and effectiveness.
6. **Evaluation plan** – Each activity and process should be evaluated in terms of the strategic plan, goals and objectives, and deliverables.
7. **Emergency preparedness** – Emergency preparedness obviously requires having an emergency preparedness plan for the entire community. But it also means ensuring that individuals and families are prepared in the event of a flood event (or other emergency). The local government could facilitate this by spearheading the development, implementation and promotion of the emergency preparedness plan. The municipal government could also bulk purchase flood mitigation and emergency preparedness items that it could then sell to the public at cost. Bulk buying would lower the cost to individual citizens and increase the

municipality's buying power. Items that could be purchased in bulk could include floodboards, hydrabarriers, first aid items, thermal blankets, crank radios, and so forth.

8. **Education** – An education campaign should be undertaken to ensure that everyone understands the flood risk. In the Tantramar Region, for example, people need to understand the history of the dykes and how the Tantramar Region is situated within them. People who live in town need to understand how their homes and businesses will be affected in the event of a flood. They need to have information so they can make educated decisions about relocating or about making their dwellings and businesses as flood proof as possible. Most importantly, they also need to know about the flood risk so that they can stay safe and healthy. Loss of life must be avoided at all costs. An education campaign should begin at the local governmental level so that the municipal council fully appreciates the flood risk and then takes a proactive approach to strategically addressing the flood risk as much as possible.
9. **Meaningful engagement** – The public should be meaningfully involved in all facets of communicating flood risk. One should determine through dialogue with target audiences what people know and what they should know. Then, one can determine how to communicate with them and design visualizations around how people prefer to be communicated with. Throughout the process, one should check the audiences' pulse on whether they are engaged and what impacts the visualizations and other communications materials are having. Numerous strategies for engaging the public could be employed, from enlisting their participation on committees to asking individuals to facilitate kitchen chats.
10. **Community building** – Communities should develop a broader sense of the collective. Artificial divisions within communities that should be overcome so that they better see themselves as a network, an interconnected web.
11. **Personal Support** – People will need support and psychological and emotional resources should be available to them. There are also numerous low cost options as well. For example, locally, neighbourhoods could be encouraged to organize and hold block discussions so people can seek support among people in the same neighbourhood and talk amongst themselves and formulate plans. A buddy system could be organized where people living in the low areas are partnered with people in the high areas so they have somewhere to go if they need to evacuate.
12. **Community support** – On a larger scale, support may be found in other communities that are facing similar circumstances. Perhaps there is an opportunity to establish a 'twin community' project that pairs communities with similar challenges so they can share their knowledge and resources towards globalizing opportunities and solutions.
13. **Incentives** – People should be provided with incentives to act.

With efforts to ensure that a community is safe, by setting the bar to challenge communities to succeed, and with the support and information to enable proactive preparation and mitigation and adaptation measures, members of a community can work individually and collectively to look beyond the short term towards long term flood risk mitigation and adaptation solutions that benefit us all.

Appendix 1

Interview Questions

Tantramar Dyke Risk Project
Researcher: Lori Ann Roness
Department of Geography
Mount Allison University

Consent Form

I am an independent research consultant and Adjunct Professor working with Dr. David Lieske, Assistant Professor in the Department of Geography at Mount Allison University. This interview is part of a larger project that examines the use of visualizations to inform the public about the threat of flooding in the Tantramar Region, and to conceptualize possible solutions to this problem.

This study involves an interview guided by a series of interview questions (see attached). It is anticipated that the interview will take approximately one hour.

We do not anticipate any foreseeable risks or discomforts in participating in this interview. You should not expect any direct benefit from taking part in this study. By participating in this interview, you will be helping us to learn more about how to communicate with the public about flood risk and help build research around climate change risk communication.

Your participation is completely voluntary. You may withdraw from this study at any time without penalty.

All information obtained in this study will be kept strictly **confidential.** Your answers will be grouped (in aggregate) so no one will be able to trace your answers back to you specifically. However, your name, title, and organization will be listed as an interviewee in an appendix of the report. If you prefer that your name not be listed, please let us know.

I also understand that my words may be quoted directly. With regards to being quoted, please check yes or no for each of the following statements:

☐ Yes ☐ No	I wish to review the notes collected during my interview.
Researchers may publish documents that contain quotations by me under the following conditions:	
☐ Yes ☐ No	I agree to be quoted directly (my name is used).
☐ Yes ☐ No	I agree to be quoted directly if my name is not published (I remain anonymous).
☐ Yes ☐ No	I agree to be quoted directly if a made-up name (pseudonym) is used.

By signing this consent form, you are indicating that you fully understand the above information and agree to participate in this study.

Participant's signature: _____

Date: _____

Researcher's signature: _____

Date: _____

If you have any questions about this study, please contact Dr. David Lieske at 364-2315 or dlieske@mta.ca.

This research has been reviewed and approved by the Mount Allison University Research Ethics Board.

If you have any questions or concerns about this study, you may contact Dr. Nauman Farooqi, Chair of the Mount Allison University Research Ethics Board, by phone (364-2281) or by e-mail at reb@mta.ca.

Tantramar Dyke Risk Project
Researcher: Lori Ann Roness
Department of Geography
Mount Allison University

Interview Questions

Personal Experience

1. What is your personal experience with talking to the general public about the risks associated with climate change-induced flooding from sea level rise ('flood risk' from hereon in)?

2. If you have such experience, please discuss the audiences you have had contact with and the specific ways in which you communicated with them (e.g., writing a pamphlet, organizing a workshop).

Communication

1. What aspects of communicating flood risk worked well, i.e., what tools or messages appeared to successfully transfer knowledge and understanding about the problem, and encourage people to take action in some way?

2. What aspects of communicating flood risk didn't appear to work well?

3. What do you feel are the main challenges or barriers to communicating flood risk to the general public?

4. What aspects of communicating flood risk are the most confusing?

5. Were there any tools or materials you wish you had access to that you feel would have assisted you in communicating about the problem?

6. Are there aspects of communicating flood risk to the general public that make you uncomfortable or cause you concern?

Audience

7. Who should messages about flood risk be directed to? Who should people talking about flood risk be talking to?

8. Who do you perceive as the most vulnerable audience?

9. What is the best way to reach these audiences that you identified?

Message Communicators

10. For each target audience you identified, who do you think should be communicating about the issue of flood risk? Who should be delivering the messages?

11. Who is the best equipped to talk to each target audience you identified?

12. What advice would you give people responsible for communicating about flood risk?

13. What would you advise government in particular about communicating about climate change?

Visualizations in General

14. What is your opinion of the effectiveness of visualization techniques as a way to inform the public about flood risk, e.g., maps, animations, video, animations, PowerPoint, etc.?

15. What role do you think visualizations in general can play in addressing the hurdles you mentioned earlier?

16. What problems do you think visualizations can solve?

17. What problems do you think visualizations cannot solve?

18. What other kinds of visualizations would you recommend for communicating about flood risk?

19. Are there particular visualizations that you would use with certain audiences and not others?

Tantramar Dyke Risk Project

20. How well do you think the Tantramar Dyke Risk Project addressed these hurdles and/or concerns about communicating about flood risk?

21. What did you like about the visualizations used in the Tantramar Dyke Risk Project?

22. What did you not like about the visualizations used in the Tantramar Dyke Risk Project?

23. Are there any visualizations that should have been used in the project and were not?

24. Was there any information that should have been covered in the project that was not?

25. What else do you think the public in the Tantramar region needs to know about flood risk?

Toolkit

26. If you were making a toolkit about communicating about flood risk, what would you put in it?

27. How would you inspire people to act positively about flood risk without becoming fearful about it?

Additional Comments

28. Is there anything else you'd like to say about communicating about flood risk?

Thank you for your feedback!