Chippewas of Georgina Island
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Project Title: Climate Change Adaptation Planning within the Chippewas of Georgina Island First Nation Reserve

FINAL REPORT

As Year two of the Climate Change Adaptation Planning Project 2013-2014 comes to a close, we are happy to report that the objectives have been achieved.

Year two included the project initiation as well as five objectives:

- Objective One: Conduct vulnerability, risk and adaptive capacity assessment
- Objective Two: Research collection, and translation of regional climate data for Lake Simcoe Watershed
- Objective Three: Review western science to compare results of Lake Simcoe Vulnerability Assessments to TEK results
- Objective Four: Public Engagement
- Objective Five: Incorporate climate change into Georgina Island subwatershed planning

Project Initiation

Project initiation included two meetings, one with the project team and the other with the Advisory Committee to review year one results, discuss the objectives and deliverables of Year Two and the assignment of tasks and timelines.

Objective One: Conduct vulnerability, risk and adaptive capacity assessment

Objective One was conducted using the framework developed in Year One, drawing from the results of the TEK survey, and the expertise of the project team. The development of adaptation responses, an adaptation plan, and an implementation plan will occur in Year Three.
Five climate hazards were identified from the TEK survey which are believed to have the most impact for the Georgina Island First Nation Community:

- Extreme Precipitation
- Winter
- Wind

- Summer
- Drought

To help visualize the impacts identified from the TEK survey and help prioritize the impacts, the team developed Impact Trees for each climate hazard. In doing this, the project team was also able to categorize the impacts into groups using the headings identified within the TEK survey such as the impacts to transportation, creeks, water quality, flooding, etc. In addition, the impact trees were used to inform the community of climate risks as well as begin to engage the community in thinking about adaptive measures during the Community Engagement Workshop. Each impact tree was developed using the community member's feedback from the TEK Survey. The five climate hazards are the root of each impact tree attached to this report for your viewing (Appendix A). An example of one of the impact trees can be found below.

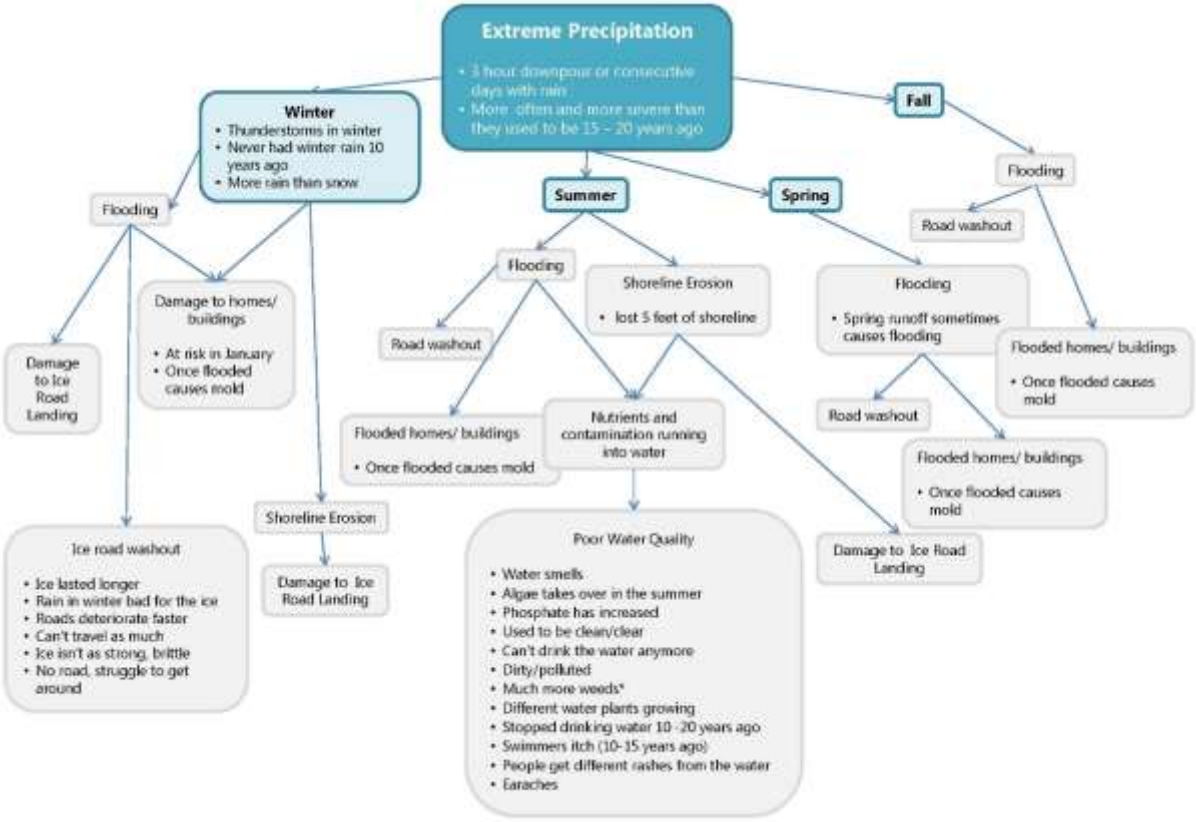


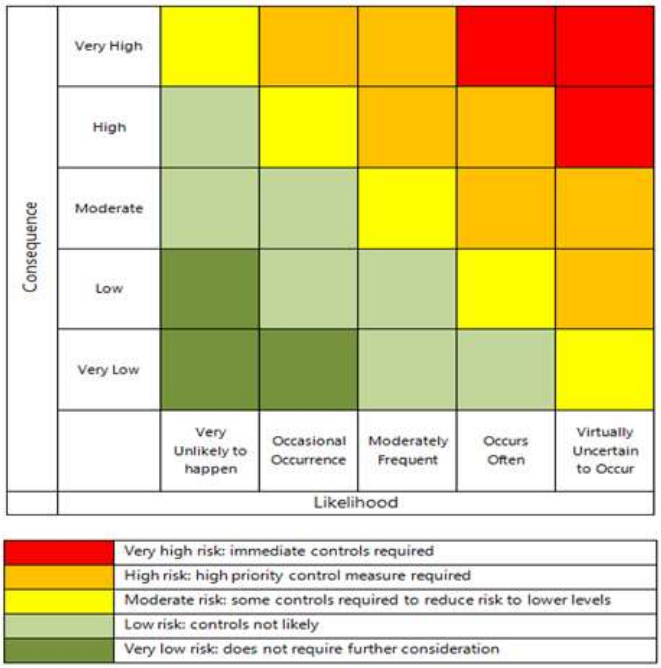
Figure 1: Extreme Precipitation Impact Tree

An Advisory Committee meeting was held where each impact tree was presented to the committee. The committee was tasked to prioritize which impacts were significant to the community. The impacts related to the top 2 priority areas were considered for the risk portion of the assessment. These charts are attached to this report as Appendix "B" and an example can be seen below.

Table 1: Prioritized impacts as determined by the Advisory Committee

Extreme Precipitation					
Vulnerability	**AC Member**	**AC Member**	**AC Member**	**AC Member**	**AC Member**
Poor water quality	1	1		1	
Flooding	2	2			
Shoreline erosion	3			2	
Road washout		3		3	

The development of the Impact trees required larger engagement from the project team for support on data and information to ensure and/or rationalize the link to climate change. Responses were noted and used to help further the vulnerability, risk and adaptive capacity assessment.



The prioritized impacts were used in the risk portion of the assessment. The project team chose the time horizon of the 2050s (2041 – 2070) as the planning period, using projections of climate change for Ontario and the Lake Simcoe area, and estimated the likelihood and the consequence of the current impact if changes continued into the future. Estimates of likelihood and consequence were used to further prioritize the impacts identified from the TEK and Advisory Committee, and results were mapped in a risk matrix (Appendix C).

Figure 2: Example of a Risk Matrix

Objective Two: Research, collection and translation of regional climate data for the Lake Simcoe Watershed

This involved collecting climate data for the Lake Simcoe Watershed. The historic and projected climate data was collected and translated into easy-to-read format. Historical temperature and precipitation data for Shanty Bay, ON was collected, treated and plotted in graphs to determine the historic trend. Future climate projections were obtained from Environment Canada's Climate Change Scenarios Network Ensemble Projections, as well as downscaled projections by Huang, Gula, and Peltier. These projections were used to evaluate future climate risks. Both historical and projected climate data was summarized in a report and were used later to determine the continuance of trends for key areas of impact. More detailed climate data is in the Climate Change Vulnerability and Adaptation Planning Framework - Workbook attached to this report as Appendix "F". This document is a working document and is currently in draft form and will not be finalized until the conclusion of the project.

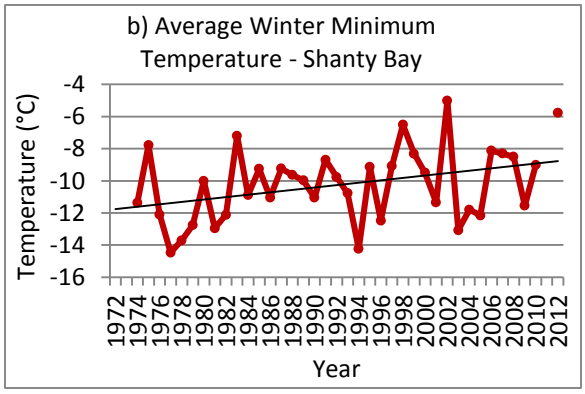


Figure 3: Example of trend for winter minimum temperature for Shanty Bay, Ontario

Objective Three: Review western science to compare results of Lake Simcoe Vulnerability Assessments to TEK results

The results of the Lake Simcoe Vulnerability Assessments and the TEK results were reviewed and areas of concurrence in both of these analyses of climate change impacts were highlighted. The results were summarized in table form. This side-by-side assessment of TEK and western science is unique and reinforce the areas of risk for The Community.

Objective Four: Public Engagement

Year Two included two community meeting/workshops.

The first community meeting was held to introduce Year Two of the project to the community. The meeting provided an overview of the project objectives. A total of 37 community members were in attendance.

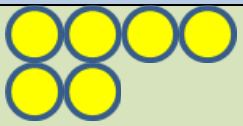
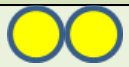
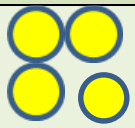
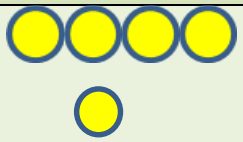
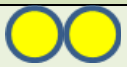
The second meeting was an interactive workshop and involved communicating the results of the vulnerability and risk assessment. Please note that workshop was originally scheduled for late February 2014, but due to unforeseen circumstances had to be postponed to April 10, 2014.

The project team, in collaboration with the Advisory Committee, organized this interactive workshop to present some of the results of the vulnerability and risk assessment and how the results of the TEK survey translated into risk. Results were shared through presentations and posters. This workshop was interactive and participants were asked to assess consequence and provide comments on the vulnerability and risks.

The project team chose the time horizon of the 2050s (2041 – 2070) as the planning period using projections of climate change for Ontario and the Lake Simcoe area, and estimated the likelihood and the consequence of the current impact if changes continued into the future. For the interactive workshop, community members were asked to think about the future and the consequences of climate change, and provide this input, as well as comments, into a Consequence Chart. The Consequence Chart was based on the five climate hazards: Extreme Precipitation, Winter, Wind, Summer, and Drought, and the prioritized impacts identified by the Advisory Committee. On the Consequence Chart community members were asked to estimate consequence by putting a dot under the appropriate "how bad" consequence for each of the impacts (see example below). Results are attached as Appendix "D"

Table 2: Example of Consequence Chart from the interactive workshop

How bad would it be for TRANSPORTATION on and off the Island if WIND was stronger and stronger wind happened more often?

		How bad will it be into the future?			
Impacts happening now or could happen now		Not Bad at all	Somewhat bad	Bad	Very Bad
Transportation	• Using the Scoot Less				
	• Ice pile-up				

The workshop had 66 community members attend. Community members were divided into 5 groups and each group was asked to estimate the consequence of the impacts for each of the five climate hazards. Feedback sheets were also given to community members in which 47 were

completed with additional comments and concerns documented for the future of Georgina Island.

Figure 4: Community Members in attendance for final Year Two Interactive Workshop

Objective 5: Incorporate climate change adaptation into subwatershed planning

The Georgina Island First Nation is currently developing a subwatershed plan with the Lake Simcoe Region Conservation Authority that will incorporate climate change impacts and adaptation. This plan will include all of the First Nations Lands (Snake, Fox and Georgina Island as well as both mainland Marina's). The TEK survey results, historical and future (projections) climate data, and the vulnerability and risk assessment, will be used and incorporated into this plan. Discussions are currently underway between Georgina Island First Nation, the Lake Simcoe Region Conservation Authority and the Ministry of Environment to begin the process of assembling all the data for the plan. Developing a subwatershed plan for an Island is a new process for all involved and the inclusion of climate change at the beginning of the process, enabling climate change to be mainstreamed into the plan is also something that has yet to be conducted. The draft work plan for this project has been attached for your review as "Appendix "E".

In conclusion, the community engagement has been a crucial element of this project. The Advisory Committee and the Community as a whole have broadened their knowledge of the impacts and vulnerabilities the community faces in regards to Climate Change and our way of life on the Island into the future. There has been great interest and involvement from the Community over the past two years for this project which is imperative for a project such as this as we head into Year Three. Ensuring that the plans and strategies that will be developed over the next year for the risks that have been identified by the Community will be implemented by the community depends a great deal on the acceptance from the Community.

Climate Change Adaptation Planning within the Chippewas of Georgina Island First Nation
Final Budget 2013-2014

	Approved Budget	Spent as Dec.31	Spent as March 31	Difference
Salaries & Wages	$52,000.00	$24,225.36	$27,774.64	$0.00
Travel, Accommodation, & meals	$3,500.00	$1,838.09	$1,661.91	$0.00
Training /Workshops	$5,800.00	$1,716.09	$4,083.91	$0.00
Professional Services	$52,500.00	$26,250.00	$26,250.00	$0.00
Communication	$700.00	$0.00	$700.00	$0.00
Audit & Evaluation	$8,000.00	$0.00	$8,000.00	$0.00
Office supplies & Equipment	$3,000.00	$1,377.13	$1,622.87	$0.00
Printing	$1,000.00	$0.00	$1,000.00	$0.00
Community Information Initiative	$0.00	$0.00	$0.00	$0.00
Data Collection, Analysis, Reporting	$1000.00	$40.06	$959.94	$0.00
Administration Costs	$22,500.00	$0.00	$22,500.00	$0.00
Total	$150,000.00	$55,446.73	$94,553.27	$0.00

Appendix A

Impact Trees:

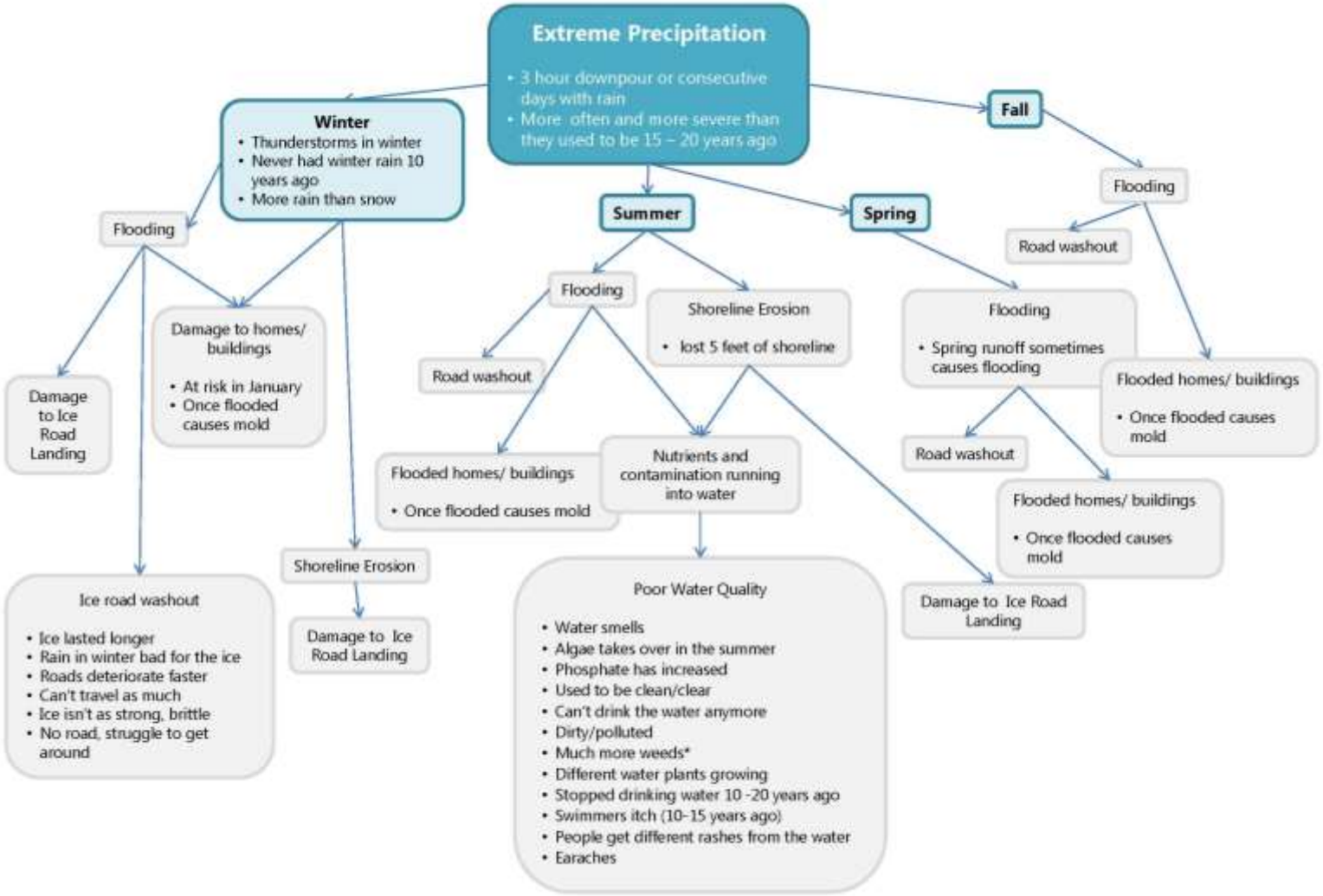


Figure 5: Impact Tree for Extreme Precipitation

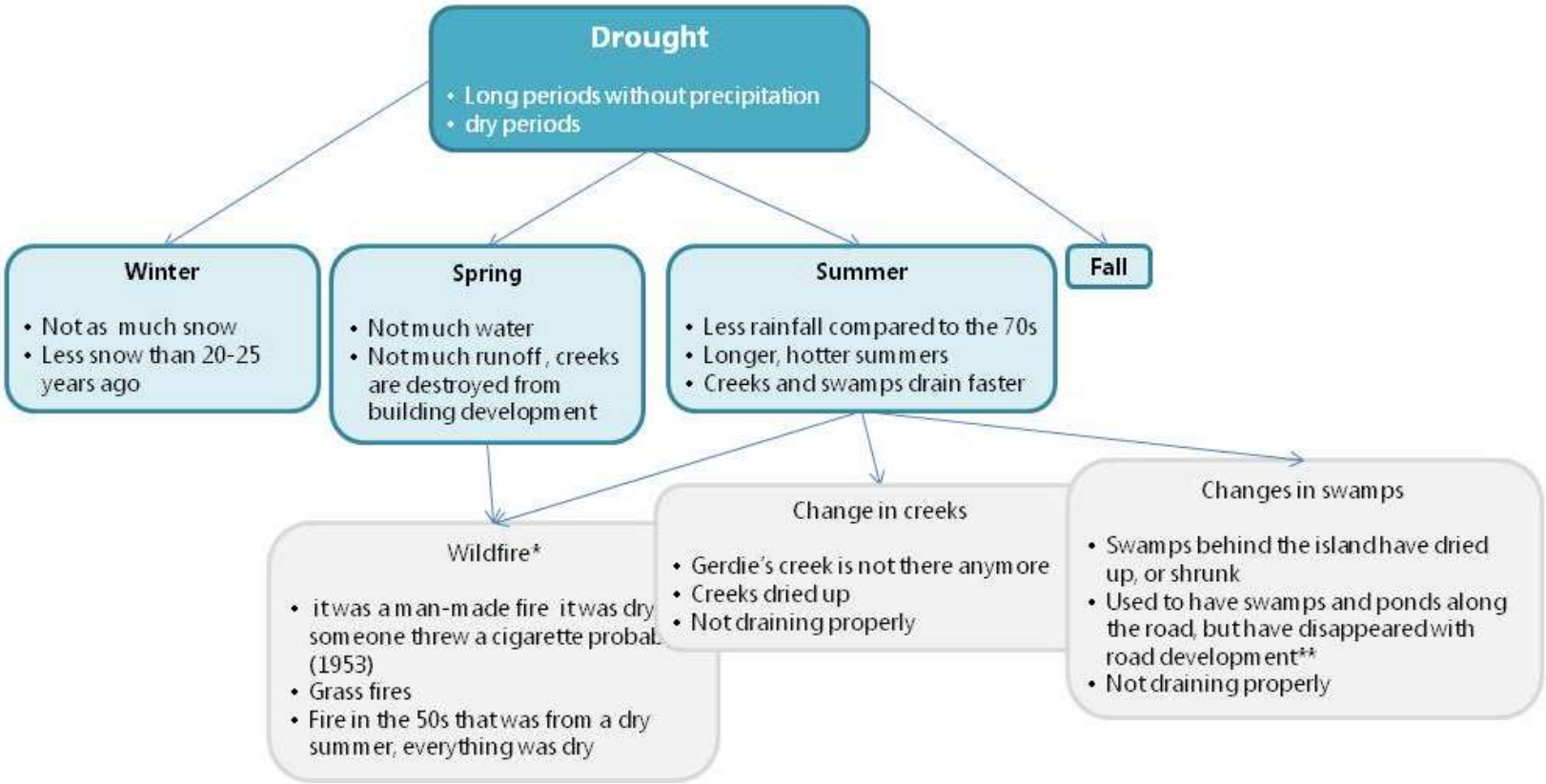


Figure 6: Impact Tree for Drought

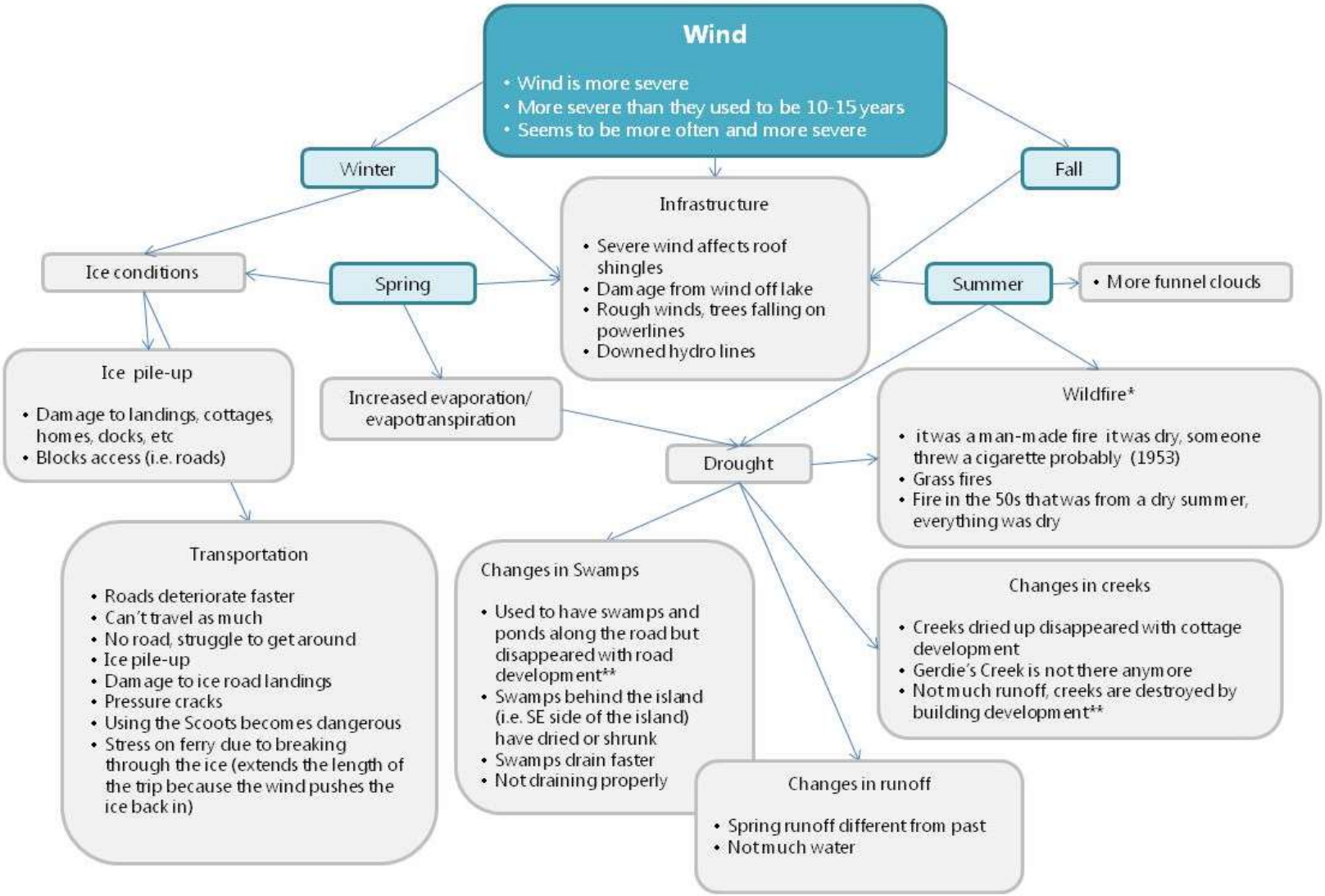


Figure 7: Impact Tree for Wind

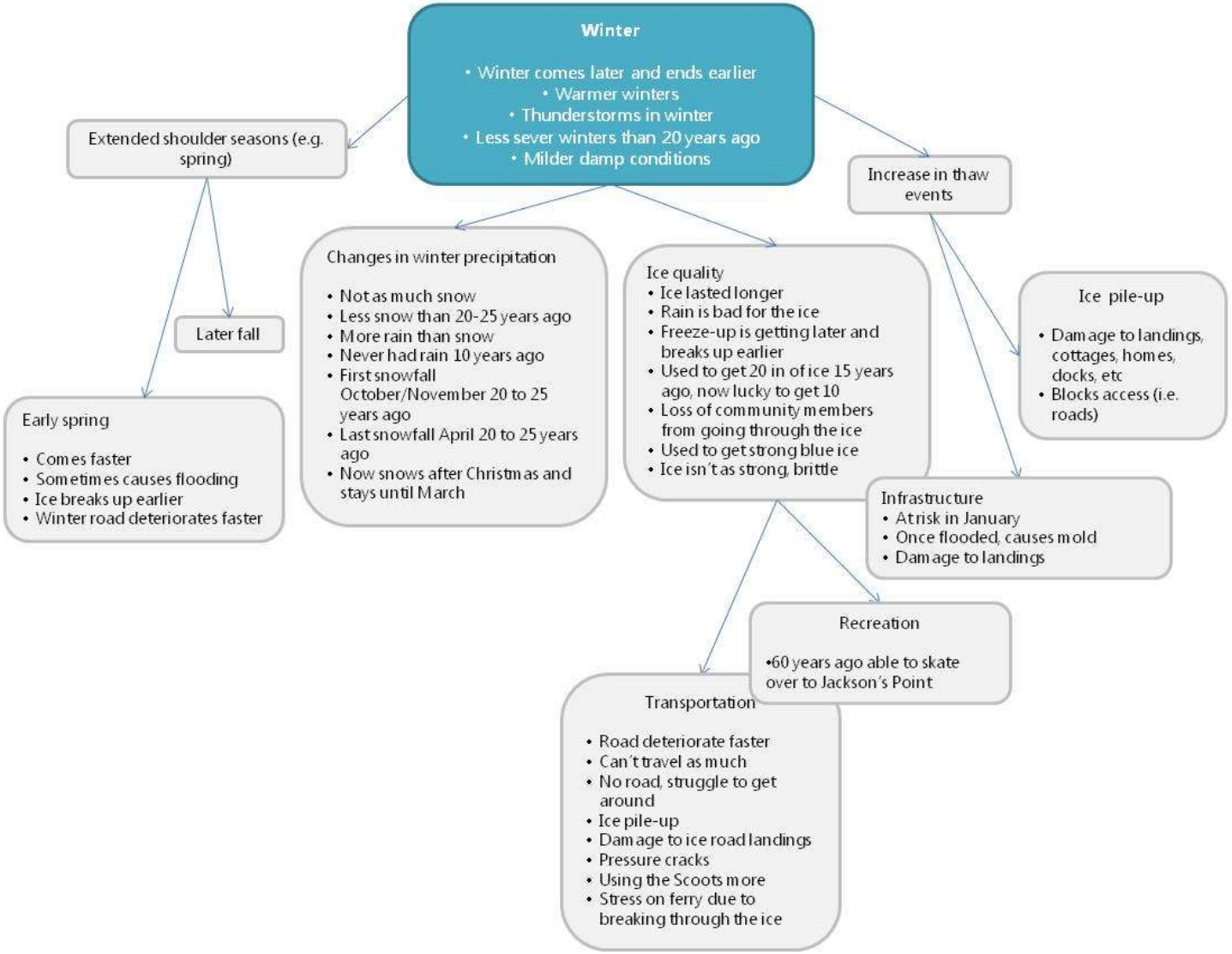


Figure 8: Impact Tree for Winter

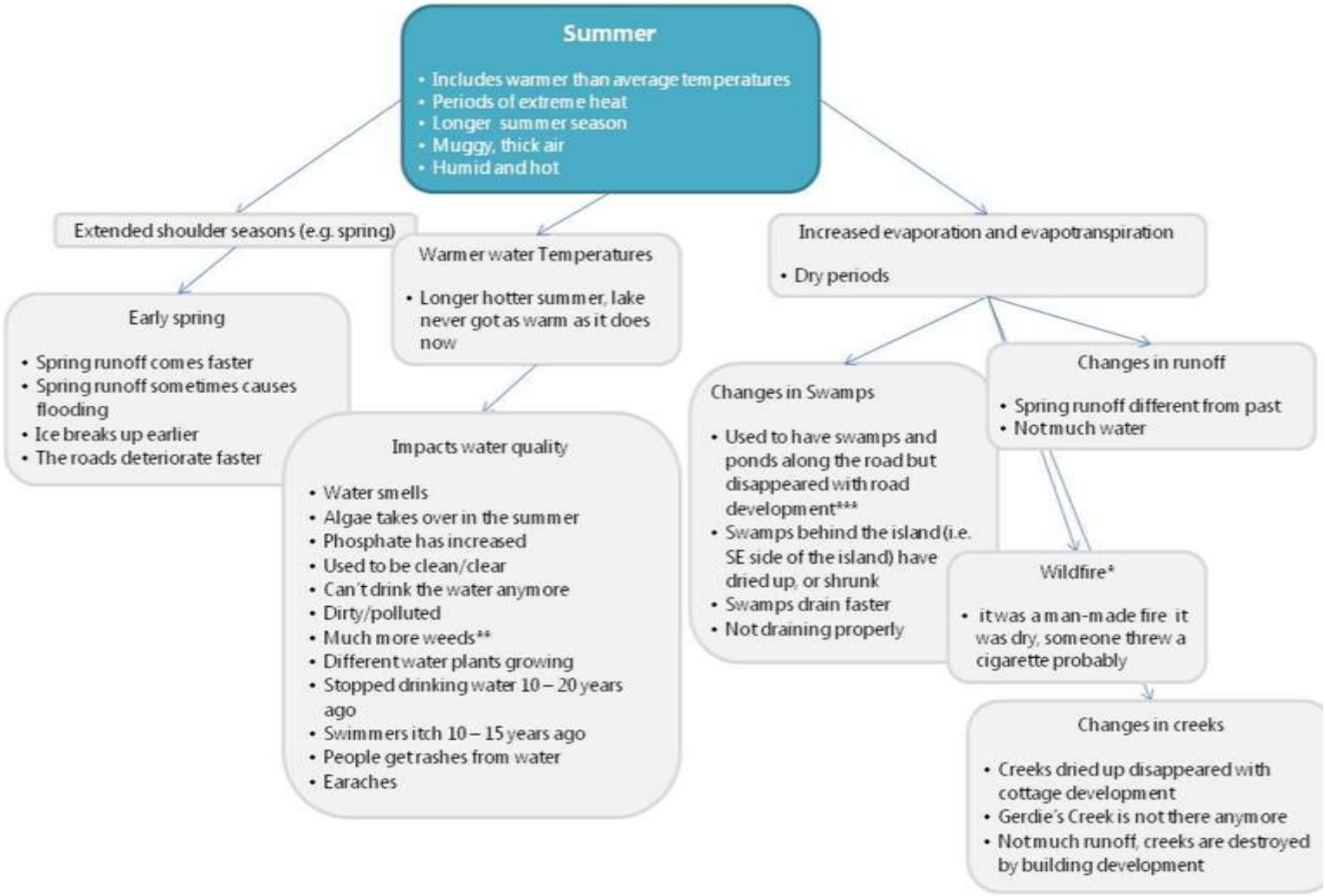


Figure 9: Impact Tree for Summer

“APPENDIX B”

ADVISORY COMMITTEE MEETING –Thursday, January 23rd, 2014

Attendees:

1. Leanne Echum
2. Lenora Charles
3. Jamie Bellerose *(guest w. Lenora Charles)* *– Previously lived on the island back when she was 7 or 8 and just moved back in November. (**Not** an Advisory Committee member therefore, response not noted)*
4. Jared BigCanoe
5. Tammy Charles
6. Heather Charles
7. Ellie Big Canoe

Response to Impact Trees:

Each member was asked to thoroughly look through each "tree" and prioritize which vulnerability impacts the community the most.

Winter

Vulnerability	AC Member	AC Member	AC Member	AC Member	AC Member
Transportation	1			1	
Ice Quality	2			2	
Changes in winter precipitation	3				
Early Spring				3	
Recreation				4	

Wind

Vulnerability	AC Member	AC Member	AC Member	AC Member	AC Member
Transportation	1			1	
Wildfires	2		1	2	
Drought				3	
Changes in swamps				4	

Drought

Vulnerability	AC Member	AC Member	AC Member	AC Member	AC Member
Changes in creeks	1			2	
Wildfires	2			1	
Changes in swamps				3	

Extreme Precipitation

Vulnerability	AC Member	AC Member	AC Member	AC Member	AC Member
Poor water quality	1	1		1	
Flooding	2	2			
Shoreline erosion	3			2	
Road washout		3		3	

Summer

Vulnerability	AC Member	AC Member	AC Member	AC Member	AC Member
Impacts water quality	1	1		1	
Changes in swamps	2	2		2	
Changes in creeks	3	3			
Early spring		4		4	
Wildfire				3	

APPENDIX “C”

Risk Matrix Results

Table 3: Risk Evaluation Matrix Results – Changes in Winter

Consequence						
	Very High			• Transportation: Road deteriorating faster • Transportation: Damage to ice road landings		
	High			• Transportation: Pressure cracks		
	Mod-erate			• Transportation: Stress on ferry due to break through ice • Ice Quality: Loss of community members through ice	• Ice Quality: thinning	
	Low		• Ice Quality: Ice lasted longer		• Ice Quality: Freeze-up getting later and breaking up earlier	
	Very Low					
		Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Uncertain to Occur
		Likelihood				

	Very high risk: immediate controls required
	High risk: high priority control measure required
	Moderate risk: some controls required to reduce risk to lower levels
	Low risk: controls not likely
	Very low risk: does not require further consideration

Table 4: Risk Evaluation Matrix Results – Wind

Consequence						
	Very High	• Wildfire				
	High					
	Mod-erate				• Transportation: Using scoots less	• Transportation: Ice pile-up • Transportation: stress on ferry due to breaking through the ice
	Low			• Transportation : damage to ice road landings • Transportation : pressure cracks		
	Very Low					
		Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Uncertain to Occur
		Likelihood				

	Very high risk: immediate controls required
	High risk: high priority control measure required
	Moderate risk: some controls required to reduce risk to lower levels
	Low risk: controls not likely
	Very low risk: does not require further consideration

Table 5: Risk Evaluation Matrix Results – Drought

Consequence						
	Very High		• Wldfire			
	High					
	Mod-erate			• Creeks not draining properly		
	Low			• Creeks drying up		
	Very Low					
		Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Uncertain to Occur
		Likelihood				

	Very high risk: immediate controls required
	High risk: high priority control measure required
	Moderate risk: some controls required to reduce risk to lower levels
	Low risk: controls not likely
	Very low risk: does not require further consideration

Table 6: Risk Evaluation Matrix Results – Extreme precipitation

Consequence						
	Very High		• Poor Water Quality: Heath issues		• Flooding – spring runoff sometimes causes flooding	
	High		Poor Water Quality: • algae taking over in summer • drinking water (stopped drinking water 10-20 yrs ago; can't drink water anymore) • more weeds • different water plants growing	• Poor Water Quality: water smells, used to be clean and clear, dirty/polluted		
	Mod-erate					
	Low			• Flooding: road washouts • Flooding: homes/buildings (mold)		
	Very Low					
		Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Uncertain to Occur
		Likelihood				

	Very high risk: immediate controls required
	High risk: high priority control measure required
	Moderate risk: some controls required to reduce risk to lower levels
	Low risk: controls not likely
	Very low risk: does not require further consideration

Table 7: Risk Evaluation Matrix Results - Changes in Summer

Consequence						
	Very High		Impacts to Water Quality: • Health issues			
	High		Impacts to Water Quality: • Drinking water (stopped drinking water 10 – 20 years ago, can't drink water anymore) • Much more weeds	Impacts to Water Quality: • water smells, used to be clean/clear; dirt/polluted • algae taking over in the summer		
	Mod-erate		Impacts to Water Quality: • different water plants growing Changes in swamps: • swamps behind island have dried up or shrunk • swamps draining faster • swamps not draining properly			
	Low					
	Very Low					
		Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Uncertain to Occur
		Likelihood				

	Very high risk: immediate controls required
	High risk: high priority control measure required
	Moderate risk: some controls required to reduce risk to lower levels
	Low risk: controls not likely
	Very low risk: does not require further consideration

APPENDIX “D”

Results of Community Interactive Workshop – April 10, 2014

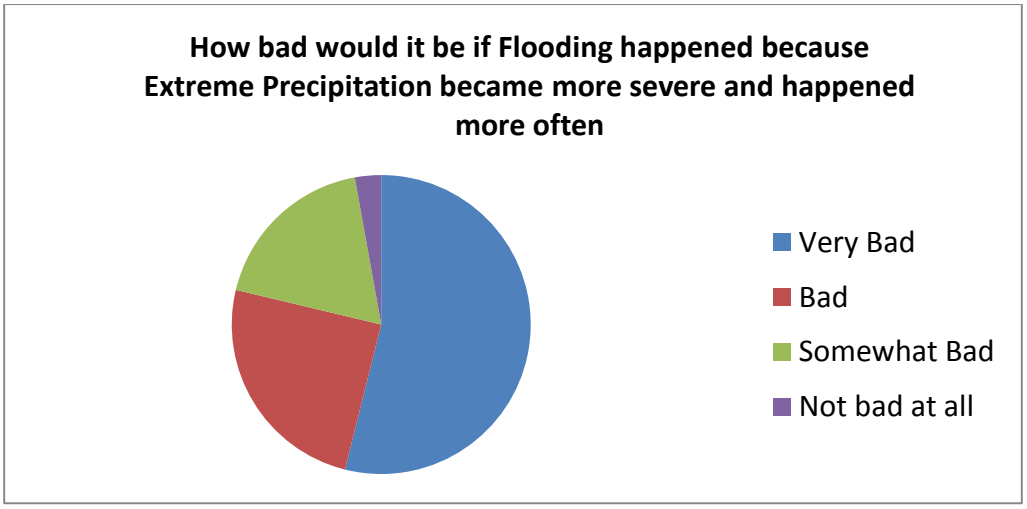


Figure 10: Extreme Precipitation Climate Hazard consequence input from workshop

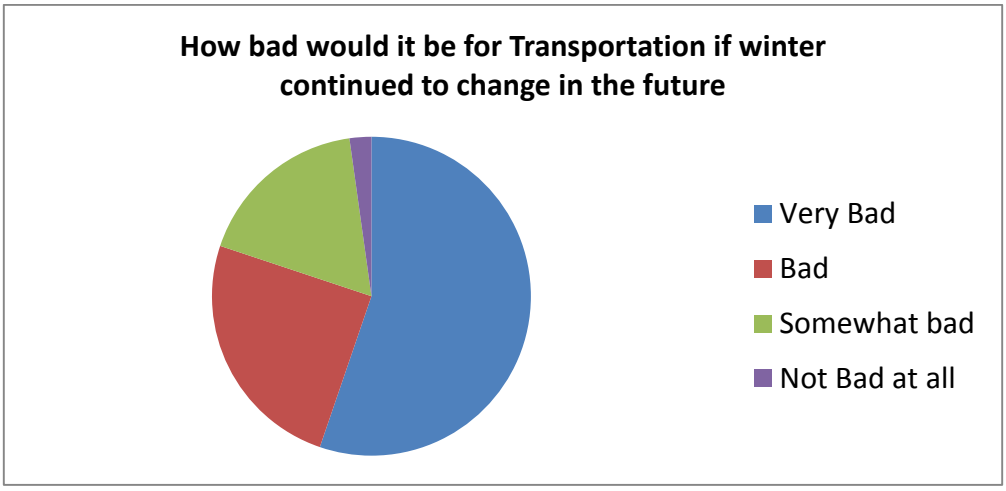


Figure 11: Winter Climate Hazard Input consequence input from Workshop

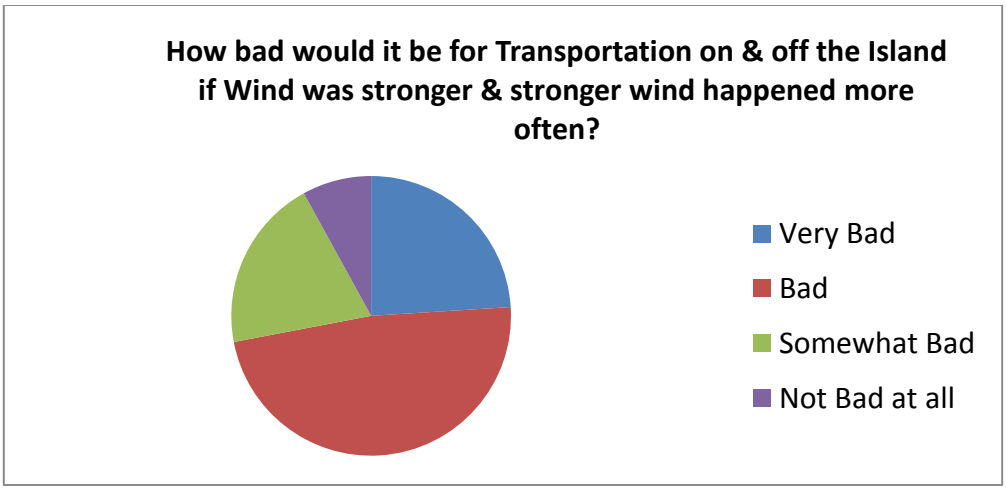


Figure 12: Wind Climate Hazard consequence input from workshop

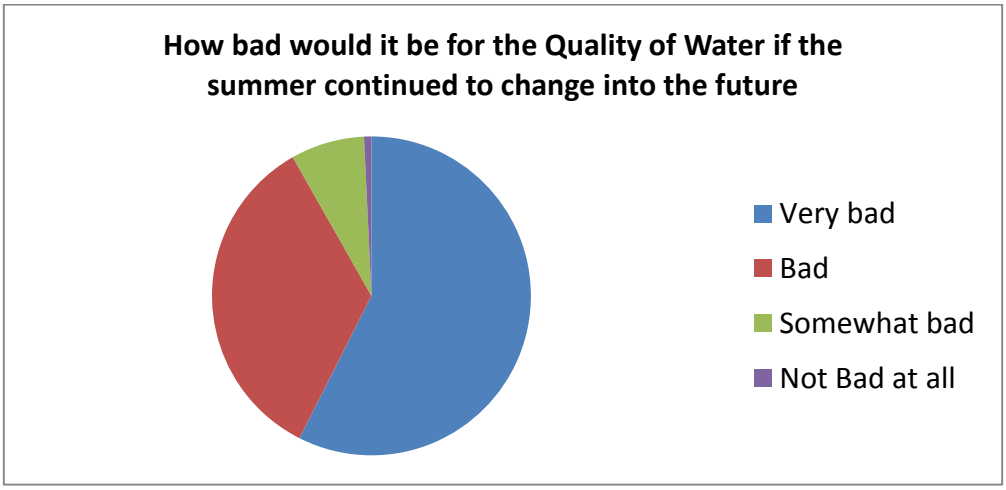


Figure 13: Summer Climate Hazard consequence input from workshop

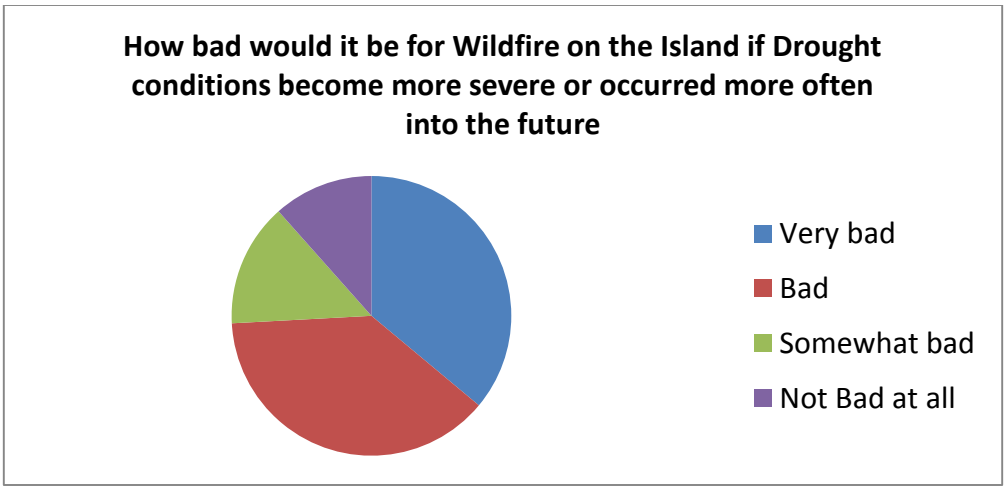


Figure 14: Drought Climate Hazard consequence input from workshop

APPENDIX "E"

Business Case – Georgina Island First Nation Subwatershed Plan
Draft for discussion – March 24, 2014

Description

Subwatershed plans have become a primary mechanism for implementing the Lake Simcoe Protection Plan. These plans, based on an ecosystem approach to environmental management, evaluate the current environmental conditions and the associated stressors, and include recommendations for implementation to protect and improve the health of the subwatershed area and the lake. Previous subwatershed plans have been completed for the river systems draining the land area around the lake, as these were seen as the ecologically relevant spatial units, interconnected through the flow of water from the headwaters to the lake. While not the typical area of study for a plan of this type, the lands of the Georgina Island First Nation also represent an ecologically relevant spatial unit for developing a similar plan, being suitable in size, consistent in land uses and management, and all draining directly to the lake.

The objective of this project is to prepare a subwatershed plan and associated implementation plan for protecting and improving the health of the islands and land of the Georgina Island First Nation (GIFN); namely Georgina Island, Fox Island, Snake Island, and two mainland access points.

Purpose

Policies 8.1 to 8.4 of the LSPP require subwatershed evaluations be completed for all priority subwatersheds within the Lake Simcoe Basin. Policies 8.1 through 8.3 state that guidelines and approaches for the development of subwatershed plans, as well as the plans themselves, should be developed in collaboration with LSRCA, First Nations and Metis communities, municipalities, MOE, MNR and OMAF.

The subwatershed plans will include a series of recommendations that have the overall intent of helping to restore and protect the health of the subwatershed and Lake Simcoe. Plan recommendations will address a broad range of issues such as stormwater management, stewardship, construction practices and environmental monitoring. Through preparation of implementation plans, priority recommendations can be acted upon at a subwatershed scale, and assist the GIFN in improving the environmental sustainability of band policies and operations.

As the subwatershed plans are produced in collaboration with GIFN, Provincial agencies and community groups, they are an ideal vehicle for progressing on the ground implementation in a coordinated fashion.

Background

The Lake Simcoe Region Conservation Authority has been developing subwatershed plans for a number of years. Initially these plans were developed opportunistically, and then under the requirements of the Oak Ridges Moraine Conservation Plan, for those subwatersheds falling under that plan. The Lake Simcoe Protection Plan, released in 2009, requires that LSRCA complete subwatershed plans for all priority subwatersheds. To date, nine subwatershed plans have been completed under this program.

A plan has not yet been developed for the Georgina Island First Nation lands, including Georgina, Snake and Fox Islands. There have, however, been a number of studies completed for the islands over the past several years, which would contribute to the development of a subwatershed plan. These include a forest management plan, species at risk assessment, wetland assessments, fish habitat management

studies, and a geology study. The GIFN is also entering into the third year of a three-year climate change study with partners at the Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR), which incorporates the traditional knowledge of members living on the island, describing changes that have been observed on the islands and in the lake, alongside observations from western science. These studies will form an integral part of the subwatershed plan.

This subwatershed plan provides the ideal mechanism for incorporating the above-mentioned studies, and the additional monitoring work to be completed in Phase 1 of the study, and for implementing the findings and recommendations of the climate change study. The Georgina Island First Nation is progressive on environmental issues, and have developed and implemented numerous plans and policies related to these issues. This interest in the environmental health and sustainability of the GIFN lands and Lake Simcoe makes this an ideal system on which to complete this subwatershed plan.

Outcomes

The subwatershed plan will provide a summary of the current conditions and stresses impacting the GIFN lands and waters. This will be the first island-scale assessment of this type, building upon existing knowledge of the environmental conditions and stressors on the GIFN lands, and will therefore be a valuable resource on matters related to water quality, water quantity, terrestrial and aquatic natural heritage in the area. The incorporation of the traditional ecological knowledge possessed by the GIFN will be unique to this subwatershed plan, and will help to ensure a more complete characterization of the study area.

This project will result in development of a series of recommendations established to help in the protection and restoration of the subwatersheds. Following the approach established for Barrie and Innisfil subwatershed plans, a supporting implementation plan will be developed that identifies the actions and milestones to actualize the recommendations. An implementation workgroup will formed to help monitor and report on implementation.

Key Deliverables/Outputs

Work will be completed for all GIFN lands: Georgina Island, Snake Island, Fox Island, and two mainland access points at Virginia Beach Marina and Island Grove Marina.

This project will include:

i. <u>Subwatershed characterization</u>
This will include a review of available studies and plans for the GIFN lands and additional monitoring work such as water quality sampling; instream benthic invertebrate and fisheries assessments; assessment of terrestrial natural heritage features, including a detailed shoreline survey, assessment of invasive species, and breeding bird and amphibian surveys; survey of agricultural practices; identification of salt vulnerable areas; and an assessment of practices at the two GIFN marinas (for discussion)

ii. <u>Development of subwatershed plan</u>
The subwatershed plan will be developed based on the draft guidelines prepared in accordance with Policy 8.1-SA of the LSPP. The work will be completed by the LSRCA and GIFN, in partnership with staff at OCCIAR. A working group will be established that includes key water management stakeholders, including the GIFN, the Ministry of the Environment and the Ministry of Natural Resources. The workgroup will ensure the subwatershed plans reflect requirements and local issues, peer review information provided, and assist in preparation of

the recommendations. The working group will meet approximately every two months during the course of the project. The information, analyses, findings and recommendations will be set out in the subwatershed plan document. Public consultation on the plan will also be undertaken and will include both resident and non-resident band members, as well as seasonal visitors.

iii. Implementation Plan

An implementation plan will be developed based on priority recommendations within the subwatershed plan. The implementation plan will include activities, milestones, and timelines required to complete the recommendations. The process of preparing the implementation plan will be similar to the subwatershed plan, ensuring input from the workgroup on the plan's content, and an opportunity for public review and comment.

iv. Public Access to (Data, Mapping, and Reports)

Once finalized, the subwatershed plan will be available to the GIFN, municipalities, other government agencies, industry practitioners and the public via the internet, pursuant to established LSRCA information sharing procedures.

Partners

Lake Simcoe Region Conservation Authority – staff, monitoring equipment and analysis

Georgina Island First Nation – staff,…

OCCIAR – staff, …

Ministry of the Environment – staff, funding

Ministry of Natural Resources – staff

Others TBD

Phasing

Phase 1 – Scoping and information collection (2014)

Work to be undertaken using LSPP funding ($30,000)

- Review available information and general subwatershed planning needs
- Identify knowledge gaps
- Develop and implement monitoring plan. For example:
    - Refinement of shoreline inventory (dependent on LSGBCUF application – as low as $2000 if we receive funding, to ~$3500 if we use a summer staff + full time staff)
    - Vegetation/invasive species inventory (various options ranging from $3000-$10000)
    - Breeding bird and amphibian surveys (GIFN to undertake?)
    - Water quality (assume six samples – wet + dry for three watercourses, plus two ½ days of sampling – approximate cost = $3000 (samples, staff time, transportation)
    - Fisheries, benthic invertebrates, temperature – three sites (one on each watercourse) for site setup, sampling, equipment, and analysis. Approximate cost = $3500
    - Others TBD
- Review of previously completed reports and extraction of relevant information = $3800

[Remaining funding to be allocated based discussions around work to be completed in support of the plan]

Phase 2 – Plan and recommendation development (January 2015-early 2016)

Funding to be determined (LSPP, OCCIAR/GIFN funding applications)

- Convene subwatershed plan working group
- Pull together all available information and incorporate into plan (current state and stressors section of plan)
- Undertake consultation with working group and community members, including band members living both on and off the reserve as well as seasonal visitors, to identify issues that may not have been evident through review of existing information
- Complete plan chapters, develop recommendations and review with working group
- Prioritize recommendations and develop implementation plan in collaboration with working group members, others as necessary

Timing

Phase 1

March-May 2014

- Project scoping
- Identify information gaps
- Develop plan for filling gaps
- Funding applications

May-October 2014

- Undertake monitoring work
- Potential review of existing studies

October-December 2014

- Data analysis
- Continued review of existing studies
- Develop business case and full proposal for Phase 2

Phase 2

January 2015 – early 2016

- Assemble information and begin to develop plan chapters, maps, and other figures
- Consult as needed (approximately four times) with working group to review and discuss completed chapters and recommendations
- Develop implementation plan
- Hold public consultation session(s)
- Hold public review period (approximately 3-4 weeks) and address/incorporate comments received
- Finalize plan
- Next steps (e.g. approval by BOD, any GIFN process…)

Linkages

There are multiple linkages to other LSPP priorities and deliverables, these include:

- Phosphorus reduction strategy
- Stormwater management policies (potentially)
- Natural heritage policies
- Stewardship related policies
- Monitoring policies

- Comprehensive monitoring strategy
- Others TBD…

APPENDIX “F”

DRAFT

Climate Change Vulnerability and Adaptation Planning Framework - Workbook

Climate Change Adaptation Planning Within the Chippewas of Georgina Island First Nation Reserve

2013-2014

Climate Change Vulnerability and Adaptation Planning Framework

This document outlines the Climate Change Vulnerability and Adaptation Planning Framework for Climate Change Adaptation Planning within the Chippewas of Georgina Island First Nation Reserve. It is a seven step (Figure 1) process that will:

- Define the methodology used to collect Traditional Ecological Knowledge (TEK) and other pertinent information to help identify climate risks and vulnerabilities (Step 2)
- Explain how vulnerabilities will be compared to western science assessments of watershed vulnerability (Step 2)
- Outline how to prioritize climate risks perceived by (community??) (Step 4)
- Outline how the results will be shared with the community (Step 1)
- Build a process to collect and prioritize adaptation recommendations and how the adaptation recommendations will be implemented (Step 5 and 6)

It is very important to keep very good notes, and records of meetings, meeting and workshop results, decisions, etc through every step of the process. Good record-keeping makes it easy to revisit a decision in the future (Black, Bruce, & Egener, 2009).

1. Let's Get Started

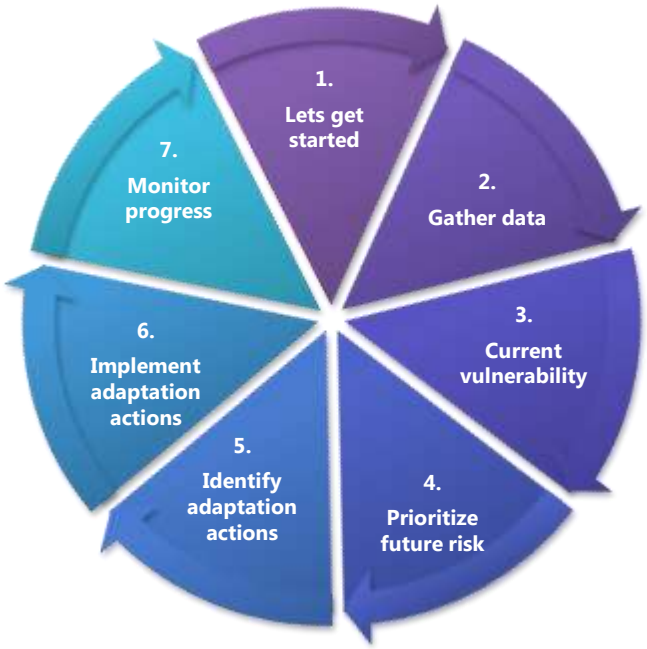


Figure 15: Climate Change Vulnerability and Adaptation Planning Framework

Gather Data

Historical Climate and Weather Data – Key Points

Shanty Bay Weather Station

Historical Temperature

- All seasons (i.e. winter, spring, summer, fall, annual) and variables (i.e. maximum, minimum, mean) warmed over the period or record (Table 2)
- Winter warmed more than the other seasons
- Winter minimum temperature warmed more than maximum temperature
- Spring, summer, fall, and annual maximum temperatures all warmed more than the minimum temperatures.
- Fall maximum temperature warmed 2°C

Historical Precipitation

- All season (i.e. winter, spring, summer, fall, annual) saw increases in precipitation (Table 2)
- Winter experienced the largest increase in precipitation (40mm)
- Fall experienced the smallest increase (3mm)

Historical Rain and Snow

- The area experienced an increase in total annual rain (50mm), and a decrease in total annual snow (-16cm) (Table 3)
- Winter experienced increases in both rain (24mm) and snow (15cm)
- Spring experienced decreases in both rain (-30mm) and snow (-7cm)
- Fall experienced an increase in rain (5mm) and a decrease in snow (-1cm)
- Summer experienced an increase in rain (13mm)

Traditional Ecological Knowledge Survey

Historical Temperature

- Earlier spring
- Spring runoff comes faster
- Long, hotter summer but lake never got as warm as it does now
- Warmer winters
- Ice lasted longer
- Less severe winters than they used to be 15 – 20 years ago
- Winter comes later and ends earlier
- Milder/damp conditions

Historical Precipitation

- Not much water in spring
- More rain than snow

Historical Rain and Snow

- Not much snow in spring
- More rain than snow
- Never had rain during winter months 10 years ago
- 20 – 25 years ago first snowfall = October / November; last = April
- Now snow after Christmas and stays until March

Storms

- Thunderstorms in winter
- More severe than they used to be 10 – 20 years ago
- Seem to be more often and more severe
- Wind is more severe

The Data

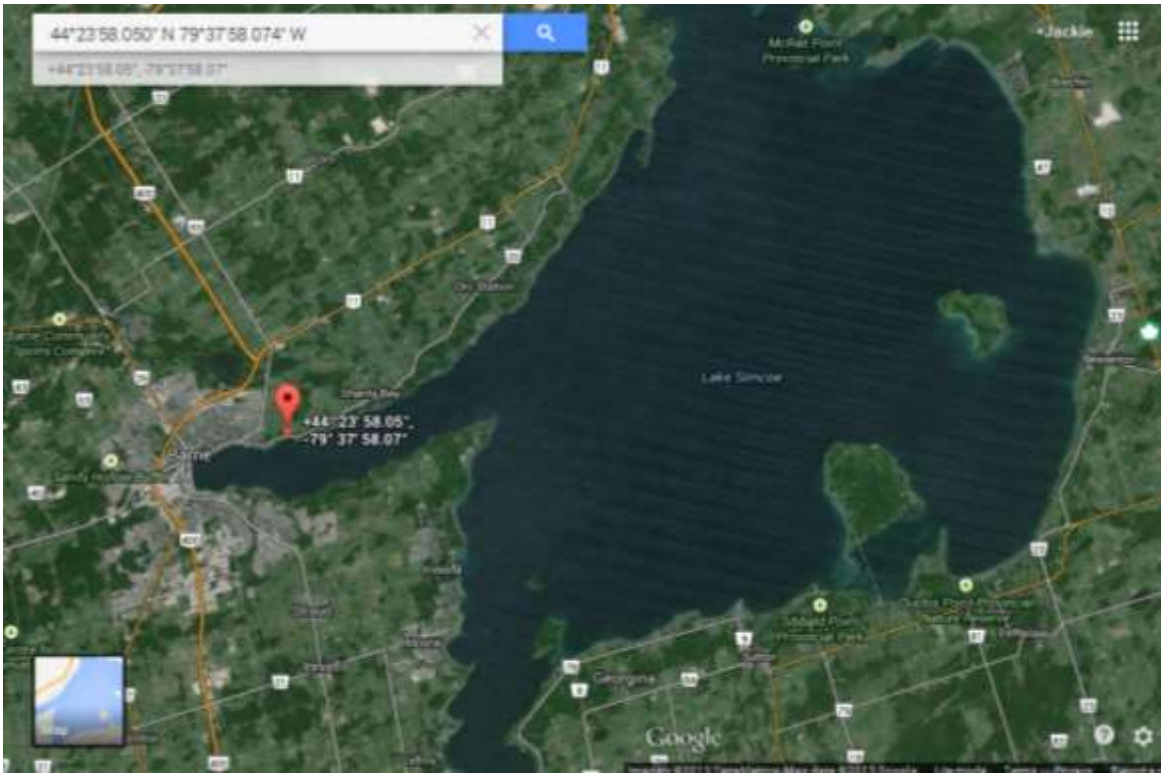
Temperature and Precipitation

Average temperature (i.e. maximum, minimum, and mean) and total precipitation, rain, and snow were plotted from climate data obtained from the Shanty Bay weather station (Figure 2) for the years 1973 to 2012 (Figures 3 to 8). Climate data was also available from the Barrie WCPP weather station, but the data was only current up to the year 2010. A climate station in Oro-Medonte (Coldwater Warminster) had data from 1971 to current, however many gaps were contained in the dataset which made it unusable. Other stations in the area (Table 1) did not have data spanning 30 years, a requirement to observe trends in the data (reference).

Table 8: Weather stations from the surrounding area

Station	Dates	Station	Dates
Barrie-Oro	2003 – present	Udora	1989 – present
Lagoon City	1994 – present	Blackstock	2001 – present
Baldwin	2004 – present	Egbert	2000 - present

Figure 16: Shanty Bay Weather Station located at 44°23'58.050" N 79°37'58.074" W.



A linear regression line was used to show the general trend of the data. Although there is obvious fluctuation in the data between years, the general trend of the data can also be observed. A summary of the changes can be found in Table 2 and 3.

Shanty Bay - Winter Temperature

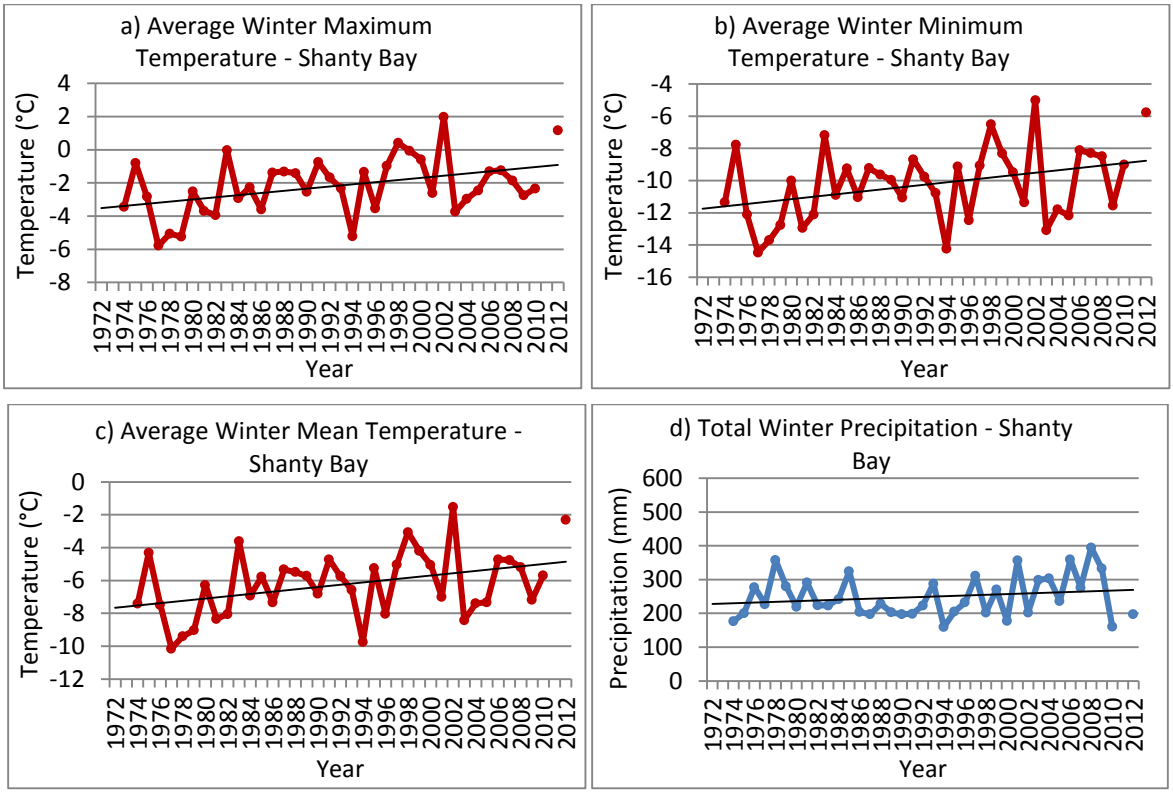
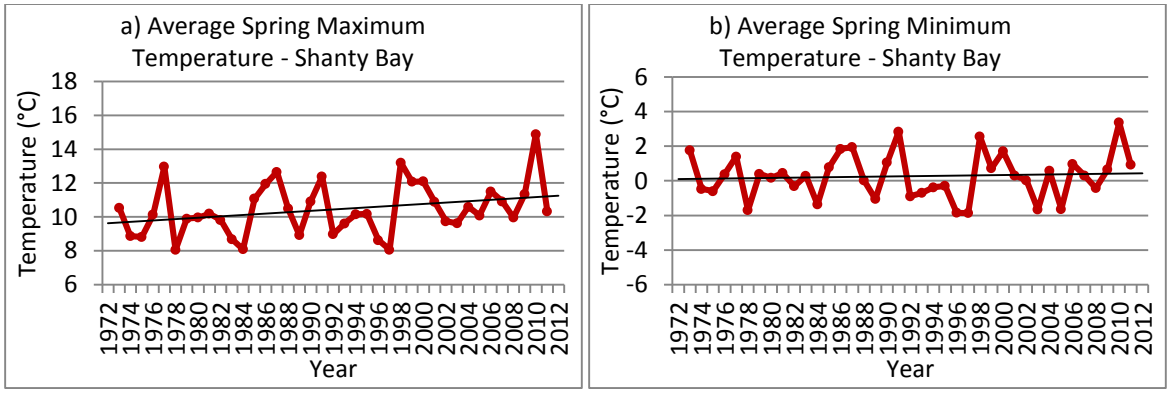


Figure 17: Average winter temperature (°C) from 1973 to 2012 for Shanty Bay. Linear regression suggests: a) average winter temperature has increased approximately 2.5°C; b) Average winter minimum temperature (°C) has increased approximately 2.7°C; c) average winter mean temperature (°C) has increased approximately 2.6°C; d) and total winter precipitation (mm) has increased approximately 40 mm over the period of record.

Shanty Bay - Spring Temperature



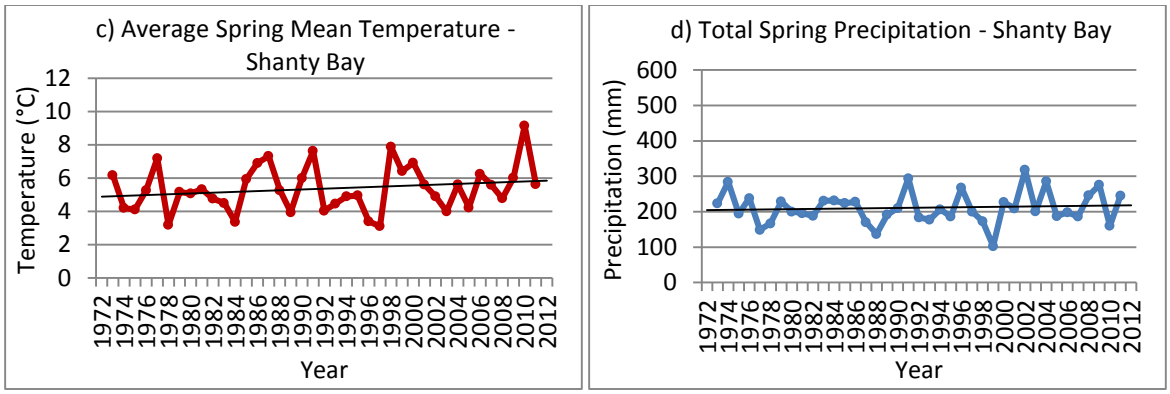


Figure 18: Average spring temperature (°C) from 1973 to 2012 for Shanty Bay. Linear regression suggests: a) average spring maximum temperature has increased approximately 1.5°C; b) Average spring minimum temperature (°C) has increased approximately 0.3°C; c) average spring mean temperature (°C) has increased approximately 0.9°C; d) and total spring precipitation (mm) has increased approximately 14 mm over the period of record.

Shanty Bay - Summer Temperature

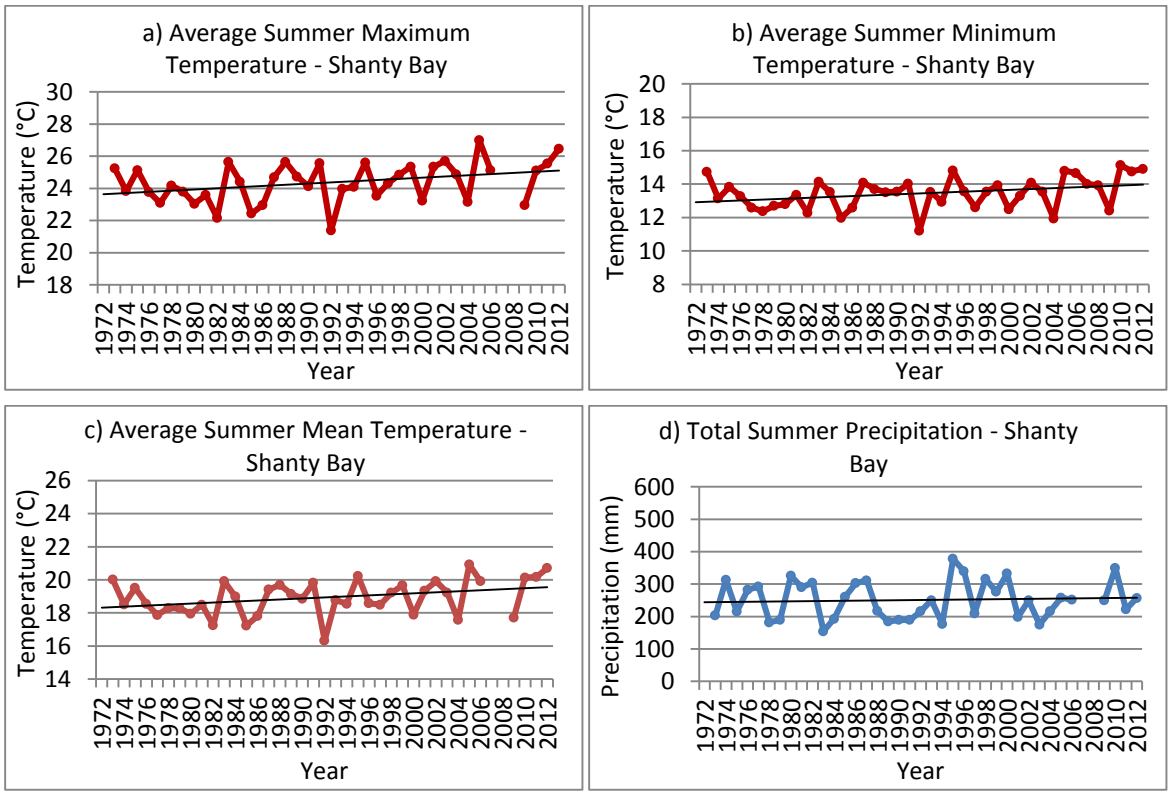


Figure 19: Average summer temperature (°C) from 1973 to 2012 for Shanty Bay. Linear regression suggests: a) average summer maximum temperature has increased approximately 1.4°C; b) average summer minimum temperature (°C) has increased approximately 1.0°C; c) average summer mean temperature (°C) has increased approximately 1.1°C; d) and total summer precipitation (mm) has increased approximately 13 mm over the period of record.

Shanty Bay - Fall Temperature

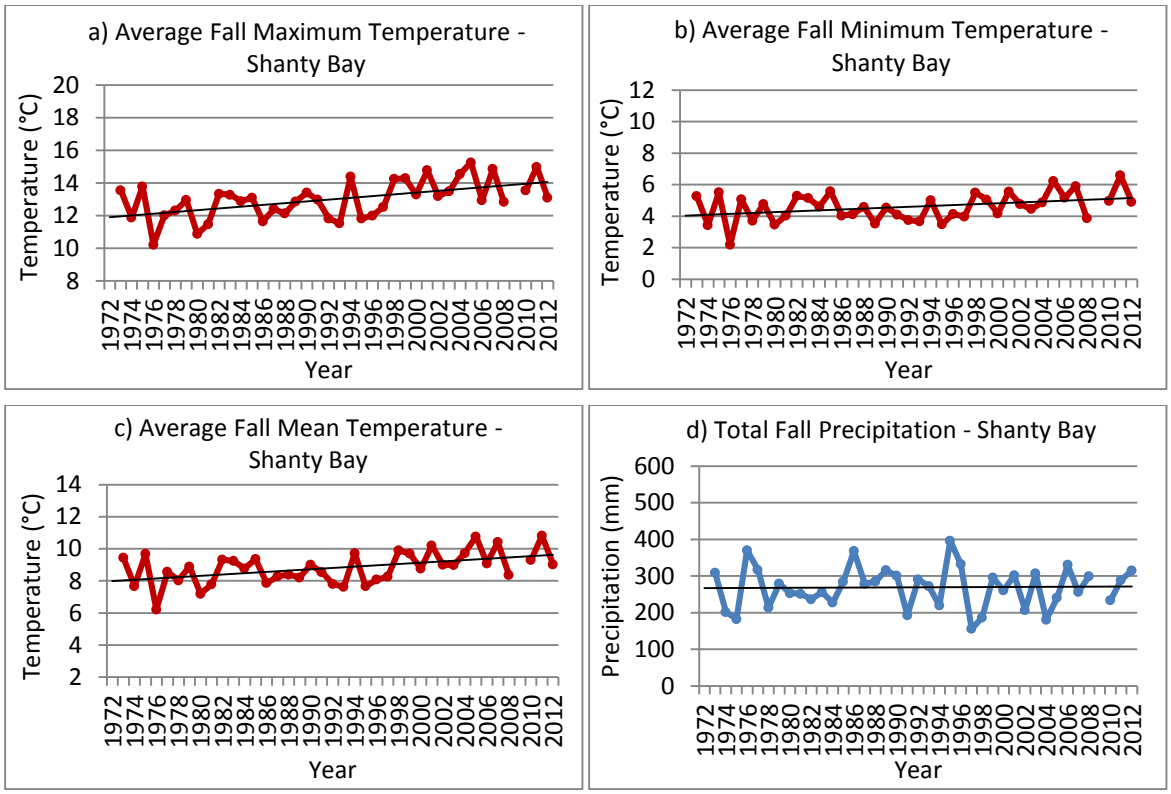


Figure 20: Average fall temperature (°C) from 1973 to 2012 for Shanty Bay. Linear regression suggests: a) average fall maximum temperature has increased approximately 2.1°C; b) average fall minimum temperature (°C) has increased approximately 1.0°C; c) average fall mean temperature (°C) has increased approximately 1.6°C; d) and total fall precipitation (mm) has increased approximately 3 mm over the period of record.

Shanty Bay - Annual Temperature

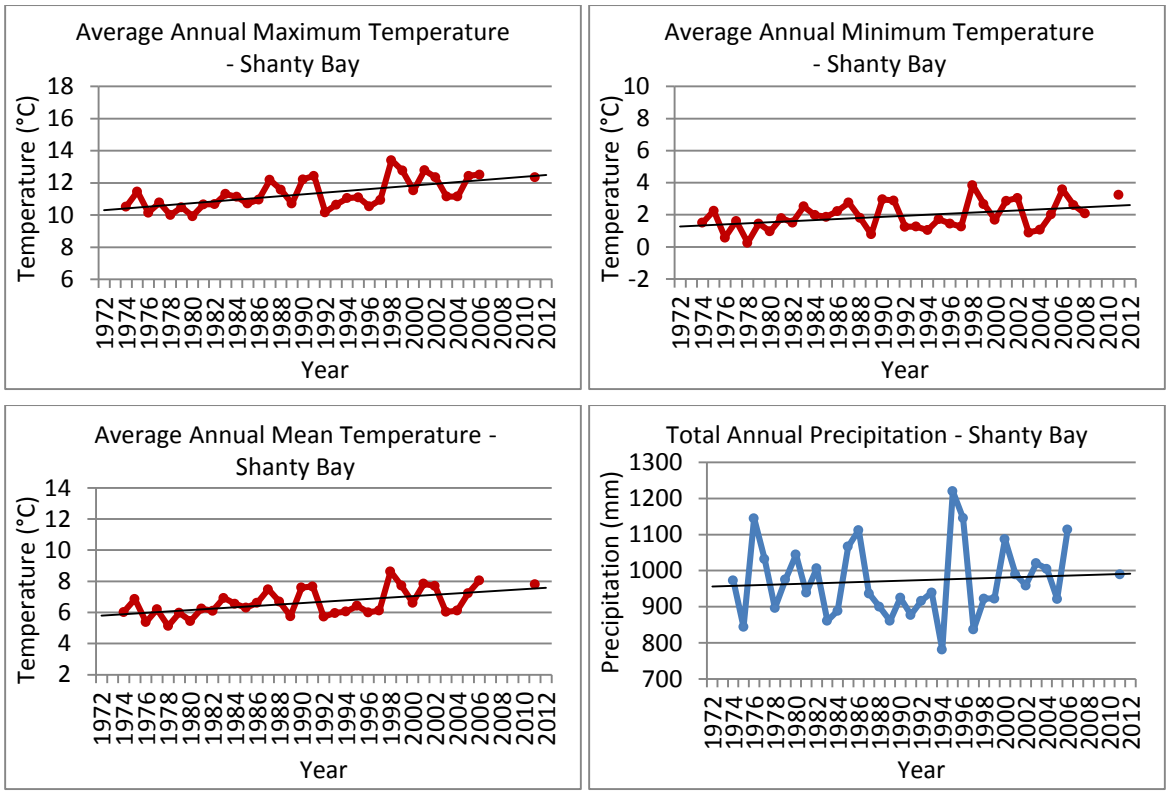
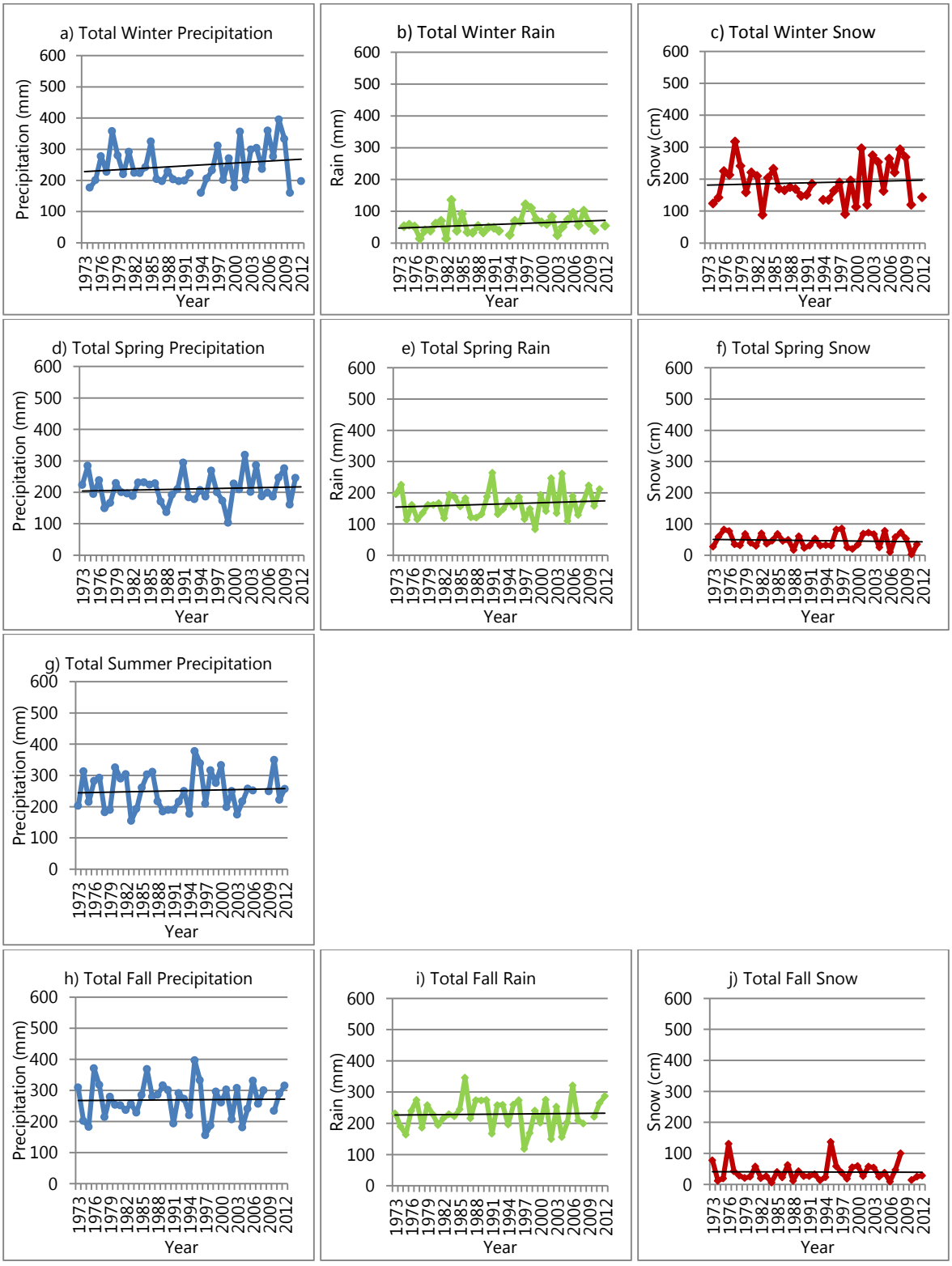


Figure 21: Average annual temperature (°C) from 1973 to 2012 for Shanty Bay. Linear regression suggests: a) average annual maximum temperature has increased approximately 2.0°C; b) average annual minimum temperature (°C) has increased approximately 1.1°C; c) average annual mean temperature (°C) has increased approximately 1.6°C; d) and total annual precipitation (mm) has increased approximately 32 mm over the period of record.

Table 9: Summary of approximate change in temperature and precipitation, from largest to smallest, at Shanty Bay weather station between 1973 and 2012

	Temperature (°C)	
Season	Variable	Change
Winter	Minimum	2.7
Winter	Mean	2.6
Winter	Maximum	2.5
Fall	Maximum	2.1
Annual	Maximum	2
Fall	Mean	1.6
Annual	Mean	1.6
Spring	Maximum	1.5
Summer	Maximum	1.4
Summer	Mean	1.1
Annual	Minimum	1.1
Summer	Minimum	1
Fall	Minimum	1
Spring	Mean	0.9
Spring	Minimum	0.3

	Precipitation (mm)	
Season	Variable	Change
Winter	Total	40
Annual	Total	32
Summer	Total	13
Spring	Total	12
Fall	Total	3


a) Total Winter Precipitation
Precipitation (mm)
b) Total Winter Rain
Rain (mm)
c) Total Winter Snow
Snow (cm)
d) Total Spring Precipitation
Precipitation (mm)
e) Total Spring Rain
Rain (mm)
f) Total Spring Snow
Snow (cm)
g) Total Summer Precipitation
Precipitation (mm)
h) Total Fall Precipitation
Precipitation (mm)
i) Total Fall Rain
Rain (mm)
j) Total Fall Snow
Snow (cm)
Year

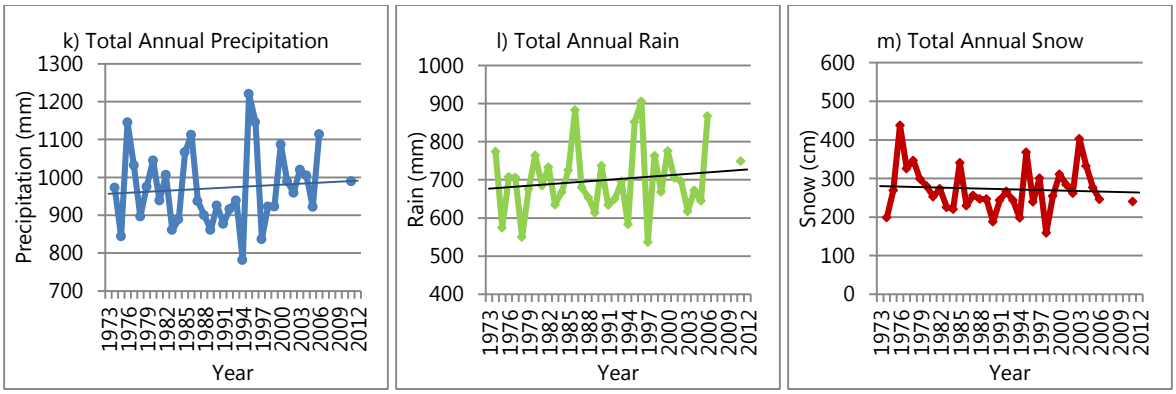


Figure 22: Total precipitation (mm), rain (mm) and snow (cm) from 1973 to 2012 for Shanty Bay – linear regression suggests: a) total winter precipitation has increased approximately 40mm; b) total winter snow has increased approximately 15mm; c) total winter rain has increased approximately 24mm; d) Total spring precipitation has increased approximately 12mm; e) total spring snow has decreased approximately 7cm; f) total spring rain has decreased approximately 30mm; g) total summer precipitation has increased approximately 13mm; h) total fall precipitation has increased approximately 3mm; i) total fall snow has decreased approximately 1cm; j) total fall rain has increased approximately 5mm; k) total annual precipitation has increased approximately 32mm; l) total annual snow has decreased approximately 16cm; m) and total annual rain has increased approximately 52mm over the period of record.

Table 10: Summary of approximate change in precipitation, rain, and snow, from largest to smallest, at Shanty Bay weather station between 1973 and 2012

Precipitation		Rain		Snow	
Season	Change (mm)	Season	Change (mm)	Season	Change (cm)
Winter	40	**Annual**	52	**Winter**	15
Annual	32	**Winter**	24	**Fall**	-1
Summer	13	**Summer**	13	**Spring**	-7
Spring	12	**Fall**	5	**Annual**	-16
Fall	3	**Spring**	-30		

Projected Changes in Temperature and Precipitation (future)

Key Points

Future Temperature

- Mean temperature is projected to increase in all seasons (i.e. winter, spring, summer, fall, annual) projections into the 2050s
- Greatest increase is projected to occur in the winter for all projections

Future Precipitation

- The projected change in precipitation is more variable for all of the projections

Table 11: Projection of climate change: change in mean temperature and change in precipitation

Researcher	Variable	Winter	Spring	Summer	Fall	Annual
CCCSN[1]	Change in mean Temperature (°C)	3.4	2.8	2.9	2.8	3.0
Huang[2]		4.0** (1.6* to 5.1***)	3.3** (1.5* to 4.0***)	4.0** (1.8* to 4.9***)	3.7** (1.6* to 4.2***)	4.0** (1.7* to 4.5***)
Gula and Peltier[3]		2.5 - 3.5		2.0 - 3.0		2.5 – 3.0
CCCSN	Change in Precipitation (%)	10.76	9.65	-0.62	3.85	10.76
Huang		15.3** (3.7* to 32.7***)	9.7** (3.1* to 20.8***)	-5.7** (-6.4* to 24.1***)	-4.0** (-3.8* to 6.9***)	5.6** (-1.2* to 16.6***)
Gula and Peltier		-5.0 to 5		0 to -20		-10 to 10

[1] Canadian Climate Change Scenarios Network (CCCSN) – Ensemble projection of 24 global climate models; projections into the 2050s (2041-2070) based on 1961-1990; High emission scenario based on SRES-A1B

[2] Huang et al, 2012; statistical downscaling technique; probabilistic climate projections into the 2050s (2040-2069) based on 1968 – 1998; projections expressed as cumulative Likelihood levels (*10%, **50%, ***90%)

[3] Gula and Peltier, 2012; dynamic downscaling technique, projections of changes in temperature for the 2050 -2060 period relative to 1979-2001; SRES A2 scenario

Traditional Ecological Knowledge

(Community Survey)

Table 12: Weather and climate changes observed by community members; identified through the TEK survey

Category (from TEK survey and/or western scientific study)	Description of impact (taken directly from TEK survey responses)
Weather changes in the different seasons, air and clouds	
Changes in spring temperatures	Early Spring
Spring runoff different from the past	Not much water
	Not as much snow
	Comes faster
	Sometimes causes flooding
	Not much runoff, creeks are destroyed from building development
Changes in summer temperature	Not as hot
	But get dry spells
	Long hotter summer, but the lake never got warm as it does now
	Rain looks darker
	Less rainfall compared to the 70s
Changes in air	Summer isn't as hot
	Muggy, thick air
	Humid and hot
Cloud shapes and patterns	Don't see the fluffy clouds
	More funnel clouds
	Cannot depend on the clouds
Changes in the number of windstorms and rain storms	Thunderstorms in winter
	More severe than they used to be 15 – 20 years ago
	Seem to be more often and more severe
	Wind is more severe
Changes in Winter Weather	Warmer winters
	Ice lasted longer
	60 years ago, able to skate over to Jackson's Point
	Less severe winters than 20-15 years ago
	Winter comes later and ends earlier
	Milder/damp conditions
Impacts of rain during the winter months	More rain than snow
	Never had rain during winter months 10 years ago
	Bad for the ice
Date of first and last snowfall	20 – 25 years ago • First – October/November • Last – April Now snow after Christmas and stays until March
Dates of freeze-up of lake, and when the ice breaks up in the spring	Getting later and breaks up earlier
	Used to get 20 inches of ice 15 years ago, now lucky to get 10
	Less community members due to going through the ice
	Effects everyone
Impacts to winter roads	The roads deteriorate faster
	Used to get strong blue ice
	Can't travel as much
	Ice isn't strong, brittle
	No road, struggle to get around

2. Identify current vulnerability

The following impacts were identified through the Traditional Ecological Knowledge survey conducted in Year One of the project (Table 7).

Table 13: List of vulnerabilities

Category (from TEK survey and/or western scientific study)	Description of impact as described by community members (taken directly from TEK survey responses)	Rationale for rejecting or advancing result to the next step in the process	Additional Notes
Changes in the Bush - *Trees, Medicinal and Edible Plants*			
Changes in the Trees and Plants	Lost all butternuts in the last 10 years	Butternut lost due to canker disease, not climate change	Butternut – declining; susceptible to butternut canker; had to factor the effects of climate change as climate varies greatly in its range[4]
	Loosing purple loose strips (purple loosestrife)	Invasive species	
	Wild leeks are dying off	Might be related to climate change	
	Wild garlic is dying out	Might be related to climate change	
	Trees in the southeast of the island are dying from cormorants	Cormorants, not climate change	
	Maple trees	Maple trees dying off, other areas are abundant	
	White ash are dying	This is due to the Emerald Ash Borer which is an invasive species *Note: is climate change making it more hospitable for them?	Sent results of these sections of the TEK to the project team to provide comment on links to climate change (see notes file)
	Elm trees have disappeared in the early 70s	Due to disesase	
	Ivy vine tree is new to island	New to island	
	Slippery elm trees are gone	Elm disease	
Types of Medicinal Plants harder to find:	Ginseng (20-25 years)	This plant is an endangered species and GI has the largest population documented in Canada	Conversations with some community members suggest that people are just not harvesting the medicinal plant any longer.
	Wiikengh		
	Crinkly root "dipneeg"	Culturally significant	
	Morel pickers		
	Poplar buds		
	Fiddleheads		
	Leaks		
	Pigweed		
	Lavender plant/flower		

[4] (Brinker & Jones)

Category (from TEK survey and/or western scientific study)	Description of impact as described by community members (taken directly from TEK survey responses)	Rationale for rejecting or advancing result to the next step in the process	Additional Notes
	Catnip		
Changes in Wet Areas - Lakes, Creeks, Swamp areas			
Changes in the Lake	Water smells		
	Algae takes over in the summer	Could increase with warming water temperature (?), along with increases in nutrients	
	Phosphate has increased		
	Used to be clean/clear		
	Can't drink the water anymore		
	Dirty/polluted		
	Rose up 1 to 2 feet (40s – 50s)		
	Much more weeds		
	Fluctuates a lot more		
	Used to have leaches and crayfish (not as many)		
	Zebra mussels have increased	Invasive species	
	Gobies disappeared (25 years ago)		
	Different water plants growing		
	No more wild rice	Due to water levels controlled by the Trent Severn Waterway	
Changes in the creeks	Creeks dried up, disappeared with cottage development	Development is another stressor	
	Gerdie's Creek is not there anymore	Cottagers filling in drainage ditch increasing risk	
Changes in the swamp	East point swamp seems to be getting bigger	Cannot make linkage to climate change	
	Used to have swamps and ponds along the road but disappeared with road development		
	Swamps behind the island have dried up, or shrunk	Evaporation?	
	Drain faster		
	Not draining properly		
Changes in Fish			
Changes in Fish	Very soft (flesh)		Sent results of these sections of the TEK to the project team to provide comment on links to climate change (see notes file)
	Carp are dying (8 – 10 years ago)		
	Trout population dropped and are smaller		
	Whitefish population dropped and are smaller		

Category (from TEK survey and/or western scientific study)	Description of impact as described by community members (taken directly from TEK survey responses)	Rationale for rejecting or advancing result to the next step in the process	Additional Notes
	Whitefish are imported and bigger		
	Can't fish for herring		
	No smelts	Earlier spring flows (?)	
	Can't fish close to the shore, perch and bass aren't where they used to be, due to the cormorants will get them in shallow water		
	Zebra mussels are gone	Zebra mussels are an invasive species and they are not gone, they've just moved to deeper water	
Changes in the places and dates when fish spawn	Used to be in October		Sent results of these sections of the TEK to the project team to provide comment on links to climate change (see notes file)
	Pickerel spawn in May		
	Due to climate, fish don't spawn in the same places around the island		
	Stock fish act different than the natural fish		
Kind of fish eaten within the Community	Whitefish		Sent results of these sections of the TEK to the project team to provide comment on links to climate change (see notes file)
	Trout		
	Pickerel		
	Perch		
	Small mouth bass		
Changes in Birds, Animals and Insects			
Different birds/animals/insects you haven't seen before	Cormorants (abundance in the last 10 years)		Sent results of these sections of the TEK to the project team to provide comment on links to climate change (see notes file)
	Eagles	Overwintered last year	
	Swans	Threatened list	
	Whipporwill		
	Morning doves	New to area	
	Hardly any seagulls		
Greater number of birds, insects or animals	Swallows are a lot less	Has been put on the endangered species list due to development and old barns being torn down, not climate change	Sent results of these sections of the TEK to the project team to provide comment on links to climate change (see notes file)
	Barn owls, snow owl		
	Wolves come around more often		
	Canada Geese are here almost year round		
	Robins stay longer, and come home sooner		
	More spiders		

Category (from TEK survey and/or western scientific study)	Description of impact as described by community members (taken directly from TEK survey responses)	Rationale for rejecting or advancing result to the next step in the process	Additional Notes
Impacts of birds, insects or animals	Cormorants • Droppings killing trees and polluting the water • Eating six times weight in fish		Sent results of these sections of the TEK to the project team to provide comment on links to climate change (see notes file)
Decrease of birds, insects or animals	Bullfrogs		Sent results of these sections of the TEK to the project team to provide comment on links to climate change (see notes file)
	Mosquitoes aren't as bad		
	Not as much pheasants		
	Not as much snakes		
	Not as much turtles		
	Not much shadflies		
	Decrease in bee population		
Effects of climate change on community infrastructure *Effects of changing weather on buildings, roads and utilities* *Impacts of weather on:*			
Homes and other buildings	At risk in January		
	Once flooded, causes mold		
	Severe winds affect roof shingles	Added to Wind impact tree	
	Damage from the wind off the lake	Added to Wind impact tree	
Powerlines	Rough winds, trees falling	Added to Wind Impact Tree	
Drinking water	Stopped drinking water 10-20 years ago		
Rainstorms and flooding	North end of island	Leanne to obtain clarification on this point	
	Drainage is blocked off	Leanne to obtain clarification on this point	
Weather Emergencies and Health			
What have people done about these changes?	Aside from water treatment, not very much, community has adapted to these changes		
Changes in flooding?	The odd flood of washing the road out but nothing too major		
Spring break up cause problems?	Not since the scoots came	However, air boats have problems operating in high wind conditions.	
Health problems from changes in weather?	Swimmers itch: 10 – 15 years ago		
	Earaches		
	People get different rashes from water		
	Dampness is hard on arthritis		

Impact Trees

Influence diagrams or impact trees were used to develop risk scenarios of first and higher order impacts, identified through the TEK survey, that could result from various climate hazards (Figures 9 - 13). This exercise helped the First Nation visualize the how changes in climate has affected their community. Each of the climate hazards were defined using the information on changes in weather from the TEK surveys.

Impact Trees

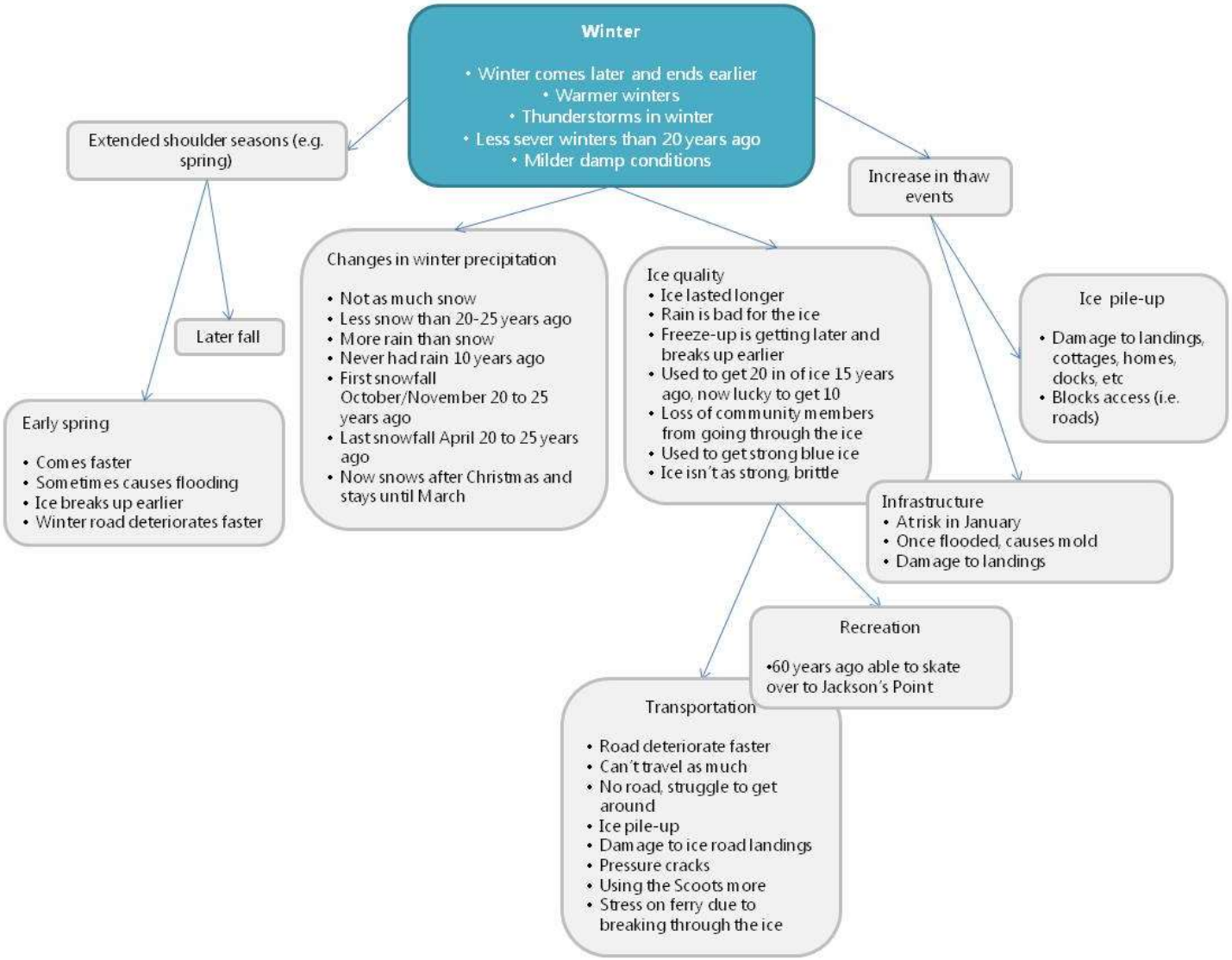


Figure 23: Impact tree for winter. Impacts were drawn directly from TEK survey results.

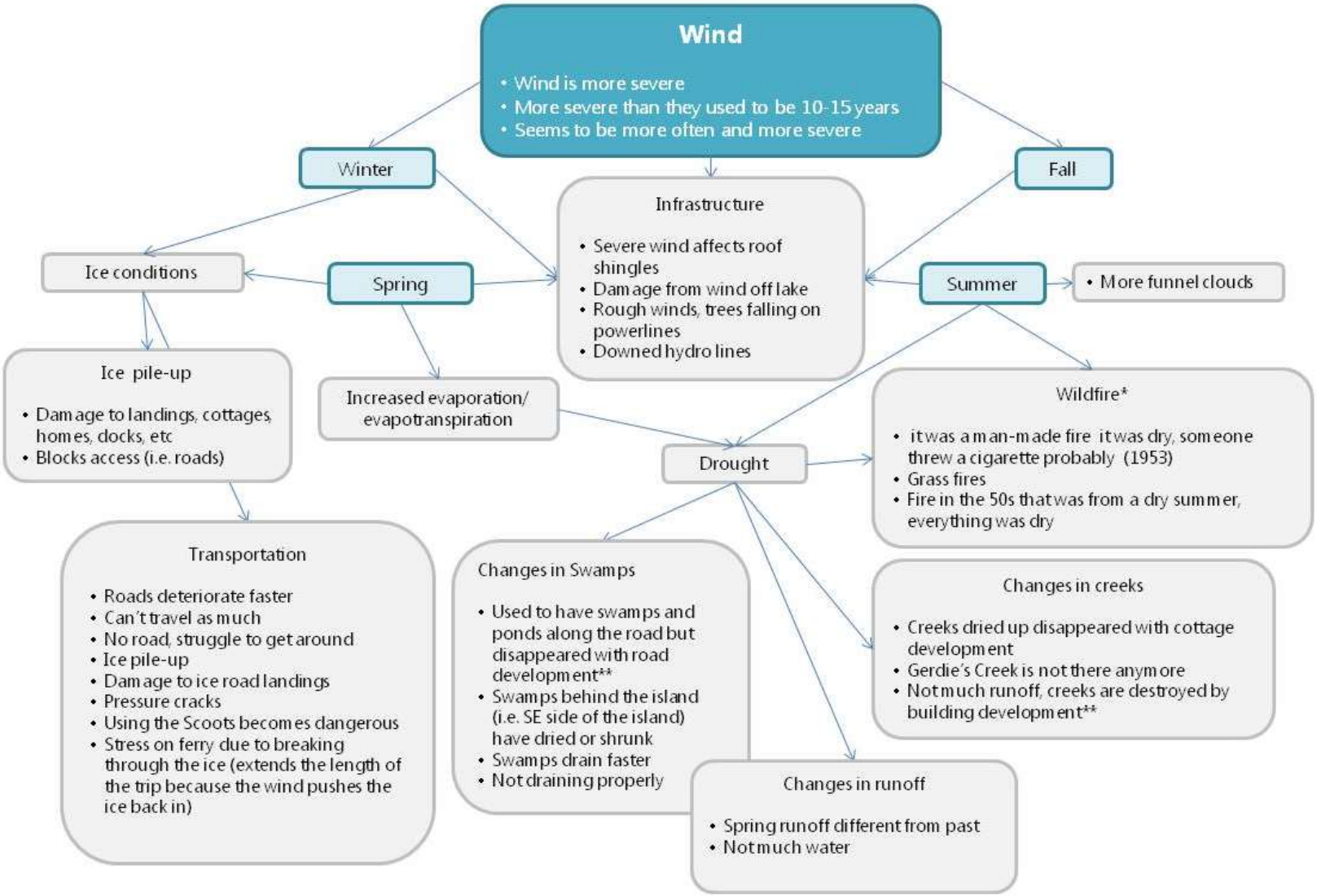


Figure 24: Impact tree for wind. Impacts were drawn directly from TEK survey results. *Question was posed to community members but was not documented as they did not see the link between climate change and potential for wildfire such as dry periods (e.g. community member remembers. **Development is a main stressor exacerbating the impact of warmer temperature.

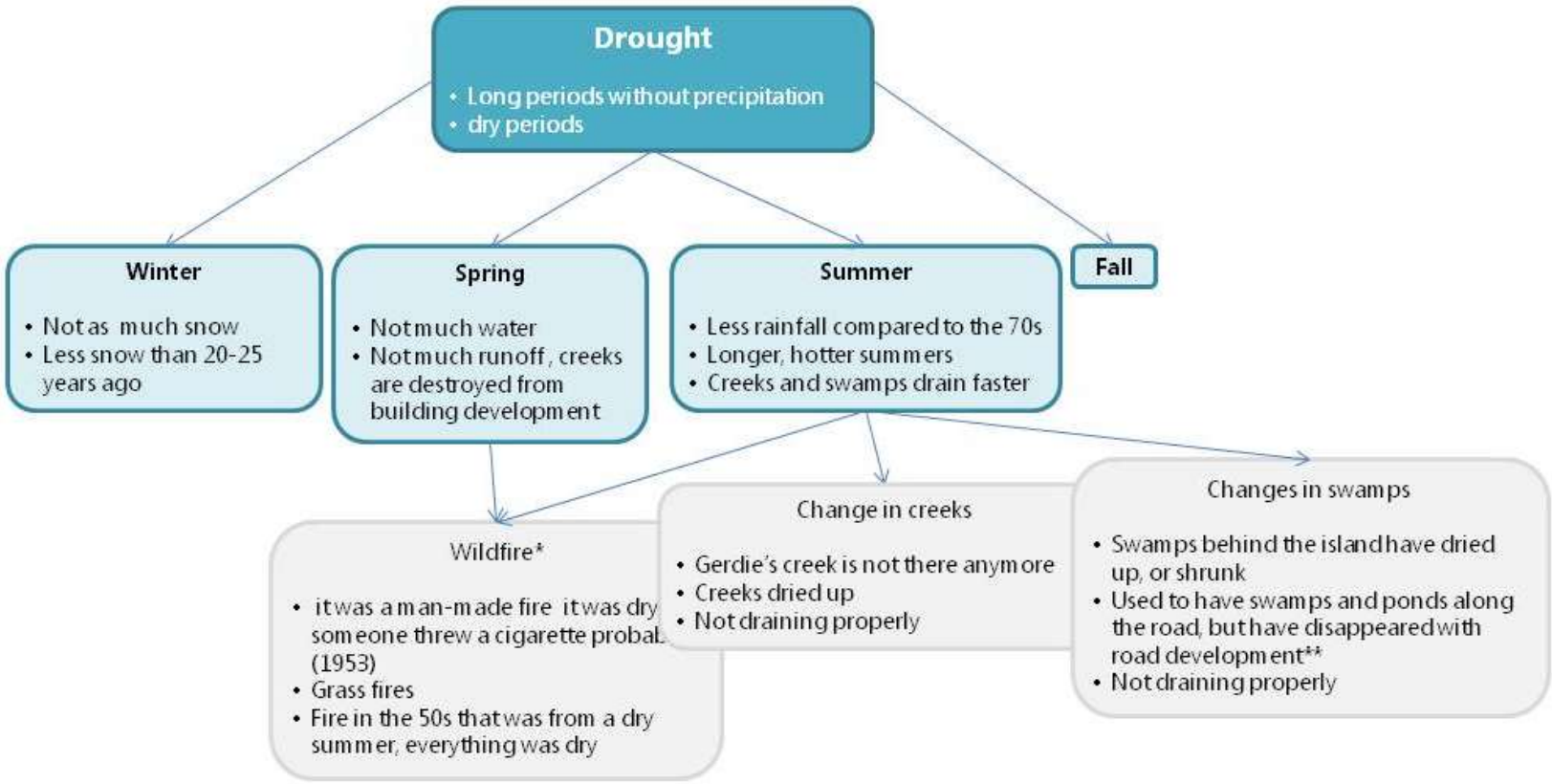


Figure 25: Impact tree for drought. Impacts were drawn directly from TEK survey results. *Question was posed to community members but was not documented as they did not see the link between climate change and potential for wildfire such as dry periods (e.g. community member remembers. **Development is a main stressor exacerbating the impact of warmer temperature.

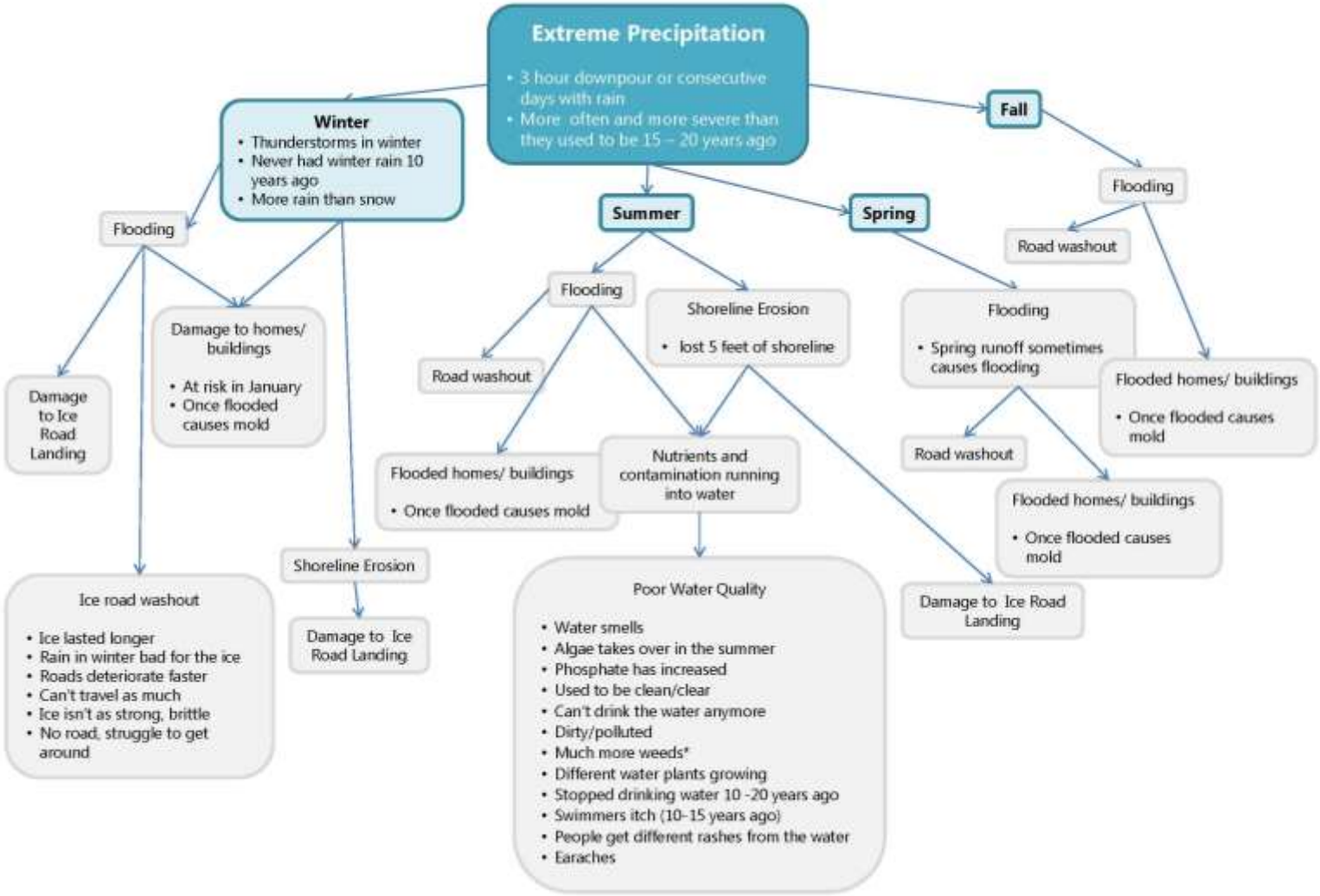


Figure 26: Impact tree for Extreme Precipitation. Impacts were drawn directly from TEK survey results. *Does increased growth of weeds in the summer (from warmer water temperature and increased nutrients) reduce the integrity of the ice?

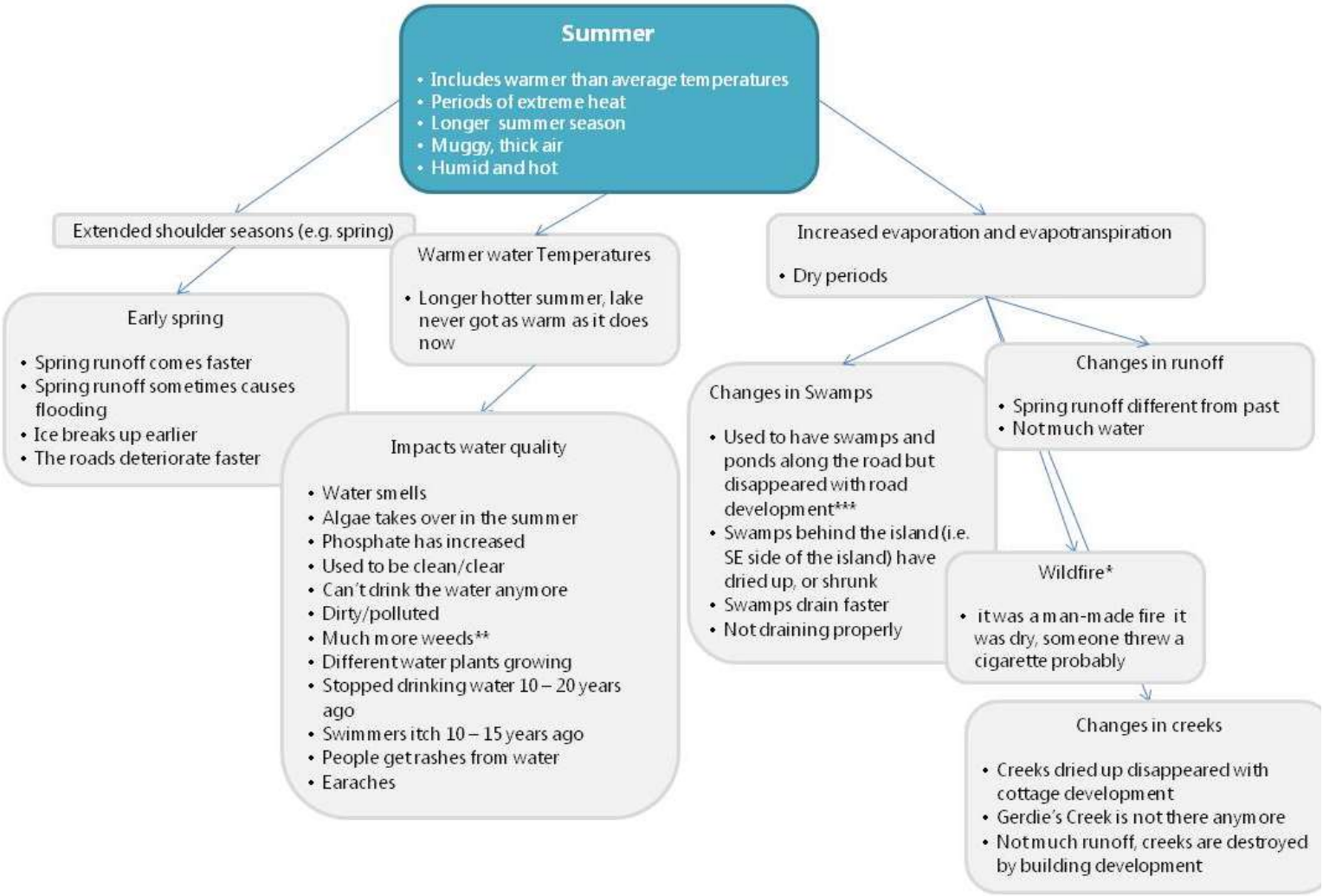


Figure 27: Impact tree for winter. Impacts were drawn directly from TEK survey results. *Question was posed to community members but was not documented as they did not see the link between climate change and potential for wildfire such as dry periods (e.g. community member remembers. ** Does increased growth of weeds in the summer (from warmer water temperature and increased nutrients) reduce the integrity of the ice? ***Development is a main stressor exacerbating the impact of warmer temperature.

A meeting with the Advisory Committee highlighted the priority areas of vulnerability for the community of Georgina Island and its members. The priority areas along with the associated impacts are outlined in Table 8.

Table 14: Priority areas for the Georgina Island First Nation community as identified by the Advisory Committee

Hazard	Impact	Impact (taken directly from TEK survey responses)
Winter	Transportation	Road deteriorates faster
		Can't travel as much
		No road, struggle to get around
		Ice pile-up
		Damage to ice road landings
		Pressure cracks
		Using the Scoots more
		Stress on ferry due to breaking through the ice
	Ice Quality	Ice lasted longer
		Rain is bad for the ice
		Freeze-up is getting later and breaks up earlier
		Used to get 20 inches of ice 15 years ago, now lucky to get 10
		Loss of community members from going through the ice
		Used to get strong blue ice
		Ice isn't as strong, brittle
Wind	Transportation	Road deteriorates faster
		Can't travel as much
		No road, struggle to get around
		Ice pile-up
		Pressure cracks
		Using the Scoots more becomes dangerous
		Stress on ferry due to breaking through the ice (extend the length of the trip because the wind pushes the ice back in)
	Wildfires	It was a man-made fire it was dry, someone threw a cigarette probably (1953)
		Grass fires
		Fire in the 50s that was from a dry summer, everything was dry
Drought	Changes in creeks	Gerdie's creek is not there anymore
		Creeks dried up
		Not draining properly
	Wildfires	It was a man-made fire it was dry, someone threw a cigarette probably (1953)
		Grass fires

Hazard	Impact	Impact (taken directly from TEK survey responses)
		Fire in the 50s that was from a dry summer, everything was dry
Extreme Precipitation	Poor Water Quality	Water smells
		Algae takes over in the summer
		Phosphate has increased
		Used to be clean/clear
		Can't drink the water anymore
		Dirty/polluted
		Much more weeds
		Different water plants growing
		Stopped drinking water 10-20 years ago
		Swimmers Itch (10-15 years ago)
		People get different rashes from the water
		Earaches
	Flooding	Spring runoff sometimes causes flooding
		Road washout
		Flooded homes/buildings – once flooded causes mold
Summer	Impacts water quality	Water smells
		Algae takes over in the summer
		Phosphate has increased
		Used to be clean/clear
		Can't drink the water anymore
		Dirty/polluted
		Much more weeds
		Different water plants growing
		Stopped drinking water 10-20 years ago
		Swimmers Itch (10-15 years ago)
		People get different rashes from the wate
		Earaches
	Changes in swamps	Used to have swamps and ponds along the road but disappeared with road development
		Swamps behind the island (i.e. SE side of island) have dried up or shrunk
		Swamps drain faster
		Not draining properly

3. Prioritize future risk

An estimation of likelihood and consequence was done for each of the impacts listed for each 'hazard' in order to prioritize future risk to Georgina Island and its residents. This estimation was done keeping in mind the projections into the future (from step 2) (Table 9).

To review, the projections suggest:

Future Temperature

- Mean temperature is projected to increase in all seasons (i.e. winter, spring, summer, fall, annual) projections into the 2050s
- Greatest increase is projected to occur in the winter for all projections

Future Precipitation

- The projected change in precipitation is more variable for all of the projections

Table 15: Projection of climate change: change in mean temperature and change in precipitation

Researcher	Variable	Winter	Spring	Summer	Fall	Annual
CCCSN[5]	Change in mean Temperature (°C)	3.4	2.8	2.9	2.8	3.0
Huang[6]		4.0** (1.6* to 5.1***)	3.3** (1.5* to 4.0***)	4.0** (1.8* to 4.9***)	3.7** (1.6* to 4.2***)	4.0** (1.7* to 4.5***)
Gula and Peltier[7]		2.5 - 3.5		2.0 - 3.0		2.5 – 3.0
CCCSN	Change in Precipitation (%)	10.76	9.65	-0.62	3.85	10.76
Huang		15.3** (3.7* to 32.7***)	9.7** (3.1* to 20.8***)	-5.7** (-6.4* to 24.1***)	-4.0** (-3.8* to 6.9***)	5.6** (-1.2* to 16.6***)
Gula and Peltier		-5.0 to 5		0 to -20		-10 to 10

An estimation of likelihood and consequence was done for each of the impacts listed for each 'hazard'.

[5] Canadian Climate Change Scenarios Network (CCCSN) – Ensemble projection of 24 global climate models; projections into the 2050s (2041-2070) based on 1961-1990; High emission scenario based on SRES-A1B

[6] Huang et al, 2012; statistical downscaling technique; probabilistic climate projections into the 2050s (2040-2069) based on 1968 – 1998; projections expressed as cumulative Likelihood levels (*10%, **50%, ***90%)

[7] Gula and Peltier, 2012; dynamic downscaling technique, projections of changes in temperature for the 2050 -2060 period relative to 1979-2001; SRES A2 scenario

Changes in Winter

Table 16: Estimate of likelihood of impacts related to changes in winter happening in the specified time horizon

Climate Event: **Changes in winter:** warmer, shorter, more rain, less snow
Time Horizon (planning period): 2050s

Risk Scenario	Very Unlikely to happen	Occasional : Occurrence	Moderately Frequent	Occurs Often	Virtually Certain to Occur
e.g. damage to homes	Not likely to occur during the planning period (1)	May or may not occur during the planning period (2)	Likely to occur at least once during the planning period (3)	Likely to occur several times during the planning period (4)	Happens often and will happen again during the planning period (5)
Transportation					
○ Road deteriorates faster (can't travel as much; no road, struggle to get around; using scoots more)					✓
○ Damage to ice road landings					✓
○ Pressure cracks*				✓	
○ Stress on ferry due to breaking through the ice				✓	
Ice Quality					
○ Ice lasted longer		✓			
○ Freeze-up is getting later and breaks up earlier				✓	
○ Used to get 20 inches of ice 15 years ago, no lucky to get 20				✓	
○ Loss of community members from going through the ice			✓		

*Local business owners believe that it is possible that the frequency and severity of pressure cracks may be increasing on Lake Simcoe; perhaps because of climate variability[8].

[8] Scott, D., Jones, B., Lemieux, C., McBoyle, G., Mills, B., Svenson, S., Wall, G. Vulnerability of Winter Recreation to Climate Change: A Study of the Lakelands Tourism Region (Southern Ontario, Canada).

Table 17: Estimate of consequence of roads deteriorating due to changes in winter in the specified time horizon if changes in winter occur

Climate Event: **Changes in winter:** warmer, shorter, more rain, less snow
Risk Scenario: **Transportation -** Road deteriorates faster so residents can't travel as much, no road, struggle to get around; using scoots more.
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)				✓			✓				✓	✓	
Low (2)													
Moderate (3)								✓	✓	✓			
High (4)		✓	✓										
Very High (5)	✓				✓	✓							✓

Consequence = 3.2
Likelihood = 5

Notes:

- Likelihood that this may happen often into the future if winter temperatures continue to warm

- Health and Safety: People could get hurt using ice road
- Displacement: Children may have to be boarded if road season is shorter
- Loss of Livelihood: Residents may miss work if road season is shorter and time in between ferry and road is longer.
- Property Damage: could damage vehicles
- Financial Impact: greater cost for residents to stay on the mainland; financial impact if they miss work
- Financial impact to the community: community maintains ice road; costs to operate scoot more often
- Water: car could go through the ice
- Land: damage to shoreline
- Aquatic: oil/gas from car going through ice
- Traditional Lifestyle: residents will not be able to travel as much

Table 18: Estimate of consequence of damage to ice roads due to changes in winter in the specified time horizon

Climate Event: **Changes in winter:** warmer, shorter, more rain, less snow
Risk Scenario: **Transportation -** Damage to ice road landings
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)							✓	✓		✓	✓	✓	
Low (2)									✓				
Moderate (3)	✓					✓							
High (4)			✓	✓	✓								
Very High (5)		✓											✓

Consequence = 2.7
Likelihood = 5

Notes:

- Likelihood that this may happen often during the planning period if winter temperatures continue to warm

- Health and Safety: could be dangerous for residents
- Displacement: residents could be stranded on the mainland
- Loss of Livelihood: residents could miss work
- Property Damage: cars could be damaged
- Financial Impact: could be costly to stay on the mainland; or costly if residents miss work
- Impact on Community Finances: moderate cost for community to repair landing; cost to run scoots more often
- Land: some impact to the land from heavy equipment needed to repair landings
- Traditional Lifestyle: would limit travel to and from the island

Table 19: Estimate of consequence of pressure cracks in the specified time horizon if changes in winter occur

Climate Event: **Changes in winter:** warmer, shorter, more rain, less snow
Risk Scenario: **Transportation** - Pressure cracks
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)							✓	✓	✓	✓	✓	✓	
Low (2)													
Moderate (3)		✓		✓		✓							✓
High (4)			✓										
Very High (5)	✓				✓								

Overall score = 2.5
Likelihood = 4

Notes:

- Likelihood that this will happen several times during the planning period if winter temperatures continue to warm

- Health and Safety: could be dangerous for residents if they hit a pressure crack when driving across the lake
- Displacement: residents could be stranded on the mainland for a short time
- Loss of Livelihood: residents could miss work for a day; or could miss work due to injury
- Property Damage: cars could be damaged
- Financial Impact: could be costly to stay on the mainland; or costly if residents miss work due to injury
- Impact on Community Finances: moderate cost for community to either repair crack or move road
- Traditional Lifestyle: would limit travel to and from the island for a day or so

Table 20: Estimate of consequence of stress on ferry due to breaking through the ice due to changes in winter in the specified time horizon

Climate Event: **Changes in winter:** warmer, shorter, more rain, less snow
Risk Scenario: **Transportation -** Stress on ferry due to breaking through the ice
Time Horizon (planning period):2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)				✓					✓		✓	✓	
Low (2)	✓							✓		✓			
Moderate (3)		✓	✓		✓		✓						
High (4)													
Very High (5)						✓							✓

Consequence = 2.5
Likelihood = 4

Notes:

- Likelihood that this will occur several times during the planning period

- Health and Safety: people could get stranded on the ferry
- Displacement: moderate consequence; may be displaced for a short time
- Loss of livelihood: moderate consequence: could be late for work due to ferry schedule being off or ferry needing to be repaired
- Property damage: low consequence for residents, no personal property would be damaged
- Impact on Community Finances: will cost community money to repair and keep ferry running
- Air: moderate consequence to the air with the ferry working harder to break the ice
- Water: low consequence to water, ferry working harder could stir up bottom of lake near the shores
- Ecosystems: see water
- Traditional Lifestyle: could impact travel to and from island

Table 21: Estimate of consequence of ice quality due to changes in winter in the specified time horizon

Climate Event: **Changes in winter:** warmer, shorter, more rain, less snow
Risk Scenario: **Ice Quality –** Ice lasted longer
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)				✓			✓	✓	✓	✓	✓	✓	
Low (2)	✓	✓	✓		✓	✓							✓
Moderate (3)													
High (4)													
Very High (5)													

Overall score = 1.6
Likelihood = 2

Notes:

- Likelihood that this may or may not occur during the planning period if winter temperatures continue to warm

Table 22: Estimate of consequence of ice quality due to changes in winter in the specified time horizon

Climate Event: **Changes in winter:** warmer, shorter, more rain, less snow
Risk Scenario: **Ice Quality –** Freeze-up getting later and breaks up earlier
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)				✓				✓	✓	✓	✓	✓	
Low (2)	✓												
Moderate (3)		✓	✓		✓		✓						
High (4)													
Very High (5)						✓							✓

Consequence = 2.3
Likelihood = 4

Notes:

- Likelihood that this will occur several times during the planning period if winter temperatures continue to warm

- Health and Safety: ice could become dangerous
- Displacement: could have a longer time between ice road and ferry; people may have to stay on the mainland away from family members
- Loss of livelihood: could miss work
- Financial Impact: missed hours at work; cost to stay on mainland
- Impact on Community Finances: could impact community with a longer ferry and scoot season (higher cost)
- Traditional Lifestyle: would limit travel

Table 23: Estimate of consequence of ice quality due to changes in winter in the specified time horizon

Climate Event: **Changes in winter:** warmer, shorter, more rain, less snow
Risk Scenario: **Ice Quality –** used to get 20 inches of ice 15 years ago, now lucky to get 10 (ice thinning)
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)				✓				✓	✓	✓	✓	✓	
Low (2)													
Moderate (3)							✓						
High (4)													
Very High (5)	✓	✓	✓		✓	✓							✓

Overall score = 3.0
Likelihood = 4

Notes:

- Likelihood that this may occur several times during the planning period if winter temperatures continue to warm

- Health and Safety: thinning ice could be very dangerous; could fall through
- Displacement: could have a longer time between ice road and ferry; people may have to stay on the mainland away from family members
- Loss of livelihood: could miss work if ice is too thin to cross
- Financial Impact: missed hours at work; cost to stay on mainland; cost of scoot
- Impact on Community Finances: could impact community with a longer ferry and scoot season (higher cost)
- Traditional Lifestyle: would limit travel

Table 24: Estimate of consequence of the loss of community members going through the ice due to changes in winter in the specified time horizon

Climate Event: **Changes in winter:** warmer, shorter, more rain, less snow
Risk Scenario: **Ice Quality –** Loss of community members going through the ice
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓					✓		✓		✓	✓	
Low (2)						✓							✓
Moderate (3)								✓		✓			
High (4)				✓									
Very High (5)	✓		✓		✓								

Overall score = 2.6
Likelihood = 3

Notes:

- Likelihood that this will occur at least once during the planning period if winter temperatures continue to warm

- Health and Safety: loss of life
- Displacement: family members may have to leave island/home
- Loss of livelihood: loss of wages
- Financial Impact: loss of wages
- Impact on Community Finances: could impact community if person was a community employee
- Ecosystem: car on bottom
- +of lake

Wind

Table 25: Estimate of likelihood of impacts related to changes in wind happening in the specified time horizon

Climate Event: **Wind** (more frequent, stronger winds)
Time Horizon (planning period): 2050s

Risk Scenario	Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Certain to Occur
e.g. damage to homes	Not likely to occur during the planning period (1)	May or may not occur during the planning period (2)	Likely to occur at least once during the planning period (3)	Likely to occur several times during the planning period (4)	Happens often and will happen again during the planning period (5)
Transportation					
○ Using the scoots less				✓	
○ Ice-pile up					✓
○ Damage to ice road landings			✓		
○ Pressure cracks			✓		
○ Stress on ferry due to breaking through the ice (extend the length of the trip because the wind pushes the ice back in)					✓
Wildfire					
○ It was a man-made fire it was dry, someone threw a cigarette probably (1953) ○ Grass fires ○ Fire in the 50s that was from a dry summer, everything was dry ○ Fire on the NW side of the island; kids did not put out bonfire	✓				

Table 26: Estimate of consequence of having to use the Scoot less due to wind during the specified time horizon

Climate Event: **Wind** (more frequent, stronger wind)
Risk Scenario: **Transportation –** Using the scoots less
Time Horizon (planning period):

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)							✓	✓	✓	✓	✓	✓	
Low (2)													
Moderate (3)				✓		✓							
High (4)		✓			✓								
Very High (5)	✓		✓										✓

Consequence score = 2.7
Likelihood = 4

Notes:

- Likelihood that this may occur several times during the planning period if wind becomes stronger and more frequent

- Health and Safety: wind makes it difficult/dangerous to use the scoot
- Displacement: residents may be displaced if Scoot cannot be used; children could be stranded on the mainland
- Loss of Livelihood: residents could miss work if Scoot is not running
- Property Damage:..
- Financial Impact: could cost money to stay on the mainland; missed hours at work
- Impact on Community Finances: low
- Traditional Lifestyle: could limit travel on and off island

Table 27: Estimate of consequence of ice pile-up due to wind during the specified time horizon

Climate Event: **Wind** (more frequent, stronger wind)
Risk Scenario: **Transportation –** Ice pile-up
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)							✓	✓				✓	
Low (2)			✓								✓		
Moderate (3)		✓							✓	✓			✓
High (4)	✓												
Very High (5)				✓	✓	✓							

Consequence = 2.9
Likelihood = 5

Notes:

- Likelihood that this may happen often during the planning period if wind becomes stronger and more frequent

- Health and Safety: could be dangerous for residents/children
- Displacement: could be displaced if ice damages homes
- Property Damage: could be very high if ice damages homes, personal property
- Financial Impact: could be very high if ice causes property damage
- Impact on Community Finances: could be very high if ice causes damage to community buildings and infrastructure.
- Land: could damage land
- Ecosystems: could cause damage to ecosystems along shore
- Traditional Lifestyle: could limit travel on, and on and off island

Table 28: Estimate of consequence of damage to ice road landings due to wind the specified time horizon

Climate Event: **Wind**
Risk Scenario: **Transportation –** Damage to ice road landings
Time Horizon (planning period):2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)							✓	✓			✓	✓	
Low (2)		✓	✓	✓						✓			
Moderate (3)	✓				✓				✓				✓
High (4)						✓							
Very High (5)													

Consequence = 2.2
Likelihood = 3

Notes:

- Likelihood that this may occur at least once during the planning period if wind becomes stronger and more frequent

- Health and Safety: could be dangerous for residents
- Displacement: access road could be limited/cut off
- Loss of Livelihood: access road could be limited/cut off and people could be stranded both on and off island
- Financial Impact: damage to personal vehicles could occur
- Impact on Community Finances: could be high to repair landings
- Land: could damage land
- Ecosystems: could cause damage to ecosystems along shore
- Traditional Lifestyle: could limit travel on, and on and off island

Table 29: Estimate of consequence of pressure cracks due to wind the specified time horizon

Climate Event: **Wind**
Risk Scenario: **Transportation –** pressure cracks
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)							✓	✓	✓	✓	✓	✓	
Low (2)		✓											✓
Moderate (3)				✓		✓							
High (4)			✓		✓								
Very High (5)	✓												

Consequence = 2.2
Likelihood = 3

Notes:

- Likelihood that this may occur at least once during the planning period if wind becomes stronger and more frequent

- Health and Safety: pressure cracks could be very dangerous to residents
- Displacement: could displace residents for a day/few hours
- Loss of Livelihood: residents could be late for work; miss hours
- Property damage: could damage car
- Financial Impact: repair costs for damaged vehicles; missed work
- Impact on Community Finances: cost to community to repair or move ice road

Table 30: Estimate of consequence of stress on ferry due to breaking through the ice due to wind the specified time horizon. Wind causes ice to pile-up near the shoreline.

Climate Event: **Wind**
Risk Scenario: **Transportation –** stress on ferry due to breaking thought the ice
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)				✓				✓	✓	✓	✓	✓	
Low (2)													
Moderate (3)			✓		✓		✓						
High (4)	✓	✓											✓
Very High (5)						✓							

Consequence = 2.5
Likelihood = 5

Notes:

- Likelihood that this may occur often during the planning period if wind becomes stronger and more frequent

- Health and Safety: windy conditions could be dangerous for ferry workers when ferry is trying to break through the ice
- Displacement: residents could be displaced if the ferry breaks down, or gets stuck; ferry schedules could be off
- Loss of Livelihood: could miss hours at work; could be late for work
- Financial Impact: could cost money to stay on the mainland; loss of wages
- Impact on Community Finances: could be high to repair ferry and/or dock
- Air: pollution from ferry working harder to break through ice
- Traditional Lifestyle: could limit travel on, and on and off island

Table 31: Estimate of consequence of reduced ice quality due to wind during the specified time horizon

Climate Event: **Wind**
○ Risk Scenario: **Wildfire**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)													
Low (2)							✓	✓					
Moderate (3)													
High (4)													
Very High (5)	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓

Consequence = 4.5
Likelihood = 1

Notes:

- Likelihood: not likely to occur often during the planning period if wind becomes stronger and more frequent
- Consequences very high is almost all categories if fire does occur

Drought

Table 32: Estimate of likelihood of impacts related to changes in drought happening in the specified time horizon

Climate Event: **Drought**
Time Horizon (planning period): 2050s

Risk Scenario	Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Certain to Occur
e.g. damage to homes	Not likely to occur during the planning period (1)	May or may not occur during the planning period (2)	Likely to occur at least once during the planning period (3)	Likely to occur several times during the planning period (4)	Happens often and will happen again during the planning period (5)
Changes in creeks					
○ *Gerdie's Creek is not there anymore*					
○ Creeks dried up			✓		
○ Not draining properly				✓	
Wildfire					
○ It was a man-made fire it was dry, someone threw a cigarette probably (1953) ○ Fire in the 50s that was from a dry summer, everything was dry ○ Grass fires		✓			

Drought: long periods without precipitation; dry periods

Table 33: Estimate of consequence of creeks drying up due to drought during the specified time horizon

Climate Event: **Drought**
Risk Scenario: Changes in creeks – **creeks drying up**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)	✓	✓	✓	✓	✓	✓	✓				✓	✓	
Low (2)									✓				✓
Moderate (3)								✓					
High (4)										✓			
Very High (5)													

Consequence = 1.5
Likelihood = 3

Notes:

- Likelihood that this may occur at least once during the planning period if drought occurs more often

- Health and Safety: very low consequence to health and safety
- Displacement: residents would not be displaced
- Loss of Livelihood: no loss of livelihood
- Financial Impact: no financial impact
- Impact on Community Finances: no financial impact
- Air: very low consequence to air
- Water: need proper drainage and filtration for water entering lake
- Land: low consequence to land
- Traditional Food: if creek contained traditional food, food would die if creek dried up
- Traditional Medicine: very low
- Traditional Lifestyle: very low

Table 34: Estimate of consequence of creeks not draining properly due to drought during the specified time horizon

Climate Event: **Drought**
Risk Scenario: Changes in creeks – **not draining properly**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)							✓				✓	✓	
Low (2)													✓
Moderate (3)	✓	✓	✓					✓	✓	✓			
High (4)													
Very High (5)				✓	✓	✓							

Consequence = 3
Likelihood = 2.9

Notes:

- Likelihood that this may occur several times during the planning period if drought occurs more often

- Health and Safety: could be dangerous if rain occurred during this dry period; flooding could result
- Displacement: residents could be displaced
- Loss of Livelihood: residents could be stranded on or off island; could miss work
- Property Damage: could occur if home/property was flooded
- Financial Impact: cost to repair home due to damage
- Impact on Community Finances: could cost community if community buildings, roads, etc were damaged
- Air: very low consequence to air
- Water: could result in contaminates running into water
- Land: more susceptible to erosion
- Ecosystem: destroy habitat; imbalances
- Traditional Lifestyle: could impact harvest

Table 35: Estimate of consequence of wildfire due to drought during the specified time horizon

Climate Event: **Drought**
Risk Scenario: Wildfire
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)													
Low (2)								✓					
Moderate (3)							✓						
High (4)													
Very High (5)	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓

Consequence = 2
Likelihood = 4.6

Notes:

- Likelihood that this may or may not occur during the planning period if drought occurs more often

Extreme Precipitation

Table 36: Estimate of likelihood of impacts related to changes in extreme precipitation happening in the specified time horizon

Climate Event: **Extreme Precipitation** (3 hour downpour or consecutive days with rain; more often and more severe than 15-20 years ago)
Time Horizon (planning period): 2050s

Risk Scenario	Very Unlikely to happen (1)	Occasional Occurrence (2)	Moderately Frequent (3)	Occurs Often (4)	Virtually Certain to Occur (5)
e.g. damage to homes	Not likely to occur during the planning period	May or may not occur during the planning period	Likely to occur at least once during the planning period	Likely to occur several times during the planning period	Happens often and will happen again during the planning period
Poor Water Quality					
○ Water smells ○ Used to be clean and clear ○ Dirty/polluted				✓	
○ Algae takes over in the summer				✓	
○ Drinking water ✓ Stopped drinking water 10-20 years ago ✓ Can't drink the water anymore				✓	
○ Much more weeds			✓		
○ Different water plants growing			✓		
○ Health Issues ✓ Swimmers Itch (10-15 years ago) ✓ People get different rashes from the water ✓ Earaches					✓
Flooding					
○ Spring runoff sometimes causes flooding			✓		
○ Road washout		✓			
○ Flooded homes/buildings – once flooded causes mold			✓		

Table 37: Estimate of consequence of water smelling and being dirty and polluted due to poor water quality from extreme precipitation during the specified time horizon

Climate Event: **Extreme Precipitation:** (3 hour downpour or consecutive days with rain; more often and more severe than 15-20 years ago)
Risk Scenario: **Poor Water Quality** – **water smells, used to be clean and clear, dirty /polluted**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)			✓	✓			✓		✓				
Low (2)		✓			✓								✓
Moderate (3)											✓	✓	
High (4)	✓					✓		✓		✓			
Very High (5)													

Consequence = 4
Likelihood = 2.5

Notes:

- Likelihood that this may occur several times during the planning period if extreme precipitation occurs more often

- Health and Safety: could cause health issues
- Displacement: low
- Impact on Community Finances: may need to upgrade water systems
- Water: effects quality of water
- Ecosystem: pollutes habitat, contamination
- Traditional Food/Medicine: contaminates food/medicine; kills food/medicine

Table 38: Estimate of consequence of algae taking over in summer resulting in poor water quality from extreme precipitation during the specified time horizon

Climate Event: **Extreme Precipitation: :** (3 hour downpour or consecutive days with rain; more often and more severe than 15-20 years ago)
Risk Scenario: **Poor Water Quality** – **algae taking over in summer**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓	✓	✓	✓		✓		✓		✓	✓	
Low (2)													✓
Moderate (3)	✓												
High (4)						✓		✓		✓			
Very High (5)													

Consequence = 4
Likelihood = 1.9

Notes:

- Likelihood that this may occur several times during the planning period extreme precipitation occurs more often

- Health and Safety: could cause illness
- Displacement: very low
- Loss of Livelihood: very low
- Property Damage: very low
- Financial Impact: very low
- Impact on Community Finances: beach clean-ups; water plant intake problems
- Air: very low
- Water: water quality
- Land: very low
- Ecosystem: loss of habitat
- Traditional Lifestyle: beach closures

Table 39: Estimate of consequence of degraded drinking water due to poor water quality from extreme precipitation during the specified time horizon

Climate Event: **Extreme Precipitation: :** (3 hour downpour or consecutive days with rain; more often and more severe than 15-20 years ago)
Risk Scenario: **Poor Water Quality** – **Drinking water: stopped drinking water 10-20 years ago; can't drink the water anymore**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓	✓	✓			✓		✓	✓	✓	✓	
Low (2)													
Moderate (3)					✓								
High (4)	✓							✓					✓
Very High (5)						✓							

Consequence = 4
Likelihood = 2.2

Notes:

- Likelihood that this may occur several times during the planning period if extreme precipitation occurs more often

- Health and Safety: could cause illness
- Displacement: very low
- Loss of Livelihood: very low
- Property Damage: very low
- Financial Impact: community members may have to buy drinking water or filtration systems
- Impact on Community Finances: upgrade or replace treatment systems
- Air: very low
- Water: pollution
- Land: very low
- Ecosystem: loss of habitat
- Traditional Lifestyle: can't drink the water

Table 40: Estimate of consequence of more weeds resulting in poor water quality from extreme precipitation during the specified time horizon

Climate Event: **Extreme Precipitation:** (3 hour downpour or consecutive days with rain; more often and more severe than 15-20 years ago)
Risk Scenario: **Poor Water Quality** – **more weeds**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓	✓				✓		✓		✓	✓	
Low (2)	✓												✓
Moderate (3)				✓									
High (4)					✓	✓		✓		✓			
Very High (5)													

Consequence = 4
Likelihood = 2.2

Notes:

- Likelihood that this may occur at least once during the planning period if extreme precipitation occurs more often

- Health and Safety: could get caught in the weeds
- Displacement: very low
- Loss of Livelihood: very low
- Property Damage: boats get caught in the weeds and cause damage
- Financial Impact: boats get caught in the weeds and cause damage
- Impact on Community Finances: could cause damage to water intake as well as ferry boats
- Air: very low
- Water: low oxygen levels
- Land: very low
- Ecosystem: loss of habitat
- Traditional Lifestyle: recreation and travel impacted

Table 41: Estimate of consequence of different water plants growing resulting in poor water quality from extreme precipitation during the specified time horizon

Climate Event: **Extreme Precipitation:** (3 hour downpour or consecutive days with rain; more often and more severe than 15-20 years ago)
Risk Scenario: **Poor Water Quality** – **different water plants growing**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓	✓				✓		✓		✓	✓	
Low (2)				✓	✓								✓
Moderate (3)	✓							✓		✓			
High (4)						✓							
Very High (5)													

Consequence = 4
Likelihood = 1.9

Notes:

- Likelihood that this may occur at least once during the planning period if extreme precipitation occurs more often

- Health and Safety: could cause illness
- Displacement: very low
- Loss of Livelihood: very low
- Property Damage: could cause damage to docks and boats
- Financial Impact: cost to repair
- Impact on Community Finances: could cause damage to water intake or cause for repair
- Air: very low
- Water: lower oxygen levels
- Land: very low
- Ecosystem: loss of habitat; low oxygen levels
- Traditional Lifestyle: recreation and travel impacted

Table 42: Estimate of consequence of health issues due to poor water quality from extreme precipitation during the specified time horizon

Climate Event: **Extreme Precipitation:** 3 hour downpour or consecutive days with rain; more often and more severe than 15-20 years ago)
Risk Scenario: **Poor Water Quality** – **Heath issues: swimmers itch (10 – 15 years ago); rashes; earaches**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓		✓		✓	✓		✓		✓	✓	
Low (2)													
Moderate (3)			✓		✓					✓			✓
High (4)	✓							✓					
Very High (5)													

Consequence = 5
Likelihood = 2.1

Notes:

- Likelihood that this may occur often during the planning period if extreme precipitation occurs more often

- Health and Safety: could be long term effects (i.e. earaches could cause hearing loss)
- Displacement: very low
- Loss of Livelihood: illness could lead to job loss
- Property Damage: very low
- Financial Impact: cost to repair
- Impact on Community Finances: illness could lead to job loss
- Air: very low
- Water: water quality is obviously deteriorated if health issues are arising
- Land: very low
- Ecosystem: deteriorated water quality will have impact on ecosystems
- Traditional Lifestyle: illness

Table 43: Estimate of consequence of spring runoff causing flooding due to extreme precipitation during the specified time horizon

Climate Event: **Extreme Precipitation: (**3 hour downpour or consecutive days with rain; more often and more severe than 15-20 years ago)
Risk Scenario: **Flooding** - **Spring runoff sometimes causes flooding**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)							✓						
Low (2)													
Moderate (3)											✓	✓	
High (4)													
Very Low (5)	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓

Consequence = 5
Likelihood = 4.4

Notes:

- Likelihood that this may at least once during the planning period if extreme precipitation occurs more often

  If there is extreme flooding this could create a huge impact for the First Nation

- Health and Safety: very high
- Displacement: very high
- Loss of Livelihood: very high
- Property Damage: very high
- Financial Impact: very high
- Impact on Community Finances: very high
- Air: very low
- Water: very high
- Land: very high
- Ecosystem: very high
- Traditional Lifestyle: very high

Table 44: Estimate of consequence of flooding causing road washouts due to extreme precipitation during the specified time horizon

Climate Event: **Extreme Precipitation:** (3 hour downpour or consecutive days with rain; more often and more severe than 15-20 years ago)
Risk Scenario: **Flooding** – **road washouts**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)							✓				✓	✓	
Low (2)			✓	✓	✓								
Moderate (3)	✓	✓						✓		✓			✓
High (4)									✓				
Very High (5)						✓							

Consequence = 2
Likelihood = 2.5

Notes:

- Likelihood that this may or may not occur often during the planning period if extreme precipitation occurs more often

- Health and Safety: community member could be hurt if they were on road when it washed out
- Displacement: community members may not be able to access their homes
- Loss of Livelihood: low
- Property Damage: low
- Financial Impact: low
- Impact on Community Finances: could be huge depending on where it occurred and damage done
- Air: very low
- Water: material could run off into lake, etc
- Land: depending on the amount of washout and where it occurred
- Ecosystem: depending on the amount of washout and where it occurred
- Traditional Lifestyle: could cause problems and delays to access homes, ferry, etc

Table 45: Estimate of consequence of homes and building being flooded and causing mold due to extreme precipitation during the specified time horizon

Climate Event: **Extreme Precipitation:** (3 hour downpour or consecutive days with rain; more often and more severe than 15-20 years ago)
Risk Scenario: **Flooding** - **homes/buildings – once flooded causes mold**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)								✓	✓	✓	✓	✓	✓
Low (2)													
Moderate (3)			✓				✓						
High (4)						✓							
Very High (5)	✓	✓		✓	✓								

Consequence = 2
Likelihood = 2.5

Notes:

- Likelihood that this may occur at least once often during the planning period if extreme precipitation occurs more often

- Health and Safety: could cause health problems if exposed to mould for a long period of timeas well as the type of mold exposed to
- Displacement: once mold occurred might have to move out of home
- Loss of Livelihood: business might be based out of home
- Property Damage: mold could destroy belongings
- Financial Impact: remediation as well as replacement of property
- Impact on Community Finances: high if it was band owned housing or CMHC housing
- Air: very low
- Water: very low
- Land: very low
- Ecosystem: very low
- Traditional Lifestyle: very low

Changes to Summer

Table 46: Estimate of likelihood of impacts related to changes in summer happening in the specified time horizon

Climate Event: **Summer** (includes warmer than average temperature; periods of extreme heat; longer summer season; muggy, thick air; humid and hot)
Time Horizon (planning period): 2050s

Risk Scenario	Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Certain to Occur
e.g. damage to homes	Not likely to occur during the planning period (1)	May or may not occur during the planning period (2)	Likely to occur at least once during the planning period (3)	Likely to occur several times during the planning period (4)	Happens often and will happen again during the planning period (5)
Impacts Water Quality					
○ Water smells ○ Used to be clean/clear ○ Dirty/polluted				✓	
○ Algae takes over in the summer				✓	
○ Drinking water ✓ Stopped drinking water 10-20 years ago ✓ Can't drink the water anymore				✓	
○ Much more weeds				✓	
○ Different water plants growing			✓		
○ Health Issues ✓ Swimmers Itch (10-15 years ago) ✓ People get different rashes from the water ✓ Earaches					✓
Changes in swamps					
○ Swamps behind the island (i.e. SE side of island) have dried up or shrunk			✓		
○ Swamps drain faster			✓		
○ Not draining properly				✓	

Table 47: Estimate of consequence of water smelling and being dirty and polluted due to poor water quality due to changes in summer during the specified time horizon

Climate Event: **Summer** (includes warmer than average temperature; periods of extreme heat; longer summer season; muggy, thick air; humid and hot)
Risk Scenario: **Impacts to Water Quality** – **water smells, use to be clean/clear, dirty/polluted**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)			✓	✓			✓		✓				
Low (2)		✓									✓	✓	
Moderate (3)													✓
High (4)					✓								
Very High (5)	✓					✓		✓		✓			

Consequence = 4
Likelihood = 2.9

Notes:

- Likelihood that this may occur several times during the planning period if changes in summer occur

- Health and Safety: could cause health issues
- Displacement: low
- Loss of Livelihood: very low
- Property Damage: very low
- Financial Impact: could have to spend money on a filtration system
- Impact on Community Finances: new treatment facility or upgrades may be needed
- Air: very low
- Water: effects water quality
- Land: very low
- Ecosystem: could destroy or cause imbalance
- Traditional Lifestyle: illness

Table 48: Estimate of consequence of algae taking over in summer due to changes in summer during the specified time horizon

Climate Event: **Summer** (includes warmer than average temperature; periods of extreme heat; longer summer season; muggy, thick air; humid and hot)
Risk Scenario: **Impacts to Water Quality** – **algae taking over in the summer**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓	✓				✓		✓		✓	✓	
Low (2)													✓
Moderate (3)	✓			✓									
High (4)					✓	✓							
Very High (5)								✓		✓			

Consequence = 4
Likelihood = 2.5

Notes:

- Likelihood that this may occur several times during the planning period if changes in summer occur

- Health and Safety: could cause illness
- Displacement: very low
- Loss of Livelihood: very low
- Property Damage:
- Financial Impact: maintenance of intake systems, docks, boats, etc
- Impact on Community Finances: maintenance of intake for treatment plant, replacement of system, beach cleanups
- Air: very low
- Water: deteriorated water quality
- Land: very low
- Ecosystem: loss of habitat; loss or damage caused
- Traditional Lifestyle: beach closures

Table 49: Estimate of consequence to drinking water: stopped drinking water 10-20 years ago, can't drink water anymore due to changes in summer during the specified time horizon

Climate Event: **Summer** (includes warmer than average temperature; periods of extreme heat; longer summer season; muggy, thick air; humid and hot)
Risk Scenario: **Impacts to Water Quality** – **Drinking water: stopped drinking water 10-20 years ago, can't drink water anymore**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓	✓	✓			✓		✓		✓	✓	
Low (2)													
Moderate (3)					✓					✓			
High (4)	✓					✓		✓					✓
Very High (5)													

Consequence = 4
Likelihood = 2.2

Notes:

- Likelihood that this may occur several times during the planning period if changes in summer occur

- Health and Safety: could cause illness
- Displacement: very low
- Loss of Livelihood: very low
- Property Damage: very low
- Financial Impact: community members may have to buy drinking water or filtration systems
- Impact on Community Finances: upgrade or replace treatment systems
- Air: very low
- Water: pollution
- Land: very low
- Ecosystem: loss of habitat
- Traditional Lifestyle: can't drink the water

Table 50: Estimate of consequence to much more weeds due to changes in summer during the specified time horizon

Climate Event: **Summer** (includes warmer than average temperature; periods of extreme heat; longer summer season; muggy, thick air; humid and hot)
Risk Scenario: **Impacts to Water Quality** – **much more weeds**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓	✓				✓		✓		✓	✓	
Low (2)	✓												✓
Moderate (3)				✓									
High (4)					✓	✓		✓		✓			
Very High (5)													

Consequence = 4
Likelihood = 2.2

Notes:

- Likelihood that this may occur several times during the planning period if changes in summer occur

- Health and Safety: could get caught in the weeds
- Displacement: very low
- Loss of Livelihood: very low
- Property Damage: boats get caught in the weeds and cause damage
- Financial Impact: boats get caught in the weeds and cause damage
- Impact on Community Finances: could cause damage to water intake as well as ferry boats
- Air: very low
- Water: low oxygen levels
- Land: very low
- Ecosystem: loss of habitat
- Traditional Lifestyle: recreation and travel impacted

Table 51: Estimate of consequence to different water plants growing due to changes in summer during the specified time horizon

Climate Event: **Summer** (includes warmer than average temperature; periods of extreme heat; longer summer season; muggy, thick air; humid and hot)
Risk Scenario: **Impacts to Water Quality** – **different water plants growing**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓	✓				✓		✓		✓	✓	
Low (2)				✓	✓								✓
Moderate (3)	✓							✓		✓			
High (4)						✓							
Very High (5)													

Consequence = 3
Likelihood = 1.9

Notes:

- Likelihood that this may occur at least once during the planning period if extreme precipitation occurs more often

- Health and Safety: could cause illness
- Displacement: very low
- Loss of Livelihood: very low
- Property Damage: could cause damage to docks and boats
- Financial Impact: cost to repair
- Impact on Community Finances: could cause damage to water intake or cause for repair
- Air: very low
- Water: lower oxygen levels
- Land: very low
- Ecosystem: loss of habitat; low oxygen levels
- Traditional Lifestyle: recreation and travel impacted

Table 52: Estimate of consequence of health issues due to changes in summer during the specified time horizon

Climate Event: **Summer** (includes warmer than average temperature; periods of extreme heat; longer summer season; muggy, thick air; humid and hot)
Risk Scenario: **Impacts to Water Quality** – **Health Issues: Swimmers Itch (10-15 years ago); people get different rashes from the water; earaches**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓		✓		✓	✓		✓		✓	✓	
Low (2)													
Moderate (3)			✓		✓					✓			✓
High (4)								✓					
Very High (5)	✓												

Consequence = 5
Likelihood = 2.2

Notes:

- Likelihood that this may occur often during the planning period if extreme precipitation occurs more often

- Health and Safety: could be long term effects (i.e. earaches could cause hearing loss)
- Displacement: very low
- Loss of Livelihood: illness could lead to job loss
- Property Damage: very low
- Financial Impact: cost to repair
- Impact on Community Finances: illness could lead to job loss
- Air: very low
- Water: water quality is obviously deteriorated if health issues are arising
- Land: very low
- Ecosystem: deteriorated water quality will have impact on ecosystems
- Traditional Lifestyle: illness

Table 53: Estimate of consequence swamps drying up due to changes in summer during the specified time horizon

Climate Event: **Summer** (includes warmer than average temperature; periods of extreme heat; longer summer season; muggy, thick air; humid and hot)
Risk Scenario: **Changes in swamps – swamps behind the island (i.e. SE side of island) have dried up or shrunk**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓	✓	✓	✓	✓	✓		✓		✓	✓	✓
Low (2)													
Moderate (3)	✓												
High (4)													
Very High (5)								✓		✓			

Consequence = 3
Likelihood = 1.8

Notes:

- Likelihood that this may at least once during the planning period if changes in summer occurs

- Health and Safety: moderate
- Displacement: very low
- Loss of Livelihood: very low
- Property Damage: very low
- Financial Impact: very low
- Impact on Community Finances: very low
- Air: very low
- Water: very high; concerns that water is not being filtered properly before reaching lake
- Land: very low
- Ecosystem: very high; habitat being lost
- Traditional Lifestyle: very low

Table 54: Estimate of consequence swamps draining faster due to changes in summer during the specified time horizon

Climate Event: **Summer** (includes warmer than average temperature; periods of extreme heat; longer summer season; muggy, thick air; humid and hot)
Risk Scenario: **Changes in swamps – swamps draining faster**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓	✓		✓		✓		✓		✓	✓	
Low (2)				✓		✓							✓
Moderate (3)													
High (4)	✓							✓		✓			
Very High (5)													

Consequence = 3
Likelihood = 1.8

Notes:

- Likelihood that this may at occur least once during the planning period if changes in summer occurs

- Health and Safety: could link to flooding
- Displacement: very low
- Loss of Livelihood: very low
- Property Damage: moderate
- Financial Impact: very low
- Impact on Community Finances: low
- Air: very low
- Water: very high; swamps draining faster do not allow for the purification of the water before it goes into the lake
- Land: very low
- Ecosystem: high; cold cause an imbalance and damage to habitat
- Traditional Lifestyle: low

Table 55: Estimate of consequence swamps not draining properly due to changes in summer during the specified time horizon

Climate Event: **Summer** (includes warmer than average temperature; periods of extreme heat; longer summer season; muggy, thick air; humid and hot)
Risk Scenario: **Changes in swamps – swamps not draining properly**
Time Horizon (planning period): 2050s

	Social			Economic			Environmental				Cultural		
Consequence	Health & Safety	Displacement	Loss of Livelihood	Property Damage	Financial Impact	Impact on Community Finances	Air	Water	Land	Ecosystem	Traditional Food	Traditional Medicine	Traditional Lifestyle
Very Low (1)		✓	✓	✓	✓		✓				✓	✓	
Low (2)						✓							✓
Moderate (3)									✓				
High (2)	✓							✓		✓			
Very High (5)													

Consequence = 3
Likelihood = 1.8

Notes:

- Likelihood that this may occur several time during the planning period if changes in summer occurs

- Health and Safety: could link to flooding
- Displacement: very low
- Loss of Livelihood: very low
- Property Damage: moderate
- Financial Impact: very low
- Impact on Community Finances: low
- Air: very low
- Water: very high; swamps draining faster do not allow for the purification of the water before it goes into the lake
- Land: very low
- Ecosystem: high; cold cause an imbalance and damage to habitat
- Traditional Lifestyle: low

Table 56: Risk evaluation matrix – Change in Winter

Consequence						
	Very High			• Transportation: Road deteriorating faster • Transportation: Damage to ice road landings		
	High			• Transportation: Pressure cracks		
	Mod-erate			• Transportation: Stress on ferry due to break through ice • Ice Quality: Loss of community members through ice	• Ice Quality: thinning	
	Low		• Ice Quality: Ice lasted longer		• Ice Quality: Freeze-up getting later and breaking up earlier	
	Very Low					
		Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Uncertain to Occur
		Likelihood				

	Very high risk: immediate controls required
	High risk: high priority control measure required
	Moderate risk: some controls required to reduce risk to lower levels
	Low risk: controls not likely
	Very low risk: does not require further consideration

Table 57: Risk evaluation matrix – Wind

Consequence						
	Very High	• Wildfire				
	High					
	Mod-erate				• Transportation: Using scoots less	• Transportation: Ice pile-up • Transportation: stress on ferry due to breaking through the ice
	Low			• Transportation : damage to ice road landings • Transportation : pressure cracks		
	Very Low					
		Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Uncertain to Occur
		Likelihood				

	Very high risk: immediate controls required
	High risk: high priority control measure required
	Moderate risk: some controls required to reduce risk to lower levels
	Low risk: controls not likely
	Very low risk: does not require further consideration

Table 58: Risk evaluation matrix – Drought

Consequence						
	Very High		• Wldfire			
	High					
	Mod-erate			• Creeks not draining properly		
	Low			• Creeks drying up		
	Very Low					
		Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Uncertain to Occur
		Likelihood				

	Very high risk: immediate controls required
	High risk: high priority control measure required
	Moderate risk: some controls required to reduce risk to lower levels
	Low risk: controls not likely
	Very low risk: does not require further consideration

Table 59: Risk evaluation matrix – Extreme precipitation (3 hour downpour or consecutive days with rain; more often and more severe than 15-20 years ago)

Consequence						
	Very High		• Poor Water Quality: Heath issues		• Flooding – spring runoff sometimes causes flooding	
	High		Poor Water Quality: • algae taking over in summer • drinking water (stopped drinking water 10-20 yrs ago; can't drink water anymore) • more weeds • different water plants growing	• Poor Water Quality: water smells, used to be clean and clear, dirty/polluted		
	Mod-erate					
	Low			• Flooding: road washouts • Flooding: homes/buildings (mold)		
	Very Low					
		Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Uncertain to Occur
		Likelihood				

	Very high risk: immediate controls required
	High risk: high priority control measure required
	Moderate risk: some controls required to reduce risk to lower levels
	Low risk: controls not likely
	Very low risk: does not require further consideration

Table 60: Risk evaluation matrix – Changes to Summer (includes warmer than average temperature; periods of extreme heat; longer summer season; muggy, thick air; humid and hot)

Consequence						
	Very High		Impacts to Water Quality: • Health issues			
	High		Impacts to Water Quality: • Drinking water (stopped drinking water 10 – 20 years ago, can't drink water anymore) • Much more weeds	Impacts to Water Quality: • water smells, used to be clean/clear; dirt/polluted • algae taking over in the summer		
	Mod-erate		Impacts to Water Quality: • different water plants growing Changes in swamps: • swamps behind island have dried up or shrunk • swamps draining faster • swamps not draining properly			
	Low					
	Very Low					
		Very Unlikely to happen	Occasional Occurrence	Moderately Frequent	Occurs Often	Virtually Uncertain to Occur
		Likelihood				

	Very high risk: immediate controls required
	High risk: high priority control measure required
	Moderate risk: some controls required to reduce risk to lower levels
	Low risk: controls not likely
	Very low risk: does not require further consideration

Interactive Workshop with Community Members

In Year 2 of this project, as shown in the previous section, the project team conducted a risk assessment of the priority impacts, under 5 different climate hazards, identified from the TEK survey conducted in Year 1. The five climate hazards identified from the survey and used in the risk assessment included: changes in winter, changes in summer, wind, drought, and extreme precipitation. The impacts identified in the TEK surveys were visualized by mapping them in an influence diagram or impact tree for each of the climate hazards. In doing this, the project team was able to categorize the impacts into groups including impacts to transportation, creeks, water quality, and flooding, etc. The impact trees were presented to the Advisory Committee and the members were asked to rank each group in order of priority. The impacts related to the top 2 priority areas were considered for the risk portion of the assessment.

The project team chose the time horizon of the 2050s (2041 – 2070) as the planning period and using the projections of climate change for Ontario and the Lake Simcoe area estimated the likelihood and the consequence of the current impact in changes continued into the future.

The interactive workshop was held to provide an update on the project and to have community members think about the consequences of climate change in their community. Specifically, how bad would it be for them, and the community if changes in winter, summer, to drought, extreme precipitation, and wind continued to happen into the future. This helped community members understand how the risks of climate change will not only affect the community, but will affect them personally and why it is important to develop adaptation action to minimize these risks. The project team chose one of the top two priority impact areas identified by the Advisory Committee to use in the interactive workshop.

Year Three

4. Develop adaptation actions

Table 61: List of adaptation actions

Risk	Adaptation Action

Table 62: Evaluation of adaptation actions

Risk	Adaptation Action	Timeframe to Implement	Cost	Effectiveness	Acceptability

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Appendix 1 – Traditional Ecological Knowledge Survey

Traditional Knowledge Survey Questions

This questionnaire was created by Dr. David Pearson, Laurentian University, Sudbury for the collection of Traditional Ecological Knowledge for Adaptation Planning in the Far North

Recipient name: _____ Interview #: _____
Interviewed by: _____ Date: _____

Changes in the "bush" – Trees and plants in your

1. Have you noticed any changes in the plants or the trees in the bush such as:
    - Areas of dead or dying trees or shrubs
    - New species or
    - Anything that has disappeared or appeared

    If so, how have they changed?
2. Is finding medicinal and edible plants harder or easier than it used to be? Why/how?
3. Do you think any of the changes in the bush have caused a problem for people in your community? Or have they been good for people? **How** has these changes affected the people in the community?

Changes in lakes and rivers

4. Have you noticed any changes in the lakes, rivers and creeks in your area, such as unusual water levels, temperature or colour? (pressure cracks, water quality)
5. If there is a large river in the community, have you noticed any changes in its flow or when it freezes and breaks up? (or lake)
6. Have you noticed any changes in the water plants found in lakes, rivers and creeks? If so, how?
7. Have you noticed unusual growth of green scum (algae) in any lakes or creeks? If so, where?
8. Do you think any of the changes in lakes and rivers have been good for people in the community? Have any changes been bad for people? How?

Changes in swamps and wet areas

9. Have you noticed swamps and wet areas changing in size or looking different in any way?

Changes in fish

10. Has the fishing changed in the community? For example, have you noticed any change in the kinds of fish or their number or size or do any of them seem to be unhealthy?
11. Have you noticed any changes in the places and dates when fish spawn?
12. Do people in your family eat the same kinds of fish and as much fish as they used to?

Other comments/concerns about changes in fish

Changes in birds, animals and insects

13. Have you noticed any kinds of birds or insects or animals you haven't seen before?
14. Have you noticed greater numbers of some kinds of birds or insects or animals? Have any of them begun to behave differently?
15. Have any changes in birds or insects or animals affected you or other people in some way?
16. Has there been any decrease of insects?

Changes in air and clouds

17. Have you noticed any changes in the air at any time during the year?
18. Have cloud shapes and patterns changed at some times of the year?

Changes in winter and spring

19. Have you noticed any change in winter temperatures? Spring temperatures? Compared with when?
20. Has there been any rain during the winter in recent years? Has it been a problem?
21. Has the date of first and last snowfall changed? From when to when?
22. How has your community been affected by changes in winter roads? (pressure cracks etc)
23. Have animals been affected by changes in winter weather and ice on lakes and rivers in your ?
24. Have you noticed changes in the date of freeze up of lakes and when the ice breaks up in the spring? Has that affected you or anyone you know?
25. Is the Spring run-off different from the past in any way?

Changes in weather during the rest of the year

26. Have you noticed changes in summer temperatures and rainfall? Compared to when?
27. Are long periods of dry or hot summer weather affecting your community more than in the past? Compared to when?
28. Have you noticed any changes in the number of windstorms and rainstorms and how severe they are? Perhaps thunder and lightning at different times of the year?
29. Has the community been affected by wildfires?

Effects of changing weather on buildings, roads and utilities

30. Do rainstorms cause flooding in your community? More than in the past? At what time of year?
31. How has changes in weather affected :
    - homes and other buildings
    - power lines
    - drinking water

32. What have people done about these changes?

Weather emergencies

33. Have you noticed changes in flooding in your community?
34. Does the spring break-up cause problems in your community? Are any of those problems different from the past?

Health

35. Have any changes in weather led to health problems in your community? Including problems like diseases carried by insects?

Other Climate Change Concerns within the Community:

Researcher	Variable	Winter	Spring	Summer	Fall	Annual
CCCSN	Change in mean Temperature (°C)	3	3.4	2.8	2.9	2.8
Huang		4 (1.6 - 5.1)	3.3 (1.5 - 4.0)	4.0 (1.8 - 4.9)	3.7 (1.6 - 4.2)	4.0 (1.7 - 4.5)
Gula and Peltier		2.5 - 3.5		3-Feb		2.5 - 3
CCCSN	Change in Precipitation (%)	10.76	9.65	-0.62	3.85	10.76
Huang		15.3 (3.7 to 32.7)	9.7 (3.1 to 20.8)	-5.7 (-6.4 to - 24.1)	-4.0 (-3.8 to 6.9)	5.6 (-1.2 to 16.6)
Gula and Peltier		-5 to 5		0 to -20		-10 to 10