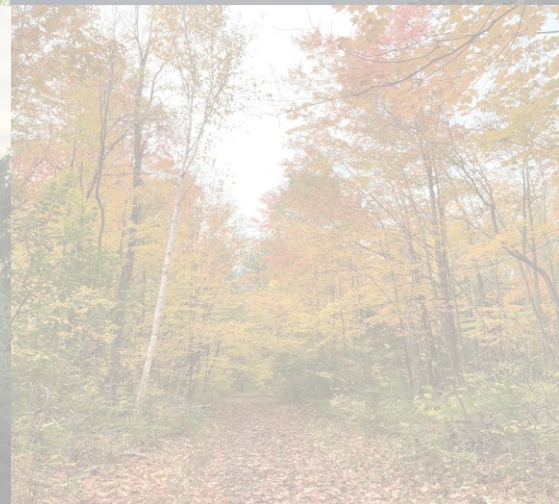
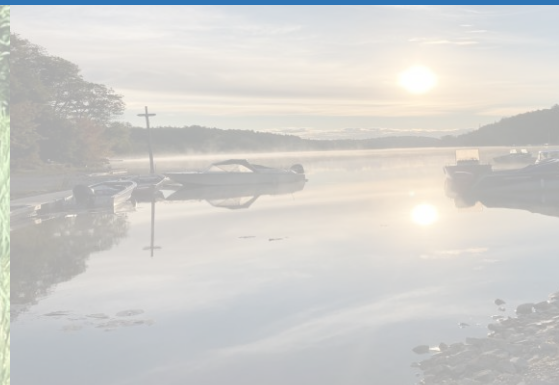
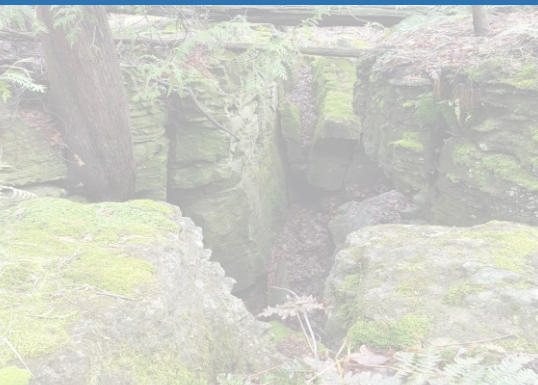




# TWO APPROACHES, ONE SHARED LEARNING JOURNEY TO SUPPORT CLIMATE-HEALTH ADAPTATION PLANNING



*Project Partners:*



**simcoe  
muskoka**  
DISTRICT HEALTH UNIT



**Public Health  
Agency of Canada**

**Agence de la santé  
publique du Canada**

## Report Authors

**Sarah K. Warren**

BHSc, MPH, Policy Analyst<sup>1</sup>, Climate Change and Health Project Associate<sup>2</sup>

**Kerry Ann Charles-Norris**

Environment Partnership Coordinator<sup>3</sup>

**Ainslie Butler**

BSch, PHD, Epidemiologist<sup>2</sup>

**Katie Hayes**

BA, MA, PhD, Climate Change and Health Project Associate<sup>2</sup>

**Rachel Mitchell**

BA, MES, Climate Change and Health Project Associate<sup>2</sup>

**Ahalya Mahendra**

MHSc, Epidemiologist<sup>1</sup>

**Brenda Armstrong**

CIPHI(C), BASc, MPH, Program Manager<sup>2</sup>

**Date:** December 2020

### Author Affiliations

<sup>1</sup> Public Health Agency of Canada, Ontario Region

<sup>2</sup> Simcoe Muskoka District Health Unit

<sup>3</sup> Cambium Indigenous Professional Services

## TABLE OF CONTENTS

Report Authors.....	2
Table of Contents.....	3
<b>Module One: Figures</b> .....	7
<b>Module One: Tables</b> .....	7
<b>Module Two: Figures</b> .....	8
Acknowledgements.....	9
Executive Summary.....	10
Module 1 .....	15
Module One: Executive Summary.....	16
1 Background.....	19
<b>1.1 Introducing Climate Change</b> .....	19
1.1.1 <i>Causes of Climate Change</i> .....	19
<b>1.2 Climate Change Impacts</b> .....	20
1.2.1 <i>Public Health Impacts of Climate Change</i> .....	20
1.2.2 <i>Climate Related Health Outcomes in Ontario</i> .....	20
<b>1.3 Variability of Climate Change Impacts on Human Populations</b> .....	22
1.3.1 <i>Vulnerability (Exposure, Sensitivity, and Adaptive Capacity)</i> .....	22
1.3.2 <i>Disproportionate Impacts and Health Inequities of Climate Change</i> .....	24
<b>1.4 Climate Change Action for Public Health</b> .....	25
1.4.1 <i>Climate Change Adaptation and Mitigation</i> .....	25
1.4.2 <i>Co-Benefits of Climate Change Action</i> .....	27
1.4.3 <i>Aligning Public Health Competencies with Climate Change Action</i> .....	27
2 Introduction .....	29
3 Methods .....	30
<b>3.1 Scoping Reviews</b> .....	30
<b>3.2 Research Team and Partners</b> .....	30
<b>3.3 Review Question and Scope</b> .....	31
3.3.1 <i>Research Question</i> .....	31
3.3.2 <i>Scope and Inclusion Criteria</i> .....	31
<b>3.4 Search Strategy</b> .....	34
<b>3.5 Literature Selection</b> .....	34
<b>3.6 Data Characterization and Extraction</b> .....	35

3.7	Analyzing, Summarizing, and Reporting.....	35
3.8	Collaboration.....	36
4	Results .....	36
4.1	Results of Search Strategy and Literature Selection .....	36
4.2	Trends by Year .....	37
4.2.1	Number of articles published by year .....	37
4.2.2	Time Trends by Intervention Type .....	38
4.2.3	Time Trends by Main Climate-sensitive Category.....	38
4.3	Trends by Geography .....	40
4.3.1	Geographic Distribution of Relevant Literature .....	40
4.3.2	Geographic Distribution by Intervention Type .....	41
4.3.3	Geographic Distribution by Climate-sensitive Categories.....	42
4.4	Trends by Intervention Types .....	44
4.4.1	Distribution of Articles by Intervention Type .....	44
4.5	Trends by Climate-sensitive Categories .....	47
4.5.1	Distribution of Articles by Main Climate-sensitive Category .....	47
4.5.2	Distribution of Articles by Specific Climate-sensitive Categories.....	48
4.5.3	Intervention Types that Address Vector-borne Disease .....	49
4.5.4	Intervention Types that Address Extreme Temperature .....	49
4.5.5	Intervention Types that Address Extreme Weather .....	50
4.5.6	Intervention Types that Address Air Quality .....	51
4.5.7	Intervention Types that Address Food and Water.....	53
4.5.8	Intervention Types that Address Ultraviolet Radiation .....	54
4.6	Interventions that Address Multiple Main Climate-sensitive Categories.....	55
4.7	Articles that Addressed Mental Health .....	56
4.7.1	Time Trends and Mental Health.....	56
4.7.2	Geographic Trends and Mental Health.....	57
4.7.3	Intervention Types that Address Mental Health .....	57
4.7.4	Common Climate-sensitive Categories Identified .....	57
5	Discussion.....	59
5.1	Summary of the range and characteristics of literature on climate-health adaptation interventions.....	59
5.1.1	Time Trends.....	59
5.1.2	Geographic Trends.....	60
5.1.3	Key Characteristics of Existing Climate-health Adaptation Interventions.....	62
5.2	Gaps in Knowledge and Practice .....	66
5.3	Recommendations for Practice and Research.....	70
5.3.1	Applying Results to Climate Change and Public Health Adaptation Planning .....	70

5.3.2	<i>Applying Results to Advance Public Health Practice and Knowledge</i> .....	72
6	<b>Conclusion</b> .....	74
6.1	<b>Strengths and Limitations</b> .....	75
6.2	<b>Next Steps to Enhance the Findings of this Scoping Review</b> .....	76
	<b>Appendices</b> .....	78
	<b>References</b> .....	93
	<b>Module 2</b> .....	120
	<b>Preface</b> .....	121
	<b>Module Two: Executive Summary</b> .....	122
1	<b>Introduction</b> .....	125
2	<b>A brief history of Indigenous peoples of Turtle Island</b> .....	126
	<b>The Indian Act</b> .....	128
	<b>First-First Nations Nurse</b> .....	129
	<b>Jordan’s Principle</b> .....	130
	<b>Connection Story</b> .....	131
3	<b>Interconnectedness to the land</b> .....	131
	<b>Traditional Ecological Knowledge</b> .....	134
	<b>Case Story</b> .....	135
	<b>Case Story</b> .....	136
	<b>Climate Change And Health Adaptation Program</b> .....	137
4	<b>Truth and Reconciliation</b> .....	137
5	<b>Including the Indigenous voice</b> .....	141
	<b>Examples of Organization Actions</b> .....	141
5.1	<b>Nothing About us Without Us</b> .....	145
	<b>Examples of Best Practices</b> .....	145
5.2	<b>Ethical Space</b> .....	145
	<b>Application Of “Two-Eyed-Seeing”</b> .....	146
5.3	<b>Two Eyed Seeing</b> .....	146
5.4	<b>Seven Grandfather Teachings</b> .....	147
5.4.1	<i>Humility,</i> .....	147
5.4.2	<i>Courage</i> .....	147
5.4.3	<i>Honesty,</i> .....	147
5.4.4	<i>Wisdom,</i> .....	147
5.4.5	<i>Truth,</i> .....	148
5.4.6	<i>Respect,</i> .....	148

5.4.7 Love, .....	148
<b>5.5 Seven Generation Thinking .....</b>	<b>148</b>
<b>Case Story of Positive Change.....</b>	<b>149</b>
<b>6 Key Messages .....</b>	<b>149</b>
<b>Appendices .....</b>	<b>152</b>
<b>References.....</b>	<b>162</b>

## Module One: Figures

Figure 1: Conceptual Model of Climate Change Vulnerability .....	23
Figure 2: Core Public Health Values and Competencies .....	28
Figure 3: Climate-sensitive Categories Relevant to Ontario, Included in the Scoping Review ...	33
Figure 4: PRISMA Flow Diagram .....	37
Figure 5: Distribution of Public Health Intervention Types by Publication Year .....	38
Figure 6: Distribution of Climate-sensitive Categories by Publication Year .....	39
Figure 7: Distribution of Articles by Geography Region .....	40
Figure 8: Distribution of Articles by Public Health Intervention Type (N=104) .....	44
Figure 9: Distribution of Articles by Main Climate-sensitive Category .....	47
Figure 10: Frequency of the Specific Climate-sensitive Categories Related to Each Main Climate-sensitive Category .....	48
Figure 11: Chord graph showing inter-relation in climate-health adaptation literature across climate-sensitive categories. Increasing chord thickness indicates more articles addressing both climate-sensitive categories.....	55
Figure 12: Summary of Articles that Address Mental Health by Publication Year .....	57

## Module One: Tables

Table 1: Major Climate-Related Health Concerns within Ontario .....	21
Table 2: Intervention Type Categories, Included in the Scoping Review .....	33
Table 3: Distribution of Articles by Publication Year .....	37
Table 4: Distribution of Articles by Main Geographic Regions and Public Health Intervention Type.....	41
Table 5: Distribution of Articles by Main Geographic Region and Main Climate-sensitive Category .....	43
Table 6: Summary of the Main Climate-sensitive Categories Addressed in Articles that use Each Public Health Intervention Type.....	45
Table 7: Summary of Public Health Intervention Types Used in Articles that Address Vector- borne Disease and Related Specific Climate-sensitive Categories.....	49
Table 8: Summary of Public Health Intervention Types Used in Articles that Address Extreme Temperature and Related Specific Climate-sensitive Categories .....	50



Table 9: Summary of Public Health Interventions Used in Articles that Address Extreme Weather and Related Specific Climate-sensitive Categories .....	51
Table 10: Summary of Public Health Interventions Used in Articles that Address Air Quality and Related Specific Climate-sensitive Categories .....	52
Table 11: Summary of Public Health Interventions Used in Articles that Address Food and Water Safety and Security and Related Specific Climate-sensitive Categories.....	53
Table 12: Summary of Public Health Interventions Among Literature that Addresses Ultraviolet Radiation (N=5) .....	54
Table 13: Articles that Highlight One Intervention that Addresses Multiple Climate-sensitive Categories.....	55
Table 14: Literature that Highlights Climate-related Mental Health Outcomes .....	58

## **Module Two: Figures**

Figure 1: First Nations Clan System .....	132
Figure 2: First Nations Perspective on Health and Wellbeing.....	133
Figure 3: Justice Murray Sinclair Statement .....	136



## **ACKNOWLEDGEMENTS**

The authors are grateful for the knowledge and expertise shared by the members of the Knowledge Translation Advisory Committee, listed below, who continue to provide guidance in developing knowledge translation products to communicate the findings of the knowledge synthesis projects.

The authors would like to acknowledge the efforts of Library Technicians Camille Coles, Simcoe Muskoka District Health Unit (SMDHU) and Lisa Glandon, Public Health Agency of Canada (PHAC) whose knowledge and expertise were instrumental in completing the literature search and report writing. A special thanks to Rachel Carson from SMDHU for her keen eye in formatting and editing. Thank you to Steven Rebellato and Dr. Charles Gardner from SMDHU and Elfreda Burkolder of PHAC for your unwavering support for this project. Lastly, the authors would like to acknowledge those they that have learned from over the years, who have shared their truths which have helped in the writing of this document.

### **Knowledge Translation Advisory Committee**

- Birgit Isernhagen, Ottawa Public Health
- Christina Schwantes, ICLEI Canada
- Donald Cole, Dalla Lana School of Public Health; Grey Bruce Health Unit
- Helen Doyle, Ontario Public Health Association, Environmental Health Working Group
- Lee Sieswerda, Thunder Bay District Health Unit
- Lisa Munday, Kingston, Frontenac and Lennox & Addington Public Health
- Morgan Levison, York Region
- Sue Shikaze, Haliburton, Kawartha, Pine Ridge District Health Unit
- Vidya Anderson, University of Toronto Climate Lab

## EXECUTIVE SUMMARY

Climate change has and will continue to have growing public health implications for the population of Ontario. Public health authorities have a duty to respond and are progressively working to address the health impacts of climate change. Many public health authorities are conducting climate change and health vulnerability and adaptation assessments. Adaptation planning is the next step public health authorities must take to promote and protect health and wellbeing, enhance resilience, and reduce the health risks associated with climate change. In doing so, the realization has been made that Indigenous world views need to be actively sought out and meaningfully incorporated into this work to ensure the most comprehensive plans reflective of the whole Ontario context are being developed moving forward.

The Public Health Agency of Canada, Ontario Region (PHAC), Simcoe Muskoka District Health Unit (SMDHU), and Cambium Indigenous Professional Services (CIPS) collaborated to conduct two knowledge synthesis projects. Module One describes a scoping review led by PHAC and SMDHU. Module Two, written by CIPS, illustrates Indigenous perspectives and the importance of including these perspectives into climate-adaptation, as well as strategies to assist public health authorities in doing so. Combined, the two knowledge synthesis projects bring together Western and Indigenous knowledge. They address a practical need of local public health authorities in Ontario to build an evidentiary basis to support climate-health adaptation planning, and advance public health practice and research.

### Climate-sensitive Categories

- Extreme Weather
- Extreme Temperature
- Air Quality
- Vector-borne Disease
- Water and Food Quality and Quantity
- Ultraviolet Radiation

### Public Health Adaptation Interventions

- Health Communication
- Health Promotion
- Environmental Adaptations
- Policy
- Planning/Decision-making
- Surveillance
- Guidelines/Frameworks
- Alerts/Advisories/Warnings
- Other

## **MODULE ONE: Characteristics of existing public health climate change adaptation interventions: A scoping review**

**S.K. Warren, A. Butler, K. Hayes, R. Mitchell, A. Mahendra, B. Armstrong**

The scoping review synthesized knowledge from the literature on climate-health adaptation interventions relevant to Ontario across six climate-sensitive categories. A summary of key findings is as follows:

### ***Time Trends***

- In recent years, climate-health adaptation interventions applicable to Ontario were increasingly implemented and published.
- The distribution of public health intervention types used and climate-sensitive categories addressed within captured literature has changed between 2014 and 2019. Changes in the frequency of publication reflect a growing empirical knowledge of the complex linkages between climate change and related health risks.

### ***Geographic Trends***

- Examples of climate-health interventions from North America (particularly Canada and the USA) and Europe are most likely to apply to the Ontario context.
- There are variations in the distribution of particular climate-sensitive categories and intervention types across geographic areas:
  - Areas with experience managing similar health risks can be useful for local adaptation planning (e.g. Australia has good examples of interventions that address ultraviolet radiation).
  - Specific regions more frequently apply different intervention types (e.g. Europe, notably the United Kingdom, captured the most examples of policy interventions).

### ***Characteristics of Existing Climate-Health Adaptation Interventions***

- The public health intervention types identified most frequently were planning/decision-making, followed by health communication. The least common intervention type addressed was guidelines/framework.
- The most frequently reported climate-sensitive category was vector-borne disease, followed by extreme temperature. Ultraviolet radiation and food and water categories were captured less.
- Certain intervention types are more commonly applied to specific climate-sensitive categories.

- Particular intervention types (primarily environmental adaptation and planning/decision-making) can address more than one main climate-sensitive category in a single intervention and may be an excellent investment to address climate-health risks.
- Less than 7% (n=7) of the collected literature specifically addressed mental health outcomes associated with climate change.

The analysis revealed several potential gaps regarding existing knowledge and practice.

### ***Critical Gaps in Knowledge and Practice***

- Some public health intervention types may be under-utilized (e.g. health promotion, policy and guideline/framework intervention types).
- Certain main and specific climate-sensitive categories may warrant greater attention (e.g. ultraviolet radiation, blue-green algae, foodborne illness, winter storms, extreme cold).
- Climate-mental health outcomes are insufficiently addressed.
- Public health authorities may not regularly apply a climate-health lens to all interventions that address climate-health risks and may not publish their experiences on climate-health adaptation interventions.
- Public health authorities need to make stronger efforts to include Indigenous voices in climate-health adaptation strategies.

The report outlines how public health authorities can operationalize the scoping review results to support local public health climate change adaptation planning and highlights critical areas of future research and activities to help this field of knowledge and practice further. A high-level summary of these recommendations are outlined below.

### ***Applying Results to Climate Change and Public Health Adaptation Planning***

- Geographic trends can support public health authorities to source relevant examples of climate-health adaptation interventions.
- Characteristics of existing climate-health interventions can support public health authorities to compile an inventory of possible climate-health interventions that can be adapted to implementation locally.
- Interventions that address multiple climate-sensitive categories can help public health authorities plan climate-health adaptation interventions that may provide a more significant investment return.
- Interpretation of the results reveals several vital considerations that can support public health climate change adaptation planning.

### ***Applying Results to Advance Public Health Practice and Knowledge***

- Increase knowledge translation activities.
- Explicitly integrate a climate-health lens.

- Invest in climate-health interventions.
- Continue to build an understanding of climate-health risks.
- Take responsibility in becoming educated on how to support Indigenous climate-health adaptation and ensure Indigenous perspectives are being incorporated.

## **MODULE TWO: Indigenous lens on climate change adaptation planning**

### **KA Charles-Norris**

Cambium Indigenous Professional Services conducted a related yet distinct project to complement the scope of the literature review. This complementary project identifies reasons why including Indigenous voices in climate-health adaptation has been a gap in public health practice. It introduces critical concepts of Indigenous ways of knowing and doing as well as introduces some best practices that public health authorities must understand and apply to work with and learn from Indigenous populations concerning climate adaptation. This knowledge synthesis project is based on the lived experiences of the author. The information presented can support public health authorities to work with and learn from Indigenous populations in culturally competent ways concerning climate change adaptation as well as to emphasize the importance of meaningful inclusion of Indigenous voices.

#### ***Brief History***

The *True History* of Canada, the many unethical events that occurred and the relationship that the government has had with the Indigenous peoples since contact is unknown by most. This history has not been voluntarily disclosed in the past, and even in the present, the disclosure is not a priority in our society. These events have had a profound effect on Indigenous people's health and wellbeing, have left important knowledge and wisdom out of decision-making, and the non-Indigenous peoples of today have gained privilege from them.

#### ***Interconnectedness to the Land***

Indigenous peoples have an intimate connection to the land and were gifted the knowledge and tools to learn from those who make their home in the natural environment. This gift was given by the *Creator* so that people understood how to survive and flourish in a sustainable way and maintain balance within the ecosystem, including being able to identify specific species to aid and cure sickness and observing nature to be proactive in preparing for environmental changes.

#### ***Truth and Reconciliation***

In 2007, the National Centre for Truth and Reconciliation was established as part of the Indian Residential Schools Settlement Agreement, the largest class-action settlement in Canadian history. The Truth and Reconciliation Commission was formed. As part of this journey of understanding Indigenous peoples and including them in the discussions and planning about our collective future in preparing for our changing climate, it is essential to understand the need

for healing. An understanding and acknowledgement of the effects of Residential Schools are required so that healing can occur and Indigenous peoples can be encouraged and supported in their journey of reconnecting and re-learning their language, culture, and traditions that were not just once forbidden but forcibly taken from both adults and children.

### ***Including Indigenous Voices***

Although we would like to think that we can speak in the past tense about events that have led to the inequalities and exclusion of Indigenous peoples today, the reality is that the past actions have seriously affected the present and will continue to do so in the future. We can ensure that from this point forward, we create a better future through the use of the best practices and critical concepts that have been identified that must be taken into consideration when pursuing the inclusion of Indigenous peoples voices and that those voices be meaningfully supported and incorporated.

### **Best Practices:**

- **Trust** is the foundation of meaningful engagement with Indigenous peoples.
- **Research** is necessary to have an understanding of the community that public health authorities want to engage.
- **Respect** is vital to ensure that trust will be earned.
- **Recognition** of the rights of Indigenous peoples and its representation in legislation.
- **Remember**, colonialism has an impact and that it will take time for those impacts to be rectified.
- **Responsibility** is on the public health professionals to ensure that they are educated so that they can appropriately and adequately provide climate change adaptation health services to the Indigenous peoples.

### **Critical Concepts:**

- ***Nothing About Us Without Us:*** No policy or action should be decided by any representative without the inclusion of the group in which the policy/action is affecting.
- ***Ethical Space:*** Respecting the views of others and ensuring a cooperative spirit between Indigenous peoples and Western institutions.
- ***Two-Eyed Seeing:*** Being able to see the importance of Western Science and Indigenous Knowledge and bring the best of both together.
- ***Seven Generations:*** Considering and ensuring that the decisions made today do not harm those yet to be born.
- ***Creators Law:*** All Beings have a purpose and must work together in harmony – including human beings.
- ***Seven Grandfather Teachings:*** Encompass the morals, values, structures, ceremonial practices, and spiritual beliefs of the Anishnabe people.





## MODULE 1

---

# Characteristics of existing public health climate change adaptation interventions: A scoping review

### **Module 1 Report Authors:**

**Sarah K. Warren**

BHSc, MPH, Policy Analyst<sup>1</sup>, Climate Change Project Associate<sup>2</sup>.

**Ainslie Butler**

BScH, PHD, Epidemiologist<sup>2</sup>

**Katie Hayes**

BA, MA, PhD, Climate Change Project Associate<sup>2</sup>

**Rachel Mitchell**

BA, MES, Climate Change Project Associate<sup>2</sup>

**Ahalya Mahendra**

MHSc, Epidemiologist<sup>1</sup>

**Brenda Armstrong**

CIPHI(C), BAsC, MPH, Program Manager<sup>2</sup>

### **DATE:**

December, 2020

### ***Author Affiliations***

<sup>1</sup> Public Health Agency of Canada,

<sup>2</sup> Simcoe Muskoka District Health Unit



## MODULE ONE: EXECUTIVE SUMMARY

Climate change has and will continue to have growing public health implications for the population of Ontario. Public health authorities have a duty to respond and are progressively working to address the health impacts of climate change. Many public health authorities are conducting climate change and health vulnerability and adaptation assessments. Adaptation planning is the next step public health authorities must take to promote and protect health and wellbeing, enhance resilience, and reduce the health risks associated with climate change.

A scoping review was conducted in partnership between the Public Health Agency of Canada, Ontario Region (PHAC) and Simcoe Muskoka District Health Unit (SMDHU) to support climate-health adaptation planning by local public health authorities across Ontario. The study synthesized knowledge from the literature on climate-health adaptation interventions relevant to Ontario across six climate-sensitive categories. The review highlights potential gaps in knowledge and practice. This work's findings can inform public health adaptation planning and drive future activities in practice and research. A summary of key findings grounded in the result interpretations is identified below.

### Climate-sensitive Categories

- Extreme Weather
- Extreme Temperature
- Air Quality
- Vector-borne Disease
- Water and Food Quality and Quantity
- Ultraviolet Radiation

### Time Trends

- In recent years, climate-health adaptation interventions applicable to Ontario were increasingly implemented and published.
- The distribution of public health intervention types used and climate-sensitive categories addressed within captured literature has changed between 2014 and 2019. Changes in the frequency of publication reflect a growing empirical knowledge of the complex linkages between climate change and related health risks.

### Public Health Adaptation Interventions

- Health Communication
- Health Promotion
- Environmental Adaptations
- Policy
- Planning/Decision-making
- Surveillance
- Guidelines/Frameworks
- Alerts/Advisories/Warnings
- Other

### Geographic Trends

- Examples of climate-health interventions from North America (particularly Canada and the USA) and Europe are most likely to apply to the Ontario context.
- There are variations in the distribution of particular climate-sensitive categories and intervention types across geographic areas:
  - Areas with experience managing similar health risks can be useful for local adaptation planning (e.g. Australia has good examples of interventions that address ultraviolet radiation).

- Specific regions more frequently apply different intervention types (e.g. Europe, notably the United Kingdom, captured the most examples of policy interventions).

### ***Characteristics of Existing Climate-Health Adaptation Interventions***

- The public health intervention types identified most frequently were planning/decision-making, followed by health communication. The least common intervention type addressed was guidelines/framework.
- The most frequently reported climate-sensitive category was vector-borne disease, followed by extreme temperature. Ultraviolet radiation and food and water categories were captured less.
- Certain intervention types are more commonly applied to specific climate-sensitive categories.
- Particular intervention types (primarily environmental adaptation and planning/decision-making) can address more than one main climate-sensitive category in a single intervention and may be an excellent investment to address climate-health risks.
- Less than 7% (n=7) of the collected literature specifically addressed mental health outcomes associated with climate change.

The analysis revealed several potential gaps regarding existing knowledge and practice.

### ***Critical Gaps in Knowledge and Practice***

- Some public health intervention types may be under-utilized (e.g. health promotion, policy and guideline/framework intervention types).
- Certain main and specific climate-sensitive categories may warrant greater attention (e.g. ultraviolet radiation, blue-green algae, foodborne illness, winter storms, extreme cold).
- Climate-mental health outcomes are insufficiently addressed.
- Public health authorities may not regularly apply a climate-health lens to all interventions that address climate-health risks and may not publish their experiences on climate-health adaptation interventions.
- Public health authorities need to make stronger efforts to include Indigenous voices in climate-health adaptation strategies.

The report outlines how public health authorities can operationalize the scoping review results to support local public health climate change adaptation planning and highlights critical areas of future research and activities to help this field of knowledge and practice further. A high-level summary of these recommendations are outlined below.

### ***Applying Results to Climate Change and Public Health Adaptation Planning***

- Geographic trends can support public health authorities to source relevant examples of climate-health adaptation interventions.
- Characteristics of existing climate-health interventions can support public health authorities to compile an inventory of possible climate-health interventions that can be adapted to implementation locally.
- Interventions that address multiple climate-sensitive categories can help public health authorities plan climate-health adaptation interventions that may provide a more significant investment return.
- Interpretation of the results reveals several vital considerations that can support public health climate change adaptation planning.

### ***Applying Results to Advance Public Health Practice and Knowledge***

- Increase knowledge translation activities.
- Explicitly integrate a climate-health lens.
- Invest in climate-health interventions.
- Continue to build an understanding of climate-health risks.
- Take responsibility in becoming educated on how to support Indigenous climate-health adaptation and ensure Indigenous perspectives are being incorporated.

Indigenous voices were not well captured by the scoping review. To address this and reduce the exclusion of Indigenous voices from public health climate change adaptation efforts, a related resource was developed, led by Cambium Indigenous Professional Services (CIPS), to complement the literature review's scope. This complementary project introduces critical concepts of Indigenous ways of knowing and doing and best practices that public health authorities must understand and apply to work with and learn from Indigenous populations concerning climate adaptation. This work, identified in Module Two, can support public health authorities to work with and learn from Indigenous peoples in culturally competent ways concerning climate change adaptation.

# 1 BACKGROUND

## 1.1 Introducing Climate Change

This century the global community is facing the unprecedented reality and unequivocal fact that climate change is impacting life as we know it (1-4). Swift, collective, and comprehensive action is required to reduce the impacts of and enhance resilience to climate change.

Climate change refers to the variability of climate<sup>1</sup> or variation in the mean state of climate over an extended period of time (4). Changes to climate systems are evident. To date, there has been approximately a 1°C rise in the global average temperature from preindustrial levels (5). Other climatic changes accompany temperature rise including an increase in atmospheric water vapour<sup>2</sup>, the warming of oceans, sea-level rise, and the melting of sea- and land ice (1, 2, 6). These changes are accompanied by an increase in the frequency, intensity and duration of extreme weather events and natural hazards (e.g. hurricanes), as well as extreme temperatures (7). Climatic changes impact natural and human systems in complex and interrelated ways (2, 5).

### 1.1.1 Causes of Climate Change

Climate change is an anthropogenic force, meaning it is an outcome of human activity. The current geological epoch has been identified as the Anthropocene, which recognizes the influence of human activity on the earth's systems since the Industrial Era (8, 9).

While there have always been changes to the earth's climate due to natural influences including solar action, volcanic activity, and natural oscillations of regional climate systems, the unprecedented changes observed this century go beyond natural influence (1, 9). It is clear that human activity is the main source of climate change (1, 5, 10). Since the Industrial Era, humans have increasingly burned fossil fuels and altered natural environments (11). These activities are an anthropogenic source of greenhouse gases (GHG) contributing to the build-up of atmospheric GHG levels (6). Carbon dioxide is the main source of increased atmospheric GHG and driver of anthropogenic climate change (10).

---

<sup>1</sup> Climate is defined as the average or expected weather conditions of a specific location over a long period of time, typically 30 years.

<sup>2</sup> Atmospheric water vapour is a greenhouse gas. As atmospheric temperatures increase the atmosphere is able to hold a greater concentration of water vapour which in turn enhances heat-trapping capabilities of the atmosphere and amplifies temperature warming.

## **1.2 Climate Change Impacts**

### **1.2.1 Public Health Impacts of Climate Change**

Climate change will have a significant impact on public health this century (1, 2). It will place higher demands on public health and add complexity to public health responses.

Climate change has diverse and widespread impacts on the physical, mental, and sociocultural health and wellbeing of individuals and communities (1, 2, 12, 13). The causal pathways of climate change on human health impacts are numerous and complex. Direct, health impacts include morbidity and mortality associated mainly with changes in extreme weather events and extreme temperatures (14, 15). Indirect effects are mediated through interactions with natural and human systems (15). Climate change will trigger disruptions to the physical, social, and economic systems that individuals and societies rely on, influencing the distribution of the social and ecological determinants of health (16, 17). Examples of health effects mediated through natural systems include vector-borne disease, waterborne disease, and air pollution (2, 14, 15, 18). Examples of those mediated through human systems include food insecurity, social disruption, population displacement, and mental health consequences (2, 5, 14, 15, 18).

Through indirect and direct pathways, climate change will generate new public health needs, while exacerbating existing public health problems and health inequities (2, 17, 19, 20). This expanded need may surpass local public health capacity to respond, and consequently, lead to excess negative health consequences (17).

Moreover, climate change creates additional challenges for public health response (21). Climate change is a complicated health risk, which makes addressing it more complex. For public health to effectively respond to protect human health from the impacts of climate change, reliable, accurate, and current information is essential (2). This requires the application, development and advancement of research, technologies and approaches that are, in part, contingent on available resources. Uncertainty around climate-health risks and the effectiveness of public health approaches to address those risks, and availability of required resources can restrict public health action (21). Furthermore, climate change planning and response requires a long-term approach, which has not been prioritized over more immediate public health concerns (21, 22).

### **1.2.2 Climate Related Health Outcomes in Ontario**

Climate-related health outcomes vary depending on the geographic location, environmental influences and the population of a specific area. While local-level impacts may vary, there are six main climate-sensitive categories that pose health concerns related to climate change within Ontario (23). The main climate-sensitive categories include extreme weather and natural hazards; extreme temperature; air quality; vector-borne disease; food and water safety and security (food and water); and ultraviolet radiation. A summary of projected changes and expected health impacts attributed to each climate-sensitive category within Ontario are highlighted in **Table 1**.

Table 1: Major Climate-Related Health Concerns within Ontario

Climate-sensitive Category	Potential Changes	Expected Health Impacts
Extreme Temperature	<ul style="list-style-type: none"> <li>Changes in the general weather patterns with a warming trend, punctuated by extremes of heat and cold</li> <li>More frequent, severe, and extended heatwaves</li> </ul>	<ul style="list-style-type: none"> <li>Heat-related morbidity and mortality</li> <li>Respiratory and cardiovascular disorders</li> <li>Possible changed patterns for cold-related illness and death</li> </ul>
Extreme Weather and Natural Hazards	<ul style="list-style-type: none"> <li>More frequent and severe extreme weather events like thunderstorms and tornados</li> <li>Heavy precipitation causing flooding</li> <li>Increased drought in some regions, affecting water supplies, agricultural production, and influence to wildfires</li> <li>Social and economic changes</li> </ul>	<ul style="list-style-type: none"> <li>Illness, injury, and death from storms, floods, fires, etc.</li> <li>Psychosocial health effects, including exacerbated or triggered mental illness</li> <li>Health impacts due to water and food safety and security</li> <li>Displacement of populations and crowding in emergency shelters</li> <li>Indirect health impacts from ecological changes, infrastructure damage, interrupted essential services (including health care)</li> </ul>
Air Quality	<ul style="list-style-type: none"> <li>Increased air pollution from higher levels of ground-level ozone and airborne particulate matter (including smoke and particles from wildfires)</li> <li>Changes in volume, timing and distribution of pollens and molds and increased aeroallergens produced by plants</li> </ul>	<ul style="list-style-type: none"> <li>Eye, nose, and throat irritation and shortness of breath</li> <li>Exacerbation of respiratory conditions</li> <li>Asthma and chronic obstructive pulmonary disease</li> <li>Aggravated allergies</li> <li>Increased risk of cardiovascular diseases</li> <li>Premature death</li> </ul>
Vector-borne Disease	<ul style="list-style-type: none"> <li>Changes in biology and ecosystems or geographic distribution of several insects, ticks, and rodents</li> <li>Faster maturation for pathogens within vectors</li> <li>Longer disease transmission season</li> </ul>	<ul style="list-style-type: none"> <li>Increased incidence of vector-borne diseases (i.e. Lyme Disease, West Nile Virus)</li> <li>Introduction of new or re-emerging infectious diseases within Ontario</li> </ul>
Food & Water Safety and Security	<ul style="list-style-type: none"> <li>Increased contamination of drinking and recreational water by run-off from heavy precipitation</li> <li>Increase algal blooms and other toxins</li> <li>Behaviour changes associated with warmer weather resulting in increased risk of water and foodborne illnesses</li> <li>Increased economic pressures for food consumption</li> </ul>	<ul style="list-style-type: none"> <li>Increased outbreaks of food- and waterborne illnesses</li> <li>Diarrheal and intestinal disorders</li> <li>Impact on nutrition due to changes in availability of local and traditional foods</li> </ul>
Ultraviolet Radiation	<ul style="list-style-type: none"> <li>Increased human exposure to ultraviolet radiation due to stratospheric ozone depletion and behaviour changes associated with warmer weather</li> </ul>	<ul style="list-style-type: none"> <li>Increased cases of sunburns, skin concerns, cataracts and eye damage</li> <li>Immune disorders</li> </ul>

Adapted from Berry et al. 2014 (24)., and Ebi et al. 2016. (23).

These climate-sensitive categories and associated health outcomes are not mutually exclusive but rather interact with each other. For instance, flooding is categorized as an extreme weather event that may cause injury or mortality (direct health impacts). Flooding can also interact with

other natural and human systems to cause other health impacts associated with waterborne illness, and mental health challenges.

Moreover, climate-sensitive categories can disrupt services and systems including healthcare, education, and transportation in addition to damaging infrastructure and property. These impacts on human systems will influence the social determinants of health, thus contributing to additional health risks and outcomes. These examples highlight the complex causal pathways in which climate change impacts health.

### 1.3 Variability of Climate Change Impacts on Human Populations

Climate change can impact everyone. However, the impacts of climate change will be experienced differently across geography and those impacts will be shaped by the social, ecological, and physiological determinants of health (the determinants of health) (1, 15). Some individuals and populations will be more vulnerable to the health impacts of climate change (2, 24).

#### 1.3.1 Vulnerability (*Exposure, Sensitivity, and Adaptive Capacity*)

Vulnerability to climate change is the degree to which communities or individuals tend to be adversely affected by climate-related health impacts (25). People are not inherently vulnerable to climate change; rather, vulnerability is constructed by the interaction of the determinants of health, shaped by the distribution of power, and resources (23, 26).

Vulnerability to the health impacts of climate change is predicated upon three interrelated components; exposure, sensitivity, and adaptive capacity (24, 27).

**Exposure** is the probability that a climate-related event or stressors will come into contact with a particular individual or population (25, 27). Exposure to climate change depends on factors that will determine the nature and magnitude of the exposures (25). These factors include geography, land-use, and topography of a specific region (24) as well as characteristics of the climate-related event like frequency, duration, and magnitude (28). It also includes factors influenced by the social and economic determinants of health such as occupation, poverty, the experience of discrimination, location, and quality of infrastructure where one lives, works, and plays (25).

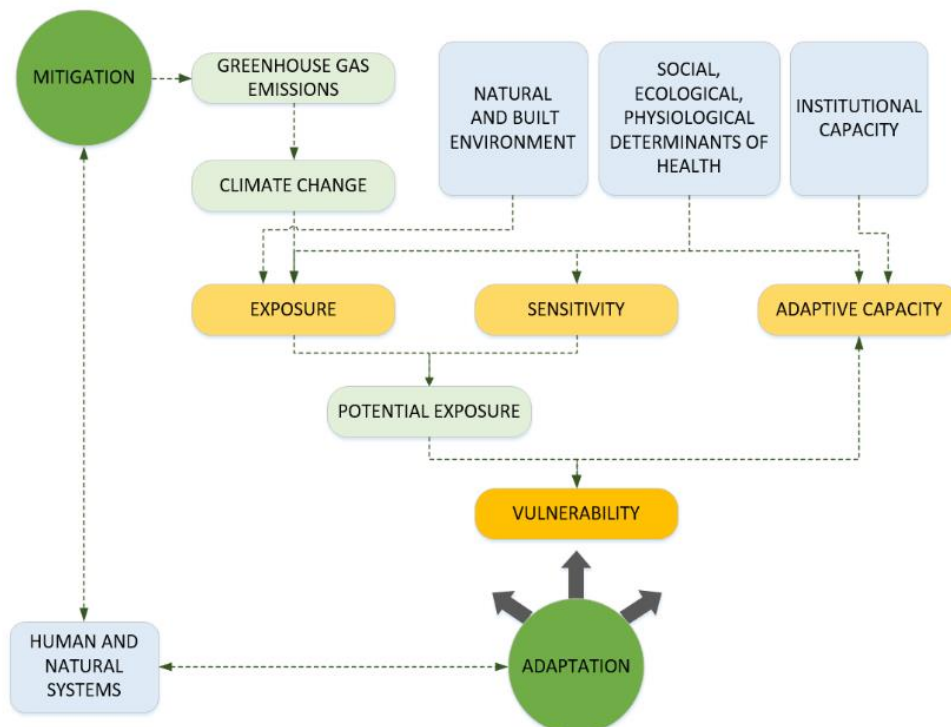
**Sensitivity** to climate change is the degree to which an individual or population is affected by a climate-related event, either positively or negatively (27). The physiological, social, and ecological determinants of health affect how climate change will impact the health of individuals and communities. These factors include, but are not limited to age, gender, health status, socioeconomic conditions such as income, education, housing, experiences of marginalization and discrimination, access to health services, other essential services, infrastructure, and access to ecological resources like water (15, 24, 27). Moreover, sensitivity is directly impacted by the effectiveness of existing adaptation measures (27).



**Adaptive capacity** is the ability of communities or individuals to successfully adapt to and manage changes posed by climate change (27, 29). Adaptive capacity is influenced by access to resources, abilities and knowledge of individuals and communities in addition to the state of infrastructure, and access to services such as health care (25, 27-29). The adaptive capacity of individuals, communities, and governments are interconnected; the extent to which local governments can cope influences the capability of individuals and communities to cope (27, 30). Adaptive capacity is tied to social capital in terms of the ability of a society to act together (28). Moreover, greater resilience; the ability to prepare for, cope with, recover from, and adapt to adverse climate-related events reflects stronger adaptive capacity (25).

The degree to which each component is affected will influence overall vulnerability to climate-related health impacts. Moreover, the experience of climate change can make individuals more vulnerable due to its influence on the determinants of health. As such, vulnerability is not only about climate change, but also life conditions that interact with climate change to either enhance or reduce overall risk (23). Vulnerability to the health impacts of climate change exists on a continuum.

Figure 1: Conceptual Model of Climate Change Vulnerability



Adapted from European Environment Agency. 2008 (31).

### **1.3.2 *Disproportionate Impacts and Health Inequities of Climate Change***

Specific populations are disproportionately affected by climate change. Climate change is a health equity issue, meaning there are unfair and avoidable differences among groups of people resulting in a disproportional burden of health impacts. These differences predominantly reflect the social determinants of health which can increase exposure and sensitivity and reduce adaptive capacity. Moreover, climate change can destabilize the determinants of health and make it more challenging for people with the least access to resources to prepare for and cope with future climate-related events. In this way, climate change can further increase health inequities (19, 30). In consequence, the least resourced and most marginalized populations are often disproportionately impacted by climate change (15, 30).

Based on existing assessments on exposure, sensitivity, and adaptive capacity, specific individuals and populations have been identified as more likely to be vulnerable to the health impacts of climate change. Such populations include:

- Older adults
- Infants and children
- Pregnant women
- Individuals with underlying health conditions
- Individuals who work outside
- Individuals with constrained access to social and economic resources
- Remote communities
- Racialized and marginalized populations

Public health authorities have a strong history of working with stakeholders to address the needs of and support populations with greater risks. However, public health engagement with Indigenous communities is less well established and is recognized within the current Ontario Public Health Standards as area of current, focused growth for public health authorities in Ontario (32). In working to supporting the needs of Indigenous communities, public health professionals are often hindered by gaps in knowledge and understanding of Indigenous peoples, the experience and impacts of colonialism, and ways to engage meaningfully.

#### **1.3.2.1 *Indigenous Populations Disproportionately Impacted by Climate Change***

Indigenous peoples and communities are disproportionately affected by climate change and its associated health outcomes (33, 34). While Indigenous peoples continuously demonstrate a high capacity to adapt to change both historically and presently, rapid changes associated with colonialism and anthropogenic climate change make this more challenging (34, 35).

Disproportionate impacts of climate change on Indigenous peoples are primarily constructed by the experience of colonization and marginalization, which undermines other determinants of health (36). Ecological conditions that support Indigenous cultures, identities, health, self-

determination and economies that are central to adaptive capacity, are and continue to be changed due to climate change (34). These changes can make geographic locations and close relationships to the environment become components of vulnerability (33, 37, 38).

Such determinants contribute to increased sensitivity and exposure while reducing adaptive capacity. Despite this, Indigenous populations continue to retain resilience and adaptive capacity, often rooted in cultural and spiritual identity (33, 34, 39-41). While Indigenous communities are often depicted as vulnerable to climate change, vulnerability is different within and between Indigenous groups based on the distribution of the determinants of health (42). Not all communities or individuals are vulnerable to climate change to the same degree.

It is essential to recognize that assessments on exposure, sensitivity, and adaptive capacity do not always focus on or include Indigenous populations (43). Moreover, those that do are typically conducted using Western conceptualizations of science, which can limit Indigenous experiences and perceptions due to dissimilarities in knowledge systems, values, power dynamics, and access (43-45). Lack of accurate and culturally appropriate assessments may restrict the development of adaptive capacity (38).

Public health authorities must learn to work with and learn from Indigenous communities in culturally appropriate means to enhance adaptive capacity and resilience to climate change. Indigenous knowledge and practices are a source of adaptive capacity (35).

## **1.4 Climate Change Action for Public Health**

Public health activities involve efforts that promote and protect health and prevent disease to improve overall health and wellbeing of a population or community and reduce health inequities within and between populations (32). Public health works to address health and wellbeing of the whole population, across all stages of life through upstream approaches that act across various channels (32).

It is clear that climate change has and will continue to have growing public health implications for the population of Ontario, and public health authorities have a duty to respond. Moreover, while climate change has been named the greatest threat to public health (2), it has also been recognized as the greatest opportunity (46).

Climate change adaptation and mitigation can directly reduce the burden of ill-health, address inequities in the social and ecological determinants of health, alleviate poverty, and enhance community and health system resilience (46). In addition, investments in climate actions have cost savings benefits (46, 47).

### **1.4.1 Climate Change Adaptation and Mitigation**

Climate change mitigation and adaptation are essential to combat climate change and reduce associated health risks (17, 30). Climate change mitigation has historically received more emphasis than adaptation (48). However, the IPCC (Interventional Panel on Climate Change)

Fourth Assessment Report (AR4) states, “that neither adaptation nor mitigation alone can avoid all climate change impacts’ however, they can complement each other and together can significantly reduce the risk of climate change” (49).

#### *1.4.1.1 Mitigation*

Climate change mitigation is defined as human actions that reduce, restrict, or remove GHGs from the atmosphere (17). Mitigation targets the sources of GHG emissions to reduce the amount released into the atmosphere or enhance GHG sinks that remove it from the atmosphere (1, 6). Thus, mitigation acts as a form of primary prevention to limit the magnitude and rate of climate change and associated health hazards (10, 17, 30, 48, 50).

Mitigation efforts should be implemented at various scales, including all levels of government, by industry and at the personal level (30). Public health plays a role in climate change mitigation. Some public health activities that support climate change mitigation includes encouraging community designs that reduce car use, advocacy for active and public transportation infrastructure, and preserving and enhancing green space (29).

#### *1.4.1.2 Adaptation*

Climate change adaptation is the process of preparing for and adjusting to actual or expected changes and impacts resulting from climate change (1, 6). Adaptation actions help communities cope with the effects of climate change that cannot be avoided by mitigation efforts (30).

Climate change adaptation aims to reduce vulnerability and enhance resilience to the impacts of climate change by ensuring that appropriate social and economic systems are in place (17).

Adaptation in a public health context involves the process of designing, implementing, monitoring, and evaluating interventions to reduce climate-health impacts or to take advantage of opportunities (51). Adaptation needs to address societal, cultural, economic, and political contexts that contribute to vulnerability (51). Adaptation addresses the impacts of climate change and thus reflects secondary and tertiary prevention (50, 52). Effective adaptation requires ongoing assessment and actions (51). Without adequate adaptation, communities will not be prepared to manage the health risks of climate change.

#### *1.4.1.3 Nexus between Adaptation and Mitigation*

The adaptation-mitigation nexus reflects the connections that link climate change adaptation and mitigation. The two approaches to climate action are not mutually exclusive and are inherently interconnected and synergistic (30, 48, 53). Adaptation and mitigation work together to produce a more significant influence on reducing vulnerability to climate change than either would separately (30, 48, 53). Adaptation efforts often have mitigation benefits, and vice versa (48). Mitigation efforts can reduce the magnitude of climate change impacts that adaptation efforts would need to manage (1, 53). Similarly, adaptation efforts contribute to reducing atmospheric GHGs, reducing the challenges and cost of mitigation efforts (1, 53).

Adaptation and mitigation strategies often have cross-cutting goals and objectives in which one approach can support the other (30, 53). This is illustrated by green space interventions which can support adaptation by reducing the Urban Heat Island effect, managing surface water runoff, and promoting mental health while also acting as a carbon sink and reducing the need for artificial cooling, effectively reducing atmospheric GHGs (30, 54).

Climate change adaptation and mitigation actions can also result in conflict or trade-offs that should be considered (30, 48, 53). This can arise due to responses or priorities that compete with one another (48). An example of a conflict that may occur between adaptation and mitigation efforts is the use of air conditioning as a method to adapt to extreme heat, which infringes on mitigation efforts by contributing to GHG emissions. Investing in sustainable energy and energy retrofits can moderate the trade-off between mitigation and adaptation.

#### **1.4.2 Co-Benefits of Climate Change Action**

Climate change action presents an extraordinary opportunity to promote and protect health and wellbeing (15, 55, 56). Addressing the root cause of climate change through mitigation will provide physical and mental health gains. Some ways in which mitigation actions can support health include: reduced air pollution, increased physical activity, decreased meat consumption, increased access to fruits and vegetables, and improved access to green space (15, 55-60).

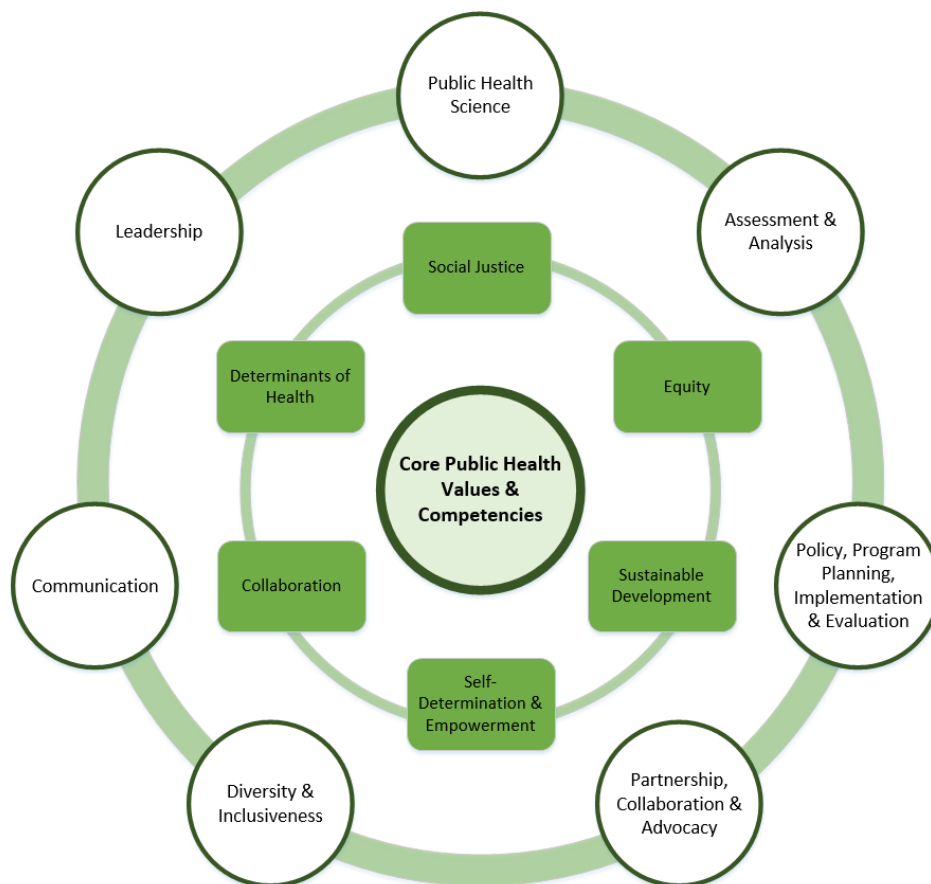
Many adaptation actions have additional mitigation and health co-benefits (55, 56, 60). Examples include green space and active transportation which can promote physical activity, positive mental health outcomes, improved air quality, and enhanced access to nutritious foods (55, 60, 61). Moreover, adaptation efforts can improve the determinants of health for additional health benefits beyond reducing climate-health risks (15).

In addition to health co-benefits, investing in climate change actions will have cost-saving benefits for individuals, organizations, and government (55, 56, 60, 62, 63). Climate actions are essential to reduce climate-health risks, but they also provide no-regret benefits that will support health and wellbeing.

#### **1.4.3 Aligning Public Health Competencies with Climate Change Action**

Public health is well suited to address climate change. Core functions, competencies, and values of public health are also required for climate adaptation (46, 50, 52, 64). Austin et al. state that, “local public health authorities are uniquely positioned to hold a large role as a key collaborator and initiator in reducing the health burden of climate change, given their implementation role, knowledge of their local population, and proximity to the impacts of climate change on health” (21). Core competencies of public health are highlighted in **Figure 2: Core Public Health Values and Competencies**.

Figure 2: Core Public Health Values and Competencies



Information Source: Public Health Agency of Canada, 2008 (65).

Many public health programs and services are necessary responses to climate change (15). Such activities include surveillance of vector-borne disease, responding to waterborne and foodborne illness outbreaks, early warning systems regarding heat, vulnerability mapping, and health communication and promotion. Moreover, core public health functions that work to address health inequities, and improve population health status reduce vulnerability to the health impacts of climate change (15). Climate change actions provide win-win situations to improve overall health and wellbeing of a population while reducing vulnerability and enhancing resilience to climate-health impacts.

## 2 INTRODUCTION

The effects of climate change on the health and wellbeing of the Ontario population is becoming increasingly apparent and understood. As more empirical evidence is undertaken and disseminated, climate-related events and associated risks are becoming more visible, and climate activism has increased awareness of the threat.

Climate change health adaptation in Ontario is in the early stages (66). Public health authorities are progressively working to address the health impacts of climate change. Many are engaged in or planning to conduct climate change and health vulnerability and adaptation assessments. Adaptation planning is the next step public health authorities must take to promote and protect health and wellbeing, enhance resilience and reduce the risks associated with climate change.

To support climate-health adaptation planning by public health authorities across Ontario, a scoping review was conducted to:

- Comprehensively review and consolidate literature on public health interventions that support climate change adaptation and address expected health impacts associated with climate-sensitive categories within Ontario;
- Summarize and disseminate findings to the public health community to inform practice and strengthen the understanding of public health interventions that address climate-health risks; and
- Identify gaps in the evidence base for climate-health adaptation interventions.

This scoping review aims to highlight the range, characteristics, and gaps in the literature available on public health interventions for climate change adaptation. The findings of this work can inform public health adaptation planning and drive future research activities.

Additionally, a related yet distinct project was conducted to complement the scope of the literature review. This complementary project captures Indigenous perspectives on climate change adaptation related to health and wellbeing. This work was led by Cambium Indigenous Professional Services (CIPS), an independent Indigenous owned consulting company whose team is uniquely all Indigenous with experience consulting and collaborating with local governments, public health, and Indigenous communities on climate change and health projects. The product provides an introduction to critical concepts, Indigenous ways of knowing and doing in addition to several examples of Indigenous-led climate change adaptation interventions. This information can support public health authorities to work with and learn from Indigenous populations in culturally competent ways concerning climate change adaptation. This project is presented in Module Two. Additional information on how this complementary project came to be is highlighted in **section 3.8**.



## 3 METHODS

### 3.1 Scoping Reviews

A scoping review provides an opportunity to synthesize knowledge and increase understanding of the range and characteristics of existing literature on climate-health adaptation and related knowledge gaps to inform public health practice, decision-making, and future research (67-69). Scoping reviews can assess the literature on broad topic areas with emerging evidence from diverse study methodologies while maintaining a systematic approach (67, 70-72).

The methodology for this scoping review followed the methodological framework established by Arksey and O'Malley (71) with enhancements as proposed by Levac, Colquhoun, and O'Brien (70). Additional insights were acquired by reviewing the experience and further recommendations from several other authors (67-69, 72-74). The review entailed the following six stages:

1. Identifying the research question;
2. Identifying relevant literature;
3. Study selection;
4. Charting the data;
5. Collating, summarizing and reporting the results; and
6. Consultation and knowledge exchange.

### 3.2 Research Team and Partners

The Simcoe Muskoka District Health Unit (SMDHU) and the Ontario Regional Office of the Public Health Agency of Canada (PHAC) collaborated to conduct this scoping review. The research team consisted of individuals who are knowledge users and experts in climate change and public health, epidemiology, and knowledge translation. Librarians from both agencies supported the development of the inclusion criteria and conducted the search strategies.

Cambium Indigenous Professional Services (CIPS), was commissioned to capture Indigenous perspectives and wisdom on climate change adaptation. CIPS is an environmental consulting company that is uniquely Indigenous-owned and entirely Indigenous staffed. Details about the collaboration between SMDHU, PHAC, and CIPS are described in **section 3.8** of this report.

A knowledge translation advisory committee was established to provide guidance in developing knowledge translation products to communicate the findings of the literature review that will have broad relevance for public health in Ontario.

### 3.3 Review Question and Scope

#### 3.3.1 Research Question

The scoping review was guided by the research question, 'What are the range and characteristics of public health interventions that support climate change adaptation and address expected health impacts associated with climate-sensitive categories within Ontario?'

Key terms contained within the research question were defined to support decision-making and enhances consistency between the aim, objectives, and inclusion/exclusion criteria (70). This strategy increases methodological transparency and rigour of the study (67). Key terms include:

- **Public health interventions:** Activities that aim to promote and protect health, prevent or reduce illness, or reduce risk exposures. Interventions include, but are not limited to, policies, programs, planning, surveillance, communications, best practices, and guidelines. For this project, public health interventions do not include risk assessments or research on associations between climate-related exposures and health outcomes.
- **Climate change adaptation:** Actions, such as policies and programs, which prepare for and respond to actual or projected climate change impacts that help individuals and communities increase resilience to the effects of climate change and reduce associated health burdens. Climate change adaptation works to reduce harms or exploit benefits associated with climate change.
- **Health impacts:** Physical and mental health outcomes that are either a direct or indirect outcome of climate change, and which are experienced within the context of Ontario.
- **Climate-sensitive categories:** Extreme temperature, extreme weather, and natural hazards, air quality, vector-borne disease, ultraviolet radiation, and water and food quality and availability.

#### 3.3.2 Scope and Inclusion Criteria

The scoping review aimed to comprehensively review and consolidate literature on public health adaptation interventions, and summarize findings to develop an evidentiary basis on the range of public health interventions that may be suitable to address climate-health impacts to inform local public health climate change adaptation planning. The following objectives were identified to achieve this aim:

- Identify and describe existing public health interventions that address health impacts due to climate change across six climate-sensitive categories relevant to Ontario;
- Disseminate the findings of the scoping review to inform public health practice;
- Integrate findings into knowledge translation products that will support public health practice within Ontario; and
- Develop an evidentiary basis to inform local public health climate change adaptation planning.

Included literature was published in either French or English between 2014 and 2019. The review initially intended to capture literature published between 2009 and 2019, to align with the first Lancet commission report on climate change and health (2). A subsequent decision was made to limit the publication dates to 2014 and 2019 to enhance study relevance to public health since climate-health adaptation is a quickly developing topic area (67). Moreover, 2014 saw an increase in the volume of literature published on climate change and health and coincided with the IPCC fifth assessment report (AR5) (6, 75). With this decision, the authors acknowledge that this review will not capture some relevant climate-health adaptation interventions published before 2014. Additionally, the initial selection of articles excluded non-English articles due to language constraints of the research team. However, language capabilities within the team evolved, and the re-run search included French articles.

Captured literature included peer-reviewed and grey literature (derived from governments, reputable organizations, and/or recognized experts). The AACODS<sup>3</sup> checklist was applied to determine whether grey literature was of sufficient quality for inclusion (76). No limitations were placed on the type of studies included. This decision lends itself to the breadth, flexibility, and characteristics of scoping reviews. The search strategy was limited to the geographic regions of North America, South America, Europe, Australia, and New Zealand to enhance results relevant to the Ontario context while capturing experiences from a variety of locations.

Inclusion criteria assessed during study selection included the following:

- At least one public health intervention, as previously defined, had to be included in the article.
- The intervention had to be a primary focus of the article and have public health relevance, although it did not need to stem from public health authorities.
- The intervention of focus was required to support climate change adaptation and/or address the physical and mental health impacts associated with climate-sensitive categories relevant to Ontario.
- Climate-sensitive categories identified suitable to Ontario (**Figure 3**) had to be clearly distinguished.

Due to the scope of this review, it is feasible that some climate-sensitive health outcomes that may become more prevalent in the near future were excluded from this review. Moreover, the study did not capture the impact of climate change on the social determinants of health and

---

<sup>3</sup> AACODS checklist (authority, accuracy, coverage, objectivity, date, significance) enables quality appraisal of grey literature.

associated health outcomes. Adaptation interventions were categorized based on the definitions highlighted in **Table 2**. Further adaptation interventions that may have health benefits, but did not have clear relevance to public health may have also been excluded from this study.

Figure 3: Climate-sensitive Categories Relevant to Ontario, Included in the Scoping Review

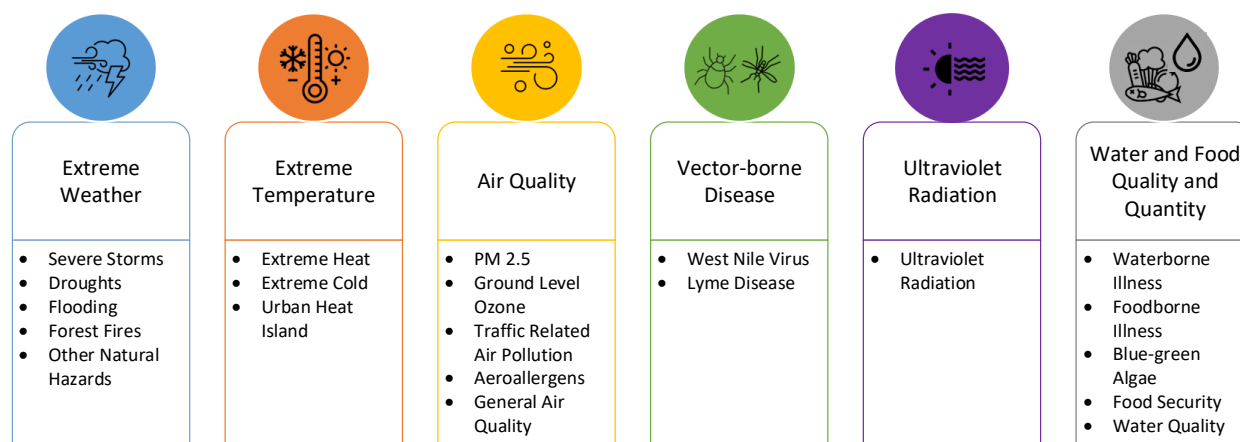


Table 2: Intervention Type Categories, Included in the Scoping Review

Public Health Intervention	Description
<b>Health Communication</b>	The use of communication strategies to inform and influence the decision and actions of individuals and communities to enhance health (77).
<b>Health Promotion</b>	Approaches that engage and empower people to increase capacity to exercise health-promoting behaviours. For this review, health promotion interventions focus on health behaviours and behaviour changes to reduce health risks, and increase control over and improve health.
<b>Environmental Adaptations</b>	Strategies that develop change, modify, or improve structural environmental elements (natural and/or human-made) to support healthy environments.
<b>Policy</b>	A plan for action on a particular topic or objective that may outline rules, principles, roles, responsibilities, values/beliefs, and/or an intention for action across various levels of actors to support public health (78, 79).
<b>Planning/Decision-making</b>	Strategies or tools that support the planning and/or decision-making process regarding actions that promote and protect health, prevent or reduce illness, or reduce risk exposures.
<b>Surveillance</b>	The systematic collection, analysis, interpretation, and dissemination of health data on an ongoing basis, to gain knowledge of the pattern of disease occurrence and potential in a community, to control and prevent disease (80).
<b>Guidelines/Frameworks</b>	Highlights a basic structure that underlines a process, system or concept and/or can provide general rules, principles or advice. Intended to support or guide the development or implementation of actions that support public health efforts.

<b>Alerts/Advisories/Warnings</b>	Actions that communicate a real or potential exposure to a particular health risk to have it avoided or managed to improve health outcomes.
<b>Other</b>	For this review, other interventions are those that have relevance to public health but do not neatly fit within the other categories identified.

### 3.4 Search Strategy

A librarian conducted the search strategy, which was tailored to the specific requirements for the electronic databases Medline, Embase, and Scopus. Searches were conducted on February 21, 2019, and again on November 7, 2019. The search was repeated to ensure the review remained up to date on the latest available literature. The search terms used aligned with the research question and scope and were derived from the following topic areas: public health, interventions, climate-sensitive categories, and geographic scope.

The re-run search conducted in November 2019, included articles published in either English or French. Since the search strategy did not include French key terms, only materials that had a translated English abstract were captured. There were no limitations placed on the type of peer-review articles collected. Results of both searches were imported into the citation manager RefWorks. Duplicates were automatically removed using RefWorks. Additional duplicates were removed as they were identified throughout the research process.

A search for grey literature was conducted in two custom Google search engines, the Carleton University Government Information Search Engine and the Harvard Think Tank Search Engine, as well as the Canadian Electronic Library database. A manual search was also conducted on the following websites: World Health Organization, European Centre for Disease Prevention and Control (ECDC), Canadian Public Health Association, and the Departments of Health for the United Kingdom, Australia, and New Zealand. The choice of these websites was based on past search experience and a *priori* decision to search grey literature for six hours of the Librarians time. The reviewers also applied a snowball technique in which outwardly relevant citations were searched.

### 3.5 Literature Selection

Literature was selected using a two-stage screening process that assessed literature based on a *priori* eligibility criteria highlighted in **section 3.3.2**. Two members of the research team independently screened titles and abstracts of retrieved literature. The reviewers pre-tested the eligibility criteria for 10 articles to refine the eligibility criteria before continuing with the remaining abstracts. Articles with promising titles and abstracts were included in a full article review. The reviewers applied the same pretesting process to the full article review. The research team met regularly throughout both stages of the screening process to discuss problems and manage uncertainties related to the study selection. In the case that an

agreement could not be reached on an article, a third member of the research team evaluated the article to make a final decision on its inclusion.

### **3.6 Data Characterization and Extraction**

A charting tool developed using Microsoft Excel captured literature characteristics including publication year, publication type, publication source, geographical region derived, climate-sensitive category, public health intervention type, whether mental health was addressed in addition to a high-level summary. The research team piloted the use of the charting tool by independently charting 10 articles. Adjustments to the charting tool were made to increase clarity and consistent use of the tool. For instance, non-defined geography category was added to capture articles derived from multiple regions, or where derived region was not specified. The research team met regularly throughout the process to ensure consistency and resolve any discrepancies or uncertainties. Based on discussions, a consensus was made on any discrepancies or by a third member of the research team. A final data cleaning process was completed to ensure the literature was charted consistently.

Public health intervention categories and climate sensitive categories were not charted exclusively. Several climate sensitive-categories and intervention types may have been captured within one intervention. Moreover, one article may have included several interventions. Charting was done by articles, not by intervention.

### **3.7 Analyzing, Summarizing, and Reporting**

An analysis guidance document was created to aid in the analysis and interpretation of the data to answer the descriptive research question. This document highlighted what value the collected data could contribute and how it could be analyzed and interpreted. For example, the document highlighted that data on publication year could identify the distribution of articles across publication years and trends by year for intervention type, climate-sensitive category, and mental health, and outlined how to express this. Additional core elements highlighted within the document related to geographic regions, intervention types, climate-sensitive categories, mental health and multiple climate-sensitive categories.

Two members of the research team worked independently to descriptively analyze the data. This resulted in two versions of interpretations of the same data, useful to capture different perspectives. The two members of the research team worked together to resolve any analysis discrepancies and brought any unresolved discrepancies to the research team for their input and feedback.

Univariate frequency was calculated and displayed as percentages for publication years, geographies, climate-sensitive categories, intervention types, mental health, and interventions that address multiple climate-sensitive categories. Moreover, cross-tabulations between two variables were calculated to look at the relationship between them and was expressed as

percentages. These descriptive statistics are useful to summarize the characteristics of the data and identify potential gaps. Data tables and heat charts were produced to summarize and display the distribution of key characteristics. The review did not strive to assess the quality or weight of the evidence for a given intervention.

The research team engaged in thematic analysis to describe the data about mental health and interventions that address multiple climate-sensitive categories in more detail and to differentiate these interventions from others that may have been included within one article.

### 3.8 Collaboration

SMDHU, an independent local public health unit, and the PHAC Ontario Regional Office, collaborated through a grant proposal process to recruit a master's student to conduct the review. The core work team was comprised of staff from SMDHU and PHAC. Other experts in the field were engaged as part of the knowledge translation advisory committee.

In the early stages of study selection, it was recognized that the search strategy did not explicitly include terms that reflected Indigenous ways of knowing and doing and accordingly associated literature on climate-health adaptation important to the context for Indigenous peoples was not captured. Recognizing this was an oversight that could have harmful implications for Indigenous peoples and communities, the research team sought guidance from Indigenous health experts and literature to determine how to address the issue. A decision was made to fund the development of a resource led by an Indigenous organization that would support public health authorities to include Indigenous voices in climate change adaptation interventions.

Cambium Indigenous Professional Services leveraged their experience working on multiple climate change projects with Indigenous communities to write a supporting standalone chapter to address climate-health adaptation as it relates to Indigenous peoples.

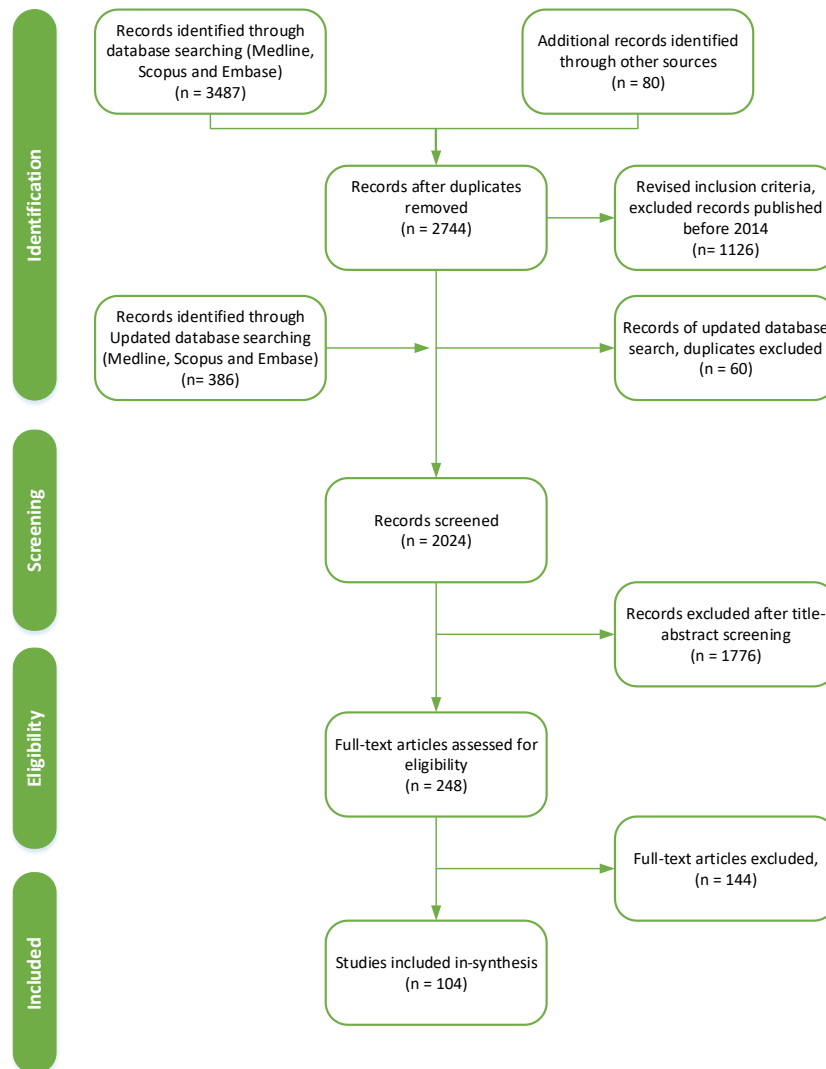
## 4 RESULTS

### 4.1 Results of Search Strategy and Literature Selection

The search strategy yielded 2,024 articles included in the abstract and title review and 248 full articles assessed for relevance **Figure 4**. 104 relevant articles were identified, comprising of peer-reviewed literature (n= 89) and grey literature (n=15). 97% (n=101) of relevant literature was published in English (n=101; 97%). Only 3 French-language articles were included, likely attributed to the use of English search terms.



Figure 4: PRISMA Flow Diagram



Adopted from Moher et al., 2009 (81)

## 4.2 Trends by Year

### 4.2.1 Number of articles published by year

The majority of included articles were published in the last two years of the study period; 2019 (29%; n=30) and 2018 (24%; n=25). There was an increase in published articles captured from the year 2015 to 2019. **Table 3** highlights the distribution of included articles by publication year.

Table 3: Distribution of Articles by Publication Year

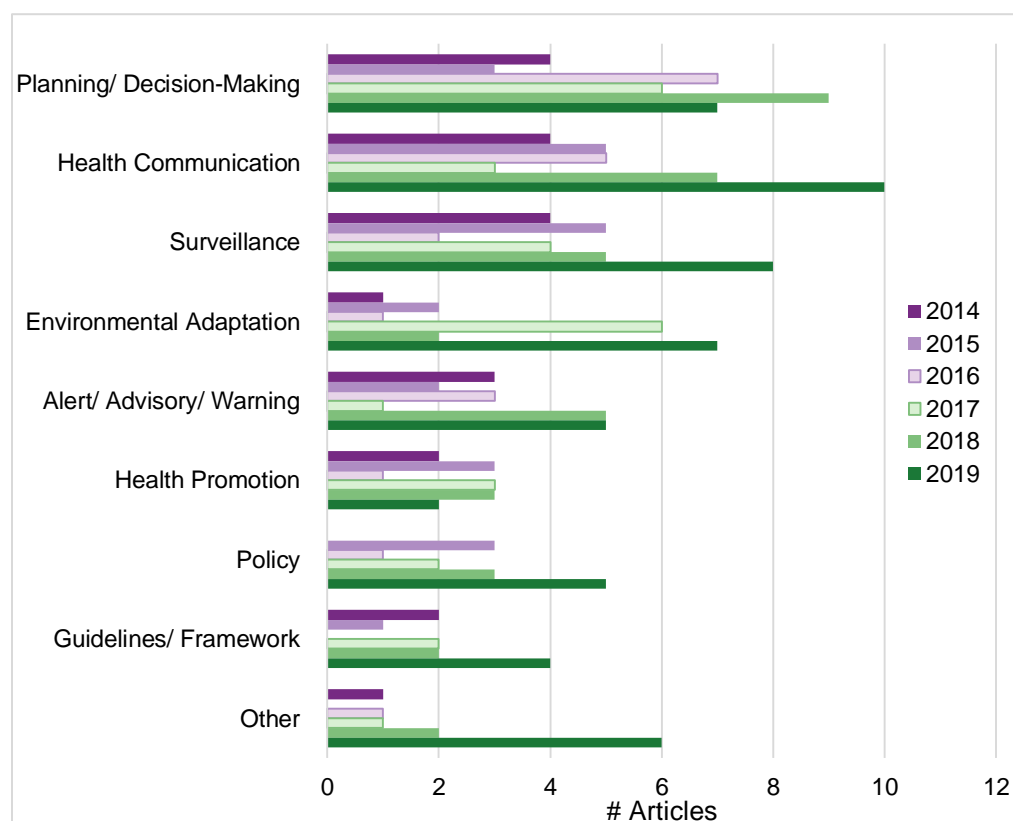
Publication Date	n	%
2014	14	13%
2015	9	9%
2016	11	11%

2017	15	14%
2018	25	24%
2019	30	29%

#### 4.2.2 Time Trends by Intervention Type

The range of intervention types portrayed within the captured literature has evolved between 2014 and 2019, as identified in **Figure 5** (for more detail see **Appendix A**). Health communication, planning/decision-making, and surveillance interventions were consistently among the most frequent intervention types captured across all publication years. Health communication and environmental adaptation interventions experienced the greatest increase in the number of publications between 2014 and 2019. The number of articles that included health promotion interventions did not increase between 2014 and 2019 and was among the least common intervention types captured over this duration. All other intervention types were included in a higher number of articles in 2019 than in 2014.

Figure 5: Distribution of Public Health Intervention Types by Publication Year

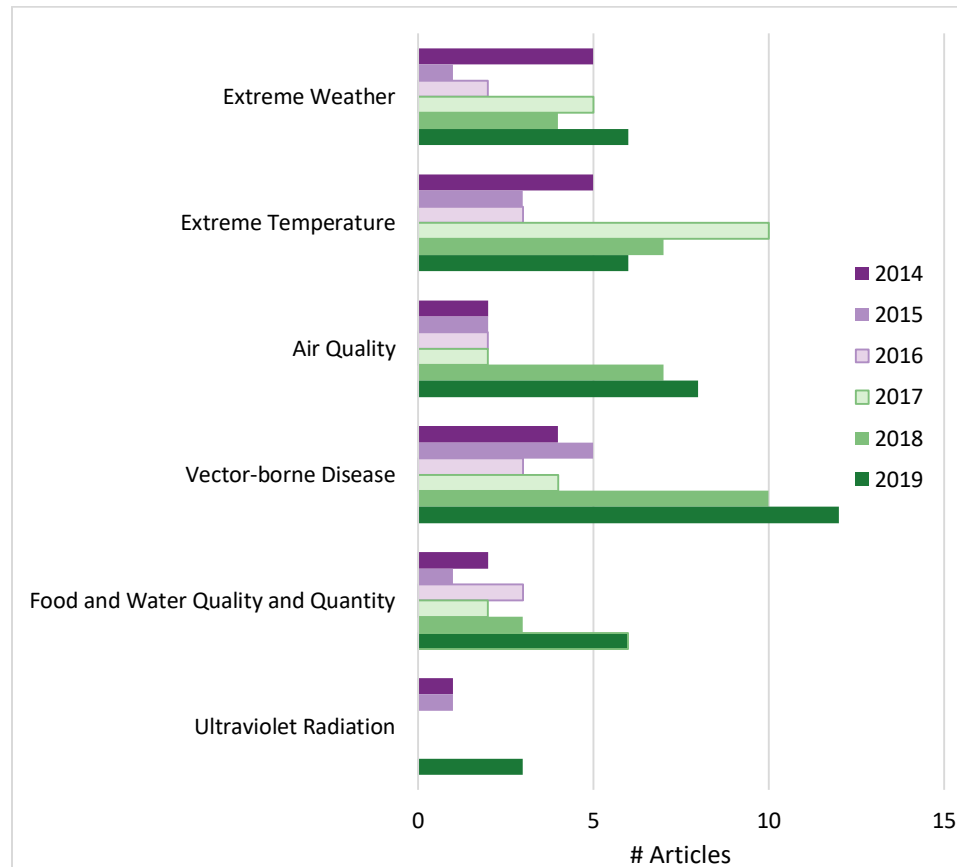


#### 4.2.3 Time Trends by Main Climate-sensitive Category

Among all captured articles, the dominant climate-sensitive categories addressed have changed between 2014 and 2019 publication years, as illustrated in **Figure 6** (for greater detail see

**Appendix B).** Among articles published in 2014, the most frequent climate-sensitive categories addressed were extreme weather (36%; n=5) and extreme temperature (36%; n=5). In contrast, the most frequent climate-sensitive category captured in articles published in 2019 was vector-borne disease (40%; n=12).

Figure 6: Distribution of Climate-sensitive Categories by Publication Year



Vector-borne disease, extreme temperature, and extreme weather were among the most frequently addressed climate-sensitive categories across all publication years. This is consistent with overall climate-sensitive categories patterns highlighted in **section 4.5**.

The number of articles that address each climate-sensitive category increased from 2014 to 2019. The climate-sensitive categories vector-borne disease and air quality experienced the greatest increase in the number of publications captured between 2014 and 2019, accounting for 29% and 40% of all articles published in 2014, and 2019 respectively. The inclusion of air quality among literature increased considerably in 2018 (28%, n=7). Before 2018, the number of articles that addressed air quality was consistently low (n=2).

Literature published in 2019 included the most number of articles for five of the six climate-sensitive categories. The greatest number of articles that address extreme temperature (n=10) were published in 2017, accounting for 67% (n=10) of all articles published in 2017. Among

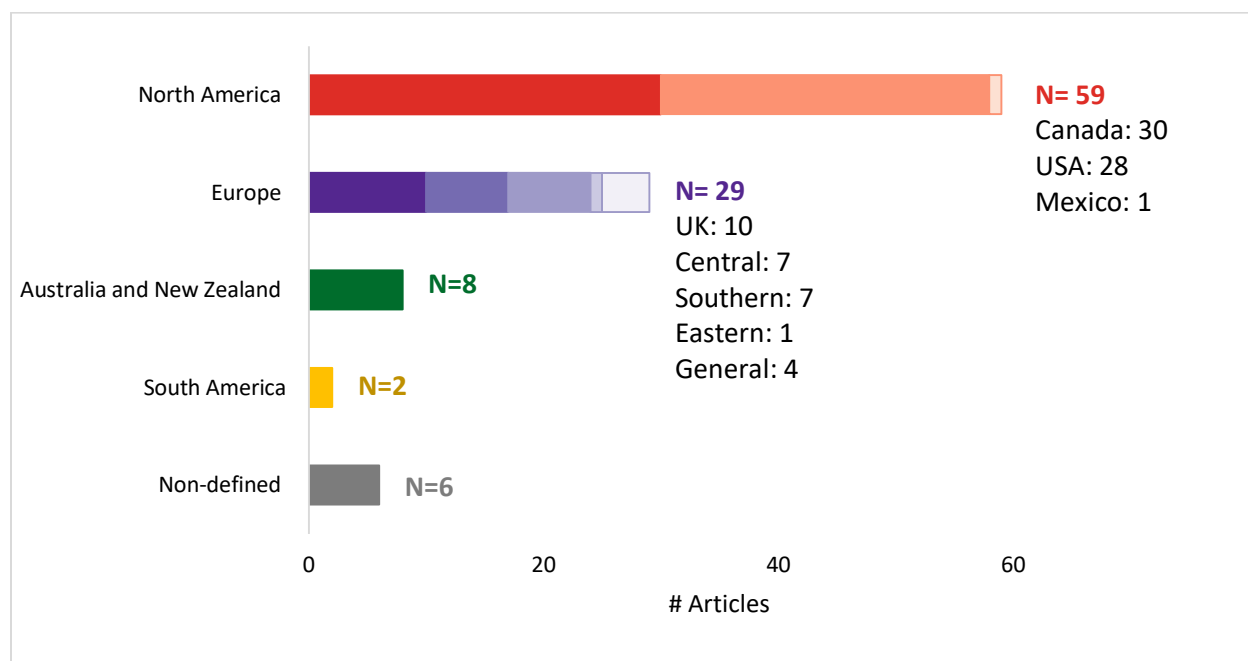
relevant literature, the number highlighting extreme temperature has decreased since 2017. Ultraviolet radiation was among the least commonly addressed climate-sensitive category across all years and was only captured in 5% (n=5) of all relevant articles.

### 4.3 Trends by Geography

#### 4.3.1 Geographic Distribution of Relevant Literature

The geographic distribution of included literature (**Figure 7**) is mainly from North America (57%; n=59), particularly from Canada (29%; n=30) and USA (27%; n=28), and Europe (28%, n=29) particularly from the United Kingdom (10%, n=10). Several articles (n=4) derived from authorities representing Europe as a whole and were captured under the specific geographic category 'general Europe'. Overall fewer articles were derived from the geographic regions South America, Australia, New Zealand, and non-defined regions. (For greater detail of the distribution of articles by main and specific geographic region, see **Appendix C** and **Appendix D**). Variations in the geographic distribution for specific intervention types and climate-sensitive categories are highlighted in section 4.3.2 and 4.3.3.

Figure 7: Distribution of Articles by Geography Region



### 4.3.2 Geographic Distribution by Intervention Type

The geographic distribution of articles by intervention type is illustrated in **Table 4**. Articles derived from the main geographic region of North America most frequently applied all intervention types, except for policy interventions. This aligns with the distribution of all articles across the main geographic regions as outlined in **section 4.3.1**. When looking at all articles that address policy, the majority derived from Europe (36%; n=5), specifically the United Kingdom (21%; n=3), as well as from non-defined regions (29%; n=4).

Table 4: Distribution of Articles by Main Geographic Regions and Public Health Intervention Type

Region	Public Health Intervention Type																	
	Health Communication		Health Promotion		Environmental Adaptations		Policy		Planning / Decision-making		Surveillance		Guidelines / Frameworks		Alerts / Advisories / Warnings		Other	
	(N=34)		(N=14)		(N=19)		(N=14)		(N=36)		(N=28)		(N=11)		(N=19)		(N=11)	
	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>
<b>Europe</b>	<b>4</b>	<b>12%</b>	<b>2</b>	<b>14%</b>	<b>5</b>	<b>26%</b>	<b>5</b>	<b>36%</b>	<b>12</b>	<b>33%</b>	<b>6</b>	<b>21%</b>	<b>3</b>	<b>27%</b>	<b>2</b>	<b>11%</b>	<b>2</b>	<b>18%</b>
United Kingdom	1	3%	1	7%	-	-	3	21%	4	11%	1	4%	1	9%	1	5%	-	-
Central Europe	2	6%	1	7%	2	11%	-	-	2	6%	1	4%	1	9%	-	-	-	-
General Europe	-	-	-	-	1	5%	1	7%	3	8%	1	4%	-	-	1	5%	1	9%
Eastern Europe	-	-	-	-	-	-	1	7%	-	-	-	-	1	9%	-	-	-	-
Southern Europe	1	3%	-	-	2	11%	-	-	3	8%	3	11%	-	-	-	-	1	9%
<b>North America</b>	<b>23</b>	<b>68%</b>	<b>7</b>	<b>50%</b>	<b>13</b>	<b>68%</b>	<b>3</b>	<b>21%</b>	<b>19</b>	<b>53%</b>	<b>18</b>	<b>64%</b>	<b>6</b>	<b>55%</b>	<b>13</b>	<b>68%</b>	<b>9</b>	<b>82%</b>

Canada	12	35%	3	21%	8	42%	2	14%	13	36%	10	36%	3	27%	7	37%	4	36%
USA	10	29%	4	29%	5	26%	1	7%	6	17%	8	29%	3	27%	6	32%	5	45%
Mexico	1	3%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South America	1	3%	1	7%	-	-	-	-	1	3%	1	4%	1	9%	-	-	-	-
Australia, New Zealand	2	6%	2	14%	-	-	2	14%	2	6%	-	-	-	-	2	11%	-	-
Non-defined	4	12%	2	14%	1	5%	4	29%	2	6%	3	11%	1	9%	2	11%	-	-

<sup>a</sup> Articles may include more than one public health intervention type, so values for n may not add up to the total number of articles published each year (N). Percentages likewise may not sum to 100%.

### 4.3.3 Geographic Distribution by Climate-sensitive Categories

Literature derived from the main geographic region of North America most frequently addressed all main climate-sensitive categories except for ultraviolet radiation (**Table 5**). Ultraviolet radiation was among the least frequently addressed climate-sensitive category by articles derived from four of the five main geographic regions. When looking at all articles that address ultraviolet radiation, Australia/New Zealand was the region which most frequently addressed this climate-sensitive category (40%; n=2).

Table 5: Distribution of Articles by Main Geographic Region and Main Climate-sensitive Category

Region	Climate-sensitive Category											
	Extreme Weather		Extreme Temperature		Air Quality		Vector-borne Disease		Ultraviolet Radiation		Food and Water	
	(N=23)		(N=34)		(N=23)		(N=38)		(N=5)		(N=16)	
	n <sup>a</sup>	%	n <sup>a</sup>	%	n <sup>a</sup>	%	n <sup>a</sup>	%	n <sup>a</sup>	%	n <sup>a</sup>	%
<b>Europe</b>	<b>4</b>	<b>17%</b>	<b>12</b>	<b>35%</b>	<b>7</b>	<b>30%</b>	<b>7</b>	<b>18%</b>	<b>1</b>	<b>20%</b>	<b>4</b>	<b>25%</b>
United Kingdom	-	-	4	12%	3	13%	-	-	1	20%	1	6%
Central Europe	1	4%	4	12%	1	4%	2	5%	-	-	-	-
General Europe	2	9%	1	3%	1	4%	2	5%	-	-	2	13%
Eastern Europe	1	4%	-	-	-	-	-	-	-	-	-	-
Southern Europe	-	-	3	9%	2	9%	3	8%	-	-	1	6%
<b>North America</b>	<b>14</b>	<b>61%</b>	<b>18</b>	<b>53%</b>	<b>12</b>	<b>52%</b>	<b>28</b>	<b>74%</b>	<b>1</b>	<b>20%</b>	<b>9</b>	<b>56%</b>
Canada	6	26%	11	32%	7	30%	15	39%	1	20%	5	31%
USA	8	35%	7	21%	4	17%	13	34%	-	-	4	25%
Mexico	-	-	-	-	1	4%	-	-	-	-	-	-
<b>South America</b>	<b>2</b>	<b>9%</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>6%</b>
<b>Australia, New Zealand</b>	<b>2</b>	<b>9%</b>	<b>2</b>	<b>6%</b>	<b>1</b>	<b>4%</b>	<b>1</b>	<b>3%</b>	<b>2</b>	<b>40%</b>	<b>1</b>	<b>6%</b>
<b>Non-defined</b>	<b>1</b>	<b>4%</b>	<b>2</b>	<b>6%</b>	<b>3</b>	<b>13%</b>	<b>2</b>	<b>5%</b>	<b>1</b>	<b>20%</b>	<b>1</b>	<b>6%</b>

<sup>a</sup> Articles may include more than one climate-sensitive category, so values for n may not add up to the total number of articles published each year (N). Percentages likewise may not sum to 100%.

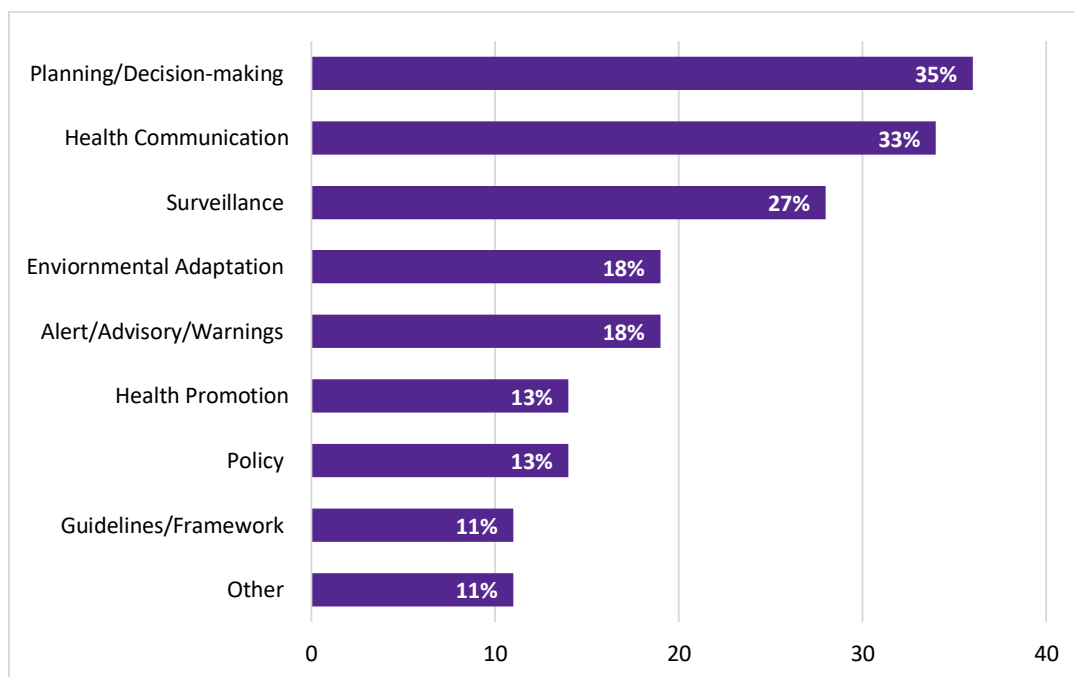


## 4.4 Trends by Intervention Types

### 4.4.1 Distribution of Articles by Intervention Type

**Figure 8** displays the frequency in which each intervention type were included in relevant literature (for alternative format see **Appendix E**). When looking at all relevant literature, the public health intervention type identified most frequently was planning/decision making (35%; n=35), a strategic intervention<sup>4</sup> to address climate-health outcomes. The second most common intervention type identified was health communication (33%; n=34), a more applied approach<sup>5</sup> to adaptation. The least common intervention types addressed were guidelines/framework (11%; n=11).

Figure 8: Distribution of Articles by Public Health Intervention Type (N=104)



Articles may include more than one public health intervention type, so values are > 104. Likewise percentages will not equal 100%.

<sup>4</sup> Strategic interventions are strategies that identify how to address an issue, or achieve an objective, and plans actions and resources to do so over some time.

<sup>5</sup> Applied interventions are strategies that apply knowledge, theory and/or techniques into actions that address an identified issue, often tailored to a particular situation and target audience.

**Table 6** presents the distribution of articles that features each public health intervention type by the main climate-sensitive category. Vector-borne disease was the most frequently addressed main climate-sensitive category among articles that included health communication, health promotion, surveillance, and ‘other’ intervention categories, accounting for 44% (n=15), 43% (n=6), 79% (n=22), and 73% (n=8) of articles respectively. Among articles that included environmental adaptation, planning/decision-making, guidelines/framework, and alerts/advisory/warning interventions types, the most frequently addressed main climate-sensitive category was extreme temperature attributing 84% (n=16), 44% (n=16), 27% (n=3), and 58% (n=11) of articles respectively. In articles that captured guidelines/framework interventions, extreme weather and extreme temperature were most frequently identified (27%; n=3). Air quality was most frequently addressed within articles that applied alerts/advisories/warnings (58%; n=11) and policy (50%; n=7) intervention types.

Table 6: Summary of the Main Climate-sensitive Categories Addressed in Articles that use Each Public Health Intervention Type

Climate-sensitive Category	Public Health Intervention Type																	
	Health Communication		Health Promotion		Environmental Adaptations		Policy		Planning / Decision-making		Surveillance		Guidelines / Frameworks		Alerts / Advisories / Warnings		Other	
	(N=34)		(N=14)		(N=19)		(N=14)		(N=36)		(N=28)		(N=11)		(N=19)		(N=11)	
	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>
Extreme Weather	10	29%	5	36%	8	42%	6	43%	10	28%	7	25%	3	27%	5	26%	4	36%
Extreme Temperature	11	32%	5	36%	16	84%	6	43%	16	44%	9	32%	3	27%	11	58%	4	36%
Air Quality	11	32%	3	21%	8	42%	7	50%	8	22%	6	21%	1	9%	11	58%	3	27%
Vector-borne Disease	15	44%	6	43%	8	42%	3	21%	15	42%	22	79%	2	18%	5	26%	8	73%

Ultraviolet Radiation	1	3%	4	29%	1	5%	1	7%	1	3%	0	0%	0	0%	0	0%	1	9%
Food and Water	8	24%	4	29%	8	42%	5	36%	7	19%	7	25%	2	18%	5	26%	5	45%

<sup>a</sup> Articles may include more than one public health intervention type category and climate-sensitive category, so numbers are > N, and percentages will not equal 100%.

Articles that include health communication and health promotion interventions address a variety of difference climate-sensitive categories. In contrast, articles that include certain intervention types, such as surveillance, alerts/advisories/warnings, and 'other', mainly address one or two climate-sensitive categories.

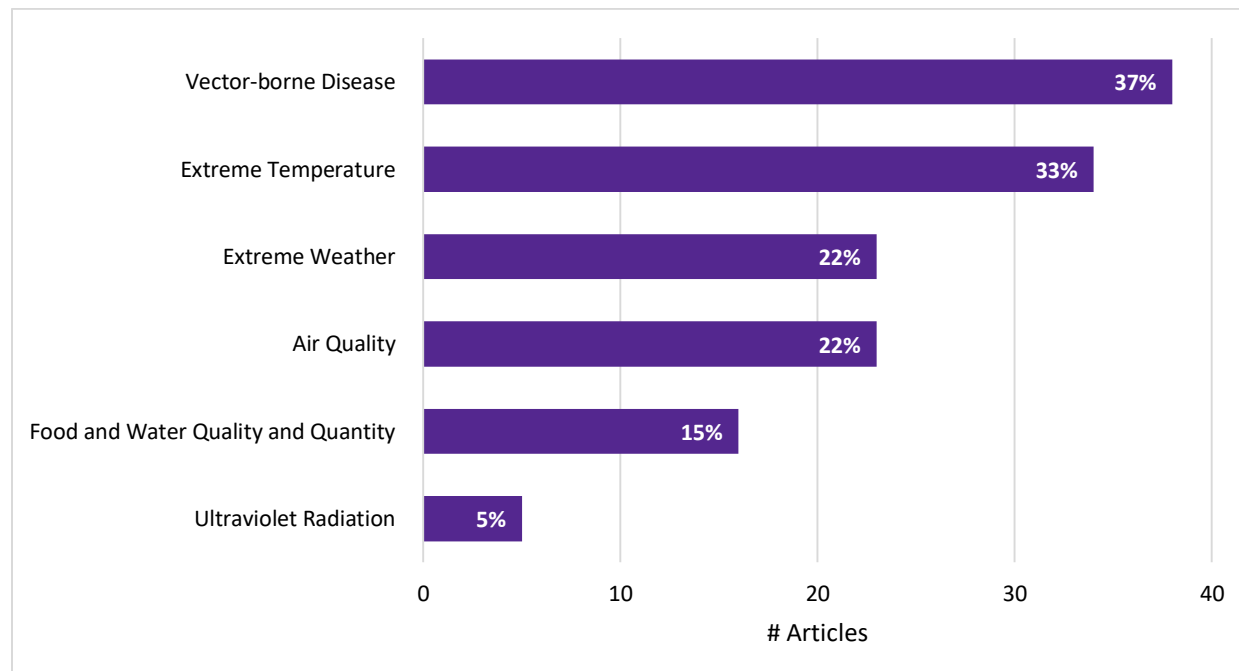
As less than 5% of all collected literature identified, the main climate-sensitive category ultraviolet radiation, unsurprisingly was among the least commonly addressed climate-sensitive category by most intervention types.

## 4.5 Trends by Climate-sensitive Categories

### 4.5.1 Distribution of Articles by Main Climate-sensitive Category

The frequency in which articles included the main climate-sensitive categories are displayed in **Figure 9** (for alternative format see **Appendix F**). The most frequently reported climate-sensitive category was vector-borne (37%; n=38), followed by extreme temperature (33%; n=34). Ultraviolet radiation was identified least often (5%; n=5).

Figure 9: Distribution of Articles by Main Climate-sensitive Category

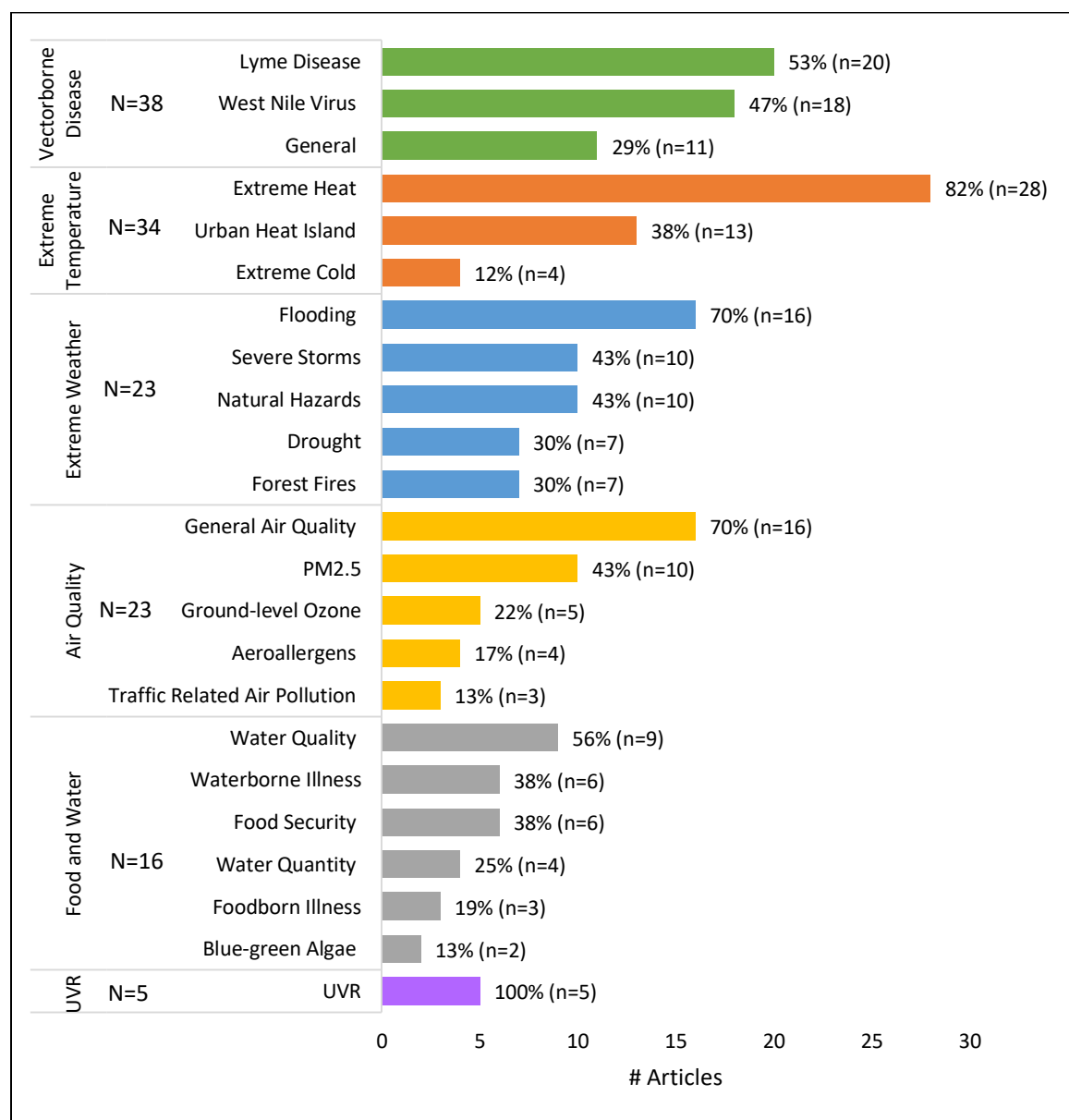


Articles may include more than one main climate-sensitive category, so numbers are >104. Likewise percentages will not equal 100%.

#### 4.5.2 Distribution of Articles by Specific Climate-sensitive Categories

The distribution of articles by specific climate-sensitive category related to each main climate-sensitive category is displayed in **Figure 10**. (For alternative format see **Appendix G**).

Figure 10: Frequency of the Specific Climate-sensitive Categories Related to Each Main Climate-sensitive Category



Articles may include more than one category so the sum is > N and percentages will not equal 100%.

### 4.5.3 Intervention Types that Address Vector-borne Disease

**Table 7** summarizes the public health intervention types applied in articles that addressed the main climate-sensitive category vector-borne disease and the related specific climate-sensitive categories. Surveillance was the most frequent intervention type captured among literature that addressed vector-borne disease (58%; n=22) and the related categories Lyme disease (50%; n=10), West Nile Virus (72%; n=13), and general vector-borne disease (73%; n=8). Health communication and planning/decision-making interventions were also common in the literature that addressed vector-borne disease and all related specific climate-sensitive categories.

*Table 7: Summary of Public Health Intervention Types Used in Articles that Address Vector-borne Disease and Related Specific Climate-sensitive Categories*

Public Health Intervention Type	Main Climate-sensitive Category		Specific Climate-sensitive Categories Related to Vector-borne Disease					
	Vector-borne Disease		Lyme Disease		West Nile Virus		General	
	(N=38)		(N=20)		(N=18)		(N=11)	
	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>z</sup>	% <sup>a</sup>	n <sup>z</sup>	% <sup>a</sup>
Health Communication	15	39%	9	45%	8	44%	6	55%
Health Promotion	6	16%	5	25%	2	11%	3	27%
Environmental Adaptations	8	21%	6	30%	4	22%	4	36%
Policy	3	8%	2	10%	3	17%	1	9%
Planning / Decision-making	15	39%	8	40%	9	50%	5	45%
Surveillance	22	58%	10	50%	13	72%	8	73%
Guidelines / Frameworks	2	5%	1	5%	1	6%	-	-
Alerts / Advisories / Warnings	5	13%	2	10%	3	17%	3	27%
Other	8	21%	5	25%	3	17%	4	36%

<sup>a</sup> Articles may include more than one category so the sum is > N, and percentages will not equal 100%.

### 4.5.4 Intervention Types that Address Extreme Temperature

The frequency in which intervention types were used in captured literature that addresses the main climate-sensitive category extreme temperature and related specific climate-sensitive categories is illustrated in **Table 8**. Environmental adaptation and planning/decision-making interventions were the two most frequently applied intervention types in the literature that

addresses extreme temperature and the related categories extreme heat and urban heat island. Among articles that address extreme cold, planning/decision-making, and alerts/advisories/warnings, intervention types were most frequently captured (75%; n=3). Policy was also frequently identified in the literature that addresses urban heat islands (31%; n=4).

Table 8: Summary of Public Health Intervention Types Used in Articles that Address Extreme Temperature and Related Specific Climate-sensitive Categories

Public Health Intervention Type	Main Climate-sensitive Category		Specific Climate-sensitive Category Related to Extreme Temperature					
	Extreme Temperature		Extreme Heat		Urban Heat Island		Extreme Cold	
	(N=34)		(N=28)		(N=13)		(N=4)	
	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>
Health Communication	11	32%	10	36%	3	23%	1	25%
Health Promotion	5	15%	5	18%	0	0%	0	0%
Environmental Adaptations	16	47%	13	46%	12	92%	1	25%
Policy	6	18%	5	18%	4	31%	2	50%
Planning / Decision-making	16	47%	14	50%	5	38%	3	75%
Surveillance	9	26%	9	32%	2	15%	1	25%
Guidelines / Frameworks	3	9%	3	11%	-	-	-	-
Alerts / Advisories / Warnings	11	32%	9	32%	2	15%	3	75%
Other	4	12%	4	14%	2	15%	1	25%

<sup>a</sup> Articles may include more than one category, so the sum is > N and percentages will not equal 100%.

#### 4.5.5 Intervention Types that Address Extreme Weather

The distribution of public health intervention types applied in articles that address the main climate sensitive-category extreme weather and related specific climate-sensitive categories are identified in **Table 9**. Health communication was the most frequently applied intervention type among all articles that addressed extreme weather and all related specific climate-sensitive categories. For all literature that addressed extreme weather, flooding and forest fires, planning/decision-making interventions were also most frequently addressed and were included in 43% (n=10), 50% (n=8), and 57% (n=4) of associated articles respectively. Environmental adaptation interventions were the second most commonly used intervention among 4 of the 5 specific climate-sensitive categories related to extreme weather. Guidelines/framework



interventions were among the least commonly used in all articles that address extreme weather and related specific climate-sensitive category related to extreme weather.

Table 9: Summary of Public Health Interventions Used in Articles that Address Extreme Weather and Related Specific Climate-sensitive Categories

Public Health Intervention Type	Main Climate-sensitive Category		Specific Climate-sensitive Category Related to Extreme Temperature									
	Extreme Weather		Severe Storms		Drought		Flooding		Natural Hazards		Forest Fires	
	(N=23)		(N=10)		(N=7)		(N=16)		(N=10)		(N=7)	
	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>
Health Communication	10	43%	6	60%	5	71%	8	50%	7	70%	4	57%
Health Promotion	5	22%	2	20%	4	57%	4	25%	3	30%	3	43%
Environmental Adaptations	8	35%	4	40%	4	57%	7	44%	4	40%	4	57%
Policy	6	26%	3	30%	2	29%	5	31%	2	20%	3	43%
Planning / Decision-making	10	43%	2	20%	4	57%	8	50%	3	30%	4	57%
Surveillance	7	30%	4	40%	5	71%	5	31%	3	30%	4	57%
Guidelines / Frameworks	3	13%	2	20%	1	14%	2	13%	2	20%	-	-
Alerts / Advisories / Warnings	5	22%	3	30%	3	43%	4	25%	2	20%	4	57%
Other	4	17%	2	20%	2	29%	4	25%	1	10%	3	43%

<sup>a</sup> Articles may include more than one category, so the sum is > N and percentages will not equal 100%.

#### 4.5.6 Intervention Types that Address Air Quality

**Table 10** summarizes the frequency in which public health intervention types were applied in articles that address air quality and related specific climate-sensitive categories. Health communication was the most frequently applied intervention type among all articles that address air quality (48%; n=11) and all the related specific climate-sensitive categories except for traffic-related air pollution. The intervention type alerts/advisories/warnings was the most frequently used intervention type among articles that addressed the main climate-sensitive category air quality (48%; n=11), and 3 of the 5 related specific categories. Among articles that targeted

aeroallergens, planning/decision-making interventions were also most frequently addressed. Policy was the most common intervention type identified in articles that addressed traffic-related air pollution. In articles that addressed air quality, only one applied a guidelines/framework intervention which was included in an article targeting traffic-related air pollution. Among articles that target the specific climate-sensitive category traffic-related air pollution, the most common intervention type addressed was policy (67%; n=2).

The majority of articles captured more than one specific climate-sensitive category related to air quality including general air quality. Therefore targeting general air quality can address several other specific climate-sensitive category related to air quality.

Table 10: Summary of Public Health Interventions Used in Articles that Address Air Quality and Related Specific Climate-sensitive Categories

Public Health Intervention Type	Main Climate-sensitive Category		Specific Climate-sensitive Category Related to Extreme Temperature									
	Air Quality		PM2.5		Ground-Level Ozone		Traffic Related Air Pollution		General Air Quality		Aeroallergens	
	(N=23)		(N=10)		(N=5)		(N=3)		(N=16)		(N=4)	
	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>
Health Communication	11	48%	6	60%	5	100%	1	33%	8	50%	3	75%
Health Promotion	3	13%	1	10%	2	40%	1	33%	2	13%	2	50%
Environmental Adaptations	8	35%	2	20%	3	60%	1	33%	7	44%	2	50%
Policy	7	30%	4	40%	2	40%	2	67%	4	25%	1	25%
Planning / Decision-making	8	35%	3	30%	2	40%	-	-	5	31%	3	75%
Surveillance	6	26%	2	20%	3	60%	1	33%	5	31%	2	50%
Guidelines / Frameworks	1	4%	-	-	-	-	1	33%	-	-	-	-
Alerts / Advisories / Warnings	11	48%	6	60%	3	60%	1	33%	8	50%	3	75%
Other	3	13%	-	-	-	-	-	-	3	19%	-	-

<sup>a</sup> Articles may include more than one category so the sum is > N and percentages will not equal 100%.

#### 4.5.7 Intervention Types that Address Food and Water

A summary of public health interventions included in articles that address the main climate-sensitive category food and water and related specific climate-sensitive categories is presented in **Table 11**.

Table 11: Summary of Public Health Interventions Used in Articles that Address Food and Water Safety and Security and Related Specific Climate-sensitive Categories

Public Health Intervention Type	Main Climate-sensitive Category		Specific Climate-sensitive Category Related to Extreme Temperature											
	Food / Water		Waterborne Illness		Foodborne Illness		Blue-Green Algae		Food Security		Water Quality		Water Quality	
	(N=16)		(N=6)		(N=3)		(N=2)		(N=6)		(N=9)		(N=4)	
	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>
Health Communication	8	50%	4	67%	2	67%	2	100%	3	50%	8	89%	2	50%
Health Promotion	4	25%	3	50%	2	67%	2	100%	1	17%	4	44%	2	50%
Environmental Adaptations	8	50%	3	50%	1	33%	2	100%	4	67%	5	56%	2	50%
Policy	5	31%	2	33%	-	-	1	50%	2	33%	4	44%	-	-
Planning / Decision-making	7	44%	3	50%	2	67%	1	50%	3	50%	6	67%	3	75%
Surveillance	7	44%	5	83%	3	100%	2	100%	3	50%	6	67%	2	50%
Guidelines / Frameworks	2	13%	1	17%	-	-	-	-	1	17%	-	-	-	-
Alerts / Advisories / Warnings	5	31%	3	50%	1	33%	1	50%	2	33%	4	44%	-	-
Other	5	31%	2	33%	1	33%	1	50%	4	67%	2	22%	1	25%

<sup>a</sup> Articles may include more than one category, so the sum is > N and percentages will not equal 100%.

In articles that identify the main climate-sensitive category food and water the most common intervention types highlighted were health communication (50%; n=8) and environmental adaptation (50%; n=8). Each specific climate-sensitive category related to food and water exhibited a different distribution of intervention types.

Among articles that target the specific climate-sensitive category food security (n=6), the most common intervention types identified were environmental adaptation (67%, n=4) and 'other' interventions (67%; n=4).

#### 4.5.8 Intervention Types that Address Ultraviolet Radiation

The distribution of public health intervention types applied in articles that address the main climate-sensitive category ultraviolet radiation is displayed in **Table 12**. Health promotion was the most frequently applied intervention type captured within the literature that addresses ultraviolet radiation (80%; n=4). Surveillance, alerts/advisories/warnings and guideline/framework interventions were not identified among articles that addressed ultraviolet radiation.

Table 12: Summary of Public Health Interventions Among Literature that Addresses Ultraviolet Radiation (N=5)

	Ultraviolet Radiation (N=5)	
Public Health Intervention Type	n <sup>a</sup>	% <sup>a</sup>
Health Communication	1	20%
Health Promotion	4	80%
Environmental Adaptations	1	20%
Policy	1	20%
Planning/Decision-making	1	20%
Surveillance	0	0%
Guidelines/Frameworks	0	0%
Alerts/Advisories/Warnings	0	0%
Other	1	20%

<sup>a</sup> Articles may include more than one public health intervention type category, so the sum is > N and percentages will not equal 100%.

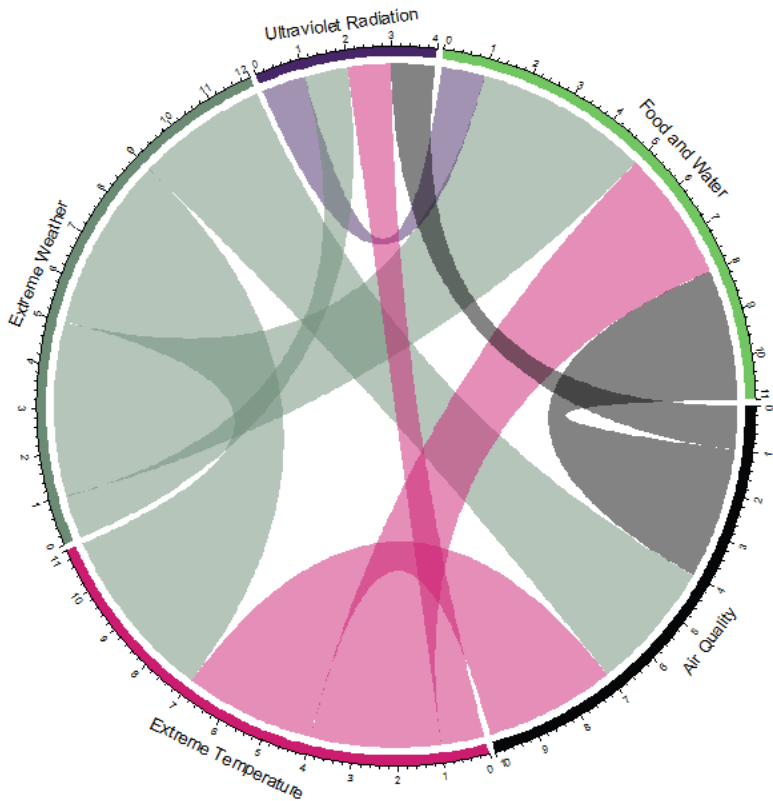
4.6 Interventions that Address Multiple Main Climate-sensitive Categories

Among all relevant literature, approximately 8% (n=8) identified a public health intervention that could address multiple climate-sensitive categories. **Table 13** briefly summarizes key characteristics of the interventions identified in that addressed multiple main climate-sensitive categories.

The most common combination of climate-sensitive categories addressed by one intervention include:

- Extreme Temperature & Extreme Weather
- Extreme Weather & Food/Water
- Extreme Weather & Air Quality
- Extreme Temperature & Air Quality
- Extreme Temperature & Food/Water
- Air Quality & Food/Water

Figure 11: Chord graph showing inter-relation in climate-health adaptation literature across climate-sensitive categories. Increasing chord thickness indicates more articles addressing both climate-sensitive categories.



**Figure 11** shows the inter-relation of climate-sensitive categories addressed by one intervention type. No intervention that addressed vector-borne disease addressed another climate-sensitive category.

Among the articles that included an intervention that was able to address multiple main climate-sensitive categories, the intervention types most often identified were environmental adaptation and planning/decision-making.

Table 13: Articles that Highlight One Intervention that Addresses Multiple Climate-sensitive Categories

Primary Intervention Type	Intervention Description	Climate-sensitive Categories Addressed	Article
Planning / Decision-making	Contingency plan for public health emergencies in relation to drought.	Extreme Weather (drought) Food and Water (waterborne illness, foodborne illness, water quality, water quantity)	Grigoletto, Cabral. 2016 (82)
	Smoke forecasting model predicts moving plumes and air pollutants	Air Quality (PM2.5) Extreme Weather (forest fires)	Rappold, Fann. 2014 (83)

	to support public health decision-making.		
	Planning guidance to support water sensitive urban design as a component of integrated urban water management.		<b>Sharma, Pezzaniti. 2016 (84)</b>
<b>Environmental Adaptations</b>	Overview of environmental adaptations needed to reduce extreme heat and urban heat island to improve health outcomes.	Extreme Weather (natural hazard) Extreme Temperature (extreme heat, urban heat island)	<b>Endlicher. 2017 (85)</b>
	Examples of green space intervention.	Extreme Weather (severe storms, flooding) Extreme Temperature (extreme heat, urban heat island) Air Quality (general) UVR Food/Water (food security)	<b>Kingsley and EcoHealth. 2019 (61)</b>
	Green Roofs.	Extreme Temperature (urban heat island) Air Quality (general) Food/Water (water quantity)	<b>Semeraro, Aretano. 86)</b>
	Examples of green space interventions and cases studies.	Extreme Temperature (extreme heat, urban heat island) Extreme Weather (flooding) Air Quality (general) Food/Water (water quality) Highlight mental health benefits	<b>World Health Organization Regional Office for Europe. 2017 (87)</b>
<b>Surveillance</b>	Emergency Room Syndromic Surveillance	Extreme Temperature (extreme heat) Extreme Weather (severe storms)	<b>Lall, Abdelnabi. 2017 (88)</b>

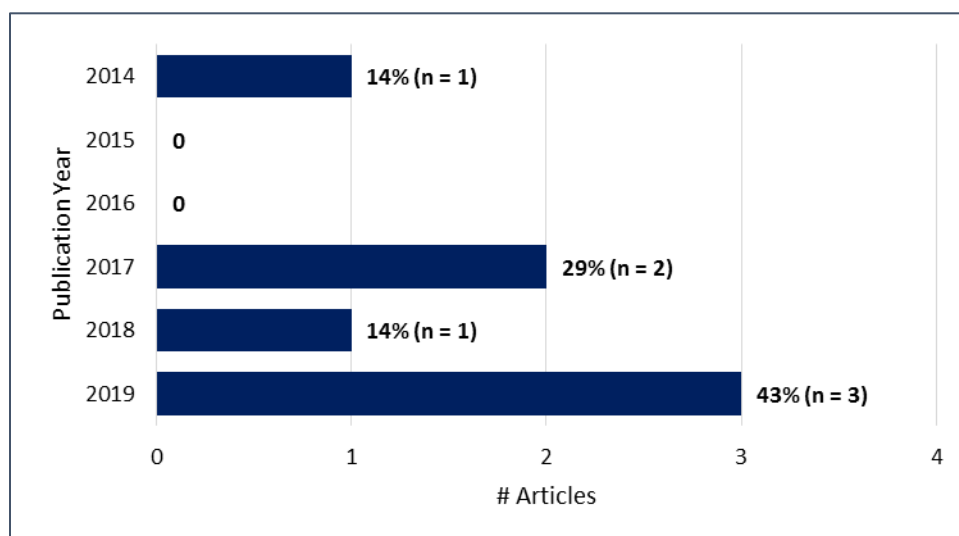
## 4.7 Articles that Addressed Mental Health

Less than 7%, (n=7) of the collected literature specifically addressed mental health outcomes associated with climate change.

### 4.7.1 Time Trends and Mental Health

The majority of articles that specifically address mental health were published in 2019 (43%; n=3). The review found only a small increase in the number of public health interventions that specifically address climate-related mental health outcomes (**Figure 12**).

Figure 12: Summary of Articles that Address Mental Health by Publication Year



#### 4.7.2 Geographic Trends and Mental Health

The majority of articles that address mental health are derived from North America (86%; n=6), specifically Canada (57%; n=4) and USA (29%; n=2). The other region which addressed mental health was Europe (14%; n=1). No other literature collected from other geographical regions addressed mental health.

#### 4.7.3 Intervention Types that Address Mental Health

All articles that addressed mental health identified multiple interventions pertaining to one or more climate-health risks. A deeper dive into the literature that identified climate-mental health outcomes was required to distinguish key characteristics of the related climate-health adaptation interventions. A range of intervention types that could address climate-mental health effects were identified (**Table 14**).

#### 4.7.4 Common Climate-sensitive Categories Identified

Interventions that aimed to address climate related mental health impacts focused on the following climate-sensitive categories:

- Extreme Weather
  - Flooding, Severe Storms, Natural Hazards, Drought, Fires
- Extreme Temperature
  - Extreme Heat
- Food and Water
  - Water Quality
  - Food Security

Table 14: Literature that Highlights Climate-related Mental Health Outcomes

Article that addressed mental health	Intervention Type *	Associated Climate-sensitive Category
<b>American Public Health. 2018 (89)</b>	<ul style="list-style-type: none"> <li>Health Communication</li> </ul>	<b>Extreme Weather</b> <b>Extreme Temperature</b>
<b>Anderson, Brown. 2017 (90)</b>	<ul style="list-style-type: none"> <li>School-based Interventions</li> <li>Children-based Interventions</li> <li>Cognitive-based Interventions</li> <li>Group-based Interventions</li> <li>Crisis Counselling Programs</li> <li>Psychological First Aid</li> <li>Eye Movement Desensitization And Reprocessing</li> <li>Psychological Debriefing</li> <li>Exposure Therapy</li> <li>Psychodynamic Psychotherapy</li> <li>Pharmacotherapeutics</li> <li>Health Promotion (Mental Health Promotion Campaign)</li> </ul>	<b>Extreme Weather</b>
	<ul style="list-style-type: none"> <li>Alerts/Advisories/Warnings</li> <li>Health Communication</li> <li>Planning/Decision-making</li> <li>Suicide Prevention Programs</li> <li>Environmental Adaptation (Green Space)</li> <li>Health Promotion (Peer-networks, Behaviours)</li> </ul>	<b>Extreme Temperature</b>
<b>Berry, Clark. 2014 (24)</b>	<ul style="list-style-type: none"> <li>School-based Programs</li> <li>Early Identification of Mental Health Challenges</li> </ul>	<b>Food &amp; Water</b>
	<ul style="list-style-type: none"> <li>Environmental Adaptations</li> <li>Alerts/Advisories/Warnings</li> <li>Planning/Decision-making</li> <li>Health Communication</li> <li>Health Promotion</li> <li>Disaster Mental Health Services</li> <li>Surveillance</li> <li>Immediate Family Reunion and Support</li> <li>Psychological First Aid</li> <li>Early Post-Disaster Psychological Interventions</li> </ul>	<b>Extreme Weather</b>
<b>(CAPE). 2019 (91)</b>	<ul style="list-style-type: none"> <li>Environmental Adaptations</li> </ul>	<b>Extreme Temperature</b>
	<ul style="list-style-type: none"> <li>Environmental Adaptations</li> <li>Planning/Decision-making</li> <li>Policies</li> <li>Mental Health Services</li> <li>Recovery Plan for Addiction and Mental Health</li> </ul>	<b>Extreme Weather</b>
<b>Kingsley and EcoHealth. 2019 (61)</b>	<ul style="list-style-type: none"> <li>Environmental Adaptations</li> </ul>	<b>Extreme Weather</b> <b>Extreme Temperature</b> <b>Air Quality</b>



		Ultraviolet radiation
		Food & Water
Schnitter and Berry. 2019 (92)	• Guidelines/Frameworks	Food & Water
World Health Organization Regional Office for Europe. 2017 (87)	• Environmental Adaptations	Extreme Weather
		Extreme Temperature
		Air Quality
		Food & Water

*\*Intervention Types identified may differ from categories applied in scoping review and may not be public health specific.*

## 5 DISCUSSION

This scoping review maps out the range and characteristics of existing literature on climate-health adaptation interventions applicable to Ontario. In complement to the results section, key concepts and general trends are summarized in **section 5.1**, followed by knowledge gaps in **section 5.2**. Recommendations for public health practice and research are expressed in **section 5.3**.

### 5.1 Summary of the range and characteristics of literature on climate-health adaptation interventions

Key trends related to time and geography, intervention type, and climate-sensitive categories can help public health authorities' source examples and lessons learned from climate-health adaptation interventions to identify, modify, and implement interventions.

#### 5.1.1 Time Trends

Analysis of the captured articles by publication year suggests that in recent years climate-health adaptation interventions, applicable to Ontario, are increasingly implemented and published. The increase in published articles captured since 2015 aligns with the adoption of the Paris Agreement in 2016 and the associated shift in discourse towards greater emphasis on climate change adaptation strategies (93, 94). The release of the IPCC AR5 in 2014 (1) may have influenced the higher number of articles captured in 2014. However, it is unclear why the literature review identified a drop in publications between 2014 and 2015.

The analysis demonstrates that climate-sensitive categories addressed in captured literature evolved throughout the period of the review (2014-2019) as identified in **section 4.2.3**. Changes in the frequency of climate-sensitive categories captured across publication year reflect an increasing occurrence and awareness of climate-related events and associated health risks in addition to growing empirical knowledge of the complex linkages between climate change and related health risks.

For example, 2017 experienced the highest number of articles that address extreme temperature. This pattern aligns with the global context of extreme heat events in that 2016 was, to date, the hottest year on record and extended into 2017, which at the time was the warmest year on record without an El Niño event (95-97). Moreover, anthropogenic global warming reached approximately 1°C in 2017 (98). The experience of extreme heat in 2016 and 2017 may have stimulated a surge in the literature that was published in 2017. This 2017 peak may also be reflective of the time taken to complete research initiated since the AR5 report. Among relevant literature, the number highlighting extreme temperature has decreased since 2017. This trend is also aligned with global temperature patterns; 2018 was cooler than 2017 and 2016 (97, 99). However, 2019 was to date, the second warmest year on record after 2016 and was only 0.04°C cooler than 2016 (97, 99, 100).

The increase in the literature that addressed vector-borne disease captured in the review aligns with a growing evidence base of the relationship between climate change and vector-borne diseases and awareness of increasing health outcomes (i.e. more cases of Lyme disease in North America) (101-106). Similarly, air quality was identified much more frequently in the captured literature published since 2018. This increase may have been influenced by a growing recognition of associated health impacts, and particularly by the attention received and concern raised by the Lancet Commission on air pollution and health, published in 2017 (107-109).

Time trends by climate-sensitive category indicate that more climate-health adaptation interventions are likely to be designed and published as the recognition of climate-sensitive categories and associated health impacts become increased. While this is unsurprising, it is also troublesome that climate-health adaptation interventions may be applied in reaction to, rather than preparation for, climate-related events and that empirical uncertainty may hinder intervention development. This interpretation reinforces the importance of using a climate-health lens for health risks associated with climate change and the continued need for empirical studies that link climate change to health outcomes. These actions may reduce the amount of uncertainty and promote adaptation actions sooner.

The distribution of public health intervention types used in captured articles has also changed across publication years, as identified in **section 4.2.2**. These changes are likely guided in part by the changes in climate-sensitive categories being addressed. The review captured an increase in the number of publications that highlight all intervention types except for health promotion. This potential knowledge gap is explored further in **section 5.2**.

Furthermore, a small increase in the number of articles that explicitly addressed mental health was identified between 2014 and 2019. This finding is explored further in **section 5.2**.

### **5.1.2 Geographic Trends**

The experience of other regions can help local authorities predict what will happen in their communities and provide a learning opportunity that can be applied to plan effective adaptation

interventions locally. This reinforces the value of engaging in knowledge translation activities to advance climate adaptation actions. Geographic trends identified by this review can help public health authorities' source relevant examples and experiences to support adaptation planning.

The geographic distribution of included literature (**section 4.3**) is likely influenced by the inclusion criteria's emphasis on climate-sensitive categories relevant to the Ontario context. Geographic regions with more similarities to Ontario's climate-health risks would be more frequently captured. The geographic distribution findings suggest that when public health authorities in Ontario plan to implement public health interventions that address climate-health impacts, examples from North America (particularly Canada and USA) and Europe are most likely to be applicable.

The specific geographic region most frequently identified was Canada. The distribution of intervention types and climate-sensitive categories included in articles derived from Canada suggests Canadian authorities are engaged in implementing a variety of climate-health adaptation interventions. Among articles from Canada, the four most commonly identified climate-sensitive categories (vector-borne disease, extreme temperature, extreme weather, and air quality) aligns with the frequency climate-health risks being addressed by public health authorities in Canada as identified in the Health Canada, *Climate Change and Health Resilience Survey* conducted in 2018 (110). This scoping review did not assess the distribution of articles across Canadian provinces, although Austin et al. found that adaptation varied across Canadian provinces/territories and while most were in early stages of adaptation, Québec was engaged in a high level of adaptation (66). Potential gaps in Canadian climate-health interventions are outlined in **section 5.2**.

There are variations in the distribution of particular climate-sensitive categories and intervention types across geographic areas. Overall, geographic patterns illustrate that climate-health interventions reflect climate-context of a specific region. When local public health authorities seek to address a particular climate-sensitive category, areas with practice managing similar health risks can be useful for local adaptation planning. For example, Australia has high levels of ultraviolet radiation and high rates of skin cancer (111-113) and thus is more likely to have public health interventions in place to address associated health risks. This region is likely to have interventions that address ultraviolet radiation that can be used to support adaptation planning in Ontario.

Similarly, the findings display that specific regions more frequently apply different intervention types. Articles from North America most frequently identified eight intervention types. Europe, notably the United Kingdom, captured the most examples of policy interventions. This suggests the policy interventions from the United Kingdom may provide a foundation to support the development of policy interventions for the Ontario context. The distribution of policy interventions is considered in greater detail in **section 5.2**.

Another potential influence on the geographic distribution of included articles is the restriction of the search strategy to English and French articles, with only English key terms used in the search strategy. Thus if regions produce a smaller amount of articles published in English, they would be captured less frequently by the review. As such, this review may not have identified relevant examples of climate-health adaptation due to language of publication.

### **5.1.3 Key Characteristics of Existing Climate-health Adaptation Interventions**

#### **5.1.3.1 Intervention Types**

An assortment of public health intervention types was identified in this review (**Figure 8**). The most common intervention type identified, planning/decision-making, is a strategic intervention<sup>6</sup> to address climate-health outcomes. The second most common intervention type identified, health communication, is a more applied approach<sup>7</sup> to adaptation. Both strategic and practical strategies can be used to address climate-health risks and should be included in public health climate change adaptation planning. The least frequently identified intervention type categories are explored in **section 5.2**.

#### **5.1.3.2 Climate-sensitive Categories**

The distribution of the main climate-sensitive categories captured in this review (**Figure 9**) also aligns with the most frequent health-risks being addressed by public health authorities identified by the *Climate Change and Health Resilience Survey* (110). In both studies, vector-borne disease, extreme weather, extreme temperature, and air quality were among the most frequently identified climate-health risks.

The search terms used in the literature search may have influenced the distribution of main and specific climate-sensitive categories. The search strategy intentionally excluded explicit terms for food and water and ultraviolet radiation to reduce the number of irrelevant articles identified. While the term water was used in combination with vector, food was not included in search terms nor was blue-green algae.

Articles that captured ultraviolet radiation and food and water were obtained using other relevant search terms like climate change and public health interventions. They may also have been captured in literature that identified more than one climate-adaptation intervention. Climate-

---

<sup>6</sup> Strategic interventions are strategies that identify how to address an issue, or achieve an objective, and plans actions and resources to do so over some time.

<sup>7</sup> Applied interventions are strategies that apply knowledge, theory and/or techniques into actions that address an identified issue, often tailored to a particular situation and target audience.

health adaptation interventions that address these climate-sensitive categories may not have been captured in this review if a robust public health and climate change lens was not applied.

Both ultraviolet radiation and food and water categories were captured less frequently in the review. In comparison, food and water categories were also less often targeted by public health authorities as identified in the *Climate Change and Health Resilience Survey* (110). Ultraviolet radiation was not assessed in the survey study (110). The similarity between the two studies indicates that despite confines of the scoping review search strategy, it is likely that ultraviolet radiation and food and water health-risks are less frequently addressed climate-sensitive categories. This potential gap is explored further in **section 5.2**.

The frequency of specific climate-sensitive categories related to a particular main climate-sensitive category provides valuable information on the climate health-risks being targeted. Many of the most frequently identified main and specific climate-sensitive categories reflect the level of awareness of climate-health risks in Ontario (i.e. extreme heat, flooding). Level of awareness is often greater for health-risks associated with climate-sensitive categories that occur more frequently, or have more severe outcomes. Climate-sensitive categories that are often less recognized were included in fewer articles (i.e. blue-green algae, extreme cold, ultraviolet radiation).

Several potential gaps in knowledge and practice related to the distribution climate-sensitive categories and related specific climate-sensitive categories are discussed in **section 5.2**.

#### *5.1.3.3 Cross Analysis of Intervention Types and Climate-sensitive Categories*

Cross analysis of intervention types and climate-sensitive categories provides insight into what intervention types are likely used to address a particular climate-sensitive category and specific climate-sensitive categories where applicable. **Section 5.3** specifies the application of these results for public health practice. Several stand out findings relevant to public health adaptation planning were discovered, and are presented here.

A range of intervention types were found to be useful to address one or more climate-health outcomes. Some intervention types, like health communication and health promotion can address a variety of different climate-sensitive categories. In contrast, some intervention types, such as surveillance and alerts/advisories/warnings mainly address one or two climate-sensitive categories, suggesting they are most applicable to a smaller selection of climate-health risks.

Findings regarding the intervention types that address vector-borne disease were particularly interesting. The review suggests surveillance is the most frequently applied intervention type to address vector-borne disease. In articles that address vector-borne disease, health promotion was one of the least commonly used intervention types (**Table 7**). Conversely, among the literature that applied health promotion interventions, vector-borne disease was the most frequently addressed climate-sensitive category (**Table 6**). Engaging in protective behaviours is

considered the best way to prevent Lyme disease and West-Nile Virus (114, 115). Preventative behaviours align with health promotion intervention type. These findings suggest that health promotion is a promising intervention type to address vector-borne disease.

The intervention type category 'other' was also most frequently captured in articles that addressed vector-borne disease. Intervention categorized under 'other' may reflect space for innovative public health interventions, such as citizen science. It may also indicate the application of specialized public health interventions explicitly tailored to the health outcome, like vaccine development. On the contrary, the higher frequency of 'other' intervention types that address vector-borne disease may have occurred because vector-borne disease was the most frequently captured climate-sensitive category in this study.

Among all articles that addressed ultraviolet radiation, the majority applied health promotion interventions, despite health promotion being one of the least commonly identified interventions types in the review. Interventions that would be expected to address ultraviolet radiation such as environmental adaptation (i.e. shade structures) and advisories were not readily identified in this review.

Cross analysis of intervention types and specific climate-sensitive categories provides some indication of which intervention types are most fitting to address a particular climate-sensitive category. Comparing findings between specific climate-sensitive categories and the related main climate-sensitive categories can identify similarities, differences, or exceptions that can be informative for public health practice.

While some specific climate-sensitive categories share a similar distribution of intervention types as the related main climate-sensitive categories, others follow different patterns. For example, the distribution of intervention types that address vector-borne disease is similar to those that target both Lyme disease and West Nile Virus. In comparison, while the specific climate-sensitive categories extreme heat and urban health island follow a similar distribution of intervention types to the central climate-sensitive category extreme temperature, articles that include extreme cold followed a different distribution of intervention types. This information can be useful to determine which intervention types are likely most applicable to health risks and whether a particular intervention type can be tailored to address multiple specific climate-sensitive categories related to one main climate-health risks.

A distinguishing finding regarding the distribution of intervention types in articles that address air quality and related specific climate-sensitive categories, revealed that addressing individual components related to air quality (PM2.5 and ground-level ozone) together (general air quality) may be more useful than addressing either component separately. Conversely, separate interventions are likely required to target the specific category aeroallergens. Likewise, different interventions may be needed to target specific climate-sensitive categories related to the main

category food and water. This is likely because these specific categories are quite distinct from each other.

#### *5.1.3.4 Climate-health Adaptation Interventions that Address Multiple Climate-health Risks*

The review revealed that certain intervention types can address more than one main climate-sensitive category in a single intervention, and may be a good investment to address climate-health risks. Environmental adaptation and planning/decision-making interventions are most likely able to address multiple climate-sensitive categories.

Environmental adaptation interventions affecting green space were able to address two or more main climate-sensitive types. The most common climate-sensitive categories addressed by green space interventions were extreme weather, extreme temperature, air quality, and food and water. Some articles addressed ultraviolet radiation.

Planning/decision-making interventions provided a strategic approach to address multiple climate-health impacts. These interventions commonly outlined how and when to implement other more applied interventions such as health communication, surveillance, health promotion, and alerts to support an overall goal.

No intervention that addresses vector-borne disease addressed another climate-sensitive category. This finding suggests that interventions designed to tackle vector-borne disease are specific and associated health-impacts are unlikely related to another climate-sensitive category.

#### *5.1.3.5 Climate-health Adaptation Interventions that Address Mental Health Outcomes*

Several articles captured by this review explicitly addressed the mental health outcomes of climate change. Of these, not one article solely identified one climate-health adaptation intervention that focused only on climate-mental health outcomes. As such, a deeper dive into these articles was required to identify key characteristics.

The scope of this research project explicitly stated that health impacts addressed by adaptation interventions included both physical and mental health outcomes directly or indirectly caused by climate change would be relevant. However, the search strategy did not explicitly include search terms for particular health outcomes, including mental health outcomes. Consequently, relevant literature that highlights public health interventions that specifically address climate-related mental health outcomes may not be captured by this review.

Analysis of the relevant articles proposes that a variety of intervention types can be used to target climate-mental health outcomes. Some articles that addressed other climate-health risks described benefits to mental health. By reducing exposure, sensitivity, and enhancing adaptive capacity to climate change through adaptation interventions broadly, individuals and communities can better cope with climate change, simultaneously improving psychosocial health risk of climate change (12). This approach to addressing climate-mental health is more

integrated and reflects a primary and secondary approach to prevention. Other literature identified interventions that focused specifically on preventing mental illness influenced by climate change. These interventions included crisis counselling, cognitive interventions, and suicide prevention.

The most common climate-sensitive categories associated with interventions targeting climate-mental health risk were extreme weather (flooding, severe storms, drought, and fire), extreme temperature (extreme heat), and food and water (water quality and food security). Emerging evidence indicates that the psychological impacts of climate change are widespread (116). Potential gaps associated with climate-health interventions that address mental health outcomes are identified in **section 5.2**.

#### *5.1.3.6 Additional Observations*

Only one article (117), written from an Indigenous standpoint, was captured in this study. This was influenced by the fact that the review was not designed with an explicit aim to capture climate-health adaptation interventions specific to the context of Indigenous peoples. Thus the search terms applied did not include language reflective of Indigenous perspectives.

The methodological omission was identified in this study because experts external to the research team were consulted on the study protocol and early findings. This flagged the lack of literature reflective of Indigenous contexts and knowledge which motivated the research team to reflect on the cause of this and the unintended consequences of the project scope. The experience highlights an advantage of collaboration and consultation between experts when conducting research.

Several interventions identified from this source did not *'fit'* under the definitions of the intervention type categories used in the review. They were consequently captured under the 'other' intervention type category. This illustrates that some interventions that address climate-health risks of Indigenous people likely do not match western conceptualization of interventions that are predominantly used. Further interpretation and ramifications of this matter are considered in **sections 5.2, 5.3, and 6.2**.

## **5.2 Gaps in Knowledge and Practice**

The analysis revealed several potential shortcomings regarding existing climate-health adaptation interventions. Recognizing these gaps in practice and knowledge presents an opportunity for public health authorities to modify activities and develop a research agenda that will contribute to the evidentiary base for climate-health adaptation initiatives, and sequentially support population health and wellbeing.



## **1. Some public health intervention types may be under-utilized.**

The distribution of intervention types (**Figure 8**), illustrates that health promotion, policy and guideline/framework interventions may be under-utilized compared to other intervention types identified in this study.

Despite being a core public health activity (32), health promotion interventions were among the less frequently captured intervention type in this review. This study applied a definition of health promotion that focused on behaviours as opposed to broader systems change during intervention type categorization and thus may have influenced the number of captured health promotion interventions. However, unlike all other intervention types identified, the number of publications that emphasized health promotion did not increase over time.

Despite the low frequency, findings illustrate that health promotion interventions can be applied to a variety of climate-sensitive categories and may be particularly useful for targeting certain health risks such as vector-borne disease and ultraviolet radiation. Overall, the findings represent an opportunity for further research into the utility of health promotion interventions for a variety of climate-health risks and investing in implementation of promising interventions.

Policy and guideline/framework interventions were also less frequently applied intervention types. This may be influenced by how they were conceptualized in the review. This study defined policy and guideline/framework interventions independently; however, in practice, there is a fine line between the conceptualization of these two intervention types. As such, the separation of these intervention types in this review may have contributed to the observed low frequency.

The geographic region North America most frequently identified all intervention types except for policy. This may indicate a gap in the implementation of policy interventions to address climate-health outcomes in North American, including Canada. However, this may also be reflective of a potential difference in the defining characteristics of policy interventions implemented across geographic regions where these interventions were captured under a different, related intervention type such as guidelines/framework.

## **2. Some main and specific climate-sensitive categories may warrant greater attention.**

The study displays that some climate-sensitive categories are less commonly addressed within climate-health adaptation intervention literature. As previously described in **section 5.1** the distribution of climate-sensitive categories could be influenced by the choice of search terms applied in this study. Regardless, this is a potential gap in practice that warrants further attention.

The distribution of climate-sensitive categories indicates (**section 4.5.1**) that few interventions target ultraviolet radiation. Moreover, geographic trends indicate ultraviolet radiation is infrequently addressed in most included geographic regions except for Australia/New Zealand

**(section 4.3.3).** These findings suggest a disparity in climate-health adaptation interventions that address ultraviolet radiation, including in Canada. This idea is reinforced by the fact that ultraviolet radiation was not assessed in the Health Canada survey (110), despite being recognized as a current and increasing climate-health risk within Canada (24, 112).

Several specific climate-sensitive categories were also identified infrequently among the included literature **(section 4.5.2)**. The specific climate-sensitive categories related to food and water, blue-green algae, and foodborne illness were not often addressed in captured literature despite evidence that they are current and growing climate-health risks (23, 24, 29, 110). Similarly, interventions that address winter storms were not captured under severe storms or natural hazards related to extreme weather although this is particularly relevant to the Ontario context (23, 24). Likewise, there were fewer interventions targeting extreme cold than extreme heat under the main climate-sensitive category extreme temperature. These specific climate-sensitive categories are increasingly a health issue due to climate change, and the fact they were less commonly captured within this review suggests it is a potential gap that public health authorities should consider.

### **3. Climate-mental health outcomes are insufficiently addressed.**

The results suggest that few interventions address climate-mental health outcomes, and only a small increase was identified between 2014 and 2019. Moreover, among articles that addressed mental health, none exclusively identified one intervention that solely targeted mental health outcomes related to a particular climate-sensitive category.

These trends align with other literature which identified that mental health impacts associated with climate change are not well understood and often overlooked, despite evidence that shows rising psychological health effects of climate change (116, 118). Hayes et al. identified that literature on psychosocial adaptation to climate change is missing in literature globally (12).

Several interventions identified in the literature addressed mental health by explicitly expressing how a climate-health adaptation intervention supports mental health and wellbeing. For example, green space interventions that targeted several climate-health risks made an explicit reference to how the intervention could benefit mental wellbeing. In comparison, some articles that did not address climate-mental health outcomes displayed similar interventions to those that explicitly described mental health benefits, and would likely have mental health benefits that were not expressed. This illustrates that climate-mental health outcomes are not always considered. Public health authorities and researchers should make these connections in climate-health work to strengthen evidentiary bases for climate-health adaptation interventions regarding mental health and wellbeing.

Emerging literature on climate change and mental health demonstrate that the climate-sensitive categories extreme weather, extreme temperature, and vector-borne disease can have direct mental health impacts (116). Moreover, climate change's influence on the determinants of

health can have psychosocial effects (119, 120). Furthermore, general concern and worry over climate change, referred to as ecological grief and anxiety, has increasingly been acknowledged as a concern for mental wellbeing (116, 118). The captured interventions that targeted mental health did not address two of these better-known sources of mental health outcomes related to climate change, vector-borne disease, and ecological grief and anxiety.

**4. Authorities may not regularly apply a climate-health lens to all interventions that address climate-health risks and may not be publishing their experiences on climate-health adaptation interventions.**

The interpretation of the results suggests that public health interventions that address a climate-health risk, may not explicitly identify or communicate a climate-health lens and/or interventions with a climate-health lens may not be consistently published. Public health work often targets health risks that are associated with climate change without directly acknowledging.

Furthermore, Public Health Authorities may lack resource capacity to publish related work.

This was exemplified by the fact that traffic-related air pollution was the least targeted specific climate-sensitive category related to air quality in the review, suggesting it is less frequently addressed than other related specific climate-sensitive categories. However, traffic-related air pollution is commonly addressed by public health authorities in different contexts (121-124). Since the review did not capture this work, it suggests a climate-health lens is not being applied to traffic-related air pollution.

Since health promotion is a core public health function, the low frequency of publication of health promotion interventions was unexpected. This intervention type may have been captured less frequently in this study because those implementing such interventions are not publishing their experiences or are not explicitly communicating a climate-health lens within publications.

Furthermore, although search terms for ultraviolet radiation were not included in this study, literature that included a clear climate-health lens should have been captured by the search strategy. This indicates that an explicit climate-health lens is not commonly being applied to climate-health interventions targeting ultraviolet radiation, and potentially other climate-health risks.

The most frequently addressed climate-sensitive categories by adaptation interventions captured in this review are those most commonly recognized as climate-health risks (i.e. flooding, extreme heat, Lyme disease). This suggests that strengthening the application of a climate-health lens, and increasingly disseminating related knowledge may result in more public health adaptation interventions that address a variety of climate-sensitive categories.

**5. Public health authorities need to make stronger efforts to include Indigenous voices in climate-health adaptation strategies.**

The review did not capture a reasonable number of articles that meaningfully incorporated Indigenous perspectives and knowledge into climate-health adaptation planning. This does *not* mean that there is a gap in climate-health adaptation interventions that take into account Indigenous contexts and perspectives. Indigenous peoples and communities are at the forefront of climate change action and have led and developed adaptation strategies themselves (33, 34, 44, 125-129). Additionally, more funding has become available to support these actions by government agencies (130-132).

More accurately, the results reflect a probable disparity in meaningful efforts to include Indigenous voices in climate-health adaptation and Indigenous research methods in public health practice. This review exemplified an unacceptable yet common ‘mistake’ in public health practice. Indigenous voices were unintentionally excluded because the review did not explicitly aim to capture or make space for Indigenous perspectives, as described in **sections 3.8 and 5.1.3.6**. In other words, because the review did not purposefully make space for Indigenous perspectives or Indigenous research methods, Indigenous knowledge and ways of knowing and doing were actually blocked from being captured.

This interpretation is supported by literature on Indigenous and decolonizing methodologies and approaches (45, 125). Research conducted through western knowledge systems and understanding cannot adequately capture Indigenous experiences and perceptions due to contrasting values, epistemologies, and power dynamics (43-45). Existing Indigenous climate change studies have highlighted a need for assessments of risk and adaptation strategies that are rooted in the understanding of Indigenous experiences and worldviews in order to effectively utilize and strengthen adaptive capacity of Indigenous peoples to promote health and wellbeing in the face of climate change. (34, 43, 133, 134). Strategies applied to address an issue are dictated by how the issue is framed; therefore neglecting Indigenous worldviews in assessments and research may restrict the development of adaptive capacity (33, 43, 133).

In an attempt to support future public health efforts, a complementary project captured critical concepts of Indigenous perspectives and knowledge that need to be understood and meaningfully integrated into adaptation planning. Additional suggestions are highlighted in **sections 5.3 and 6.2**.

## **5.3 Recommendations for Practice and Research**

### ***5.3.1 Applying Results to Climate Change and Public Health Adaptation Planning***

Public health authorities are encouraged to use the results of this scoping review to inform local public health climate change adaptation planning. This section proposes how public health authorities can operationalize these results to address local climate-health risks in Ontario.

**1. Geographic trends can support public health authorities to source relevant examples of climate-health adaptation interventions.**

Ontario public health authorities can learn from the experiences of other regions facing similar climate-health risks to inform local adaptation planning. Geographic trends identified by this study can support public health authorities to find relevant examples of climate-health adaptation interventions from a variety of regions by intervention types and climate-sensitive categories. Examples and lessons learned from other regions can be tailored and applied to the local context.

**2. Characteristics of existing climate-health interventions can support public health authorities to compile an inventory of possible climate-health interventions that can be adapted to implement locally.**

Cross analysis of intervention types and climate-sensitive categories display a range of existing public health intervention types and the climate-sensitive categories that they are likely to target. Public health authorities can use this collection of knowledge on the characteristics of existing interventions to compile an inventory of possible measures that can be adapted and implemented locally.

Compiling an inventory list of possible climate-health adaptation interventions is endorsed by the *Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guideline* as an initial step in adaptation planning (23).

**3. Interventions that address multiple climate-sensitive categories can help public health authorities plan climate-health adaptation interventions that may provide a greater return on investment.**

Characteristics of interventions that can address multiple climate-sensitive categories can help authorities plan for interventions that can support climate change adaptation and address expected health outcomes related to several climate-sensitive categories. Implementing one intervention that can address multiple climate-health risks may provide a greater return on investment.

This review identified several examples of public health interventions capable of addressing multiple health risks. Moreover, key characteristics of these interventions reveal related climate-sensitive categories that are likely to be addressed simultaneously if interventions are designed to do so.

**4. Interpretation of the results reveal several key considerations that can support public health climate change adaptation planning.**

The results and interpretation of this scoping review have identified several important considerations for public health practice. When developing local public health climate change adaptation plans, public health authorities should consider the following:

- Health communication and health promotion intervention types are likely versatile and can be tailored to tackle a variety of climate-sensitive categories.
- Some intervention types, like surveillance and alerts/advisory/warnings, predominantly address one or two climate-sensitive categories.
- The intervention type 'other' captured by this review often indicates space for innovative or distinctive approaches to address particular climate-health risks, sometimes for specific populations (e.g. Indigenous).
- Both strategic and practical approaches can be applied to address local climate health risks.
- Public health interventions that aim to address air quality broadly can effectively address multiple components of air pollution such as PM2.5, ground-level ozone and traffic-related air pollution. There may be less opportunity for overlap between pollution-related interventions and those addressing aeroallergens.
- Existing mental health supports and services can support mental wellbeing and prevent mental illness related to climate change. Identifying and mapping out local mental health services and supports can contribute to climate-health adaptation planning.
- Reflect on how interventions can address both physical and mental health consequences of climate-sensitive categories.
- Consider whether existing public health interventions could benefit from incorporating a climate-health lens. Existing interventions may function as a climate-health adaptation intervention.
- Public health authorities may be able to identify promising intervention types that address climate-sensitive categories by comparing the proportion of intervention types that address climate-sensitive categories and vice-versa.

### ***5.3.2 Applying Results to Advance Public Health Practice and Knowledge***

In light of several potential gaps in practice and knowledge revealed by the scoping review and supporting literature, several actions are suggested for public health authorities and researchers. Engaging in these suggested activities can contribute to advancing public health practice and the evidentiary base regarding public health and climate change adaptation interventions.

#### **1. Increase knowledge translation activities.**

The public health community will benefit from knowledge exchange activities from authorities that develop, implement, and evaluate climate-health adaptation interventions. This may be particularly beneficial for climate-health adaptation interventions that include intervention types and climate-sensitive categories that were identified less frequently in the review. Knowledge translation products should provide information about the processes and outcomes of interventions to inform other public health authorities and the research community.

Public Health Authorities may lack the resources required to engage in knowledge translation activities, such as publishing. Other public health authorities and stakeholders can support knowledge translation activities on climate-health adaptation interventions by providing or sharing required resources.

## **2. Explicitly integrate a climate-health lens.**

Public health activities may address climate-related health risks without explicitly acknowledging or applying a climate-health lens. Public health authorities should consider and explicitly state how a climate-health lens can be incorporated into existing interventions that support climate change adaptation and address expected climate-health outcomes. The inclusion of a climate-health lens can enhance knowledge on how climate change is connected with health outcomes already being addressed and build the evidentiary basis. It can increase recognition for climate-health risks and therefore lead to the development of climate-health adaptation interventions. Moreover, applying a climate-health lens may identify additional health benefits that can further rationalize public health activities to stakeholders.

## **3. Invest in climate-health interventions.**

Public health authorities and researchers should invest in developing, piloting, implementing, and evaluating climate-health interventions. The scoping review findings can help authorities develop a research agenda. The review identifies promising intervention types to address specific climate-sensitive categories, including multiple health-risks that can be advanced. Identified gaps regarding intervention types and climate-sensitive categories should also be targeted.

## **4. Continue to build understanding of climate-health risks.**

The review identified that climate-sensitive categories that are more recognizable and understood are more likely to be addressed by climate-health adaptation interventions. Thus, advancing empirical evidence on health-risks may lead to more interventions. Climate-sensitive categories less often captured in this review should be prioritized.

Additionally, climate-mental health outcomes must be prioritized by public health authorities and researchers. Mental health must be included in climate change and health vulnerability and adaptation assessments to better understand current and projected climate-related mental health outcomes and potential adaptation strategies. Further recommendations regarding incorporating mental health indicators into climate change and health vulnerability adaptation assessments are highlighted in Hayes & Poland (2019).

Indigenous values, ways of knowing and doing and experiences must be rooted in assessments of climate-health risks for Indigenous peoples and communities, in order to strengthen adaptation capacity effectively.

## **5. Public health authorities have a moral responsibility to become educated on how to support Indigenous climate-health adaptation.**

The complementary project (Module Two), identifies Indigenous perspectives and the importance of including these perspectives into climate-adaptation, as well as strategies to assist public health authorities in doing so. It is important that public health authorities understand and meaningfully apply these perspectives to work with and learn from Indigenous peoples regarding climate-health adaptation planning and implementation.

Public health authorities are encouraged to use this document as an *introduction* to critical concepts that should be further explored, built-on, and applied to develop respectful, reciprocal relationships with Indigenous communities and work towards appropriate adaptation strategies that take into account Indigenous contexts and worldviews. Public health authorities must become educated on the influence that colonization has on climate-health vulnerability, Indigenous conceptualizations of health and wellbeing, and the importance of land as a key determinants of Indigenous health. Moreover, public health authorities must learn how to promote decolonizing methodologies.

## **6 CONCLUSION**

The scoping review synthesized knowledge on the range and characteristics of public health interventions that support climate change adaptation and address expected health impacts associated with climate-sensitive categories within Ontario. The review adopted a broad focus on interventions that had public health relevance published within the last 5 years (2014-2019).

The findings of this review are a starting point to advance public health practice and knowledge on climate-health adaptation interventions. Key themes that were analysed include time trends, geographic trends, climate sensitive categories, intervention types, interventions that target multiple climate-sensitive categories, and whether mental health impacts were addressed were identified.

Literature published on interventions that address a variety of climate-health risks that have public health relevance in Ontario is increasing. Certain intervention types are more commonly applied to certain climate-sensitive categories, while some can address multiple health risks which may provide a good investment. Mental health was not commonly addressed. This, as well as several other areas, require further investment to establish a stronger evidence base to support public health climate change adaptation planning.

This report has highlighted ways in which public health authorities can use this information to support local public health and climate change adaptation plans. It also provides key areas of future research and activities that would further support this field of knowledge and practice.



This project was possible because of the collaboration between the Simcoe Muskoka District Health Unit, the Public Health Agency of Canada Ontario Region, and Cambium Indigenous Professional Services.

## 6.1 Strengths and Limitations

The review addresses a practical need for local public health authorities in Ontario. *The Ontario Public Health Standards* require Public Health Authorities to conduct climate change and health vulnerability and adaptation assessments (32, 135). The logical next step, following vulnerability assessments, is to plan and implement climate-health adaptation interventions to promote and protect health and wellbeing. Moreover, public health authorities have a moral and ethical imperative to apply a climate-health lens because of the significant public health risk that climate change poses.

The scoping review applied a methodological rigour while allowing for rapid synthesis of the literature to address the knowledge gap as health units in Ontario work to complete vulnerability assessments and identify climate change adaptation interventions.

As such, this review presents a timely and practice evidentiary basis, done with rigour, to respond to the Ontario public health authorities' needs, created by the Ontario Public Health Standards and moral obligation. The review provides information on key characteristics of climate-health interventions which can help public health authorities identify and prioritize climate-health adaptation interventions. It also offers insight into potential gaps in public health practice and knowledge. The review is practical, in that it determines how public health authorities can use critical findings to support climate change adaptation, planning, and advance public health activities and practice to respond to potential gaps identified.

This scoping review project was deliberately broadly scoped to seek information on existing climate change related interventions that may be of relevance in the Ontario context. This was a strength of the review. By maintaining a breadth, the study was able to capture and identify gaps in the North American context. For example, by including geographic regions outside of Canada, the review was able to capture ultraviolet radiation interventions from Australia and Policy interventions from the United Kingdom. Furthermore, the breadth of the study can help public health authority's forecast, so as climate shifts, authorities can pull examples from areas with more experience with a particular climate-sensitive category or intervention type.

While this review has several strengths, there are also some limitations to be acknowledged. The scope of this review makes it possible that not all relevant literature was identified. The research team made decisions regarding the scope of the project to make the study feasible. These decisions and their potential impacts on the study has been reported on throughout the methods (**section 3**) and discussion (**section 5**) of this report. Reporting on these decisions and their potential impact maintains transparency of this review.

The data collection and analysis processes limited the ability to discern which intervention types and climate-sensitive categories were associated with a particular intervention within one article. A deeper dive into the literature was applied to make this distinction for interventions that addressed mental health and those that addressed multiple climate-sensitive categories.

A shortcoming of the review was that it did not commonly capture adaptation interventions that took into account Indigenous peoples context and ways of knowing and doing. The authors recognize that this is because the scoping review was not designed with the explicit aim to capture this information. Thus, search terms did not include language reflective of Indigenous ways of knowing and doing. This shortcoming is unfortunately often cited in public health work and can perpetuate colonial systems of knowledge and practice. In response to this issue, Cambium Indigenous Professional Services was contracted to complete an associated project that focused explicitly on adaptation to climate change as it relates to Indigenous-specific ways of knowing and doing. This complementary project will hopefully help Public Health Authorities avoid this mistake in the future.

## **6.2 Next Steps to Enhance the Findings of this Scoping Review**

This scoping review lays the groundwork for better understanding of the range and characteristics of public health interventions that address associated health risks across climate-sensitive categories relevant to Ontario. Several next steps are recommended to specifically address limitations of this scoping review, and advance this body of work beyond the scope of this research project. Recommendations and the rationale for each are as follows:

- Future research on existing climate-health interventions should capture the intervention implementation bodies to highlight the interdisciplinary intersectional collaboration needed to deliver an intervention. This could help public health audiences see the type of collaborative actions needed to support climate change adaptation efforts.
- Forthcoming investigations should identify specific health outcomes that the climate-health adaptation interventions are targeting as opposed to climate-sensitive categories. This information is useful to increase the understanding of which health issues are being addressed by interventions and can help public health authorities integrate climate adaptation work into existing activities that address specific health outcomes.
- Capturing the target populations in future assessments would help to identify whether specific vulnerable populations are targeted by the interventions. This can help identify if and how health equity considerations are, or are not, being taken into account within interventions. It can also help public health authorities understand which groups are being targeted and who's adaptation needs are being considered.
- Future reviews should capture characteristics of barriers and opportunities for adaptation interventions, including if and how literature on climate-health adaptation interventions document or discuss them. This would be useful information to inform adaptation

planning and implementation of similar climate-health adaptation interventions. It could also identify success factors or implementation tools that could help with the application of interventions in Ontario.

- Knowledge synthesis on the characteristics of existing capacity building strategies for the implementation of adaptation interventions could be beneficial. This information can help public health authorities identify how to build capacity and readiness within a public health authority or community to implement adaptation activities more efficaciously.
- A study should exclusively capture the range and characteristics of adaptation strategies that address climate-health impacts for Indigenous populations within Ontario.
- Lastly empirical evidence on the quality and effectiveness of existing interventions would be extremely informative to public health authorities. This information can help authorities prioritize different interventions and provide insights into which interventions would be the best investment for health.

Capturing this information in future projects will build the evidentiary base for local climate change adaptation and sequentially further support public health authorities in the adaptation planning processes and implementation.

## Appendices

### Appendix A: Distribution of Public Health Interventions Types across Publication Years

Public Health Intervention Type	Publication Year											
	2014 (N=14)		2015 (N=9)		2016 (N=11)		2017 (N=15)		2018 (N=15)		2019 (N=30)	
	n <sup>a</sup>	% <sup>a</sup>	n	%	n	%	n	%	n	%	n	%
Health Communication	4	29%	5	56%	5	45%	3	20%	7	28%	10	33%
Health Promotion	2	14%	3	33%	1	9%	3	20%	3	12%	2	7%
Environmental Adaptations	1	7%	2	22%	1	9%	6	40%	2	8%	7	23%
Policy	-	-	3	33%	1	9%	2	13%	3	12%	5	17%
Planning / Decision-making	4	29%	3	33%	7	64%	6	40%	9	36%	7	23%
Surveillance	4	29%	5	56%	2	18%	4	27%	5	20%	8	27%
Guidelines / Frameworks	2	14%	1	11%	-	-	2	13%	2	8%	4	13%
Alerts / Advisories / Warnings	3	21%	2	22%	3	27%	1	7%	5	20%	5	17%
Other	1	7%	-	-	1	9%	1	7%	2	8%	6	20%

<sup>a</sup> Articles may include more than one public health intervention type, so values for n may not add up to the total number of articles published each year (N). Percentages likewise may not sum to 100%.

## Appendix B: Distribution of Main Climate-sensitive Categories by Publication Year

Main Climate-Sensitive Category	Publication Year											
	2014 (N=14)		2015 (N=9)		2016 (N=11)		2017 (N=15)		2018 (N=25)		2019 (N=30)	
	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>	n <sup>a</sup>	% <sup>a</sup>
Extreme Weather	5	36%	1	11%	2	18%	5	33%	4	16%	6	20%
Extreme Temperature	5	36%	3	33%	3	27%	10	67%	7	28%	6	20%
Air Quality	2	14%	2	22%	2	18%	2	13%	7	28%	8	27%
Vector-borne Disease	4	29%	5	56%	3	27%	4	27%	10	40%	12	40%
Ultraviolet Radiation	1	7%	1	11%	0	0%	0	0%	0	0%	3	10%
Food and Water	2	14%	1	11%	3	27%	2	13%	3	12%	6	20%

<sup>a</sup> Articles may include more than one main climate-sensitive category, so values for n may not add up to the total number of articles published each year (N). Percentages likewise may not sum to 100%.

## Appendix C: Distribution of Articles by Main Geographic Region (N=104)

Main Geographic Region	n	% Total
North America	59	57%
Europe	29	28%
South America	2	2%
Australia, New Zealand	8	8%
Non-Defined	6	6%

## Appendix D: Distribution of Articles by Specific Geographic Region (N=104)

Specific Geographic Region	n	% Total <sup>a</sup>	% Associated Main Geographic Region <sup>b</sup>
<b>Canada</b>	30	29%	51%
<b>USA</b>	28	27%	47%
<b>Mexico</b>	1	1%	2%
<b>United Kingdom</b>	10	10%	34%
<b>Central Europe</b>	7	7%	24%
<b>General Europe</b>	4	4%	14%
<b>Eastern Europe</b>	1	1%	3%
<b>Southern Europe (Mediterranean)</b>	7	7%	24%

<sup>a</sup> The % of the total number of articles (N=104).

<sup>b</sup> The % associated with main geographic region for Canada, USA and Mexico is North America (N=59); The % associated with the main geographic region for United Kingdom, Central Europe, General Europe, Eastern Europe, Southern Europe is Europe (N=29).

## Appendix E: Distribution of Articles by Public Health Intervention Type (N=104)

Public Health Intervention Type	n <sup>a</sup>	% <sup>a</sup>
<b>Planning / Decision-making</b>	36	35%
<b>Health Communication</b>	34	33%
<b>Surveillance</b>	28	27%
<b>Environmental Adaptations</b>	19	18%
<b>Alerts / Advisories / Warnings</b>	19	18%
<b>Health Promotion</b>	14	13%
<b>Policy</b>	14	13%
<b>Guidelines / Frameworks</b>	11	11%
<b>Other</b>	11	11%

<sup>a</sup> Articles may include more than one public health intervention type, so values are >104. Likewise percentages will not equal 100%.

## Appendix F: Distribution of Articles by Main Climate-sensitive Category (N=104)

Main Climate-Sensitive Category	n <sup>a</sup>	% <sup>a</sup>
<b>Vector-borne Disease</b>	38	37%
<b>Extreme Temperature</b>	34	33%
<b>Extreme Weather</b>	23	22%
<b>Air Quality</b>	23	22%
<b>Food and Water</b>	16	15%
<b>Ultraviolet Radiation</b>	5	5%

<sup>a</sup> Articles may include more than one main climate-sensitive category, so values are >104. Likewise percentages will not equal 100%.

## Appendix G: Frequency of the Specific Climate-sensitive Categories Related to Each Main Climate-sensitive Category

Main Climate-sensitive Category	N <sup>a</sup>	Specific Climate-sensitive Category	n <sup>a</sup>	% <sup>a</sup>
<b>Vector-borne Disease</b>	38	Lyme Disease	20	53%
		West Nile Virus	18	47%
		General	11	29%
<b>Extreme Temperature</b>	34	Extreme Heat	28	82%
		Urban Heat Island	13	38%
		Extreme Cold	4	12%
<b>Extreme Weather</b>	23	Flooding	16	70%
		Severe Storms	10	43%
		Natural Hazards	10	43%
		Drought	7	30%
		Forest Fires	7	30%
<b>Air Quality</b>	23	General Air Quality	16	70%
		PM2.5	10	43%
		Ground-level Ozone	5	22%

		Aeroallergens	4	17%
		Traffic Related Air Pollution	3	13%
<b>Food and Water</b>	16	Water Quality	9	56%
		Waterborne Illness	6	38%
		Food Security	6	38%
		Water Quantity	4	25%
		Foodborne Illness	3	19%
		Blue-green Algae	2	13%
<b>UVR</b>	5	UVR	5	100%

<sup>a</sup> Articles may include more than one category, so sum is greater than N, and percentages will not equal 100%.

## Appendix H: Captured Articles that Address the Main Climate-sensitive Category Vector-borne Disease

Article	Specific Climate-sensitive Category Related to Vector-borne Disease	Public Health Intervention(s)
<b>Aenishaenslin, Gern. 2015 (136)</b>	Lyme Disease	Planning/Decision-making
<b>American Public Health. 2018 (89)</b>	Vector-borne Disease General	Health Communication Health Promotion Environmental Adaptations Planning/Decision-making Surveillance Alerts/Advisories/Warnings
<b>Anderson, Brown. 2017 (90)</b>	West Nile Virus Lyme Disease Vector-borne Disease General	Health Communication Health Promotion Environmental Adaptations Policy Surveillance Alerts/Advisories/Warnings
<b>Antonise-Kamp, Beaujean. 2017 (137)</b>	Lyme Disease	Health Communication Health Promotion
<b>Barker. 2019 (138)</b>	West Nile Virus	Planning/Decision-making Surveillance
<b>Bartumeus, Oltra. 2018 (139)</b>	West Nile Virus Vector-borne Disease General	Health Communication Planning/Decision-making Surveillance
<b>Bateman, Cook. 2018 (140)</b>	Lyme Disease	Guidelines/Frameworks



<b>Berry, Clark. 2014 (24)</b>	West Nile Virus Lyme Disease Vector-borne Disease General	Health Communication Health Promotion Environmental Adaptations Planning/Decision-making Surveillance Other
<b>Bonnet and Richardson. 2018 (141)</b>	Lyme Disease Vector-borne Disease General	Planning/Decision-making Other
<b>Bouchard, Aenishaenslin. 2018 (142)</b>	Lyme Disease	Planning/Decision-making
<b>Bouchard, Aenishaenslin. 2018 (142)</b>	Lyme Disease	Health Communication Environmental Adaptations Surveillance
<b>California Department of Public. 2017 (143)</b>	West Nile Virus	Surveillance Guidelines/Frameworks
<b>(CAPE). 2019 (91)</b>	West Nile Virus Lyme Disease	Health Communication Environmental Adaptations Policy Planning/Decision-making Surveillance Alerts/Advisories/Warnings
<b>Chiari, Prosperi. 2015 (144)</b>	West Nile Virus	Surveillance
<b>Clow, Ogden. 2018 (145)</b>	Lyme Disease	Planning/Decision-making
<b>DeFelice, Birger. 2019 (146)</b>	West Nile Virus	Planning/Decision-making Surveillance
<b>Dubey, Amritphale. 2014 (147)</b>	West Nile Virus	Health Communication
<b>Fischhoff, Keesing. 2019 (148)</b>	Lyme Disease	Environmental Adaptations
<b>Germain, Simon. 2019 (149)</b>	West Nile Virus Lyme Disease Vector-borne Disease General	Health Communication Planning/Decision-making Surveillance
<b>Hinckley, Meek. 2016 (150)</b>	Lyme Disease	Other
<b>Hines and Sibbald. 2015 (151)</b>	Lyme Disease	Health Communication Health Promotion Surveillance
<b>Hongoh, Campagna. 2016 (152)</b>	West Nile Virus	Planning/Decision-making

<b>Jourdain, Samy. 2019 (153)</b>	West Nile Virus Vector-borne Disease General	Surveillance
<b>Koffi, Savage. 2017 (154)</b>	Lyme Disease	Surveillance
<b>Lewis, Boudreau. 2018 (155)</b>	Lyme Disease	Health Communication Health Promotion Surveillance
<b>Martin, Borucki. 2019 (156)</b>	West Nile Virus Vector-borne Disease General	Surveillance
<b>Napoli, Iannetti. 2015 (157)</b>	West Nile Virus	Surveillance
<b>Nasci and Mutebi. 2019 (158)</b>	West Nile Virus	Other
<b>Nichols, Andersson. 2014 (159)</b>	Vector-borne Disease General	Surveillance Alerts/Advisories/Warnings
<b>Ogden, Koffi. 2014 (160)</b>	Lyme Disease	Surveillance
<b>Pamela and Nation Government. 2018 (117)</b>	Vector-borne Disease General	Other
<b>Potter, Jardine. 2019 (161)</b>	West Nile Virus	Health Communication
<b>Ripoche, Gasmi. 2018 (162)</b>	Lyme Disease	Surveillance
<b>Rochlin, Ninivaggi. 2019 (163)</b>	Lyme Disease Vector-borne Disease General	Health Communication Environmental Adaptations Other
<b>Soucy, Slatculescu. 2018 (164)</b>	Lyme Disease	Planning/Decision-making
<b>Tarter, Levy. 2019 (165)</b>	West-Nile Virus	Health Communication Surveillance Other
<b>Varnado and Goddard. 2016 (166)</b>	West Nile Virus	Planning/Decision-making
<b>Watts, Adger. 2015 (55)</b>	West Nile Virus	Health Communication Environmental Adaptations Policy Planning/Decision-making Surveillance Alerts/Advisories/Warnings

Appendix I: Captured Articles that Address the Main Climate-sensitive Category  
Extreme Temperature

Article	Specific Climate-sensitive Category Related to Extreme Temperature	Public Health Intervention(s)
<b>Alavipanah, Wegmann. 2015 (167)</b>	Extreme Heat Urban Heat Island	Environmental Adaptations
<b>American Public Health. 2018 (89)</b>	Extreme Heat	Health Communication Health Promotion Environmental Adaptations Planning/Decision-making Surveillance Alerts/Advisories/Warnings
<b>Anderson, Brown. 2017 (90)</b>	Extreme Heat	Health Communication Health Promotion Environmental Adaptations Policy Surveillance Alerts/Advisories/Warnings
<b>Anderson. 2016 (168)</b>	Extreme Heat	Health Communication Planning/Decision-making Alerts/Advisories/Warnings
<b>Beaudoin and Gosselin. 2016 (169)</b>	Urban Heat Island	Health Communication Environmental Adaptations
<b>Benmarhnia, Zhao. 2019 (170)</b>	Extreme Cold	Policy Planning/Decision-making Alerts/Advisories/Warnings
<b>Berisha, Hondula. 2017 (171)</b>	Extreme Heat	Health Promotion
<b>Berry, Clark. 2014 (24)</b>	Extreme Heat	Health Communication Health Promotion Environmental Adaptations Planning/Decision-making Surveillance Other
<b>Bittner, Matthies. 2014 (172)</b>	Extreme Heat	Planning/Decision-making
<b>Boyson, Taylor. 2014 (173)</b>	Extreme Heat	Planning/Decision-making
<b>(CAPE). 2019 (91)</b>	Extreme Heat Urban Heat Island Extreme Cold	Health Communication Environmental Adaptations Policy Planning/Decision-making Surveillance Alerts/Advisories/Warnings Other
<b>Carmona, Linares. 2017 (174)</b>	Extreme Heat	Planning/Decision-making
<b>Center for Climate Energy Solutions. 2017 (175)</b>	Extreme Heat Urban Heat Island	Environmental Adaptations Planning/Decision-making

<b>Chiu, Vagi. 2014 (176)</b>	Extreme Cold	Alerts/Advisories/Warnings
<b>Elliot, Bone. 2014 (177)</b>	Extreme Heat	Surveillance
<b>Endlicher. 2017 (85)</b>	Extreme Heat Urban Heat Island	Environmental Adaptations
<b>Graham, Vanos. 2017 (178)</b>	Extreme Heat	Environmental Adaptations Planning/Decision-making
<b>Grothmann, Leitner. 2017 (179)</b>	Extreme Heat	Health Communication Guidelines/Frameworks
<b>Hatvani-Kovacs, Bush. 2018 (180)</b>	Extreme Heat Urban Heat Island	Policy
<b>Katiyo, Dorey. 2018 (181)</b>	Extreme Cold	Planning/Decision-making
<b>Kingsley and EcoHealth. 2019 (61)</b>	Extreme Heat Urban Heat Island	Environmental Adaptations Other
<b>Lall, Abdelnabi. 2017 (88)</b>	Extreme Heat	Surveillance
<b>Lee, Voogt. 2018 (182)</b>	Extreme Heat Urban Heat Island	Environmental Adaptations
<b>MacIntyre, Khanna. 2019 (183)</b>	Extreme Heat	Health Communication Guidelines/Frameworks
<b>Marando, Salvatori. 2019 (184)</b>	Urban Heat Island	Environmental Adaptations
<b>Martin. 2016 (185)</b>	Extreme Heat	Health Communication Planning/Decision-making Surveillance Alerts/Advisories/Warnings
<b>McGregor, Bessemoulin. 2015 (186)</b>	Extreme Heat	Health Communication Health Promotion Surveillance Guidelines/Frameworks Alerts/Advisories/Warnings
<b>National Health Service. 2018 (187)</b>	Extreme Heat	Planning/Decision-making
<b>Semeraro, Aretano. 86)</b>	Urban Heat Island	Environmental Adaptations
<b>Watts, Adger. 2015 (55)</b>	Extreme Heat Urban Heat Island	Health Communication Environmental Adaptations Policy Planning/Decision-making Surveillance Alerts/Advisories/Warnings
<b>Weinberger, Zanobetti. 2018 (188)</b>	Extreme Heat	Alerts/Advisories/Warnings
<b>Williams, Hanson-Easey. 2018 (189)</b>	Extreme Heat	Alerts/Advisories/Warnings

<b>World Health Organization Regional Office for Europe. 2017 (87)</b>	Extreme Heat Urban Heat Island	Environmental Adaptations Policy Planning/Decision-making
<b>Zhang, Murray. 2017 (190)</b>	Extreme Heat Urban Heat Island	Environmental Adaptations Planning/Decision-making

## Appendix J: Captured Articles that Address the Main Climate-sensitive Category Extreme Weather

Article	Specific Climate-sensitive Category Related to Extreme Weather	Public Health Intervention(s)
<b>American Public Health. 2018 (89)</b>	Severe storms Drought Flooding Natural Hazards Forest Fire	Health Communication Health Promotion Environmental Adaptations Planning/Decision-making Surveillance Alerts/Advisories/Warnings
<b>Anderson, Brown. 2017 (90)</b>	Severe storms Drought Flooding Forest Fire	Health Communication Health Promotion Environmental Adaptations Policy Surveillance Alerts/Advisories/Warnings
<b>Appuhamilage, Barbir. 2019 (191)</b>	Severe storms Flooding Natural Hazards	Policy Guidelines/Frameworks
<b>Berry, Clark. 2014 (24)</b>	Drought Flooding Natural Hazards Forest Fire	Health Communication Health Promotion Environmental Adaptations Planning/Decision-making Surveillance Other
<b>(CAPE). 2019 (91)</b>	Flooding Forest Fire	Health Communication Environmental Adaptations Policy Planning/Decision-making Surveillance Alerts/Advisories/Warnings Other
<b>Endlicher. 2017 (85)</b>	Natural Hazards	Environmental Adaptations
<b>Gainey, Brown. 2018 (192)</b>	Flooding Natural Hazards	Health Promotion
<b>Genes, Chary. 2014 (193)</b>	Severe storms Natural Hazards	Health Communication
<b>Grigoletto, Cabral. 2016 (82)</b>	Drought	Health Communication Health Promotion Planning/Decision-making Surveillance
<b>Kingsley and EcoHealth. 2019 (61)</b>	Severe storms Flooding	Environmental Adaptations Other

<b>Lall, Abdelnabi. 2017 (88)</b>	Severe storms	Surveillance
<b>Levy, Jenkins. 2014 (194)</b>	Severe storms Flooding Natural Hazards	Health Communication
<b>MacIntyre, Khanna. 2019 (183)</b>	Severe storms Flooding Natural Hazards	Health Communication Guidelines/Frameworks
<b>Pamela and Nation Government. 2018 (117)</b>	Severe storms Drought Flooding Forest Fire	Other
<b>Rappold, Fann. 2014 (83)</b>	Forest Fire	Planning/Decision-making Alerts/Advisories/Warnings
<b>Scott and Errett. 2018 (195)</b>	Flooding Natural Hazards	Health Communication
<b>Sena, Barcellos. 2014 (196)</b>	Drought	Guidelines/Frameworks
<b>Sharma, Pezzaniti. 2016 (84)</b>	Flooding	Planning/Decision-making
<b>Valois, Caron. 2019 (197)</b>	Flooding	Planning/Decision-making
<b>Watts, Adger. 2015 (55)</b>	Severe storms Drought Flooding Natural Hazards	Health Communication Environmental Adaptations Policy Planning/Decision-making Surveillance Alerts/Advisories/Warnings
<b>Westcott, Ronan. 2019 (198)</b>	Forest Fire	Policy
<b>World Health Organization Regional Office for Europe. 2017 (87)</b>	Flooding	Environmental Adaptations Policy Planning/Decision-making
<b>World Health Organization Regional Office for Europe. 2017 (199)</b>	Flooding	Planning/Decision-making

*\*Climate-sensitive categories and public health intervention categories are not mutually exclusive. One article may highlight multiple climate-sensitive categories and/or intervention types*

#### .Appendix K: Captured Articles that Address the Main Climate-sensitive Category Air Quality

Article	Specific Climate-sensitive Category Related to Air Quality	Public Health Intervention(s)
<b>American Public Health. 2018 (89)</b>	Ground-level Ozone Air Quality General Aeroallergens	Health Communication Health Promotion Environmental Adaptations Planning/Decision-making

		Surveillance Alerts/Advisories/Warnings
<b>Anderson, Brown. 2017 (90)</b>	PM 2.5 Ground-level Ozone Traffic Related Air Pollutants Aeroallergens	Health Communication Health Promotion Environmental Adaptations Policy Surveillance Alerts/Advisories/Warnings
<b>Berry, Clark. 2014 (24)</b>	Air Quality General	Health Communication Health Promotion Environmental Adaptations Planning/Decision-making Surveillance Other
<b>Borbet, Gladson. 2018 (200)</b>	PM 2.5 Ground-level Ozone Air Quality General	Health Communication
<b>Brunt, Barnes. 2018 (201)</b>	Air Quality General	Policy
<b>(CAPE). 2019 (91)</b>	Air Quality General	Health Communication Environmental Adaptations Policy Planning/Decision-making Surveillance Alerts/Advisories/Warnings Other
<b>Chen, Li. 2018 (202)</b>	PM 2.5 Air Quality General	Alerts/Advisories/Warnings
<b>Glazener and Khreis. 2019 (203)</b>	PM 2.5 Traffic Related Air Pollutants	Policy
<b>Goix, Petrovic. 2018 (204)</b>	Air Quality General	Surveillance
<b>Johnston, Wheeler. 2018 (205)</b>	PM 2.5 Aeroallergens	Health Communication Planning/Decision-making Alerts/Advisories/Warnings
<b>Kingsley and EcoHealth. 2019 (61)</b>	Air Quality General	Environmental Adaptations Other
<b>Lyons, Rodgers. 2016 (206)</b>	Air Quality General	Alerts/Advisories/Warnings
<b>Masselot, Chebana. 2019 (207)</b>	PM 2.5 Air Quality General	Alerts/Advisories/Warnings
<b>Mehiriz and Gosselin. 2019 (208)</b>	Air Quality General	Health Communication Alerts/Advisories/Warnings
<b>Morishita, Thompson. 2015 (209)</b>	PM 2.5	Health Communication Policy
<b>Patella, Florio. 2019 (210)</b>	Aeroallergens	Planning/Decision-making
<b>Pennington, Sircar. 2019 (211)</b>	Air Quality General	Health Communication Alerts/Advisories/Warnings

<b>Radisic and Newbold. 2016 (212)</b>	PM 2.5 Ground-level Ozone Air Quality General	Health Communication
<b>Rappold, Fann. 2014 (83)</b>	PM 2.5	Planning/Decision-making Alerts/Advisories/Warnings
<b>Semeraro, Aretano. 86)</b>	Air Quality General	Environmental Adaptations
<b>Vardoulakis, Kettle. 2018 (213)</b>	Traffic Related Air Pollutants	Guidelines/Frameworks
<b>Watts, Adger. 2015 (55)</b>	PM 2.5 Ground-level Ozone Air Quality General	Health Communication Environmental Adaptations Policy Planning/Decision-making Surveillance Alerts/Advisories/Warnings
<b>World Health Organization Regional Office for Europe. 2017 (87)</b>	Air Quality General	Environmental Adaptations Policy Planning/Decision-making

#### Appendix L: Captured Articles that Address the Main Climate-sensitive Category Food and Water

Articles	Specific Climate-sensitive Category Related to Food and Water	Public Health Intervention(s)
<b>American Public Health. 2018 (89)</b>	Water Quality	Health Communication Health Promotion Environmental Adaptations Planning/Decision-making Surveillance Alerts/Advisories/Warnings
<b>Anderson, Brown. 2017 (90)</b>	Waterborne Illness Blue-green Algae Water Quality	Health Communication Health Promotion Environmental Adaptations Policy Surveillance Alerts/Advisories/Warnings
<b>Berry, Clark. 2014 (24)</b>	Waterborne Illness Foodborne Illness Blue-green Algae Food Security Water Quality Water Quantity	Health Communication Health Promotion Environmental Adaptations Planning/Decision-making Surveillance Other
<b>(CAPE). 2019 (91)</b>	Food Security Water Quality	Health Communication Environmental Adaptations Policy Planning/Decision-making Surveillance Alerts/Advisories/Warnings Other
<b>Grigoletto, Cabral. 2016 (82)</b>	Waterborne Illness Foodborne Illness	Health Communication Health Promotion



	Water Quality Water Quantity	Planning/Decision-making Surveillance
<b>Hynds, Naughton. 2018 (214)</b>	Water Quality	Health Communication Policy
<b>Kingsley and EcoHealth. 2019 (61)</b>	Food Security	Environmental Adaptations Other
<b>Nichols, Andersson. 2014 (159)</b>	Waterborne Illness Foodborne Illness	Surveillance Alerts/Advisories/Warnings
<b>O'Brien and Xagorarakis. 2019 (215)</b>	Waterborne Illness	Guidelines/Frameworks Other
<b>Pamela and Nation Government. 2018 (117)</b>	Food Security	Other
<b>Schnitter and Berry. 2019 (92)</b>	Food Security	Guidelines/Frameworks
<b>Semeraro, Aretano. 86)</b>	Water Quantity	Environmental Adaptations
<b>Sharma, Chandramouli. 216)</b>	Water Quality	Health Communication
<b>Sharma, Pezzaniti. 2016 (84)</b>	Water Quality Water Quantity	Planning/Decision-making
<b>Watts, Adger. 2015 (55)</b>	Waterborne Illness Food Security Water Quality	Health Communication Environmental Adaptations Policy Planning/Decision-making Surveillance Alerts/Advisories/Warnings

#### Appendix M: Captured Articles that Address the Main Climate-sensitive Category Ultraviolet Radiation

Article	Specific Climate-sensitive Category Related to Ultraviolet Radiation	Public Health Intervention(s)
<b>Victoria Cancer Council. 2019 (217)</b>	Ultraviolet Radiation	Health Promotion
<b>Garcia-Romero, Geller. 2015 (218)</b>	Ultraviolet Radiation	Health Communication Health Promotion Policy Planning/Decision-making
<b>Hacker, Horsham. 2019 (219)</b>	Ultraviolet Radiation	Health Promotion

<b>Kingsley and EcoHealth. 2019 (61)</b>	Ultraviolet Radiation	Environmental Adaptations Other
<b>Oyebanjo and Bushell. 2014 (220)</b>	Ultraviolet Radiation	Health Promotion

Appendix N: Captured Articles that Address the Main Climate-sensitive Category  
General Climate Change

Article	Specific Climate-sensitive Category Related to General Climate Change	Public Health Intervention
<b>Marinucci, Luber. 2014 (221)</b>	General Climate Change	Guidelines/frameworks

## References

1. IPCC. Climate Change 2014: Synthesis Report [Internet]. Geneva Switzerland: Intergovernmental Panel on Climate Change 2014. Available from: [https://www.ipcc.ch/site/assets/uploads/2018/02/SYR\\_AR5\\_FINAL\\_full.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf).
2. Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, et al. Managing the Health Effects of Climate Change. *The Lancet*. 2009; 373(9676): 1693-733.
3. World Health Organization. COP24 Special Report: Health & Climate Change [Internet]. World Health Organization 2018.
4. IPCC. Annex III: Glossary 2013. In: Climate Change 2013: The Physical Science Basis Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Internet]. Cambridge, United Kingdom and New York, NY, USA.: Cambridge University Press; [1448-64]. Available from: [https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5\\_AnnexIII\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_AnnexIII_FINAL.pdf).
5. IPCC. Summary for Policymakers. 2018. In: Global Warming of 15°C An IPCC Special Report on the impacts of global warming of 15°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Internet]. IPCC. Available from: <https://www.ipcc.ch/sr15/chapter/spm/spm-introduction/>.
6. Environment and Climate Change Canada. Canada's Changing Climate Report [Internet]. Ottawa, ON: Government of Canada; 2019. Available from: <https://changingclimate.ca/CCCR2019>.
7. Levy B, Patz, Jonathan. Applying a Public Health Context to Climate Change 2015. In: Climate Change and Public Health [Internet]. New York, NY: Oxford University Press; [3-22]. Available from:

<https://books.google.ca/books?hl=en&lr=&id=HsyuCQAAQBAJ&oi=fnd&pg=PP1&dq=climate+change+and+public+health+barry&ots=Mt5q2ZSZhf&sig=T->

[0RErhy8wed2nEVFFAypxqPNE4&redir\\_esc=y#v=onepage&q=climate%20change%20and%20public%20health%20barry&f=false](https://books.google.ca/books?hl=en&lr=&id=HsyuCQAAQBAJ&oi=fnd&pg=PP1&dq=climate+change+and+public+health+barry&ots=Mt5q2ZSZhf&sig=T-0RErhy8wed2nEVFFAypxqPNE4&redir_esc=y#v=onepage&q=climate%20change%20and%20public%20health%20barry&f=false).

8. Crutzen PJ. Geology of Mankind. *Nature*. 2002; 415(6867): 23-.
9. McMichael AJ. Earth as Humans' Habitat: Global Climate Change and The Health of Populations. *Int J Health Policy Manag*. 2014; 2(1): 9-12.
10. IPCC. Climate Change 2013: The Physical Science Basis. [Internet]. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press; 2013. Available from: [https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5\\_all\\_final.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_all_final.pdf).
11. Environment and Natural Resources Canada. Causes of Climate Change [Internet]. Online Government of Canada; 2019 [Available from: <https://www.canada.ca/en/environment-climate-change/services/climate-change/causes.html>].
12. Hayes K, Berry P, Ebi KL. Factors Influencing the Mental Health Consequences of Climate Change in Canada. *Int J Environ Res Public Health*. 2019; 16(9): 1583.
13. McMichael AJ. Globalization, Climate Change, and Human Health. *New England Journal of Medicine*. 2013; 368(14): 1335-43.
14. McMichael AJ, Lindgren E. Climate change: present and future risks to health, and necessary responses. *Journal of internal medicine*. 2011; 270(5): 401-13.
15. Smith KR, Woodward A, Campbell-Lendrum D, Chadee D, Honda Y, Liu Q, et al. Human Health: Impacts, Adaptation, and Co-Benefits. 2014. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability Part A: Global and Sectoral Aspects Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Internet].

Cambridge, United Kingdom and New York, Ny, USA: Cambridge University Press; [709-54.].

16. Canadian Public Health Association. Global Change and Public Health: Addressing the Ecological Determinants of Health [Internet]. Canadian Public Health Association 2015 [cited 2020 June 30, 2020]. Available from:

[https://www.cpha.ca/sites/default/files/assets/policy/edh-discussion\\_e.pdf](https://www.cpha.ca/sites/default/files/assets/policy/edh-discussion_e.pdf).

17. Keim ME. Building Human Resilience: The Role of Public Health Preparedness and Response as an Adaptation to Climate Change. American journal of preventive medicine. 2008; 35(5): 508-16.

18. Friel S, Marmot M, McMichael AJ, Kjellstrom T, Vågerö D. Global Health Equity and Climate Stabilisation: A Common Agenda. The Lancet. 2008; 372(9650): 1677-83.

19. American Public Health Association. Climate Change: Mastering the Public Health Role A Practical Guidebook [Internet]. Washington, DC. : American Public Health Association 2011. Available from: [https://www.apha.org/~media/files/pdf/factsheets/climate\\_change\\_guidebook.ashx](https://www.apha.org/~media/files/pdf/factsheets/climate_change_guidebook.ashx).

20. McMichael AJ. A Widening Research Agenda: Challenges and Needs. 2015 [cited July 2019]. In: Climate Change and Public Health [Internet]. Oxford University Press, [cited July 2019].

21. Austin SE, Ford JD, Berrang-Ford L, Biesbroek R, Ross NA. Enabling local public health adaptation to climate change. Soc Sci Med. 2019; 220: 236-44.

22. Frumkin H, McMichael AJ. Climate Change and Public Health: Thinking, Communicating, Acting. American journal of preventive medicine. 2008; 35(5): 403-10.

23. Ebi K, Anderson, Vidya., Berry, Peter., Paterson, Jaclyn., Yusa, Anna. Ontario Climate Change and Health Toolkit [Internet]. Toronto, Ontario: Ministry of Health and Long-Term Care; 2016. Available from:

[http://www.health.gov.on.ca/en/common/ministry/publications/reports/climate\\_change\\_toolkit/climate\\_change\\_toolkit.pdf](http://www.health.gov.on.ca/en/common/ministry/publications/reports/climate_change_toolkit/climate_change_toolkit.pdf).

24. Berry P, Clark K-L, Fleury MD, Parker S. Human Health 2014. In: Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation [Internet]. Ottawa, ON: Government of Canada;; [ 191-232]. Available from:

[https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2014/pdf/Chapter7-Human-Health\\_Eng.pdf](https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2014/pdf/Chapter7-Human-Health_Eng.pdf).

25. Gamble JL, J. Balbus, M. Berger, K. Bouye, V. Campbell, K. Chief, K. Conlon, A. Crimmins, B. Flanagan,, C. Gonzalez-Maddux EH, S. Hutchins, L. Jantarasami, S. Khoury, M. Kiefer, J. Kolling, K. Lynn, A. Manangan, M. McDonald,, R. Morello-Frosch MHR, P. Sheffield, K. Thigpen Tart, J. Watson, K.P. Whyte, and A.F. Wolkin,. Ch. 9: Populations of Concern. . 2016. In: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment [Internet]. Washington, DC,: U.S. Global Change Research Program; [ 247–86]. Available from:

[https://health2016.globalchange.gov/low/ClimateHealth2016\\_09\\_Populations\\_small.pdf](https://health2016.globalchange.gov/low/ClimateHealth2016_09_Populations_small.pdf).

26. World Health Organization. Social Determinants of Health [Internet]: World Health Organization; [Available from:

[https://www.who.int/social\\_determinants/en/](https://www.who.int/social_determinants/en/).

27. Berry P. Chapter 8: Vulnerability, Adaptation and Adaptive Capacity in Canada. 2008. In: Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacities [Internet]. Ottawa, Ontario: Government of Canada [367-448]. Available from:

[https://cdn.dal.ca/content/dam/dalhousie/pdf/faculty/science/emaychar/Reports%20Section/Emay\\_HumanHealthChangClim.pdf](https://cdn.dal.ca/content/dam/dalhousie/pdf/faculty/science/emaychar/Reports%20Section/Emay_HumanHealthChangClim.pdf).

28. Adger WN. Social Aspects of Adaptive Capacity. Climate Change, Adaptive Capacity and Development. p. 29-49.

29. Levison M, Whelan, Marina., Butler, Ainslie. A Changing Climate: Assessing Health Impacts and Vulnerabilities Due to Climate Change

Within Simcoe Muskoka [Internet]. Barrie, Ontario: Simcoe Muskoka District Health Unit; 2017.

30. Laukkonen J, Blanco PK, Lenhart J, Keiner M, Cavric B, Kinuthia-Njenga C. Combining climate change adaptation and mitigation measures at the local level. *Habitat International*. 2009; 33(3): 287-92.

31. European Environment Agency. Impacts of Europe's Changing Climate: 2008 Indicator-Based Assessment [Internet]. Copenhagen, Denmark 2008. Available from: [https://ec.europa.eu/jrc/sites/jrcsh/files/jrc\\_reference\\_report\\_2008\\_09\\_climate\\_change.pdf](https://ec.europa.eu/jrc/sites/jrcsh/files/jrc_reference_report_2008_09_climate_change.pdf).

32. Ministry of Health and Long-Term Care. Protecting and Promoting the Health of Ontarians Ontario Public Health Standards: Requirements for Programs, Services, and Accountability [Internet]. Ministry of Health and Long-Term Care;; 2018. Available from: [http://www.health.gov.on.ca/en/pro/programs/publichealth/oph\\_standards/docs/protocols\\_guidelines/Ontario\\_Public\\_Health\\_Standards\\_2018\\_en.pdf](http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/protocols_guidelines/Ontario_Public_Health_Standards_2018_en.pdf).

33. Ford JD. Indigenous Health and Climate Change. *Am J Public Health*. 2012; 102(7): 1260-6.

34. Whyte K. Indigenous Climate Change Studies: Indigenizing Futures, Decolonizing The Anthropocene. *English Language Notes*. 2017; 55(1): 153-62.

35. IPCC. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Internet]. Cambridge, United Kingdom and New York, USA: Cambridge University Press; 2014 [cited 2020 July 7, 2020]. Available from: [https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-PartA\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-PartA_FINAL.pdf).

36. Reading Charlotte WF. Health Inequities and Social Determinants of Aboriginal Peoples' Health [Internet]. Prince George, BC: National Collaborating Centre for Aboriginal Health 2009 [cited 2020 July 6].

Available from: <https://www.ccnsa-nccah.ca/docs/determinants/RPT-HealthInequalities-Reading-Wien-EN.pdf>.

37. Cunsolo Willox A, Harper SL, Ford JD, Landman K, Houle K, Edge VL. "From This Place and of This Place:" Climate Change, Sense of Place, and Health In Nunatsiavut, Canada. *Soc Sci Med*. 2012; 75(3): 538-47.
38. Ford JD, Sherman M, Berrang-Ford L, Llanos A, Carcamo C, Harper S, et al. Preparing for the Health Impacts of Climate Change In Indigenous Communities: The Role of Community-Based Adaptation. *Global Environmental Change*. 2018; 49: 129-39.
39. Maru YT, Stafford Smith M, Sparrow A, Pinho PF, Dube OP. A linked vulnerability and resilience framework for adaptation pathways in remote disadvantaged communities. *Global Environmental Change*. 2014; 28: 337-50.
40. Restoule J-P, Gruner S, Metatawabin E. Learning from Place: A Return to Traditional Mushkegowuk Ways of Knowing. *Canadian Journal of Education/Revue canadienne de l'éducation*. 2013; 36(2): 68-86.
41. Wilson A. Living Well: Aboriginal Women, Cultural Identity and Wellness [Internet]. The Prairie Women's Health Centre of Excellence;; 2004. Available from: <http://www.pwhce.ca/pdf/livingWell.pdf>.
42. Ford JD, Berrang-Ford L, King M, Furgal C. Vulnerability of Aboriginal Health Systems in Canada to Climate Change. *Global Environmental Change*. 2010; 20(4): 668-80.
43. Cochran P, Huntington OH, Pungowiyi C, Tom S, Chapin FS, Huntington HP, et al. Indigenous frameworks for observing and responding to climate change in Alaska. *Climatic Change*. 2013; 120(3): 557-67.
44. Belfer E, Ford JD, Maillet M. Representation of Indigenous Peoples in Climate Change Reporting. *Climatic Change*. 2017; 145(1): 57-70.
45. Linda Tuhiwai Smith. *Decolonizing Methodologies: Research and Indigenous Peoples*. 2nd ed. London, United Kingdom., New York, USA Zed Books Ltd; 2012.



46. Watts N, Adger WN, Agnolucci P, Blackstock J, Byass P, Cai W, et al. Health and Climate Change: Policy Responses to Protect Public Health. *Lancet* (London, England). 2015; 386(10006): 1861-914.
47. The Federation of Canadian Municipalities. TIBoC. Investing in Canada's Future: The Cost of Climate Adaptation at the Local Level [Internet]. 2020 [cited 2020 July 7, 2020]. Available from: <http://assets.ibc.ca/Documents/Disaster/The-Cost-of-Climate-Adaptation-Report-EN.pdf>.
48. I.C.L.E.I Local Governments for Sustainability. Finding the Nexus: Exploring Climate Change Adaptation and Mitigation [Internet]. Online 2012. Available from: [https://www.retooling.ca/Library/ReTooling\\_Resource\\_Library/Finding\\_the\\_Nexus\\_Exploring\\_Climate\\_Change\\_Adaptation\\_and\\_Mitigation.pdf](https://www.retooling.ca/Library/ReTooling_Resource_Library/Finding_the_Nexus_Exploring_Climate_Change_Adaptation_and_Mitigation.pdf).
49. IPCC. Climate Change 2007: Synthesis Report. [Internet]. Intergovernmental Panel On Climate Change 2007 [cited 2020 June 17, 2020]. Available from: [https://www.ipcc.ch/site/assets/uploads/2018/02/ar4\\_syr\\_full\\_report.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/ar4_syr_full_report.pdf).
50. Frumkin H, Hess, Jeremy., Luber, George. Public Health Policies and Actions 2015 [cited July 2019]. In: *Climate Change and Public Health* [Internet]. Oxford University Press, [cited July 2019]; [1-30].
51. Ebi KL, Semenza JC. Community-Based Adaptation to the Health Impacts of Climate Change. *American journal of preventive medicine*. 2008; 35(5): 501-7.
52. Frumkin H, Hess J, Luber G, Malilay J, McGeehin M. Climate Change: The Public Health Response. *Am J Public Health*. 2008; 98(3): 435-45.
53. Landauer M, Juhola S, Söderholm M. Inter-Relationships Between Adaptation and Mitigation: A Systematic Literature Review. *Climatic Change*. 2015; 131(4): 505-17.

54. Kingsley M, EcoHealth O. Commentary - Climate change, health and green space co-benefits. *Health Promot Chronic Dis Prev Can.* 2019; 39(4): 131-5.
55. Watts N, Adger WN, Agnolucci P. Health and climate change: Policy responses to protect public health. *Environnement, Risques et Sante.* 2015; 14(6): 466-8.
56. UNEP. The Adaptation Gap Report 2018 [Internet]. Nairobi, Kenya: United Nations Environment Programme (UNEP); 2018. Available from: <https://www.unenvironment.org/resources/adaptation-gap-report>.
57. Haines A, McMichael AJ, Smith KR, Roberts I, Woodcock J, Markandya A, et al. Public Health Benefits of Strategies to Reduce Greenhouse-Gas Emissions: Overview and Implications for Policy Makers. *Lancet (London, England).* 2009; 374(9707): 2104-14.
58. Haines A. Health Co-Benefits of Climate Action. *The Lancet Planetary Health.* 2017; 1(1).
59. Haines A, Ebi K. The Imperative for Climate Action to Protect Health. *The New England journal of medicine.* 2019; 380(3): 263-73.
60. Perrotta K. Climate Change Toolkit for Health Professionals [Internet]. Canadian Association of Physicians for the Environment (CAPE); 2019. Available from: <https://cape.ca/wp-content/uploads/2019/05/Climate-Change-Toolkit-for-Health-Professionals-Updated-April-2019-2.pdf>.
61. Kingsley M, EcoHealth O. Climate Change, Health and Green Space Co-benefits. *Health Promotion and Chronic Disease Prevention in Canada.* 2019; 39(4): 131-5.
62. Evans C, Feltmate B. Water on the Rise: Protecting Canadian Homes from the Growing Threat of Flooding [Internet]. University of Waterloo,; Intact Centre on Climate Adaptation,; 2019. Available from: <https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/04/Home-Flood-Protection-Program-Report-1.pdf>.

63. Federation of Canadian Municipalities, Insurance Bureau of Canada, editors. Investing in Canada's Future: The Cost of Climate Adaptation at the Local Level 2020.
64. Patrick R, Townsend M, Nuttman S. Health Promotion and Climate Change: Exploring The Core Competencies Required For Action. Health promotion international. 2011; 27(4): 11.
65. Public Health Agency of Canada. Core Competencies for Public Health in Canada [Internet]. 2008. Available from: <https://www.canada.ca/content/dam/phac-aspc/documents/services/public-health-practice/skills-online/core-competencies-public-health-canada/cc-manual-eng090407.pdf>.
66. Austin SE, Ford JD, Berrang-Ford L, Araos M, Parker S, Fleury MD. Public health adaptation to climate change in Canadian jurisdictions. Int J Environ Res Public Health. 2015; 12(1): 623-51.
67. Berrang-Ford L, Pearce T, Ford JD. Systematic review approaches for climate change adaptation research. Regional Environmental Change. 2015; 15(5): 755-69.
68. Daudt HML, van Mossel C, Scott SJ. Enhancing the Scoping Study Methodology: A Large, Inter-Professional Team's Experience with Arksey and O'Malley's Framework. BMC Medical Research Methodology. 2013; 13(1): 48.
69. Colquhoun HL, Levac D, O'Brien KK, Straus S, Tricco AC, Perrier L, et al. Scoping Reviews: Time for Clarity in Definition, Methods, and Reporting. Journal of clinical epidemiology. 2014; 67(12): 1291-4.
70. Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. Implementation Science. 2010; 5(1): 69.
71. Arksey H, O'Malley L. Scoping Studies: Towards A Methodological Framework. International Journal of Social Research Methodology. 2005; 8(1): 19-32.
72. Peters MDJ, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for Conducting Systematic Scoping Reviews. International Journal of Evidence-Based Healthcare. 2015; 13(3): 141-6.

73. The Joanna Briggs Institute. Joanna Briggs Institute Reviewers' Manual: 2015 edition / Supplement [Internet]. Adelaide, South Australia: The Joanna Briggs Institute; 2015. Available from: <https://nursing.lsuhsu.edu/JBI/docs/ReviewersManuals/Scoping-.pdf>.
74. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Annals of internal medicine*. 2018; 169(7): 467-73.
75. Watts N, Amann M, Arnell N, Ayeb-Karlsson S, Belesova K, Berry H, et al. The 2018 Report of The Lancet Countdown on Health and Climate Change: Shaping The Health of Nations for Centuries to Come. *The Lancet*. 2018; 392(10163): 2479-514.
76. Tyndall J. AACODS Checklist [Internet]. Flinders University 2010. Available from: [https://dspace.flinders.edu.au/xmlui/bitstream/handle/2328/3326/AACODS\\_Checklist.pdf?sequence=4&isAllowed=y](https://dspace.flinders.edu.au/xmlui/bitstream/handle/2328/3326/AACODS_Checklist.pdf?sequence=4&isAllowed=y).
77. Centers for Disease Control and Prevention. Gateway to Health Communication [Internet]: Centers for Disease Control and Prevention,; 2020 [Available from: <https://www.cdc.gov/healthcommunication/healthbasics/WhatIsHC.html>].
78. Food Security Projects of the Nova Scotia Nutrition Council, The Atlantic Health Promotion Research Centre DU. Section 4: What is Policy? 2005. In: *Thought About Food? A Workbook on Food Security and Influencing Policy* [Internet]. Available from: <http://www.foodthoughtful.ca/English.pdf>.
79. World Health Organization. The WHO Health Promotion Glossary [Internet]. Geneva, Switzerland World Health Organization, ; 1998. Available from: <https://www.who.int/healthpromotion/about/HPR%20Glossary%201998.pdf?ua=1>.
80. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. *Principles of Epidemiology in Public*

Health Practice [Internet]. Third ed.2012. Available from:

<https://www.cdc.gov/csels/dsepd/ss1978/SS1978.pdf>.

81. Moher D, Liberati A, Tetzlaff J, Altman DG, The PG. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLOS Medicine*. 2009; 6(7): 6.
82. Grigoletto JC, Cabral AR, Bonfim CV, Rohlfes DB, Silva ELE, de Queiroz FB, et al. Management of Health Sector Actions in Drought Situations. *Ciencia & saude coletiva*. 2016; 21(3): 709-18.
83. Rappold AG, Fann NL, Crooks J, Huang J, Cascio WE, Devlin RB, et al. Forecast-Based Interventions Can Reduce The Health and Economic Burden of Wildfires. *Environmental science & technology*. 2014; 48(18): 10571-9.
84. Sharma AK, Pezzaniti D, Myers B, Cook S, Tjandraatmadja G, Chacko P, et al. Water Sensitive Urban Design: An Investigation of Current Systems, Implementation Drivers, Community Perceptions and Potential to Supplement Urban Water Services. *Water (Switzerland)*. 2016; 8(7).
85. Endlicher W. Climate Change, Heat Waves, and Public Health In Germany: Avoid the Avoidable and Adapt to the Inevitable. *BsGlg*. 2017; 68(1): 69-76.
86. Semeraro T, Aretano R, Pomes A, editors. Green Roof Technology as a Sustainable Strategy to Improve Water Urban Availability. *IOP Conference Series: Materials Science and Engineering; 3rd World Multidisciplinary Civil Engineering, Architecture, Urban Planning Symposium, WMCAUS 2018; 2019: Institute of Physics Publishing*.
87. World Health Organization Regional Office for Europe. Urban Green Space Interventions and health: A Review of Impacts and Effectiveness. 2017. p. 1-203.
88. Lall R, Abdelnabi J, Ngai S, Parton HB, Saunders K, Sell J, et al. Advancing the Use of Emergency Department Syndromic Surveillance Data, New York City, 2012-2016. *Public health reports (Washington, DC: 1974)*. 2017; 132(1): 23S-30S.

89. American Public Health A. Adaptation in Action Part II 2018: Updated Grantee Success Stories from CDC's Climate and Health Program. 2018. p. 1-35.
90. Anderson H, Brown C, Cameron LL, Christenson M, Conlon KC, Dorevitch S, et al. Climate and Health Intervention Assessment: Evidence on Public Health Interventions to Prevent the Negative Health Effects of Climate Change. Climate and Health Program, Centers for Disease Control and Prevention.; 2017. Contract No.: Report.
91. (CAPE) CAoPftE. Climate Change Toolkit for Health Professionals: Module 7 – Preparing for Climate Change in Our Communities. [Internet].2019. Available from: <https://cape.ca/wp-content/uploads/2019/04/Module-7-FINAL-FINAL-UPLOAD-Solo-APRIL-5-2019.pdf>.
92. Schnitter R, Berry P. The Climate Change, Food Security and Human Health Nexus in Canada: A Framework to Protect Population Health. Int J Environ Res Public Health. 2019; 16(14): 16.
93. Adoption of the Paris Agreement,, (2015).
94. United Nations Framework Convention on Climate Change. What is the Paris Agreement? [Internet]. online [Available from: <https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement>.
95. National Oceanic and Atmospheric Administration. 2018 Was 4th Hottest Year On Record For The Globe [Internet]. Online: National Oceanic and Atmospheric Administration,; 2019 [Available from: <https://www.noaa.gov/news/2018-was-4th-hottest-year-on-record-for-globe>.
96. Climate Breaks Multiple Records In 2016, With Global Impacts [press release]. Online: World Meteorological Organization,, March 21, 2017 2017.
97. Climate Central. Top 10 Warmest Years on Record [Internet]. Online Climate Central; 2020 [Available from:

<https://www.climatecentral.org/gallery/graphics/top-10-warmest-years-on-record>.

98. Hoegh-Guldberg O, D. Jacob, M. Taylor, M. Bindi, S. Brown, I. Camilloni, A. Diedhiou, R. Djalante, K.L. Ebi, F. Engelbrecht, J. Guiot, Y. Hijioka, S. Mehrotra, A. Payne, S.I. Seneviratne, A. Thomas, R. Warren, and G. Zhou,. Impacts of 1.5°C Global Warming on Natural and Human Systems. 2018. In: Global Warming of 15°C An IPCC Special Report on the impacts of global warming of 15°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Internet]. Intergovernmental Panel on Climate Change, ; [175-311]. Available from: [https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15\\_Chapter3\\_Low\\_Res.pdf](https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Chapter3_Low_Res.pdf).

99. National Oceanic and Atmospheric Administration. State of the Climate: Global Climate Report for Annual 2019 [Internet]. Online: NOAA; 2020 2020/06/15]. Available from: <https://www.ncdc.noaa.gov/sotc/global/201913>.

100. National Oceanic and Atmospheric Administration. 2019 was 2nd Hottest Year On Record For Earth Say NOAA, NASA [Internet]. Online: National Oceanic and Atmospheric Administration,; 2020 [cited 2020 2020/06/15]. Available from: <https://www.noaa.gov/news/2019-was-2nd-hottest-year-on-record-for-earth-say-noaa-nasa>.

101. Monaghan AJ, Moore SM, Sampson KM, Beard CB, Eisen RJ. Climate Change Influences on The Annual Onset of Lyme Disease in the United States. Ticks and Tick-borne Diseases. 2015; 6(5): 615-22.

102. Greig JD, Young I, Harding S, Mascarenhas M, Waddell LA. A Scoping Review of Lyme Disease Research Relevant to Public Health. Canada Communicable Disease Report. 2018; 44(10): 243-56.

103. Climate Atlas of Canada. Lyme Disease Under Climate Change [Internet]2019 [Available from: <https://climateatlas.ca/lyme-disease-under-climate-change>.



104. Gasmi S, Ogden NH, Lindsay LR, Burns S, Fleming S, Badcock J, et al. Surveillance for Lyme disease in Canada: 2009-2015. *Can Commun Dis Rep*. 2017; 43(10): 194-9.
105. Paz S. Climate change impacts on West Nile virus transmission in a global context. *Philos Trans R Soc Lond B Biol Sci*. 2015; 370(1665): 20130561.
106. Ludwig A, Zheng H, Vrbova L, Drebot MA, Iranpour M, Lindsay LR. Increased risk of endemic mosquito-borne diseases in Canada due to climate change. *Canada communicable disease report = Relevé des maladies transmissibles au Canada*. 2019; 45(4): 91-7.
107. Landrigan PJ, Fuller R, Acosta NJR, Adeyi O, Arnold R, Basu N, et al. The Lancet Commission on Pollution and Health. *The Lancet*. 2018; 391(10119): 462-512.
108. Kelly FJ, Fussell JC. Air pollution and public health: emerging hazards and improved understanding of risk. *Environ Geochem Health*. 2015; 37(4): 631-49.
109. World Health Organization. Ambient Air Pollution [Internet]: World Health Organization,; [Available from: <https://www.who.int/airpollution/ambient/health-impacts/en/>].
110. Berry P, Enright P, Health Canada. Survey of Health Sector Officials: A Contribution to Health Canada's Climate Change and Health Adaptation Capacity Building Program and the National Assessment. Ottawa: Health Canada; 2019. Report No.: 18009WE. Report Developed for Health Canada by the Survey Research Centre.
111. Ferlay J, Colombet M, Soerjomataram I, Mathers C, Parkin DM, Piñeros M, et al. Estimating the Global Cancer Incidence and Mortality In 2018: Globocan Sources And Methods. *International Journal of Cancer*. 2019; 144(8): 1941-53.
112. World Health Organization. Ultraviolet Radiation and Skin Cancer 2017. Available from: [https://www.who.int/news-room/q-a-detail/ultraviolet-\(uv\)-radiation-and-skin-cancer](https://www.who.int/news-room/q-a-detail/ultraviolet-(uv)-radiation-and-skin-cancer).



113. International Agency for Research on Cancer. Cancers Attributable to UV Radiation [Internet]: World Health Organization, ; 2020 [Available from: <https://gco.iarc.fr/causes/uv/#>
114. Centers for Disease Control and Prevention. West Nile Virus: Prevention [Internet]2019 [Available from: <https://www.cdc.gov/westnile/prevention/index.html>.
115. Public Health Agency of Canada. Prevention of Lyme disease [Internet]2015 [Available from: <https://www.canada.ca/en/public-health/services/diseases/lyme-disease/prevention-lyme-disease.html>.
116. Hayes K, Poland B. Addressing Mental Health in a Changing Climate: Incorporating Mental Health Indicators into Climate Change and Health Vulnerability and Adaptation Assessments. *Int J Environ Res Public Health*. 2018; 15(9).
117. Pamela M, Nation Government C. Community Proposal Climate Change Adaptation Action Plan. Montreal, QC, CA; 2018. Contract No.: Report.
118. Cunsolo A, Harper SL, Minor K, Hayes K, Williams KG, Howard C. Ecological Grief and Anxiety: The Start of a Healthy Response to Climate Change? *The Lancet Planetary Health*. 2020; 4(7): e261-e3.
119. Padhy SK, Sarkar S, Panigrahi M, Paul S. Mental Health Effects of Climate Change. *Indian J Occup Environ Med*. 2015; 19(1): 3-7.
120. Hayes K, Blashki G, Wiseman J, Burke S, Reifels L. Climate change and mental health: risks, impacts and priority actions. *Int J Ment Health Syst*. 2018; 12: 28-.
121. Gardner C, Armstrong B, Reballato S, Moloughney B, Fazli G, Harris R, et al. Planning for Health: Promising Practices for Healthy Built Environment in Ontario's Public Health Unit [Internet]. Simcoe Muskoka District Health Unit; 2019. Available from: [https://www.simcoemuskokahealth.org/docs/default-source/TOPIC\\_Environment\\_PlanningForHealth/planning-for-health-promising-practices\\_19dec2019.pdf?sfvrsn=2](https://www.simcoemuskokahealth.org/docs/default-source/TOPIC_Environment_PlanningForHealth/planning-for-health-promising-practices_19dec2019.pdf?sfvrsn=2).

122. City of Toronto. Avoiding the TRAP: Traffic-Related Air Pollution in Toronto and Options for Reducing Exposure. [Internet]. Toronto, ON: City of Toronto;; 2017. Available from: <https://www.toronto.ca/legdocs/mmis/2017/hl/bgrd/backgroundfile-108070.pdf>.
123. Toronto Public Health. Reducing Health Risks from Traffic-Related Air Pollution (TRAP) in Toronto. Report for Action. City of Toronto; 2017 2017/10/16. Contract No.: PE23.7.
124. Public Health Ontario. Traffic Related Air Pollution: Avoiding the TRAP Zone 2016. Available from: <https://www.publichealthontario.ca/-/media/documents/o/2016/ohp-trap.pdf?la=en>.
125. Tuck E. The Promise of Indigenous Research [Internet]. Indigenous Education Tools. Available from: [http://indigenouseducationtools.org/assets/primaryimages/IET05\\_ThePromiseofIndigenousResearchIssue5.pdf](http://indigenouseducationtools.org/assets/primaryimages/IET05_ThePromiseofIndigenousResearchIssue5.pdf).
126. Indigenous Climate Hub. Indigenous Climate Hub: Climate Change Adaptation [Internet] 2020 [Available from: <https://indigenousclimatehub.ca/>.
127. McLean KG. Land Use, Climate Change Adaptation and Indigenous Peoples Our World [Internet]. 2012; September 2, 200. Available from: <https://ourworld.unu.edu/en/land-use-climate-change-adaptation-and-indigenous-peoples#:~:text=For%20indigenous%20peoples%2C%20resilience%20is,and%20adapting%20in%20unique%20ways>.
128. Indigenous Climate Action. Indigenous Climate Action [Internet] 2020 [Available from: <https://www.indigenousclimateaction.com/>.
129. Climate Justice Resilience Fund. Indigenous Communities are at the Forefront of Climate Resilience 2019. Available from: <https://www.climatechangenews.com/2019/11/28/indigenous-communities-forefront-climate-resilience/>.

130. Government of Canada. First Nation Adapt Program [Internet]2020 [Available from: <https://www.rcaanc-cirnac.gc.ca/eng/1481305681144/1594738692193>].
131. Government of Canada. Funding Opportunities to Support Adaptation Action [Internet]2019 [Available from: <https://www.canada.ca/en/environment-climate-change/services/climate-change/adapting/funding.html>].
132. Government of Canada. Climate Change and Health Adaptation Program [Internet]2020 [Available from: <https://www.sac-isc.gc.ca/eng/1536238477403/1536780059794>].
133. Jones R. Climate Change and Indigenous Health Promotion. Global health promotion. 2019; 26(3\_suppl): 73-81.
134. Ford JD, Keskitalo ECH, Smith T, Pearce T, Berrang-Ford L, Duerden F, et al. Case Study and Analogue Methodologies In Climate Change Vulnerability Research. WIREs Climate Change. 2010; 1(3): 374-92.
135. Ministry of Health and Long-Term Care. Healthy Envrionments and Climate Change Guideline 2018 [Internet]. Ministry of Health and Long-Term Care;; 2018. Available from: [http://www.health.gov.on.ca/en/pro/programs/publichealth/oph\\_standards/docs/protocols\\_guidelines/Healthy\\_Environments\\_and\\_Climate\\_Change\\_Guideline\\_2018\\_en.pdf](http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/protocols_guidelines/Healthy_Environments_and_Climate_Change_Guideline_2018_en.pdf).
136. Aenishaenslin C, Gern L, Michel P, Ravel A, Hongoh V, Waaub J-P, et al. Adaptation and Evaluation of a Multi-Criteria Decision Analysis Model for Lyme Disease Prevention. PloS one. 2015; 10(8): e0135171.
137. Antonise-Kamp L, Beaujean DJMA, Crutzen R, van Steenbergen JE, Ruwaard D. Prevention of tick bites: an evaluation of a smartphone app. BMC infectious diseases. 2017; 17(1): 744.
138. Barker CM. Models and Surveillance Systems to Detect and Predict West Nile Virus Outbreaks. Journal of medical entomology. 2019.
139. Bartumeus F, Oltra A, Palmer JRB. Citizen Science: A Gateway for Innovation in Disease-Carrying Mosquito Management? Trends in parasitology. 2018; 34(9): 727-9.

140. Bateman B, Cook T, Dennis L, Farrant G, Jacobson E, Kelso L, et al. Report of the Lyme Disease and Tick-borne Illnesses Task Force. 2018. p. 1-26.
141. Bonnet PS, Richardson J. Broad-Spectrum Vaccine Against Tick-Borne Pathogens. *Bulletin de l'Academie Veterinaire de France*. 2018; 171(1).
142. Bouchard C, Aenishaenslin C, Rees EE, Koffi JK, Pelcat Y, Ripoché M, et al. Integrated Social-Behavioral and Ecological Risk Maps to Prioritize Local Public Health Responses to Lyme Disease. *Environmental health perspectives*. 2018; 126(4): 047008.
143. California Department of Public H. California Mosquito-Borne Virus Surveillance and Response Plan. 2017. p. 1-62.
144. Chiari M, Prosperi A, Faccin F, Avisani D, Cerioli M, Zanoni M, et al. West Nile Virus Surveillance in the Lombardy Region, Northern Italy. *Transboundary and emerging diseases*. 2015; 62(4): 343-9.
145. Clow KM, Ogden NH, Lindsay LR, Russell CB, Michel P, Pearl DL, et al. A field-based indicator for determining the likelihood of *Ixodes scapularis* establishment at sites in Ontario, Canada. *PloS one*. 2018; 13(2): e0193524.
146. DeFelice NB, Birger R, DeFelice N, Gagner A, Campbell SR, Romano C, et al. Modeling and Surveillance of Reporting Delays of Mosquitoes and Humans Infected With West Nile Virus and Associations With Accuracy of West Nile Virus Forecasts. *JAMA network open*. 2019; 2(4): e193175.
147. Dubey D, Amritphale A, Sawhney A, Dubey D, Srivastav N. Analysis of YouTube as a source of information for West Nile Virus infection. *Clinical medicine & research*. 2014; 12(3-4): 129-32.
148. Fischhoff IR, Keesing F, Pendleton J, DePietro D, Teator M, Duerr STK, et al. Assessing Effectiveness of Recommended Residential Yard Management Measures Against Ticks. *Journal of medical entomology*. 2019; 56(5): 1420-7.

149. Germain G, Simon A, Arsenault J, Baron G, Bouchard C, Chaumont D, et al. Quebec's Multi-Party Observatory on Zoonoses and Adaptation to Climate Change. *Canada Communicable Disease Report*. 2019; 45(5): 143-8.
150. Hinckley AF, Meek JI, Ray JAE, Niesobecki SA, Connally NP, Feldman KA, et al. Effectiveness of Residential Acaricides to Prevent Lyme and Other Tick-borne Diseases in Humans. *The Journal of infectious diseases*. 2016; 214(2): 182-8.
151. Hines D, Sibbald SL. Citizen science: Exploring its application as a tool for prodromic surveillance of vector-borne disease. *Canada communicable disease report = Relevé des maladies transmissibles au Canada*. 2015; 41(3): 63-7.
152. Hongoh V, Campagna C, Panic M, Samuel O, Gosselin P, Waaub J-P, et al. Assessing Interventions to Manage West Nile Virus Using Multi-Criteria Decision Analysis with Risk Scenarios. *PloS one*. 2016; 11(8): e0160651.
153. Jourdain F, Samy AM, Hamidi A, Bouattour A, Alten B, Faraj C, et al. Towards harmonisation of entomological surveillance in the mediterranean area. *PLoS Neglected Tropical Diseases*. 2019; 13(6): e0007314.
154. Koffi JK, Savage J, Thivierge K, Lindsay LR, Bouchard C, Pelcat Y, et al. Evaluating the submission of digital images as a method of surveillance for *Ixodes scapularis* ticks. *Parasitology*. 2017; 144(7): 877-83.
155. Lewis J, Boudreau CR, Patterson JW, Bradet-Legris J, Lloyd VK. Citizen Science and Community Engagement in Tick Surveillance-A Canadian Case Study. *Healthcare (Basel, Switzerland)*. 2018; 6(1).
156. Martin E, Borucki MK, Thissen J, Garcia-Luna S, Hwang M, Wise de VM, et al. Mosquito-Borne Viruses and Insect-Specific Viruses Revealed in Field-Collected Mosquitoes by a Monitoring Tool Adapted from a Microbial Detection Array. *Applied and Environmental Microbiology*. 2019; 85(19).

157. Napoli C, Iannetti S, Rizzo C, Bella A, Di Sabatino D, Bruno R, et al. Vector borne infections in Italy: results of the integrated surveillance system for West Nile disease in 2013. *BioMed research international*. 2015; 2015: 643439.
158. Nasci RS, Mutebi J-P. Reducing West Nile Virus Risk Through Vector Management. *Journal of medical entomology*. 2019; 56(6): 1516-21.
159. Nichols GL, Andersson Y, Lindgren E, Devaux I, Semenza JC. European monitoring systems and data for assessing environmental and climate impacts on human infectious diseases. *Int J Environ Res Public Health*. 2014; 11(4): 3894-936.
160. Ogden NH, Koffi JK, Lindsay LR. Assessment of a screening test to identify Lyme disease risk. *Canada communicable disease report = Releve des maladies transmissibles au Canada*. 2014; 40(5): 83-7.
161. Potter A, Jardine A, Morrissey A, Lindsay MDA. Evaluation of a Health Communication Campaign to Improve Mosquito Awareness and Prevention Practices in Western Australia. *Frontiers in Public Health*. 2019; 7: 54.
162. Ripoche M, Gasmi S, Adam-Poupart A, Koffi JK, Lindsay LR, Ludwig A, et al. Passive Tick Surveillance Provides an Accurate Early Signal of Emerging Lyme Disease Risk and Human Cases in Southern Canada. *Journal of medical entomology*. 2018; 55(4): 1016-26.
163. Rochlin I, Ninivaggi DV, Benach JL. Malaria and Lyme disease - the largest vector-borne US epidemics in the last 100 years: success and failure of public health. *BMC Public Health*. 2019; 19(1): 804.
164. Soucy J-PR, Slatculescu AM, Nyiraneza C, Ogden NH, Leighton PA, Kerr JT, et al. High-Resolution Ecological Niche Modeling of *Ixodes scapularis* Ticks Based on Passive Surveillance Data at the Northern Frontier of Lyme Disease Emergence in North America. *Vector borne and zoonotic diseases (Larchmont, NY)*. 2018; 18(5): 235-42.
165. Tarter KD, Levy CE, Yaglom HD, Adams LE, Plante L, Casal MG, et al. USING CITIZEN SCIENCE TO ENHANCE SURVEILLANCE OF *Aedes Aegypti*

- IN ARIZONA, 2015-17. *Journal of the American Mosquito Control Association*. 2019; 35(1): 11-8.
166. Varnado WC, Goddard J. Use of the VectorTest for Advanced Warning of Human West Nile Virus Cases in Mississippi. *Journal of environmental health*. 2016; 79(5): 20-4.
167. Alavipanah S, Wegmann M, Qureshi S, Weng Q, Koellner T. The Role of Vegetation In Mitigating Urban Land Surface Temperatures: A Case Study of Munich, Germany During The Warm Season. *Sustainability (Switzerland)*. 2015; 7(4): 4689-706.
168. Anderson V. A Harmonized Heat Health Warning and Information System for Ontario (HWIS). 2016. p. 1-23.
169. Beaudoin M, Gosselin P. An Effective Public Health Program To Reduce Urban Heat Islands In Quebec, Canada. *Revista panamericana de salud publica = Pan American journal of public health*. 2016; 40(3): 160-6.
170. Benmarhnia T, Zhao X, Wang J, Macdonald M, Chen H. Evaluating The Potential Public Health Impacts of The Toronto Cold Weather Program. *Environment international*. 2019; 127: 381-6.
171. Berisha V, Hondula D, Roach M, White JR, McKinney B, Bentz D, et al. Assessing Adaptation Strategies for Extreme Heat: A Public Health Evaluation of Cooling Centers In Maricopa County, Arizona. *Weather, Climate, and Society*. 2017; 9(1): 71-80.
172. Bittner MI, Matthies EF, Dalbokova D, Menne B. Are European Countries Prepared For The Next Big Heat-Wave? *European journal of public health*. 2014; 24(4): 615-9.
173. Boyson C, Taylor S, Page L. The National Heatwave Plan - A Brief Evaluation of Issues for Frontline Health Staff. *PLoS Currents*. 2014: ecurrents.dis.aa63b5ff4cdaf47f1dc6bf44921afe93.
174. Carmona R, Linares C, Ortiz C, Miron IJ, Luna MY, Diaz J. Spatial Variability in Threshold Temperatures of Heat Wave Mortality: Impact Assessment on Prevention Plans. *International journal of environmental health research*. 2017; 27(6): 463-75.

175. Center for Climate Energy Solutions. Resilience Strategies for Extreme Heat. 2017. p. 1-14.
176. Chiu CH, Vagi SJ, Wolkin AF, Martin JP, Noe RS. Evaluation of The National Weather Service Extreme Cold Warning Experiment in North Dakota. *Weather, Climate, and Society*. 2014; 6(1): 22-31.
177. Elliot AJ, Bone A, Morbey R, Hughes HE, Harcourt S, Smith S, et al. Using Real-Time Syndromic Surveillance to Assess the Health Impact of The 2013 Heatwave In England. *Environmental research*. 2014; 135: 31-6.
178. Graham DA, Vanos JK, Kenny NA, Brown RD. Modeling the Effects of Urban Design on Emergency Medical Response Calls during Extreme Heat Events in Toronto, Canada. *Int J Environ Res Public Health*. 2017; 14(7).
179. Grothmann T, Leitner M, Glas N, Prutsch A. A Five-Steps Methodology to Design Communication Formats that can Contribute to Behavior Change: The Example of Communication for Health-Protective Behavior Among Elderly During Heat Waves. *SAGE Open*. 2017; 7(1).
180. Hatvani-Kovacs G, Bush J, Sharifi E, Boland J. Policy Recommendations to Increase Urban Heat Stress Resilience. *Urban Climate*. 2018; 25: 51-63.
181. Katiyo S, Dorey S, Bone A. The Cold Weather Plan for England: Protecting Health and Reducing Harm From Cold Weather. 2018: 1-57.
182. Lee I, Voogt JA, Gillespie TJ. Analysis and Comparison of Shading Strategies to Increase Human Thermal Comfort in Urban Areas. *Atmosphere*. 2018; 9(3).
183. MacIntyre E, Khanna S, Darychuk A, Copes R, Schwartz B. Evidence Synthesis - Evaluating Risk Communication During Extreme Weather and Climate Change: A Scoping Review. *Health Promotion and Chronic Disease Prevention in Canada*. 2019; 39(4): 142-56.
184. Marando F, Salvatori E, Sebastiani A, Fusaro L, Manes F. Regulating Ecosystem Services and Green Infrastructure: Assessment of Urban Heat



Island Effect Mitigation in the Municipality of Rome, Italy. *Ecological Modelling*. 2019; 392: 92-102.

185. Martin JL. Responding to the Effects of Extreme Heat: Baltimore City's Code Red Program. *Health security*. 2016; 14(2): 71-7.

186. McGregor GR, Bessemoulin P, Ebi K, Menne B. Heatwaves and Health: Guidance on Warning-System Development. WMO. 2015; (1142).

187. National Health Service E. Heatwave Plan for England: Protecting Health and Reducing Harms From Severe Heat and Heatwaves. 2018: 1-46.

188. Weinberger KR, Zanobetti A, Schwartz J, Wellenius GA. Effectiveness of National Weather Service Heat Alerts in Preventing Mortality in 20 US Cities. *Environment international*. 2018; 116: 30-8.

189. Williams S, Hanson-Easey S, Nitschke M, Howell S, Nairn J, Beattie C, et al. Heat-Health Warnings In Regional Australia: Examining Public Perceptions and Responses. *Environmental Hazards*. 2018.

190. Zhang Y, Murray AT, Turner BL, II. Optimizing Green Space Locations to Reduce Daytime and Nighttime Urban Heat Island Effects in Phoenix, Arizona. *Landscape and Urban Planning*. 2017; 165: 162-71.

191. Appuhamilage GP, Barbir J, Lloveras XR. Analysis of Existing Disaster Risk Reduction Programs and Enhancement of Capacity Development for Health Risks from Floods in Western Balkan. *Climate Change Management: Springer*; 2019. p. 335-50.

192. Gainey CE, Brown HA, Gerard WC. Utilization of Mobile Integrated Health Providers During a Flood Disaster in South Carolina (USA). *Prehospital and Disaster Medicine*. 2018; 33(4): 432-5.

193. Genes N, Chary M, Chason K. Analysis of Twitter Users' Sharing of Official New York Storm Response Messages. *Medicine* 20. 2014; 3(1): e1.

194. Levy M, Jenkins JL, Seaman K. A Fire Department Community Health Intervention to Prevent Carbon Monoxide Poisoning Following a Hurricane. *PLoS Currents*. 2014.

195. Scott KK, Errett NA. Content, Accessibility, and Dissemination of Disaster Information via Social Media During the 2016 Louisiana Floods. *Journal of public health management and practice : JPHMP*. 2018; 24(4): 370-9.
196. Sena A, Barcellos C, Freitas C, Corvalan C. Managing the Health Impacts of Drought in Brazil. *Int J Environ Res Public Health*. 2014; 11(10): 10737-51.
197. Valois P, Caron M, Gousse-Lessard A-S, Talbot D, Renaud J-S. Development and Validation of Five Behavioral Indices of Flood Adaptation. *BMC Public Health*. 2019; 19(1): 245.
198. Westcott R, Ronan K, Bambrick H, Taylor M. Public Health and Natural Hazards: New Policies and Preparedness Initiatives Developed From an Australian Bushfire Case Study. *Australian & New Zealand Journal of Public Health*. 2019; 43(4): 395-400.
199. World Health Organization Regional Office for Europe. Flooding: Managing Health Risks in the WHO European Region. 2017. p. 1-91.
200. Borbet TC, Gladson LA, Cromar KR. Assessing Air Quality Index Awareness and Use In Mexico City. *BMC public health*. 2018; 18(1): 538.
201. Brunt H, Barnes J, Longhurst JWS, Scally G, Hayes E. Enhancing Local Air Quality Management to Maximise Public Health Integration, Collaboration and Impact in Wales, Uk: A Delphi Study. *Environmental Science and Policy*. 2018; 80: 105-16.
202. Chen H, Li Q, Kaufman JS, Wang J, Copes R, Su Y, et al. Effect of Air Quality Alerts on Human Health: A Regression Discontinuity Analysis in Toronto, Canada. *The Lancet Planetary health*. 2018; 2(1): e19-e26.
203. Glazener A, Khreis H. Transforming Our Cities: Best Practices Towards Clean Air and Active Transportation. *Current environmental health reports*. 2019.
204. Goix L, Petrovic T, Chanzy E, Reuter P-G, Linval F, Adnet F, et al. [Impact Of The Air Quality On Health - Analysis Of The Activity Of A Samu-Center 15 In Paris Area - The IQUASS Study]. *Presse Medicale*. 2018; 47(11-12 Pt 1): e169-e74.

205. Johnston FH, Wheeler AJ, Williamson GJ, Campbell SL, Jones PJ, Koolhof IS, et al. Using Smartphone Technology to Reduce Health Impacts From Atmospheric Environmental Hazards. *Environmental Research Letters*. 2018; 13(4).
206. Lyons RA, Rodgers SE, Thomas S, Bailey R, Brunt H, Thayer D, et al. Effects of an Air Pollution Personal Alert System on Health Service Usage in a High-Risk General Population: A Quasi-Experimental Study Using Linked Data. *Journal of epidemiology and community health*. 2016; 70(12): 1184-90.
207. Masselot P, Chebana F, Lavigne E, Campagna C, Gosselin P, Ouarda TBMJ. Toward an Improved Air Pollution Warning System in Quebec. *Int J Environ Res Public Health*. 2019; 16(12).
208. Mehiri K, Gosselin P. Evaluation of the Impacts of a Phone Warning and Advising System for Individuals Vulnerable to Smog. Evidence from a Randomized Controlled Trial Study in Canada. *International Journal of Environmental Research & Public Health* [Electronic Resource]. 2019; 16(10): 05 22.
209. Morishita M, Thompson KC, Brook RD. Understanding Air Pollution and Cardiovascular Diseases: Is It Preventable? *Current Cardiovascular Risk Reports*. 2015; 9(6).
210. Patella V, Florio G, Magliacane D, Giuliano A, Russo LF, D'Amato V, et al. Public Prevention Plans to Manage Climate Change and Respiratory Allergic Diseases. Innovative Models Used in Campania Region (Italy): The Twinning Aria Implementation and the Allergy Safe Tree Decalogue. *Translational Medicine @ Unisa*. 2019; 19: 95-102.
211. Pennington AF, Sircar K, Hsu J, Zahran HS, Damon SA, Mirabelli MC. Communication Channels for Air Quality Alerts in The United States. *Preventive Medicine Reports*. 2019; 14.
212. Radisic S, Newbold KB. Factors Influencing Health Care and Service Providers' and Their Respective "At Risk" Populations' Adoption of The Air Quality Health Index (Aqhi): A Qualitative Study. *BMC health services research*. 2016; 16: 107.

213. Vardoulakis S, Kettle R, Cosford P, Lincoln P, Holgate S, Grigg J, et al. Local Action on Outdoor Air Pollution to Improve Public Health. *International journal of public health*. 2018; 63(5): 557-65.
214. Hynds P, Naughton O, O'Neill E, Mooney S. Efficacy of a National Hydrological Risk Communication Strategy: Domestic Wastewater Treatment Systems in The Republic of Ireland. *Journal of Hydrology*. 2018; 558: 205-13.
215. O'Brien E, Xagorarakis I. A Water-Focused One-Health Approach for Early Detection and Prevention of Viral Outbreaks. *One Health*. 2019; 7: 100094.
216. Sharma K, Chandramouli CV, Wang X, Moreland J, Zhou CQ, editors. Virtual 3D Septic System Model for Education and Outreach Activities. *World Environmental and Water Resources Congress 2019: Groundwater, Sustainability, Hydro-Climate/Climate Change, and Environmental Engineering - Selected Papers from the World Environmental and Water Resources Congress 2019; 19th World Environmental and Water Resources Congress 2019: Groundwater, Sustainability, Hydro-Climate/Climate Change, and Environmental Engineering; 2019: American Society of Civil Engineers (ASCE)*.
217. Victoria Cancer Council. SunSmart Program. 2019.
218. Garcia-Romero M, Geller AC, Kawachi I. Using Behavioral Economics to Promote Healthy Behavior Toward Sun Exposure in Adolescents and Young Adults. *Preventive medicine*. 2015; 81: 184-8.
219. Hacker E, Horsham C, Ford H, Hartel G, Olsen CM, Pandeya N, et al. UV Detection Stickers Can Assist People to Reapply Sunscreen. *Preventive medicine*. 2019; 124: 67-74.
220. Oyebanjo E, Bushell F. A Critical Evaluation of the Uk Sunsmart Campaign and Its Relevance to Black And Minority Ethnic Communities. *Perspectives in public health*. 2014; 134(3): 144-9.
221. Marinucci GD, Lubet G, Uejio CK, Saha S, Hess JJ. Building Resilience Against Climate Effects-A Novel Framework to Facilitate

Climate Readiness in Public Health Agencies. *Int J Environ Res Public Health*. 2014; 11(6): 6433-58.

## MODULE 2

---

# Indigenous lens on climate adaption planning

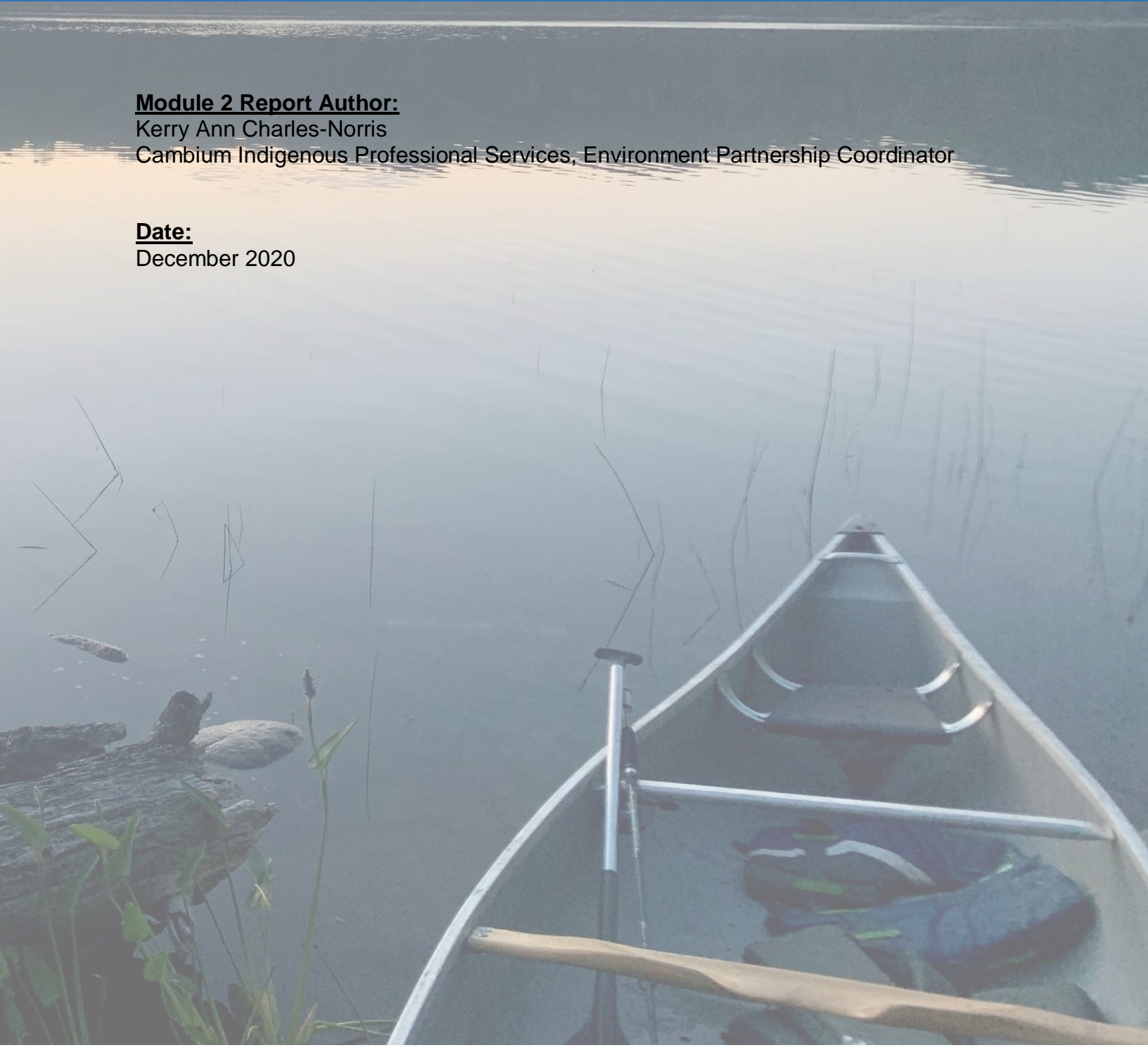
**Module 2 Report Author:**

Kerry Ann Charles-Norris

Cambium Indigenous Professional Services, Environment Partnership Coordinator

**Date:**

December 2020



## Preface

Aaniin, boozhoo, Kerry-Ann Charles-Norris nindizhinikaaz, Georgina Island nindoonjibaa, Ma'iingan Dodem, Anishnabe Kwe. (Hello, greetings, my name is Kerry-Ann Charles-Norris and I come from Georgina Island First Nation, I am of the Wolf Clan and I am an Indigenous woman).

I do not know much of my language even though my dad was a fluent speaker, as we (my four siblings and I) were never taught due to reasons that I hope the words that follow will help you to understand. I also hope that these words will create even a miniscule understanding of the true story of our shared history here in North America, known to the Indigenous Peoples as (Mishiike Minisi) Turtle Island and will assist you in this collective journey and pursuit of well-being and reconciliation in a time of environmental crisis.

Being a Community member of the Chippewas of Georgina Island First Nation, living within my Community, as well as having the privilege of working in my Community for many years in various aspects, has given me great insight into the issues that have had an effect and continue to have an effect not only on my Community but other Indigenous Communities within Ontario, across Canada and even the world. My experience includes, but is not limited to, working with our youth in various capacities, by-law development and enforcement, serving a term as a Council Member and being the Environment Co-ordinator for almost a decade. Although each of my positions entailed a gamut of responsibilities, the latter is really where I have found my passion. Working in the environment field has allowed me to not only learn about the importance of protecting and preserving Shkaakaamikwe (Mother Earth) but has also allowed me to learn about who I am as an Indigenous person and the importance of that when it comes to protecting and preserving that in which sustains us *All* so that we can achieve health and well-being or Mino Baamaadzwin (a good life). This has also been where I have come to learn about climate change and have been able to take this seemingly vast and complex issue and use it to start to open up communication, build relationships internally and externally, breakdown barriers and create opportunities to work together for our collective future. This began through the development of climate change adaptation plans in my own Community as well as assisting others in doing so, which utilizes Traditional Ecological Knowledge (TEK) as the foundation. Being able to be directly involved in various aspects of my Community before getting involved in climate change work and then being able to work with other First Nation Communities in undertaking such work, has given me a perspective that I have shared within this document. I hope this perspective will help you as a Public Health professional to ensure that as you embark on developing your Climate Change adaptation plans as they pertain to public health, that you stop to think and actively create opportunities to include the Indigenous voices in a meaningful way; as the benefits will be immense, not only for the Indigenous peoples but all peoples alike.



## MODULE TWO: EXECUTIVE SUMMARY

Climate change has and will continue to have growing public health implications for the population of Ontario. Public health authorities have a duty to respond and are progressively working to address the health impacts of climate change. Many public health authorities are conducting climate change and health vulnerability and adaptation assessments. Adaptation planning is the next step public health authorities must take to promote and protect health and wellbeing, enhance resilience, and reduce the health risks associated with climate change. In doing so, the realization has been made that Indigenous world views need to be actively sought out and meaningfully incorporated into this work to ensure the most comprehensive plans reflective of the whole Ontario context are being developed moving forward.

Cambium Indigenous Professional Services conducted a knowledge synthesis project that illustrates Indigenous perspectives and the importance of including these perspectives into climate-adaptation and strategies to assist public health authorities in doing so. This project complements the scope of the literature review described in Module One. It identifies reasons why including Indigenous voices in climate-health adaptation has been a gap in public health practice. It introduces critical concepts of Indigenous ways of knowing and doing and introduces some best rules that public health authorities must understand and apply to work with and learn from Indigenous populations concerning climate adaptation.

This knowledge synthesis project is based on the lived experiences of the Author. The information presented can support public health authorities to work with and learn from Indigenous populations in culturally competent ways concerning climate change adaptation as well as to emphasize the importance of meaningful inclusion of Indigenous voices.

### ***Brief History***

The *True History* of Canada, the many unethical events that occurred and the relationship that the government has had with the Indigenous peoples since contact is unknown by most. This history has not been voluntarily disclosed in the past, and even in the present, the discloser is not a priority in our society. These events have had a profound effect on Indigenous people's health and wellbeing, have left important knowledge and wisdom out of decision-making, and the non-Indigenous peoples of today have gained privilege from them.

### ***Interconnectedness to the Land***

Indigenous peoples have an intimate connection to the land and were gifted the knowledge and tools to learn from those who make their home in the natural environment. This gift was given by the *Creator* so that people understood how to survive and flourish in a sustainable way and maintain balance within the ecosystem, including being able to identify specific species to aid and cure sickness and observing nature to be proactive in preparing for environmental changes.



## ***Truth and Reconciliation***

In 2007, the National Centre for Truth and Reconciliation was established as part of the Indian Residential Schools Settlement Agreement, the largest class-action settlement in Canadian history. The Truth and Reconciliation Commission was formed. As part of this journey of understanding Indigenous peoples and including them in the discussions and planning about our collective future in preparing for our changing climate, it is essential to understand the need for healing. An understanding and acknowledgement of the effects of Residential Schools are required so that healing can occur and Indigenous peoples can be encouraged and supported in their journey of reconnecting and re-learning their language, culture, and traditions that were not just once forbidden but forcibly taken from both adults and children.

## ***Including Indigenous Voices***

Although we would like to think that we can speak past tense about events that have led to the inequalities and exclusion of Indigenous peoples today, the reality is that the past actions have seriously affected the present and will continue to do so in the future. We can ensure that from this point forward, we create a better future through the use of the best practices and critical concepts that have been identified that must be taken into consideration when pursuing the inclusion of Indigenous peoples voices and that those voices be meaningfully supported and incorporated.

### **Best Practices:**

- **Trust** is the foundation of meaningful engagement with Indigenous peoples.
- **Research** is necessary to have an understanding of the community that public health authorities want to engage.
- **Respect** is vital to ensure that trust will be earned.
- **Recognition** of the rights of Indigenous peoples and its representation in legislation.
- **Remember** colonialism has an impact and that it will take time for those impacts to be rectified.
- **Responsibility** is on the public health professionals to ensure that they are educated so that they can appropriately and adequately provide climate change adaptation health services to the Indigenous peoples.

### **Critical Concepts:**

- ***Nothing About Us Without Us:*** No policy or action should be decided by any representative without the inclusion of the group in which the policy/action is affecting.
- ***Ethical Space:*** Respecting the views of others and ensuring a cooperative spirit between Indigenous peoples and Western institutions.
- ***Two-Eyed Seeing:*** Being able to see the importance of Western Science and Indigenous Knowledge and bring the best of both together.

- **Seven Generations:** Considering and ensuring that the decisions made today do not harm those yet to be born.
- **Creators Law:** All Beings have a purpose and must work together in harmony – including human beings.
- **Seven Grandfather Teachings:** Encompass the morals, values, structures, ceremonial practices, and spiritual beliefs of the Anishnabe people.

## 1 INTRODUCTION

When changes occur in the weather that a region normally experiences, it is called climate change and can be defined as, “any significant change in long-term weather patterns. It can apply to any major variation in temperature, wind patterns or precipitation that occurs over time.”(1). Climate change impacts are being felt all over the world and are a real and pressing issue for the health of Ontarians and Canadians. It has both direct and indirect impacts on the health of individuals and communities, with the greatest impacts being on vulnerable and marginalized populations. Climate change poses significant risks to communities’ health and well-being, the economy, and the natural environment. The sensitivity of the natural environment to changes in weather and climate affect the ecosystems and socioeconomic aspects of all communities’ but more so the Indigenous Communities because of where they live, and how they continue to rely on the environment for economic and cultural sustenance. There are several areas in which climate change is, and will have, an impact on all aspects of Ontarians’ lives. The main climate-sensitive areas that have been identified to have health impacts in Ontario include extreme temperatures (i.e. more 30+ days during the summer months making it dangerous to work/play outside), vector-borne disease (i.e. vector host survival that carry diseases such as Lyme disease and West Nile Virus), air quality (i.e. increased respiratory illnesses), ultraviolet radiation (i.e. damage to skin and eyes) as well as food and water quality/quantity (i.e. scarcity and contamination)

Climate change adaptation is part of a process whereby stakeholders determine circumstances that are caused or have compounding effects by the changing climate and develop a plan of action to adapt to the changing conditions and to lessen the worst effects. It is about adopting policies and practices which use knowledge of the past and the present to understand the changes and as a guiding principle in order to be prepared to deal with the many possible effects of climate change in the future.

In Ontario, the Ministry of Health and Long-Term Care, through the Ontario Public Health Standards, has directed Public Health Authorities to develop climate change vulnerability and adaptation assessments to mitigate health risks leading to healthier, more resilient communities and individuals across Ontario and to engage key stakeholders in future climate change and health adaptation work. The Public Health Agency of Canada (PHAC), Ontario Region, in partnership with Simcoe Muskoka District Health Unit, conducted a literature review to build an evidentiary base on the characteristics of adaptation interventions that address expected health impacts associated with climate-sensitive categories applicable to Ontario. The synthesized knowledge can support local public health agencies conducting adaptation planning. Module one was developed to communicate the findings of the literature review to inform public health practice provincially.

Upon initiating the literature review, it was identified that the Indigenous population had been overlooked in the initial scoping and there is currently not a best practise on including their perspectives or how to respectfully engage to do so, nor has there been a directive for such engagement until recently. With this, it has been recognized that there is a definite need to include the Indigenous peoples in this undertaking as they are key stakeholders representing approximately 2.8% of the Ontario population and are the fastest growing people in Ontario (2). Indigenous peoples are increasingly being recognized for the significant knowledge and wisdom they hold in regards to environmental sustainability and protection but are being disproportionately impacted by climate change. Cambium Indigenous Professional Services (CIPS) is a First Nation owned and fully Indigenous staffed organization that has extensive experience in how climate change can have far reaching impacts for Indigenous Communities and how past events have and continue to compound these impacts. CIPS have and continue to share knowledge they possess as being First Nation individuals as well as the knowledge they have gained from working on multiple projects in Indigenous Communities and with local Public Health Authorities. The CIPS Team also understands themselves and conveys to the non-Indigenous world that although each Community share similar values, each Community is their own unique and distinct peoples and must be treated as such.

## **2 A BRIEF HISTORY OF INDIGENOUS PEOPLES OF TURTLE ISLAND**

Indigenous peoples of Turtle Island (North America) have been here since time immemorial and were a thriving, healthy people who lived off the land and by the *Creators Law* until contact by the European settlers.

There is much to tell about the *True* history of Canada and the relationship that the government has had with the Indigenous peoples since contact. The many *Treaties* in which promises were made and broken, the calculated inflicted suffering that took place such as the *Residential Schools*, the ghastly legislation that has been enacted, namely the *Indian Act* and the trauma from these and others that the First People of this country have suffered throughout the past and into the present. Many of these events are unknown by most, but they have had a profound effect on Indigenous people's health and wellbeing and, conversely, the non-Indigenous peoples of today have gained privilege from them.

This history has not been voluntarily disclosed in the past and, even in the present, the disclosure is not a priority in our society. This leaves the responsibility of learning about this history and about the Indigenous peoples of Turtle Island with the individuals of Canada, especially those working in public health. Knowing and understanding this knowledge is imperative to being able to recognize the health outcomes, inequities faced, and wisdom held by Indigenous peoples and is essential for building relationships and engaging in actions that decolonize public health activities.

With the information that follows, it is hoped that the knowledge of the past and present will aide in understanding the importance of including the voices and perspectives of Indigenous peoples as we embark on the journey of determining climate change vulnerabilities that pose risk to Ontarians and develop adaptation plans that protect our collective future.

Although the *Residential School* system is the most publicly known practice that the government established to assimilate the Indigenous peoples and integrate them into the Canadian society there were also other calculated colonization undertakings. As part of what was termed, “*get rid of the Indian problem*” the government established *Indian Hospitals*. In the late 1800’s and early 1900’s, Christian missionary efforts were funded by the federal government to provide basic hospital care on some reserves, as many would have to travel far distances from their homes to be treated for diseases introduced by the settlers and that the Traditional Healers did not have medicines or treatments for. During the 1920’s up until the 1960’s the government aggressively expanded this system of *Indian Hospitals* which now admitted patients based on their *Indian status*, rather than disease.

Most Indian hospitals were established in either residential schools or facilities owned by the armed forces and were often overcrowded, inappropriate and ill-equipped to stop the spread of life-threatening disease. They were found to operate at almost half the cost of the settler’s facilities and did not provide midwives, Indigenous medicines or holistic concepts of sickness and treatment. In fact, both government and Missionaries tried to suppress the work of Indigenous healers and midwives to further assimilation goals, which forced them to practise in secret. Although many people were made well in these hospitals, patients recall being lonely, vulnerable and fearful. Some suffered abuse, as some medical staff were racist, most if not all did not understand the cultures and languages, which was coupled with being underpaid and overworked, causing frustrations to be taken out on patients.

In 1945, the Indian Health Services became part of the newly created Department of National Health and Welfare. There were hundreds of new hospitals constructed. However, this increased racial inequality as these new hospitals, regarded as *white* hospitals, created incredible opportunities for nurses and doctors which made it increasingly difficult to find

medical professionals to work at the Indian hospitals. These hospitals were often located side by side.

In the 1950's the Indian Act was amended to include the *Indian Health Regulation* which meant that any Indigenous person who refused treatment or left to return home before being discharged from the hospital could be arrested and jailed or taken back to the hospital. Infants and children who were diagnosed with tuberculosis were taken from their homes. Men and women were forced to leave their Communities which meant at times that families were left without a father to provide food or a mother to give her children the comfort and love needed. Those who died at these hospitals were buried at the nearest cemetery with unmarked graves unless the family paid for the costs to return them home. As many of the Communities were poverty stricken, this was not often an option.

Although these hospitals and legislative approaches were justified as a means to control Tuberculosis (TB), there were many reasons that motivated the aggressive establishment and support of these facilities including the need of the *settler society* to feel protected and separated from *Indian Tuberculosis*, to ensure that these establishments could keep as many patients as possible admitted to maintain government funding, as well as to ensure there were a number of patients available for medical experiments.

As these facilities were being established, the Indigenous Communities welcomed the promise of health and hospital care similar to the non-Indigenous communities but, as many before, this promise, too, was broken and conditions were not improved. Many Indigenous people also felt that this was recognition of the *Treaty* responsibilities, but the government did not share this acknowledgement and instead claimed that it was a moral obligation, specifically to protect the rest of the Canadian population from disease.

## THE INDIAN ACT

*As far back as the 1920's Government officials' requested that there be legal backing for forcible removal of Indigenous peoples from their Communities and an Amendment to the Indian Act was passed in 1927. This Amendment still remains in effect today.*

### INDIAN ACT, 1985

#### **Regulations**

*73 (1) The Governor in Council may make regulations:*

*f) to prevent, mitigate and control the spread of diseases on reserves, whether or not the diseases are infectious or communicable;*

*(g) to provide medical treatment and health services for Indians;*

*(h) to provide compulsory hospitalization and treatment for infectious diseases among Indians; (3)*

Epidemics such as TB and smallpox resulted in high rates of mortality among Indigenous people. These losses included traditional healers (which created a loss of knowledge which remains today) who were also being discredited due to the lack of knowledge about the new illnesses that were brought by the settlers. The loss of life from these epidemics also cleared the way for colonization and the advancement of “Terra Nullius” or settlement of “Empty Land” and the control over Indigenous Communities by government that we see today.

By the 1960’s, the government planned to close the Indian Hospitals and expand the community hospitals. This was met with resistance from some of the Indigenous Communities, mainly because they believed that the funds that were meant for their health care should be used to improve their facilities and not given to settler community hospitals. Moreover, it was a treaty right for Indigenous people to have access to adequate health care like every other Canadian.

In 1979, the government finally recognized its constitutional and treaty responsibilities for health care of the Indigenous peoples (4) and Indian hospitals are now closed with some converted into primary care clinics in Communities.

Directly linked to assimilation and colonization practices and policies, at present, Indigenous peoples and Communities still endure poorer health due to inadequate funding as well as inappropriate and discriminatory treatment. This is coupled with higher rates of unemployment, higher rates of incarceration, lower levels of income, higher suicide rates especially in youth and inadequate funding for education and housing among others. These determinants of health are now being exacerbated by our changing climate. Events such as warming temperatures, lack of precipitation and the increase of extreme weather are creating huge gaps in the connections Indigenous people have to the small pieces of land that they have been forced to settle, creating unsuitable habitat as well as substantial habitat loss for many of these *Beings* (plants and animals) that are accessed for sustenance, medicinal and traditional practices as well as economic sustainability.

### **FIRST-FIRST NATIONS NURSE**

*Edith Anderson Monture was the first First Nations woman to become a registered nurse in Canada, but she actually had to leave the country to pursue her dream. Born on April 10, 1890 in Six Nations of the Grand River, Ont., the Mohawk woman struggled to be accepted to a Canadian nursing school. At the time, First Nations faced involuntary enfranchisement (loss of Indian status) for pursuing higher education.*

*She moved to the United States to attend the New Rochelle nursing school in New York state, and completed her degree in 1914 (5).*

With climate change now being another determinant of health and layer of distress that is being felt and which poses significant risks to Indigenous Communities’ health and well-being,

economy, and the natural environment, it is also creating challenges for Indigenous peoples that most other Ontarians would not understand. There is an inherent and intimate connection that exists between Mother Earth and Indigenous peoples which is the core of Indigenous peoples' being. All teachings, traditions, culture and even language stems from the earth as a guide to achieving and sustaining well-being. These cultural and traditional practices, formerly illegal, disrupting the intergenerational transfer of knowledge, are now being passed down without the necessary changes being made that reflect our changing climate. As access to traditional medicinal plants and other things that are used for holistic health, well-being and sustenance is sought, the effects of our changing climate pose real risks, threats and challenges to many as the context in which they are being relayed may not reflect our rapidly changing landscape.

Despite this and other events, Indigenous peoples have remained resilient and continue their journey to pick up the pieces of their shattered ways of being left by colonisation, using their inherent knowledge of and connection to the natural environment to adapt to change. As their language, culture, stories and traditions, once lost, resurface, are practiced and adjusted to

#### **JORDAN'S PRINCIPLE**

*Is a legal requirement resulting from the Orders of the Canadian Human Rights Tribunal (CHRT) and is not a policy or program.*

*Jordan's Principle is a child-first principle that aims to eliminate service inequities and delays for First Nations children.*

*Jordan's Principle states that any public service ordinarily available to all other children must be made available to First Nations children without delay or denial.*

*Jordan's Principle is named in honour of Jordan River Anderson, a young First Nations boy from Norway House Cree Nation in northern Manitoba, who spent his entire life in hospital while caught in a jurisdictional dispute between the governments of Canada and Manitoba, which both refused to pay for the in-home medical care necessary for Jordan to live in his home and community. 'Assembly of First Nations (6)*

reflect the changes that have occurred, this resilience will continue.

The events of the past have systemically had effects on the present and although disappointing, it is not surprising that the Indigenous perspectives and voices were not the top of mind as this work in public health and climate change adaptation began. Many public health authorities have struggled with building relationships with local Indigenous Communities and people due to the deep distrust and fear among Indigenous people resulting from the history as outlined here.

There is also fear inside those within the public health field of saying or doing something wrong and contributing or triggering trauma and as knowledge is increased about the true history of Canada and the relationship with the Indigenous peoples, so is the fear. This is then confounded by the barriers of provincial/territorial and federal legislative mandates. It is hoped, as we move

forward down this path together we ensure that the Indigenous peoples are not only included but included in an equal and meaningful way.



### 3 INTERCONNECTEDNESS TO THE LAND

In order to ensure that the Indigenous voices are being sought out and meaningfully incorporated into all aspects of climate change planning there must first be an understanding of the intimate, interconnectedness that Indigenous peoples have with Mother Earth.

In the Anishnabe worldview, *Creators Law* is the governing belief that all of creation is in a circular relationship where all *Beings*, human and other, are created equal, care about, respect and thrive to be kind and in harmony with one another. Indigenous peoples followed this *Law* for millennia and the outcomes and effects were abundant thriving biological diversity that sustained *All*.

It is believed that Indigenous peoples were gifted the knowledge and tools to learn from other *Beings* who make their home in the natural surroundings. This gift was given by the *Creator* so that people understood how to survive and flourish in a sustainable way and maintain balance within the ecosystem (*Never take the first, never take the last and always only take what is needed.*) This includes being able to identify specific species to use to aid and cure sickness and observing nature to be proactive in preparing for environmental changes. Along with this gift the Indigenous peoples were also given the responsibility to teach and ensure other humans understood and adopted this concept.

#### CONNECTION STORY

*The “Clan System” in which First Nation governance structures along with many other denotations are grounded and although the type of animal and/or representation for the Clans may vary from Community to Community the concept remains the same in that each of the animals represents specific characteristics which not only describe and connects with people as Individuals but everything and everyone as a whole. Each animal representing teachings, life lessons, knowledge and so much meaning. Due to the effects of our changing climate, Indigenous peoples are witnessing habitat that is so important for animals such as these rapidly decreasing, pushing them out of territory and out of reach. This is also occurring with many other species that Indigenous people have become to understand, have become connected with and in which sustains them not only physically but mentally, emotionally and spiritually. This has and will continue to have a huge impact on the Indigenous peoples’ holistic well-being. Although Indigenous peoples have been changing and adapting with their surroundings for time immemorial, a change this rapid has not been witnessed. As these changes continue to occur, not only do the species become displaced and the health and well being of the people who are dependant on them for their existence start to deplete, but valuable teachers and students are separated and the knowledge that was once used to survive is no longer valid leaving others disconnected and vulnerable.*

Clan System Chart BLM 8.2



Figure 1: First Nations Clan System (7)

This inherent gift and responsibility, has been hindered by attempts of assimilation, colonization and cultural genocide and is now being exacerbated by the effects of a changing climate. The devastating destruction of our natural environment to meet the ever growing economic greed are now compounded by the alterations that are occurring to the environment due to climate change. These changes are having and will continue to have devastating affects on the health and well-being of Ontario's population but evenmore so the Indigeous peoples because of this interconnectedness.

Indigenous peoples have a holistic perspective on health and wellbeing that considers mental, emotional, physical and spiritual aspects of an individual. Western knowledge tends to focus on and/or segregate these aspects. An integral part of this holistic approach and at the very core of Indigenous peoples' well-being is the state of their natural environment because of the initmate interconnectedness that they have with Mother Earth. Access to healthy diverse landscapes to harvest traditional foods and medicines, practice culture and spiritual beliefs, uphold the responsibility that was given by the *Creator* to protect and preserve our natural environment as well as the ability to observe the connections and behaviours of the non-human *Beings* that prompt us to act accordingly to change, is essential to Indigenous peoples well-being and the

survival of Indigenous culture, language and traditions which nourish spirituality and is the primary element of Indigenous peoples' existence.

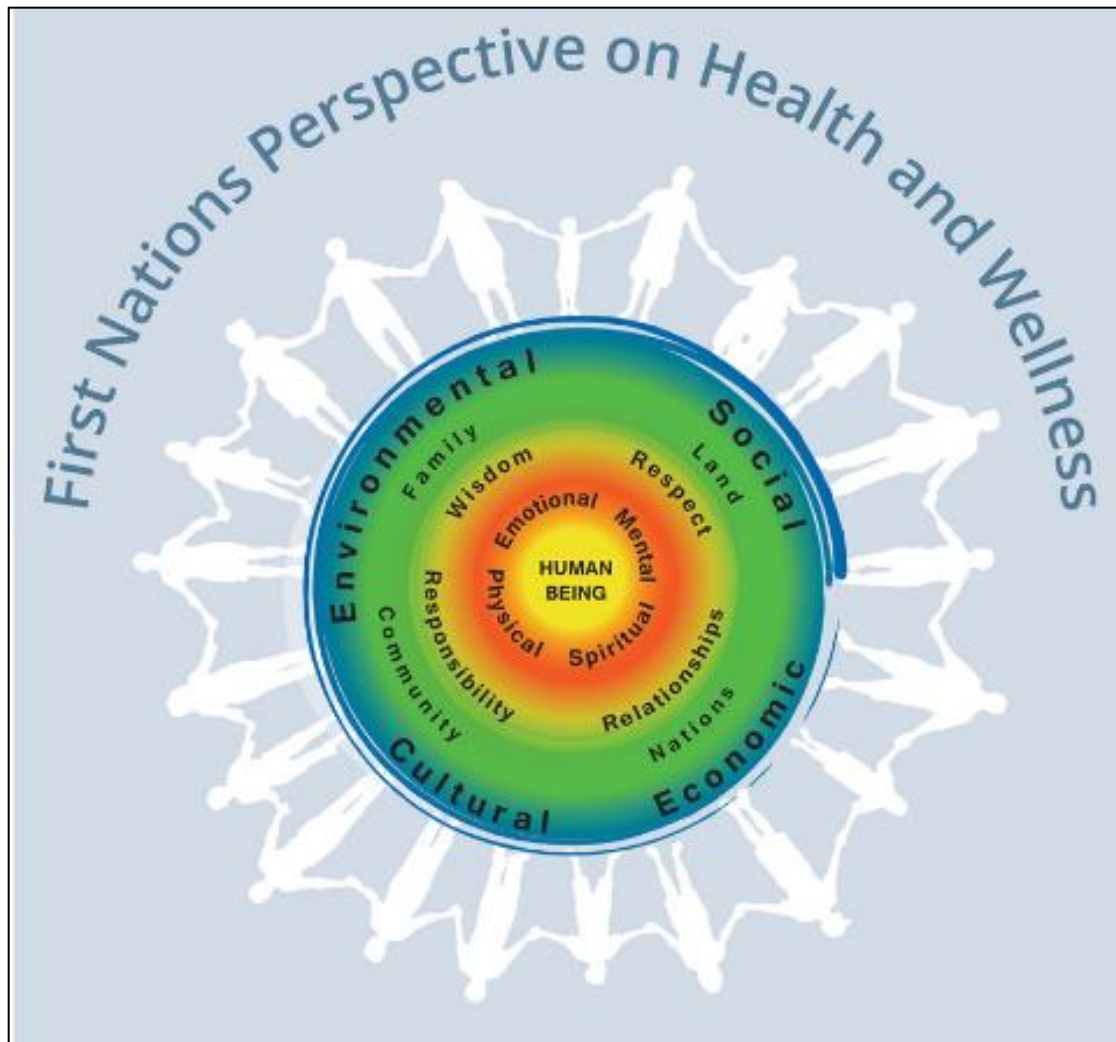


Figure 2: First Nations Perspective on Health and Wellness (8)

The more frequent severe weather, including intense storms, winds, droughts and precipitation in the form of rain during the winter months, the extreme temperatures which affect air and water quantity/quality and the shifting of seasons that are effecting the health, abundance and survival of traditional foods (both plant and animal) are just some of the effects that are being observed and felt by Indigenous peoples and Communities within Ontario. These changes are also creating ideal conditions for new vector-borne diseases to not only survive, but also thrive, in areas that they would not have in the past. Lakes, wetlands, streams, rivers and other bodies of water are not freezing and/or drying up, taking with them the vital, sacred medicinal plants

that heal a wide variety of ailments, are used for ceremony and other spiritual uses and carry significant traditional teachings that are being lost as they disappear.

### **Traditional Ecological Knowledge**

*“Traditional Ecological Knowledge (TEK) encompasses different ways of knowing which is culturally based, place specific, collective, holistic and also includes long periods of observation. Western Science differs from TEK because there is a time limited observation process, science usually requires a quantitative validation, and it is often believed and considered valid once written down into textbooks whereas oral tradition is knowledge that is embedded within Indigenous ways of knowing.” (9)*

The effects of climate change are being felt more in northern Communities where traditional practices are becoming conflicting. Elders are becoming increasingly wary of passing Traditional Ecological Knowledge (TEK) to the next generation. This is because traditional harvesting areas and routes used for generations are no longer safe to travel due to quickly changing conditions, such as melting ice and permafrost, causing potential for injury and death. There is also fear about negative health implications of consuming traditional foods and medicines that were once healthy. As the climate warms the vital *Beings* needed for our survival are increasingly becoming contaminated with new disease (ie. Chronic Wasting Disease and Brain Worm in animals such as Moose and Deer) making the meat inedible or causing food-borne illness. Timing of harvests are also changing. The shorter shoulder seasons and unpredictable shifts in weather are having severe effects on seasonal growing and animal migration patterns as well as creating unsuitable conditions for harvesting. Examples of this include frosts that are occurring late in the spring damaging and destroying crucial berry patches and/or the unseasonably warm temperatures that are occurring more frequently in late fall when hunting is to take place causing meat to get infested with bugs or rot in the warm temperatures.

## CASE STORY

*The Chippewas of Georgina Island (GIFN), is a First Nation located off the shores of Sutton West Ontario in Lake Simcoe, just an hour north of Toronto. Over the past decade through observations made by community members and the implementation of a climate change adaptation project founded on the collection of Traditional Ecological Knowledge (TEK) a number of health issues and concerns related to the changing climate have been identified.*

*The warming planet has challenged the community and forced them to adapt to and cope with numerous climate related risks including those that are and will have a devastating impact on their health and well-being. One of those impacts includes the identification of black legged ticks, which carry the vector borne disease Lyme disease. Tests have been undertaken on tick specimens collected in the community that have been positive indicating that this disease is now indeed very much prevalent within the community. Stories from the Elders describe that in the past the winter weather was cold enough and lasted long enough to ensure that if there were ticks and/or other vector carriers that they were unable to survive and were therefore not a threat. This new threat to the community may not only be detrimental to an individual's physical health but can also have an effect on one's mental, emotional and spiritual health as the harvesting of traditional foods and medicines now pose a health risk as does other outdoors activities.*

*In order to address this issue the Community has turned to their Elders and have learned that some of their Traditional Medicines act as natural deterrents for vectors such as ticks. With this knowledge, the Community is presently undertaking research and implementing this knowledge with support from the Climate Change Health Adaptation Program funding 2019-2020.*

The use of TEK can assist to adapt to these situations as has been done for millenia. Supporting Indigenous peoples to be able to re-connect to the land and observe and protect it as instructed by the *Creator* will allow us to understand and take cues as to how to prepare ourselves for the changes that are ahead and even lessen changes that may have an adverse effect on our health and well-being. As governments, non-Indigenous organizations and many non-Indigenous peoples become aware of the wisdom and knowledge that Indigenous peoples hold through TEK, many funding agencies are starting to “decolonize the processes” in which Indigenous Communities apply and receive funding to implement projects within their Communities. Funding agencies such as Health Canada, Crown Indigenous Relations and Northern Affairs Canada (CIRNAC) and Natural Resources Canada (NRCan) are encouraging community members to put forward project ideas that ensure the transfer of knowledge from Elders to youth and that collect information through traditional ways such as sharing of stories, legends and teachings amongst each other about their families, territories and experiences. They are giving the Communities the opportunity to identify priority projects and act accordingly



based on their unique needs, beliefs and situations, unlike the past and very present for some, where use of funding is dictated based on formulas or non-Indigenous community needs.

Public health authorities play a huge role in ensuring that the wisdom and knowledge of the Indigenous peoples are actively supported and meaningfully implemented as the sharing of this knowledge will be profound when developing plans to adapt and mitigate the health effects that are predicted to affect not just the Indigenous peoples but all Ontarians alike.

In all sectors of government as well as non-governmental organizations, people are starting to understand and believe in the benefits of Indigenous knowledge, which Indigenous peoples have tried to share since contact. An understanding of the importance of learning and sharing knowledge with each other, and the importance of adhering to the *Creators Law*, as well as respecting the very intimate connection and responsibility that *All Beings* have to one another, is crucial as we find ourselves amidst a social as well as an environmental crisis.

All programs and policies, including those developed and implemented by the public health authorities need to be designed to ensure opportunities are being created for the reassertion of Indigenous rights and responsibilities to take care of Mother Earth in culturally appropriate and

### CASE STORY

*I am a trapper and have been out on the land all of my life and in the fall of 2008, I was out on the land and came across a Beaver dam being built that was 3 feet high and couldn't understand why the Beavers were doing this and that spring a big flood occurred. At that time, I didn't think anything of it. A few years later in 2010, again in the fall, I was back out on the land and came across another Beaver dam being built that was 3 feet high and again sure enough that spring there was another big flood. After the second flood, I began to understand why the Beaver was building such a big dam in the fall. He was preparing for the floods that were coming. ~ Climate Change Health Adaptation Program, Review Committee Member*

Community driven ways. This needs to be done through allowing Indigenous Communities to take control of their own research agendas, the creation of opportunities to re-learn traditions, teachings, cultures and languages as well as allowing for time needed to do so. This re-connection and an understanding of Turtle Island is essential knowledge that cannot have stringent timelines and needs to be understood so that it can be shared with others and once again *All Beings* can live equally, respectfully and in kindness and harmony with one another.

The Climate Change Health Adaptation Program (CCHAP) is a great example of this new approach in working with Indigenous Communities. CCHAP has

funded ninety-four (94) Communities across Canada since 2017 to 2021 with a total of twenty (20) being from Ontario. Types of projects that have been funded, include food security, health vulnerability assessments, adaptation planning, vector-borne disease and water quantity/quality.

## CLIMATE CHANGE AND HEALTH ADAPTATION PROGRAM

*CCHAP for First Nations South of 60°N at Indigenous Services Canada supports First Nation Communities in addressing the health impacts of climate change through building capacity, developing research skills, and creating health-related adaptation plans and communication materials. Indigenous leadership plays a key role in the success of the program. Central to the CCHAP is the concept of a community / regional-based approach to research, allowing Communities to identify the areas of adaptation research and vulnerability assessments that are of greatest importance to them (10).*

Attached in Appendix A is a brief description of the projects in Ontario that are currently being funded.

## 4 TRUTH AND RECONCILIATION

As part of this journey of understanding Indigenous people and including them in the discussions and planning about our collective future, it is important to understand the need for healing. Many Indigenous peoples of Canada who live in Community and in urban centers, are fragmented from the events of the past, without realizing or understanding what those events were. They get stuck in a perpetual cycle that is not of their making. Past generations were forced to become someone whom they were not; forced physically, mentally and emotionally as both adults and children to live by someone else's guidelines, culture and spiritual beliefs, even forced to speak another language as they witnessed their own disappear, along with a little piece of themselves. There is not much of a difference in today's generations as they too are being systematically forced to do the same. This is just a glimpse into the trauma that has been suffered by Indigenous people and a huge reason that many are so disconnected and unbalanced today. Things such as high unemployment rates, high rates of incarceration, low graduation rates, low levels of income and high suicide rates (especially in youth) as well as poor health do not just stem from inadequate funding but are very real impacts from past events like *Indian Hospitals* and *Residential Schools* which have caused *Intergenerational Trauma*<sup>8</sup>, a

---

<sup>8</sup> "Intergenerational trauma is usually seen within one family in which the parents or grandparents were traumatized, and each generation of that family continues to experience trauma in some form...Direct survivors of these experiences often transmit the trauma to later generations when they don't recognize or have the opportunity to address their issues. Over the course of time, these behaviours often destructive, become normalized within the family and their community, leading to the next generation suffering the same problems. (11)

very real thing. An understanding and acknowledgement of this must take place by *all* Canadians, be it that they are Indigenous or not, so that healing can occur and Indigenous people can be encouraged and supported in their journey of reconnecting and re-learning their language, culture and traditions that were not just once forbidden but forcibly taken from both adults and children. Without this understanding, acknowledgement and healing, the journey ahead to adapt to our changing climate will be a difficult one, as this will make it difficult for Indigenous peoples to pick up their “Bundles” (the teachings, traditions, practices and gifts that the *Creator* has given in understanding Mother Earth and her needs) and even more difficult for the sharing of the wisdom within those “Bundles” with others that will support the planning needed to prepare for and adapt to the changing climate.



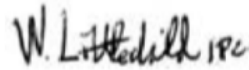
It is due to the courage and determination of former students—the Survivors of Canada’s residential school system—that the Truth and Reconciliation Commission of Canada (TRC) was established. They worked for decades to place the issue of the abusive treatment that students were subjected to at residential schools on the national agenda. Their perseverance led to the reaching of the historic Indian Residential Schools Settlement Agreement.

All Canadians must now demonstrate the same level of courage and determination, as we commit to an ongoing process of reconciliation. By establishing a new and respectful relationship between Aboriginal and non-Aboriginal Canadians, we will restore what must be restored, repair what must be repaired, and return what must be returned.

In preparation for the release of its final report, the Truth and Reconciliation Commission of Canada has developed a definition of *reconciliation* and a guiding set of principles for truth and reconciliation. This definition has informed the Commission’s work and the principles have shaped the calls to action we will issue in the final report.



Justice Murray Sinclair  
CHAIR, TRUTH AND RECONCILIATION COMMISSION OF CANADA



Chief Wilton Littlechild  
COMMISSIONER



Dr. Marie Wilson  
COMMISSIONER

Figure 3: Justice Murray Sinclair Statement

As part of this healing journey, in 2007 the National Centre for Truth and Reconciliation was established, as part of the Indian Residential Schools Settlement Agreement, which was the largest class action settlement in Canadian history, and the Truth and Reconciliation Commission was formed (12). With a six (6) year mandate to listen to and record the stories of Indian Residential School survivors, over 6,740 statements were heard and almost 100 Honorary Witnesses were inducted to work on Reconciliation. As a framework for this task the Commission used the United Nations Declaration on the Rights of Indigenous Peoples and developed ten guiding principles in which reconciliation is to be based on and in 2015 the Truth and Reconciliation Calls to Action were released.

Included in the calls to action are a number of calls for those in the health sector (Appendix B). It is the responsibility of the public health representatives to review and understand these calls along with the United Nations Declaration so that those representatives can assist and actively take part in reconciliation, while also ensuring that they are acting in the best interest of the peoples they serve. Without taking the steps to learn about the history of the Indigenous peoples as well as accepting the responsibility to do so, public health representatives are doing an injustice to the Indigenous peoples of this land, the non-Indigenous peoples as well as the land itself. There is much to learn as we begin down the path of reconciliation but this step will also lead us down the path of reconciliation with the land, a key component when planning for the future health and the effects of our changing climate.

In today's world, many have not been educated or informed of much or any of this information and in a time of "Reconciliation" and a "Changing Climate" you cannot prepare for a changing climate without reconciling with the *First Peoples* of this land and the land itself. Organizations and individuals alike must be informed about the past in order to be able to understand our present and make real attainable strategies for our collective future which ensures health and well-being of *All Beings*. As Canadians become more and more educated about Canada's *True* history, and as *Reconciliation* takes place through the opening of the minds, hearts and spirits, the building of trust, relationships and the sharing of knowledge will no longer be a barrier to success in adapting to our changing climate and we will start to see the beginning of a *New* history.

## 5 INCLUDING THE INDIGENOUS VOICE

Organizations, including public health authorities, are undertaking self-reflection activities to better understand the past and current relationships with the Indigenous Communities and urban populations. Many are starting to embark on this journey as the *Truth* about Canada's history surfaces and people become more and more aware of the atrocious events of colonialism which have occurred and on which Canada has been founded. People are starting to understand that the conditions and the many visible needs that Indigenous peoples face in both community and urban settings, in all areas of living, are indeed not of their own doing but rather stem from colonialism and actions that have taken place in the past and continue to contribute to the present. Individuals as well as organizations such as the PHAC are realizing that there needs to be a drastic shift in the way that Indigenous peoples are perceived and communicated with, but more importantly, how services that are being developed and delivered need to be done in partnership to ensure that they are not only appropriate and are meeting the "First Peoples" of "Turtle Islands" needs, but so that the rest of society can benefit from the knowledge they possess.

Although we would like to think that we can speak past tense about events that have lead to the inequalities for Indigenous peoples today, the reality is that the actions of the past have seriously affected the present and will continue to do so into the future, particularly if we do not start including Indigenous voices in the conversations that are occurring around improving these conditions. The effects of the inequities, misrepresentation and in particular the exclusion of Indigenous knowledge, opinions and voices that have occurred and in many cases continue to occur, are being felt around the globe as Climate Change increasingly poses threats to our collective health and well-being.

Just as the Indigenous voices have been deliberately disregarded, discredited and at times condemned, so has the notion of Climate Change by some. It is vitally important in the face of our changing climate to not only listen to the wisdom of the Indigenous people but to ensure that

### EXAMPLES OF ORGANIZATION ACTIONS

*Ministry of Health and Long-Term Care  
Relationship with Indigenous Communities  
Guideline, 2018*

[http://health.gov.on.ca/en/pro/programs/publichealth/oph\\_standards/docs/protocols\\_guidelines/Relationship\\_with\\_Indigenous\\_Communities\\_Guideline\\_en.pdf](http://health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/protocols_guidelines/Relationship_with_Indigenous_Communities_Guideline_en.pdf)

*Ontario Professional Planners Institute  
Indigenous Planning Perspectives Task  
Force Report*

<https://ontarioplanners.ca/inspiring-knowledge/indigenous-perspectives-in-the-planning-profession/introduction>

*Natural Resources Canada recently  
released the Natural Resource Canada's  
Initiative for Knowledge Co-creation in  
Collaboration with indigenous Communities  
2019*

what is being said by them is incorporated into the actions that are developed and implemented in a meaningful way. The wisdom held and the inherent connection to Mother Earth that is ingrained within Indigenous knowledge will be integral to adapting to the changes ahead.

In knowing and understanding this, anyone wishing to engage with the Indigenous peoples must also know and understand that due to the diversity of the Indigenous populations that have called North America home since time immemorial, it is difficult to articulate and/or formulate specific guidelines to ensure that meaningful partnerships, dialogue and inclusion of the Indigenous people is occurring. In Canada, there are 632 First Nation Communities with Ontario being the home of 133, which is the largest population in Canada (13). Each of these Communities has their own distinct needs, priorities and ways of knowing and doing, with only approximately half living within Community. This means that those who do not reside within community have made their homes within the urban centres and other areas outside reserve lands. Metis and Inuit peoples are also not included in these numbers and also have their own needs, priorities and ways of knowing and doing (14).

Even though there are not specific guidelines to meet this need, there are some best practices and concepts that can be applied to ensure that the Indigenous voices are being sought out, listened to and incorporated meaningfully into actions being pursued.

As climate change adaptation planning as well as other health related activities are undertaken, the following list of best practices should be considered when public health professionals are pursuing the meaningful inclusion of Indigenous peoples voices.

- **TRUST** is the foundation of meaningful engagement with Indigenous peoples.
  - Trust has to be earned. It will take time, consistency, and transparency.
  - Trust is not readily given due to the history of Indigenous relations in Canada. It is next to impossible to respectfully and effectively engage with Indigenous peoples without knowledge of this history.
- **RESEARCH** is necessary to have an understanding of the Community/Organization that public health authorities want to engage.
  - Research long before engagement with a community/organization. Do your due diligence.
    - Developing a holistic understanding of the community before interaction is critical.
  - Researching the following will be a good starting place
    - History of the community/organization
    - Community/organization profiles and statistics
    - Fishing, hunting, and gathering activities
    - Environmental concerns
    - Spiritual practices

- Governance - custom, elected, or majority elected leadership
- Tribal council affiliations
- Decision making structures
- Role of hereditary leaders and Elders
- Community priorities
- Socio-economic context
- Previous/present relationships and what they look(ed) like
- **RESPECT** is vital to ensuring that **TRUST** will be earned
  - Respect the ongoing impacts of colonialism. The **Indian Act** still very much controls and constrains the lives and opportunities of Indigenous Peoples
  - Respect **cultural differences**. You are working with another culture and as such, the values of that culture need to be understood and respected.
    - Cultural Awareness or Competency training should be completed
    - Be mindful that each community/organization is unique and have their own ways of knowing and doing.
  - Respect that **your timeline is YOURS, not theirs.**
    - Do not try to engage when the community may be involved in cultural or traditional activities that may take them onto the land and away from the office.
    - Remember that Communities are very community oriented and certain events such as the passing of a community member may have impacts on scheduling and/or meetings may be cancelled last minute.
  - Respect that **what you as a public health representative and your organization value, may not have the same value** in the community/organization.
    - While your initiative may bring opportunities, they may not have the same value to a community
- **RECOGNITION** of the Rights of Indigenous peoples is legislated
  - Recognize and respect Indigenous Peoples' rights as defined in **s. 35 of the Constitution Act, 1982**
    - Indigenous peoples have had to fight very hard to have their rights recognized in the **Constitution** and upheld in the courts.
  - Recognize and respect the United Nations Declaration on the Rights of Indigenous Peoples
    - The declaration was adopted by resolution of the United Nations General Assembly on September 13, 2007 but was not indorsed by Canada until November 2010 and not fully supported until May of 2016.
- **REMEMBER** that it has been over many generations that colonialism has had an impact and that it will be over many generations for those impacts to be rectified

- Remember engagement is not *one size fits all* - each community is unique unto itself as is each organization.
- Remember prior to engaging with the Communities/organizations **you cannot predict** how the relationship will unfold or how people or initiatives will be viewed.
- Remember relationships and meaningful engagement and inclusion **can not be built with a rigid timeline nor can they be fast tracked.**
- Remember engagement should not be something done off the corner of the desk. It's a **critical component** of ensuring the meaningful inclusion of Indigenous voices and **should be afforded an appropriate budget.**
- Remember to ensure that everyone who will be engaging with Indigenous people should be **educated.**
  - Develop a training plan for staff.
    - All Staff should be trained in the History of Canada especially those interacting with Indigenous people.
    - The training may be far outside of their normal training activities but should be a necessary component for all Canadians.
- **RESPONSIBILITY** is on the Public Health Professionals to ensure that they are educated so that they can appropriately and adequately provide climate change adaptation health services to the Indigenous peoples, learn from the knowledge that Indigenous peoples possess and meaningfully implement that knowledge for the benefit of *All*.

There are some concepts that have recently emerged in the Environment field that are gaining traction from Indigenous Communities and may prove to be helpful in ensuring the meaningful inclusion of the Indigenous voices in the development of public health climate change adaptation and mitigation action. These concepts include the terms **Nothing About Us Without Us, Ethical Space, Two Eyed Seeing, Seven Grandfather Teachings, Seven Generations Thinking.**

## 5.1 Nothing About us Without Us

*Nothing about us without us* is a slogan used to communicate the idea that no policy or action should be decided by any representative without the full and direct participation of members of the group(s) affected by that policy. This involves national, ethnic, disability-based or other groups that are often thought to be marginalized from political, social, and economic opportunities (14). This term has been adopted and clearly articulated by the Indigenous leadership and people as a whole especially when it comes to health and climate change.

## 5.2 Ethical Space

The concept of *Ethical Space* defined by Elder Willie Ermine (a Cree man and an Assistant Professor with the First Nation's University of Canada)

*"is formed when two societies, with disparate worldviews, are poised to engage each other. It is the thought about diverse societies and the space in between them that contributes to the development of a framework for dialogue between human Communities. The ethical space of engagement proposes a framework as a way of examining the diversity and positioning of Indigenous peoples and Western society in the pursuit of a relevant discussion on Indigenous legal issues and particularly to the fragile intersection of Indigenous law and Canadian legal systems. Ethical standards and the emergence of new rules of engagement through recent Supreme Court rulings call for a new approach to Indigenous-Western dealings. The new partnership model of the ethical space, in a cooperative spirit between Indigenous peoples and Western institutions, will create new currents of thought that flow in different directions of legal discourse and overrun the archaic ways of interaction"(15).*

### EXAMPLES OF BEST PRACTICES



"NOTHING ABOUT US,  
WITHOUT US" FIRST NATIONS  
MUST BE FULLY INCLUDED IN  
TOMORROW'S FIRST  
MINISTERS MEETING ON  
HEALTH AND CLIMATE  
CHANGE

[http://www.chiefs-of-ontario.org/news\\_item/nothing-about-us-without-us-first-nations-must-be-fully-included-in-tomorrows-first-ministers-meeting-on-health-and-climate-change/](http://www.chiefs-of-ontario.org/news_item/nothing-about-us-without-us-first-nations-must-be-fully-included-in-tomorrows-first-ministers-meeting-on-health-and-climate-change/)



'Nothing about us, without us':  
First Nations want say in climate  
change policy

<https://globalnews.ca/news/2554145/nothing-about-us-without-us-first-nations-want-say-in-climate-change-policy/>

This term is being adopted and modified by many such as the Indigenous Circle of Experts (ICE) who are a team of multidisciplinary Indigenous experts in different fields who have come together to work collectively in protecting the environment and ensuring the inclusion of the Indigenous voice in doing so. Working with various environmental organizations and government, they have collaboratively developed the document, “We rise together - Achieving Pathway to Canada Target 1 through the creation of Indigenous Protected and Conserved Areas in the spirit and practice of reconciliation” (16). This document outlines how Canada can achieve its international commitments to conserve 17% of its freshwater and land through co-ordinated efforts as agreed to under the United Nations Convention on Biological Diversity.

### 5.3 Two Eyed Seeing

In 2004, Albert Marshall, Moose Clan of the Mi'kmaw Nation, Eskasoni in Unama'ki – Cape Breton, Nova Scotia brought the term “Two-Eyed Seeing” or “Etuaptmumk in the Mi'kmaw language, into the Integrative Science co-learning journey and has defined it as follows: “*Two-Eyed-Seeing* is learning to see from one eye with the strengths of Indigenous knowledge and ways of knowing, and from the other eye with the strengths of Western (and/or scientific) knowledge and ways of knowing while learning to use both of these eyes together for the benefit of all” (17).

This tool is being embraced by many people as well as organizations and as part of “Reconciliation” and ensuring that we are paving a path forward collectively that will ensure for all our future generations.

There are many positive and encouraging examples of this new path forward that not only creates space for the Indigenous voices and perspectives to be heard, but also understood and meaningfully included in the discussions and decisions that are being made during this time as our climate is rapidly changing. These examples need to be further explored by the public health professionals, embraced, learned from, encouraged and championed.

#### APPLICATION OF “TWO-EYED-SEEING”

*Two-Eyed Seeing in Research and its Absence in Policy: Little Saskatchewan First Nation Elders' Experiences of the 2011 Flood and Forced Displacement*

<https://ojs.lib.uwo.ca/index.php/iipj/article/view/7532>

*An Application of Two-Eyed Seeing: Indigenous Research Methods with Participatory Action Research*

<https://journals.sagepub.com/doi/full/10.1177/1609406918812346>

*Canadian Journal of Nursing Research Two-eyed seeing: a framework for understanding Indigenous and non-Indigenous approaches to Indigenous health research*

<https://cjunr.archive.mcgill.ca/article/viewFile/2348/2342>



To also aide public heath representatives to be inclusive and act in respectful ways the concepts of the “**Seven Grandfather Teachings**” as well as the “**Seven Generations**” principle can be looked upon.

## **5.4 Seven Grandfather Teachings**

To also help in this journey another simple yet complex concept that is one of the guiding principles of life for many Indigenous People are what is known as the Seven Grandfather Teachings of, Humility, Courage, Honesty, Wisdom, Truth, Respect and Love. The Seven Grandfather Teachings encompass the morals, values, structures, ceremonial practices and spiritual beliefs of the Aanishnabe people. These teachings ensured the survival of the people and reflects what we all strive for in life which is to live a good life or Mno Bmaadzawin. If you strive to live your life following these seven principles, a good life is obtainable.

**5.4.1 Humility**, is represented by the wolf. For the wolf, life is lived for his pack and the ultimate shame is to be outcast. Humility is to know that you are a sacred part of creation. Live life selflessly and not selfishly. Respect your place and carry your pride with your people and praise the accomplishments of all. Do not become arrogant and self-important. Find balance in within yourself and all living things.

**5.4.2 Courage**, is represented by the bear. The mother bear has the courage and strength to face her fears and challenges while protecting her young. The bear also shows us how to live a balanced life with rest, survival and play. To face life with bravery is to know Courage. Find your inner strength to face the difficulties of life and the courage to be yourself. Defend what you believe in and what is right for your community, family, and self. Make positive choices and have conviction in your decisions. Face your fears to allow yourself to live your life.

**5.4.3 Honesty**, is represented by the Sasquatch. He understands who he is and how to walk in his life. He reminds us to be ourselves and not someone we are not. An honest person is said to walk tall like the Sasquatch as he accepts himself and knows how to use his gift. He does not seek the power, speed or beauty of others. He uses what he has been given to survive and thrive. To walk through life with integrity is to know honesty. Be honest with yourself. Recognize and accept who you are. Accept and use the gifts you have been given. Do not seek to deceive yourself or others.

**5.4.4 Wisdom**, is represented by the beaver because he uses his natural gift wisely for his survival. The beaver also alters his environment in an environmentally friendly and sustainable way for the benefit of his family. To cherish knowledge is to know wisdom. Use your inherent gifts wisely and live your life by them. Recognize your differences and those of others in a kind and respectful way. Continuously observe the life of all things around you. Listen with clarity and a sound mind. Respect your own limitations and those of all of your surroundings. Allow yourself to learn and live by your wisdom.

**5.4.5 Truth**, represented by the Turtle as he was here during the creation of Earth and carries the teachings of life on his back. The turtle lives life in a slow and meticulous manner because he understands the importance of both the journey and the destination. Truth is to know all of these things. Apply faith and trust in your teachings. Show honor and sincerity in all that you say and do. Understand your place in this life and apply that understanding in the way that you walk. Be true to yourself and all other things.

**5.4.6 Respect**, is represented by the buffalo. The buffalo gives every part of his being to sustain the human way of living, not because he is of less value, but because he respects the balance and needs of others. To honor all creation is to have respect. Live honorably in teachings and in your actions towards all things. Do not waste and be mindful of the balance of all living things. Share and give away what you do not need. Treat others the way you would like to be treated. Do not be hurtful to yourself or others.

**5.4.7 Love**, is represented by the eagle because he has the strength to carry all the teachings. The eagle has the ability to fly highest and closest to the creator and also has the sight to see all the ways of being from great distances. The Eagle's teaching of love can be found in the core of all teachings, therefore an eagle feather is considered the highest honor and a sacred gift. To know love is to know peace. View your inner-self from the perspective of all teachings. This is to know love and to love yourself truly. Then you will be at peace with yourself, the balance of life, and all things and also with the creator.

## **5.5 Seven Generation Thinking**

We must also consider our next seven generations in our thinking. This is a concept that most find difficult to do but it is a view which the Indigenous people have and another reason they have been able to thrive and survive for millennia in a rich sustainable environment.

People often ask what does seven generations look like. It is hard for most to think that far into the future and to think in a context that takes others into consideration that far into the future. This concept though, can be easily visualized in a way that connects you to the importance of adopting this philosophy in your everyday decision-making. When you talk seven generations, one can envision that you are referring to the following:

***Your Great Grandmother,  
Your Grandmother,  
Your Mother,  
You,  
Your Child,  
Your Grandchild,  
Your Great Grandchild.***

## **6 KEY MESSAGES**

Climate change impacts are being felt all over the world and are a real and pressing issue for the health of Ontarians and Canadians, Indigenous or not. It poses significant risks to communities, the economy, and the natural environment. It has already had and will continue to have both direct and indirect impacts on the health of individuals, communities and species, with the greatest impacts being on vulnerable and marginalized populations. It has been identified that the sensitivity of the natural environment to changes in weather and climate affect the ecosystems and socioeconomic aspects of all communities but more so the Indigenous Communities because of where they live, and how they continue to rely on the environment for economic and cultural sustenance. So, when speaking of climate change and health it can no longer be ignored that the inclusion of the Indigenous voices is not only necessary but imperative due to the intimate connection that occurs between the First Peoples and Mother Earth.

Almost every aspect of Indigenous peoples' traditions, culture, language and practices stem from their natural surroundings. The environment is not only crying out for help right now but is also giving us, the people, instructions on how to respond to the current climate change crisis.

## **CASE STORY OF POSITIVE CHANGE**

*The updated Healthy Environments and Climate Change Guideline was released on March 20, 2018, and includes a new requirement for local public health agencies to undertake a climate change and health assessment. To support public health actions based on these health assessments, Simcoe Muskoka district Health Unit (SMDHU) and the Public Health Agency of Canada (PHAC) Ontario Region collaborated to complete a literature review to identify the range and characteristics of public health interventions that support climate change adaptation and address expected health impacts to support public health agencies in climate change and health adaptation strategies and actions.*

*On May 24<sup>th</sup> 2019, the project team recognized that there had been no deliberate consideration for the impacts to Indigenous peoples and communities included within the search criteria for the study. As the process was well underway, it was determined that funding would be allocated to this oversight and Cambium Aboriginal Inc. would be contracted to work alongside the PHAC and SMDHU team to develop a document that would be an essential module within the project and bring to light some of the best practises that other health partners could engage in to ensure respectful inclusion of indigenous voices not only in planning and implementing work on climate change adaptation but in engaging and working collaboratively with Indigenous Communities in general.*

The Indigenous peoples have been gifted with the knowledge and tools to learn from those who make their home within the natural surroundings. This gift was given by the *Creator* so that we, the people, understood how to survive and flourish in a sustainable way and maintain balance within the ecosystem (*Never take the first, never take the last and always only take what is needed*). This includes being able to identify specific species to aid and cure sickness and observing nature to be proactive in preparing for environmental changes. Along with this gift the Indigenous peoples were also given the responsibility to teach and ensure other humans understood and adopted this concept.

Many organizations, including the federal and provincial governments, as well as local public health authorities, have recognized the value of the knowledge that Indigenous peoples hold especially when it comes to climate change adaptation. The importance of not only creating opportunities for their voices to be heard but ensuring their knowledge is being rooted into the conversations that precede the development of policies and legislation and ensuring the meaningful inclusion of this wisdom is embedded in the plans for the future cannot be stressed enough.

As part of this journey of understanding Indigenous peoples and including them in the discussions and planning about our collective future, it is important to understand the need for healing from events that have taken place in the past such as the “Residential Schools”. In today's world, many have not been educated or informed of much or any of the *True* history of Canada and in a time of “Reconciliation” and a “Changing Climate” you cannot prepare for a changing climate without reconciling with the *First Peoples* of this land and the land itself.

**Defined by the TRC, “Reconciliation” means the following:**

***“Reconciliation is about establishing and maintaining a mutually respectful relationship between Aboriginal and non-Aboriginal peoples in this country. In order for that to happen, there has to be awareness of the past, acknowledgement of the harm that has been inflicted, atonement for the causes, and action to change behaviour.”(18)***

You must also know and understand that due to the diversity of the Indigenous populations that have called North America home since time immemorial, it is difficult to articulate and/or formulate specific guidelines to ensure that meaningful partnerships, dialogue and inclusion of the Indigenous people is occurring and there are some basic principals that can be used for guidance.

- **TRUST** is the foundation of meaningful engagement with Indigenous peoples
- **RESEARCH** is necessary in order to have a better understanding of the Community/Organization that you want to engage
- **RESPECT** is vital to ensuring that **TRUST** will be earned
- **RECOGNITION** of the Rights of Indigenous peoples is legislated

- **REMEMBER** that it has been over many generations that colonialism has had an impact and that it will be over many generations for those impacts to be rectified
- **RESPONSIBILITY** is on the public health practitioners to ensure that they are educated so that they can appropriately and adequately provide climate change adaptation health services to the Indigenous peoples, learn from the knowledge that Indigenous peoples possess and meaningfully implement that knowledge

Although there have been many disheartening events in the past that have tarnished the relationship of Indigenous peoples and society, there are many positive initiatives and projects that are taking place. These initiatives are supporting and encouraging the recognition of past events as well as the meaningful inclusion of Indigenous perspectives and voices. This undertaking is one such initiative that will lead to planning measures that will be beneficial to us *All* as we begin to work together in the face of a changing climate.

## Appendices

### Appendix A - Climate Change Health Adaptation Program Ontario Funded Projects

#### **Fort William First Nation (2019-2020)**

**Year(s) Funded:** 2019-2020

**Topic Area:** Adaptation Planning

**Title:** Climate Change & Health Adaptation in Fort William First Nation: Planning for the Future, Today

**Project Objectives:**

- Have a framework for the project based on the medicine wheel.
- Educate and inform community members about climate change in general, the links between climate change and health, and adaptation.
- Share findings with the Thunder Bay District Health Unit to inform their *Climate Change and Health Vulnerability and Adaptation Assessment* process and outcome.
- Share findings with community members with an easy to understand report.
- Building capacity for climate change and health adaptation in Fort William First Nation (FWFN).
- Foster intergenerational knowledge sharing and relationship building between FWFN Elders and youth.
- Build respectful relationships between Lakehead University climate change scholars, FWFN Members, and Thunder Bay District Health Unit Staff.
- Share knowledge and experiences related to climate change and health adaptation planning with other FN Communities in the Lake Superior watershed.

**Activities:**

- Hire two Indigenous youth (one Lakehead student and one high school student) and train them as part of this project. Project partners will train the youth in qualitative research data collection and climate change impact and adaptation science.
- Conduct three workshops, all workshops will be interactive, conducted in ways that respect traditional knowledge and align with cultural values and practice:
  - The first workshop will provide basic information on climate change and the impacts of climate change on food and water resources, and wildlife in the traditional territory of FWFN.
  - The second workshop will focus on the links between climate change and health specifically.

### **Pays Plat First Nation (2019-2020)**

**Year(s) Funded:** 2019-2020

**Topic Area:** Adaptation Planning

**Title:** Pays Plat First Nation – Preparing Today for Our Health Tomorrow

**Project objectives:**

- Continue and complete previous phases of Pays Plat's Climate Change and Health Adaptation Program (CCHAP).
- Build on achieved successes and allow for forward movement into the next stage by creating and implementing an adaptation plan with focus on both short- and long-term objectives.
- Advocate and raise awareness to the potential threats of climate change for the health and well-being to the community of Pays Plat First Nation (PPFN).

**Activities:**

- Hold workshops with guest speakers. Potential speakers include a climate change specialist, a water scientist, and a specialist in creating adaptation plans.
- Conduct interviews with Elders, Hunters and Medicine Gatherers. The information obtained from Elders, Hunters and Medicine Gatherers will continue to be added to a database.
- Conduct the watershed evaluation. To perform this component of the project, field work investigations consisting of water and sediment will be continued, building upon the data collected from the past phases of the project.
- Information will be gathered and then create an in-depth report on our findings. Climate change and health booklets will be generated for each community member as well as on-going newsletters and pamphlets regarding updates and new findings.
- Create a draft of climate change adaptation plan. Gather an adequate amount of data to be able to accurately assess the potential threats to the health and well-being of the community.

### **Fort Albany First Nation (2019-2020)**

**Year(s) Funded:** 2019-2020

**Topic Area:** Food Security

**Title:** Climate Change and Food Security in Subarctic Canada: Adaptation through the Harmonization of Indigenous Harvesting Pursuits and Agroforestry Activities to Form a Sustainable Import-substitution Strategy (Year 2)

**Project objectives:**

- To diversify the traditional harvest to include the harvest of fish, and overabundant geese.
- To increase the number and size of agroforestry plots.
- To further transition from the university-led partnership to a Fort Albany First Nation-led partnership.
- To increase community, regional, and national awareness to the challenges and opportunities associated with climate change and food security.
- To use both Indigenous knowledge and western science constructs to end food insecurity in Fort Albany through the harmonization of traditional harvesting and agroforestry gardening activities, to form a sustainable import-substitution strategy.
- To further refine the Sharing-the-Harvest protocol (i.e., a best practice framework) with respect to climate change adaptation and subarctic food security.

**Activities**

- Harvest overabundant lesser snow geese, giant Canada geese and fish, and share these traditional foods with community.
- Composting: Animal by-products produced during the above described harvesting will be put into an Actium composter with other locally-sourced material (e.g. sawdust, dried grasses and leaves or other high C substrates). Composting animal by-products will be managed following established procedures. Compost will be sieved to remove non-decomposed material; sieved composts will be stored until applied to agroforestry gardens.
- Enhance perennials in agroforestry sites by planting new perennials and evaluating already planted perennials from last year. The agroforestry component will continue to incorporate annual vegetables, and will be enhanced with the use of perennials. A perennial, asparagus (*Asparagus officinalis*), was planted three years ago in Fort Albany, and since it takes 2-3 years to yield “asparagus”, the team will evaluate the viability of this easy-to-maintain vegetable crop during the tenure of the proposed project. In addition, the team proposes to add more fruits (berries) to the agroforestry community and home gardens.
- Expanding (scaling up) the number and/or size of agroforestry sites to therefore increase produce yield.

**Moose Factory/Mocreebec Eeyoud (2019-2020)**

**Year(s) Funded:** 2019-2020

**Topic Area:** Food Security



**Title:** The Living, Learning Leading Garden Project

**Project Objectives:**

- Bolster community confidence.
- To adapt our activities to the first year's lessons learnt about our climate and health needs.
- To generate a second year of climate data (knowledge).
- To build increased capacity for large-scale and high-quality production under a multi-year plan that is based on adaptation and lessons learnt.
- The four objectives have been set based on the lessons learnt and hard work undertaken in 2018.

**Activities:**

- Hire and build capacity of two (2) local staff: Agri-Food, Health & Climate Advisors – one (1) full-time for six months (Senior) and one (1) full-time for four months (Assistant).
- Collect a second year of baseline climate data in order to compare and contrast with 2018.
- Complete the building of a second greenhouse structure within the grounds of the Cree Village Ecolodge in order to expand the capacity to grow produce requiring more than 90 days to grow.
- Use existing greenhouse (built in 2018) to get an advance start on specific plants prior to transplanting into regular plots on the grounds of the Cree Village Ecolodge (season expansion).
- Expand on the growing capacity of perennial and traditional plants: i.e. raspberries, strawberries, rhubarb, Haskap berries, Saskatoon berries, blueberries, and sweet grass.
- Implement techniques and use of materials to reduce work load during growing season and to enhance the growing conditions for ground-level gardens, e.g. garden mats.
- Hire two (2) youth summer workers (using Ontario grant funding) with the objective of sowing seeds (knowledge) in climate, health and agri-food related issues among the next generation.
- Work with individuals in the community and continue to support household gardeners through workshops, regular information sessions, and timely advise on how to address challenges.
- Produce sufficient quantities of a select 25 plants (highest health/output value) to make the case for large-scale gardening as an economically sustainable option, despite climate challenges.

- Finish remaining work on the roof of the garden shed, including adding waterproof measures and tiles. The shed will be used to store garden tools and supplies and may be used as workspace during wet forecast.
- Finish building a cold storage room in the basement of the Ecolodge, the room will be an 8' x 8' sealed off room for storage.
- Purchase another greenhouse to be assembled next year.
- Pre-order seeds and other supplies for next year's growing season.
- Advanced purchasing of chest freezers for preservation of produce from gardens.

### **Red Rock Indian Band**

**Year(s) Funded:** 2019-2020

**Topic Area:** Food Security

**Title:** Adapting to Climate Change: The Old Meets the New Ways

**Project Objective:** The purpose of the project is to conduct community-based research related to food security and health adaptation to Climate Change effects. The Project will integrate local Traditional Knowledge and contemporary knowledge that will allow the community to access healthy foods in times of limited access due to climate change effects.

#### **Activities:**

- Collect traditional knowledge from Elders.
- Share information surrounding health effects of our reliance on fast food or grocery stores versus growing their own foods, harvesting animals, and traditional uses of the water.
- Research possible weatherized greenhouses.
- Teach traditional methods of food harvesting, preparation, and storage.

### **Atikameksheng Anishnawbek First Nation (2019-2020)**

**Year(s) Funded:** 2019-2020

**Topic Area:** Food Security/Environmental Changes to Moose

**Title:** A Preliminary Investigation of Moose Populations at Atikameksheng Anishnawbek through the Combination of Traditional Ecological Knowledge and Western Science

**Project Objective:** The purpose of the project is to gather baseline data on Moose populations (and other large mammal population), to ensure that the community remains vigilant in monitoring potential threats for this, and other iconic species. Conduct tests and compare multiple methods for surveying Moose populations to inform best practices/management strategies to effectively manage natural resources. The project will monitor Moose (and other species indirectly) through a combination of Traditional Ecological Knowledge and Western

Science, which in unison will enhance community understanding of Moose population demographics.

**Activities:**

- Conduct Values Mapping and Oral History Interviews. This activity will help community gain an understanding of large mammal, focusing on Moose, population dynamics over time. A lot of knowledge is passed through stories, thus recording these stories will provide an extensive dataset for population biology.
- Host interactive group mapping sessions with Elders, and interactive group mapping sessions with all community members. By having a map present, the project will be able to actively engage Elders in seeing the landscape. This method will be part of the integration of Indigenous Traditional Knowledge (ITK) in determining Moose population densities along with population dynamics. We respect the privilege to only publish what our Elders feel comfortable sharing.
- Western Science studies will be conducted through pellet group counts, a camera trap study, and snow tracking. **Pellet group counts** are a known method for estimating mammal density. Previous researchers have used this method to identify both Moose and White-tailed deer densities. We will use randomized plot designs, as is the norm in the literature, to conduct this study. **Camera trap** will allow us to identify different densities of large mammals observed, and will also aid in determining seasonal and temporal behavioral patterns given each picture will be stamped with the date and time taken. This method will also allow us to see possible hair loss from Winter Tick on Moose. Pictures will be shared with community and showcase the diverse wildlife within community. **Snow tracking** through quadrat surveys in the winter after fresh snowfall will help to better understand movement patterns and presence/absence of large mammals. This method will encourage volunteers to better understand the winter ecology of large mammals.

**Chippewas of Georgina Island First Nation (2019-2020)**

**Year(s) Funded:** 2019-2020

**Topic Area:** Vector Borne Diseases

**Title:** Addressing Health Impacts and Vulnerabilities within Chippewas of Georgina Island First Nation: Vector-borne Diseases in a Warming Climate

**Project Objectives:**

- Assist the Georgina Island First Nation community in enhancing the climate change adaptation work they have already undertaken.
- To retain skilled and trained members of the climate change adaptation team to continue to build capacity on climate change within the community.

- Further develop the community's understanding of vector borne diseases, their relation to climate change and the threats posed to community members, while ensuring they remain informed with current information.
- Continue to identify and raise awareness, re-learn, teach and continue the cultural and Traditional practices that are held within the community to deter vectors.
- Enable the program to be self-sustaining through economic development initiatives which would include a business aspect and partnership with elementary students.
- Create methodology and lessons learned document to share information and knowledge gathered with other Communities and organizations to assist and inform plans for the benefit of future generations.

#### **Activities:**

- Conduct research and gather additional information on Health Vulnerability and associated impacts. To stay current on recent activity and developments in vector-borne disease migration by going through internet and literature reviews.
- Hold events and workshops to be pro-active in preventing infection derived from traditional cultural practices, with environmental and community benefits.
- Continue to collect and review existing TEK in the community will aid in identifying any gaps that may exist and ensure that rediscovered traditional practices are incorporated into adaptation planning. Elders will be a focus for gathering new traditional uses, practices and stories.
- Learning opportunity for members of the project team to work with the students and staff from Waabgon Gaamig to identify a location for the greenhouse, purchase the greenhouse and contract out to have the greenhouse constructed.
- Use of Traditional Knowledge collected through the TEK surveys and literature reviews done to date, seeds of native plant species that have been identified to be natural repellents will be sourced out and planted in the greenhouse for the students to nurture and grow.
- Hold planting events of seeds of native plant species will occur in public places such as our Nanbush Trails and or Community Tree Park. The community will have a minimum of two planting events in the fall of 2019.
- Hold two events/workshops for the community to raise awareness of the project, health risks, and adaptation plans/precautions.

A full list of Ontario funded projects and details can be found on the Climate Telling website at <http://www.climatetelling.info/>

## Appendix B - Truth and Reconciliation Calls to Action and The United Nations Declaration on the Rights of Indigenous Peoples

*“The The Truth and Reconciliation Commission of Canada believes that in order for Canada to flourish in the twenty-first century, reconciliation between Aboriginal and non-Aboriginal Canada must be based on the following principles.”*

*The United Nations Declaration on the Rights of Indigenous Peoples is the framework for reconciliation at all levels and across all sectors of Canadian society.*

*First Nations, Inuit, and Métis peoples, as the original peoples of this country and as self-determining peoples, have Treaty, constitutional, and human rights that must be recognized and respected.*

*Reconciliation is a process of healing of relationships that requires public truth sharing, apology, and commemoration that acknowledge and redress past harms.*

*Reconciliation requires constructive action on addressing the ongoing legacies of colonialism that have had destructive impacts on Aboriginal peoples’ education, cultures and languages, health, child welfare, the administration of justice, and economic opportunities and prosperity.*

*Reconciliation must create a more equitable and inclusive society by closing the gaps in social, health, and economic outcomes that exist between Aboriginal and nonAboriginal Canadians.*

*All Canadians, as Treaty peoples, share responsibility for establishing and maintaining mutually respectful relationships.*

*The perspectives and understandings of Aboriginal Elders and Traditional Knowledge Keepers of the ethics, concepts, and practices of reconciliation are vital to long-term reconciliation.*

*Supporting Aboriginal peoples’ cultural revitalization and integrating Indigenous knowledge systems, oral histories, laws, protocols, and connections to the land into the reconciliation process are essential.*

*Reconciliation requires political will, joint leadership, trust building, accountability, and transparency, as well as a substantial investment of resources.*

*Reconciliation requires sustained public education and dialogue, including youth engagement, about the history and legacy of residential schools, Treaties, and Aboriginal rights, as well as the historical and contemporary contributions of Aboriginal peoples to Canadian society.*

**Defined by the TRC, “Reconciliation” means the following:**

***“Reconciliation is about establishing and maintaining a mutually respectful relationship between Aboriginal and non-Aboriginal peoples in this country. In order for that to happen, there has to be***

*awareness of the past, acknowledgement of the harm that has been inflicted, atonement for the causes, and action to change behaviour.”*

***“In order to redress the legacy of residential schools and advance the process of Canadian reconciliation, the Truth and Reconciliation Commission makes the following calls to action).”***

### **Health Calls to Action**

18. We call upon the federal, provincial, territorial, and Aboriginal governments to acknowledge that the current state of Aboriginal health in Canada is a direct result of previous Canadian government policies, including residential schools, and to recognize and implement the health-care rights of Aboriginal people as identified in international law, constitutional law, and under the Treaties.

19. We call upon the federal government, in consultation with Aboriginal peoples, to establish measurable goals to identify and close the gaps in health outcomes between Aboriginal and non-Aboriginal Communities, and to publish annual progress reports and assess long-term trends. Such efforts would focus on indicators such as: infant mortality, maternal health, suicide, mental health, addictions, life expectancy, birth rates, infant and child health issues, chronic diseases, illness and injury incidence, and the availability of appropriate health services.

20. In order to address the jurisdictional disputes concerning Aboriginal people who do not reside on reserves, we call upon the federal government to recognize, respect, and address the distinct health needs of the Métis, Inuit, and off-reserve Aboriginal peoples.

21. We call upon the federal government to provide sustainable funding for existing and new Aboriginal healing centers to address the physical, mental, emotional, and spiritual harms caused by residential schools, and to ensure that the funding of healing centres in Nunavut and the Northwest Territories is a priority.

22. We call upon those who can effect change within the Canadian health-care system to recognize the value of Aboriginal healing practices and use them in the treatment of Aboriginal patients in collaboration with Aboriginal healers and Elders where requested by Aboriginal patients.

23. We call upon all levels of government to:

- i. Increase the number of Aboriginal professionals working in the health-care field.
- ii. Ensure the retention of Aboriginal health-care providers in Aboriginal Communities.
- iii. Provide cultural competency training for all healthcare professionals.

24. We call upon medical and nursing schools in Canada to require all students to take a course dealing with Aboriginal health issues, including the history and legacy of residential schools, the United Nations Declaration on the Rights of Indigenous Peoples, Treaties and Aboriginal rights, and Indigenous teachings and practices. This will require skills-based training in intercultural competency, conflict resolution, human rights, and anti-racism.

### **Settlement Agreement Parties and the United Nations Declaration on the Rights of Indigenous Peoples**

48. We call upon the church parties to the Settlement Agreement, and all other faith groups and interfaith social justice groups in Canada who have not already done so, to formally adopt and comply with the principles, norms, and standards of the United Nations Declaration on the Rights of Indigenous Peoples as a framework for reconciliation. This would include, but not be limited to, the following commitments:

- i. Ensuring that their institutions, policies, programs, and practices comply with the United Nations Declaration on the Rights of Indigenous Peoples.
- ii. Respecting Indigenous peoples' right to self-determination in spiritual matters, including the right to practice, develop, and teach their own spiritual and religious traditions, customs, and ceremonies, consistent with Article 12:1 of the United Nations Declaration on the Rights of Indigenous Peoples.
- iii. Engaging in ongoing public dialogue and actions to support the United Nations Declaration on the Rights of Indigenous Peoples.
- iv. Issuing a statement no later than March 31, 2016, from all religious denominations and faith groups, as to how they will implement the United Nations Declaration on the Rights of Indigenous Peoples.

49. We call upon all religious denominations and faith groups who have not already done so to repudiate concepts used to justify European sovereignty over Indigenous lands and peoples, such as the Doctrine of Discovery and terra nullius.

### **Professional Development and Training for Public Servants**

57. We call upon federal, provincial, territorial, and municipal governments to provide education to public servants on the history of Aboriginal peoples, including the history and legacy of residential schools, the United Nations Declaration on the Rights of Indigenous Peoples, Treaties and Aboriginal rights, Indigenous law, and Aboriginal–Crown relations. This will require skills-based training in intercultural competency, conflict resolution, human rights, and anti-racism.

## References

1. Ontario Environment and Energy. Climate change strategy [Internet]. Online Government of Ontario; 2019. Available from <https://www.ontario.ca/page/climate-change-strategy>
2. Ontario Ministry of Finance. 2016 CENSUS HIGHLIGHTS: Factsheet 10 [Internet]. Online Government of Ontario; 2016. Available from: <https://www.fin.gov.on.ca/en/economy/demographics/census/cenhi16-10.html>
3. Justice Laws Website. Indian Act - R.S.C., 1985, c. I-5 [Internet]. Online Government of Canada; 2019. Available from: <https://laws-lois.justice.gc.ca/en/g/acts/l-5/20190815/P1TT3xt3.html>
4. Christina Aboriginal Infrastructure Developments. Indian Health Policy 1979 from Health Canada [Internet]. Online Christian Aboriginal Infrastructure Developments; Available from: <http://caid.ca/IndHeaPol1979.pdf>
5. CBC News Indigenous. Edith Anderson Monture: The 1<sup>st</sup> First Nations registered nurse in Canada [Internet]. Online Canadian Broadcasting Corporation; 2019. Available from <https://www.cbc.ca/news/indigenous/edith-anderson-monture-indigenous-nurses-day-1.5126441>
6. AFN Social Development. Our Portfolio: Jordan's Principle [Internet]. Online Assembly of First Nations. Available from <https://www.afn.ca/policy-sectors/social-secretariat/jordans-principle/>
7. Northern College cultural Information. Clans [Internet]. Online Northern College. Available from <http://www.northernnc.on.ca/indigenous/clans/>
8. Wellness and First Nations Health Authority. Wellness Stream [Internet]. Online First Nations Health Authority. Available online <https://www.fnha.ca/wellness/wellness-and-the-first-nations-health-authority/wellness-streams>
9. Toronto Zoo Turtle Island Conservation. The Ways of Knowing Guide [Internet]. Online Toronto Metro Zoo. Available from [https://www.torontozoo.com/pdfs/tic/Stewardship\\_Guide.pdf](https://www.torontozoo.com/pdfs/tic/Stewardship_Guide.pdf)
10. Climate Change Projects. Projects by region [Internet]. Online Climate Telling; 2020. Available from <http://www.climate-telling.info/projects-by-region-map.html>
11. CRTI Free Resource Blog. Integrational Trauma, Healing, and Resiliency [Internet]. Online Crisis & Trauma Resource Institute. Available from <https://ca.ctrinstitute.com/blog/intergenerational-trauma/#:~:text=%E2%80%9CUntreated%20trauma%2Drelated%20stress%20experienced,to%20second%20and%20subsequent%20generations.&text=Intergenerational%20trauma%20is%20usually%20seen,experience%20trauma%20in%20some%20form%E2%80%A6>



12. National Centre for Truth and Reconciliation. About [Internet]. Online University of Manitoba. Available from <https://nctr.ca/about-new.php>
13. Wikipedia the free encyclopedia. Nothing About Us Without Us. Wikipedia; 2020. Available from [https://en.wikipedia.org/wiki/Nothing\\_About\\_Us\\_Without\\_Us](https://en.wikipedia.org/wiki/Nothing_About_Us_Without_Us)
14. University of Toronto Library. The Ethical Space of Engagement. Online University of Toronto; 2007. Available from <https://jps.library.utoronto.ca/index.php/ilj/article/view/27669/20400>
15. ICE Report and Recommendations. We Rise Together-Achieving Pathway to Canada Target 1 through the creation of Indigenous Protected and Conserved Areas in the spirit and practice of reconciliation [Print and Internet]. Online Indigenous Circle of Experts; 2018. Available from [https://static1.squarespace.com/static/57e007452e69cf9a7af0a033/t/5ab94aca6d2a7338ecb1d05e/1522092766605/PA234-ICE\\_Report\\_2018\\_Mar\\_22\\_web.pdf](https://static1.squarespace.com/static/57e007452e69cf9a7af0a033/t/5ab94aca6d2a7338ecb1d05e/1522092766605/PA234-ICE_Report_2018_Mar_22_web.pdf)
16. Two Eyed Seeing - an overview of Guiding principle plus some integrative science. Online Institute for Integrative Science and Health; 2017. Available from [http://www.integrativescience.ca/uploads/files/TwoEyedSeeing\\_ECC%20Canada\\_2017.pdf](http://www.integrativescience.ca/uploads/files/TwoEyedSeeing_ECC%20Canada_2017.pdf)
17. Truth and Reconciliation Commission of Canada. National Centre for Truth and Reconciliation - University of Manitoba. Available from <http://www.trc.ca/>
18. Ontario Native Literacy Coalition Resources. Teachings of the Seven Sacred/Seven Grandfathers Student Manual. Online Ontario Native Literacy Coalition; 2010. Available from <http://onlc.ca/wp-content/uploads/2014/06/7-Grandfathers-Student-Manual1.pdf>