CLIMATE CHANGE ADAPTATION IN CONSERVATION HALTON

A WATERSHED APPROACH TO IMPROVING CLIMATE RESILIENCY

LATORNELL SYMPOSIUM
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Conservation Halton

PRESENTERS

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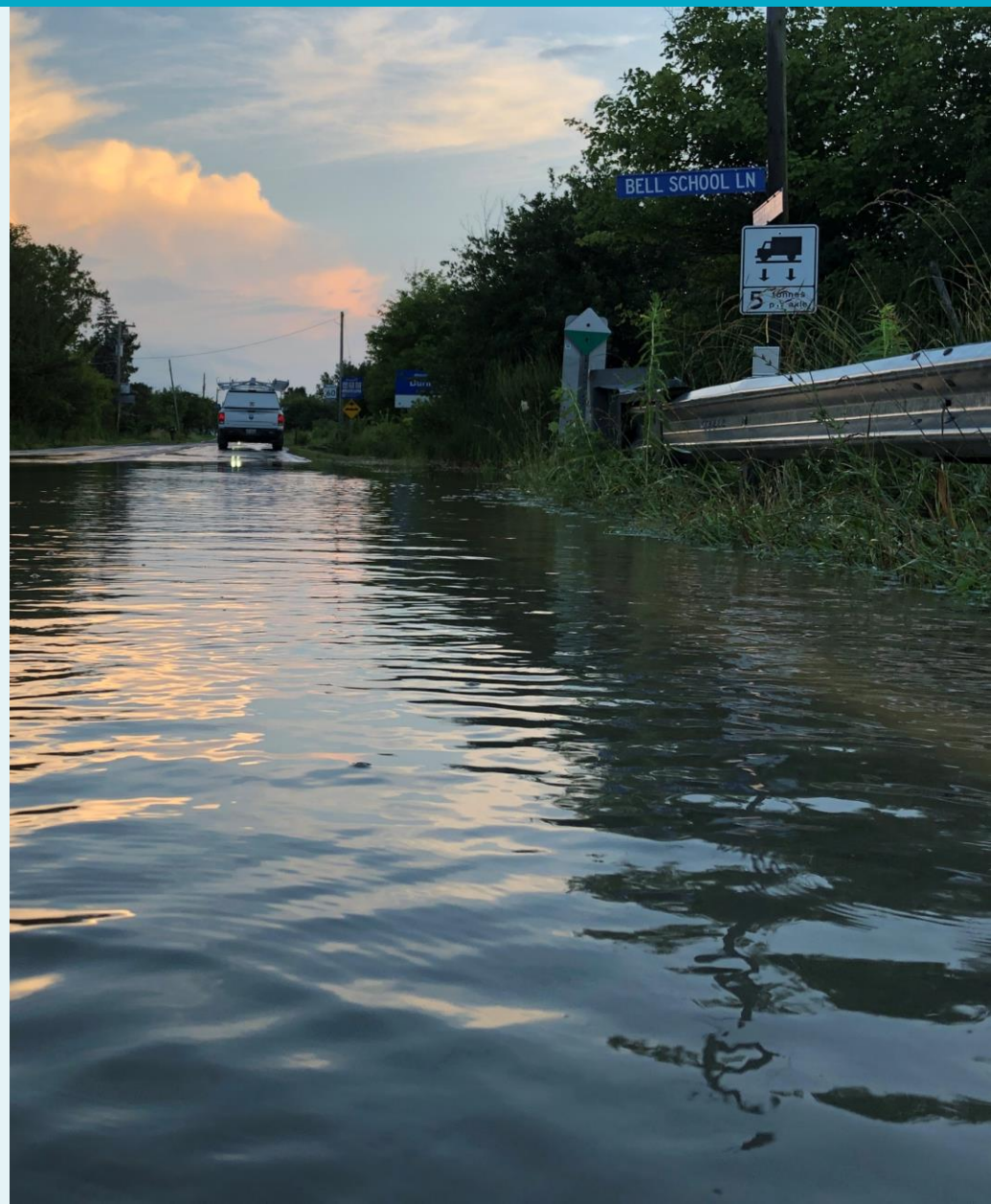
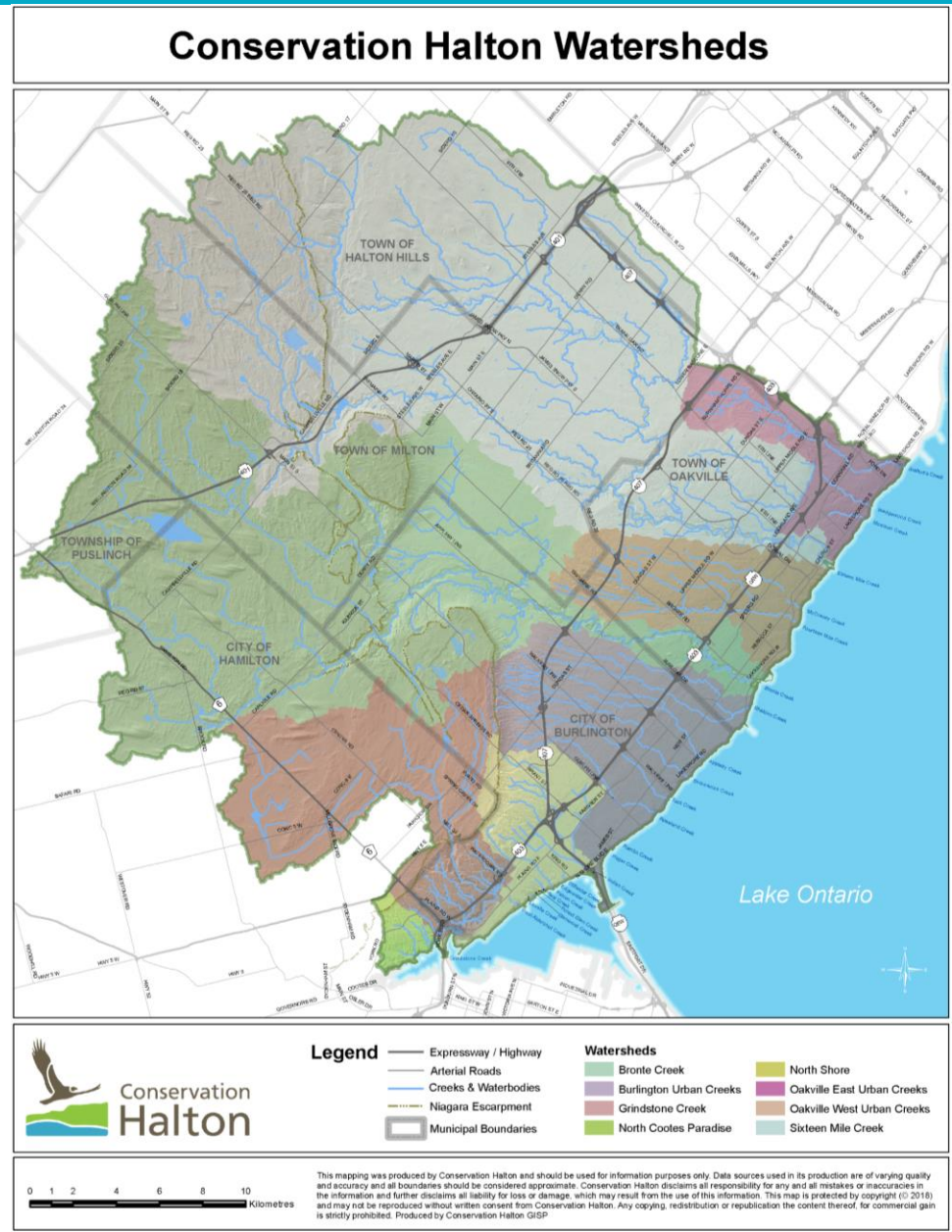
INTRODUCTION

- Climate change is resulting in warmer, wetter, & wilder weather
- CH undertook a Watershed Climate Change Vulnerability & Risk Assessment (Assessment) & Climate Resiliency Plan (Plan)
- Presentation:
  - Provides insights into how the changing weather is affecting natural resources in CH
  - Outlines actions to address impacts & risks to improve adaptive capacity & resiliency



ABOUT CONSERVATION HALTON

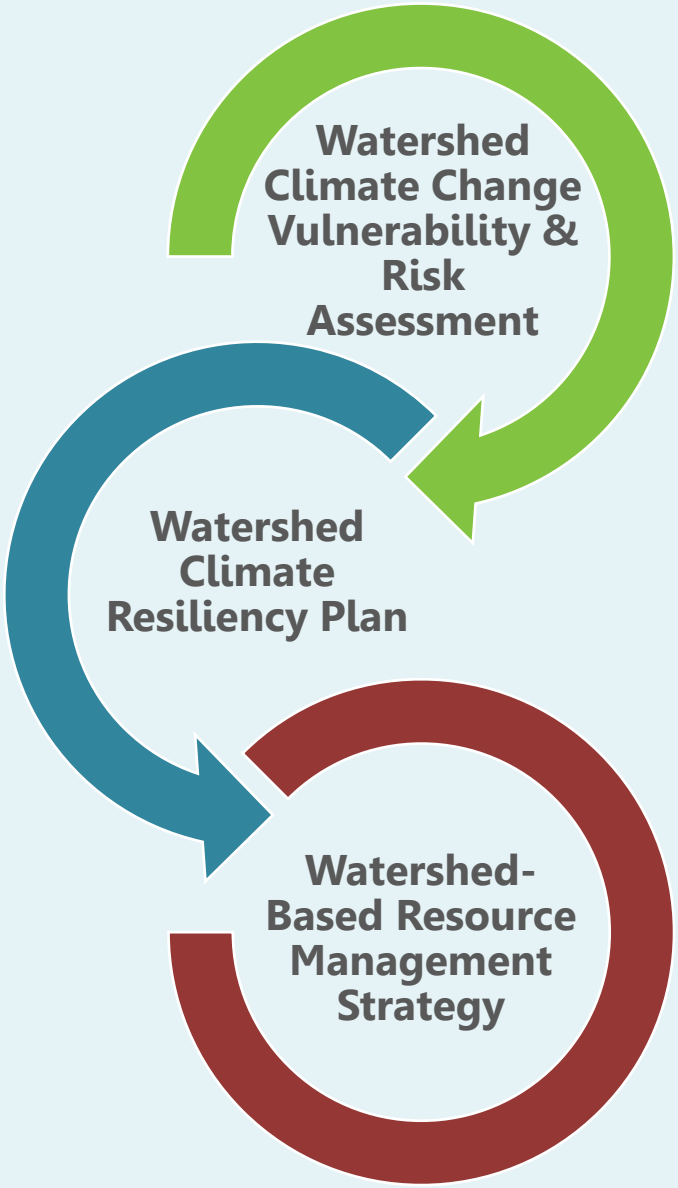
- Established in 1963
- More than 1000 square kilometres bisected by the Niagara Escarpment
- 51 km of Hamilton Harbour & L. Ontario shoreline
- Grindstone, Bronte, & Sixteen Mile Creek watersheds, plus 18 smaller urban watersheds
- Lies within the Greater Golden Horseshoe



ABOUT CONSERVATION HALTON

- CH delivers an array of programs and services that:
  - Monitor environmental conditions, trends & risks
  - Protect communities from natural hazards
  - Manage & restore natural resources & biodiversity
- Assessment & Plan use science to assess conditions, trends, & risks to inform CH's decisions:
  - Manage natural hazards & natural resources
  - Protect & strengthen ecosystem integrity

PROCESS & FLOW OF INFORMATION



CLIMATE RESILIENCY PLAN - PURPOSE

- Improve adaptive capacity & resiliency of key natural resources by evaluating CH's programs & services:
  - Identify gaps, opportunities, & actions to better support climate change adaptation
- Enables CH to:
  - Assess key natural resource issues & natural hazards risks using a climate lens
  - Manage risks associated with natural resource issues & natural hazards

PLAN APPROACH

- Consider watershed characteristics, water cycle, impact of human activities, interconnectedness of watershed
- Focus on climate change adaptation
- Decisions based on best available climate & weather science
- Appropriate risk management tools & techniques
- Natural resource-based solutions are effective & often lower cost alternative for adapting to climate change
- Monitoring & adjusting programs & services is essential
- Stakeholders share climate change action

- Plan development first step: completion of the Assessment

Fabio Tonto, P.Eng., MEPP
Technical Lead, Climate Risk

Matrix Solutions Inc., a Montrose Environmental Company

Matrix Solutions joined Montrose Environmental Group through acquisition in June 2023

Montrose At A Glance

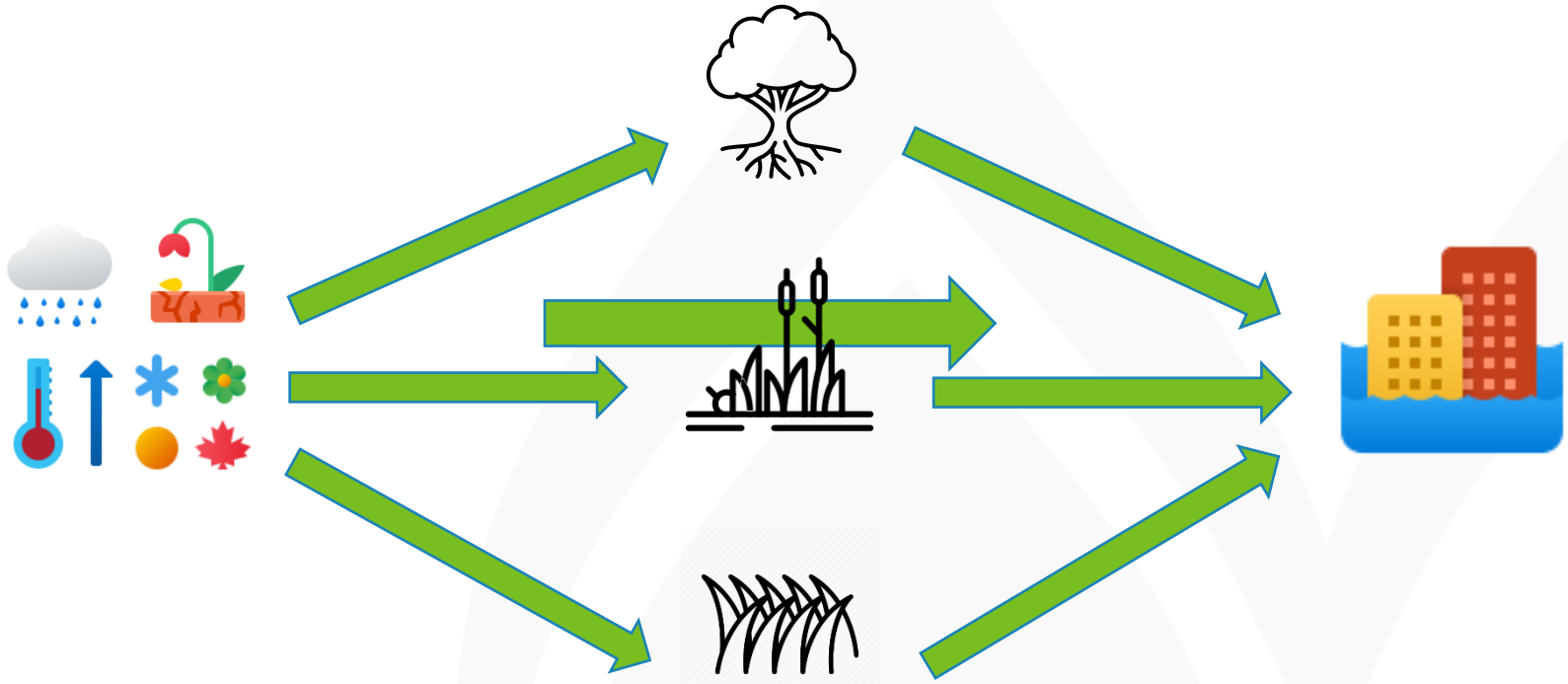
Montrose provides strategic, integrated solutions that guide organizations through environmental challenges, ultimately delivering business value and positively impacting our planet and society.

We implement environmental solutions that scale.

- ~3,200 employees
- ~100 locations worldwide
- ~5,600 clients from the private and public sectors
- 6 patents issued in 2022, for a total of 18 patents

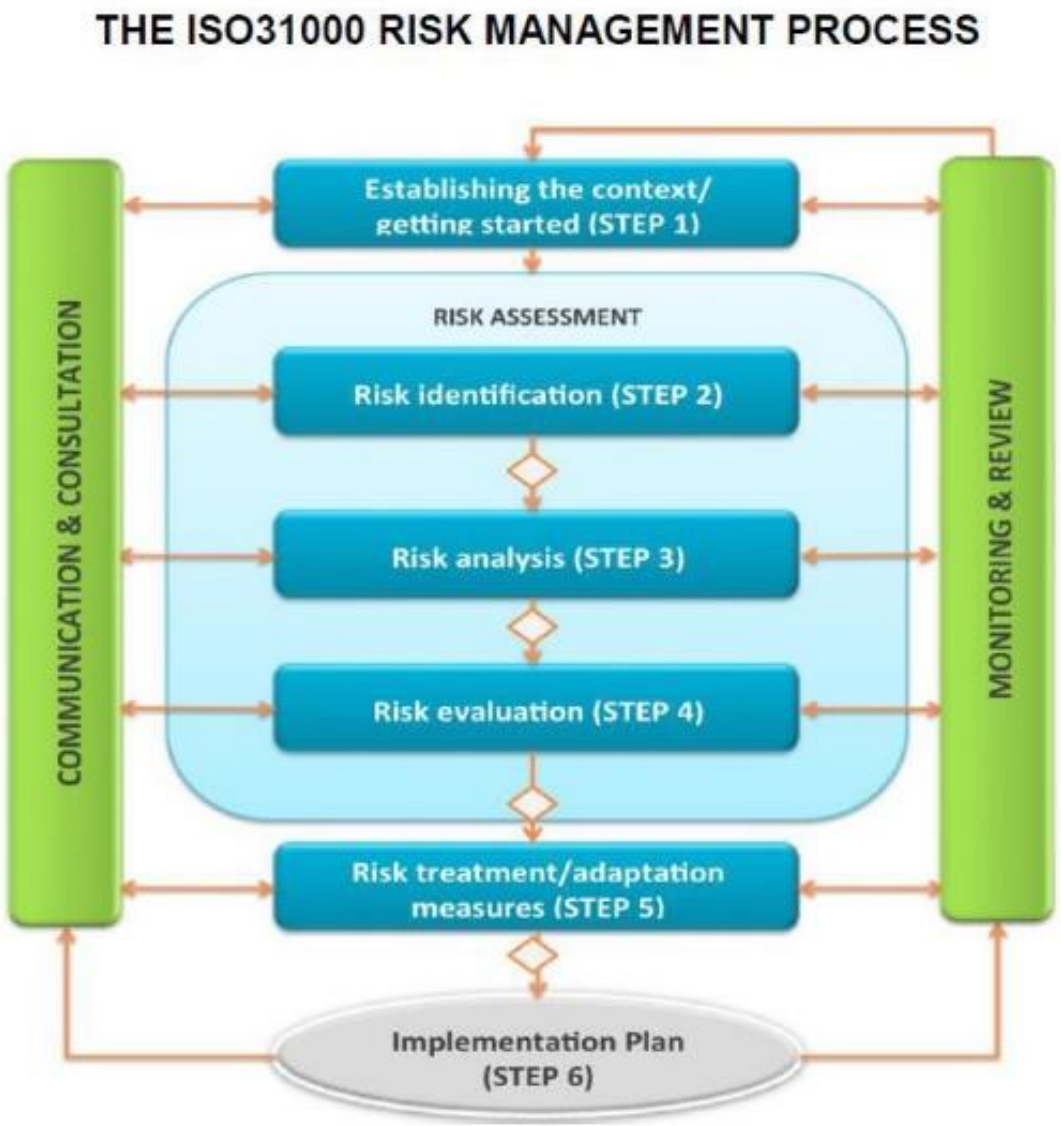
MONTROSE ENVIRONMENTAL

Assessing Risk on Natural Resources…
How does it work?



Evaluate through the lens of natural resources

Framework: ISO31000 Risk Management



Risk Assessment Process

Natural Resource	Climate Hazard						
	Lake Levels	High Precipitation	Low Precipitation	High Temperature	Low Temperature	Seasonal Changes	Winds
Stream	x	x	x	x	x	x	
Pond/Lake		x	x	x		x	x
Lakeshore	x	x		x	x	x	x
Groundwater		x	x	x	x	x	x
Wetland - Swamp		x	x	x	x	x	x
Wetland - Marsh	x	x	x	x	x	x	x
Forest		x	x	x	x	x	x
Meadow		x	x	x	x	x	x
Special Features		x	x	x	x	x	x

Interactions

	None (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Human Health and Property	Unlikely to result in injuries, illness, fatalities, and mental and emotional distress.	Minor injuries or illness. Short-term mental or emotional distress.	Minor injuries or illness. Short-term mental or emotional distress.	Severe injuries, illness, or fatalities. Long-term mental or emotional distress.	Mass severe injuries, illness, and multiple fatalities. Mass long-term mental or emotional distress.

Consequences

PIEVC HLSG Probability Scoring			
Likelihood	Middle Baseline Approach	Method	Suggested Rational
1	Establish Current Climate Baseline Per Parameter	Likely to occur less frequently than current climate	50% to 100% reduction in frequency or intensity with reference to baseline mean
2			10% to 50% reduction in frequency or intensity with reference to baseline mean
3		Likely to occur as frequently as current climate	Baseline mean conditions or a change in frequency or intensity of ±10% with reference to the baseline mean
4			10% to 50% increase in frequency or intensity with reference to baseline mean
5		Likely to occur more frequently than current climate	50% to 100% increase in frequency or intensity with reference to baseline mean

Likelihood

Risk

LIKELIHOOD						
5	5	10	15	20	25	
4	4	8	12	16	20	
3	3	6	9	12	15	
2	2	4	6	8	10	
1	1	2	3	4	5	
	1	2	3	4	5	
	CONSEQUENCES					

Natural Resources and Climate Hazards

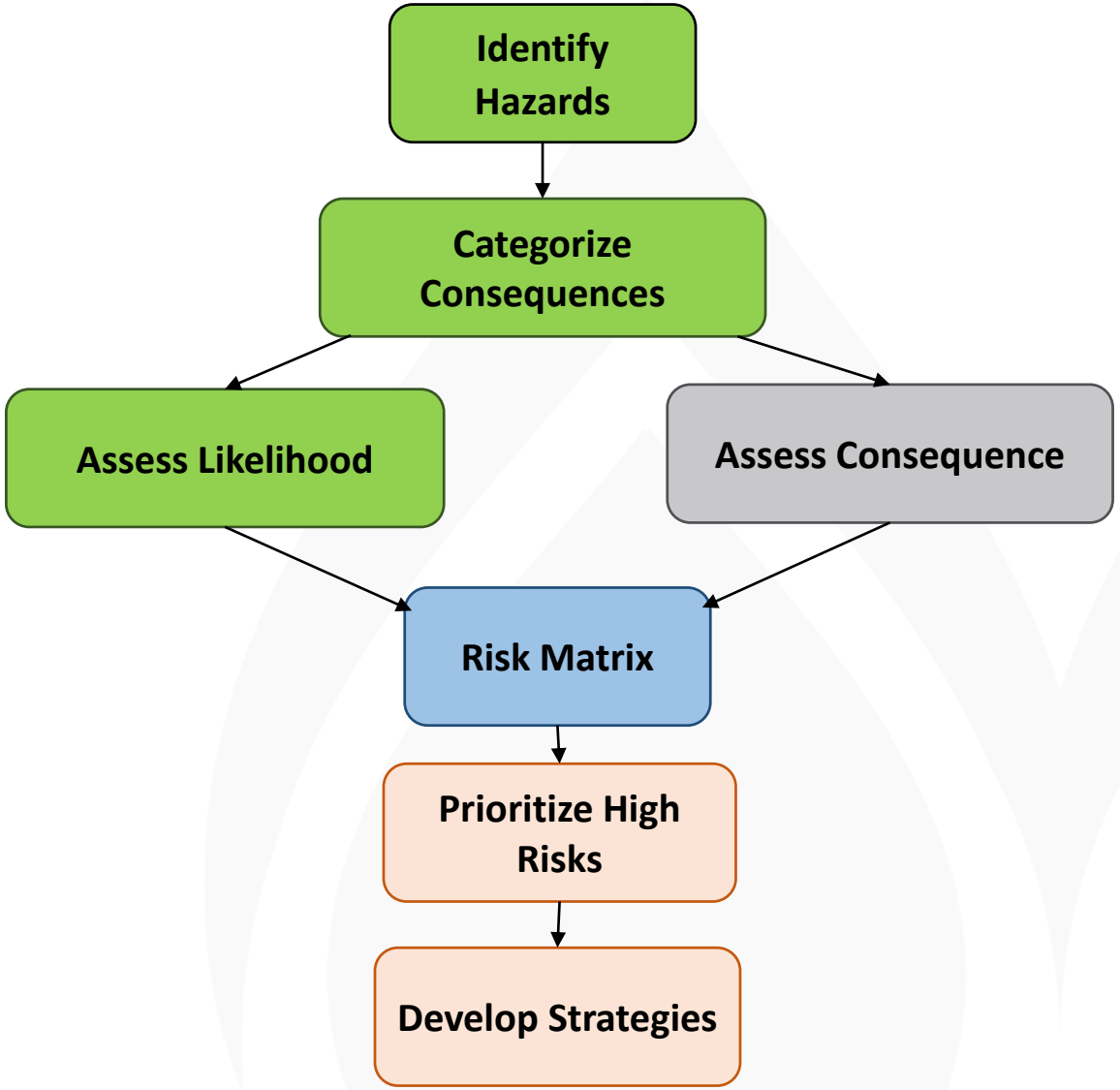
Natural Resource
Stream
Pond/Lake
Wetland-swamp
Wetland-marsh
Lakeshore
Forest
Meadow
Groundwater
Vernal Pools

Climate Hazard
High Precipitation
High Temperatures
Lake Levels
Low Precipitation
Low Temperatures
Seasonal Changes
Wind

Interactions

Natural Resource	Climate Hazard						
	Lake Levels	High Precipitation	Low Precipitation	High Temp	Low Temp	Seasonal Changes	Winds
Stream	X	X	X	X	X	X	
Pond/Lake		X	X	X		X	X
Lakeshore	X	X		X	X	X	X
Groundwater		X	X	X	X	X	
Wetland - Swamp		X	X	X	X	X	X
Wetland - Marsh	X	X	X	X	X	X	
Forest		X	X	X	X	X	X
Meadow		X	X	X	X	X	
Vernal Pools		X	X	X	X	X	X

Evaluating Risk



Consequence Categories

Human Health and Property	**Terrestrial Ecology**	**Aquatic Ecology**	**Water Quality**	**Erosion and Sedimentation**	**Flooding**	**Conservation Halton Services**

Example Consequence Scores

	None (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Flooding	Unlikely to result in increase in riverine or shoreline flooding magnitude, frequency, and extent	Minor increase in riverine or shoreline flooding magnitude, frequency, and extent. Localized flooding/ overland flow. Localized river or shoreline reaches affected in one or a few watersheds.	Minor increase in riverine or shoreline flooding magnitude, frequency, and extent. Roadway overland flow overtopping Localized river or shoreline reaches in several watersheds affected.	Long-term, major increase in riverine or shoreline flooding magnitude, frequency, and extent. Long-term roadway overland flow overtopping. Large stretches or river or shoreline reaches in several watersheds.	Widespread long-term increase in riverine or shoreline flooding magnitude, frequency, and extent. Widespread long-term roadway overland flow overtopping. Large stretches of river or shoreline reaches in many watersheds.

Example Consequence Scores

	None (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Aquatic Ecology	Unlikely to result in damage or loss of habitat or ecological function, negligible impact on biodiversity.	Short- term damage or loss. Short-term, recoverable impact on biodiversity. Few ecological features affected. Localized areas affected in one or a few watersheds.	Short- term damage or loss. Short-term, recoverable impact on biodiversity. Few ecological features. Localized areas affected in several watersheds.	Long term damage or loss. Long-term, recoverable impact on biodiversity. Many ecological features impacted. Large portions in several watersheds.	Widespread long- term damage or loss. Long-term, non-recoverable impact on biodiversity. Many ecological features. Large portions in many watersheds.

Climate Projections / Scenarios Likelihood

Scenarios	Description	Burlington		Aberfoyle	
		2050	2080	2050	2080
Dry Conditions	Dry conditions will be caused by increased temperatures and changes in precipitation patterns. Both average temperature and number of days above 30 degrees increase significantly. Annual precipitation increases, with rainfall or snow events becoming more frequent and intense, while dry periods may similarly increase. In addition, increases in evapotranspiration will result in drier conditions. Seasonal reductions in infiltration will affect headwater streams.	4	4	4	4
Rainfall	Increase in rainfall intensities of both short duration, high frequency storms and less frequent large storms. Likely in increase in bank full,1-year flows that cause stream erosion. Increase in larger events that cause floodplain inundation.	4	4	4	4
Heat Stress	Increase in average temperatures and humidex levels, whereby hot days will cause heat stress in people, flora and fauna. Stream temperatures will increase, especially during low water conditions.	5	5	5	5
Seasonal Changes	Changes in multiple climate parameters cause complex changes in the watersheds. These include, but are not limited to, shorter shoulder seasons, increase in growing days, earlier spring freshette. Overall, seasonal changes will be reflected by a warmer winter, hotter summer and shorter shoulder seasons, along with greater climate variability. Impacts may include conditions that are more hospitable to invasive species while adversely affecting native species at risk.	4	4-5	4	4-5
Snowpack Reduction	An increase in winter temperatures will lead to less snowfall, more snowmelt and an increase in rain on snow events.	4	5	4	5
Wind	An expected increase on average wind speeds and wind gusts. Coupled with longer periods of exposed water due to less lake ice, and possible higher lake levels may cause an increase in shoreline erosion.	4	4	4	4

Risk Scores: 2050

Risk Scoring: Natural Resource versus Climate Hazard Scenario									
Natural Resource	Climate Hazard Scenario	Climate Hazard Likelihood Score	Human Health and Property Risk Score (1-25)	Terrestrial Ecology Risk Score (1-25)	Aquatic Ecology Risk Score (1-25)	Water Quality Risk Score (1-25)	Erosion & Sedimentation Risk Score (1-25)	Flooding Risk Score (1-25)	Conservation Halton Services Risk Score (1-25)
Forests	Dry Conditions	4	12	16	12	12	8	8	12
Groundwater	Dry Conditions	4	16	16	20	16	8	8	12
Lakeshore	Dry Conditions	4	8	12	16	16	12	12	8
Meadow	Dry Conditions	4	8	12	8	8	8	8	4
Pond/Lake	Dry Conditions	4	12	12	16	16	12	12	12
Special Features - vernal pools	Dry Conditions	4	8	16	12	8	8	8	8
Stream	Dry Conditions	4	12	12	20	16	12	16	8
Wetland-Marsh	Dry Conditions	4	12	16	16	12	8	16	8
Wetland-Swamp	Dry Conditions	4	12	16	12	12	8	12	8
Forests	Heat Stress	5	20	20	15	15	10	10	20
Groundwater	Heat Stress	5	20	15	25	25	10	10	15
Lakeshore	Heat Stress	5	15	15	20	25	10	10	15
Meadow	Heat Stress	5	10	20	10	10	5	5	10
Pond/Lake	Heat Stress	5	15	15	20	25	5	5	15
Special Features - vernal pools	Heat Stress	5	10	20	20	15	5	5	5
Stream	Heat Stress	5	15	15	25	25	10	10	10
Wetland-Marsh	Heat Stress	5	15	15	20	15	15	15	10
Wetland-Swamp	Heat Stress	5	15	20	20	15	15	15	10
Forests	Rainfall	4	8	12	8	12	8	8	12
Groundwater	Rainfall	4	12	12	16	16	12	12	12
Lakeshore	Rainfall	4	16	8	16	16	20	20	12
Meadow	Rainfall	4	12	12	8	8	12	8	8
Pond/Lake	Rainfall	4	12	12	16	16	16	16	12
Special Features - vernal pools	Rainfall	4	8	16	12	8	8	8	8
Stream	Rainfall	4	16	12	20	16	20	20	12
Wetland-Marsh	Rainfall	4	12	12	12	12	12	12	8
Wetland-Swamp	Rainfall	4	12	16	16	12	12	12	8
Forests	Seasonal Changes	4	12	16	12	12	4	4	12
Groundwater	Seasonal Changes	4	16	16	16	20	8	4	12
Lakeshore	Seasonal Changes	4	12	16	20	16	12	12	12
Meadow	Seasonal Changes	4	12	12	4	4	4	4	8
Pond/Lake	Seasonal Changes	4	12	16	20	16	12	12	8
Special Features - vernal pools	Seasonal Changes	4	8	16	16	4	8	8	4
Stream	Seasonal Changes	4	12	16	20	20	12	12	12
Wetland-Marsh	Seasonal Changes	4	8	16	16	16	12	12	8
Wetland-Swamp	Seasonal Changes	4	12	16	16	16	12	12	8
Forests	Snowpack Reduction	4	12	12	12	8	8	8	12
Groundwater	Snowpack Reduction	4	12	12	12	12	8	4	4
Lakeshore	Snowpack Reduction	4	12	8	12	16	12	12	12
Meadow	Snowpack Reduction	4	8	8	8	8	4	8	4
Pond/Lake	Snowpack Reduction	4	12	12	16	16	8	8	12
Special Features - vernal pools	Snowpack Reduction	4	8	16	16	12	8	8	8
Stream	Snowpack Reduction	4	12	12	16	16	12	12	12
Wetland-Marsh	Snowpack Reduction	4	12	12	16	16	8	8	12
Wetland-Swamp	Snowpack Reduction	4	12	12	16	16	8	8	12
Forests	Wind	4	8	12	12	8	8	4	12
Lakeshore	Wind	4	16	8	12	12	16	16	16
Meadow	Wind	4	8	8	8	8	4	4	4
Pond/Lake	Wind	4	12	8	8	12	8	8	12
Special Features - vernal pools	Wind	4	4	12	8	4	4	4	4
Stream	Wind	4	8	8	8	8	8	12	8
Wetland-Marsh	Wind	4	8	12	4	8	4	4	4
Wetland-Swamp	Wind	4	12	12	8	8	4	4	8

Risk Matrix Findings

Risk Rating – Stream/Heat Stress

Natural Resource	Climate Hazard Scenario	Human Health and Property Risk Score (1-25)	Terrestrial Ecology Risk Score (1-25)	Aquatic Ecology Risk Score (1-25)	Water Quality Risk Score (1-25)	Erosion & Sedimentation Risk Score (1-25)	Flooding Risk Score (1-25)	Conservation Halton Services Risk Score (1-25)
Stream	Heat Stress	15	15	25	25	10	10	10

Risk Rating – Stream/Rainfall

Natural Resource	Climate Hazard Scenario	Human Health and Property Risk Score (1-25)	Terrestrial Ecology Risk Score (1-25)	Aquatic Ecology Risk Score (1-25)	Water Quality Risk Score (1-25)	Erosion & Sedimentation Risk Score (1-25)	Flooding Risk Score (1-25)	Conservation Halton Services Risk Score (1-25)
Stream	Rainfall	16	12	20	16	20	20	12

Recommendations Example – Flooding

Operations

- Continue updating Conservation Halton's flood forecasting and warning system

Monitoring

- Continue to monitor ice jams
- Expand weather station network to provide coverage over the jurisdiction

Manage

- Maintain and expand natural areas (forest, wetland, etc.) to help maintain the hydrologic conditions in the watershed.

Modelling

- Continue updating regulatory flood hazard mapping around streams to reflect the potential changes due to climate change
- Use future climate scenarios, natural resource scenarios, and hydrologic and hydraulic models to identify potential flood risk zones.
- Use hydrologic modelling to measure the potential impacts and help inform possible mitigation measures of climate change on wetlands.

Recommendations Example – Aquatic Ecology

Monitoring

Continue and adjust, if needed, the aquatic monitoring system that includes:

- regular assessments of stream levels,

- impacts of climate change causing a reduction in fish spawning habitats

Restoration

Implement the recommendations in the report *Effects of Climate Change on Biodiversity within Conservation Halton's Watersheds* to "Develop species-specific monitoring and restoration strategies for target species at risk and climate-vulnerable species on Conservation Halton lands."

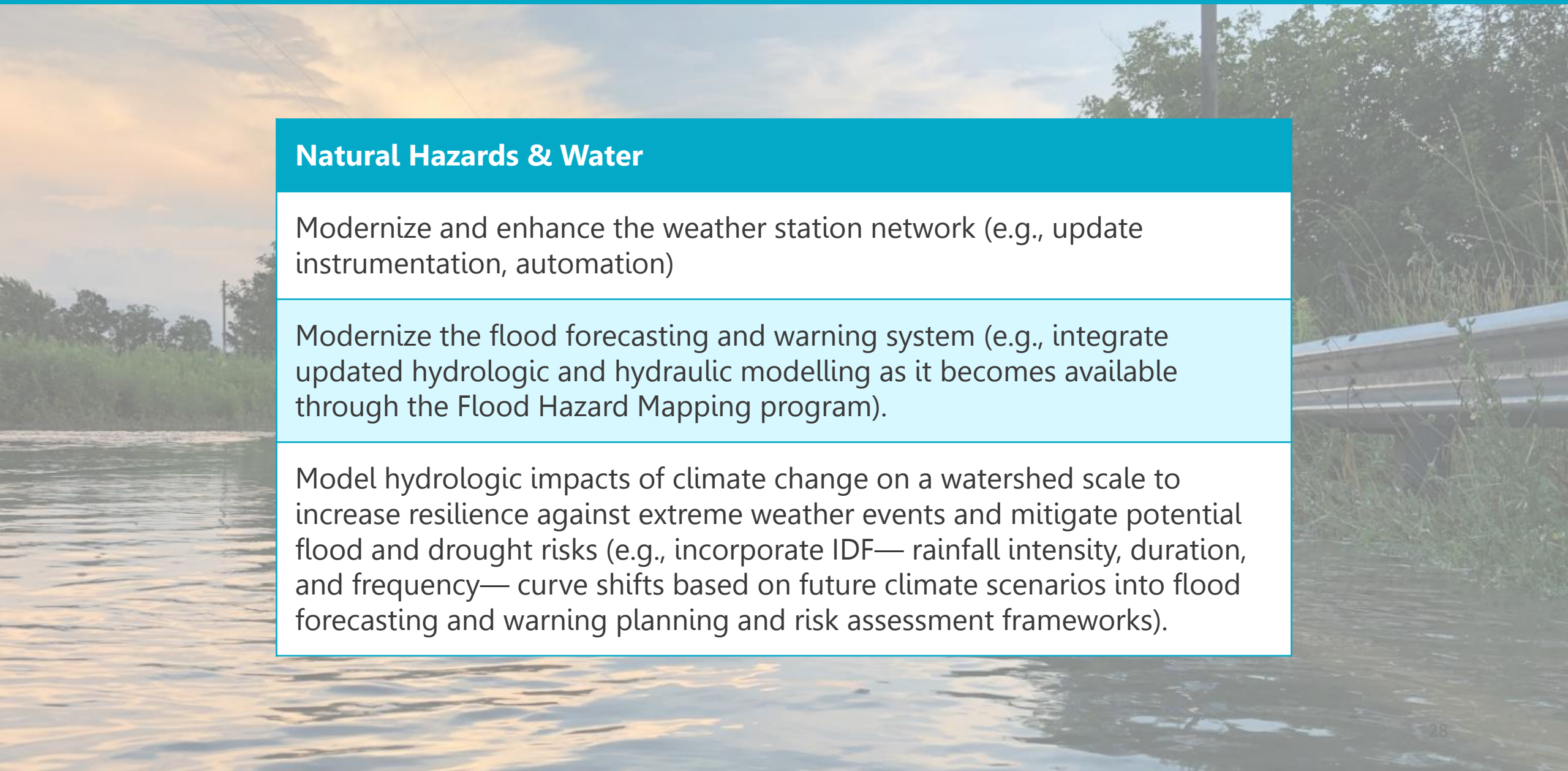
Modelling

Undertake modelling of future climate scenarios to better understand and predict the impacts of climate change on the thermal dynamics of streams. E.g. Identify the risk of specific streams no longer being refugia for cold-water species.

ACTIONS TO IMPROVE CLIMATE RESILINECY

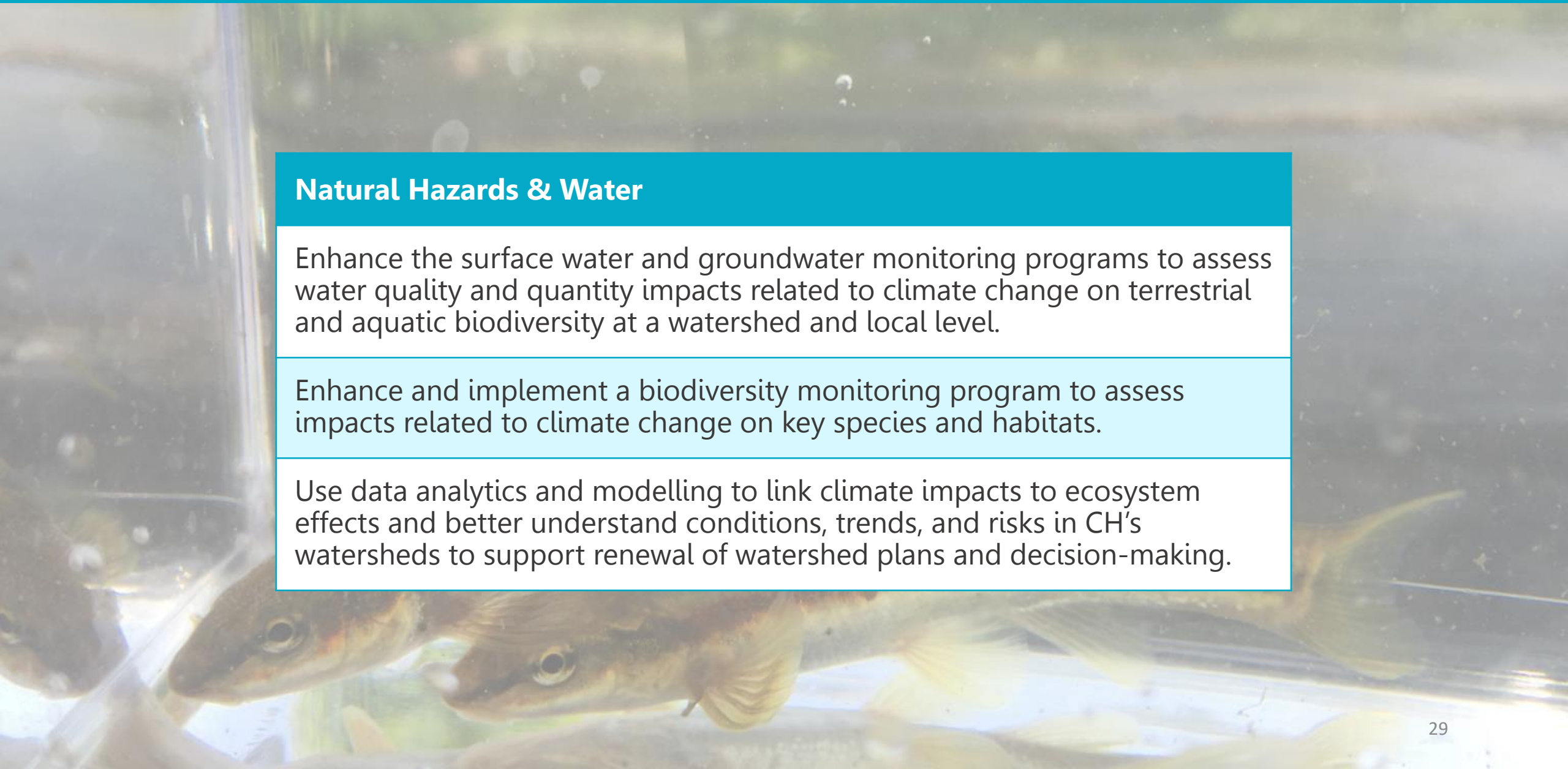
- Assessment recommendations helped identify gaps, challenges, & opportunities for incorporating climate change resiliency into CH's existing programs & services
- Actions improve the:
  - Ability of CH's programs & services to address climate change impacts
  - Adaptive capacity & resiliency of key natural resources
- **Natural Hazards & Water (28 Actions)**
- **Planning & Permitting (2 Actions)**
- **Conservation Lands & Recreation (4 Actions)**
- **Corporate Services (2 Actions)**

EXAMPLE ACTIONS: FLOODING



Natural Hazards & Water
Modernize and enhance the weather station network (e.g., update instrumentation, automation)
Modernize the flood forecasting and warning system (e.g., integrate updated hydrologic and hydraulic modelling as it becomes available through the Flood Hazard Mapping program).
Model hydrologic impacts of climate change on a watershed scale to increase resilience against extreme weather events and mitigate potential flood and drought risks (e.g., incorporate IDF— rainfall intensity, duration, and frequency— curve shifts based on future climate scenarios into flood forecasting and warning planning and risk assessment frameworks).

EXAMPLE ACTIONS: AQUATIC ECOLOGY



Natural Hazards & Water
Enhance the surface water and groundwater monitoring programs to assess water quality and quantity impacts related to climate change on terrestrial and aquatic biodiversity at a watershed and local level.
Enhance and implement a biodiversity monitoring program to assess impacts related to climate change on key species and habitats.
Use data analytics and modelling to link climate impacts to ecosystem effects and better understand conditions, trends, and risks in CH's watersheds to support renewal of watershed plans and decision-making.

IMPLEMENTATION

- Actions incorporated into Watershed Strategy (Plan provides more detailed actions)
- Ensures CH's programs & services better address issues & mitigate risks associated with climate change impacts
- Plan realized through implementation of Watershed Strategy & annual budgeting process

Thank you

https://www.conservationhalton.ca/watershed-strategy/

Conservation Halton