Linking Climate Change Vulnerability and Risk Assessments and Asset Management

AMOntario Climate Change and Asset Management Conference

Al Douglas
Climate Risk Institute

February 23, 2021

Nipigon River Bridge
CBC News, 2018

Forest fire near Pikangikum First Nation
CBC News, 2019

Nipigon River Bridge Failure
Ministry of Transportation, 2016

Highway 607 in French River
CTV Northern Ontario, 2019

CLIMATE RISK INSTITUTE

---Founded in May 2019 with 18 years of organizational experience

----------Non-profit corporation, academically affiliated

----------Mobilize knowledge, improve capacity, and enhance adaptation action and climate resiliency

----------Education and outreach, training, vuln and risk assessment, adaptation planning, policy evaluation

Anna Zaytseva, B.A. (Hons), M.Sc.

Anna is an Advisory and Technical Services Liaison of the Climate Risk Institute. She is passionate about sustainable development, climate change adaptation and

Suzanne Seiling, BES, MCC

Suzanne Seiling is an Adaptation Extension Liaison with the Climate Risk Institute. Suzanne's areas of experience and expertise include: vulnerability

Glenn Milner, P.Eng., MCC

Glenn is the Engineering and Climate Risk Lead at the Climate Risk Institute. Over the past 10 years, he has worked on climate risk and adaptation initiatives across Ontario,

Kirsten MacMillan, B.A.Sc., B.A., E.I.T.

Kirsten is a Climate and Engineering Analyst with the Climate Risk Institute. Kirsten's work focuses on the technical analyses of climate and infrastructure projects,

Erik Sparling, B.A. (Sc), M.A

Erik is Vice President of the Climate Risk Institute. He has 15 years' experience providing and overseeing delivery of research, analysis, training,

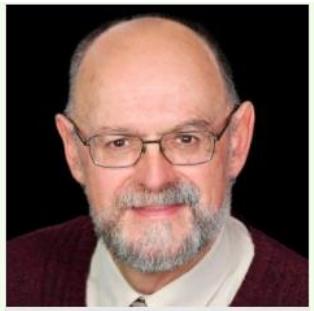
Jacqueline Richard, B.Sc., M.Sc.

Jackie is the Coordinator of the Climate Risk Institute. She has been working in the field of climate change impacts and adaptation since 2001 and

Paul Cobb

Paul is a Project Manager with the Climate Risk Institute. An engineer by training, he has dedicated his career to finding and implementing climate change solutions. Currently,

CRI Associates



Guy Félio

Guy Félio, PhD., P.Eng., FCSCE is a civil engineer with a Ph.D. from Texas A&M University. He has more than 35 years of experience in the field as a university professor, researcher, consultant and

Dirk Nyland

Dirk Nyland, P.Eng., IRP, Chief Engineer, British Columbia Ministry of Transportation and Infrastructure, Victoria, BC (retired). Mr. Nyland has over 45 years' experience in

Joel Nodelman

Joel Nodelman engineering a management over forty yea practice. Over primary missi environmental

Joan Nodelman

Jeff O'Driscoll

Jeff O'Driscoll, P.Eng., is a leader in assessing climate change resilience on infrastructure and held the designation of Infrastructure Resiliency Professional (IRP) from Engineers Canada. Jeff is a Civil Engineer with over 30

Elvis Asong

Dr. Asong has over 15 years of experience in providing targeted climate service analyses for critical planning efforts, such as for infrastructure design, energy, water management, oil and gas, forestry, and agricultural

Norman Shippee

Norman Shippee, Ph.D., is the Canadian Technical Lead for Climate Change Vulnerability and Adaptation and Senior Climate Scientist at Stantec Consulting, based in Ottawa, Ontario. He is a Climatologist with extensive research and

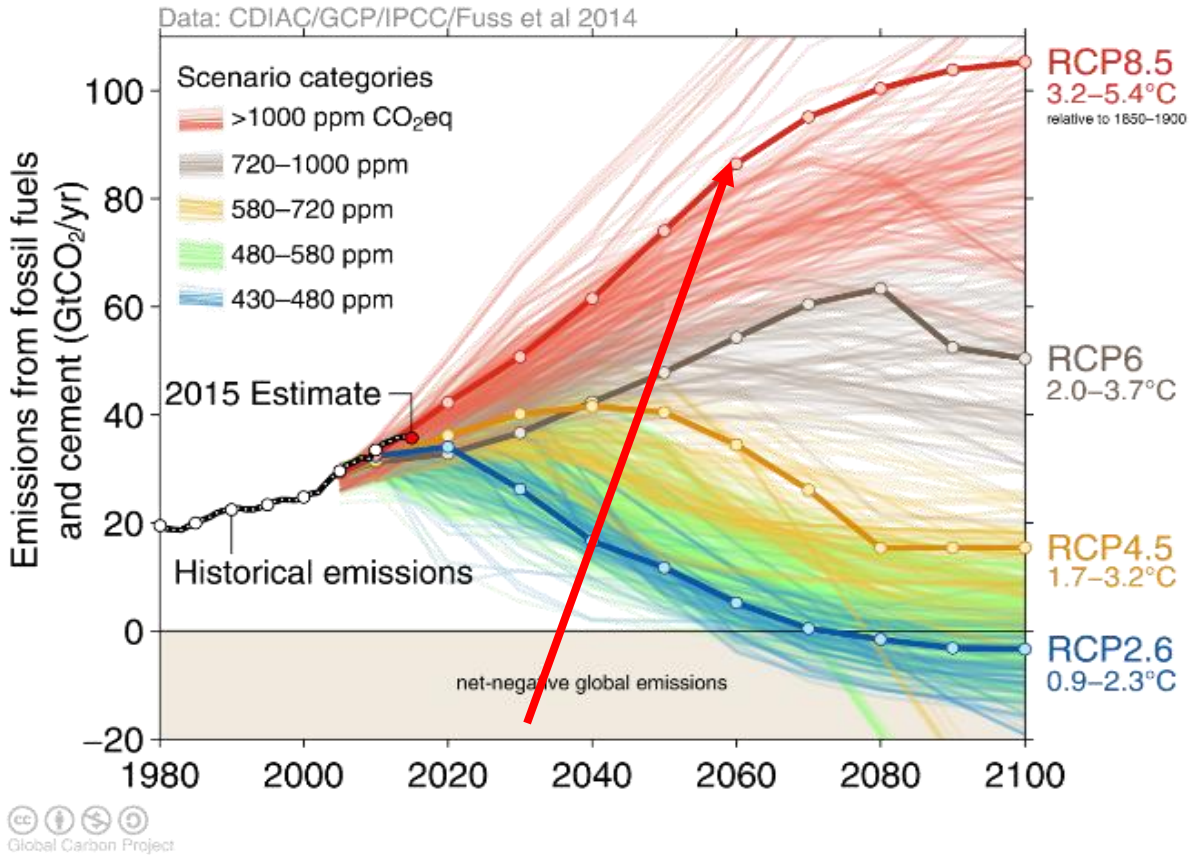
Stephanie Austin

Stephanie Austin has worked on climate change adaptation since 2014 with diverse experiences in climate services, capacity building, research, adaptation policy analysis, public health and infrastructure. She is currently

Pathways

- Representative Concentration Pathways are "**representative**" of possible future greenhouse gas concentration scenarios.

- AR6 - Shared Socio-economic Pathways show how global society, demographics and economics might change over the next century



AMONTario
ASSET MANAGEMENT ONTARIO

Impetus - Economics

- GDP could be **25-40% lower** by 2100
- Tipping points - damage on the current trajectory towards 3.7°C is calculated as **$550t**
- Many risks may be **uninsurable**

Chief Risk Officers (CRO) Forum, 2019

https://www.thecroforum.org/wp-content/uploads/2019/01/CROF-ERI-2019-The-heat-is-on-Position-paper-1.pdf

AMONTario
ASSET MANAGEMENT ONTARIO

Government-Level Cost-Benefit Ratios

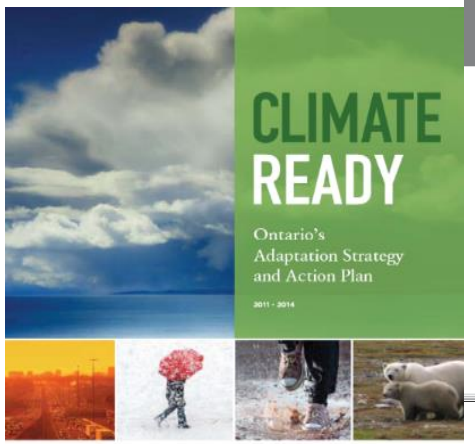
Investing **$1** in prevention results in avoided costs of…

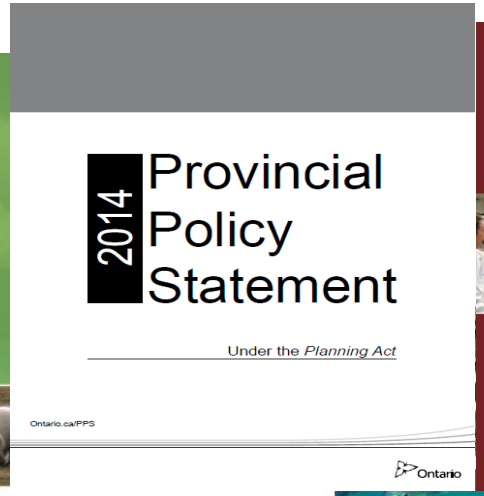
$4	**$5**	**$6**	**$6**	**$40**
from investments in improved resilience	from governments' climate resilience investments	from hazard mitigation investments	from disaster mitigation investments	related to the (prevented!) 1997 Winnipeg flood alone
Source: Global Commission on Adaptation	**Source**: The Economist	**Source**: US National Institute of Building Sciences	**Source**: Federation of Canadian Municipalities	**Source**: Government of Manitoba

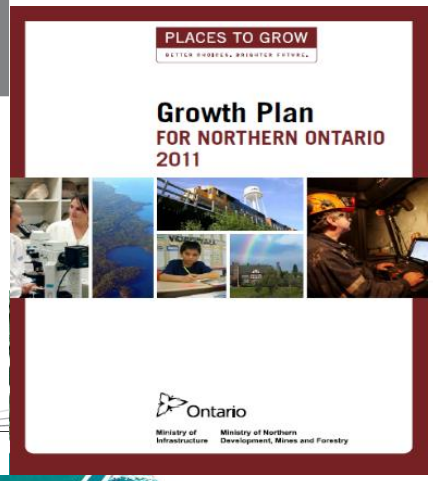
Courtesy, Tom Ewart, Cooperators Insurance

AMONTario
ASSET MANAGEMENT ONTARIO

Impetus – Policy and Regulations



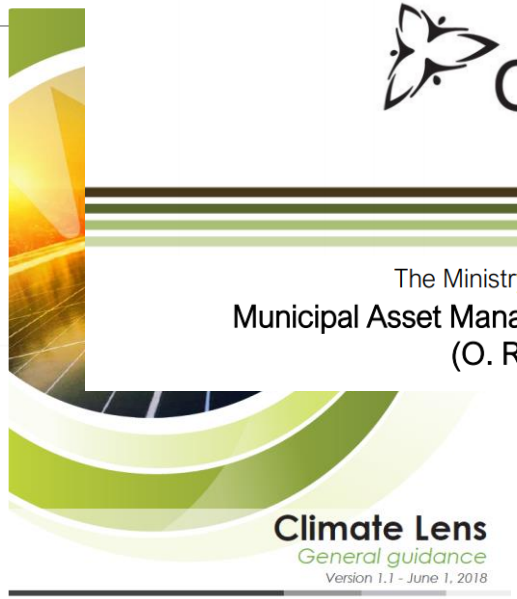


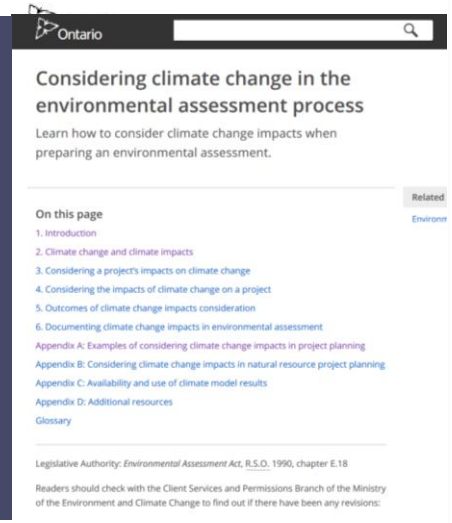


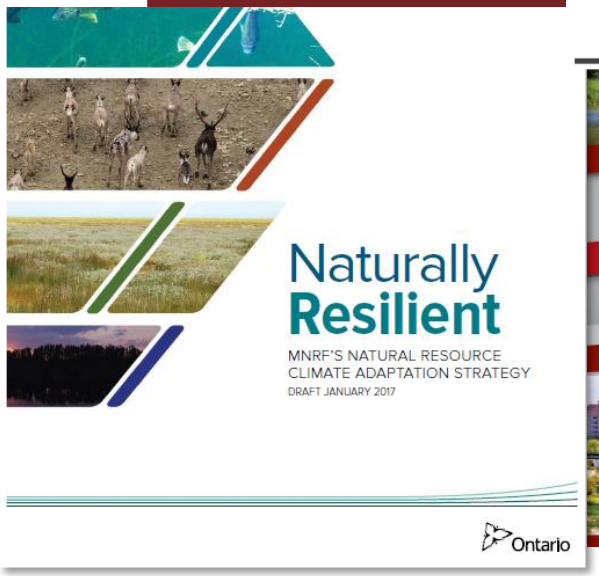
Ontario

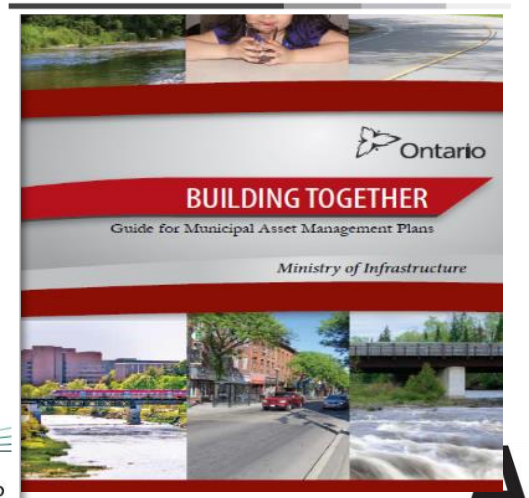
The Ministry of Infrastructure

Municipal Asset Management Planning Regulation
(O. Reg. 588/17)



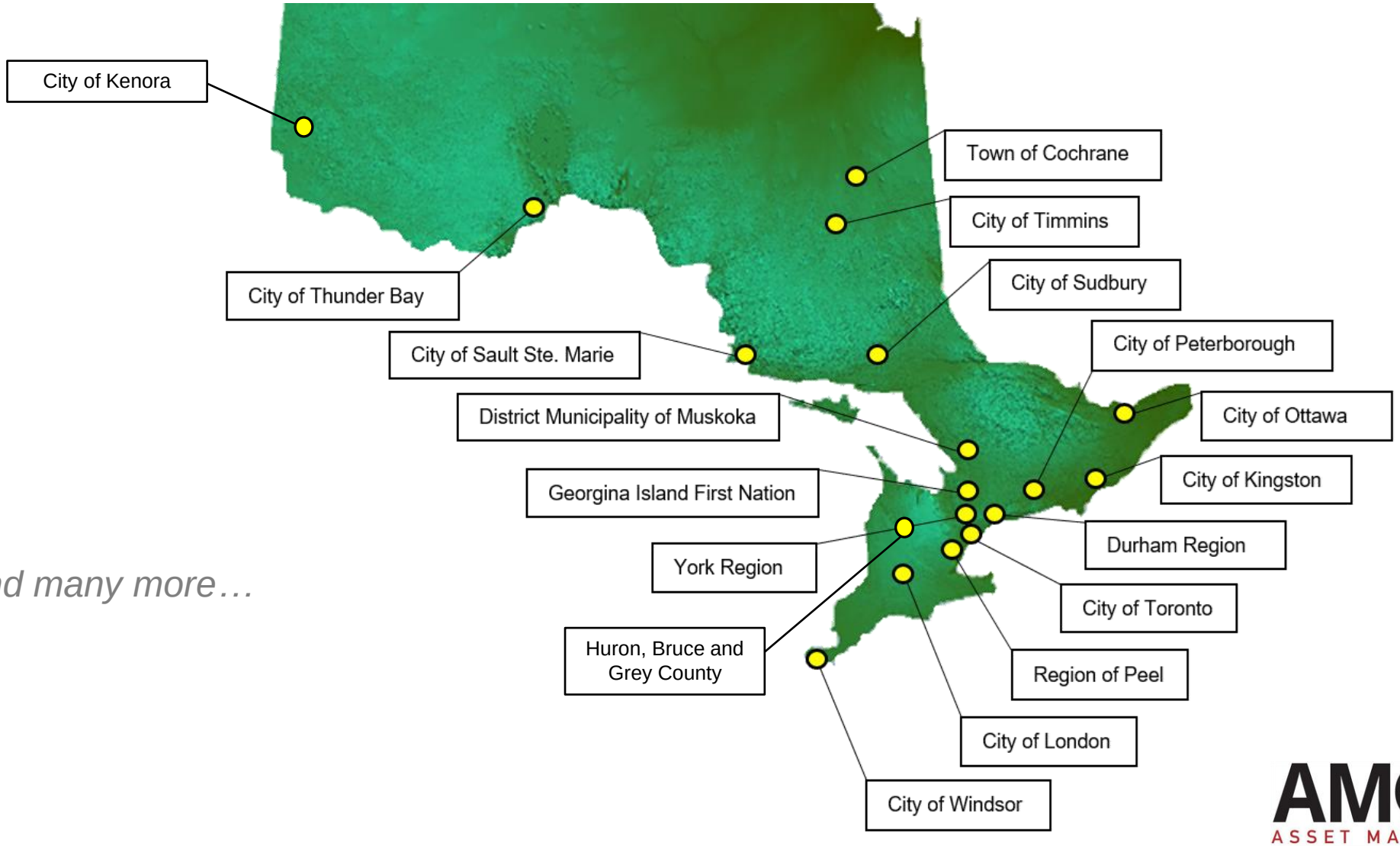






AMONTario
ASSET MANAGEMENT ONTARIO

Municipal Adaptation is Happening in Ontario



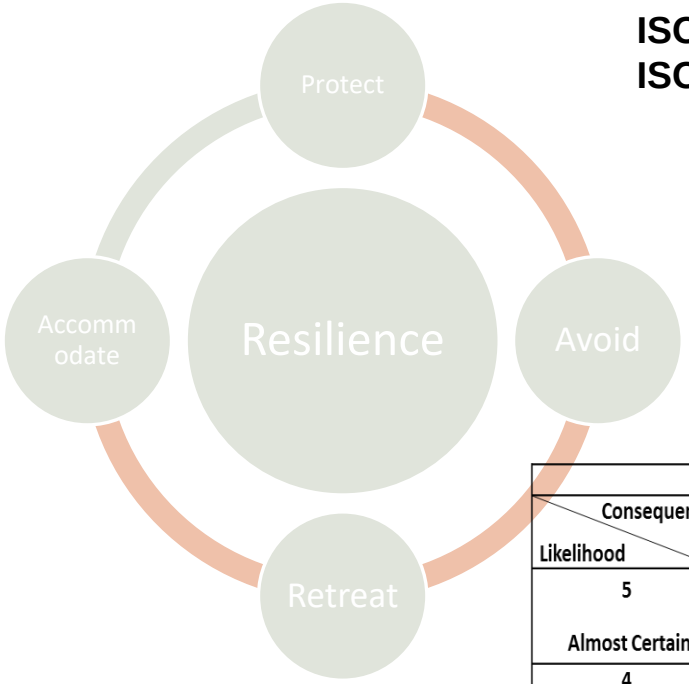
And many more…

AMONTario
ASSET MANAGEMENT ONTARIO

ADAPTATION: actions that increase built, social, or natural capacities to better withstand the impacts of climate change.

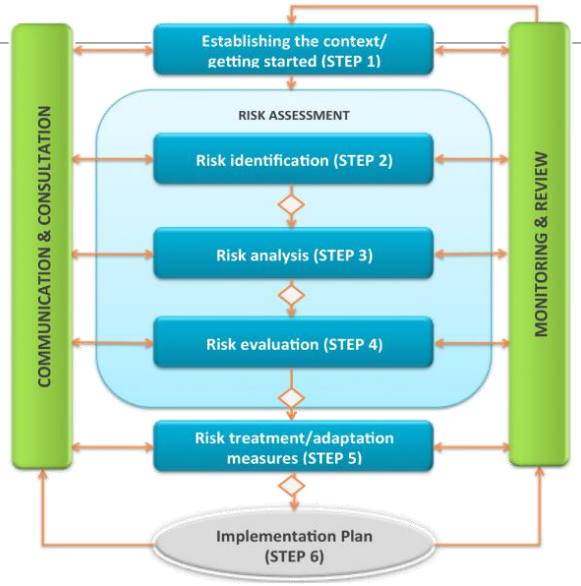
Process to Assess Risk – Tools and Frameworks

PARA for flood risk



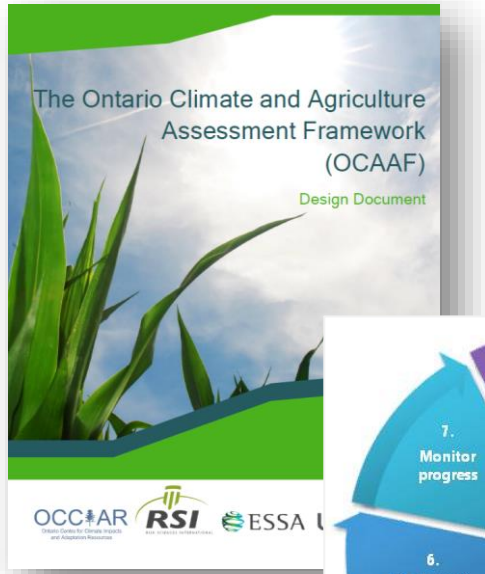
Doberstein, Fitzgibbons & Mitchell, 2018, Natural Hazards

ISO 31000:2018
ISO 14090:2019
ISO 14091



Event Risk Rating					
Consequence / Likelihood	1 Minor	2 Low	3 Medium	4 High	5 Major
5 Almost Certain	Medium (5)	Significant (10)	Significant (15)	High (20)	High (25)
4 Likely	Medium (4)	Medium (8)	Significant (12)	High (16)	High (20)
3 Possible	Low (3)	Medium (6)	Significant (9)	Significant (12)	High (15)
2 Unlikely	Low (2)	Low (4)	Medium (6)	Significant (8)	Significant (10)
1 Rare	Low (1)	Low (2)	Medium (3)	Medium (4)	Significant (5)

Risk to agriculture

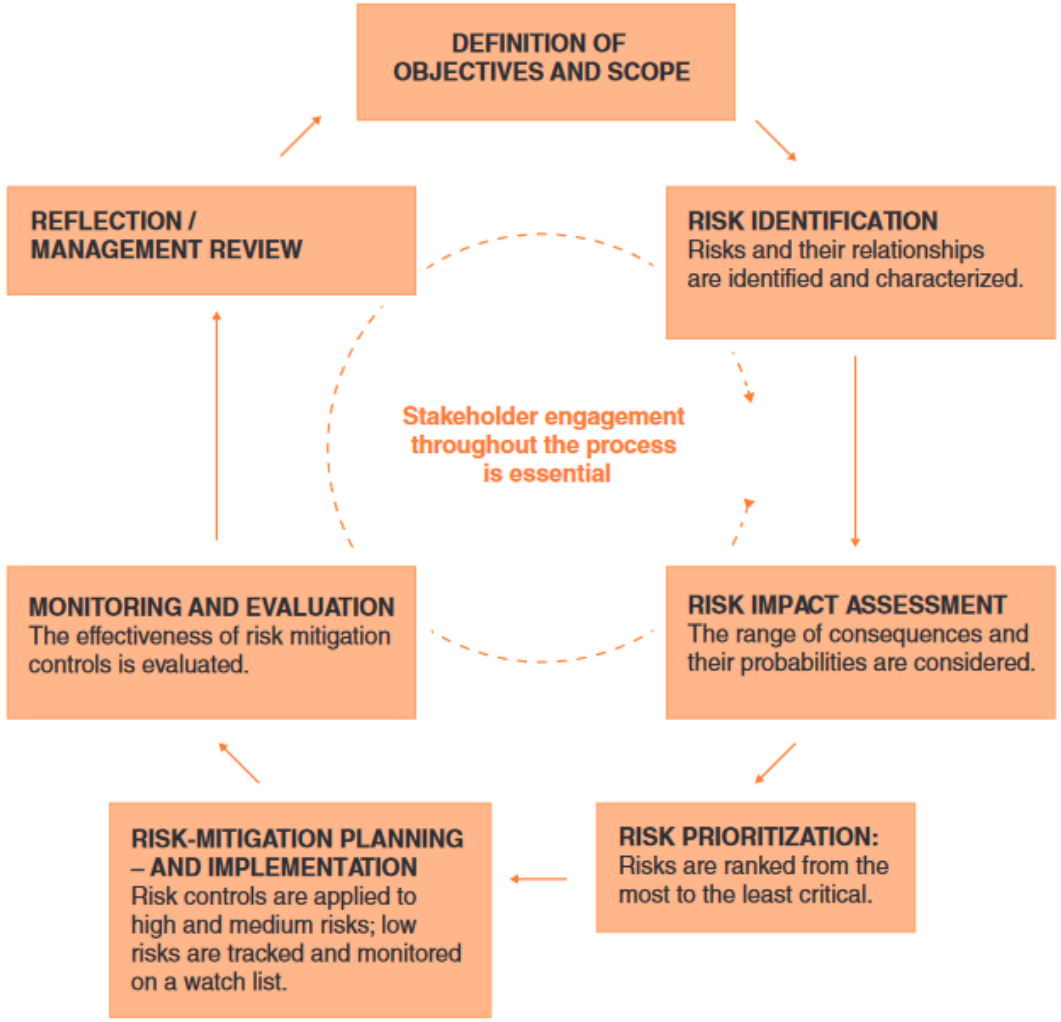


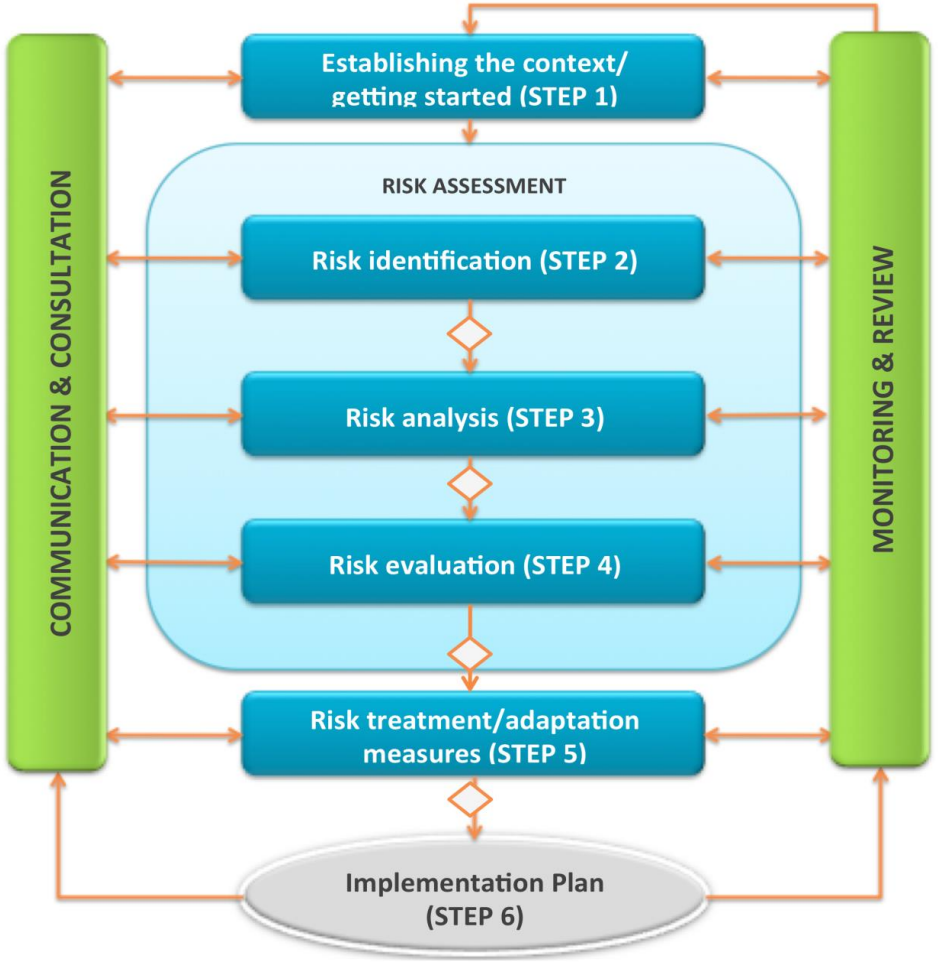
Indigenous Communities

AMONTario
ASSET MANAGEMENT ONTARIO

Risk-Management Cycles

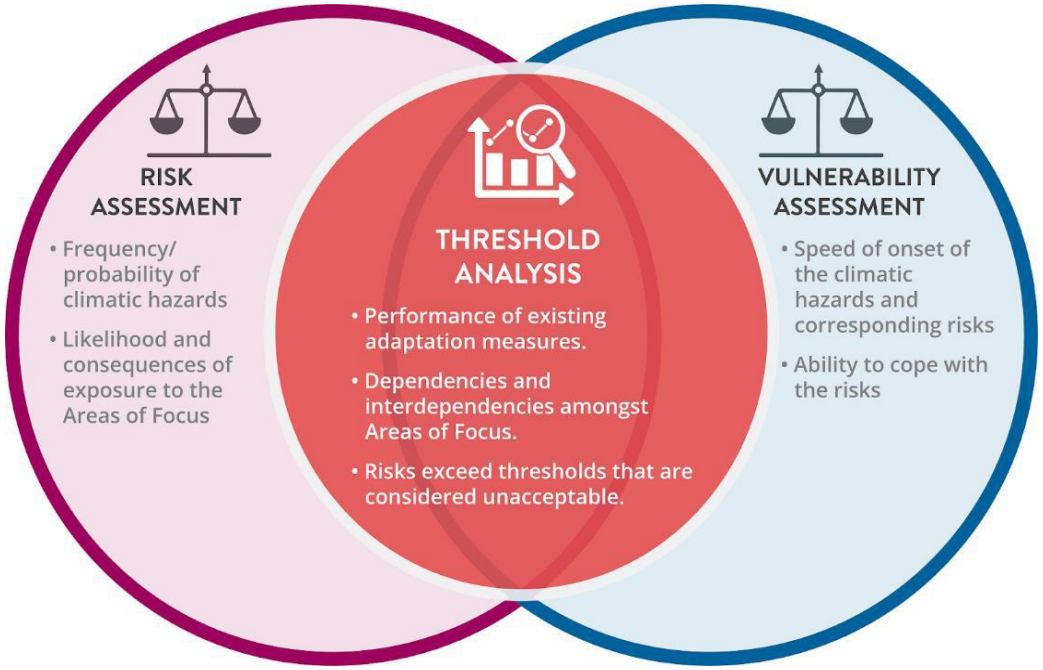
Compare with ISO31000 Framework…

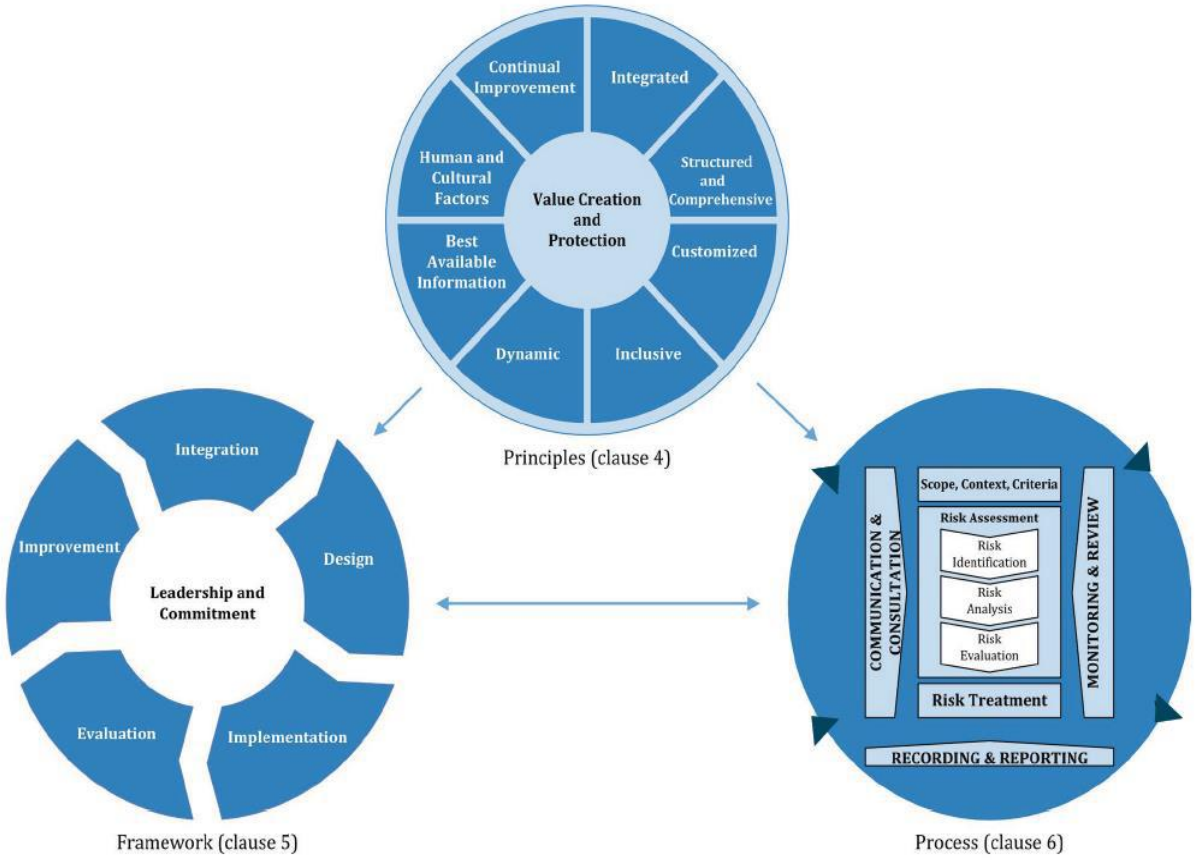




AMONTario
ASSET MANAGEMENT ONTARIO

ISO 31000:2018 Guidelines for Risk Management and ISO 14090: 2019-6 Adaptation to Climate Change - Principles, Requirements and Guidelines





Transparent, Systematic, Consistent

AMONTario
ASSET MANAGEMENT ONTARIO

Defining Metrics for Risk Assessment Components

WHAT IS THE FREQUENCY/PROBABILITY OF THE CLIMATIC HAZARD?		
Score	**Category**	**Definition(s) – Design with the Ministry**
16	Frequent	1. For quantifiable hazards such as floods, annual frequency (or Return Period) for a specific magnitude event will be utilized (i.e., 1:100 year flood, 1:500 year flood). 2. Climatic hazards, such as growing season, may change over time, so a relative means of measuring the "change" based on confidence levels will likely be utilized.
8	Probable	
4	Occasional	
2	Remote	
1	Improbable	

WHAT IS THE LIKELIHOOD THE AREA OF FOCUS WILL BE IMPACTED BY THE CLIMATIC HAZARD?		
Score	**Category**	**Definition(s) – Design with the Ministry**
16	Very High	1. Can be measured objectively, as a % chance if there is sufficient certainty with the analysis? 2. Alternatively, professional judgement and experience can be used to measure this based on answering questions such as:: a. Has it happened here before? b. Can/could it happen here? c. Has it happened before anywhere?
8	High	
4	Medium	
2	Low	
1	Very Low	

WHAT ARE THE CONSEQUENCES OF THE IMPACT TO THE AREA OF FOCUS?		
Score	**Category**	**Definition(s) – Design with the Ministry**
16	Very High	**Human Health and Public Safety** • Take into consideration the ways in which traditional lifestyles and culture will be impacted and subsequent physical and mental health is altered. **Potential Environmental Damage** • Take into consideration the full range of impacts from short term impacts (full recovery) to irreparable damage/ecosystems cannot regenerate. **Disruption to Services** • Take into consideration how long the climatic hazard will disrupt public services, use of a specific asset type or subcomponent of an Area of Focus (i.e., duration of a flood event within a community). **Potential for Financial Losses (or gains)** • Take into consideration both capital and operational losses (or gains), usually represented in $.
8	High	
4	Medium	
2	Low	
1	Very Low	

CAN THE AREA OF FOCUS ADAPT? IS THERE SUFFICIENT CAPACITY TO COPE?		
Score	**Category**	**Definition(s) – Design with the Ministry**
16	Always Effective	As the score goes up, it reflects an increase in effectiveness of the adaptation measures, whether they are existing or proposed.
8	Highly Effective	
4	Moderate Effectiveness	
2	Minimal Effectiveness	
1	Not Effective	

AMONTario
ASSET MANAGEMENT ONTARIO

Determining the Risk Level

Risk Matrix for Dam Failure Impact Assessment

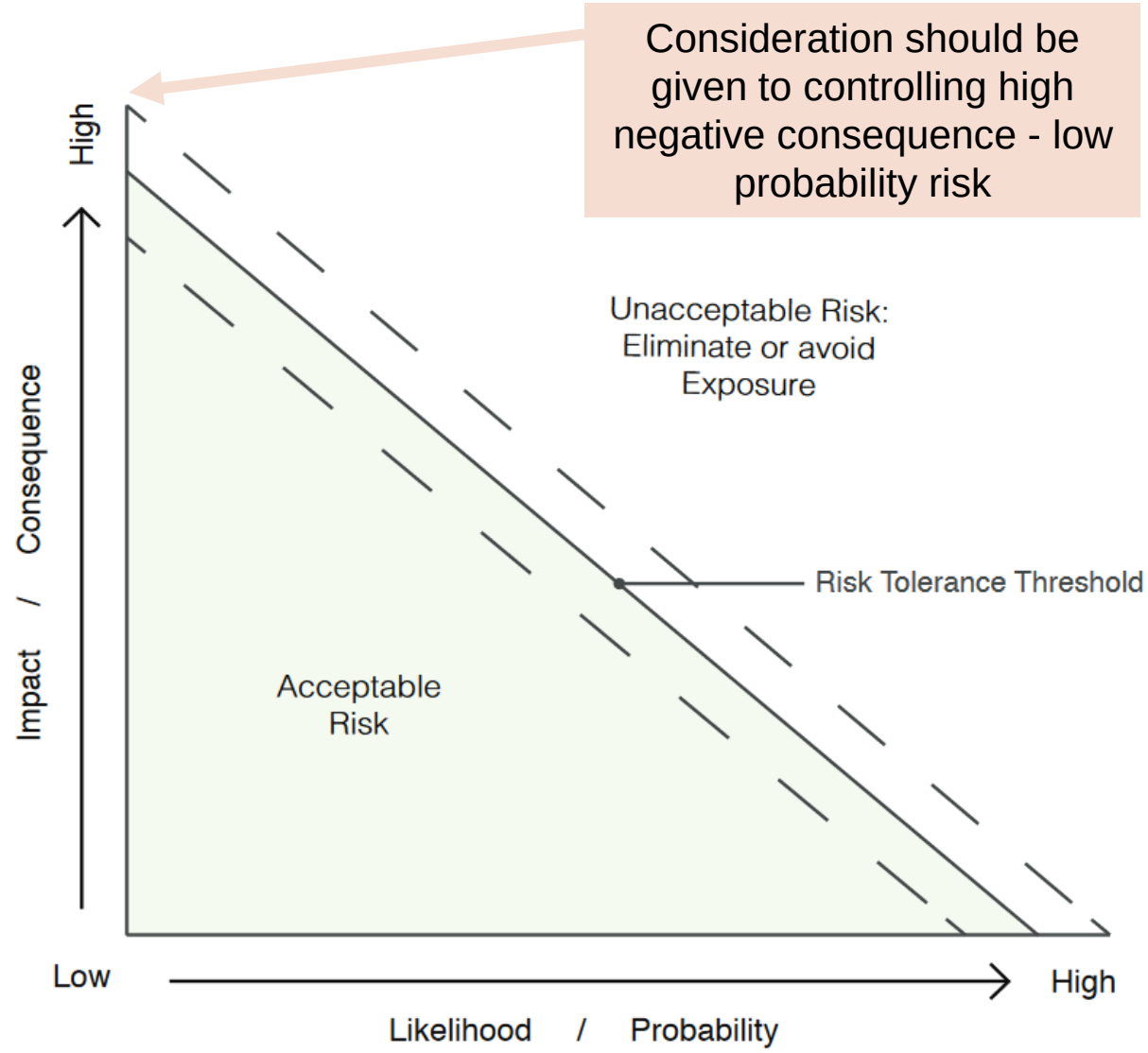
Consequence severity →		Low	Significant	High	Very High	Extreme
Failure Likelihood ↓		1	3	5	7	9
Certain	**11**	11	33	55	77	99
Likely	**7**	7	21	35	49	63
Potential	**5**	5	15	25	35	45
Unlikely	**3**	3	9	15	21	27
Rare	**1**	1	3	5	7	9

Risk Rating		Response
Alert	**>32**	- Immediate attention required
Caution	**21 to 31**	- Enhanced monitoring, early DSR, emergency planning required until required repairs completed
Stable	**9 to 20**	- Regular inspections per CDA, may audit on increased frequency, operations per updated OMS
No concerns	**<9**	- Regular inspections per CDA to identify any changes

- Determine the consequence of failure and the failure likelihood.
- The matrix helps determine which sites need attention and helps to create a **priority** list.

AMONTario
ASSET MANAGEMENT ONTARIO

Risk Mapping



Management's risk appetite (risk tolerance) needs to be understood to control risks to within tolerance levels.

Risks need not be eliminated unless the tolerance level is zero.

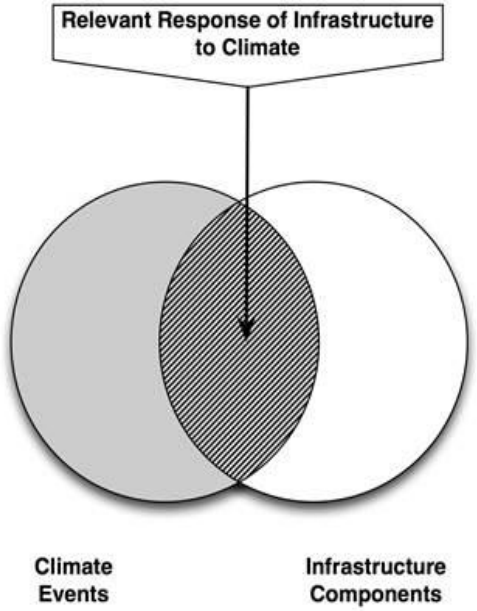
AMONTario
ASSET MANAGEMENT ONTARIO

PIEVC Engineering Protocol - A Risk Screening Tool

- Five step evaluation process
- A tool derived from standard risk management methodologies
- Intended for use by qualified engineering professionals
- Requires contributions from those with pertinent local knowledge and experience
- Focused on the principles of vulnerability and resiliency

PIEVC CVIIP

The Public Infrastructure Engineering Vulnerability Committee (PIEVC) Protocol was developed by Engineers Canada, with support from Natural Resources Canada, to assist engineers in factoring climate change impacts into plans for design, operation and maintenance of public infrastructure.



AMONTario
ASSET MANAGEMENT ONTARIO

Climate Change Risk Assessment and Asset Management

Concept/Component	CCRA	AM
Standardized process	ISO 31000; 14090	ISO 5500, 55001, 55002
Assessment of Impact	Driven by climate hazards	Life cycle, level of service
Economics	Return on Adaptation Investment	Capital and operating; ROI
Dynamic environment	Socioeconomics, mitigation, thresholds	Thresholds, population growth, service expectations
Data and information	Climate change data, critical thresholds,	GIS mapping, inventory, cost
Solutions/Implementation	Adaptation plans and measures	Upgrades, O&M, service
Iterative/Adaptive	New science, risk tolerance and perceptions	Ongoing over time with new assets added
Scalability	Municipality, region, watershed	Interconnectedness, classes
Communications	Public, stakeholders, thematic experts, multi-disciplinary	Interdepartmental, multiple disciplines

Framework and Process

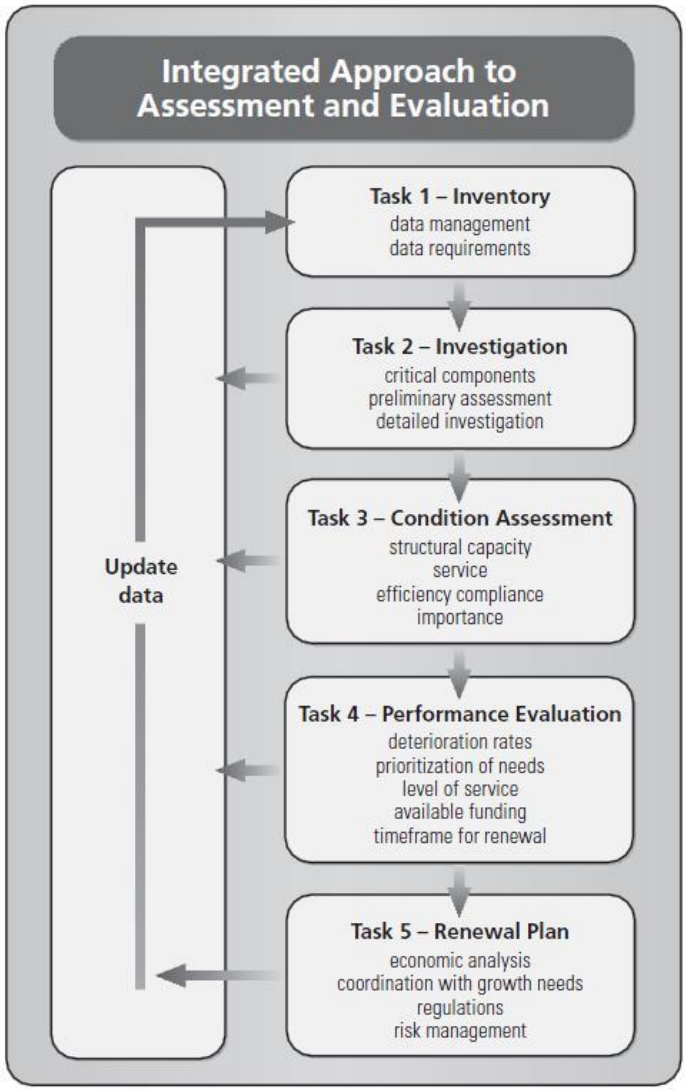
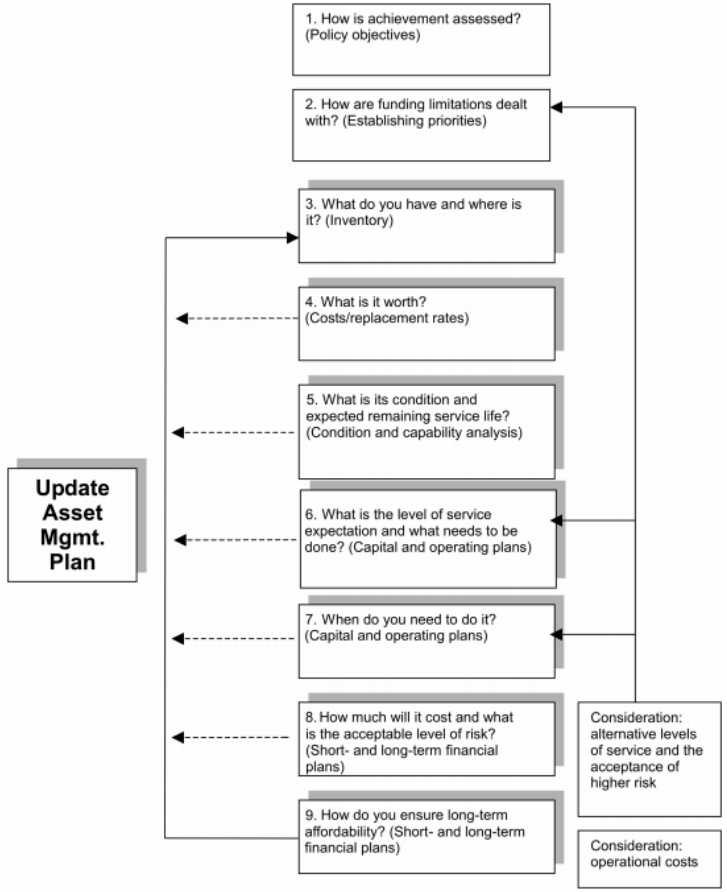


Figure 3–1: Asset Management Planning Framework



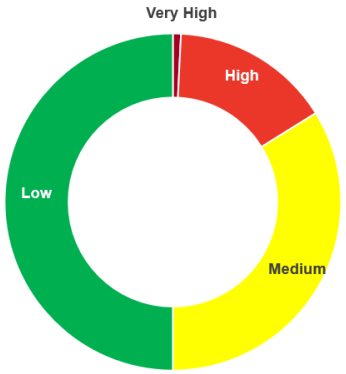
AMONTario
ASSET MANAGEMENT ONTARIO

Example: Ontario Flood Risk Assessment Outputs for AM

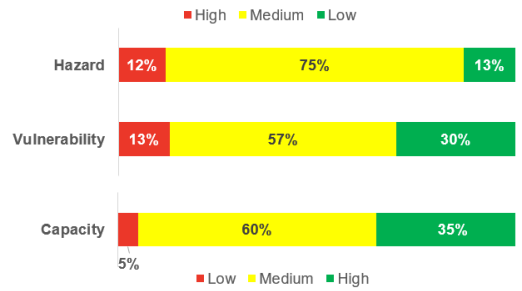
Inventory of assets → **Characterize flooding hazard** → **Historical impact analysis** → **Indicator-based risk assessment** → **Priority screening outputs and tool** → Integration into GIS software and mobilization to AM and facility management staff

Critical
Prominent
High Replacement Value

Riverine flooding
Urban flooding
Infrastructure leaks, failure, etc.



Asset-specific flood risk factors



Ontario Climate Consortium and Conservation Ontario, 2019

AMONTario
ASSET MANAGEMENT ONTARIO

Infrastructure Resiliency Professional - IRP

Course – Asset Management and Climate Resiliency

NEW course starting March 8, 2021!

The online **Asset Management and Climate Resiliency course** will begin on March 8, 2021.

The course **consists of seven* (7) two-hour sessions delivered through an online video-enabled webinar platform.** *Session 7 will be three and a half-hours in length.

It was designed to fulfill one of the knowledge requirements of the **Infrastructure Resilience Professional (IRP) Credentialling Program**, but it can also be taken as a stand-alone course for professional development credits

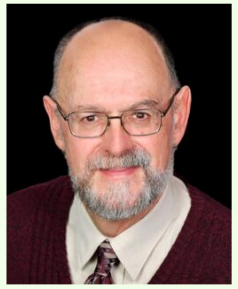
Course Fee:

- $625 plus HST (if pursuing the IRP credential)
- $475 plus HST (if for professional development only)

Fees cover course instruction and presentation materials in pdf format. Participants will be provided access to course materials one week prior to the beginning of the Course. This training is intended for individual instruction, not for groups under a single

Course Instructors

Guy Félio



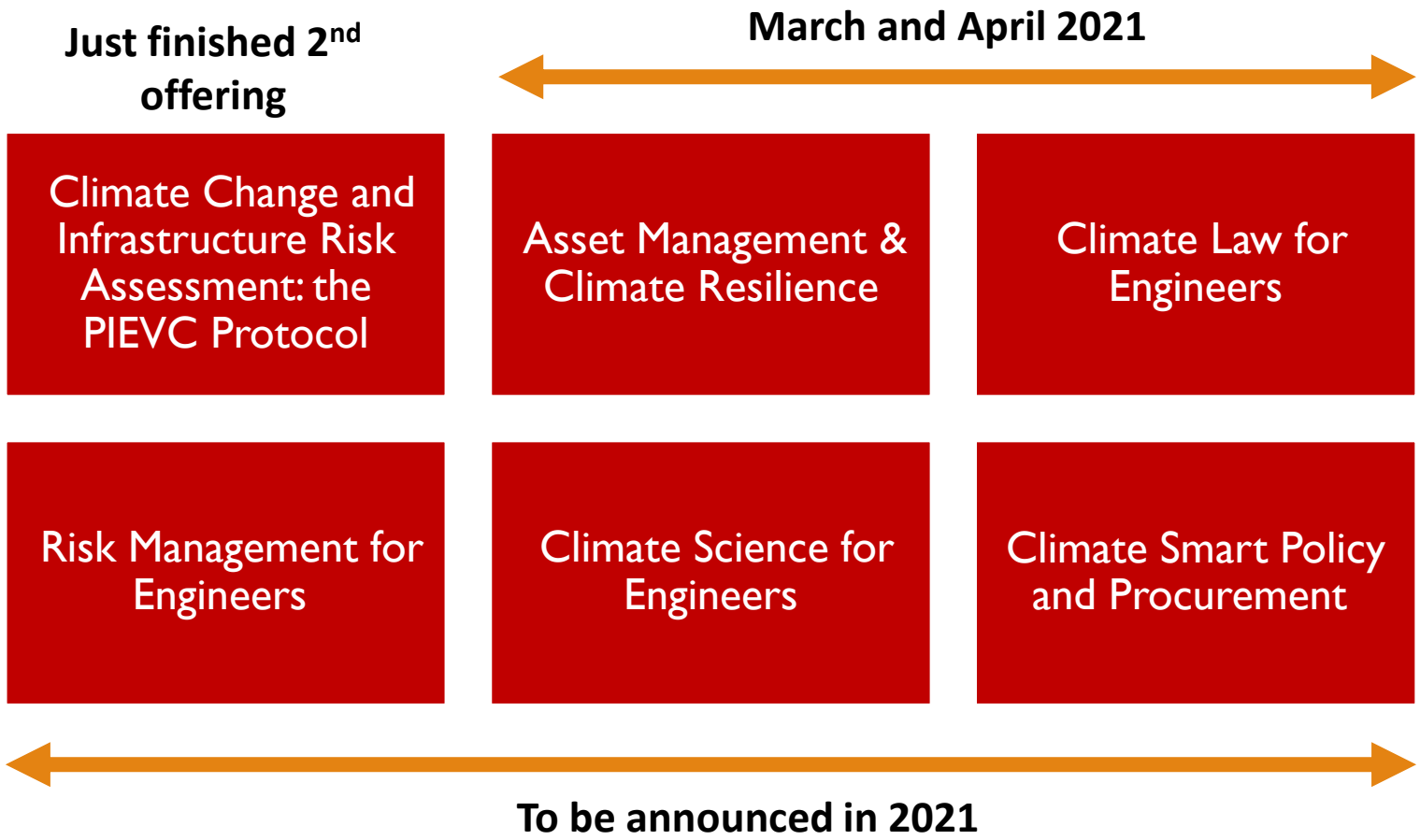
Guy Félio, PhD., P.Eng., FCSCE is a civil engineer with a Ph.D. from Texas A&M University. He has more than 35 years of experience in the field as a university professor, researcher, consultant and policy advisor. He focuses on finding practical, innovative, and cost-effective sustainable and resilient solutions for clients, in particular the owners and operators of infrastructure and facilities. He draws on his research, policy development, engineering, and teaching experience in his approach to problem-solving. Read more...

March 8, 2021

AMONTario
ASSET MANAGEMENT ONTARIO

Infrastructure Resilience Professional (IRP) Credentialling Program

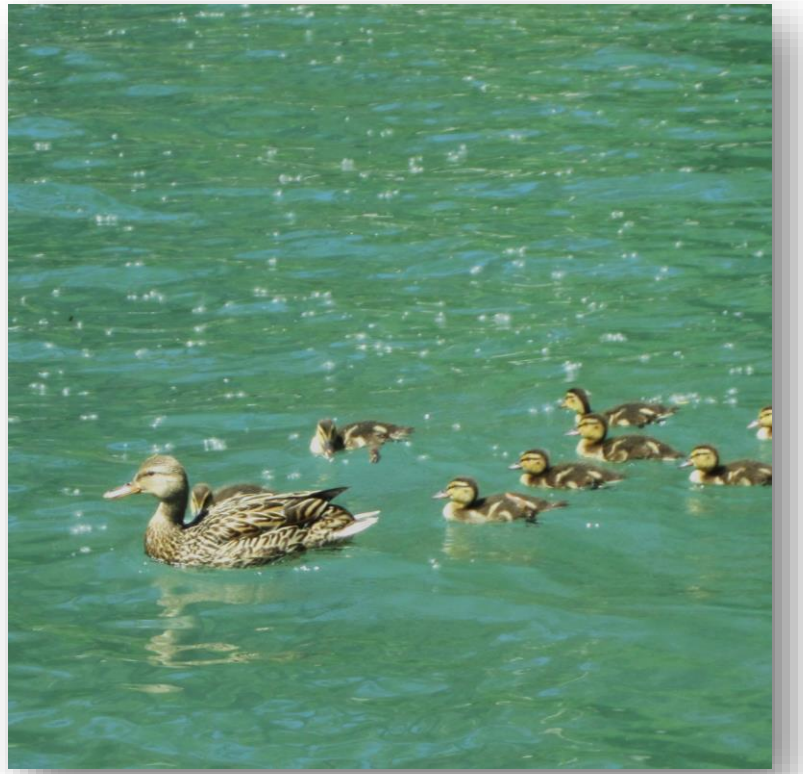
Designed to help infrastructure practitioners strengthen the **knowledge** and **competencies** they require to advance more **climate-resilient approaches** for the planning, design and management of infrastructure.



AMONTario
ASSET MANAGEMENT ONTARIO

Parting Messages

- Enhanced and continued risk from climate change requires continued planning and action
- Methodical process to assess and manage climate risks occurring
- Synergies between asset management planning and climate change risk assessment
- Iterative in an ever-changing environment



AMONTario
ASSET MANAGEMENT ONTARIO

CLIMATE RISK INSTITUTE

Thank You

Contact:

AL.DOUGLAS@climateriskinstitute.ca

Climateriskinstitute.ca

AMONTario
ASSET MANAGEMENT ONTARIO