Climate Change Risk Assessment: Core Principles for All Sectors

DILLON CONSULTING

- An introductory module on Climate Change Risk Assessment Objectives, Risk Assessment Core Principles and Approaches.

MANITOBA CLIMATE RESILIENCE TRAINING

1

1

MANITOBA CLIMATE RESILIENCE TRAINING

MANITOBA CLIMATE RESILIENCE TRAINING

Supported by Natural Resources Canada's Building Regional Adaptation Capacity and Expertise (BRACE) Program

2

2

Training Module Outline

- Purpose and Objective of Climate Change Risk Assessment (CCRA)
  - Key Terms
  - Climate Change as a Mechanism of Risk
- Identifying Climate Hazards
  - Risk Estimation and Analysis
  - Combining Likelihood and Consequence to Estimate Risk Levels
- 3 Tiers of CCRA
  - What is a Tier 1 CCRA?
  - What is involved in a Tier 2 CCRA?
  - Tier 3 CCRA Characteristics.

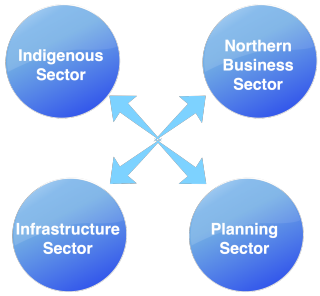
3

DILLON CONSULTING

3

Who This Training Is For

- This course was developed to provide foundational concepts in CCRA to all Manitoba BRACE MCRT Sectors.
- This course is a prerequisite for the **design-oriented** CCRA Course: "**Infrastructure Climate Risk Assessment Featuring the PIEVC Process**"



4

DILLON CONSULTING

4

Climate Change Risk Assessment (CCRA): Fundamentals

- CCRA is a process used to help business **identify their climate change-induced risks** from emerging climate change impacts. **A process with 3 key steps**:
  - **Identify Climate Hazards** and Anticipated Impacts
  - **Assess and Prioritise Risks**
  - **Plan to Reduce Identified Risks**
- CCRA answers the question "**What might the future look like for us and what climate conditions will we need to adapt to?**"
- The process looks at impacts to
  - **People**
  - **Property**
  - **Operations**
  - **Environment**

Image Sources: R Rempel, CBC Manitoba, CBC Manitoba

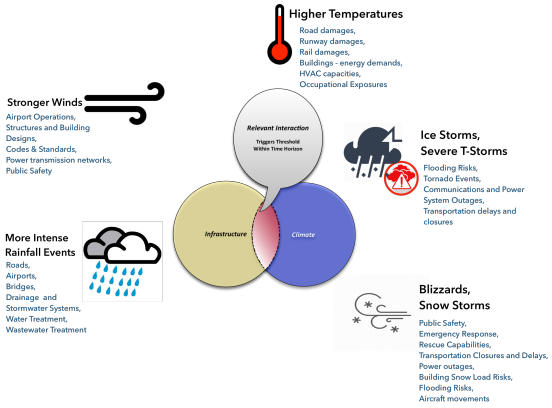
DILLON CONSULTING

5

5

Climate Change Risk Assessment: A Process to Address Climate Risks for Business

- **Climate change induces several key risks** to businesses, infrastructure providers.
- Risks stem from impacts to critical infrastructure, services, people
  - (transport, drainage, utilities, etc.)
- Risks lurk in other areas that are important to businesses, communities



DILLON CONSULTING

6

6

Responding to Climate Impacts: 3 Options Available

- For Climate Change, businesses have 3 responses available:

1. **Do Nothing – Business As Usual**
   - Leave your business prone to impacts: Often expensive, disruptive.
   - NOT considered a viable option.

Image Credits: Huffington Post, CBC North

DILLON CONSULTING

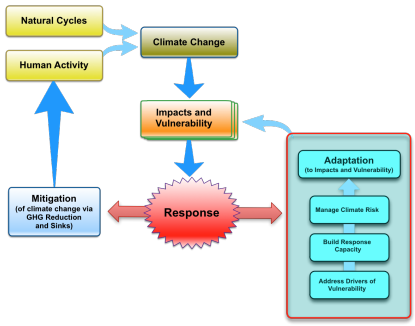
7

Responding to Climate Impacts: 3 Options Available…

- Only two viable responses remain:

2. **Mitigate Emissions causing Climate Change**
   - Apply strategies to **reduce the Greenhouse Gas emissions that cause** climate change

3. **Adapt to Climate Impacts**
   - Implement measures or changes to **increase your business' ability to cope** with climate impacts



Climate Change Risk Assessments provide the critical decision support information to inform your risk reduction planning.

DILLON CONSULTING

8

Defining Key Terms

Risk can be described in several ways, but at its essence, **risk is the possibility or probability of suffering a harm or loss, or the possibility of benefiting from an opportunity.**

- A source of opportunity to business
  - E.g. – *higher temperatures mean a longer open water season, so my lodge may see opportunity to extend operations for a longer fishing season.*
- A hazard or threat to the business. This is a "downside" risk.
  - E.g. – *wildfire events could cause loss of structures on our site property.*
- *Risk is the effect of uncertainty on objectives (ISO 31000).*

9

DILLON CONSULTING

9

Important Risk Considerations

- Any job or activity involves some level of hazard or risk.
- When risk is acknowledged, there is then a need for safety.
- Many businesses develop Safety Plans to manage their known risks.

10

DILLON CONSULTING

10

How Much Risk?

- We experience two kinds of risk:
  - *Perceived Risk:* a subjective judgement made by an individual
  - *Actual Risk:* the quantifiable aspects of risk (data on likelihood, impact severity of the risk)
- Our **perceived risk** is not always in line with **actual risk.**

11

DILLON CONSULTING

11

Defining Key Terms…

Perceiving Risk *(cont'd)*

- Our perceived risk is not always in line with actual risk
- For example, **more people die each year from falling out of bed (450 persons/year in USA) than they do from shark attacks.**
- This means the actual risk of death by falling out of bed is higher than from a shark attack..

but

- Many ocean swimming tourists perceive greater risk from the potential shark attack than from falling out of the bed in their hotel room.

12

DILLON CONSULTING

12

Defining Key Terms: Components of Risk

- At its essence, risk is the product of two components:

$$R = P \times S$$

Where those components are:

P= Probability (Likelihood)

S= Severity of the consequence of an event, *should it occur*.

Probability/Likelihood:
If numerical data-based, call it Probability
If qualitative, description-based, call it Likelihood

13

DILLON CONSULTING

13

Risk Characteristics: Low/High, High/Low Events

Image Credits: Reuters

Since risk is the combined effect of probability and severity ***both*** elements must be considered…

Very low likelihood and high severity can still be a serious risk:

- **Low Probability, High Impact Severity Example**: Japan's Fukishima Nuclear Reactor:
  - Earthquake triggers tsunami, causing massive floodwave,
  - Main power supply fails
  - Backup power systems flood and fail - no power for reactor cooling
  - loss of reactor cooling means **multiple reactor meltdown**.
- Catastrophic Severity resulting from this **very low likelihood, high severity** event.

14

DILLON CONSULTING

14

Risk Characteristics: Low/High, High/Low Events

Image: CBC News

Since risk is the combined effect of probability and severity ***both*** elements must be considered…

Very high likelihood and low severity may be a very low risk

- **High Probability, Low Severity Example**: Winnipeg's Forks Riverwalk:
  - River levels fluctuate due to spring runoff, seasonal rains
  - Large, high intensity rainstorms occur
  - Flash runoff from rains enters river, water levels rapidly rise
  - Riverwalk is flooded from rising water levels. Floods persist for parts of the season.
- Low Severity from this **high likelihood, low severity** event. The Riverwalk is designed to be routinely flooded, so very high likelihood of flooding, but impacts are low risk – they just rinse off the river mud and re-open.

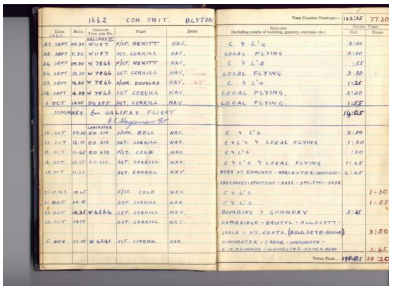
DILLON CONSULTING

15

15

Risk Characteristics

- In an ideal world, we have access to all the data that allows us to do a statistical analysis and generate numerical probabilities.
- The world is often not ideal, and we often lack data sufficient to create precise numerical values, so we then rely on **historical, operational and other experience to assign a descriptive, non-numerical classification**).
- Both approaches are acceptable, and usually necessary.
  - Its unusual to have data in hand for everything.



DILLON CONSULTING

16

16

Qualitative Definitions of Probability: Aviation Industry

- **Extremely Improbable:** should virtually never occur
- **Extremely Remote:** Unlikely to occur when considering several systems of the same type, but has to be considered as being possible
- **Remote:** Unlikely to occur during the total operational life of each system, but may occur
- **Reasonably Probable:** May occur once during the total operational life of one system
- **Frequent:** May occur once or several times during operational life

Source: ICAO Doc 5859 – Safety Management Manual

17

DILLON CONSULTING

17

Quantitative Definitions of Probability: Aviation Industry

- **Extremely Improbable:** < 10^{-9} per flight hour
- **Extremely Remote:** 10-7 to 10-9 per flight hour
- **Remote:** 10-5 to 10-7 per flight hour
- **Reasonably Probable:** 10-3 to 10-5 per flight hour
- **Frequent:** 1 to 10-3 per flight hour

Source: ICAO Doc 5859 – Safety Management Manual

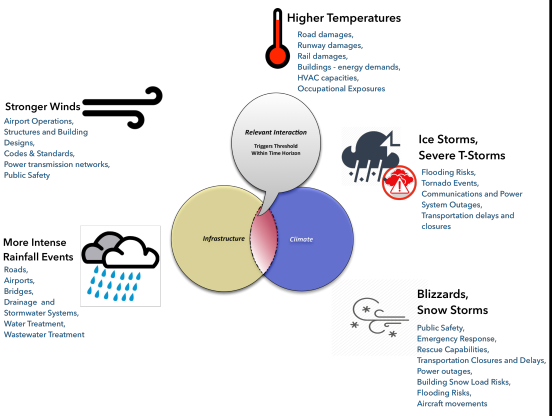
18

DILLON CONSULTING

18

Climate Change as a Mechanism of Risk to your Business/Organisation

- Climate change triggers impacts that create risks to assets, operations, and staff.
- In select cases, impacts may translate into benefits.
  - Example: climate change resulting in warmer temperatures will result a lower requirement for heating days per year. This likely will result in reduced demand on heating systems.
- Let's explore how climate risks arise and key areas of climate risk to businesses



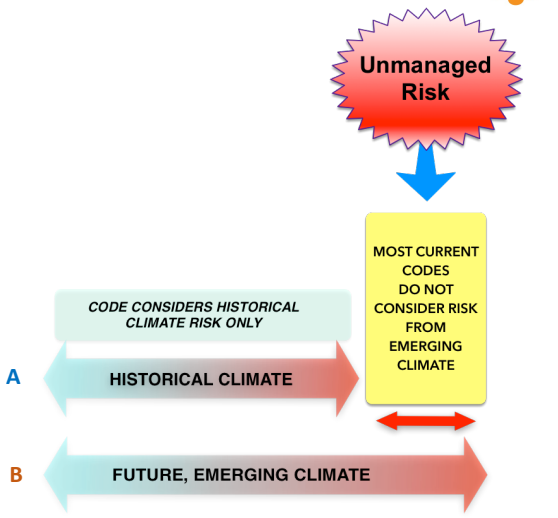
DILLON CONSULTING

19

19

Climate Change Risk: How Does This Happen?

- Today, Engineers face two realities in design:
  - **A:** The operating environment defined by historical (prior) climate
  - **B:** The operating environment defined by a newer, shifted climate.
- The gap between the two climates, if not designed for, can contain un-managed risk.



DILLON CONSULTING

20

20

Climate Change-Induced Risk to Businesses, Communities

- Climate Change has potential to induce several key risks to the businesses and communities:
  - **Regulatory Risks**
  - **Physical Risks**
  - **Risks to Reputation**
  - **Litigation Risks**
- For business continuity and reputational credibility, **businesses need to anticipate risks in each of these areas**

Image: CBC

21

DILLON CONSULTING

21

Regulatory Risks

- Regulations always evolve with time. Climate change means new regulations will continue to be introduced, joining many already in effect in two main areas:
  1. **Traditional Regulation**: Permits, Building Codes, Energy-efficiency requirements
  2. **Market-Based Regulation**: carbon taxes, fuel tariffs, emissions trading.

Image: The Economist, Sept. 2019

22

DILLON CONSULTING

22

Regulatory Risks…

- Newer regulations take several forms:
  - Improved **vehicle efficiency requirements**
  - Stronger **efficiency requirements in residential and commercial sectors**
  - Increased **reliance on renewables**
  - Strengthened **emission regulations**
  - Steps to **regulate emissions that were previously not regulated.**
- To avoid the most serious impacts of climate change, **we need to meet global emission targets.**
- **Those targets are only achievable with far-reaching regulatory changes.**
- **Expect regulatory changes to continue** as more severe impacts from climate change affect communities and economic sectors.

Image: Daily Energy Insider

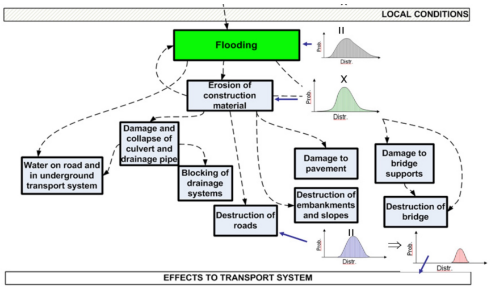
23

DILLON CONSULTING

23

Physical Risks

- Important for businesses to review their operations, movements, supply sources for sensitivity to climate impacts
- What systems does your business rely upon and what are the sensitivities to climate for those systems?
- Operational exposure to physical risks depends on
  - Sector of the business (any issues with your supply chain?)
  - Location where business operates



Source: VTT Technical Research Centre of Finland, 2011

24

DILLON CONSULTING

24

Reputational Risks

- In today's economy, **business reputation represents a significant share of brand value**:
  - **How your business addresses climate change, sustainability concerns will have an impact on its reputation**
  - Risks to business reputation are greater for
    - Sectors with **high emission levels**
    - Sectors that **interface directly with the public**
  - **Failure to comply with legislation can damage your reputation**
  - Increasingly, sectors such as energy, aviation, automobile industries are **expected to act beyond basic legal requirements**.

25

25

Legal Risks

Evolving and increasing legislation means higher risk of litigation in key areas affecting all sectors:

- Actions **targeting heavy emitters**
- **Legal challenges related to emerging jurisdictional carbon controls**
  - Carbon regulation expanding in Canada, and globally
- Legal scrutiny of greenhouse gas emissions, and **Climate Risk Disclosure**

26

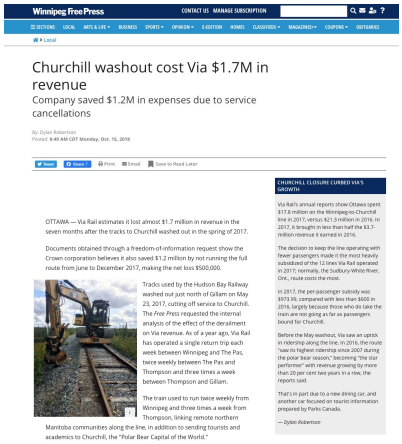
26

Climate Change Risks to Operations

It boils down to this:

Climate change is operating environment change.

- **Climate change will be more disruptive, for longer than COVID-19 has been to business, communities.**
- **There is no vaccine for climate change.**
- Changes, and their effects, can create risk for company/community operations.
  - Supply chain disruptions
  - Water quality and supply issues for water-dependent operations/processes
  - Cooling for IT systems, controls



Winnipeg Free Press

Churchill washout cost Via $1.7M in revenue

Company saved $1.2M in expenses due to service cancellations

By: Dylan Robertson
Posted: 8:49 AM CDT Monday, Oct. 15, 2018

OTTAWA — Via Rail estimates it lost almost $1.7 million in revenue in the seven months after the tracks to Churchill washed out in the spring of 2017.

Documents obtained through a freedom-of-information request show the Crown corporation believes it also saved $1.2 million by not running the full route from June to December 2017, making the net loss $500,000.

Tracks used by the Hudson Bay Railway washed out just north of Gillam on May 23, 2017, cutting off service to Churchill. The Free Press requested the internal analysis of the effect of the derailment on Via revenue. As of a year ago, Via Rail has operated a single return trip each week between Winnipeg and The Pas, twice weekly between The Pas and Thompson and three times a week between Thompson and Gillam.

The train used to run twice weekly from Winnipeg and three times a week from Thompson, linking remote northern Manitoba communities along the line, in addition to sending tourists and academics to Churchill, the "Polar Bear Capital of the World."

CHURCHILL CLOSURE CURBED VIA'S GROWTH

Via Rail's annual reports show Ottawa spent $17.8 million on the Winnipeg-to-Churchill line in 2017, versus $21.3 million in 2016. In 2017, it brought in less than half the $3.7-million revenue it earned in 2016.

The decision to keep the line operating with fewer passengers made it the most heavily subsidized of the 12 lines Via Rail operated in 2017; normally, the Sudbury-White River, Ont., route costs the most.

In 2017, the per-passenger subsidy was $673.39, compared with less than $600 in 2016, largely because those who do take the train are not going as far as passengers bound for Churchill.

Before the May washout, Via saw an uptick in ridership along the line. In 2016, the route "saw its highest ridership since 2007 during the polar bear season," becoming "the star performer" with revenue growing by more than 20 per cent two years in a row, the reports said.

That's in part due to a new dining car, and another car focused on tourist information prepared by Parks Canada.

— Dylan Robertson

DILLON CONSULTING

Climate Change Risks to Assets

- **Climate Change is operating environment change.**
- Changes happening where your assets operate will pose risks to company assets due to impacts from:
  - Wildfire events
  - Overland flooding
  - Extreme heat events
  - Drought
  - Severe storms
  - Increased Snowloads

"Among S&P 500 Companies, 60% own assets that are at high risk of at least one type of climate change physical risk."

"The Big Picture on Climate Risk", S&P Global, 2020

DILLON CONSULTING

Climate Change Risks to Staff

Climate Impact	Mechanisms	Staff Impacts
Extreme Heat Events	• Prolonged exposure to extreme heat.	• Heat stress • Heat stroke • Heat exhaustion
Air Pollution	• Changes in ground level ozone and particulate pollution levels	• Heart disease • Respiratory disease • Allergic reactions
Extreme Weather Events	• Floods, landslides, storms, lightning, wildfires, drought	• Occupational fatalities • Injury, disease, mental stress
Biological Hazards	• Changes in Temperature and Rainfall affect pathways for pathogens, invasive species, etc.	• Vector-borne disease • Mold-related asthma • Allergies
Indoor Climate	• Higher temperatures stress existing climate control.	• Indoor air quality degradation • Heat stress

NIOSH, 2016

- Climate Change and its effect on environment can also pose risks to both indoor and outdoor workers.

DILLON CONSULTING

29

Defining Climate Hazards

- A Climate Hazard is…

..”the potential occurrence of **natural, physical event or trend** *that* **may cause loss of life, injury or other health impact, as well as damage and loss to property, infrastructure, livelihoods, services, ecosystems and environmental resources.”**

Intergovernmental Panel on Climate Change (IPCC), 2016

DILLON CONSULTING

30

Identifying Climate Hazards

Climatic Conditions

Understanding the character, magnitude and rate of change in the climatic conditions to which businesses will face

Sensitivities of Assets, Infrastructure, Operations

How sensitive is my business to climatic changes?

Built-in Capacity of the business

What level of built-in capacity within my business exists to absorb net consequences from changing climatic conditions?

Identifying climate hazards includes consideration of all 3 elements!

31

31

Climate Change Risk Assessment:

Providing Results Needed to Reduce Climate Impacts

- CCRA is a 4-step process.

Source: National Climate Change Adaptation Research Facility, Australia Department of the Environment and Energy, 2017

32

32

Climate Change Risk Assessment:
Steps in CCRA

Establish Context

- Define scope of assessment
- Set goals for assessment
- Identify stakeholders

Source: National Climate Change Adaptation Research Facility, Australia Department of the Environment and Energy, 2017

33

33

Climate Change Risk Assessment:
Steps in CCRA

Step 1 Context

- Some example business goals and their descriptions

Business Goal	Description
Minimise loss of infrastructure services	Maintain services from essential infrastructure
Minimise disruption of supply chain	Maintain supplies of critical materials
Minimise injury, disease or hospitalization to customers, staff, suppliers	Preserve and enhance public health and safety
Minimise loss of economic activity	Maintain business continuity

34

34

Climate Change Risk Assessment:
Steps in CCRA

Identify Past/Current Climate Risks

- Review your business' objectives and identify climate risks that could negatively affect those objectives related to your business' products and/or services.

Source: National Climate Change Adaptation Research Facility, Australia Department of the Environment and Energy, 2017

Which climate hazards affect any or some of your products, services? Document these linkages!

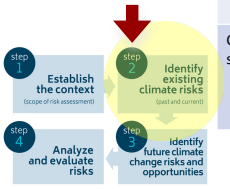
35

35

Climate Change Risk Assessment:
Steps in CCRA

Identify Past/Current Climate Risks…

- Identify high priority risk events that can be considered in the risk assessment.



Risk Cause	Sudden Onset or Ongoing Event?	Impact Concern
Change in average temperatures (air, river, lake)	Ongoing	• Seasonality • Aquatic life • Winter road network
Increase in extreme heat events	Sudden onset	• Human health, heat exhaustion • Operational limitations
Increases in Extreme Precipitation	Sudden onset	• Overland flooding • Road washouts
Changes in seasonal precipitation (snow, rain)	Ongoing	• Downed power lines • Ice accretion and slip/fall hazards • Drought
Change in wind patterns and speeds	Ongoing	• Airborne debris, building damages • Tree limb failure and utilities (hydro, etc.), wildfires

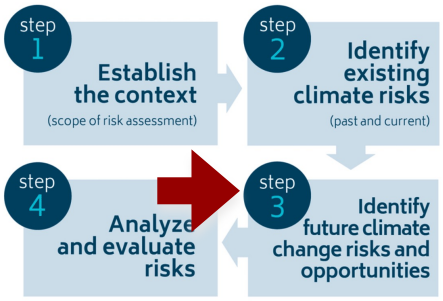
36

36

Climate Change Risk Assessment:
Providing Results Needed to Reduce Climate Impacts

Identify Future Climate Risks and Opportunities

- Make a list of your exposed assets/services
- List all the weather and climate-related events that could disrupt or damage your assets/services



What aspects of your assets, operations, products/services, staff are impacted by these hazards?

37

DILLON CONSULTING

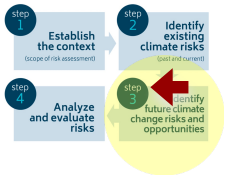
37

Climate Change Risk Assessment:
Providing Results Needed to Reduce Climate Impacts

Identify Future Climate Risks and Opportunities

- Make a list of your exposed assets/services
- List all the weather and climate-related events that could disrupt or damage those assets/services

Assets/Services	Hazards
Summer Tourism Season Revenue	Warmer temps likely means longer operating season (opportunity)
Staff Safety	Extreme Heat events
Warehouse Building	Site Drainage – extreme rainfall, Snowloads, extreme snowfall
Supply Chain/Winter Road Network	Warmer temps and shorter winter season leads to shorter, less reliable winter road season.



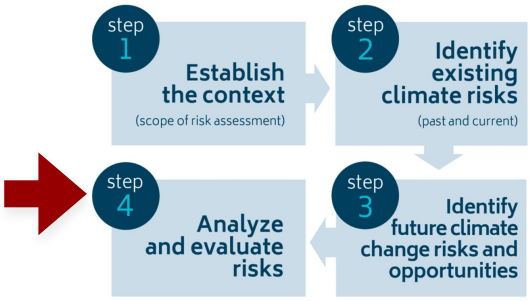
38

DILLON CONSULTING

38

Climate Change Risk Assessment:
Providing Results Needed to Reduce Climate Impacts

- Analysing and Evaluating Risks requires estimates for
  1. **Probability of Hazard** – obtained from data or trend analysis
  2. **Severity of Impact** – obtained from business experience, multi-disciplinary considerations (health, engineering, financial, regulatory, etc.)



When a hazard occurs, how bad is the severity of that impact to your business?

39

DILLON CONSULTING

39

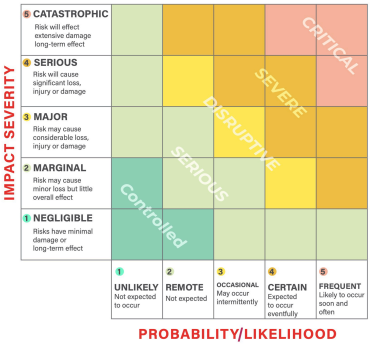
Simple 5-Point Scales for Assessments

40

DILLON CONSULTING

40

Combining Probability and Severity Ratings: 5 Point Scale



SCORE	RISK LEVEL	RESPONSE
1-2	CONTROLLED	Limited Monitoring Only
3-6	SERIOUS	Active Monitoring
8-9	DISRUPTIVE	Investigation Needed
10-16	SEVERE	Rapid Action Required
20-25	CRITICAL	Immediate, Crucial Priority

Risk Level= Probability x Impact Severity

- Prioritise your risks by risk levels.
- Reduce the highest scoring risks as your top priority.
- Strategically plan to reduce all your identified risks in an order that makes sense for your business.
- The results from CCRA are rich with decision-support information on your climate risks.

DILLON CONSULTING

41

41

Overview of the 3 Tiers of CCRA

Tier 1 — Identify Impacts and Preliminary Qualitative Risk Assessment

Tier 2 — Semi-quantitative Risk Analysis
Systematic Mapping (cross sector risks)
Policy Risk Analysis (includes gap analysis)

Tier 3 — Fully Quantitative Risk Analysis
-Data insufficiency significant barrier to T3
-Very few sectors have req'd data to complete T3


Community


System


Networked Assets

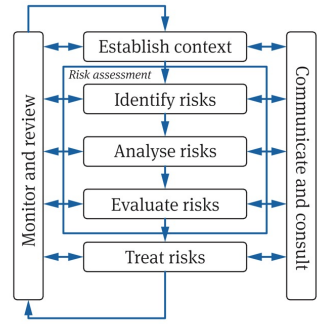
DILLON CONSULTING

42

42

Introduction to Tier 1 CCRAs

- Tier 1 Primary Elements:
  - Defining what's in, what's out, geographic boundary conditions
  - Identifying existing stressors potentially exacerbated by climate change
  - Projecting climate-related effects, including changes in climate variability and determining how these effects impact infrastructure
  - Identifying and evaluating the likelihood and consequence of climate-related impacts
  - Characterizing uncertainty and assumptions
  - Communicating risks to stakeholders



Source: ISO 31000: Risk Management Guidance

DILLON CONSULTING

43

43

Tier 1 Example: ISO 31 000

- Can be data-driven, qualitative, or both.
- Infrastructure Canada's Climate Lens Requirements, reference to ISO 31000 for **Resilience Assessments**

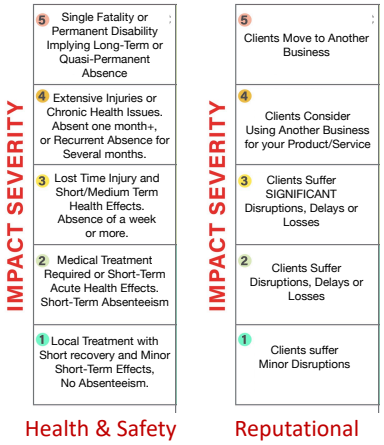
DILLON CONSULTING

44

44

Tier 1: Consequence Evaluation

- Consequence Evaluation:
  - Can look at Impact Severity in one or more areas:
    - Health & Safety
    - Reputational
    - Operational
    - Environment
    - Financial
    - Legal
    - Community and other stakeholders



45

45

Tier 1: Likelihood Evaluation

- Likelihood Evaluation:
  - Numerical scale, covering range between low and almost certain likelihood of occurrence.

LIKELIHOOD RATINGS		
Almost certain	5	Recurrent events - expect this event almost annually. Single event - highly likely (>90% probability).
Probable	4	Recurrent events - expect this event several times in your career. Single event - more likely to occur than not (50-90% probability).
Possible	3	Recurrent events - expect this event to occur once in your career, at any time. Single event - less likely than not, but still appreciable chance of occurring (10-50%).
Unlikely	2	Recurrent events - event hasn't occurred during your career yet, but could occur at some time. Single event - unlikely but not negligible (1-10%).
Rare	1	Recurrent events - event has occurred elsewhere, but in exceptional circumstances. Single event - not expected to occur, but possible (<1%).

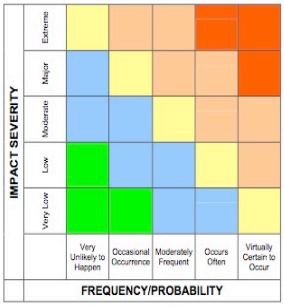
Source: World Bank Group, International Finance Corp. Climate Risk and Business-PORTS

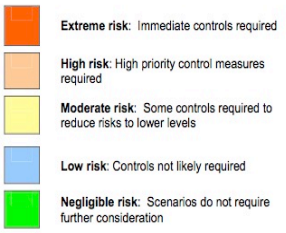
46

46

Tier 1: Risk Prioritisation

- Prioritization applies a Likelihood and Consequence Matrix:





Source: New Zealand Risk Guidebook

47

47

Tier 1: More Training

- For more detailed training on Tier 1 CCRAs, please proceed to the **CCRA for MB Northern Business Course Module.**
- This module will demonstrate a **Tier 1 CCRA applied to a business example**.

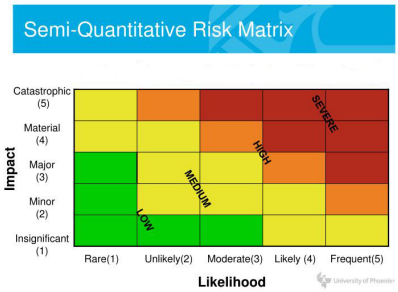
mcrtproject.ca/courses/

48

48

Tier 2 CC Risk Assessment

- Tier 2 Characteristics
  - Semi-quantitative Risk Analysis
  - Systematic Mapping (indirect and cross-sector risks)
  - Policy Risk Assessment (gap analysis)
  - Best conducted by a multi-disciplinary team (climate scientists, engineers, process operators, maintenance staff)
- Tier 1 assessment process informs selection of higher priority impact areas or assets for Tier 2 Analysis
- Many approaches to T2 analyses



49

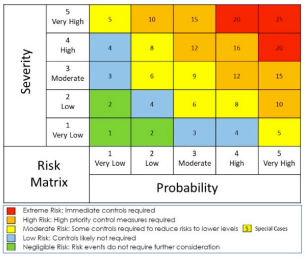
Tier 2: PIEVC Risk Framework

- **PIEVC means "*Public Infrastructure Engineering Vulnerability Committee*"**
- **Developed and launched by Engineers Canada**
- **In 2020, Engineers Canada transferred ownership and control of PIEVC to the Institute for Catastrophic Loss Reduction (ICLR), the Climate Risk Institute and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH**
- An assessment protocol to assess and prioritize climate vulnerabilities for critical public infrastructure
- Objectives:
  - look at infrastructure vulnerability to climate change from an engineering perspective
  - Facilitate development of best engineering practices that adapt to climate change impacts

Adapting infrastructure to a changing climate

PIEVC

PUBLIC INFRASTRUCTURE ENGINEERING VULNERABILITY COMMITTEE

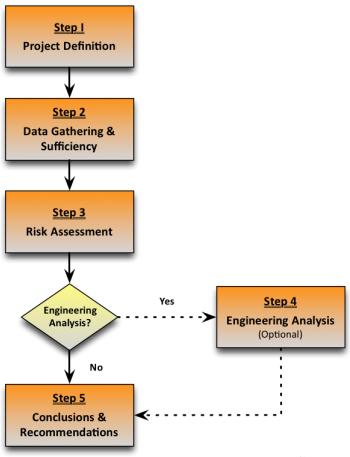


50

Tier 2 CCRAs: PIEVC

PIEVC Protocol Steps

A Five Step Process

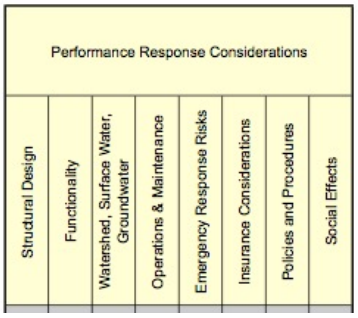


51

51

Tier 2: Considerations for Risk in PIEVC

- Specifically, PIEVC looks at the aspects of a facility with anticipated sensitivities to changes in specific climate parameters. PIEVC guides to look for problems in areas of:
  - Structural Serviceability
  - Serviceability
  - Operations & Maintenance
  - Emergency Response Risks
  - Insurance Considerations
  - Policies and Procedures
  - Economics
  - Public Health & Safety
  - Environmental Effects



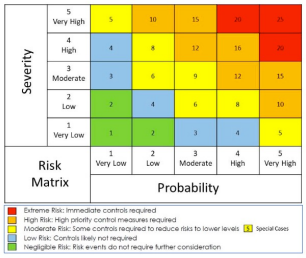
i.e. "When extreme rain event occurs, what response is possible in these key performance areas?"

52

52

Tier 2: Identifying Climate Interactions in PIEVC

Infrastructure Components	Climate Parameters: Temperature: Mid-winter Thaw (Dec/Jan/Feb Tmin>=3C)				Temperature: Freeze-Thaw Cycles (Winter, 30 cycles -3C to +3C)				Temperature: Frost Penetration (1.51m depth; need to revisit threshold)				Rainfall: Extreme Rainfall (threshold for ponding causing road closure, 4-6in ponding; 25 mm in 1hr)				Rainfall: Extreme Rainfall (Threshold for flooding; 55mm in 1 hour; ~1:14 year event based on current IDF)				Rainfall: Extreme Rainfall (Catastrophic events; 1:100 year event; 79.5mm in 1hr based on current IDF)			
Catchment Ground Surfaces	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
Roads	n			0	n			0	n			0	y	4	3	12	Y	2	4	8	Y	1	5	5
Grass	n			0	n			0	n			0	y	4	2	8	Y	2	3	6	Y	1	4	4
Parking Lots	n			0	n			0	n			0	y	4	3	12	Y	2	4	8	Y	1	5	5
Rooftops -residential	n			0	n			0	n			0	y	4	1	4	Y	2	1	2	Y	1	1	1
Weeping Tile	n			0	n			0	n			0	y	4	1	4	y	2	1	2	y	1	3	3



- For each infrastructure component, PIEVC assessors look at each climate factor and ask:
  - Will a component react in some way to a change involving this climate parameter?
  - If yes, a "checkmark" is indicated, identifying this interaction.

DILLON CONSULTING

53

53

Tier 2: Verifying Results in Workshop Session

- **Verify Results in Workshop**. Allows confirmation of:
  - Protocol data and workflow
  - Climate data availability, suitability and applicability
  - Vulnerability assessment rationale, results and verification with system operators and managers
- **This kind of brainstorming is best practice for ALL Tiers of Climate Risk Assessment.**
  - Leverages multiple perspectives on climate impacts **across your business**.

DILLON CONSULTING

54

54

Tier 2: Workshop Master Results

Infrastructure Components	Climate Parameters																																	
	Temperature												Rainfall												Wind Speed				Lightning				Hail			
	Mid-winter Thaw (Dec/Jan/Feb Tmin>=3C)				Freeze-Thaw Cycles (Winter, 30 cycles -3C to +3C)				Frost Penetration (1.51m depth; need to revisit threshold)				Extreme Rainfall (threshold for ponding causing road closure, 4-6in ponding; 25 mm in 1hr)				Extreme Rainfall (Threshold for flooding, 55mm in 1 hour; ~1:14 year event based on current IDF)				Extreme Rainfall (Catastrophic events; 1:100 year event; 79.5mm in 1hr based on current IDF)				Thunderstorm Winds (90km/h+, Apr-Sep)											
Catchment Ground Surfaces	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
Roads	n			0	n			0	n			0	y	4	3	12	Y	2	4	8	Y	1	5	5	n			0	n			0	n			0
Grass	n			0	n			0	n			0	y	4	2	8	Y	2	3	6	Y	1	4	4	n			0	n			0	n			0
Parking Lots	n			0	n			0	n			0	y	4	3	12	Y	2	4	8	Y	1	5	5	n			0	n			0	n			0
Rooftops -residential	n			0	n			0	n			0	y	4	1	4	Y	2	1	2	Y	1	1	1	n			0	n			0	y	2	1	2
Weeping Tile	n			0	n			0	n			0	y	4	1	4	y	2	1	2	y	1	3	3	n			0	n			0	n			0
Existing Lift Station	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
Manhole Chamber (shallow)	n			0	y	2	1	2	y	5	1	5	y	4	1	4	y	2	1	2	y	1	1	1	n			0	n			0	n			0
Pump	n			0	n			0	n			0	y	4	1	4	y	2	1	2	y	1	1	1	n			0	y	2	1	2	n			0
Back-up Pump *(natural gas)*	n			0	n			0	n			0	n			0	n			0	n			0	n			0	n			0	n			0
Building (brick, concrete roof)	n			0	y	2	1	2	n			0	n			0	n			0	n			0	y	4	1	4	y	2	2	4	n			0
Floats	n			0	n			0	n			0	n			0	n			0	n			0	n			0	n			0	n			0
Electrical Panel	n			0	n			0	n			0	n			0	n			0	n			0	n			0	y	2	1	2	n			0
Internal piping (Cast Iron)	n			0	n			0	n			0	n			0	n			0	n			0	n			0	n			0	n			0
Heater	n			0	n			0	n			0	n			0	n			0	n			0	n			0	y	2	1	2	n			0
Outlet (flap valve external to	n			0	n			0	n			0	y	4	1	4	y	2	1	2	y	1	1	1	n			0	n			0	n			0

Extreme Risk: Immediate controls required
High Risk: High priority control measures required
Moderate Risk: Some controls required to reduce risks to lower levels 5 Special Cases
Low Risk: Controls likely not required
Negligible Risk: Risk events do not require further consideration

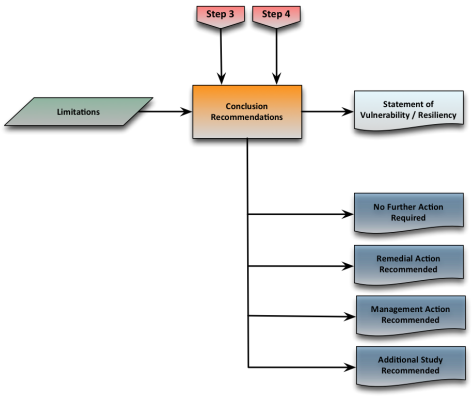
55

DILLON CONSULTING

55

Tier 2: Reporting PIEVC Results, Recommendations

- Results from PIEVC are rich in decision-support information. Info packages tailored for
  - Government officials (briefing level)
  - Owners and operators of the infrastructure (technical detail)
- Generally, four major categories of recommendations:
  1. Remedial action required to upgrade
  2. Management action required to address infrastructure capacity shortfalls
  3. No further action required
  4. Data gaps or data quality require more study for proper assessment



56

DILLON CONSULTING

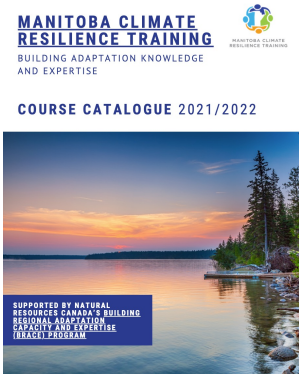
56

Tier 2: More Training on PIEVC

- For more detailed training on Tier 2 CCRAs, please proceed to the **MCRT Course:**

Infrastructure Climate Risk Assessment Featuring the PIEVC Process

- This module will provide detailed training on conducting a PIEVC assessment, tailored for the design community.



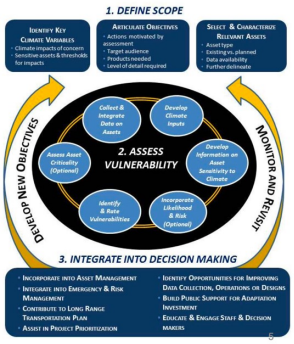
mcrtproject.ca/courses/

57

57

Introduction to Tier 3 CCRAs

- Highest detail and effort to complete.
- Conducted on a critical network scale (e.g. state highway network)
- Multiple detailed steps to complete
- Example: FHWA Maryland State Highway Administration Climate Vulnerability Assessment

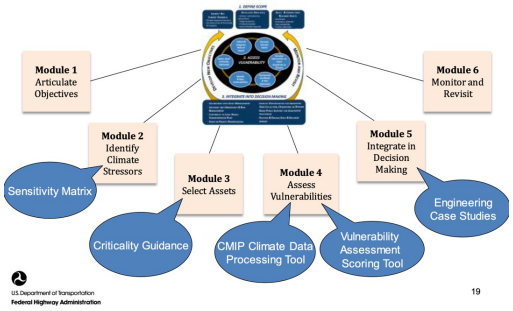


58

58

Introduction to Tier 3 CCRAs

- Involved detailed modelling of multiple climate stressors
  - Sea Level Rise
  - Storm Surge
  - Precipitation
- This study assessed:
  - over 220 bridge assets
  - State road network
  - State culverts and drainage conveyances
- Study took 2 years to complete, included teams of MDOT staff, consulting engineers, local university climate experts.
- Tier 3 is not commonly used due to complexity and cost. Suitable for holders of large asset portfolios.

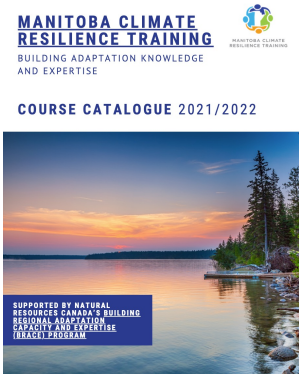


59

59

Where to From Here?

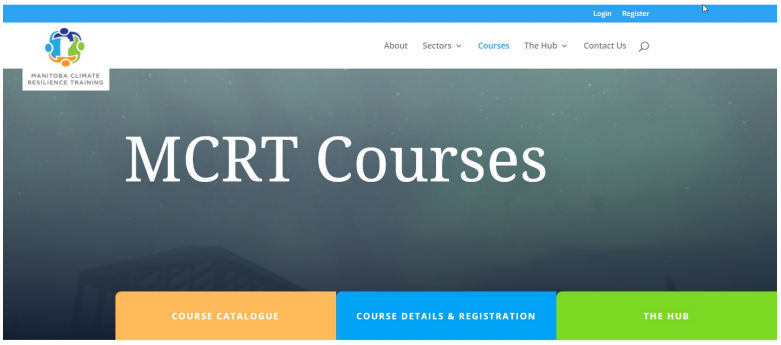
- For **Business Sector participants**, proceed to the
  - **CCRA for Manitoba Business Module.**
    - Tier 1 CCRA applied to the business context.
- For **design professionals**, proceed to the
  - **Infrastructure Climate Risk Assessment Featuring the PIEVC Process Module**



mcrtproject.ca/courses/

60

60



https://mcrtproject.ca/courses/

61

61

Feedback

Post-Pilot Class Participation Survey:

- Your feedback is extremely important to us, critical to course module refinement
- Links to a survey will be emailed to you within 24 hours

62

62


MANITOBA CLIMATE
RESILIENCE TRAINING
Manitoba
Natural Resources Canada
Ressources naturelles Canada
Canada
ICLEI
ENGINEERS
GEOSCIENTISTS
MANITOBA
DILLON
CONSULTING
Prairie
Climate Centre
From Risk to Resilience

63