Adaptation Deep Dive

Introduction by

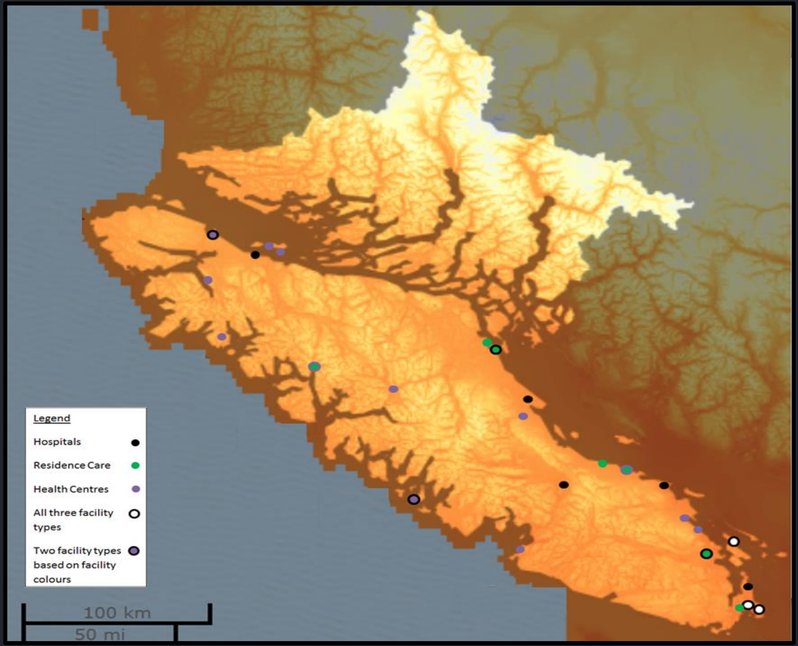
Deanna Fourt, Director of Design, Energy and Sustainability • Vancouver Island Health Authority

December 7, 2017, Vancouver, BC

Introduction

Island Health: Who We Are

- One of 7 health authorities in BC
- 765,000 people served on Vancouver Island, the islands in the Salish Sea and Johnstone Strait

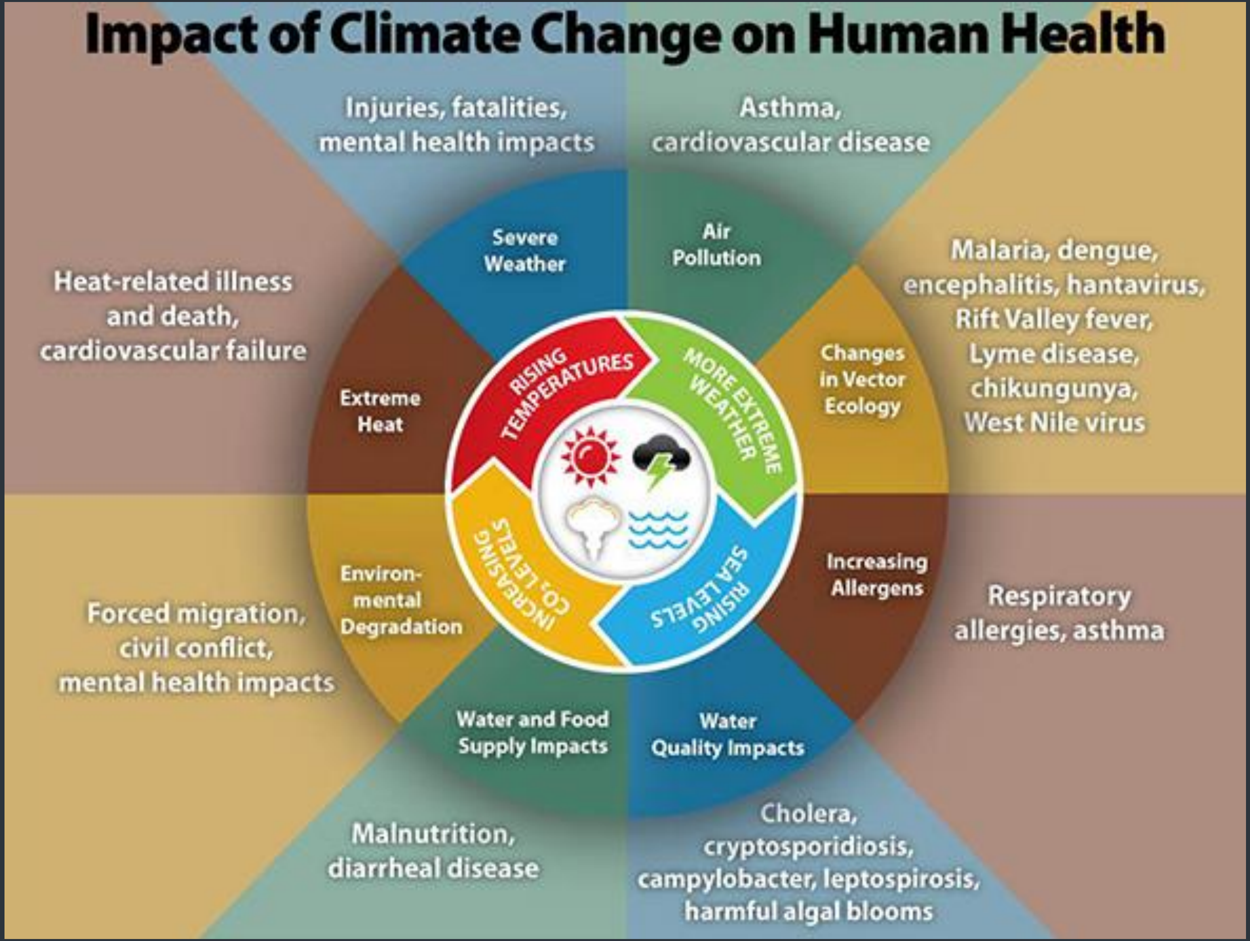


Motivation

- BC's 2016 Climate Leadership Plan calls for 10-year *emissions reduction* and *adaptation* plans.
  - Island Health has a 5 year emissions reduction plan.
  - Do not have an adaptation plan. This is a first step.

*"A **climate resilient health system** is one that is capable to anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stress, so as to bring sustained improvements in population health, despite an unstable climate."*

\- World Health Organization, 2015


Impact of Climate Change on Human Health
Injuries, fatalities, mental health impacts
Asthma, cardiovascular disease
Severe Weather
Air Pollution
Heat-related illness and death, cardiovascular failure
Extreme Heat
RISING TEMPERATURES
MORE EXTREME WEATHER
Changes in Vector Ecology
Malaria, dengue, encephalitis, hantavirus, Rift Valley fever, Lyme disease, chikungunya, West Nile virus
INCREASING CO2 LEVELS
RISING SEA LEVELS
Environ-mental Degradation
Increasing Allergens
Forced migration, civil conflict, mental health impacts
Respiratory allergies, asthma
Water and Food Supply Impacts
Water Quality Impacts
Malnutrition, diarrheal disease
Cholera, cryptosporidiosis, campylobacter, leptospirosis, harmful algal blooms

Physical Impacts

-Power or water outages
-Inadequate HVAC
-Building envelope damage
-Waste or stormwater back-flows
-and more

Social Impacts

-Patient surges
-Longer patient stays
-Strain on medical & basic supplies
-Increased demand on staff & mental health impacts
-and more

Disruption to health care service delivery

Adapted from: *Climate Risks & Impacts to Health Care Service Delivery*.

Presentation Overview

- Climate Vulnerability Assessment of Nanaimo Regional General Hospital
- Climate Adaptation Research and Mapping Project
- Q & A

Climate Vulnerability Assessment of Nanaimo Regional General Hospital

Joe Ciarniello, M.Eng, P.Eng, CEM • **Vancouver Island Health Authority**

Robert Lepage, M.A.Sc., P.Eng., Ph.D. Candidate • **RDH Building Science Inc.**

Trevor Murdock, M.Sc. • **Pacific Climate Impacts Consortium**

Introduction

- How important is keeping hospitals fully operational? CRITICAL
- NRGH - second largest hospital campus (Royal Jubilee Hospital in Victoria is the largest)
  - Serves ~350,000 people
  - Construction dates range from early 1960’s to 2012
  - 55,000 m^2 floor area, 34 GWh total annual energy consumption
- Pilot project: to learn “how to”
- Build capacity for conducting PIEVC risk assessments

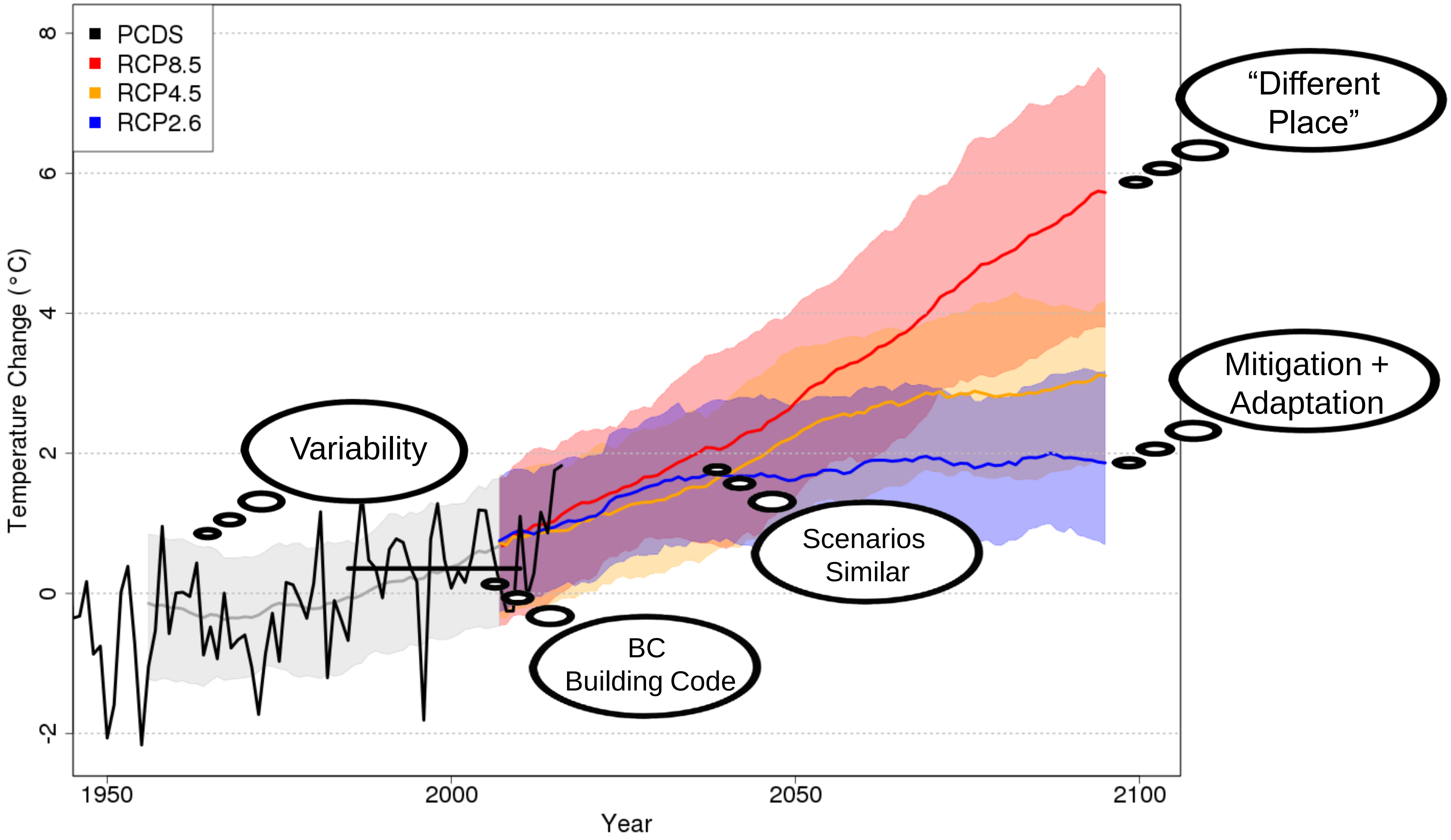
Presentation Themes

- Climate change and climate projections
- PIEVC Protocol
- Climate vulnerability assessment of NRGH
- What climate scientists can & can’t provide engineers

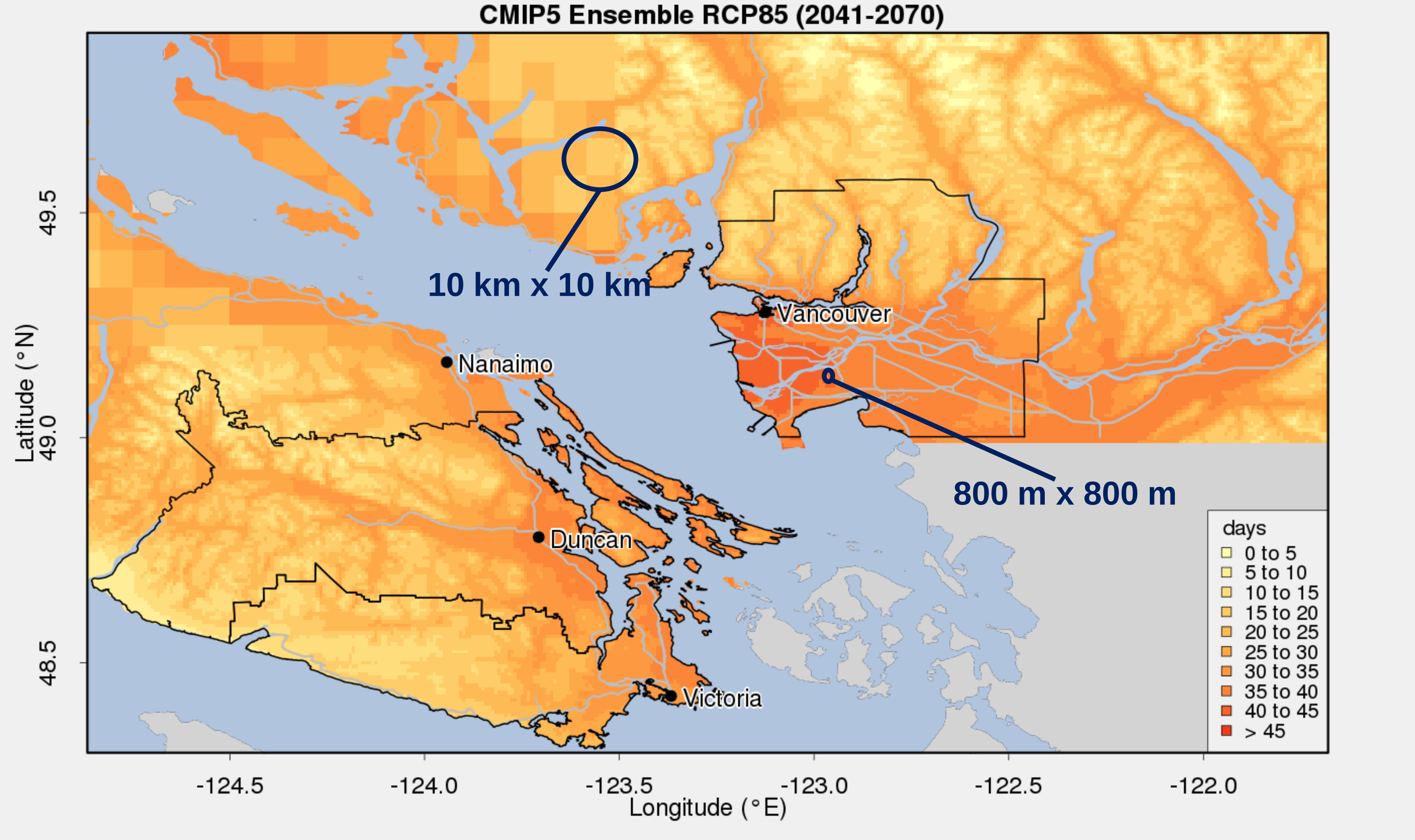
Climate is Changing, But What Does That Mean for Engineers?

Downscaling

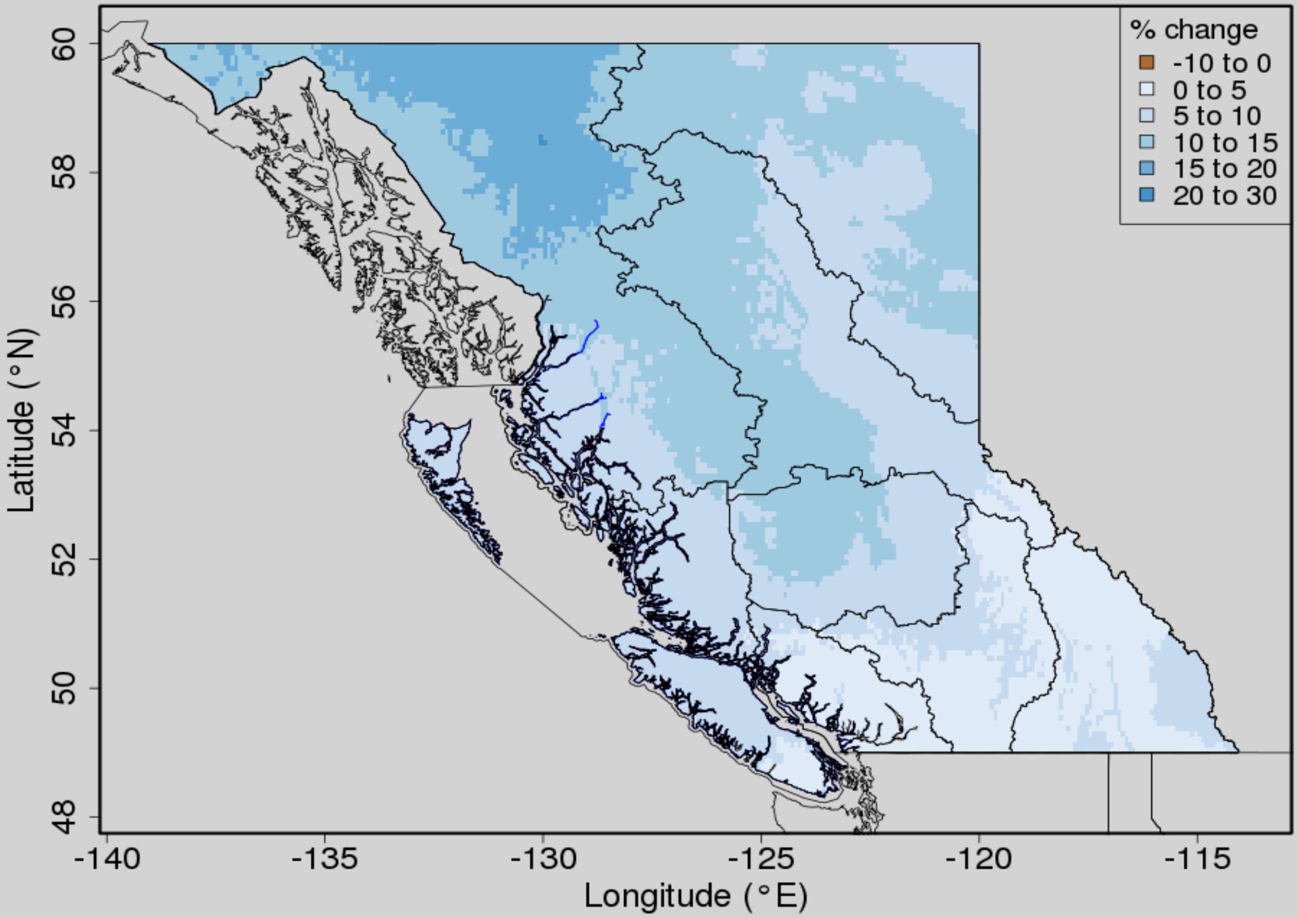
Projected future temperature change in BC



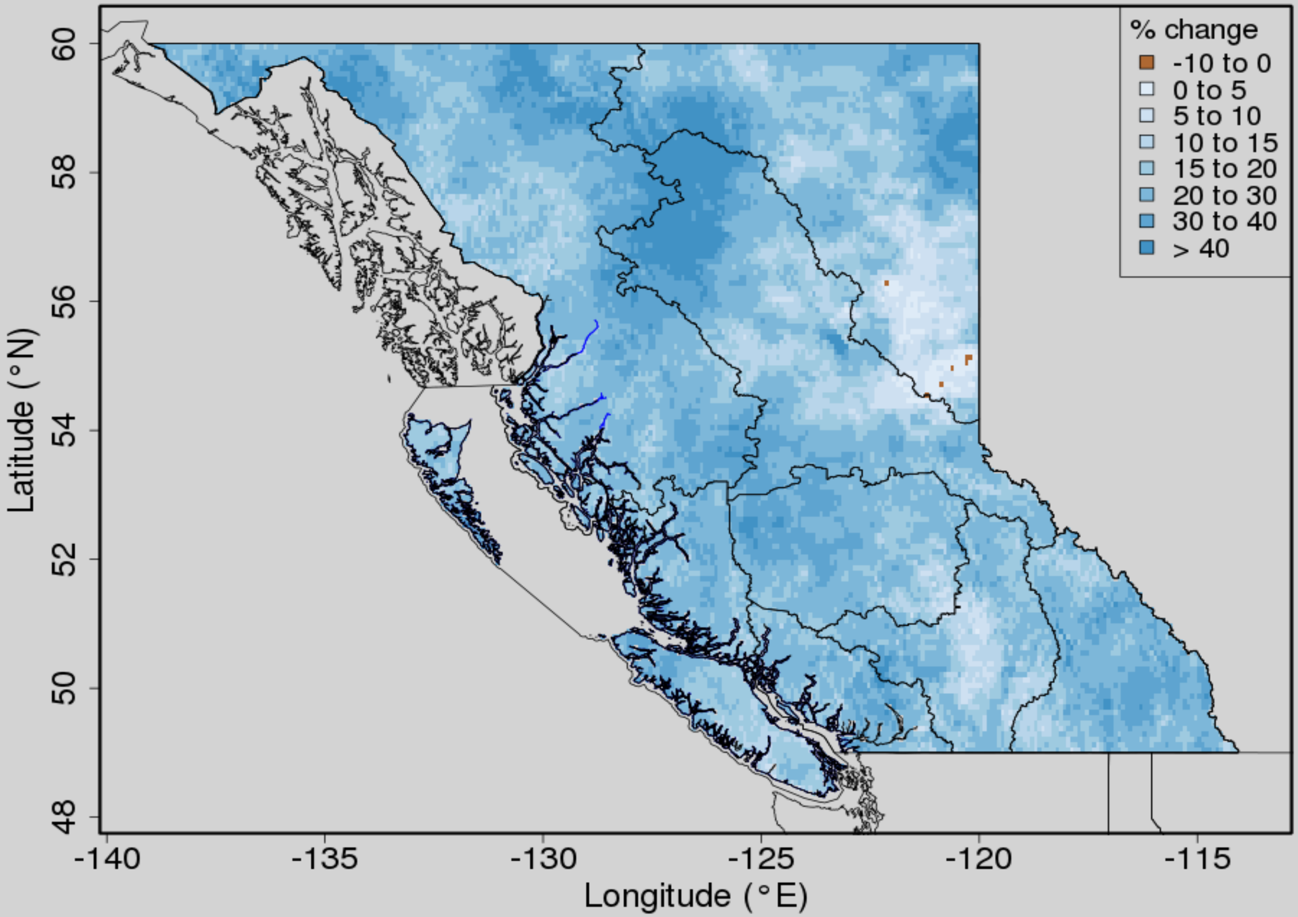
Change in number of days >25°C

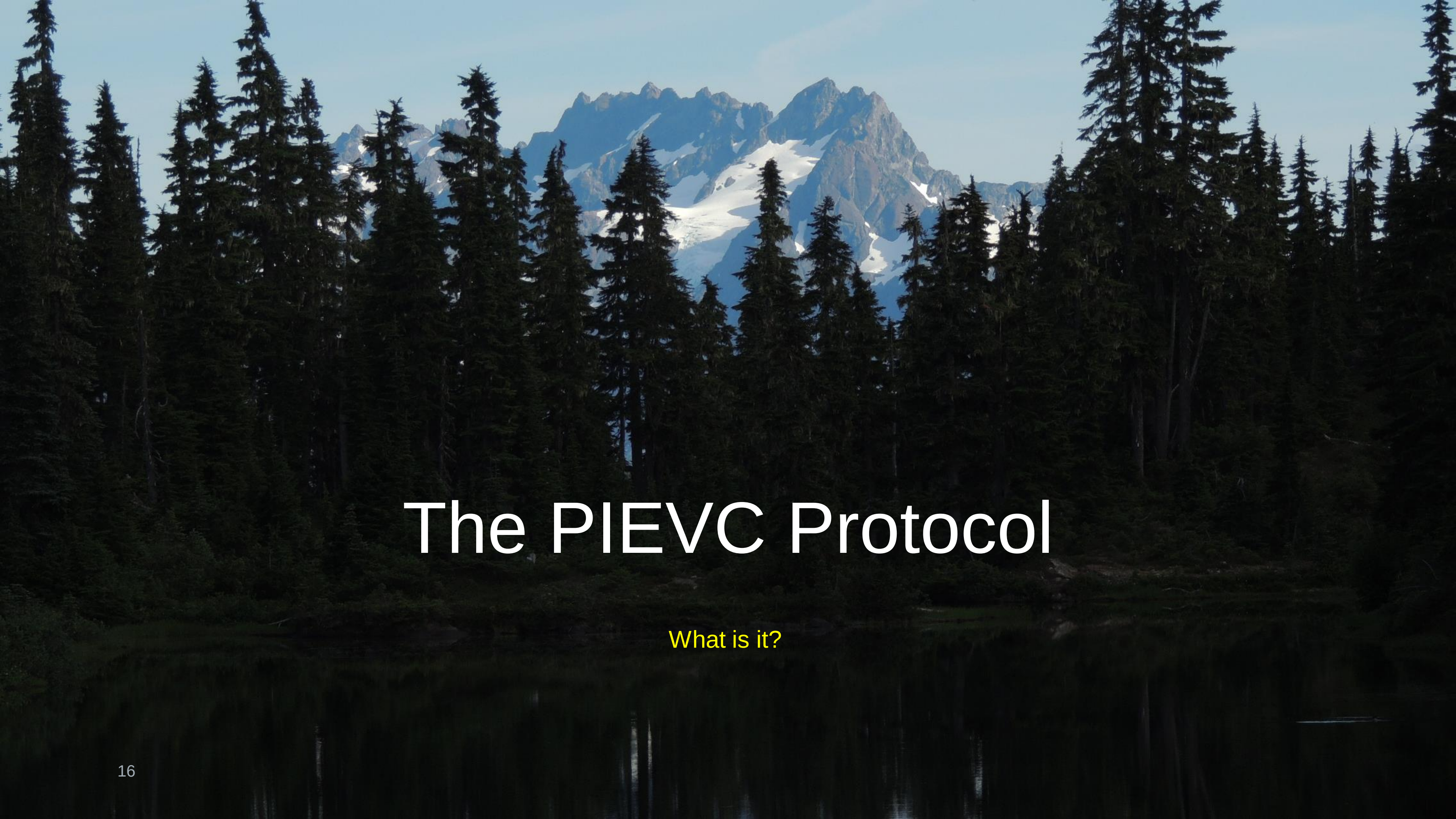


2050s Annual Precipitation



2050s "1-in-20" wet day



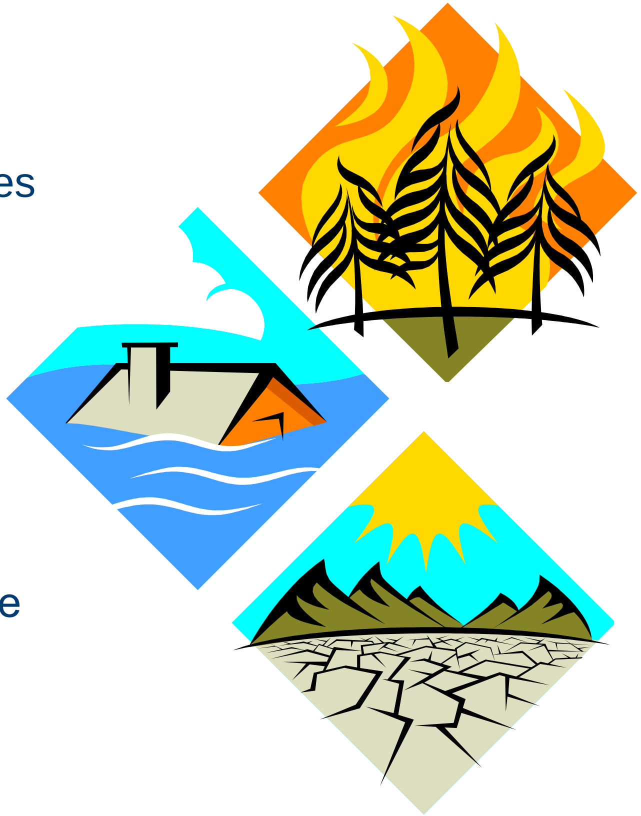


The PIEVC Protocol

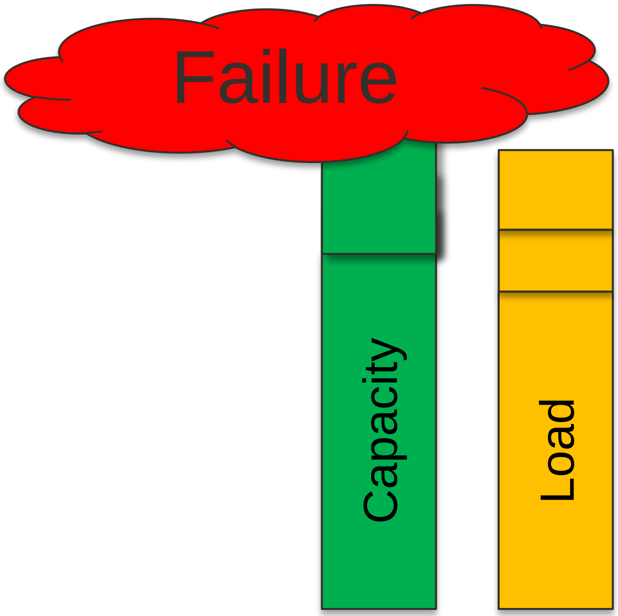
What is it?

Why Define Climate Risks and Vulnerabilities?

- To deal with the uncertainties of future climate
- To deal with risks to physical infrastructure & services
- Protect people, property and environment
- Better manage infrastructure lifecycle, operations, reduce costs and avoid surprises
- It's the first step in risk reduction planning to improve climate resilience



How do Small Changes Lead to Catastrophic Failure?

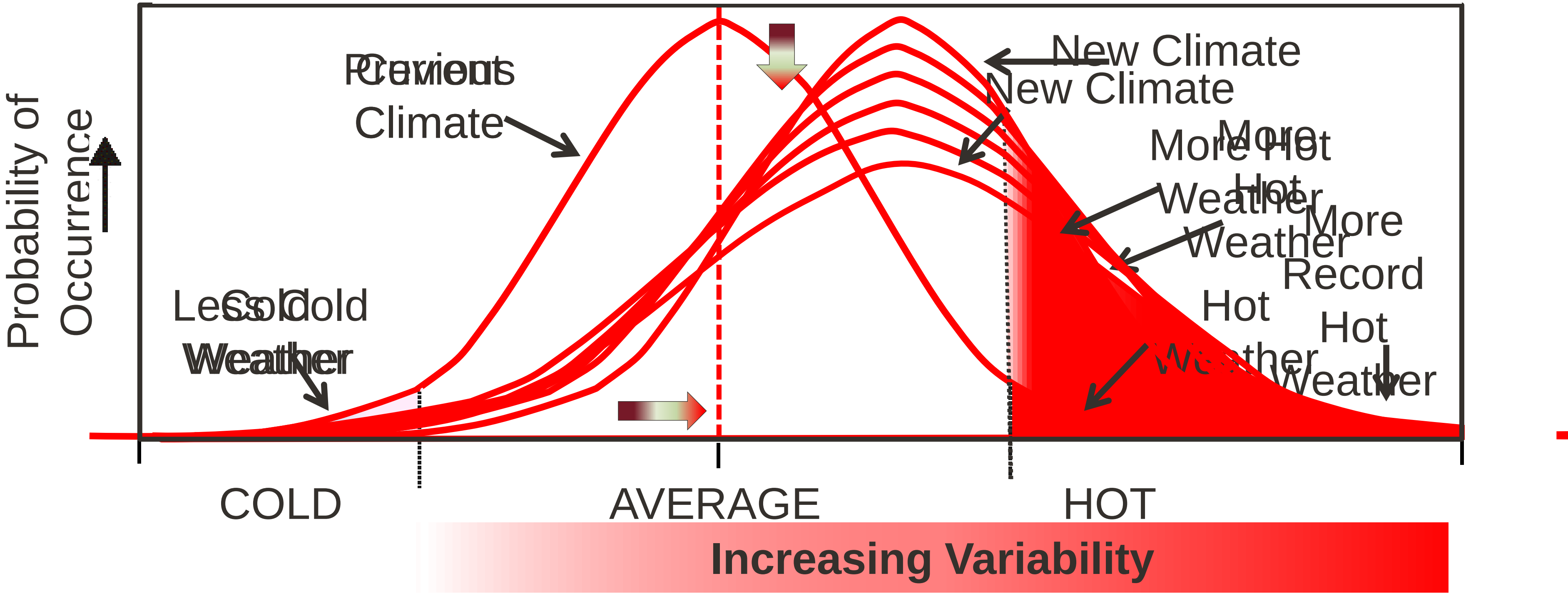


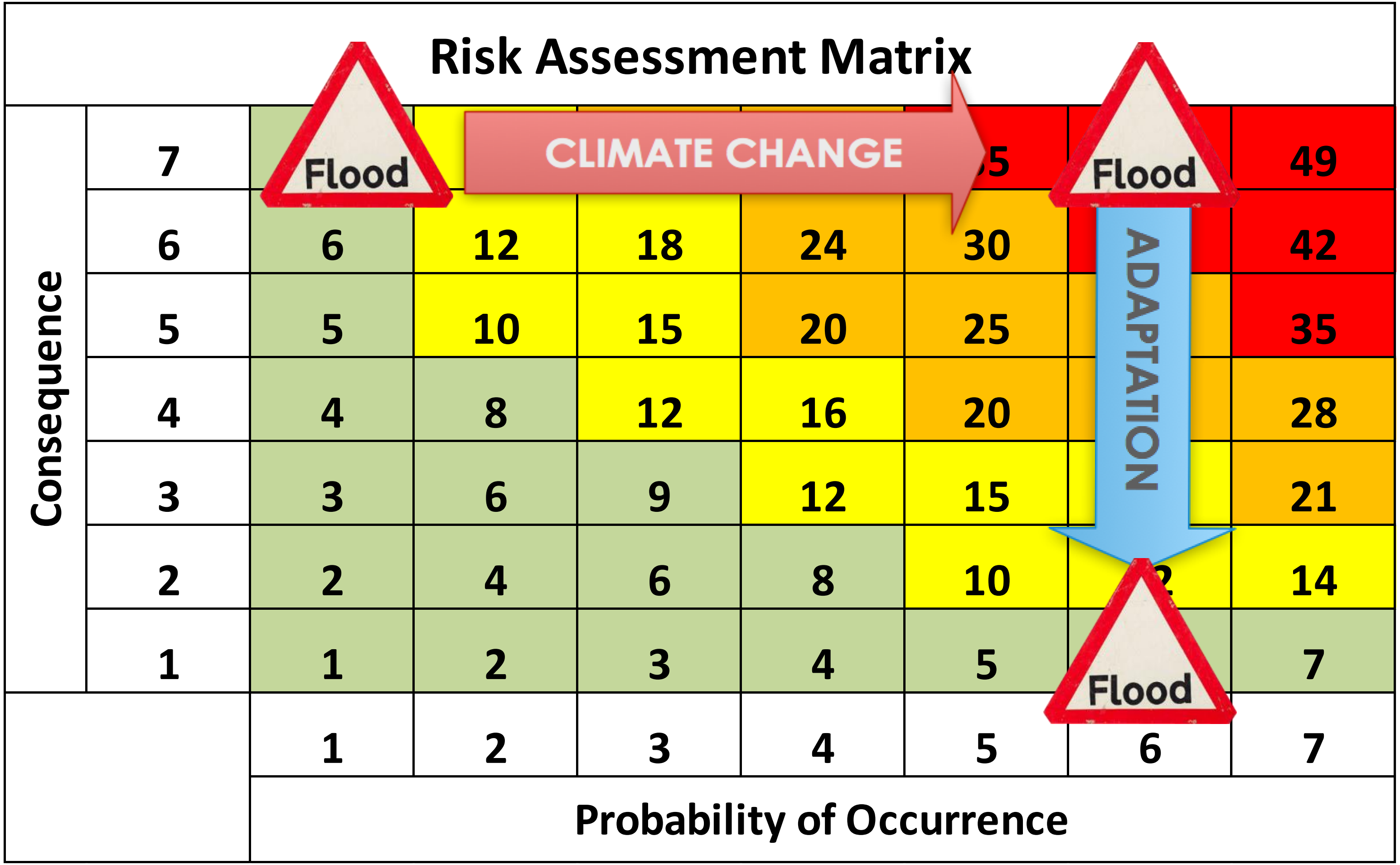
- Design Capacity
- Safety Factor
- Impact of age on structure
- Impact of unforeseen weathering

- Design Load
- Change of use over time
  - e.g. population growth
- Severe climate event

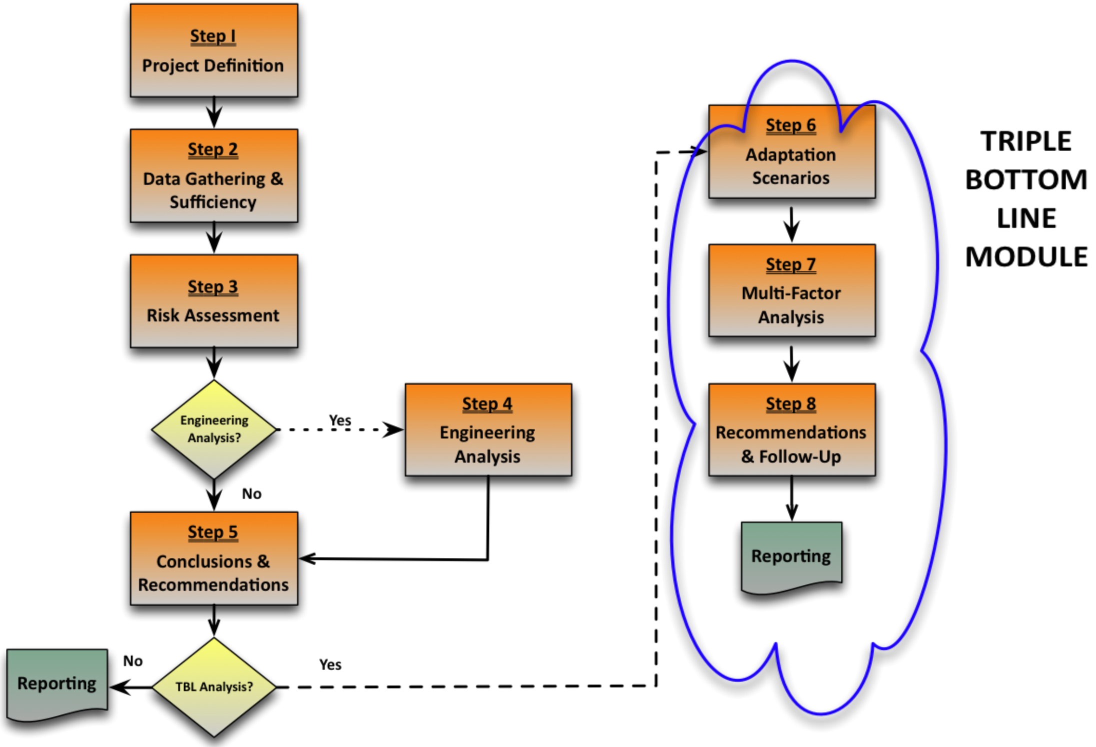
The probability of extreme changes in climate parameters

INCREASES IN MEAN and VARIANCE




Risk Assessment Matrix
Flood
CLIMATE CHANGE
Flood
ADAPTATION
Flood
Consequence
7 49
6 6 12 18 24 30 42
5 5 10 15 20 25 35
4 4 8 12 16 20 28
3 3 6 9 12 15 21
2 2 4 6 8 10 14
1 1 2 3 4 5 7
1 2 3 4 5 6 7
Probability of Occurrence

PIEVC Protocol
5 Steps plus an Optional TBL Module



The PIEVC Protocol, Now & Future

- 45+ projects/studies to date across Canada
  - Water, storm & waste water systems, roads & bridges, buildings (1 hospital), transportation & energy infrastructure
- PIEVC Workshops: on-site and on-line versions available
- Evolution to a permanent on-going program of Engineers Canada
  - Infrastructure Resilience Professional Credential (IRP) – Launched June 2016
- PIEVC Lite Version
  - Simple, lower cost
  - No Step 4 - engineering analysis
- PIEVC First Nations (FN) Version by April 2018

The Assessment of Nanaimo Regional General Hospital

The Infrastructure

Risk Assessment

Challenges

The PIEVC Protocol

- Process to assess *infrastructure component* response to impacts of a changing climate
- 5 Step Roadmap
  1. Concept
  2. Scoping
  3. Team Building
  4. Execution
  5. Reporting

Infrastructure

Nanaimo Regional General Hospital

→ Nursing Tower 1963

→ Rehabilitation1969

→ Phase 1 Addition 1992

→ Ambulatory Care 1995

→ Renal and Perinatal 2008

→ New Emergency Department 2012

Infrastructure Breakdown

Infrastructure Breakdown

- Mechanical
- Enclosure
- Civil
- Electrical
- Structural
- Water

Risk Assessment

Risk Assessment

- Risk:
- $Probability\ or\ Likelihood\ of\ an\ Event\ Occuring \times Consequence\ or\ Severity\ of\ Occurence$
- Identify patterns and assess vulnerability
- Vulnerability: Load surpassing adaptive capacity

PIEVC SEVERITY SCORES		
	Severity	
Score	Method D	Method E
0	No Effect	Negligible Not Applicable
1	Measurable	Very Low Some Measurable Change
2	Minor	Low Slight Loss of Serviceability
3	Moderate	Moderate Loss of Serviceability
4	Major	Major Loss of Serviceability
5	Serious	Loss of Capacity Some Loss of Function
6	Hazardous	Major Loss of Function
7	Catastrophic	Extreme Loss of Asset

Severity of Occurrence								
	7	7	14	21	28	35	42	49
	6	6	12	18	24	30	36	42
	5	5	10	15	20	25	30	35
	4	4	8	12	16	20	24	28
	3	3	6	9	12	15	18	21
	2	2	4	6	8	10	12	14
	1	1	2	3	4	5	6	7
		1	2	3	4	5	6	7
		Probability of Occurrence						

PIEVC SCORES		
Score	Probability Method A	Severity Method E
0	Negligible Not Applicable	Negligible Not Applicable
1	Highly Unlikely Improbable	Very Low Some Measurable Change
2	Remotely Possible	Low Slight Loss of Serviceability
3	Possible Occasional	Moderate Loss of Serviceability
4	Somewhat Likely Normal	Major Loss of Serviceability
5	Likely Frequent	Loss of Capacity Some Loss of Function
6	Probably Often	Major Loss of Function
7	Highly Probable Approaching Certainty	Extreme Loss of Asset

Probability - Climate Parameters

- Relied on climate scientists: Pacific Climate Impacts Consortium (PCIC)
- Interpreted climate model data
- Focus on engineering design parameters
- 3 Classes of Parameters:

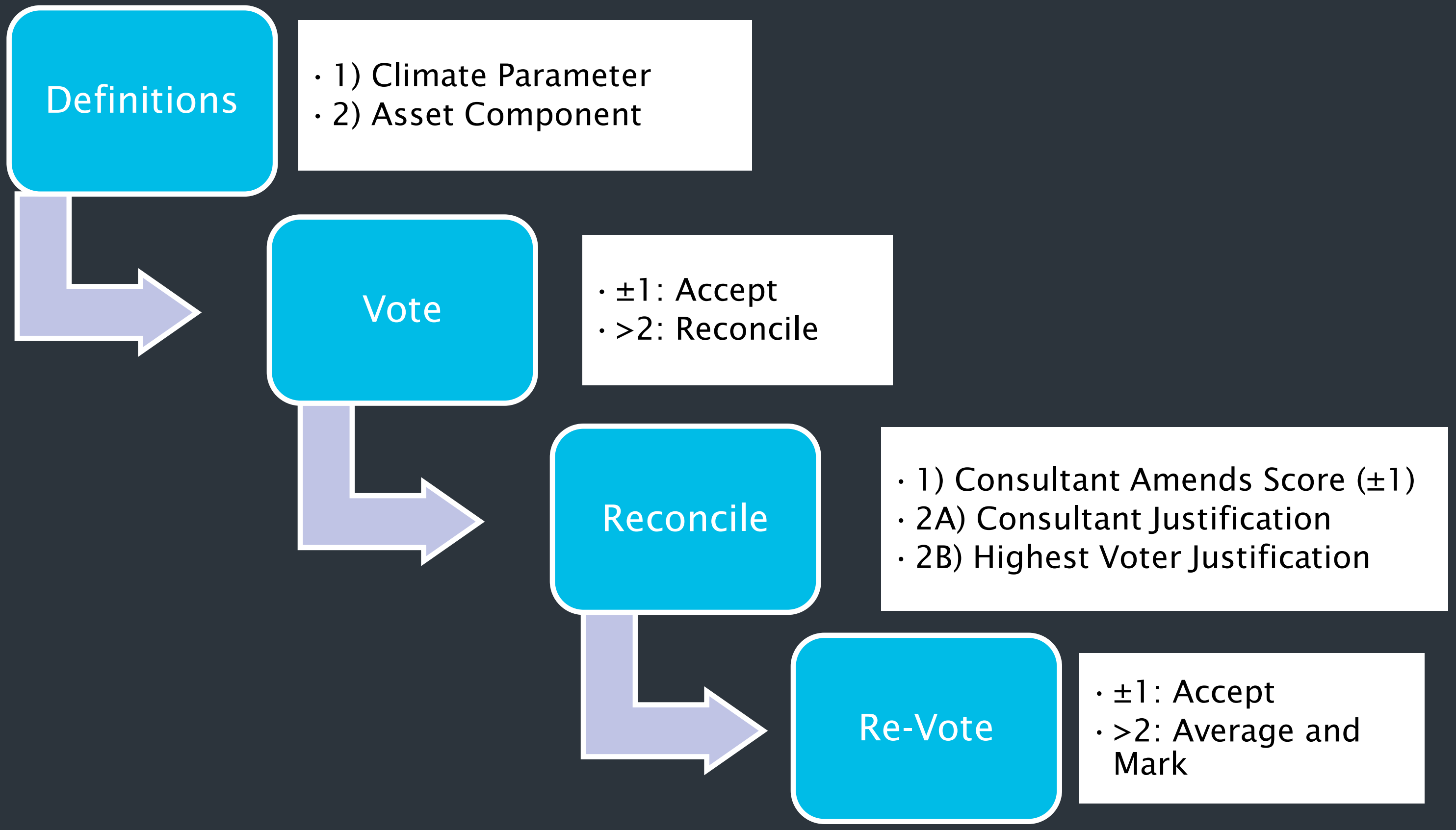
1. Heat
2. Moisture
3. Wind

Probability Scores

Climate Parameter	Definitions	Indicator	Code	RCP 8.5 – 2050 Forecasted Relative Values			Robustness	Probability Score
				10%	Avg	90%	H/M/L	1-7
Heat Waves	A stretch of unseasonably warm weather.	Cooling Dry Bulb (0.4%) [°C]	26.8	28.8	30.0	31.2	High	7

Severity Workshop

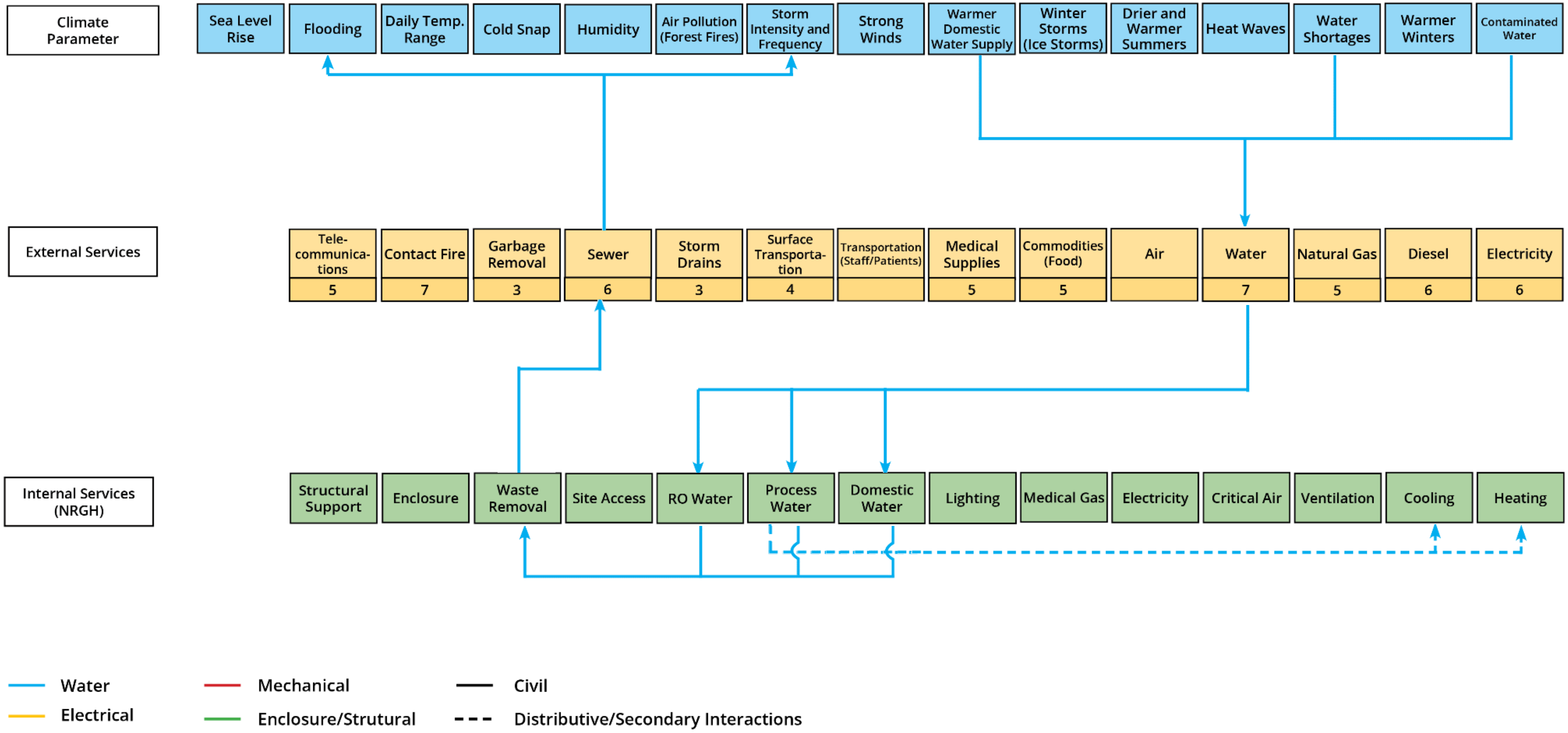
- Identify severity of impact on hospital operations given infrastructure component failure
- Gathered all experts in one room
- Consensus based

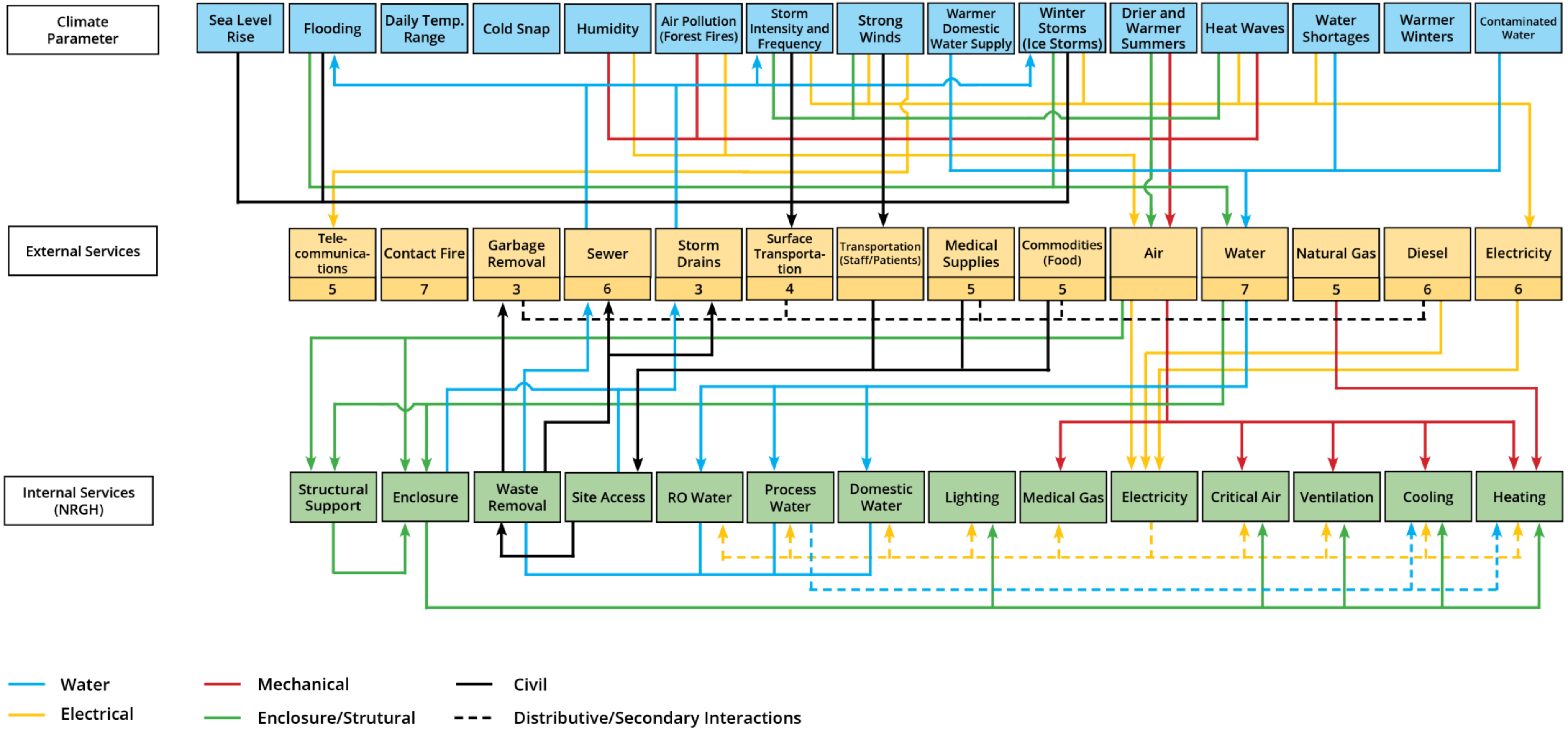

Definitions
• 1) Climate Parameter
• 2) Asset Component
Vote
• ±1: Accept
• >2: Reconcile
Reconcile
• 1) Consultant Amends Score (±1)
• 2A) Consultant Justification
• 2B) Highest Voter Justification
Re-Vote
• ±1: Accept
• >2: Average and Mark

	Infrastructure Components	2						
		Heat waves						
		Y/N	P	S			R	Rationale For Severity Score
M	MECHANICAL			VIHA Score	Consultant Score	Decision		
	Critical Air Systems							
12	O/A intakes							
13	Fans							
14	Cooling Coils							
15	Heating Coils							
16	Humidification							
17	Air Distribution							

Special Case	Low Risk	Medium Risk	High Risk

			Climate Parameter and Risk Score														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Division	**Category**	**Infrastructure Component**	Contaminated Water	Heat Waves	Strong Winds	Storm Intensity and Frequency	Warmer Winters	Air Pollution (Forest Fires)	Cold Snap	Winter Storm (Ice Storm)	Humidity	Daily Temperature Range	Dryer and Warmer Summers	Water Shortages	Sea Level Rise	Warmer Domestic Supply Water	Flooding
Civil	Landscaping	Trees/irrigation/grass/vegetation		21													
Civil	Landscaping	Retaining walls															20
Civil	Landscaping	Trees/irrigation/grass/vegetation												18			
Civil	Landscaping	Trees/irrigation/grass/vegetation											14				
Civil	Landscaping	Trees/irrigation/grass/vegetation			12												
Civil	Site Access Systems	Loading docks				12											
Civil	Site Access Systems	Loading docks															12
Civil	Site Access Systems	Roads/Parking Areas															12
Civil	Civil	Fire Supression System (i.e. fire hydrants)															
Civil	Landscaping	Drainage infrastructure - grading and drains															
Civil	Landscaping	Signage															
Civil	Landscaping	Water supply - con. Reservoir															
Civil	Sanitary Sewer	Acid neutralizer															
Civil	Sanitary Sewer	Grease interceptors															
Civil	Site Access Systems	Helipad															
Civil	Site Access Systems	Pedestrian															
Civil	Waste storage & removal	Bio-waste															
Civil	Waste storage & removal	General Waste															
Civil	Waste storage & removal	Kitchen															


Climate Parameter
Sea Level Rise
Flooding
Daily Temp. Range
Cold Snap
Humidity
Air Pollution (Forest Fires)
Storm Intensity and Frequency
Strong Winds
Warmer Domestic Water Supply
Winter Storms (Ice Storms)
Drier and Warmer Summers
Heat Waves
Water Shortages
Warmer Winters
Contaminated Water
External Services
Tele-communica-tions
5
Contact Fire
7
Garbage Removal
3
Sewer
6
Storm Drains
3
Surface Transporta-tion
4
Transportation (Staff/Patients)
Medical Supplies
5
Commodities (Food)
5
Air
Water
7
Natural Gas
5
Diesel
6
Electricity
6
Internal Services (NRGH)
Structural Support
Enclosure
Waste Removal
Site Access
RO Water
Process Water
Domestic Water
Lighting
Medical Gas
Electricity
Critical Air
Ventilation
Cooling
Heating
Water
Electrical
Mechanical
Enclosure/Strutural
Civil
Distributive/Secondary Interactions



Climate Parameter
Sea Level Rise
Flooding
Daily Temp. Range
Cold Snap
Humidity
Air Pollution (Forest Fires)
Storm Intensity and Frequency
Strong Winds
Warmer Domestic Water Supply
Winter Storms (Ice Storms)
Drier and Warmer Summers
Heat Waves
Water Shortages
Warmer Winters
Contaminated Water
External Services
Tele-communica-tions
5
Contact Fire
7
Garbage Removal
3
Sewer
6
Storm Drains
3
Surface Transporta-tion
4
Transportation (Staff/Patients)
Medical Supplies
5
Commodities (Food)
5
Air
Water
7
Natural Gas
5
Diesel
6
Electricity
6
Internal Services (NRGH)
Structural Support
Enclosure
Waste Removal
Site Access
RO Water
Process Water
Domestic Water
Lighting
Medical Gas
Electricity
Critical Air
Ventilation
Cooling
Heating
Water
Electrical
Mechanical
Enclosure/Strutural
Civil
Distributive/Secondary Interactions

Vulnerability Trends

- Heat Waves, Humidity, and Water Shortages
- Main challenges: Sensible and Latent Cooling
- Susceptible Systems:
  - Mechanical – Cooling Plant
  - Mechanical – Critical Air
  - Water Shortages – Jurisdiction

Prioritization

VFA Data

- Cross-reference at risk systems with VFA Data
- Low-cost opportunity to upgrade with like-for-like. Assets within 10 year horizon
- Use forecasted climatic design parameters as input for new system & study

Challenges

Challenges

- Jurisdictional Authority
- Hierarchical Systems – System Redundancies, Different Exposures
- Non-Infrastructure (Operational) Actions
- Climate Change – Design Uncertainty, Seasonality, Cascading Effects, Non-Climatic Effects, Clinical Impacts

How to use climate data

Sources

Best Practices

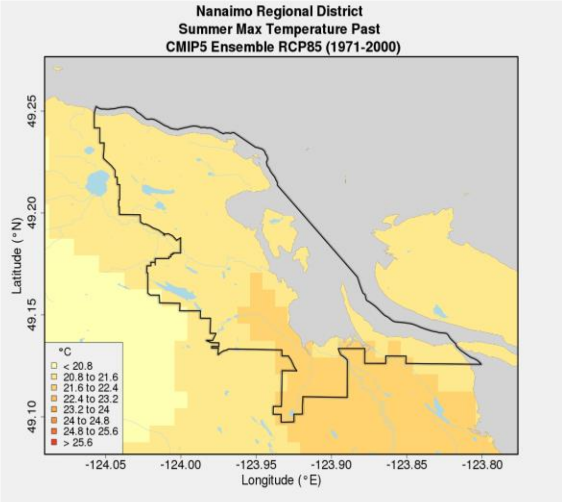
Where do we go from here?

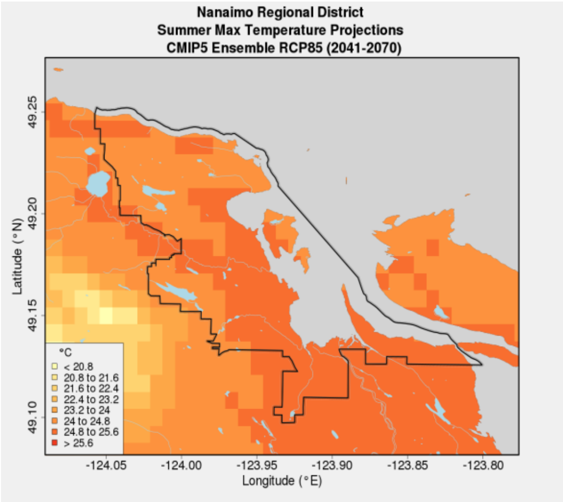
Where are these quotes from?

- “Climate is not static”
- “Past and ongoing… greenhouse gas emissions are expected to alter most climatic regimes in the future”
- “… buildings will need to be designed, maintained, and operated to adequately withstand ever changing climate loads.”
- “The analysis generally assumes that the past climate will be representative of the future climate”

Downscaled climate projections

- 10 km (BCCAQ) with 800m bias correction (PRISM)
- 12 GCMs, RCP 8.5, 1950-2100
- Daily
- Nighttime low temperature, daytime high temperature, precipitation





Additional climate parameters

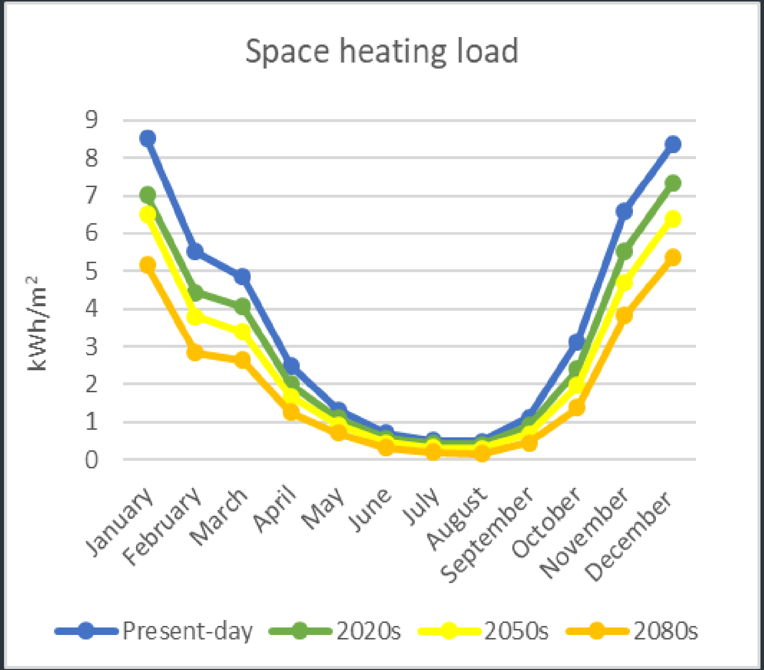
- Indices of extremes derived from daily temperature and precipitation

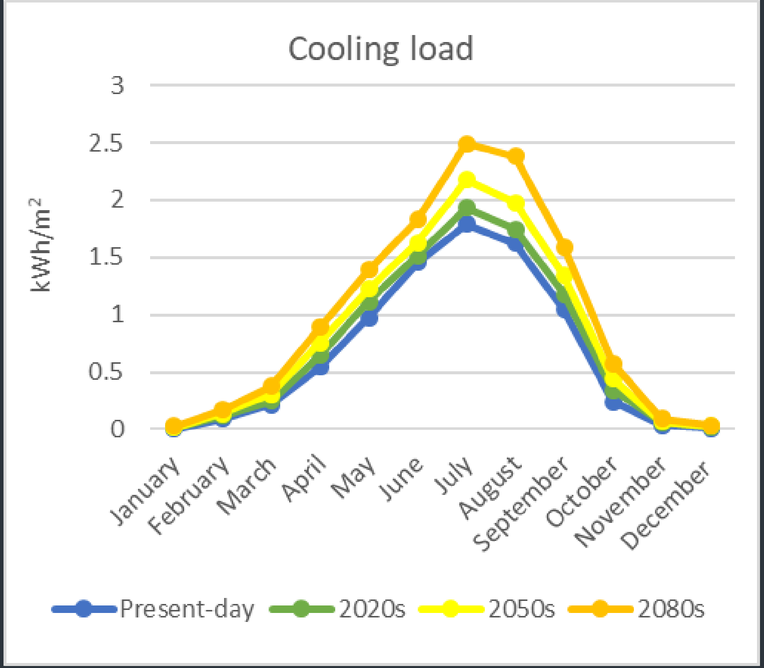
- Daily snowpack model

- Daily humidity & wind: Global Climate Models (~100 km)

TABLE 3.3 CLIMATE PARAMETERS – CURRENT AND FORECAST VALUES		Code / Present Values	RCP 8.5 – 2050 Forecasted Relative Values		
Climate Parameter	Indicator		10%	Avg	90%
Contaminated Water	Biological Oxygen Demand / Particulate Suspension	<=5NTU, Coliform <10/100mL	-	-	-
Heat Waves	Cooling Dry Bulb (0.4%) [°C]	26.8	28.8	30.0	31.2
Strong Winds	1/50 Wind Pressure [Pa]	500	116	505	890
Storm Intensity and Frequency	1/5 Wind Driven Rain Pressure [Pa]	200	40.9	205	378
Warmer Winters	Heating Degree-Day Base 18.0 [°C-Day]	3000	1884	2165	2465
Air Pollution (Forest Fires)	N/A	-	-	-	-
Cold Snap	Heating Dry Bulb (99%) [°C]	-8	-3.5	-2.3	-0.6
Winter Storm (Ice Storm)	Snow Load [kPa]	2.3	0.46	1.15	2.07
Humidity	Mean Coincident Wet Bulb [°C]	17	18.2	19.6	20.7
Daily Temperature Range	N/A	-	-	-	-
Drier and Warmer Summers	Cooling Degree Day Base 18.3 [°C-Day]	67	160	308	442
Water Shortages	Monthly maximum daily maximum temperature [°C]	30.6	33	34.2	35
Sea Level Rise	N/A	-	-	-	-
Warmer Domestic Water Supply	Average summer time temperature [°C]	30.6	32.7	34.1	32.5
Flooding	1 in 50 year 1-day rainfall [mm]	91	99.8	116	134.2

Complementary approach:
energy modelling with future weather files





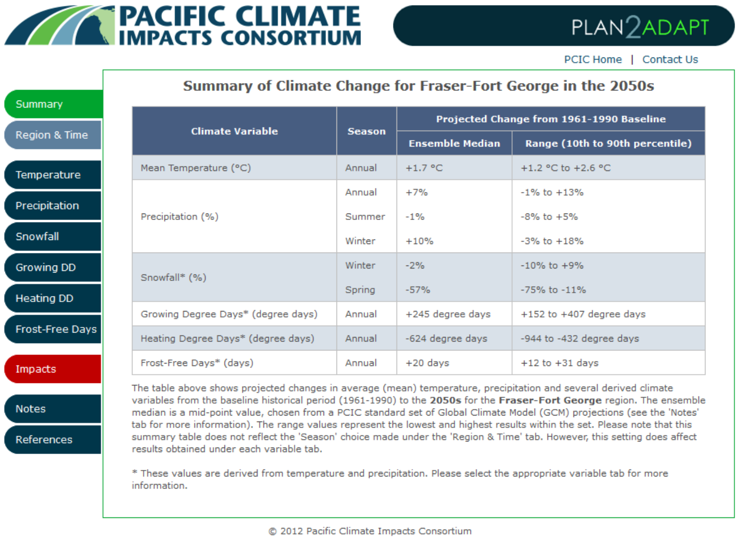
M. Ek, T. Murdock, S. Sobie, B. Cavka, B. Coughlin, R. Wells

Best practices

- Make use of climate information – at whatever level of detail available
- Use a range of future projections
- Cross-disciplinary engagement
- Iteration, iteration, iteration

ONLINE ADAPTATION TOOLS, WHAT ARE THEY GOOD FOR?

Resources to accompany BC Regional Adaptation Collaborative webinar
30 November 2016



Summary of Climate Change for Fraser-Fort George in the 2050s

Climate Variable	Season	Projected Change from 1961-1990 Baseline: Ensemble Median	Projected Change from 1961-1990 Baseline: Range (10th to 90th percentile)
Mean Temperature (°C)	Annual	+1.7 °C	+1.2 °C to +2.6 °C
Precipitation (%)	Annual	+7%	-1% to +13%
	Summer	-1%	-8% to +5%
	Winter	+10%	-3% to +18%
Snowfall* (%)	Winter	-2%	-10% to +9%
	Spring	-57%	-75% to -11%
Growing Degree Days* (degree days)	Annual	+245 degree days	+152 to +407 degree days
Heating Degree Days* (degree days)	Annual	-624 degree days	-944 to -432 degree days
Frost-Free Days* (days)	Annual	+20 days	+12 to +31 days

The table above shows projected changes in average (mean) temperature, precipitation and several derived climate variables from the baseline historical period (1961-1990) to the **2050s** for the **Fraser-Fort George** region. The ensemble median is a mid-point value, chosen from a PCIC standard set of Global Climate Model (GCM) projections (see the 'Notes' tab for more information). The range values represent the lowest and highest results within the set. Please note that this summary table does not reflect the 'Season' choice made under the 'Region & Time' tab. However, this setting does affect results obtained under each variable tab.

* These values are derived from temperature and precipitation. Please select the appropriate variable tab for more information.

Plan2Adapt http://pacificclimate.org/analysis-tools/plan2adapt

PICS short course http://pics.uvic.ca/education/climate-insights-101#quicktabs-climate_insights_101=1

ClimateBC

- **HectaresBC** http://www.hectaresbc.org
- **ClimateWNA** http://genetics.forestry.ubc.ca/cfgc/ClimateWNA/ClimateWNA.html
- **ClimateBC Online** http://www.genetics.forestry.ubc.ca/cfcg/ClimateBC40/Default.aspx
- **BC Climate Explorer** http://www.bc-climate-explorer.org/

PCIC Data Portals https://pacificclimate.org/data

Data Basin
https://nplcc.databasin.org/galleries/5a3a424b36ba4b63b10b8170ea0c915e#expand=105363%2C106698%2C106712%2C110010%2C105359%2C105364

https://pacificclimate.org/news-and-events/news/2016/webinar-climate-tools

Wrap-Up

Infrastructure Adaptation: Review of What It Means

Lessons Learned

Next Steps for Island Health

Infrastructure Adaptation: Review of What it Means

- Gain ***climate understanding*** → ***engage climate scientists***
- Understanding ***risks and vulnerabilities***
- ***Prioritize the risks*** (Urgent to Least Urgent)
- ***Minimize the risks*** (engage Risk Reduction Programs)
- ***Evaluate costs and benefits*** to reduce risks
- ***Communicate*** to decision-makers
- Combining these provides key elements of an ***Infrastructure Climate Risk Assessment*** and ***Risk Mitigation Plan***
- …and its not just for existing infrastructure

Lessons Learned

- Secure strong mandate from management
    - Ensures adequate time from subject matter experts – not easy to do in a hospital

- This needs to be an on-going iterative effort

- w.r.t. Standard of Practice and what it means for engineers?
    - New information may indicate standards/codes should be reconsidered

9 Principles of Climate Change Adaptation for Engineers (source: Engineers Canada)

- Professional Judgment
  - Integrate Adaptation into Practice
  - Review Adequacy of Current Standards
  - Exercise Professional Judgement
- Integrating Climate Information
  - Interpret Climate Information
  - Work with Specialists and Stakeholders
  - Use Effective Language
- Practice Guidance
  - Plan for Service Life
  - Use Risk Assessment for Uncertainty
  - Monitor Legal Liabilities

Note that Engineers Canada does not regulate the engineering profession in BC, EGBC does.

Next Steps for Island Health at NRGH

- Key retrofits/upgrades to pursue include, but not limited to:
  - Review and update maintenance procedures
  - Increased cooling capacity, redundancy, and load shedding strategies
  - Ability to recirculate 100% of ventilation air with enhanced filtration (reinstall return-air systems)
  - Back-up potable water supply
  - On-Site O_2 generation

Acknowledgements

- Natural Resources Canada – Climate Change Impacts & Adaptation Division for partial project funding: $40,000
- Clinical and Facilities staff at NRGH for their time, knowledge, and active participation in the workshops
- David Lapp for overall guidance, support and encouragement
- The consulting team:

Climate Adaptation Research and Mapping Project

Ting Pan, M.Sc., Sustainability Coordinator • **Vancouver Island Health Authority**

Trevor Murdock, M.Sc. • **Pacific Climate Impacts Consortium**

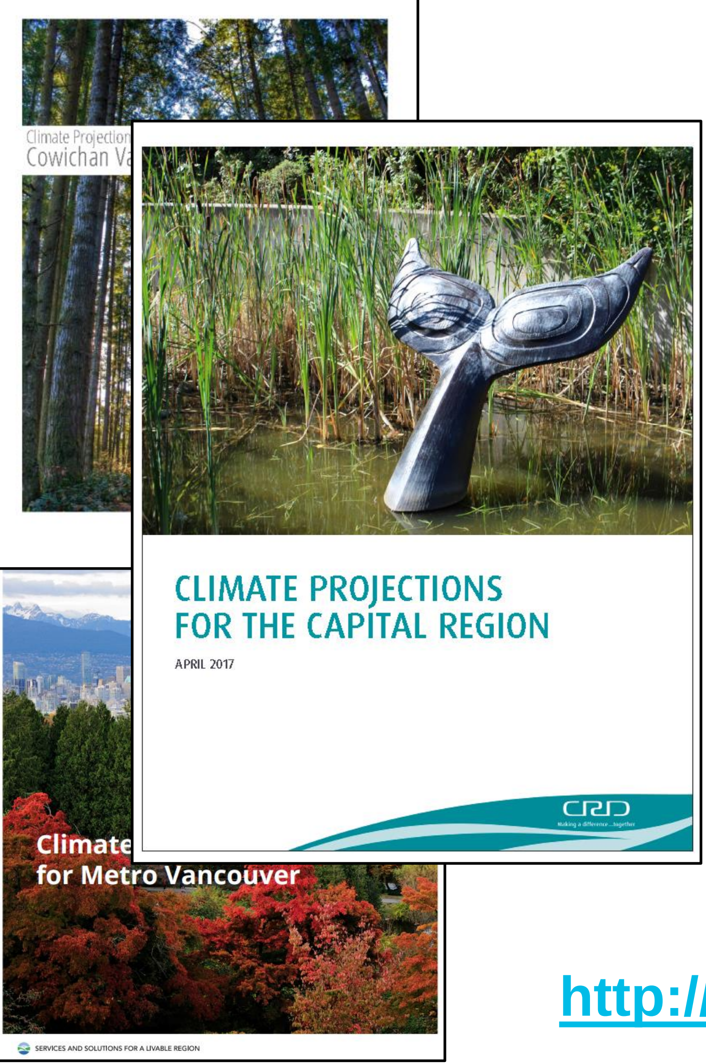
Climate Adaptation Research and Mapping

- Internship Grant Funded by the Pacific Institute of Climate Solutions
- Intern – Riley Richardson – Uvic Student Climate Adaptation Researcher
- Outcomes:
  - Climate projection maps with Island Health facilities on them
  - Climate variables for selected sites
  - Climate Adaptation Assessment Toolkit customized for Island Health

Climate Adaptation Research and Mapping

Pioneering work by the following organizations:

- For mapping
  - Capital Regional District
  - Cowichan Valley Regional District
  - Pacific Climate Impacts Consortium
- For assessment tool development
  - Lower Mainland Health Organizations
  - BC Housing
  - Canadian Coalition of Green Health Care
  - The U.S. Department of Health and Human Services



Co-produced climate reports

- Intense, iterative feedback between climate scientists and local governments

- PCIC:
  - ensure accurate interpretation
  - help convene conversations

- Local gov't:
  - results tailored to local needs incl. planning processes
  - include what climate impacts mean to region & possible responses

http://www.crd.bc.ca/about/data/climate-change

What does climate change mean in CRD?

Warmer winter temperatures and fewer days below freezing

- 80% fewer frost days

More extreme hot days in summers and longer dry spells in summer months

- 3x days > 25 C
- 20% drier summers

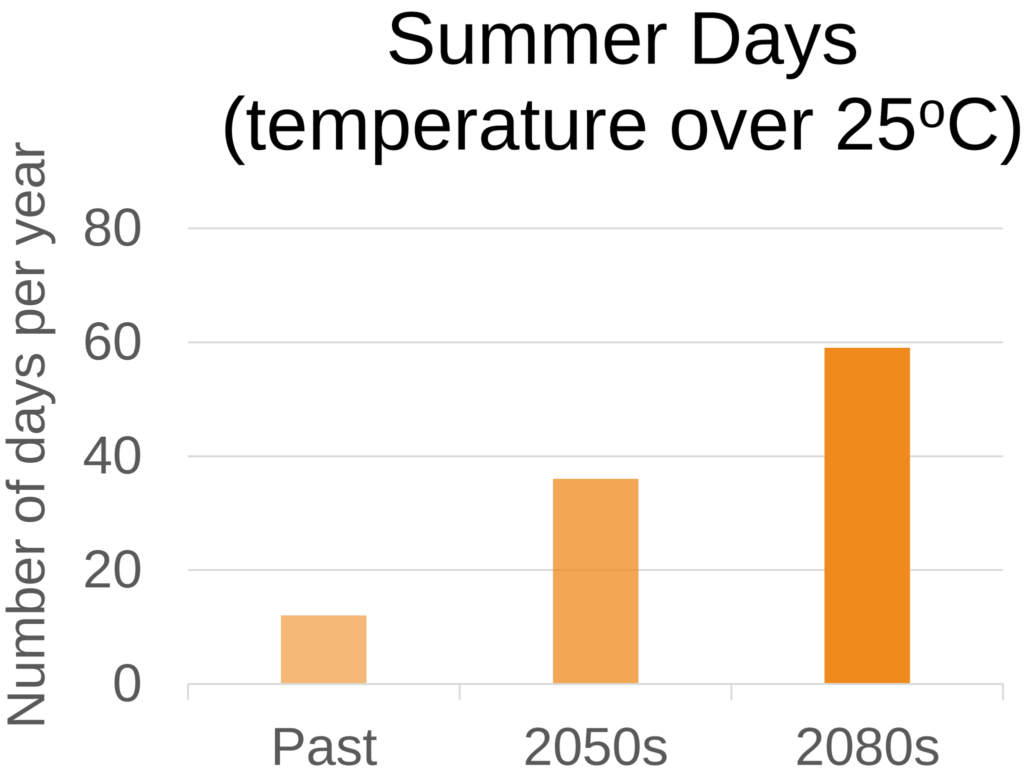
More precipitation in the fall, winter and spring

- ~15% wetter fall season

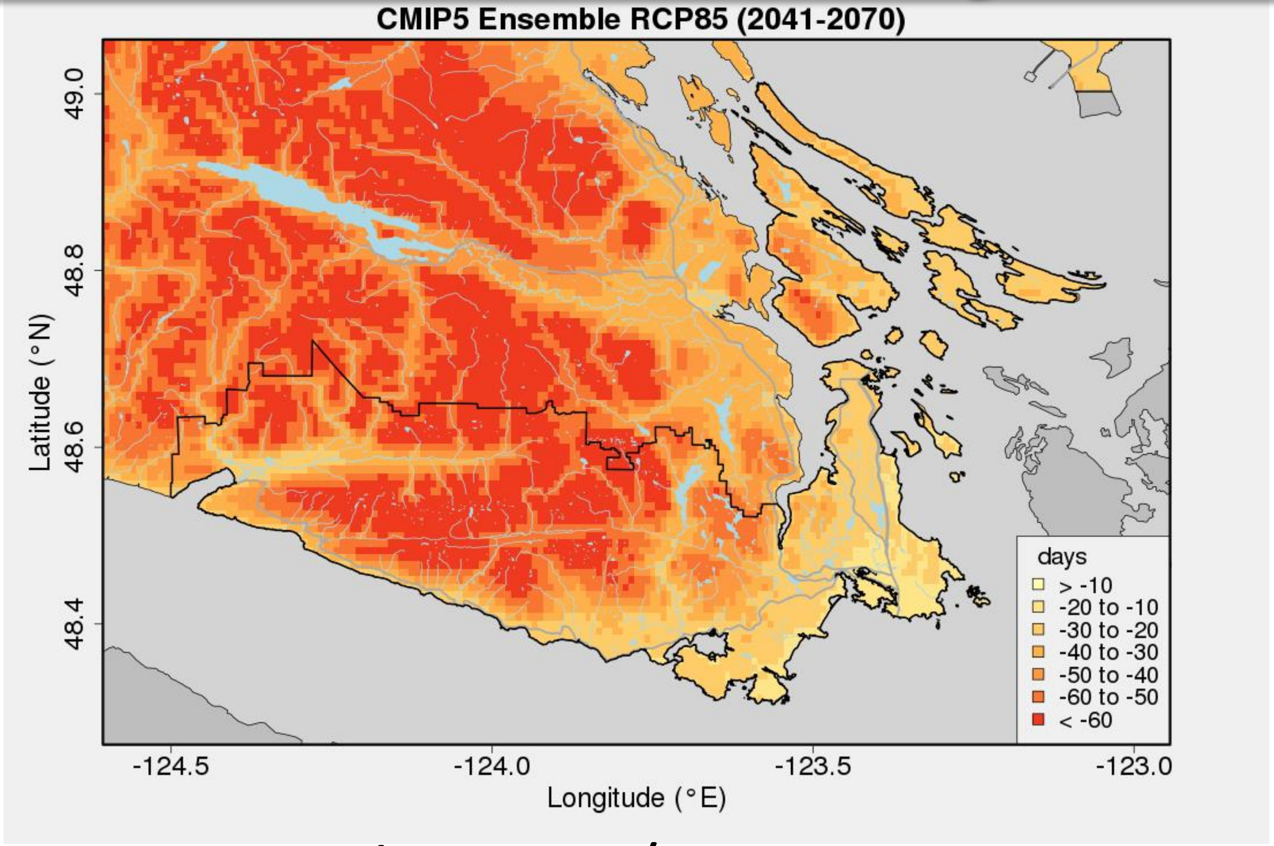
Increased frequency and intensity of precipitation and storm events

- ~30% stronger 1-in-20 year one day rainfall

Hotter summers



Fewer frost days



2050s: ~70% decrease / ~80% Greater Victoria

CRD Climate Projections Report → Impacts

http://www.crd.bc.ca/about/data/climate-change

- Human Health
- Rainwater Management And Sewerage
- Water Supply And Demand
- Tourism And Recreation
- Transportation Network
- Ecosystems And Species
- Buildings And Energy Systems

Building and energy systems

As our climate warms and storm events become more intense and frequent, the business case for investing in durable, resilient buildings improves. Buildings provide site-specific opportunities to address challenges, such as heat and drought, through technologies, including rainwater capture and reuse, stormwater detention and management, resilient landscaping, green roofs and walls, and passive shading. In some years, buildings may need to withstand heavier snow loads and precipitation events, higher and more frequent winds, higher temperatures and longer duration of heat waves, and in coastal areas, rising sea levels. Building retrofits (e.g., insulation, heat pumps) to address both heating and cooling demand, and additional climate adaptation measures, including storm-resistant design and materials, should be considered. Future climate projections and energy efficiency will also be important to consider for new construction, as this could result in long-term cost savings and future-proofing.

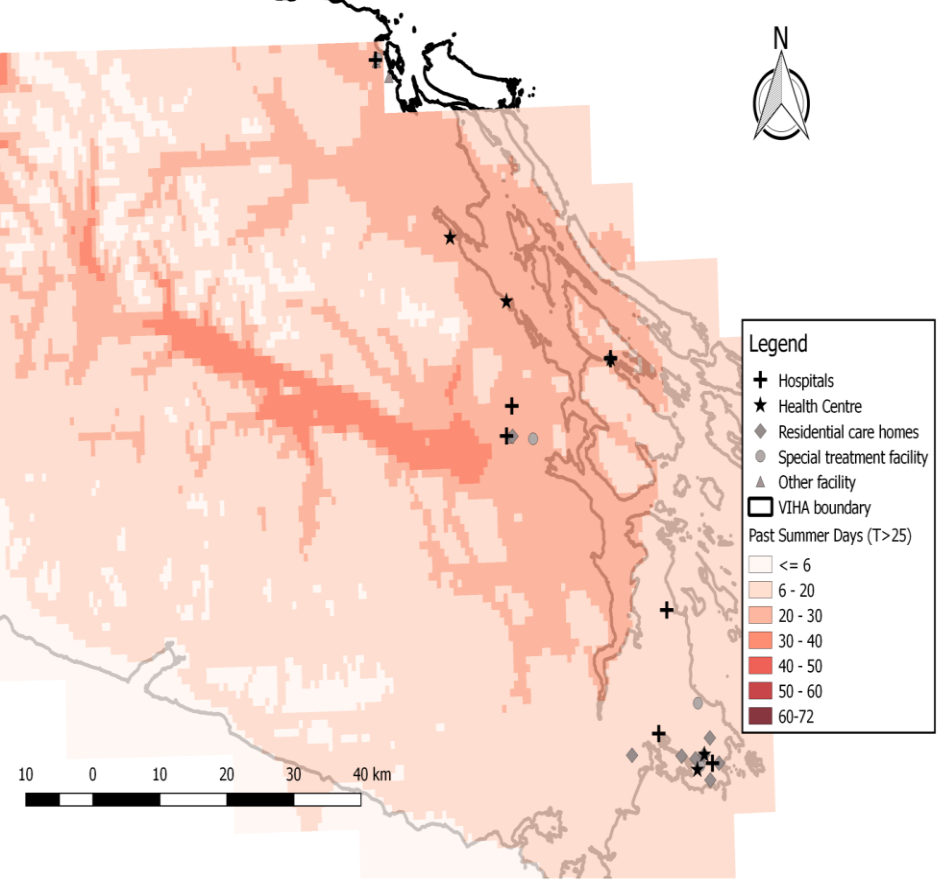
Concentrating development in already developed areas can create opportunities for natural ecosystems to buffer changes to our climate. Protecting the existing and future flood plains from development can reduce risks of personal injury and damage to property from extreme storm events. Also, avoiding conversion of agricultural land to residential and commercial uses will better enable our region to become more self-reliant as traditional agricultural areas become less arable.

In response to warmer year-round temperatures, seasonal and longer-term energy demands will change across the region. Significant shifts are also anticipated across BC, with an increase in cooling demand and decreasing heating demand over time. These shifts in energy demands can be offset with comprehensive energy retrofits to enhance the energy efficiency of existing buildings using air sealing, insulation, and space and water heating upgrades, and initiatives designed to reduce consumption from baseloads (lighting and appliances). Constructing energy efficient (or net-zero ready) homes and buildings would also substantially reduce energy demand. There may also be opportunities for solar electricity production and other types of renewable energy.

Climate Adaptation Research and Mapping

- Latest projections – more variables, higher resolution, covering more than half of Island Health owned facilities
- Selected 15 climate variables the most relevant to our facilities
- Results:
  - Maps
  - Climate variable values for sites

	Climate Variables
1	Cooling Degree Days
2	Heating Degree Days
3	Annual Average Min Temperature
4	Annual Max Temperature
5	Summer Days T>25
6	1-in-20 Hottest Day
7	Maximum Length of Dry Spell
8	1-in-20 Wettest Day Precipitation
9	Annual Precipitation
10	Summer Precipitation
11	Winter Precipitation
12	Single Day Max Precipitation
13	Five-Day Max Precipitation
14	99^{th} Percentile Wettest Days
15	95^{th} Percentile Wettest Days



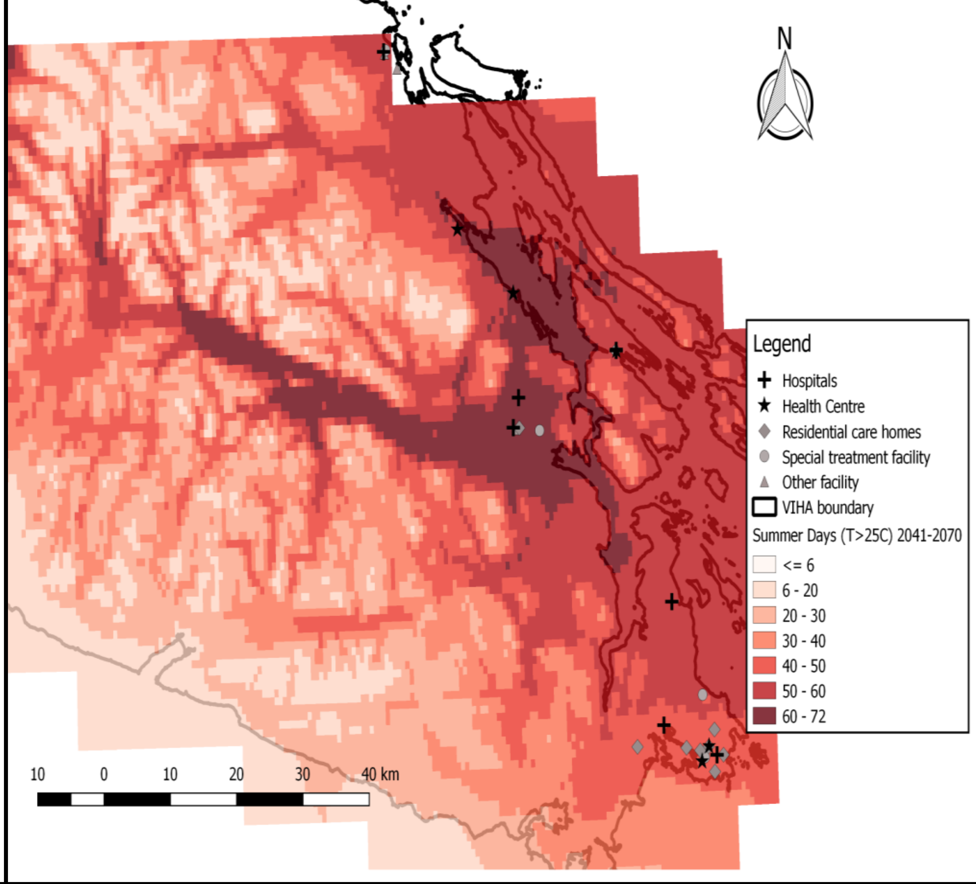
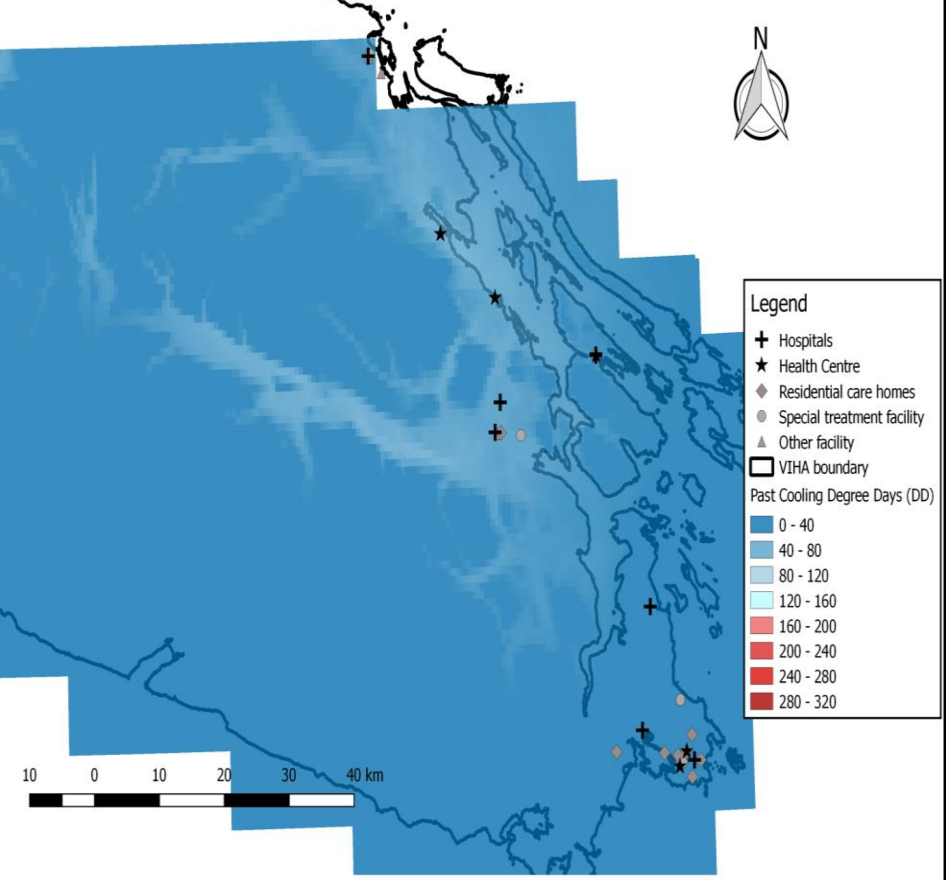


Figure 1: Historical summer days for 1971-2000 in the South Island region.

Figure 2: Projected summer days for the 2050's (2041-2070) in the South Island region.



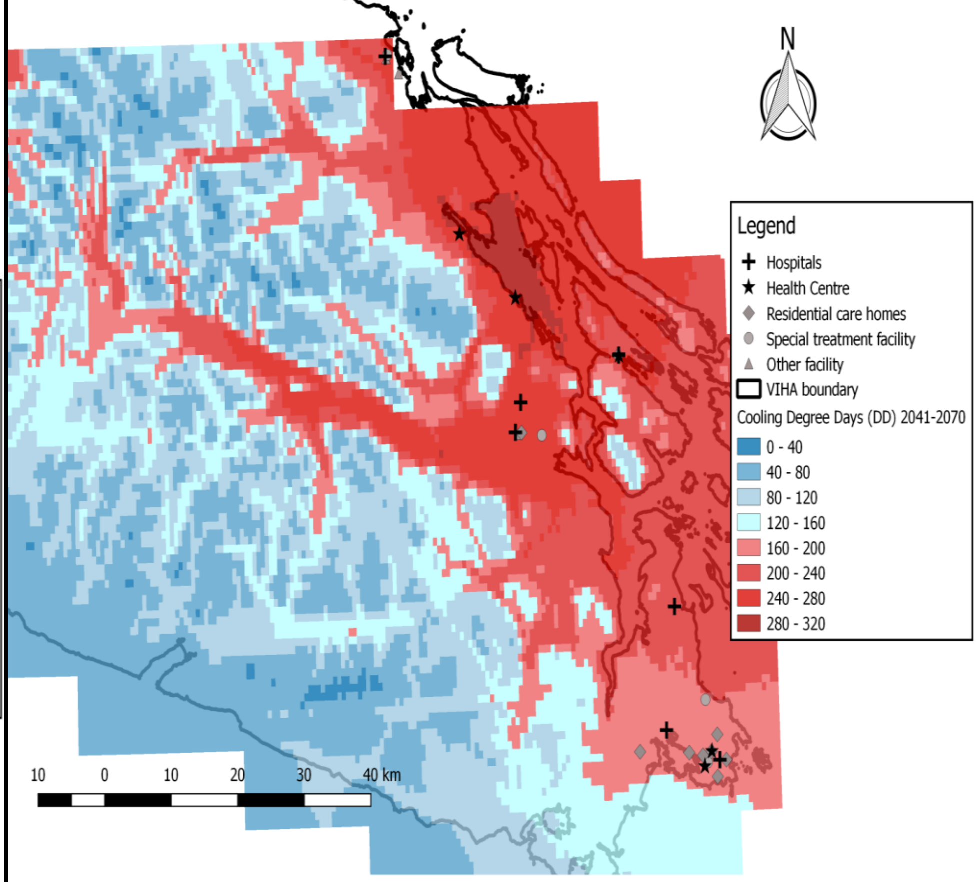


Figure 3: Historical annual cooling degree days for the South Island region averaged over 1971-2000.

Figure 4: Projected future annual cooling degree days into the 2050's (2041-2070) for the South Island.

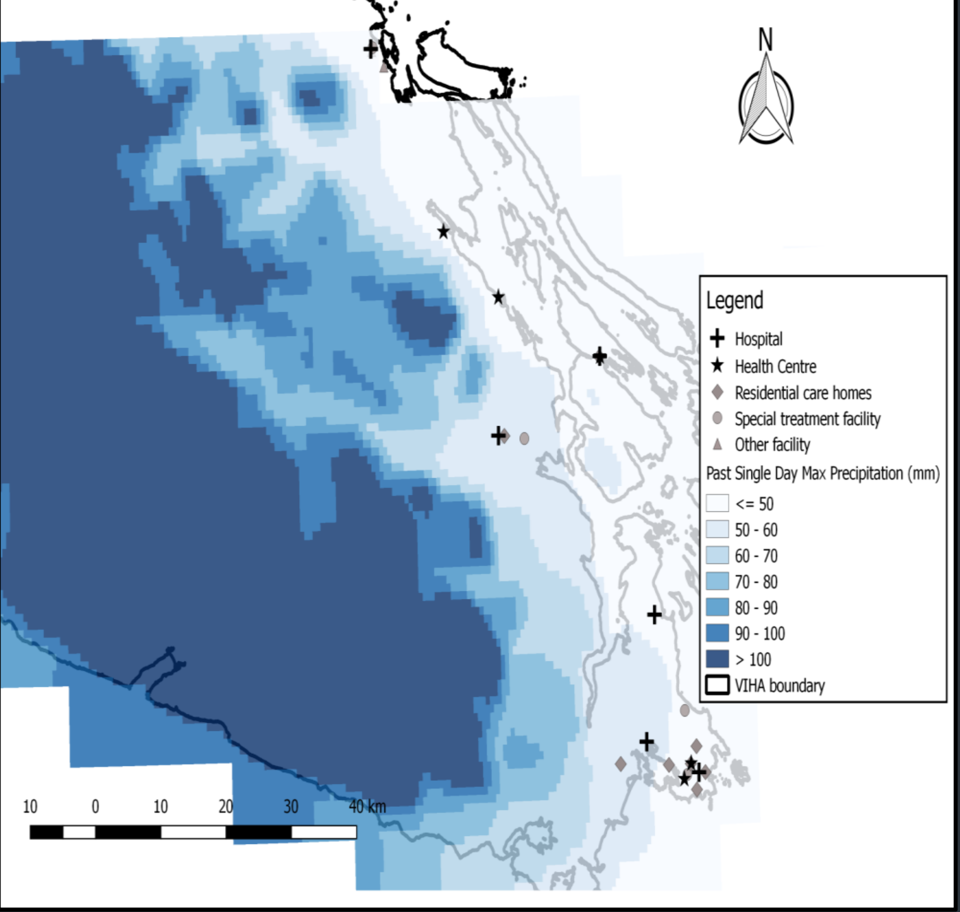


Figure 5: Past single day maximum precipitation over 1971-2000 for the South Island.

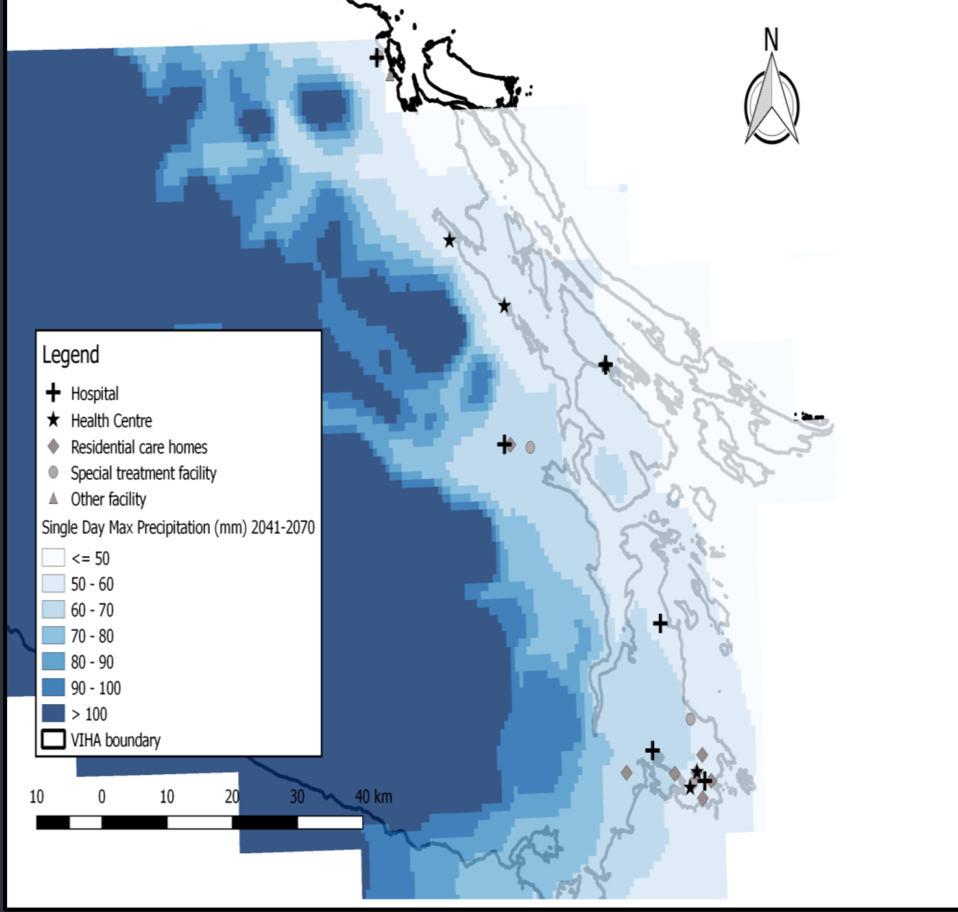


Figure 6: Projected single day maximum precipitation for the 2050's (2041-2070) in the South Island region.

1 of 15 climate variables

	Past Cooling Degree Days (CDD)	Cooling Degree Days (CDD) 2041-2070	Percent Change in CDD
Hospitals			
Royal Jubilee Hospital	20	176	765%
Saanich Peninsula Hospital	33	206	520%
Victoria General Hospital	24	180	660%
Cowichan District Hospital	66	267	307%
Nanaimo Regional General Hospital	56	240	329%
Lady Minto Hospital	51	243	379%
New Cowichan District Hospital	63	262	319%

Climate Change Adaptation Assessment Toolkit

- Involve key stakeholders at a particular site
- Take 2-6 hours to respond to questions related to their roles and responsibilities
- Cover 5 elements:
  1. Climate Risks and Community Vulnerabilities
  2. Land Use, Building Design and Regulatory Context
  3. Infrastructure Protection
  4. Essential Clinical Care Service Delivery Planning
  5. Environmental Protection and Ecosystem Adaptations
- Excel and online versions

Resilience scores	Number of questions	Score (%)
Element 1: Climate Risks and Community Vulnerabilities Assessment	39	**78%**
General	11	**23%**
Step 1: Climate Risks	5	**100%**
Step 2: Community Preparedness and Vulnerabilities	5	**100%**
Step 3: Climate Risk and Vulnerability Analysis	10	**100%**
Step 4: System-wide Climate Risk and Vulnerability Analysis	7	**100%**
Element 2: Land Use, Building, Design, and Regulatory Context	55	**73%**
General	10	**100%**
Step 1: Land Use, Siting, and Landscape	5	**64%**
Step 2: Transportation and Site Access	12	**63%**
Step 3: Critical Building Inventory	6	**58%**
Step 4: Building Construction and Vertical Transportation	16	**66%**
Step 5: Passive Survivability Inventory	3	**100%**

Extreme Weather Impact Surveys

Intent:

- To understand the actual impact of extreme weather events that might increase in frequency and intensity due to climate change
- To illustrate the need to prepare for them
- To build a knowledge base in order to formulate appropriate response strategies

Heat Wave Impact Surveys

- Surveys sent to sites and functions across Island Health
- 218 responses in total
- Responses from a wide range of areas:
  - admitting
  - ambulatory care
  - community and home care services
  - volunteer resources
  - support services
  - facility management
  - long term care
  - medical imaging and more

Next Steps for Island Health

- Test our climate adaptation assessment tool at our own sites
- Assess where and when to use the PIEVC protocol in the future
- Ensure new construction & major renovations use climate projections to inform design (e.g. NRGH Intensive Care Unit)
- Develop staff capacity to identify and implement adaptation measures
- Develop a 10-year adaptation plan integrated with updated mitigation plan


THANK YOU