The Technical Opportunities and Economic Implications of Permafrost Decay on Public Infrastructure in the Northwest Territories

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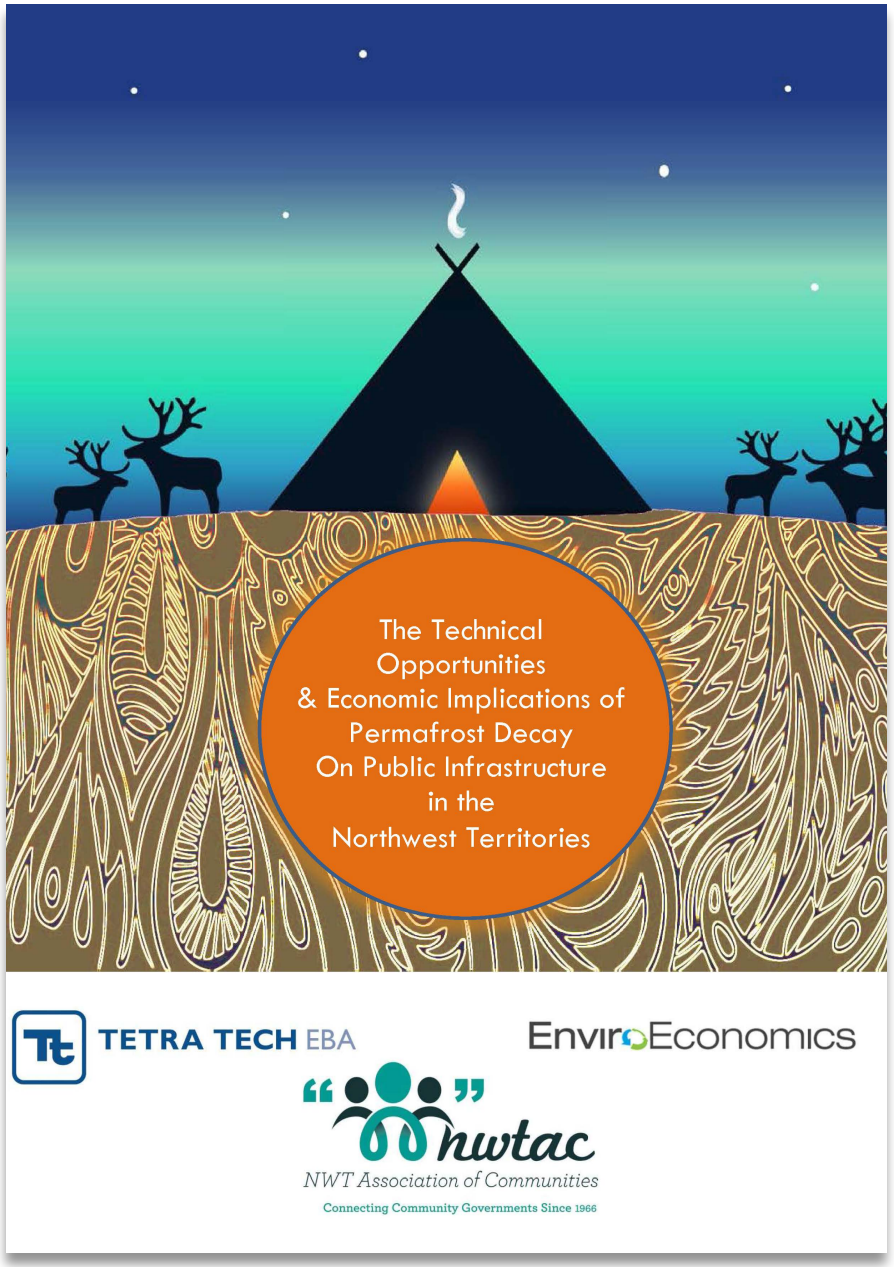
Initiated by a desire to understand the scale of the costs associated with Permafrost Decay



PROJECT TEAM

TETRA TECH EBA

EnviroEconomics

nwtac

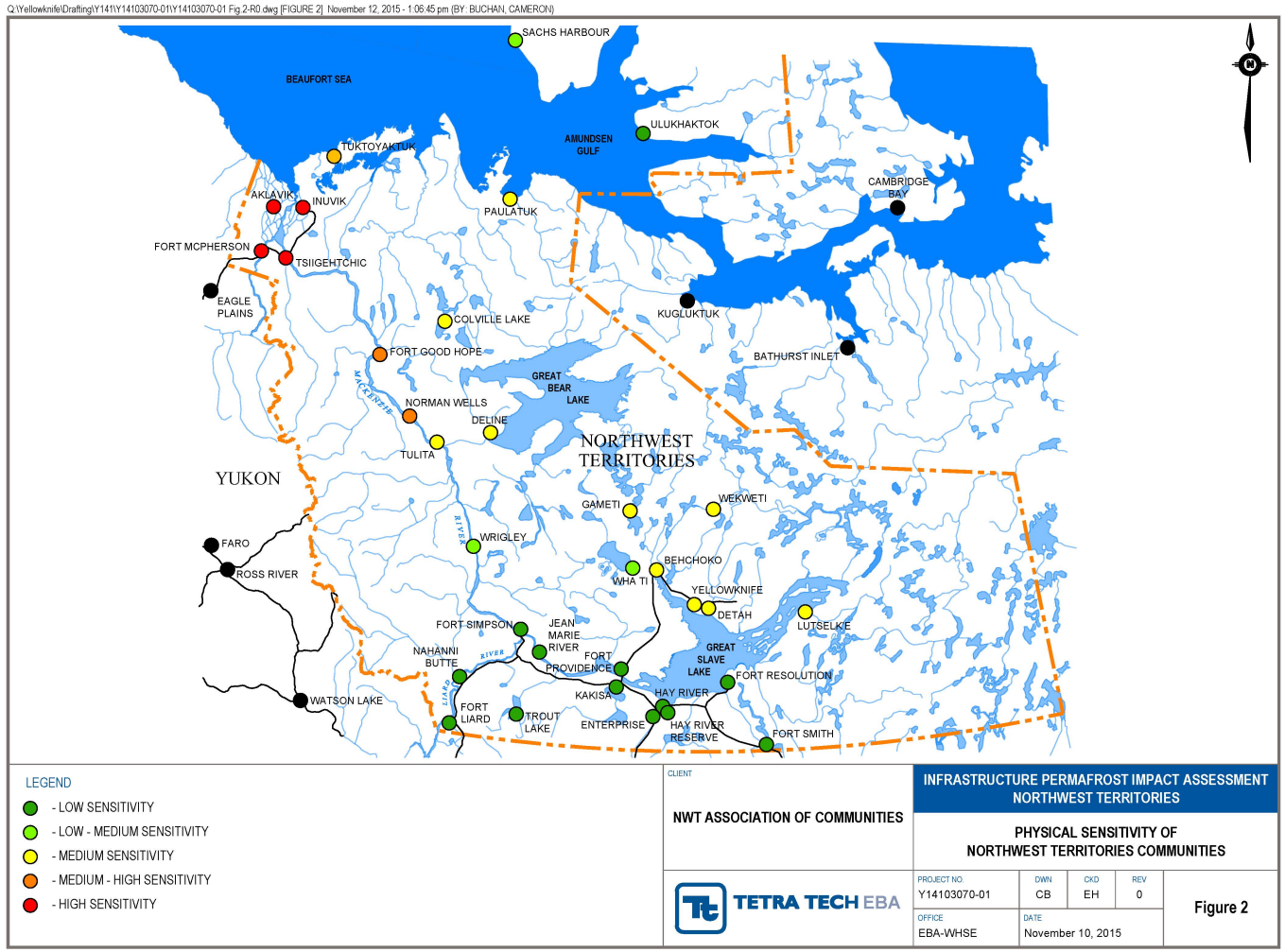
NWT Association of Communities

Connecting Community Governments Since 1966

INVENTORY

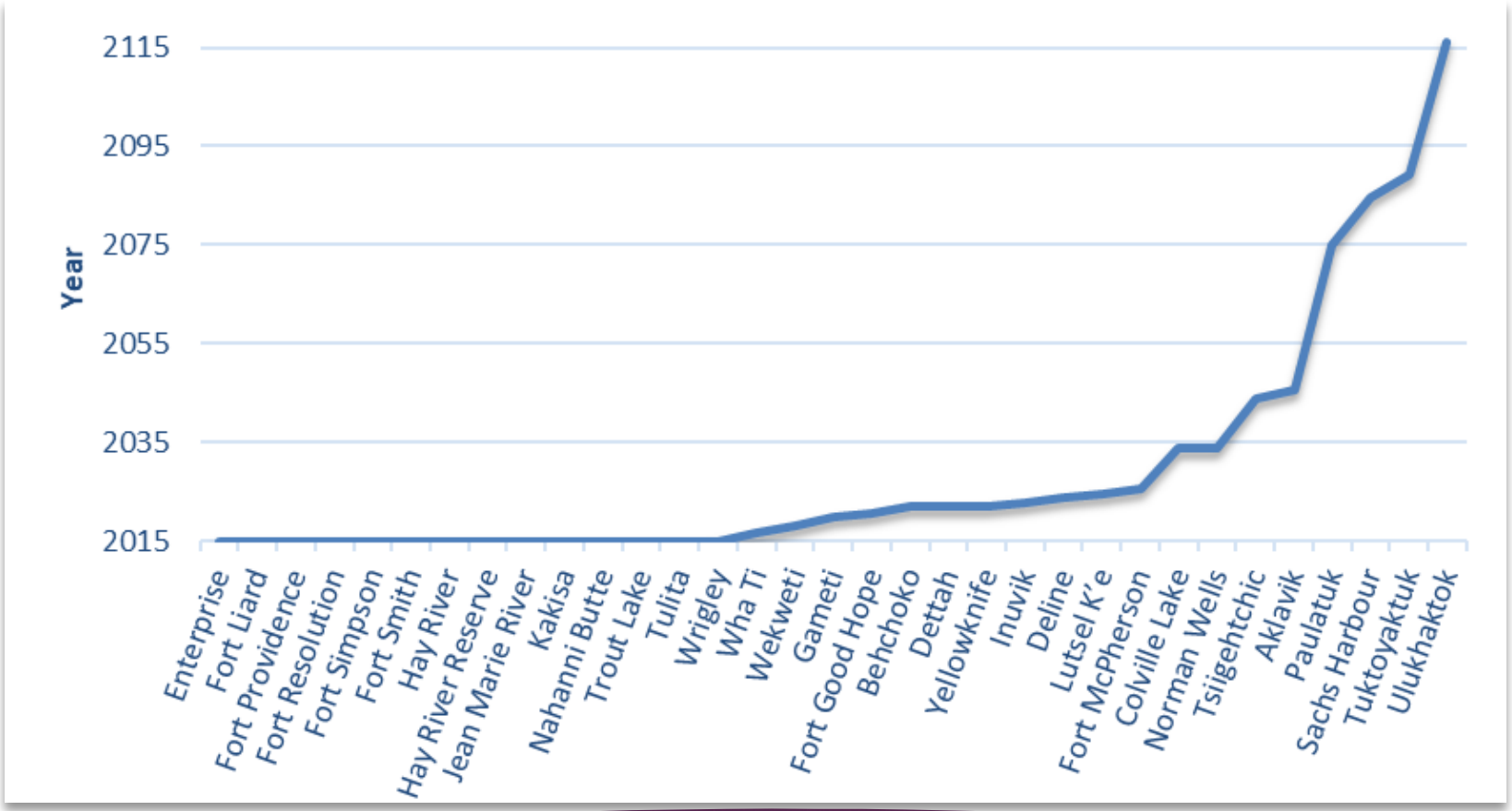
- Community – NWTAC Insurance Program Data
- Territorial – Insurance and Infrastructure
- Federal

PHYSICAL SENSITIVITY OF NWT COMMUNITIES

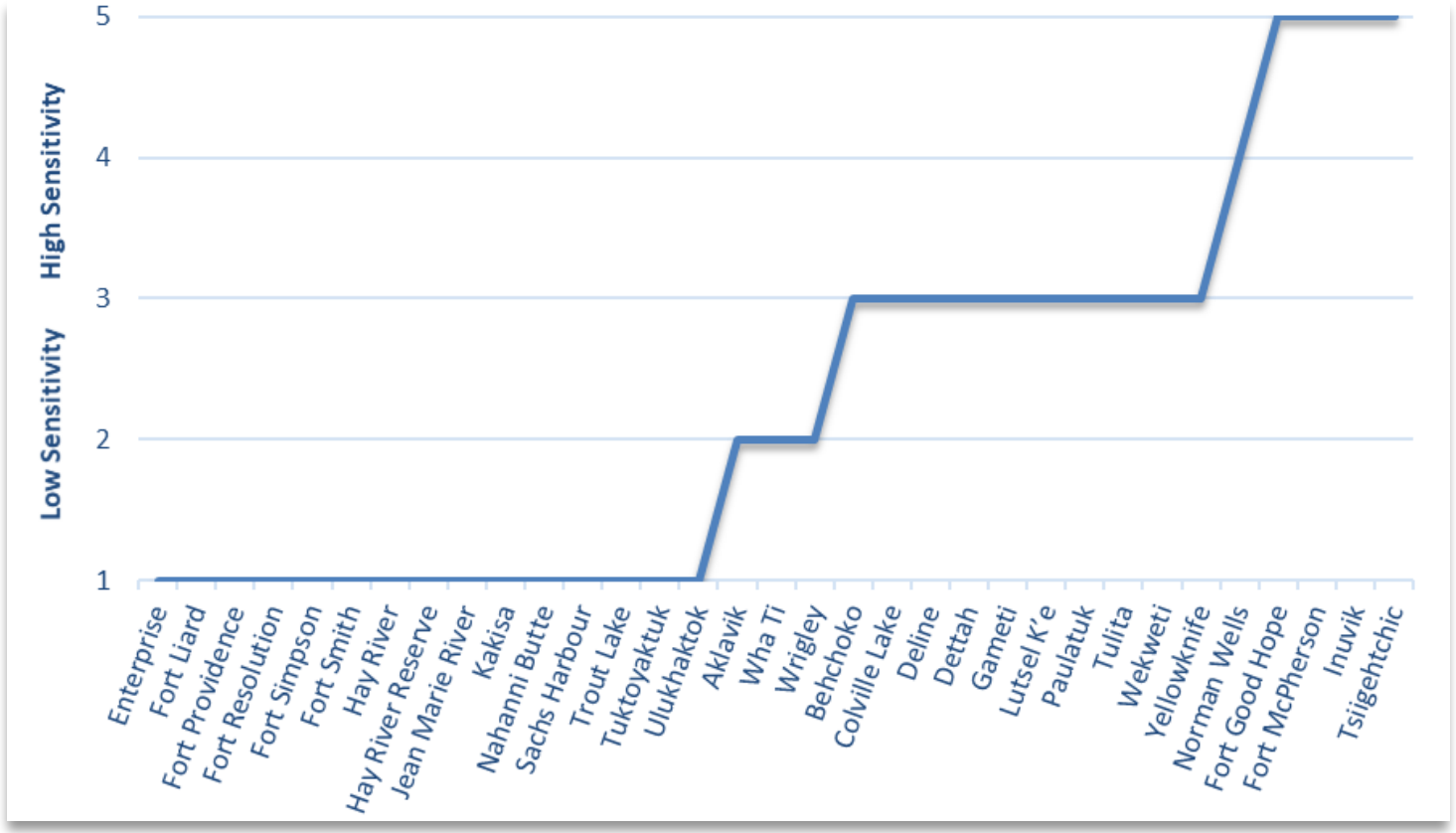


COMMUNITY SENSITIVITY FACTOR

- ***Community permafrost sensitivity***
- ***Identify critical threshold years***
- ***Identify an overall physical vulnerability factor***



CRITICAL THRESHOLD YEARS by COMMUNITY



PHYSICAL SENSITIVITY FACTOR by COMMUNITY

Infrastructure Vulnerability Factor

- To develop infrastructure vulnerability, the overall community vulnerability factors were used as the starting point to assess the vulnerability of each infrastructure class
- For ***buildings***, effort was made to understand the current state of repair of the buildings, where they're located in the community and the associated permafrost risk given location and soil type. This means that each of the 1,740 buildings in the 33 communities was assigned a unique vulnerability factor.
- Similarly, the type of ***road in each community*** and ***highways*** was assigned a vulnerability factor. Three classes of roads were assigned vulnerability factors using engineering judgement, again using a scale of 1 to 5 to reflect increasing sensitivity.

OVERALL VULNERABILITY FACTOR

Buildings OVF = 0.67 * IVF + 0.33 * CSF

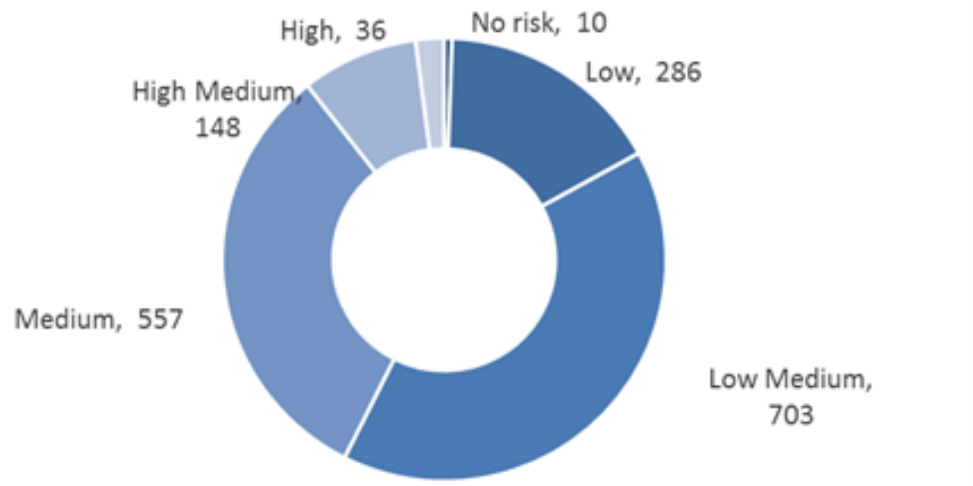
Roads OVF = 0.33 * IVF + 0.67 * CSF

Where,

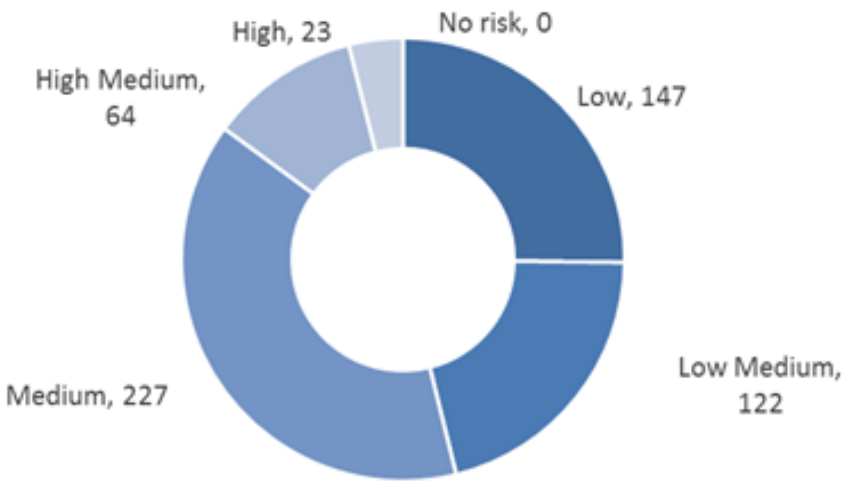
OVF denotes Overall Vulnerability Factor;
IVF denotes Infrastructure Vulnerability Factor; and
CSF denotes Community Sensitivity Factor.

OVERALL VULNERABILITY FACTOR by INFRASTRUCTURE TYPE

Number of Buildings



KM of Community Roads



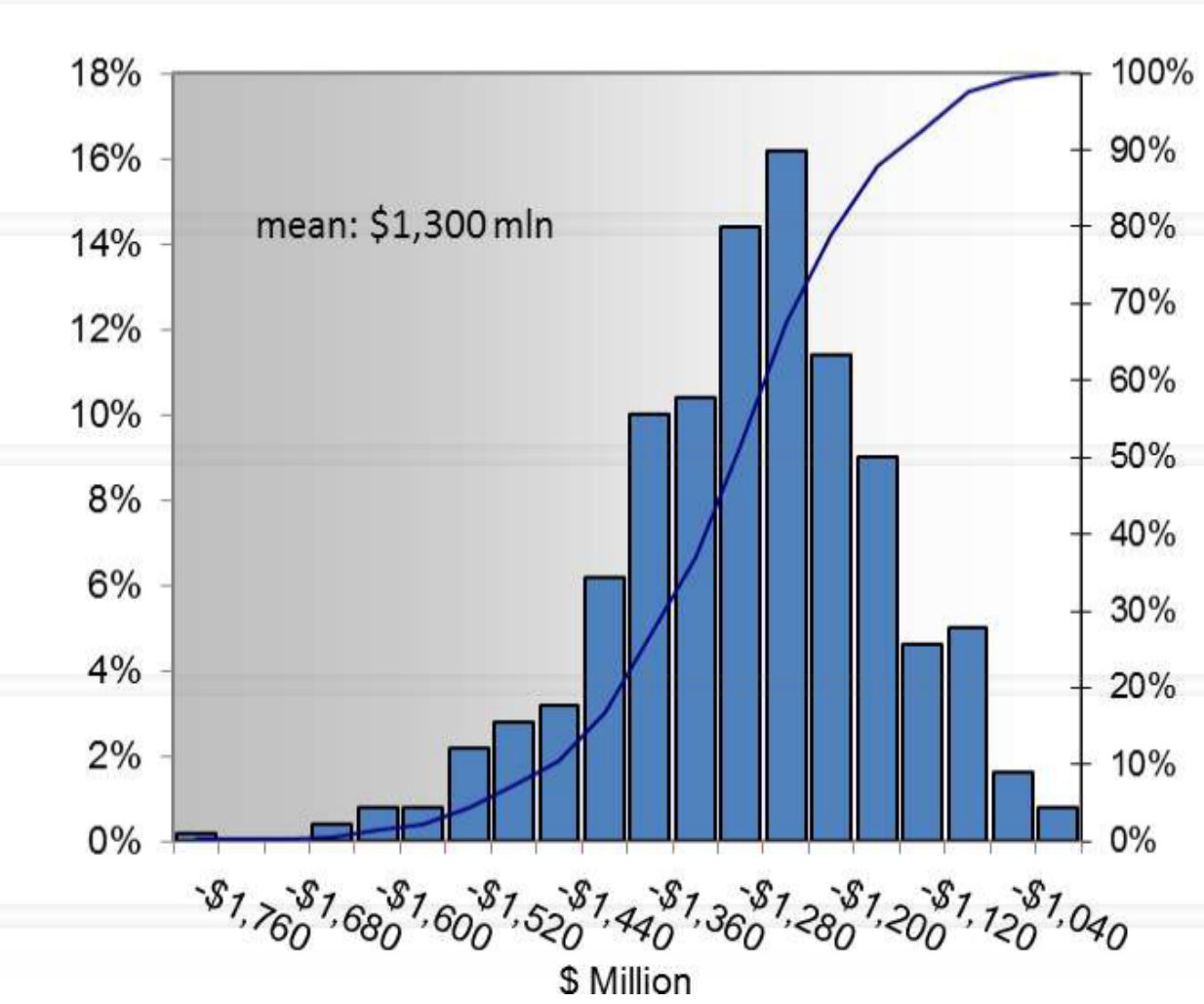
APPROACH to ESTIMATING COSTS and BENEFITS

- **Cost Benefit Analysis**
  - **What are the costs of current climate-induced damages?**
  - **What are the benefits of adaptation actions?**
- **Economic Impact Analysis**

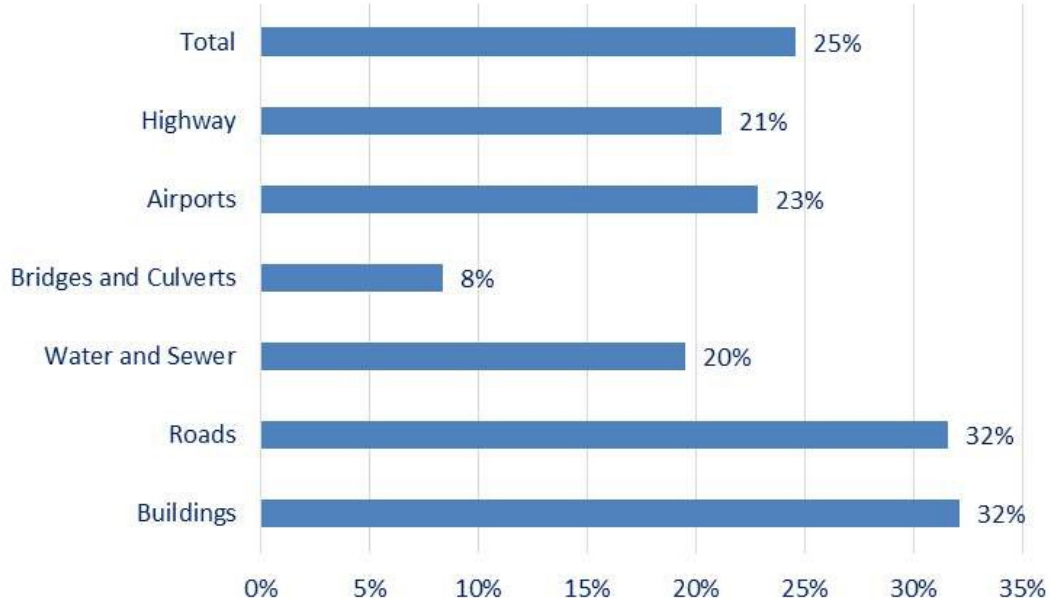
Distribution of Total Cost

The total costs of the permafrost impact on assets in the 33 communities is in the order of **$1.3 billion**

On an annual basis, the economic losses are likely in the order of **$51 million**.



Value at Risk Relative to Infrastructure Value



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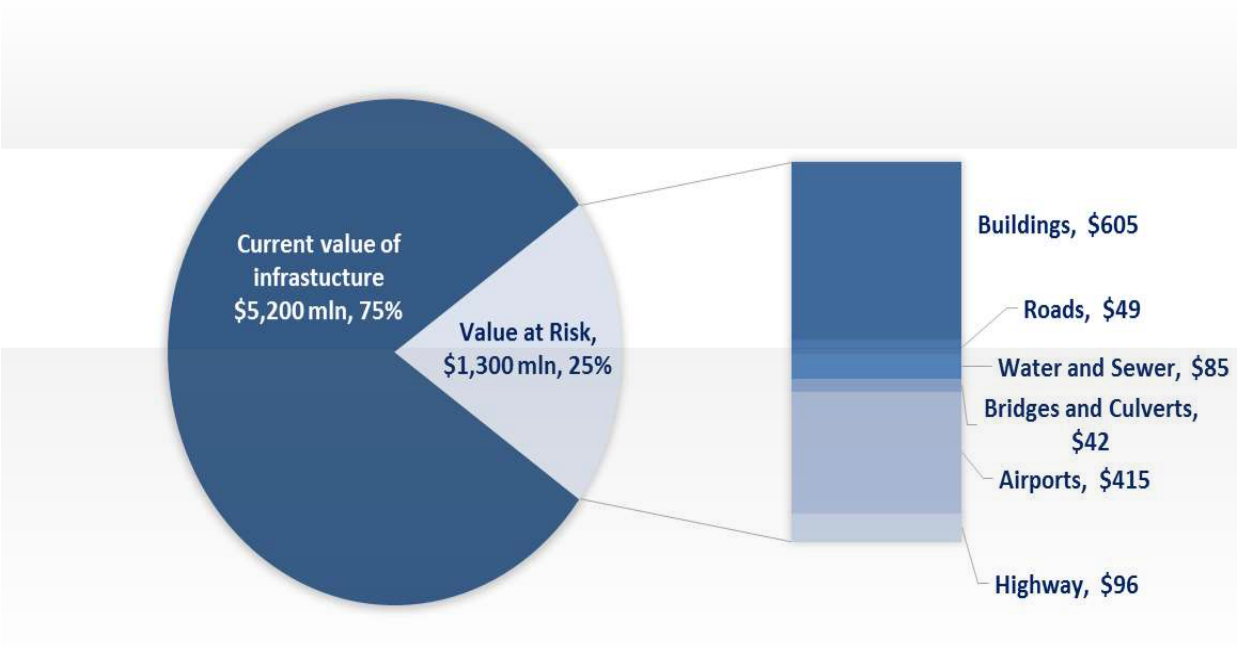


ANNUAL ECONOMIC IMPACT

	Annual GDP Lost (Million)	Annual Employment Loss (FTE)	Annual Labour Income Lost (Million)
Buildings	-$11.68	-89	-$8.38
Roads	-$0.95	-7	-$0.68
Water and Sewer	-$2.43	-18	-$1.74
Bridges and Culverts	-$1.33	-10	-$0.95
Airports	-$8.03	-61	-$5.76
Highway	-$1.86	-14	-$1.33
Total	**-$25.19**	**-192**	**-$18.07**

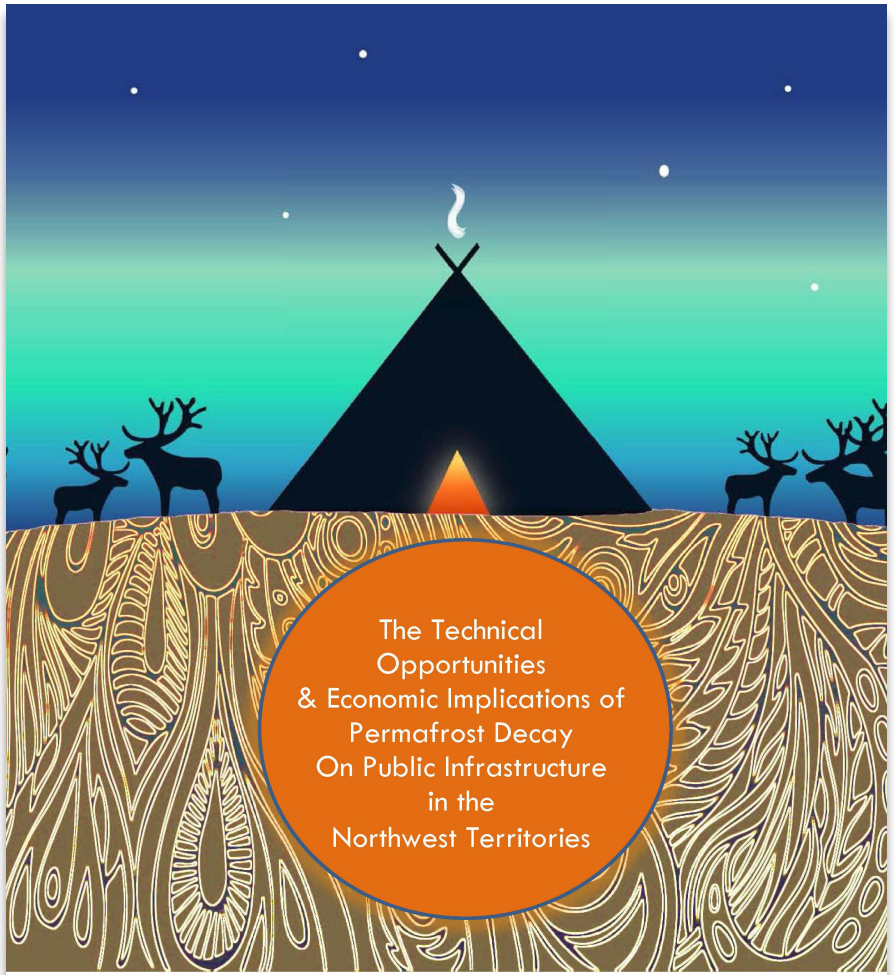
OPPORTUNITY

- Engineering and Construction
- Infrastructure Planning and Siting as it relates to permafrost mapping, geotechnical review and on-going monitoring
- Engineering & Design Standards
- Maintenance and the associated reduction of risk through maintenance practices (ie/ strategic snow cleaning of vulnerable permafrost areas in roads and around buildings or drainage techniques around buildings)
- Project Management Standards
- Construction Techniques and Practices

OPPORTUNITY

- Remediation techniques for all types of infrastructure
- Development of specialized equipment, approaches and materials
- Training, Guidance and Tools
- Maintenance of Data around climate, precipitation and permafrost
- Standards and Codes

THANK YOU!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