Associated Engineering

GLOBAL PERSPECTIVE.
LOCAL FOCUS.

Climate Change and Buildings

Developing a building assessment triage tool

Mark Porter PEng., StructEng., FIStructE

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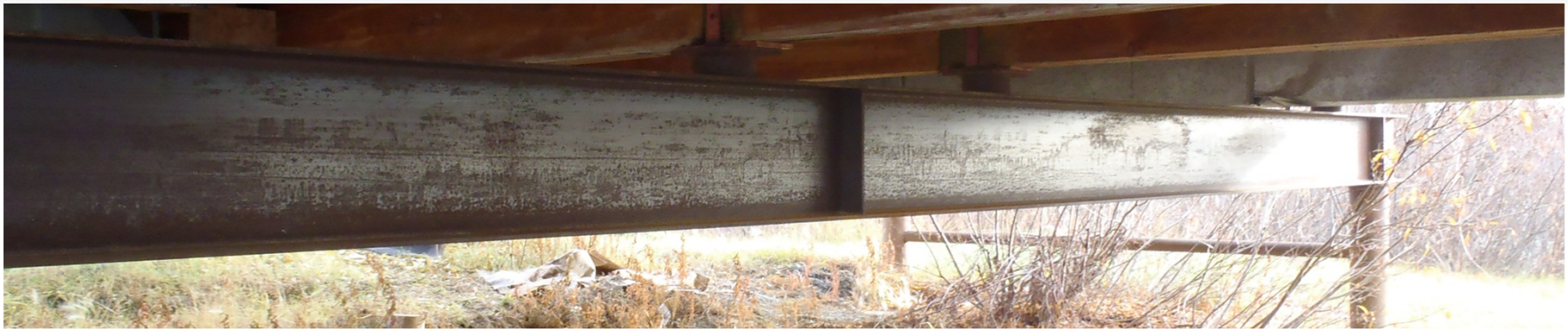
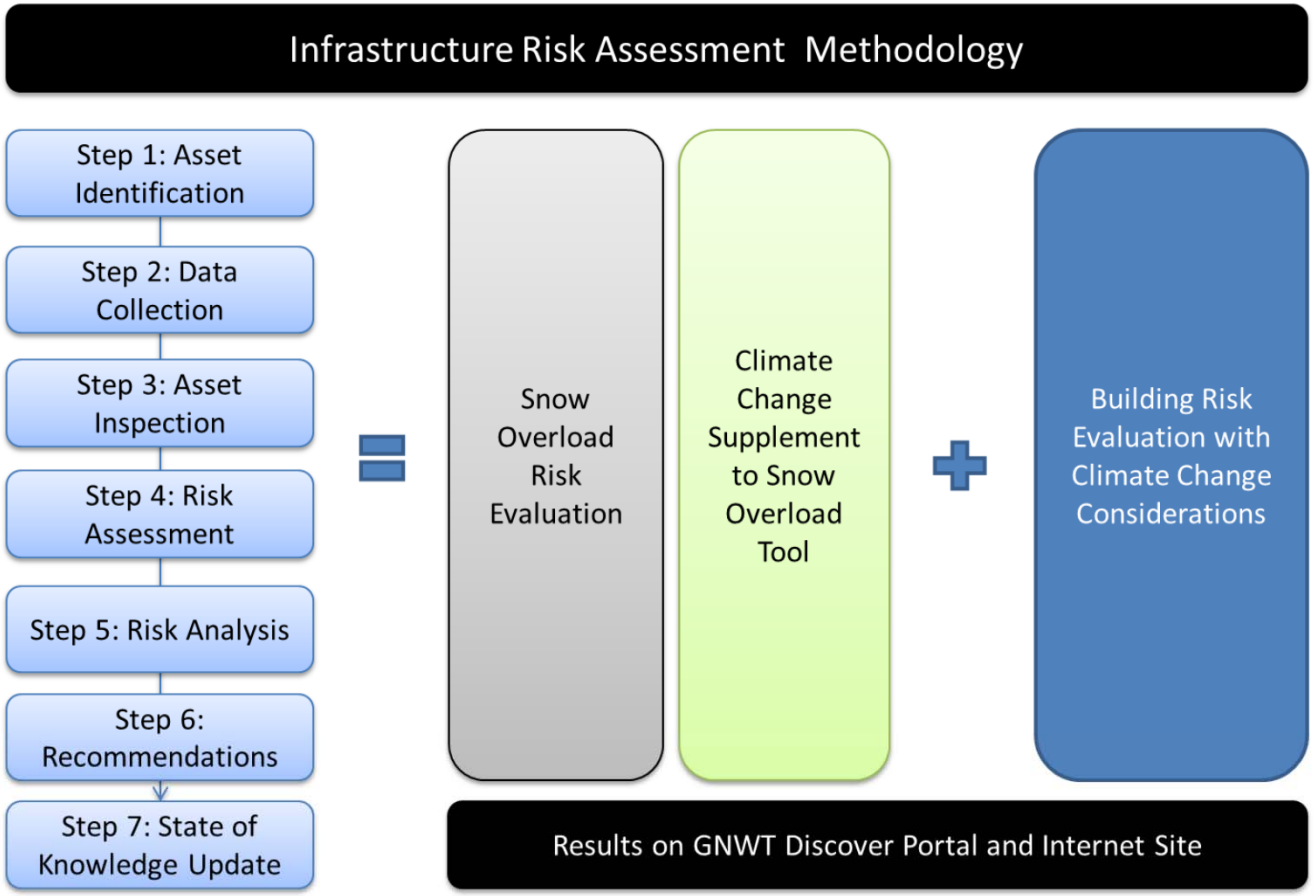
CANADA'S BEST MANAGED COMPANIES

What's the project

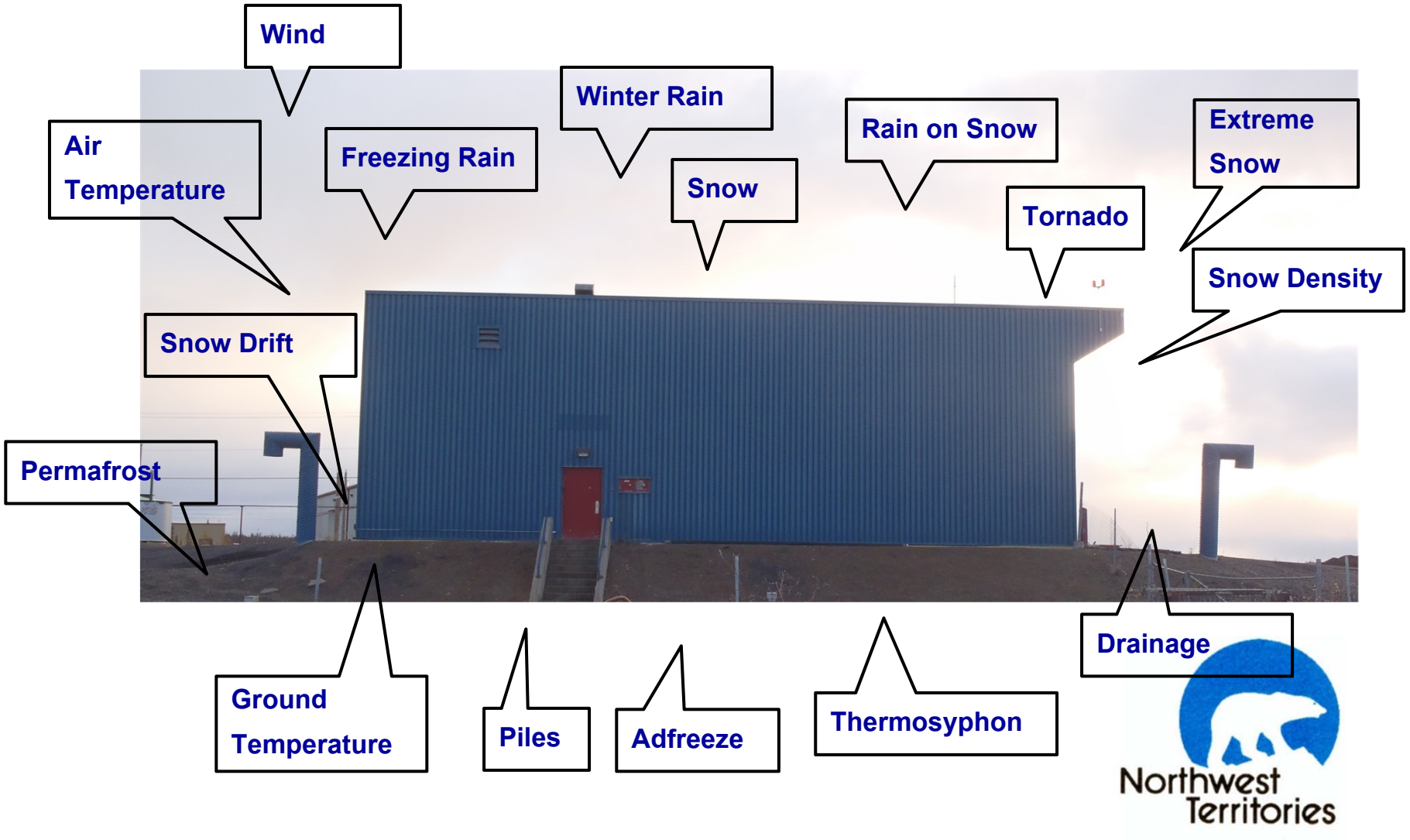


- Develop a 'triage' tool to assess climate change capacity
- Focus on snow loading and permafrost degradation
- Tool requirements: rapid and reliable
- Easy to use (don't need to be an engineer)
- Empowers communities to make their own assessments (reduces costs, harnesses local knowledge)
- Assigns a level of risk to each building

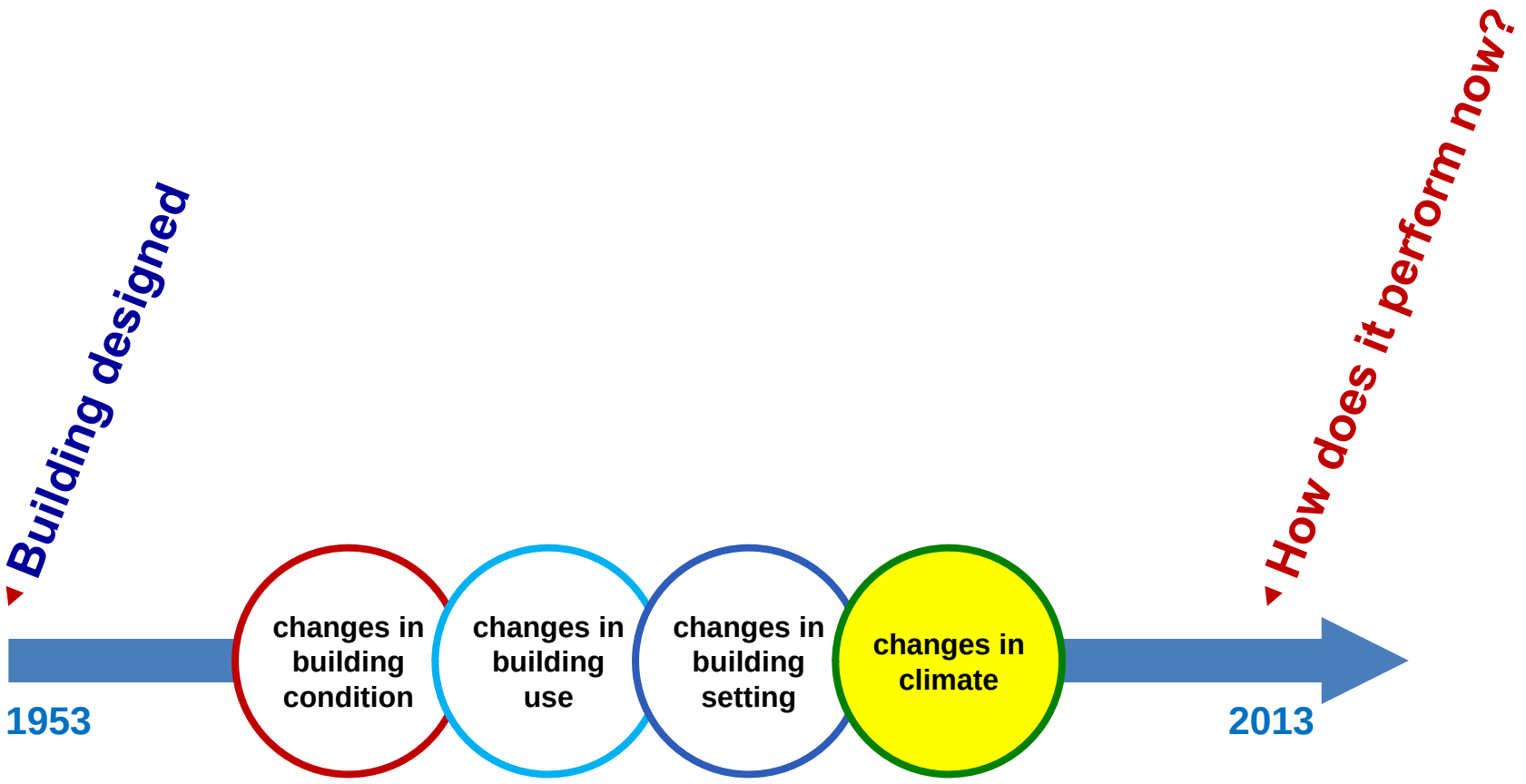
What's the project



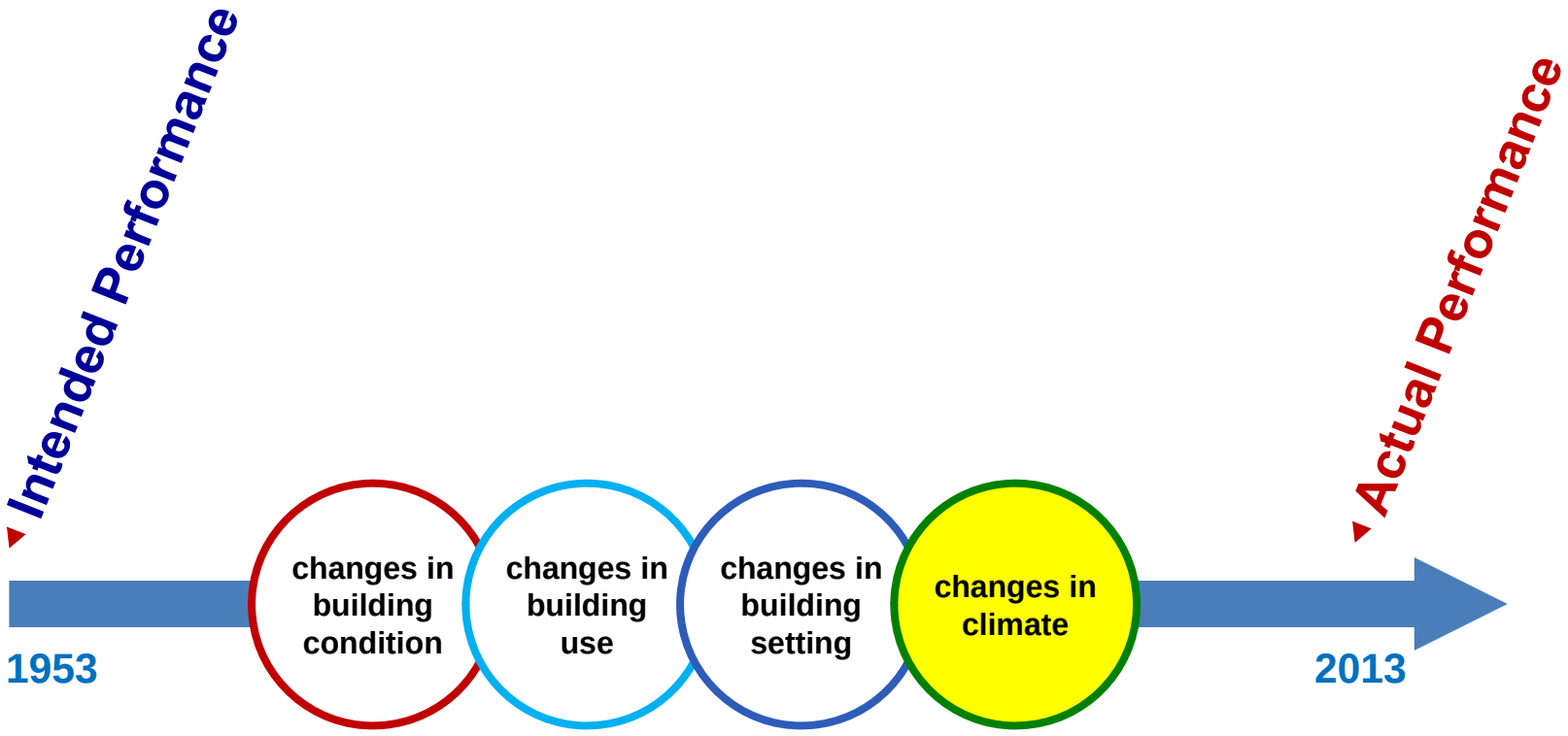
What's the project



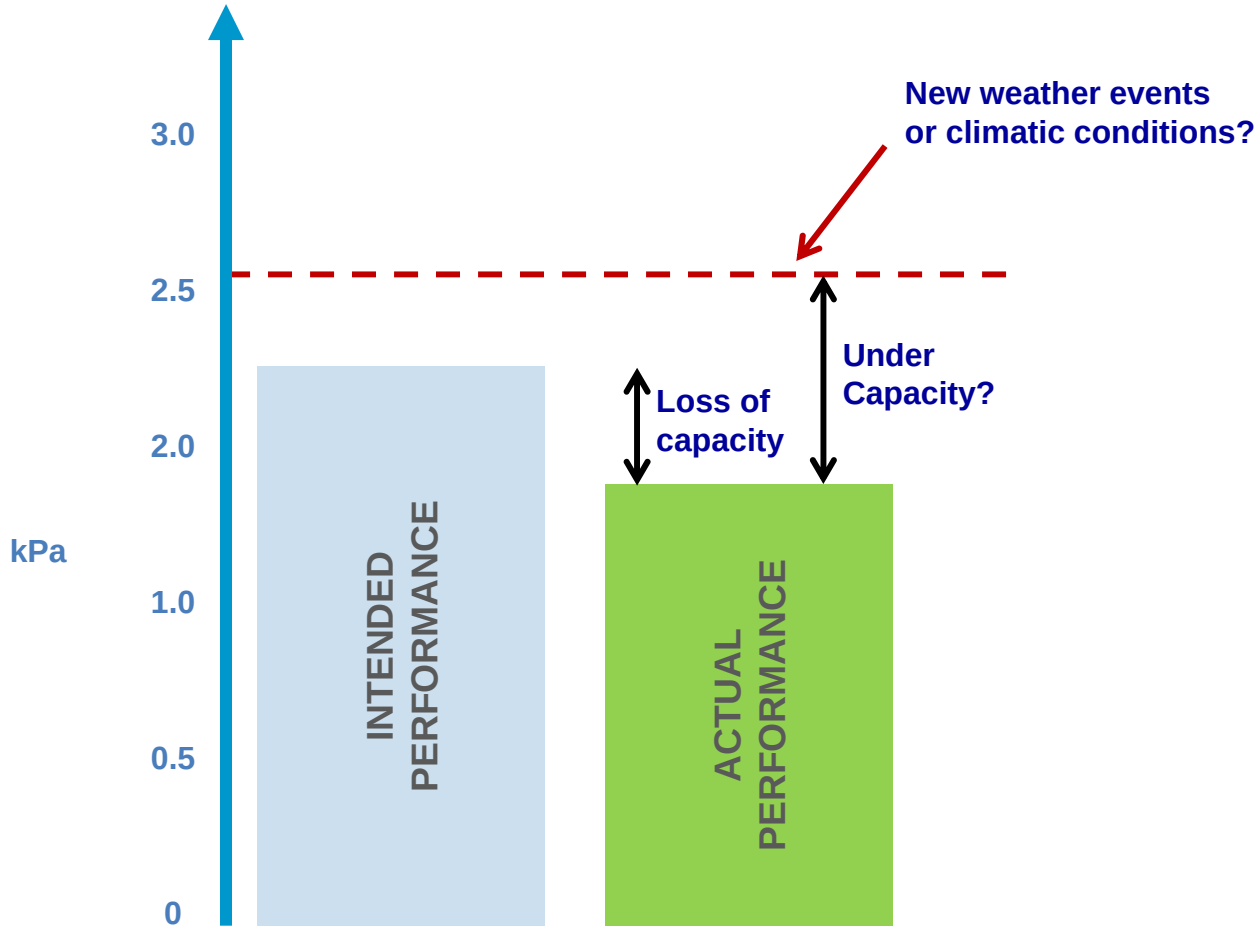
What's Changed?



Intended vs. Actual



What do we mean by ‘Capacity’



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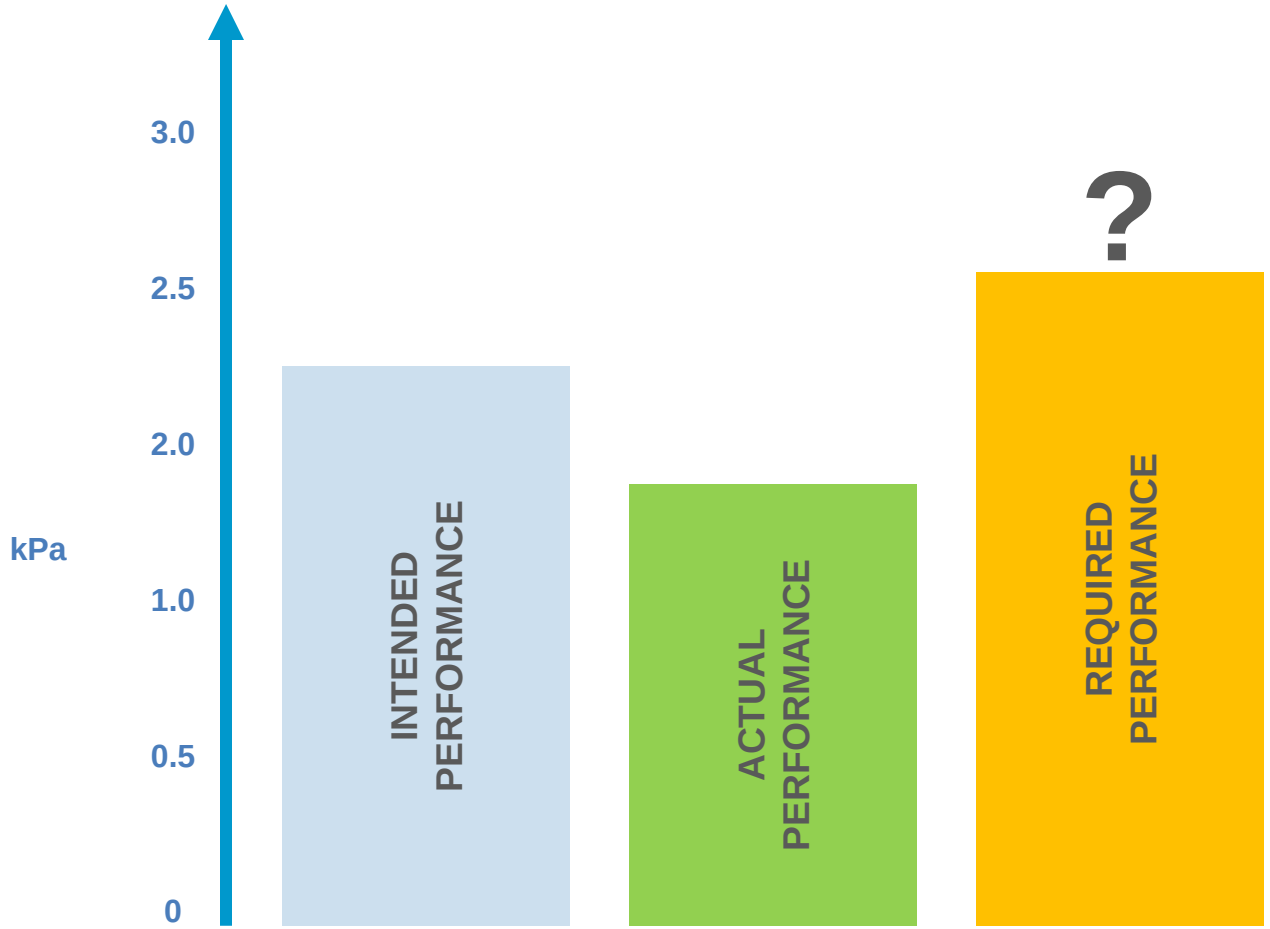


What does the tool focus on?

7 Parameters:

1. Building's importance & use
2. Building's 'basic' assessment
3. Ease with which wind can remove snow (exposure)
4. Ease with which storm water is removed
5. Slope of roof and roof materials
6. Roof shape, foundation & crawl space design, presence & size of significant roof features
7. Deterioration of foundations, roof and building

What does the tool focus on?

Permafrost related parameters:

1. Sloping of the ground around the building
2. Control of roof drainage
3. Use of the land immediately surrounding the building
4. Presence of open air space between the building and the ground

Building Assessment

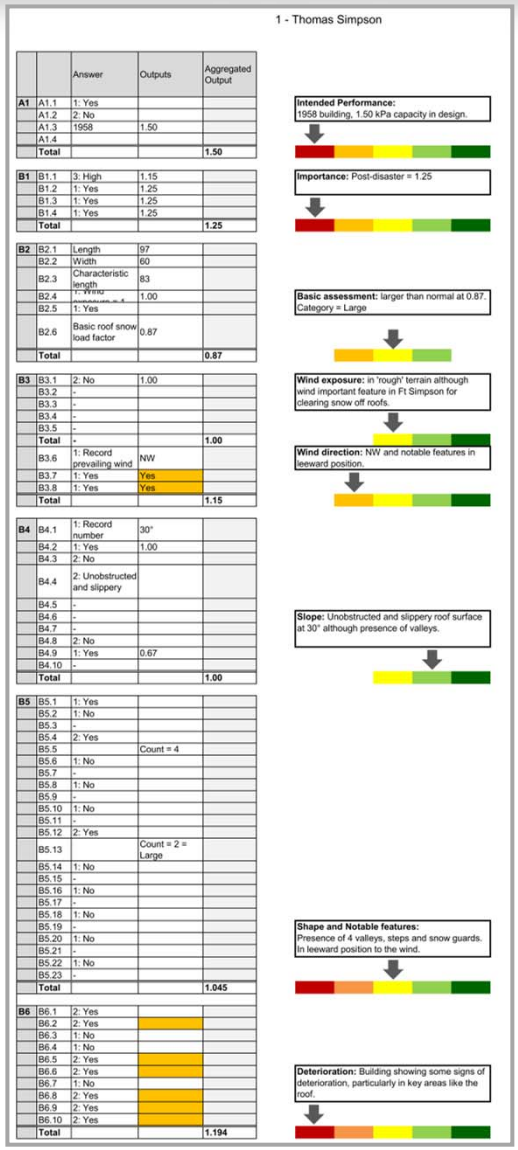
GNWT Risk Assessment

Location: Inuvik

1.	**Building (Asset No.):** ( )	**Inspector:**	**Date:**
2.	☒ *Take a photograph of this sheet! (first photograph of this assessment)*		
	Background information		
3.	**Construction Type:** ☐ Timber ☐ Masonry ☐ Other _____		
4.	**Foundation Type:** ☐ Posts ☐ Concrete Strip ☐ Piles ☐ Basement ☐ Other _____		
5.	**Importance Category:** ☐ Low ☐ Normal ☐ High ☐ Post-Disaster **Emergency Use:** ☐ Been used in an emergency? ☐ Will be used in an emergency? ☐ Emergency Generator		
	Context		
6.	**Wind Exposure:** ☐ Open Terrain ☐ Rough Terrain **North of Treeline:** ☐ Yes ☐ No **Local Permafrost:** ☐ Yes ☐ No **Positive Site Drainage (>4°):** ☐ Yes ☐ No **Adjacent, Taller Obstructions within 5m?** ☐ Yes ☐ No **Evidence of Adjacent Ground Snow Buildup:** ☐ Yes ☐ No		
	Measurements		
7.	**Plan Length (m):**	**Plan Width (m):**	**Eave Overhang (m):**

	Sketch			
1.	**Context:** ☐ North ☐ Prevailing Wind ☐ Tree ☐ Adjacent Obstruction			
2.	**Roof Features:** ☐ Dormer ▲ ☐ Chimney ⊗ ☐ Equipment ✖		☐ Step	☐ Arch
3.	☐ **Identify Local Damage**	6.	☐ **Identify leeward aspects likely to accumulate snow**	
4.	☐ **Identify Evidence of Previous Snow Build Up**	7.	☐ **Identify valleys likely to accumulate snow**	
5.	☐ **Identify Roof Heights**	8.	☐ **Identify snowguards**	

Building Scorecards



1 - Thomas Simpson

		Answer	Outputs	Aggregated Output
A1	A1.1	1: Yes		
	A1.2	2: No		
	A1.3	1958	1.50	
	A1.4			
	Total			1.50
B1	B1.1	3: High	1.15	
	B1.2	1: Yes	1.25	
	B1.3	1: Yes	1.25	
	B1.4	1: Yes	1.25	
	Total			1.25
B2	B2.1	Length	97	
	B2.2	Width	60	
	B2.3	Characteristic length	83	
	B2.4	1: Wind exposure = 1	1.00	
	B2.5	1: Yes		
	B2.6	Basic roof snow load factor	0.87	
	Total			0.87
B3	B3.1	2: No	1.00	
	B3.2	-		
	B3.3	-		
	B3.4	-		
	B3.5	-		
	Total	-		1.00
	B3.6	1: Record prevailing wind	NW	
	B3.7	1: Yes	Yes	
	B3.8	1: Yes	Yes	
	Total			1.15
B4	B4.1	1: Record number	30°	
	B4.2	1: Yes	1.00	
	B4.3	2: No		
	B4.4	2: Unobstructed and slippery		
	B4.5	-		
	B4.6	-		
	B4.7	-		
	B4.8	2: No		
	B4.9	1: Yes	0.67	
	B4.10	-		
	Total			1.00
B5	B5.1	1: Yes		
	B5.2	1: No		
	B5.3	-		
	B5.4	2: Yes		
	B5.5		Count = 4	
	B5.6	1: No		
	B5.7	-		
	B5.8	1: No		
	B5.9	-		
	B5.10	1: No		
	B5.11	-		
	B5.12	2: Yes		
	B5.13		Count = 2 = Large	
	B5.14	1: No		
	B5.15	-		
	B5.16	1: No		
	B5.17	-		
	B5.18	1: No		
	B5.19	-		
	B5.20	1: No		
	B5.21	-		
	B5.22	1: No		
	B5.23	-		
	Total			1.045
B6	B6.1	2: Yes		
	B6.2	2: Yes		
	B6.3	1: No		
	B6.4	1: No		
	B6.5	2: Yes		
	B6.6	2: Yes		
	B6.7	1: No		
	B6.8	2: Yes		
	B6.9	2: Yes		
	B6.10	2: Yes		
	Total			1.194

Intended Performance: 1958 building, 1.50 kPa capacity in design.

Importance: Post-disaster = 1.25

Basic assessment: larger than normal at 0.87. Category = Large

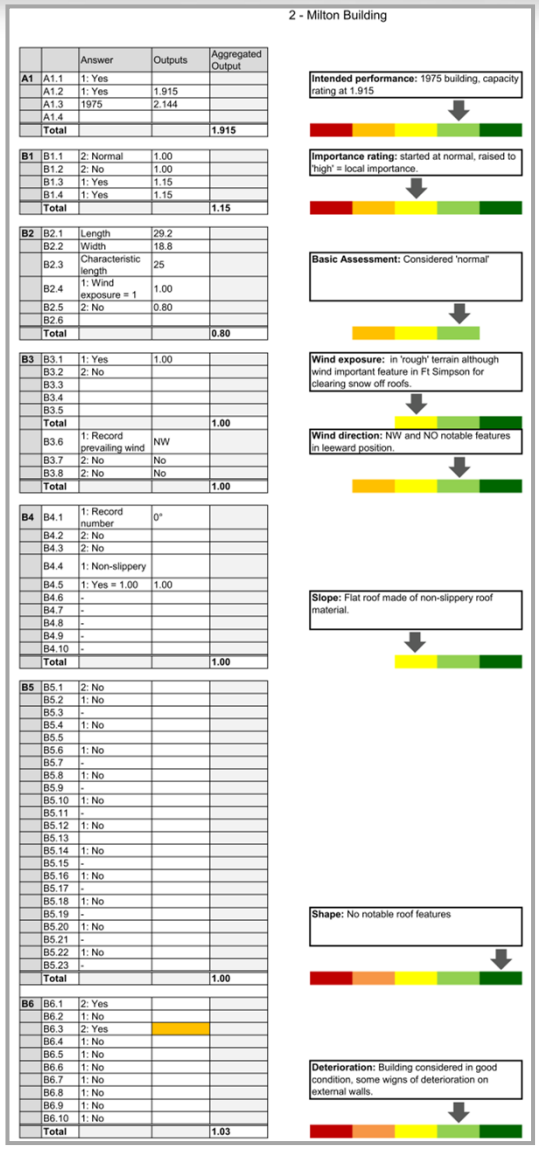
Wind exposure: in 'rough' terrain although wind important feature in Ft Simpson for clearing snow off roofs.

Wind direction: NW and notable features in leeward position.

Slope: Unobstructed and slippery roof surface at 30° although presence of valleys.

Shape and Notable features: Presence of 4 valleys, steps and snow guards. In leeward position to the wind.

Deterioration: Building showing some signs of deterioration, particularly in key areas like the roof.



2 - Milton Building

		Answer	Outputs	Aggregated Output
A1	A1.1	1: Yes		
	A1.2	1: Yes	1.915	
	A1.3	1975	2.144	
	A1.4			
	Total			1.915
B1	B1.1	2: Normal	1.00	
	B1.2	2: No	1.00	
	B1.3	1: Yes	1.15	
	B1.4	1: Yes	1.15	
	Total			1.15
B2	B2.1	Length	29.2	
	B2.2	Width	18.8	
	B2.3	Characteristic length	25	
	B2.4	1: Wind exposure = 1	1.00	
	B2.5	2: No	0.80	
	B2.6			
	Total			0.80
B3	B3.1	1: Yes	1.00	
	B3.2	2: No		
	B3.3			
	B3.4			
	B3.5			
	Total			1.00
	B3.6	1: Record prevailing wind	NW	
	B3.7	2: No	No	
	B3.8	2: No	No	
	Total			1.00
B4	B4.1	1: Record number	0°	
	B4.2	2: No		
	B4.3	2: No		
	B4.4	1: Non-slippery		
	B4.5	1: Yes = 1.00	1.00	
	B4.6	-		
	B4.7	-		
	B4.8	-		
	B4.9	-		
	B4.10	-		
	Total			1.00
B5	B5.1	2: No		
	B5.2	1: No		
	B5.3	-		
	B5.4	1: No		
	B5.5			
	B5.6	1: No		
	B5.7	-		
	B5.8	1: No		
	B5.9	-		
	B5.10	1: No		
	B5.11	-		
	B5.12	1: No		
	B5.13			
	B5.14	1: No		
	B5.15	-		
	B5.16	1: No		
	B5.17	-		
	B5.18	1: No		
	B5.19	-		
	B5.20	1: No		
	B5.21	-		
	B5.22	1: No		
	B5.23	-		
	Total			1.00
B6	B6.1	2: Yes		
	B6.2	1: No		
	B6.3	2: Yes		
	B6.4	1: No		
	B6.5	1: No		
	B6.6	1: No		
	B6.7	1: No		
	B6.8	1: No		
	B6.9	1: No		
	B6.10	1: No		
	Total			1.03

Intended performance: 1975 building, capacity rating at 1.915

Importance rating: started at normal, raised to 'high' = local importance.

Basic Assessment: Considered 'normal'

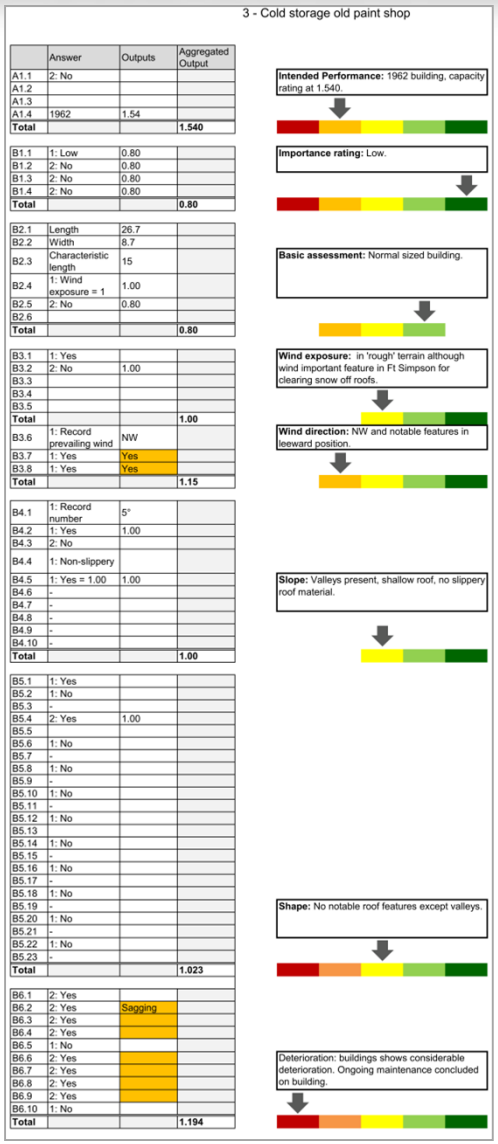
Wind exposure: in 'rough' terrain although wind important feature in Ft Simpson for clearing snow off roofs.

Wind direction: NW and NO notable features in leeward position.

Slope: Flat roof made of non-slippery roof material.

Shape: No notable roof features

Deterioration: Building considered in good condition, some wigns of deterioration on external walls.



3 - Cold storage old paint shop

	Answer	Outputs	Aggregated Output
A1.1	2: No		
A1.2			
A1.3			
A1.4	1962	1.54	
Total			1.540
B1.1	1: Low	0.80	
B1.2	2: No	0.80	
B1.3	2: No	0.80	
B1.4	2: No	0.80	
Total			0.80
B2.1	Length	26.7	
B2.2	Width	8.7	
B2.3	Characteristic length	15	
B2.4	1: Wind exposure = 1	1.00	
B2.5	2: No	0.80	
B2.6			
Total			0.80
B3.1	1: Yes		
B3.2	2: No	1.00	
B3.3			
B3.4			
B3.5			
Total			1.00
B3.6	1: Record prevailing wind	NW	
B3.7	1: Yes	Yes	
B3.8	1: Yes	Yes	
Total			1.15
B4.1	1: Record number	5°	
B4.2	1: Yes	1.00	
B4.3	2: No		
B4.4	1: Non-slippery		
B4.5	1: Yes = 1.00	1.00	
B4.6	-		
B4.7	-		
B4.8	-		
B4.9	-		
B4.10	-		
Total			1.00
B5.1	1: Yes		
B5.2	1: No		
B5.3	-		
B5.4	2: Yes	1.00	
B5.5			
B5.6	1: No		
B5.7	-		
B5.8	1: No		
B5.9	-		
B5.10	1: No		
B5.11	-		
B5.12	1: No		
B5.13			
B5.14	1: No		
B5.15	-		
B5.16	1: No		
B5.17	-		
B5.18	1: No		
B5.19	-		
B5.20	1: No		
B5.21	-		
B5.22	1: No		
B5.23	-		
Total			1.023
B6.1	2: Yes		
B6.2	2: Yes	Sagging	
B6.3	2: Yes		
B6.4	2: Yes		
B6.5	1: No		
B6.6	2: Yes		
B6.7	2: Yes		
B6.8	2: Yes		
B6.9	2: Yes		
B6.10	1: No		
Total			1.194

Intended Performance: 1962 building, capacity rating at 1.540.

Importance rating: Low.

Basic assessment: Normal sized building.

Wind exposure: in 'rough' terrain although wind important feature in Ft Simpson for clearing snow off roofs.

Wind direction: NW and notable features in leeward position.

Slope: Valleys present, shallow roof, no slippery roof material.

Shape: No notable roof features except valleys.

Deterioration: buildings shows considerable deterioration. Ongoing maintenance concluded on building.

Summary

- Each building takes about 1 hour to assess
- Standard assessment field-form:
  - Comparable data
  - Ease of use
- If scores badly then triggers a full building assessment
- Allows weather scenarios to be compared to the capacity of the building
- Where good climate change data exists, time to failure assessments could be made

Next Steps

- Halfway through the process but:
  - Database of building types and performance
  - Relating performance to capacity for change

- Guidance for adaptive design and best practice
- Allows for ‘triage’ assessment easily applied in all locations
- Help to inform building designers and managers.