Preliminary Assessment

Information Gathering

Ed Hoeve & Robin McKillop

NWT
RIVERBANK EROSION
WORKSHOP 2025
DEC 2-4 | CHATEAU NOVA HOTEL | YELLOWKNIFE

Two Parts

- Information gathering – levels of assessment
- What to expect from an assessment report – some examples

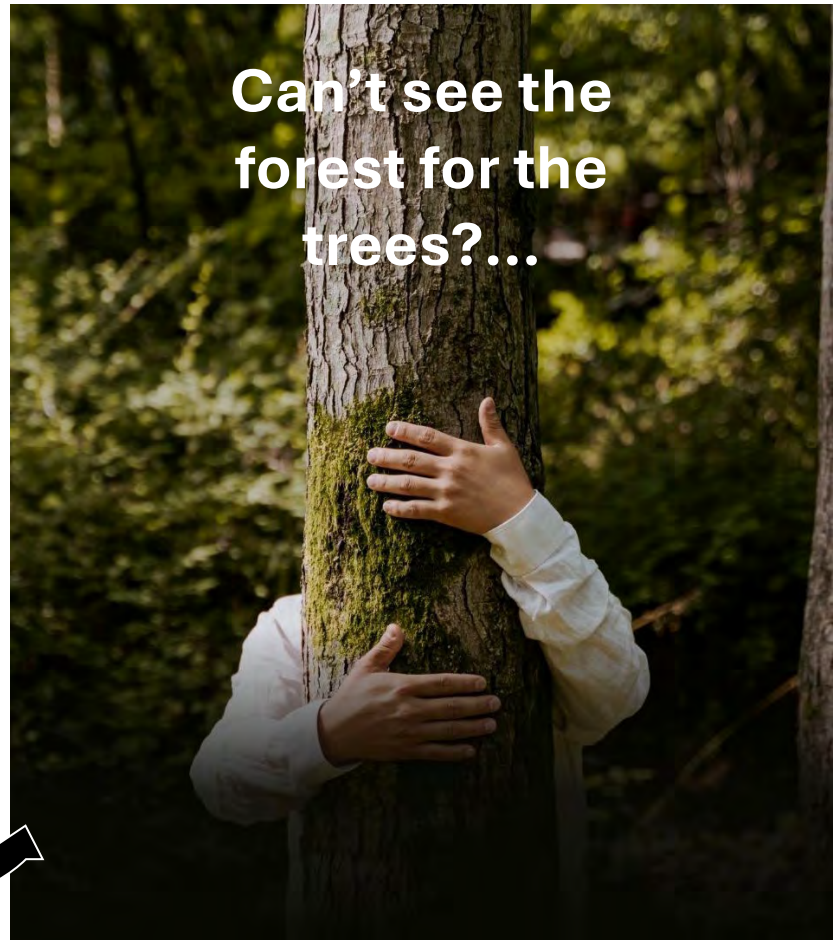
Exploring Step 3: Gather and Assess Initial Information

Desktop Review and Analysis

Desktop, first!

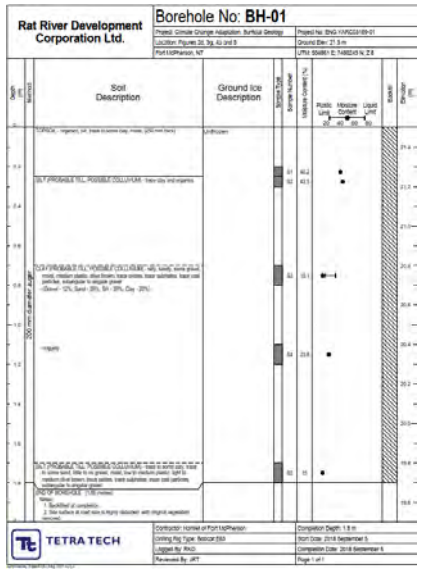
Initial screening can be done by anyone, then a technical specialist is usually required

- Gathering and assessment of initial information should always begin with **desktop review and analysis**
- Why?…
  - Best Bang for Your Buck!
    - Perhaps $10,000 – $25,000
  - It informs site (field) assessment
  - It can be completed any time of year
  - It often reveals important clues about riverbank instability that otherwise go unnoticed

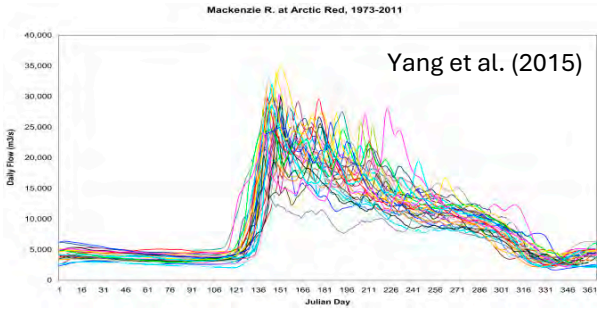


Desktop Review

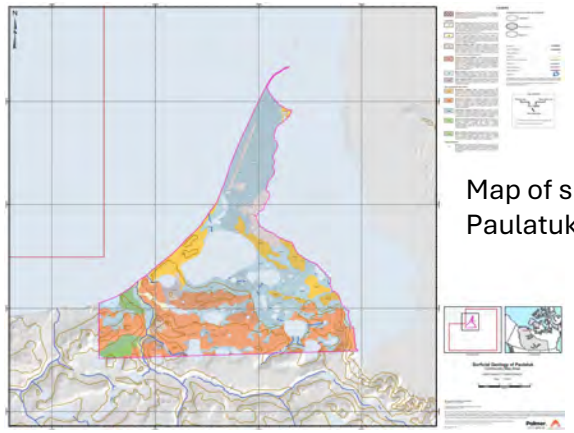
- Seek and review existing data that inform understanding of riverbank instability
  - **Previous reports**
  - **Imagery**
  - **Maps**
  - **River flow records**
    - Water Survey of Canada



Fort McPherson in 1930s (Tetra Tech, 2019)

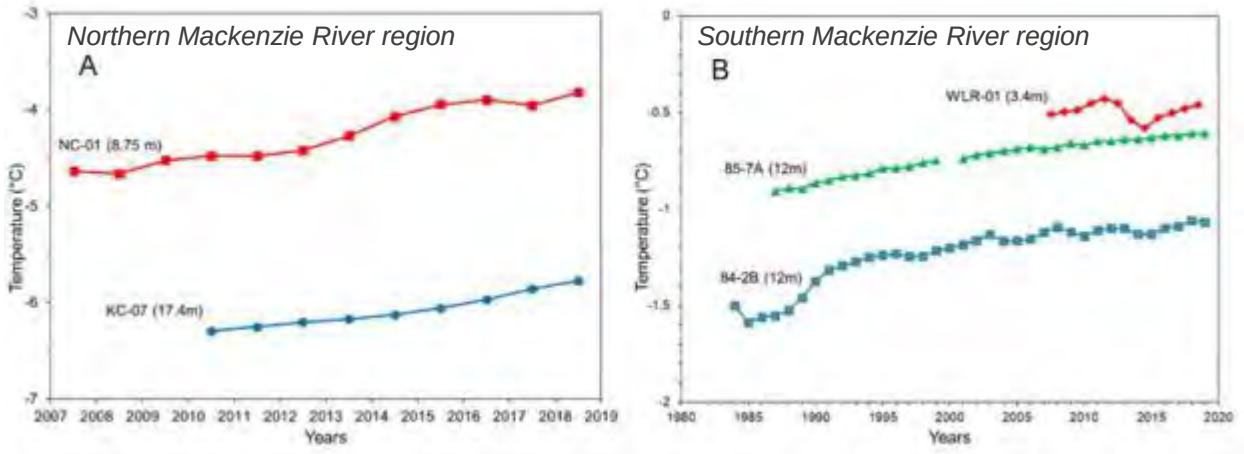


Yang et al. (2015)

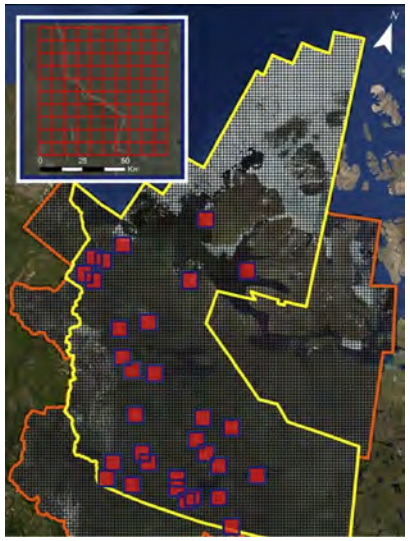


Map of surface geology of Paulatuk (SLR, in press)

Permafrost

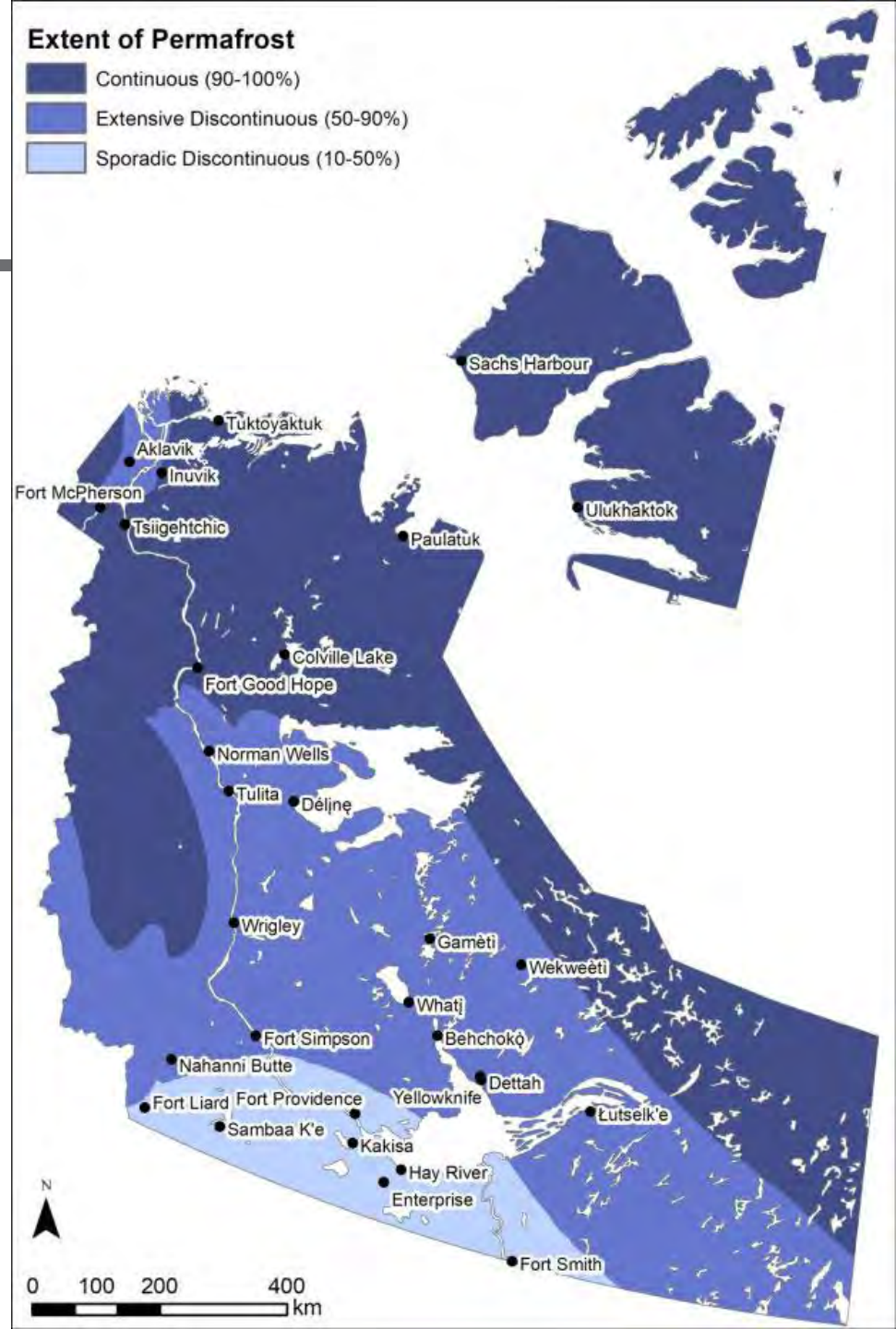


Credit: NWT State of the Environment Report (Permafrost)



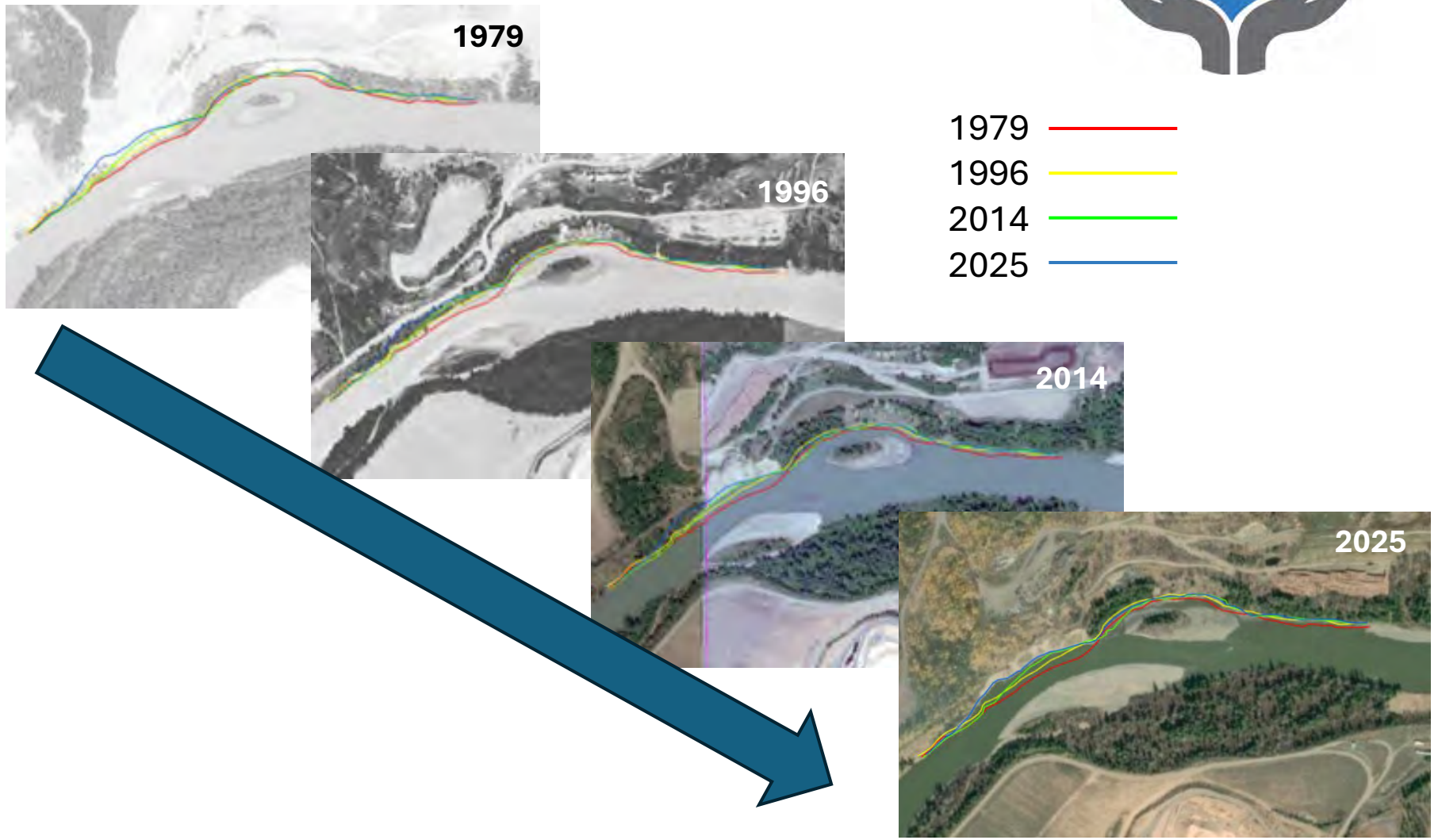
https://www.nwtgeoscience.ca/services/northwest-territories-thermokarst-mapping-collective

Adapted by GNWT from Heginbottom et al. (1995)



Trend Analysis

- Past river behaviour is (usually) a good predictor of future behaviour
- Air photos, satellite imagery, etc.



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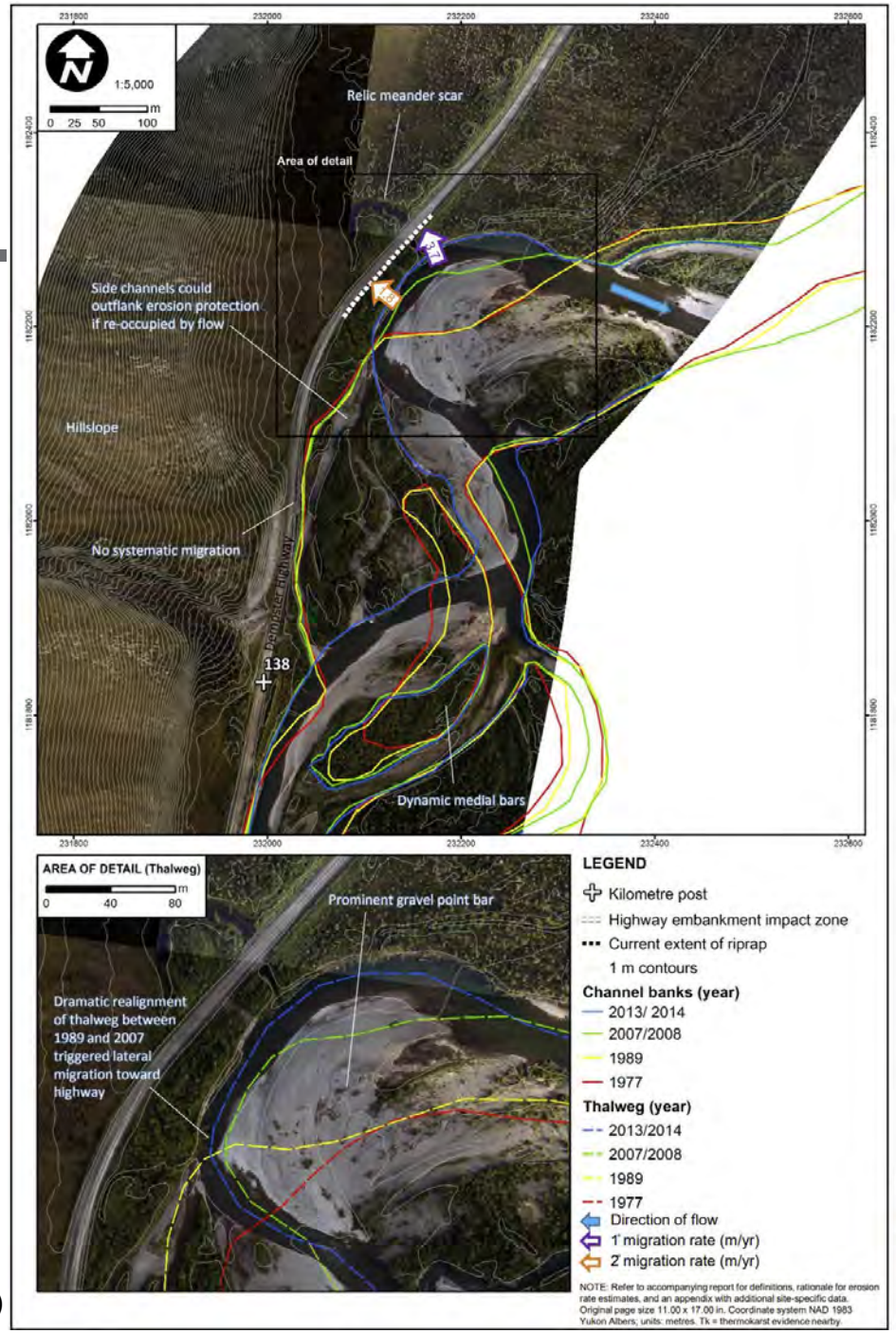


SITE	CHANNEL	MEANDER	RIPRAP REQUIREMENTS
Section Klondike/Ogilvie	Setting Fluvial plain	1' migration rate (m/yr) 3.7	Timeframe until impact (yr) 6-10
Watercourse Blackstone River	Permafrost Deep, ice-rich	1' trajectory NNW	Lateral extent (m) 140
Riprap history No riprap	Bank height (m) 2.1	2' migration rate (m/yr) 1.8	Slope length (m) 7.6
Hwy-watercourse proximity (m) 21	Low-flow width (m) 20	2' trajectory WNW	Thickness (m) 1
Position in meander belt Within	Bankfull width (m) 140	Confinement Unconfined	Volume (m³) 1,063

Timeframe until impact

Volume of riprap needed

MEANDER MORPHOLOGY
This encroachment site is located within an unconfined, wandering gravel-bed reach of Blackstone River. At the reach-scale, the channel has maintained a relatively consistent planform over the period of record through significant lateral migration. The encroachment is within the meander belt, which suggests the channel could migrate farther west. In the vicinity of the encroachment site, the channel evolved from two threads to one dominant thread between 1989 and 2007, which would have concentrated erosive energy and increased the potential for lateral migration. Without intervention, continued lateral migration will likely impact the highway embankment within 6 to 10 years.

IMPLICATIONS OF RIPRAP APPLICATION
Riprap application does not pose further risk to infrastructure.

ALTERNATIVE EROSION PROTECTION STRATEGIES
N/A

SPECIAL CONSIDERATIONS
If this wandering channel were to re-adopt its pattern from 1989, there may be increased potential for erosion farther upstream than is predicted based on the more recent (2007 and 2013) planform.

Yukon Government

PALMER ENVIRONMENTAL CONSULTING GROUP INC.
KRYOTEK

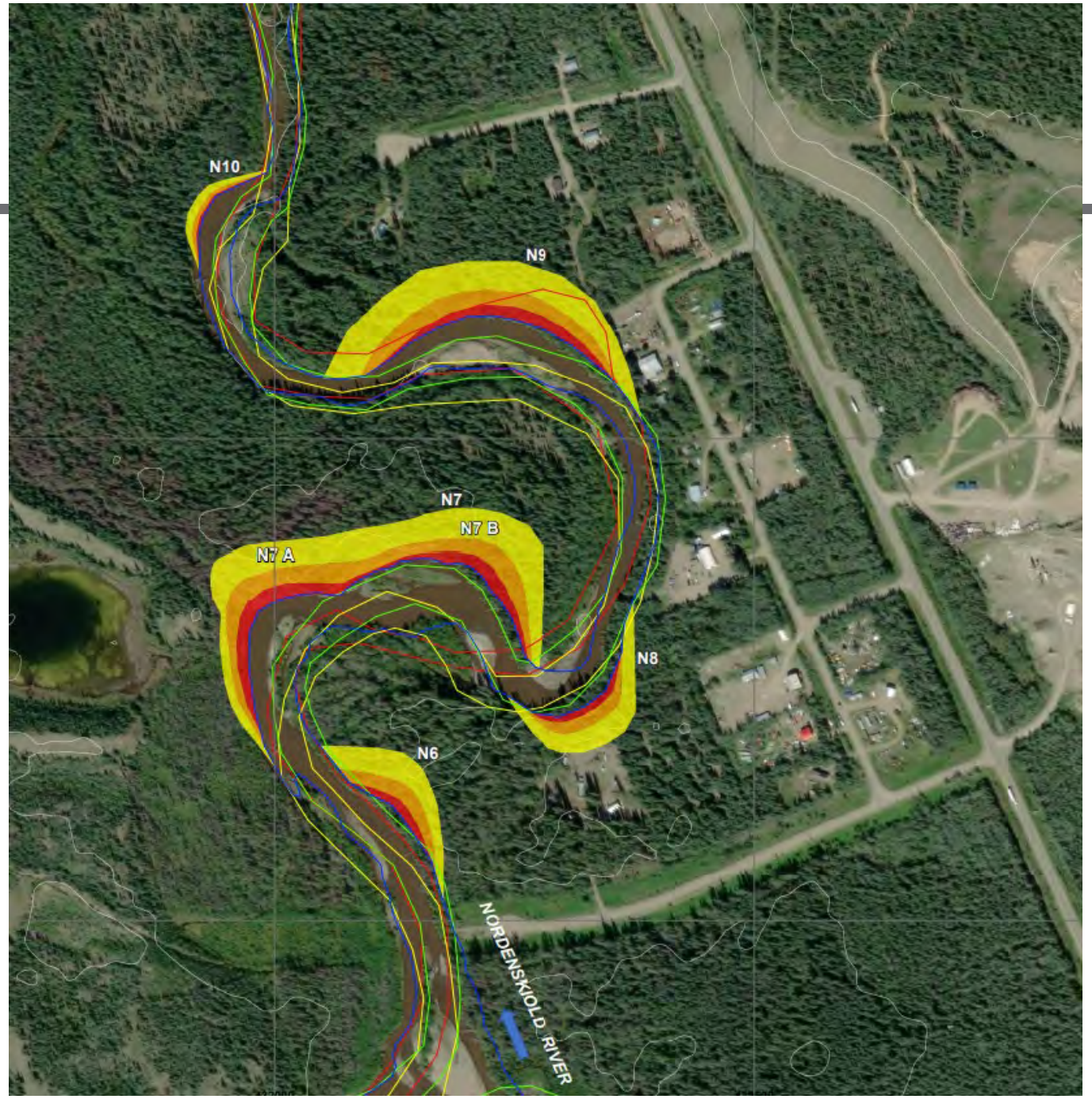
Project: Dempster Meander Migration Hazards
Project number: 14132
Client: Yukon Government

KM 138.5

SLR (formerly Palmer): Cronmiller et al. (2020)

Trend Analysis

- Projection of *future* position of banks of Nordenskiold River (Yukon) based on past trends
  - Rate
  - Direction



Erosion Hazard Zones

- 0–10 years
- 10–25 years
- 25–50 years

Channel Planform Year

- 2019
- 2018
- 1994
- 1977
- 1969
- 1953

SLR (formerly Palmer): Cronmiller et al. (2020)

Surficial Geology & Geohazard Mapping

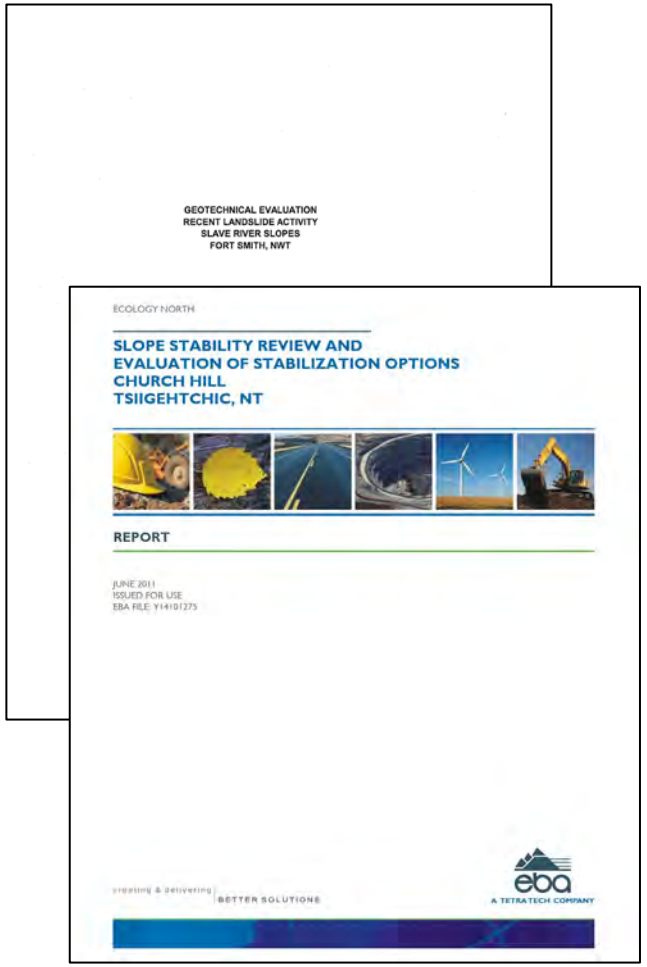
Credit: Tetra Tech

- Preliminary until 'ground-truthed'
- Types and distribution of different **soils**
- Locations of previous **mass movements**
- Surface indicators of permafrost and **ground ice**

➔ ***Optimizes geotechnical investigation!***

What to expect from Desktop assessment?

- Summary of any **previous work**
  - Hydrology/hydraulics, geomorphology, geotechnical, etc.
- Overview of **local conditions** relevant to assessing riverbank stability at site(s) of concern
  - Recall the “controls” of river behaviour?
- Map showing locations, extents and rates of **riverbank erosion** (if any)
  - Such information can highlight urgency for funding!
- Initial ideas about the main **cause(s)** of riverbank instability



What is commonly *missing* from Desktop assessments completed to date?

- **Documentation** of analysis of **river migration trends** and further insights
- Consideration of the role of **sediment supply**, **transport** and **deposition zones** (bars) on erosion patterns
- Interpretation of high-resolution **LiDAR data** (newly available!)
- Evaluation of the **relationship** between **river (and ice!) flow** and the timing, locations and amount of **erosion**

Analysis of Fluvial (River) Geomorphology

Site Visit

Having a look at what is going on

Who is Who

- Geotechnical engineers
- Geomorphologists
- Water resources engineers
- Permafrost specialists
- Ecologists
- Archaeologists

What will they do

- Examine the site, trying to understand causes and how active things are
- Assess threats to local infrastructure
- Take photos
- Take measurements or assist with setting up initial monitoring

Some thoughts on photos

- Helpful to put the feature in context

Huh?

Better

Best

Some thoughts on photos

- Overviews are good when you can get them

Baird 2019

Detailed Assessment

Collecting option evaluation and design information

(Additional) Types of Investigation

- Drone surveys (LiDAR surveys)
- Geotechnical drilling (or test pits)
- Install monitoring instrumentation (movement, water, temperature)
- Geophysical surveys
- River measurements or bathymetric surveys
- Ecological Surveys

Not Discussing Procurement

- Hopefully, you'll know what to ask for
- Refer to the guide for help with asking for proposals

Budget and Timing Considerations

- Site visit:
  - 3 or 4 “0’s”, depending on how many
  - Best in late spring or early summer
- Desktop review
  - 4 “0’s”
  - Anytime
- Detailed assessment
  - 4 to 5 “0’s”
  - Various times of year

Assessment Reports

What to expect from them

What to expect

- Opinions on risk levels – likelihood and severity
- Evaluation of options
- Recommendations on next steps
- Some idea of future costs (if you are lucky!)

		Consequence		
		Low	Moderate	High
Likelihood	High			
	Moderate			
	Low			

Three examples

- Fort McPherson (site visit)
- Tsiigehtchic (desktop assessment)
- Norman Wells (detailed assessment)

Fort McPherson Health Centre

- Nehtruh-EBA report for Rat River Development Corporation, July 2019
- Very thorough desktop review and site visit
- Assessed risks to various infrastructure
- Risk at William Firth Health Centre assessed to be very high
- Outlined options to reduce risk
- Protect elements at risk – reduce potential for slope movements

Table 5.2.5-7: Risk Matrix – William Firth Health Centre

Risk to Element		Consequence of Slope Failure		
		Low	Moderate	High
Likelihood of slope failure affecting the element	Low	Very Low	Low	Moderate
	Moderate	Low	Moderate	High
	High	Moderate	High	**Very High**

Fort McPherson Health Centre, continued

- Hoeve site visit, summer of 2025
- Tension crack location unchanged in 6 years
- Same interpretation about bedrock – (timber) piles likely in bedrock
- An initial response could be to tie the inner piles to the outer piles

Tsiigehtchic Church Hill Slide

EBA 2011

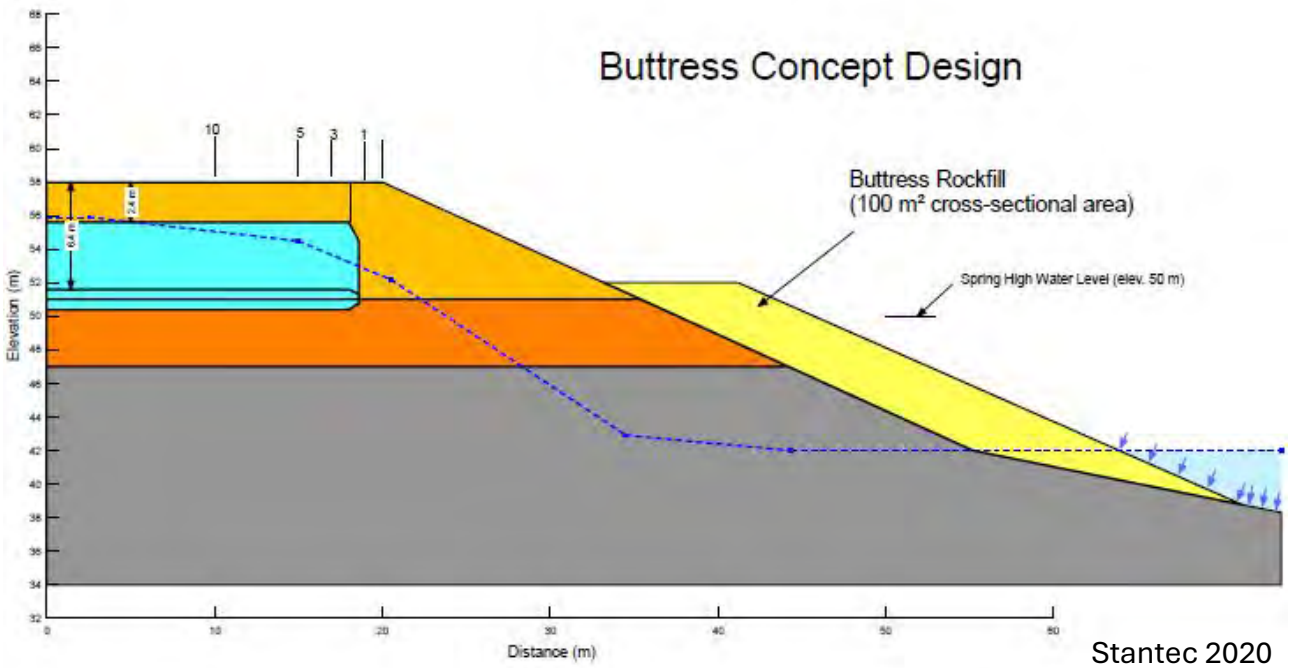
- EBA report for Ecology North (on behalf of the community), June 2011
- Very thorough desktop review and site visit with shallow holes
- Alternative solutions identified, with risk assessment and broad cost projections
- Not aware that anything came of it… next steps guidance?

Tsiigehtchic Church Hill Slide, continued

AM2 Geotechnical 2024

- AM2 Geotechnical report for PlanIt North (on behalf of the community), March 2024
- Desktop review, essentially of previous EBA report, with minor updating of conditions and enhanced options discussion, again with rough costing
- Added discussion of next steps
- Added discussion of action plan
- Added figures to show potential layout

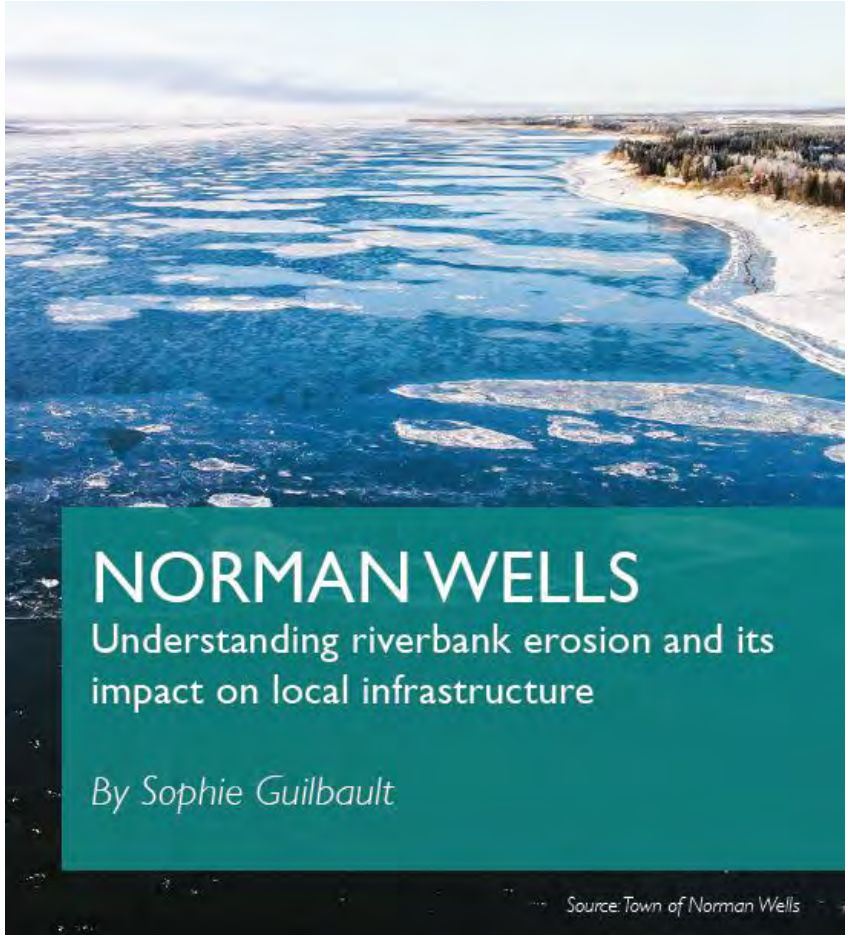
Norman Wells Riverbank Erosion



Stantec 2020

- Stantec (draft?) report for Town of Norman Wells, April 2020
- Includes: drilling, topographic survey, mapping, monitoring
- Over large area: 7.7 km, and a range of infrastructure
- Also includes preliminary analysis and rough costing
- But… still recommends more investigation and analysis for design
- Where to go from there?

Normans Wells Riverbank Erosion, continued



- Report did not contain a summary; a separate summary was prepared
- Climate change/permafrost degradation focus
- Interesting idea – using "meshed tires" from the landfill to stabilize slopes – potential complement to rock?