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Forced Field-fits: When Site Conditions Change Before Natural Channel Designs Get Constructed

Robin McKillop, M.Sc., P.Geo. and Max Osburn, P.Eng.

Source to Stream Conference

March 22, 2023

PalmerTM

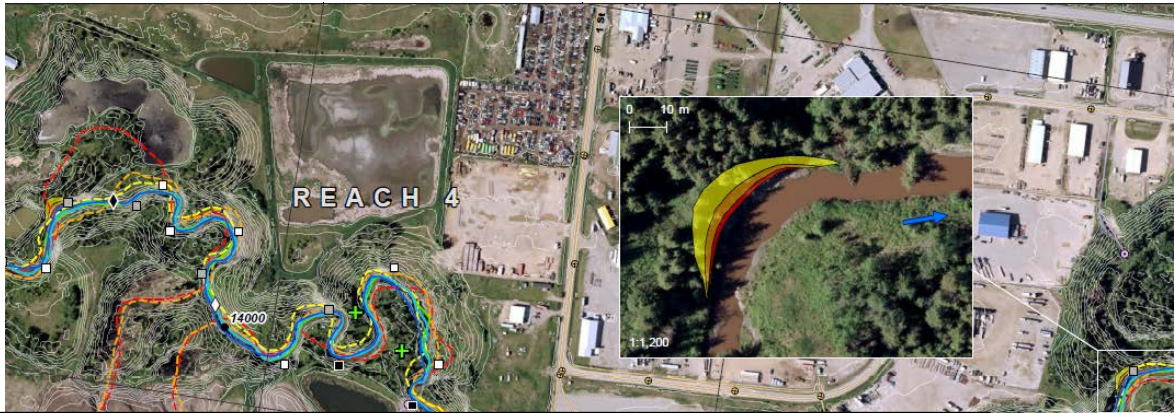
Outline

1. Introduction and Rationale
2. Forced Field-fit Experience Highlights
3. Lessons Learned and Improvement Priorities

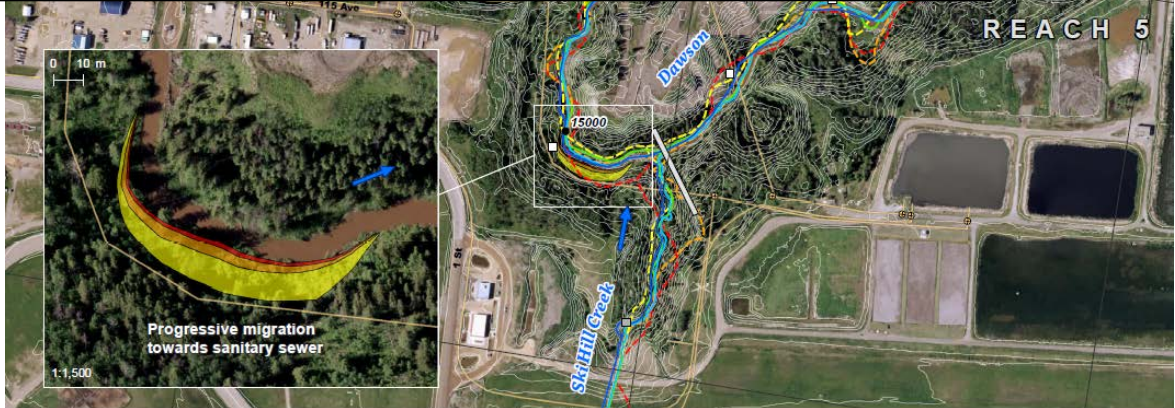


1. Introduction and Rationale

Natural channels are dynamic!...

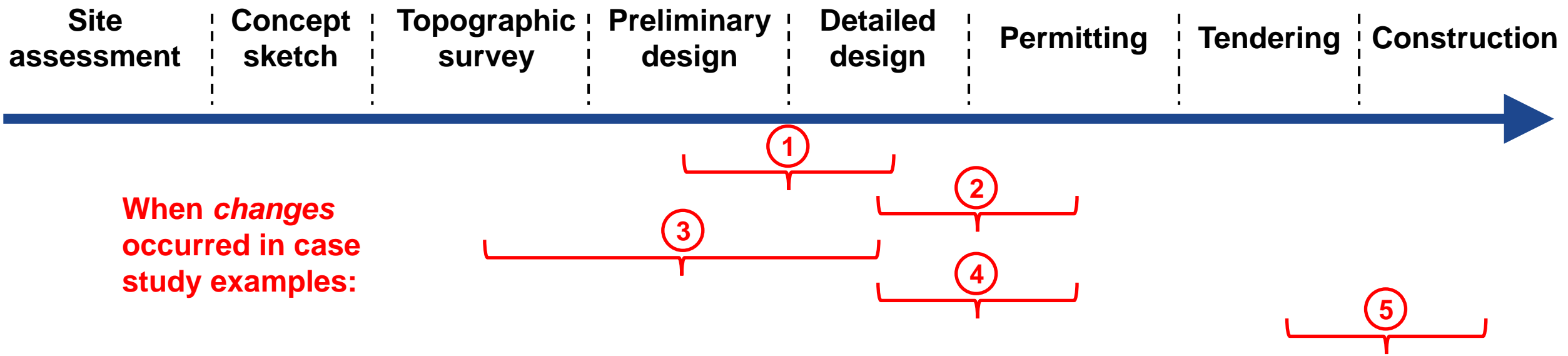


It's commonly the most *dynamic* systems that require our attention, in association with property and infrastructure protection, so we must plan and implement natural channel designs accordingly



Natural channel design timeline

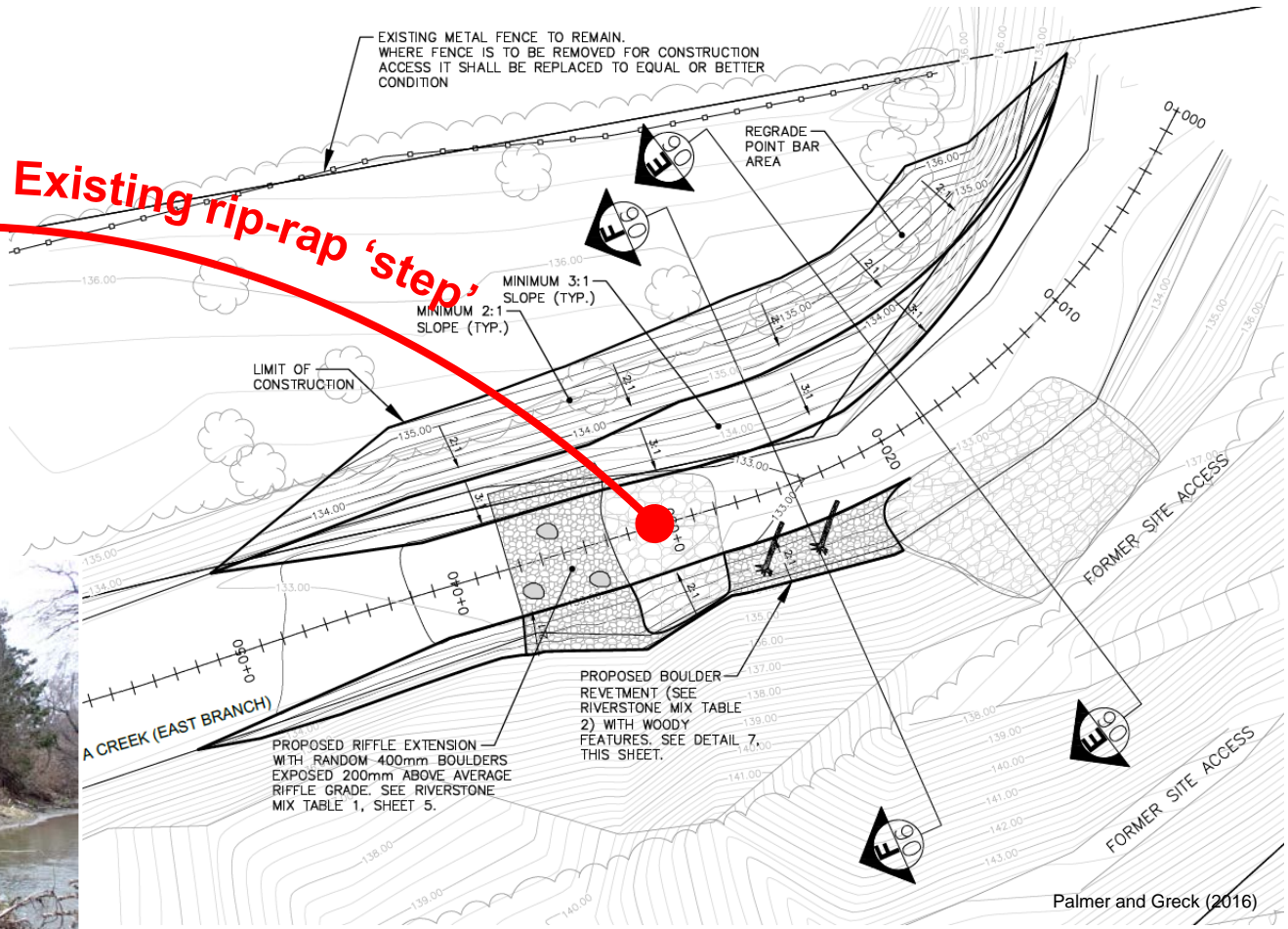
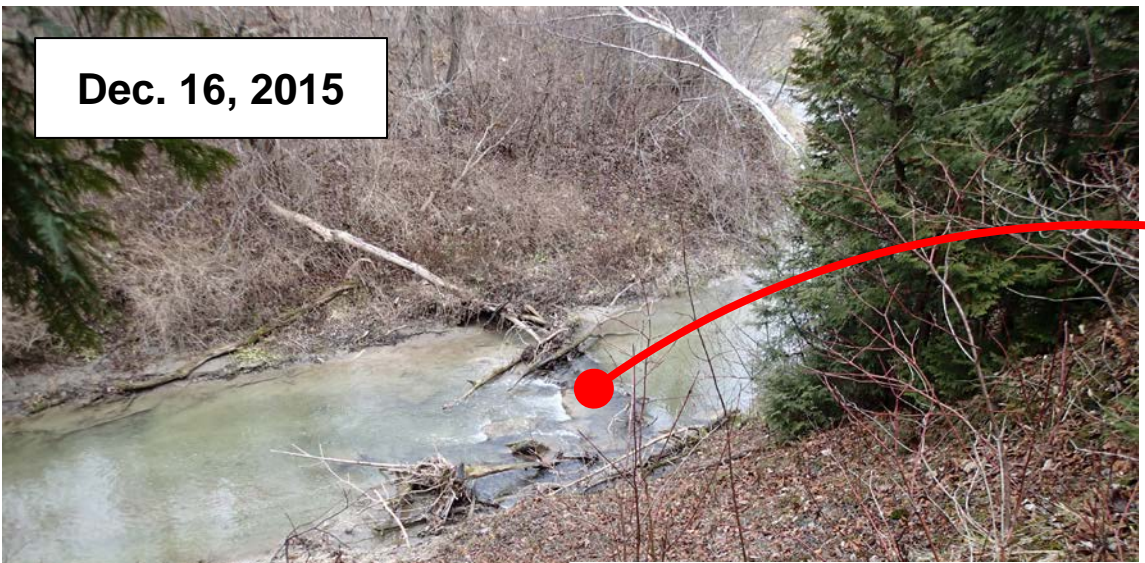
- Sequence and stages of natural channel design (NCD)
- Duration: months to several years!
- Different implications depending on timing of “change”



2. Forced Field-fit Experience Highlights

1. Bed aggradation between design and construction, East Oshawa Creek: BEFORE

Dec. 16, 2015



Palmer and Greck (2016)

1. Bed aggradation between design and construction, East Oshawa Creek: BEFORE

Lengthy permitting and tendering process...

1. Bed aggradation between design and construction, East Oshawa Creek: AFTER

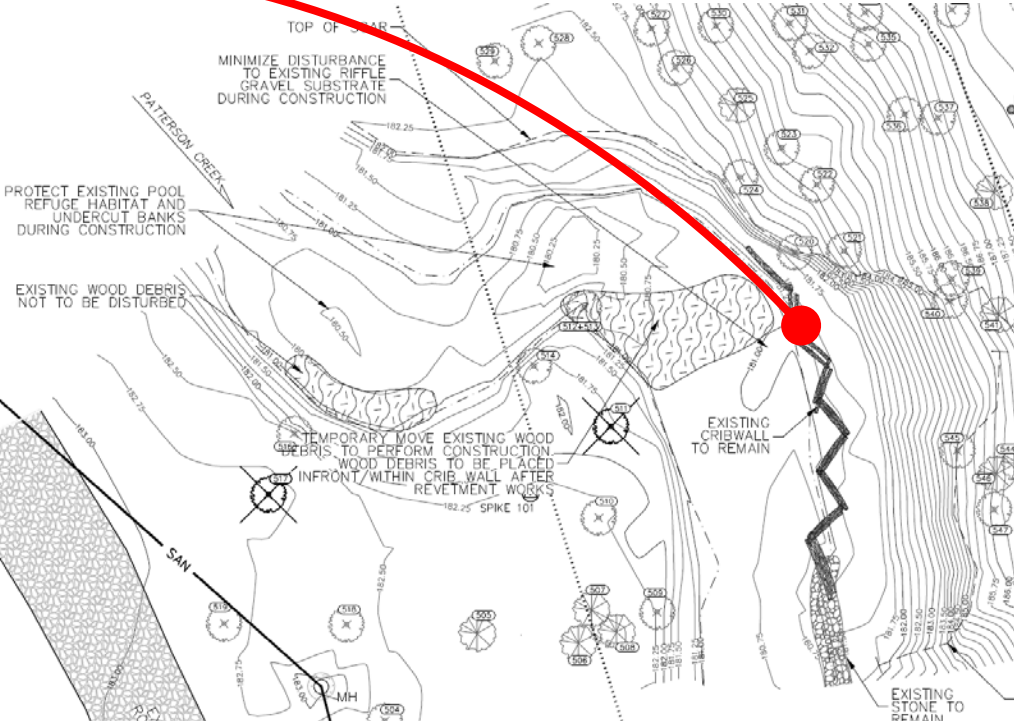


- **Field-fit solution:**
 - On-site acknowledgment of change in conditions
 - Agreement to eliminate “riffle extension” design element without any drawing revisions
 - Documentation of field-fit change in inspection log

2. Logjam reconfigurations between design and construction, Patterson Creek: BEFORE



Topographic survey: Aug. 2017
Stamped design: Oct. 16, 2018



Palmer and Greck (2016)

2. Logjam reconfigurations between design and construction, Patterson Creek: AFTER

Nov. 12, 2019 – Site visit with TRCA & DFO (rep. MECP = Redside dace)



2. Logjam reconfigurations between design and construction, Patterson Creek: AFTER

Dec. 10, 2019 – Reissued drawing with design adjustments, but without updating topographic survey

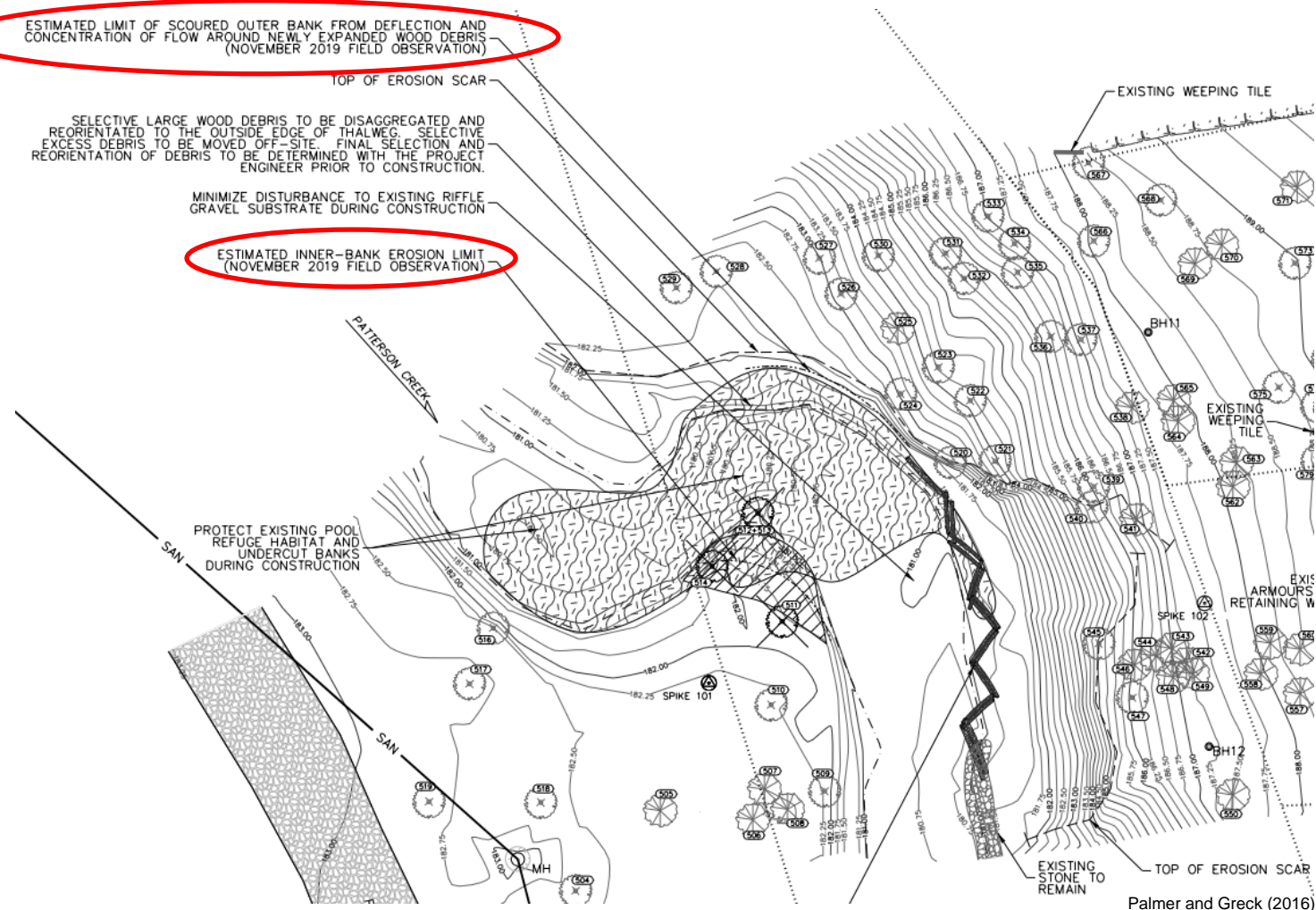
ESTIMATED LIMIT OF SCOURED OUTER BANK FROM DEFLECTION AND CONCENTRATION OF FLOW AROUND NEWLY EXPANDED WOOD DEBRIS (NOVEMBER 2019 FIELD OBSERVATION)

TOP OF EROSION SCAR

SELECTIVE LARGE WOOD DEBRIS TO BE DISAGGREGATED AND REORIENTED TO THE OUTSIDE EDGE OF THALWEG. SELECTIVE EXCESS DEBRIS TO BE MOVED OFF-SITE. FINAL SELECTION AND REORIENTATION OF DEBRIS TO BE DETERMINED WITH THE PROJECT ENGINEER PRIOR TO CONSTRUCTION.

MINIMIZE DISTURBANCE TO EXISTING RIFFLE GRAVEL SUBSTRATE DURING CONSTRUCTION

ESTIMATED INNER-BANK EROSION LIMIT (NOVEMBER 2019 FIELD OBSERVATION)



– Field-fit solution:

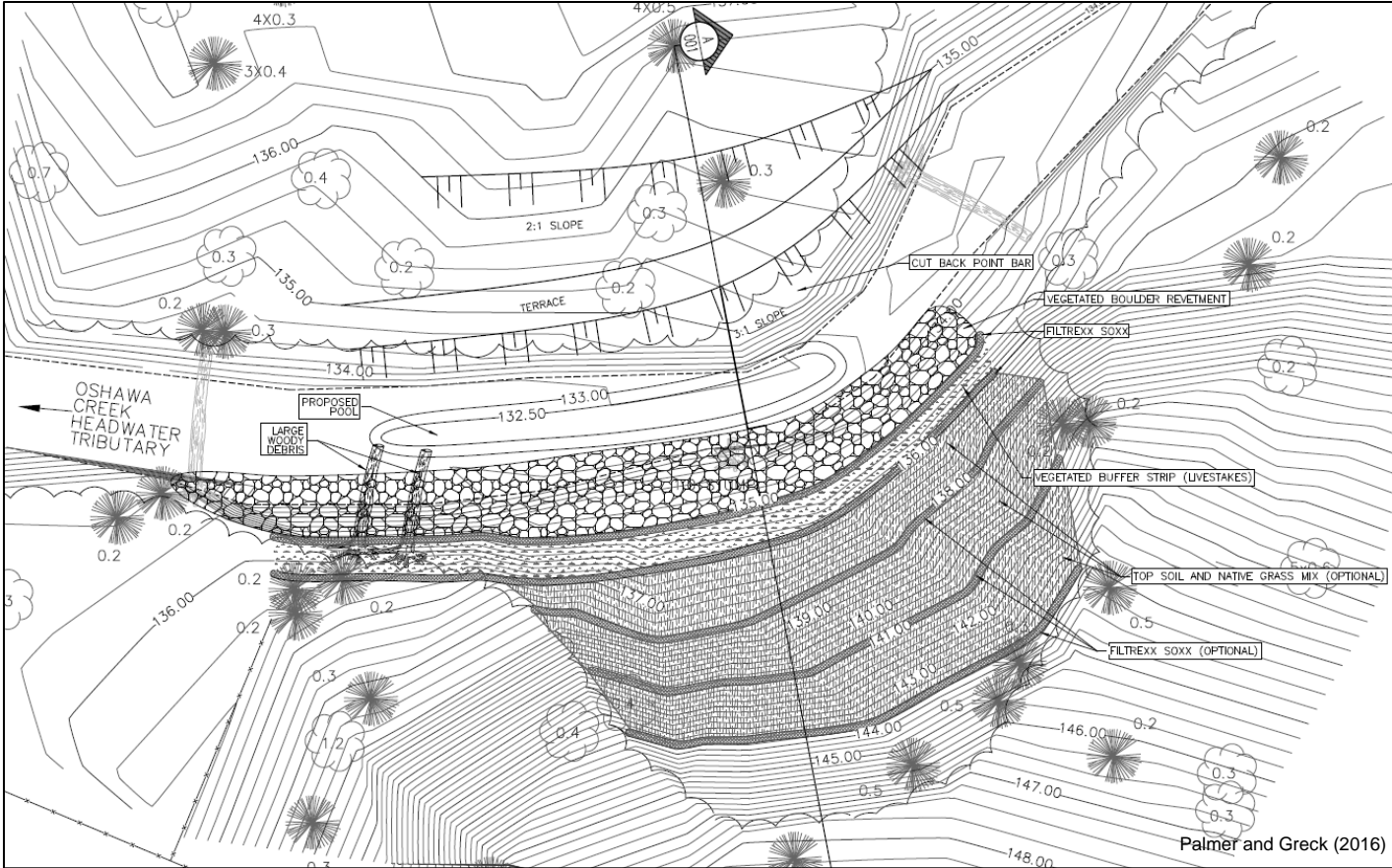
- Coordinated site visit with TRCA & DFO to observe changes
- Agreement to reissue drawing set with minor adjustments/notes but without updating the topo survey

3. Bed and bank erosion between concept and detailed design, tributary of East Oshawa Creek: BEFORE



Dec. 16, 2015

Mar. 2016 Topographic survey
Dec. 2016 Concept design

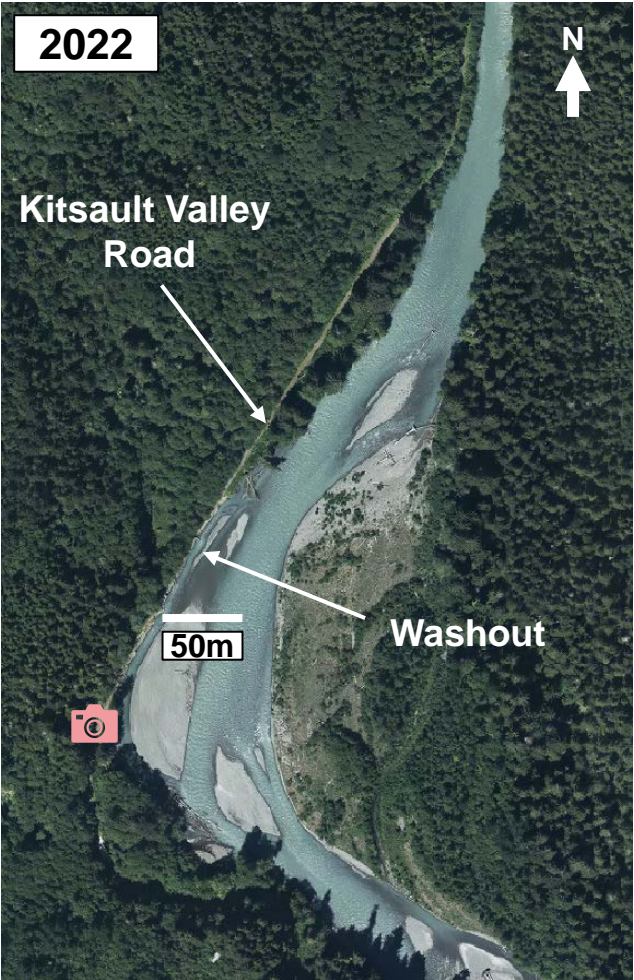


Palmer and Greck (2016)

3. Bed and bank erosion between concept and detailed design, tributary of East Oshawa Creek: BEFORE

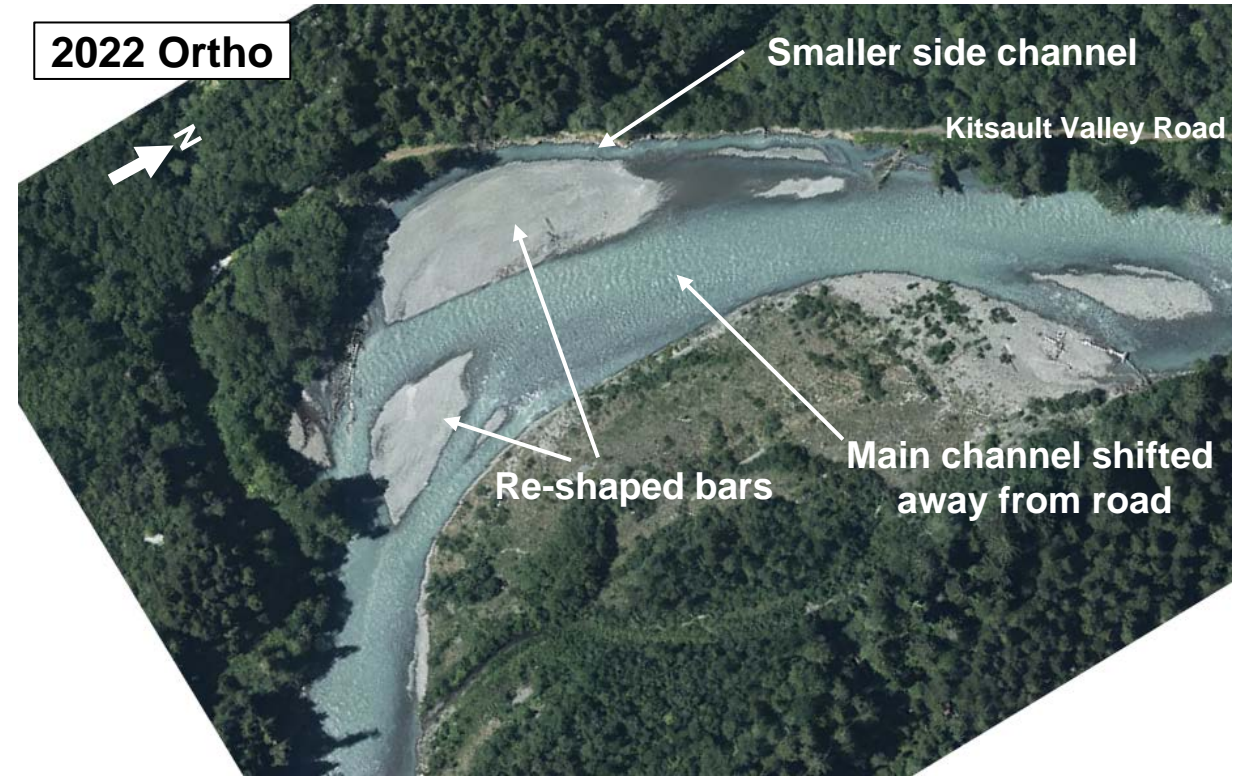
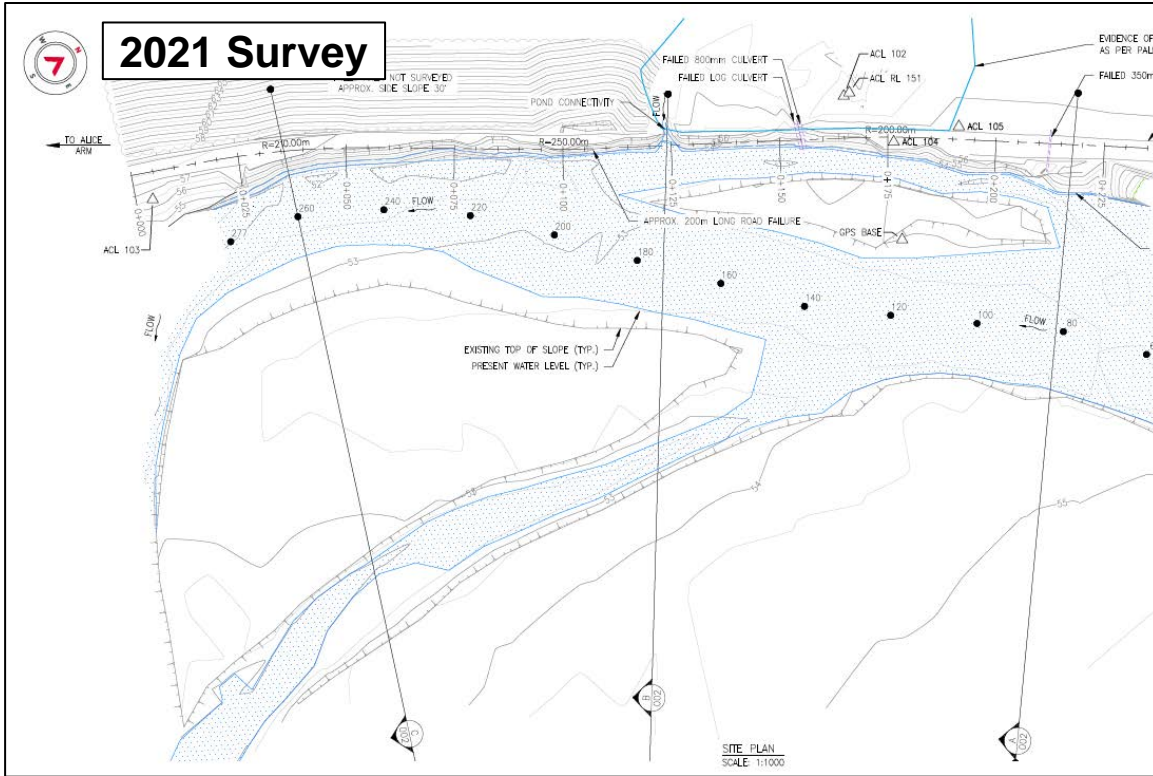
Lengthy construction access agreement process...

4. Repeated wash-outs prior to repair and stabilization of Kitsault Valley Road, northwest BC



Main channel often migrates >10m per year
Highly dynamic!

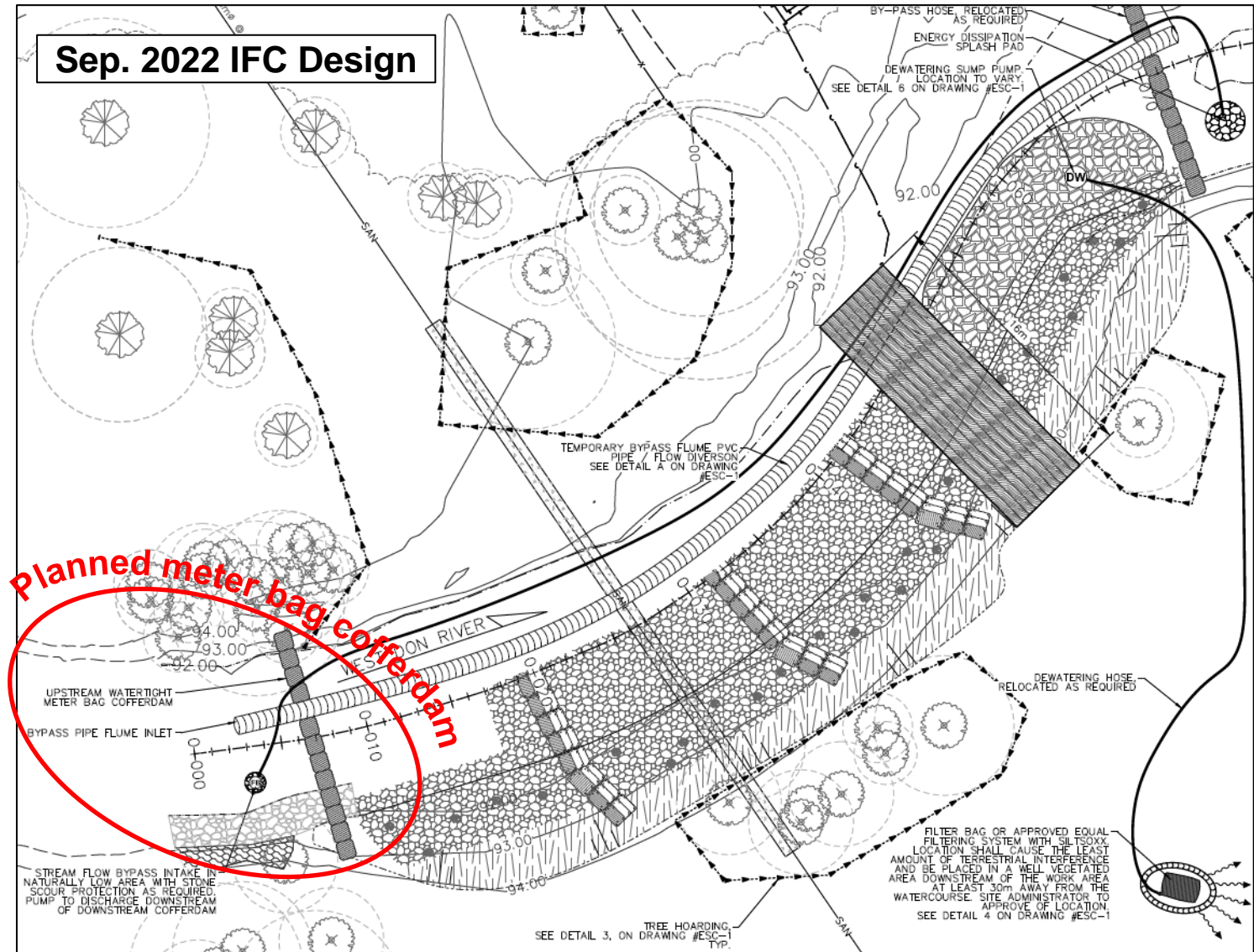
4. Repeated wash-outs prior to repair and stabilization of Kitsault Valley Road, northwest BC



**Survey completed in 2021 not representative of site conditions in 2022.
Worth re-surveying? Or accept that field-fits will be required and build assumptions into design?**

5. In-stream work area isolation challenges during construction, West Don River, E.T. Seton Park, Toronto

- Trade-offs in different approaches: duration, disturbance & effectiveness
- **Field-fit solution:** sheet pile replaces metre bags; changes noted in inspection log and construction verification report



3. Lessons Learned and Improvement Priorities

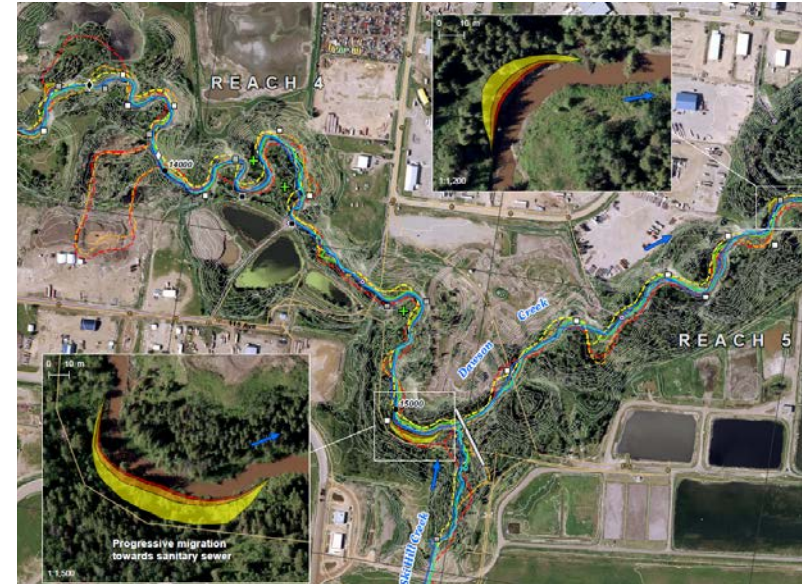
What constitutes an “acceptable” field-fit?

- **Application** – What is the objective of the work?
 - Habitat restoration vs. ESC plan vs. bridge abutment protection
 - Emergency works!
- **Site context** – What is the implication of partial failure?
 - Constraints and risk to life, property, infrastructure or environment
- **Change** – What is the nature and magnitude of adjustment?
 - Relative departure from the norm for given site/system
- **Timeline** – Is there an opportunity to formally redesign?
 - Timing of change in NCD process



Top 10 Opportunities for Improvement

1. Assess site dynamics through **geomorphological analysis**
2. Proactively **forecast and accommodate** adjustments in design
3. Complete **topographic survey** as late as possible
4. Develop **typicals** easily applied to different site conditions
5. Strive to **streamline permitting/approvals** process
6. Incorporate “**field-fit language**” into drawings/specs
7. Include **provisional tender items** to account for uncertainty in quantities/volumes
8. Build **contractor experience** into bidding evaluation
9. Allow for **designer site visits** during construction
10. Require **experienced construction inspector/contract admin**



Do all we can to incorporate flexibility into design!



Questions?

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