

Recycled Tires as Lightweight Fill

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Presentation Outline

Part 1: Embankment Failure and Repair Options

Part 2: TDA – Tire Derived Aggregate

Part 3: St. Stephen Rte 1 Reconstruction Design

Part 4: Lessons Learned and Conclusions





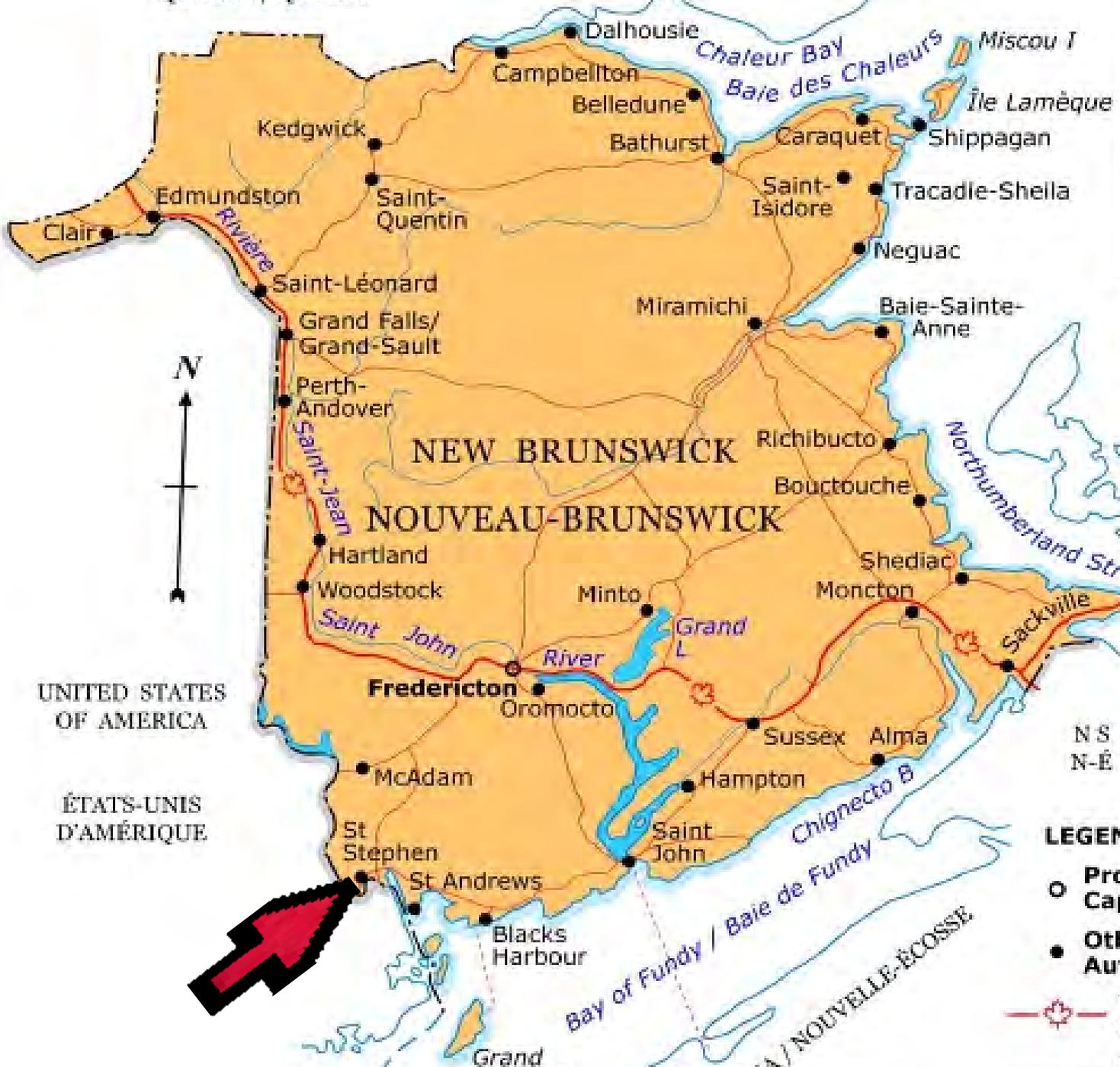
QUEBEC / QUÉBEC



CANADA

Gulf of St Lawrence / Golfe du Saint-Laurent

PRINCE EDWARD ISLAND / ÎLE-DU-PRINCE-ÉDOUARD



UNITED STATES OF AMERICA

ÉTATS-UNIS D'AMÉRIQUE

NS / N-É

LEGEND / LÉGENDE

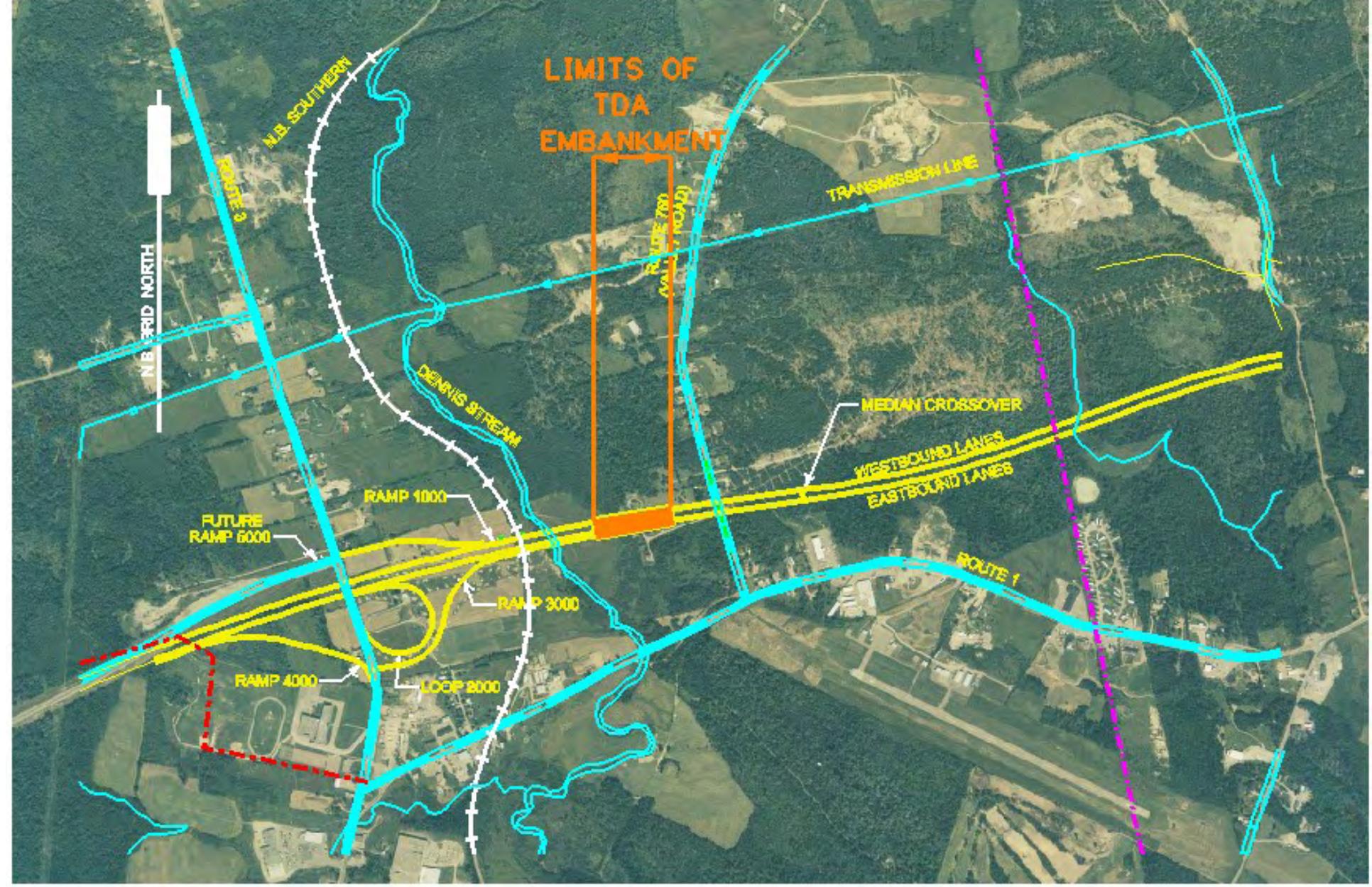
○ Provincial capital / Capitale provinciale

● Other populated places / Autres lieux habités

—🍁— Trans-Canada Highway / La Transcanadienne

Major road /





DEPARTMENT OF TRANSPORTATION

DESIGN BRANCH
FREDERICTON

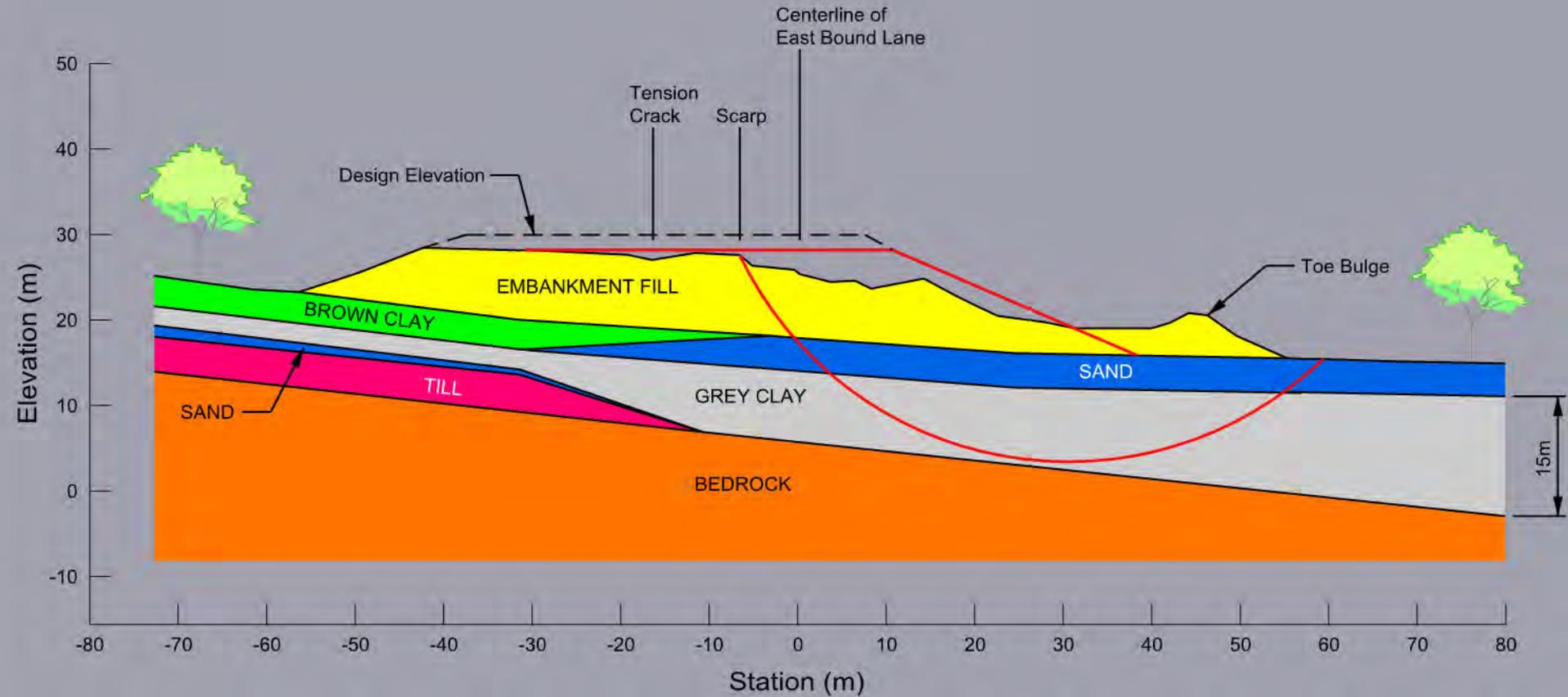


TDA EMBANKMENT

DWG. No.

1 of 1

EMBANKMENT FAILURE CONDITION





Foundation
Soils



Toe Bulge



Re-Construction Options

2 Fundamental Strategies were considered:

1. Stabilize or improve the Foundation Soil and build embankment using original soil, or
2. Use Lightweight Fill and leave the foundation soil in place.

Design Options

Foundation Improvement:

- Removal and Replacement
- Stone Columns

Lightweight Fill:

- Geof foam
- Tire Derived Aggregate (TDA)

Why did NBDOT select TDA?

- Lightweight
- Proven Track Record in the Civil Engineering Community in the USA (ASTM Standard Exists)
- Locally Available (TRACC Facility in Minto, NB)
- Economically Viable
- Sustainability Benefits (1.4 M Tires to Good Use)
(Energy Savings Compared to other recycling options)

Tire Derived Aggregate (TDA)

TDA from shredding scrap tires into 50 to 300 mm sizes.



TDA Properties and Applications

- Lightweight (1/3 Weight of Soil) – Embankments
- Free Draining – Landfills, Septic Leach Fields
- Low Earth Pressures – Retaining Wall Backfill
- Good Thermal Resistivity - Insulation below roadways
- Compressible – Induced Trench Applications
- Absorbs Vibrations – Rail Industry

Design Considerations – TDA as Lightweight Fill

- ASTM D6270-98 (Reapproved 2004) “Use of Scrap Tires in Civil Engineering Applications”
- Class II Shreds
- Final In-Place Unit Weight
- Overbuild
- Guidelines to Limit Internal Heating Reaction

Guidelines to Limit Heating Reaction

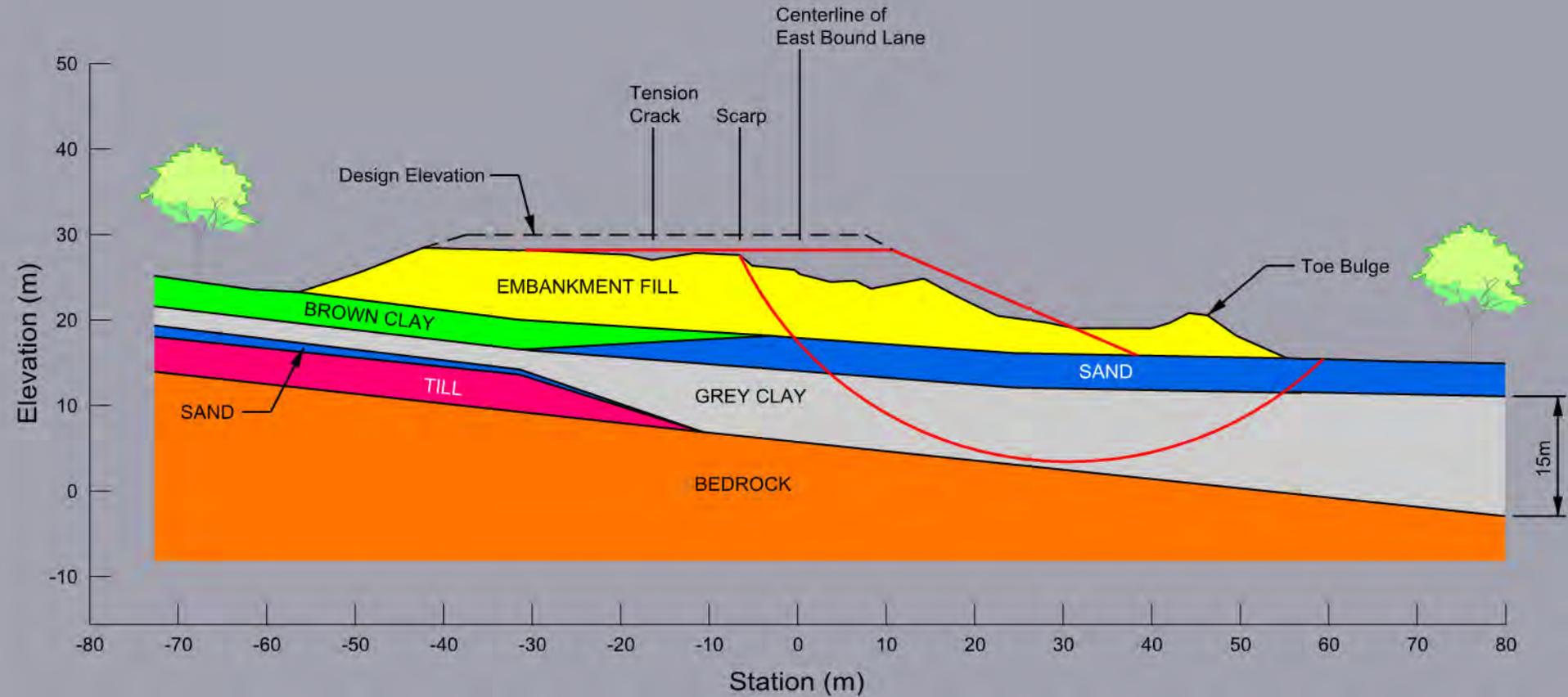
- Maximum 3 m thick
- TDA Gradation
- Metal Fragments
- Minimize Infiltration of Air and Water
- Separated with a geotextile from surrounding soil
- No hydrocarbon contamination, fire or fire remnants, or organic matter

St. Stephen Embankment Reconstruction Project

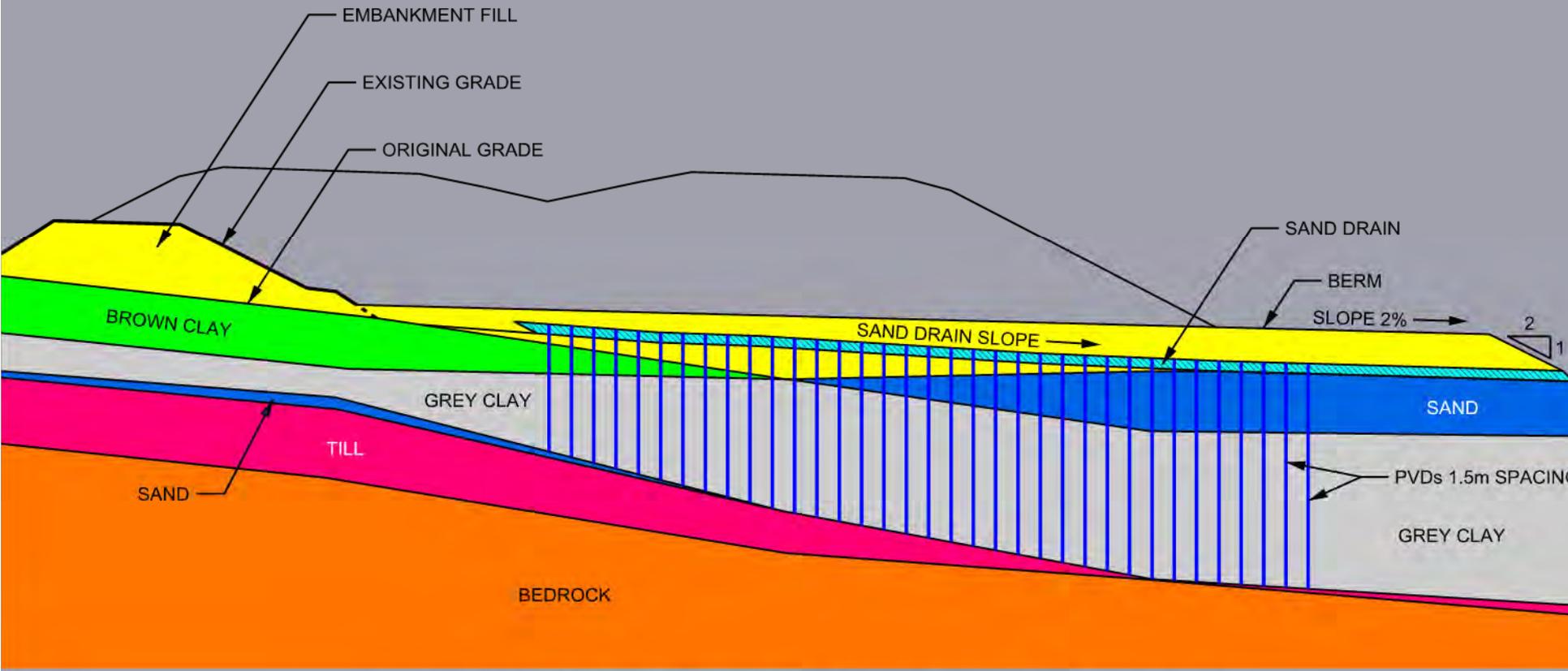
Construction Sequence:

- Excavate failed mass down to original grade
- Install Pre-fabricated Vertical Drains through clay (Time Factor)
- Use TDA to lighten the embankment load
- Use a Staged Construction Approach to maintain stability
- Monitor progress using geotechnical instrumentation

EMBANKMENT FAILURE CONDITION



ST. STEPHEN EMBANKMENT RECONSTRUCTION PROJECT



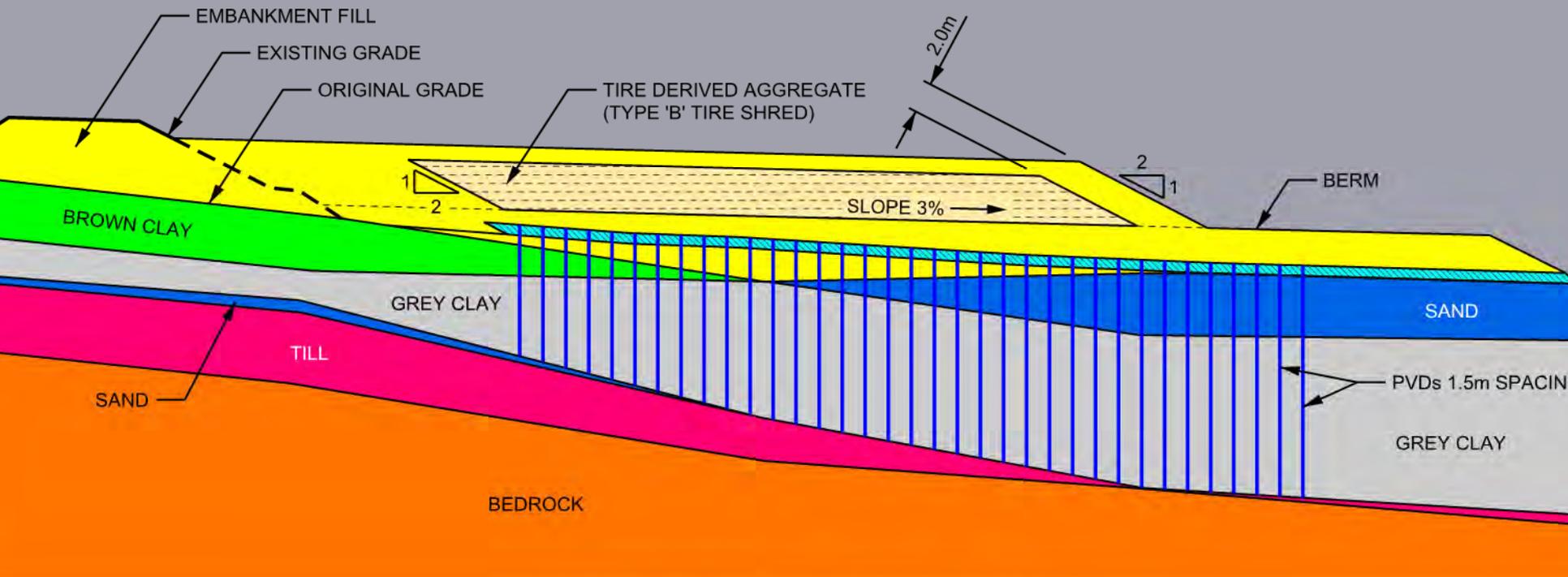
PVDs / SAND DRAIN / INSTRUMENTATION / STABILIZATION BERM

Vertical Drains





ST. STEPHEN EMBANKMENT RECONSTRUCTION PROJECT



FIRST TDA CELL & SOIL SEPARATOR

St. Stephen Embankment Reconstruction Project

- TDA Supply:
 - TRACC, Minto, NB – 160 kms from job site
 - TDA quality specifications were developed using ASTM and Maine DOT Specifications - Inspection
- TDA Transportation:
 - Floating Floor Trailers were used

TDA Stockpile at TRACC



Loading TDA at TRACC



TDA Delivery to Job Site (35 m³ per load)



1st Layer of TDA



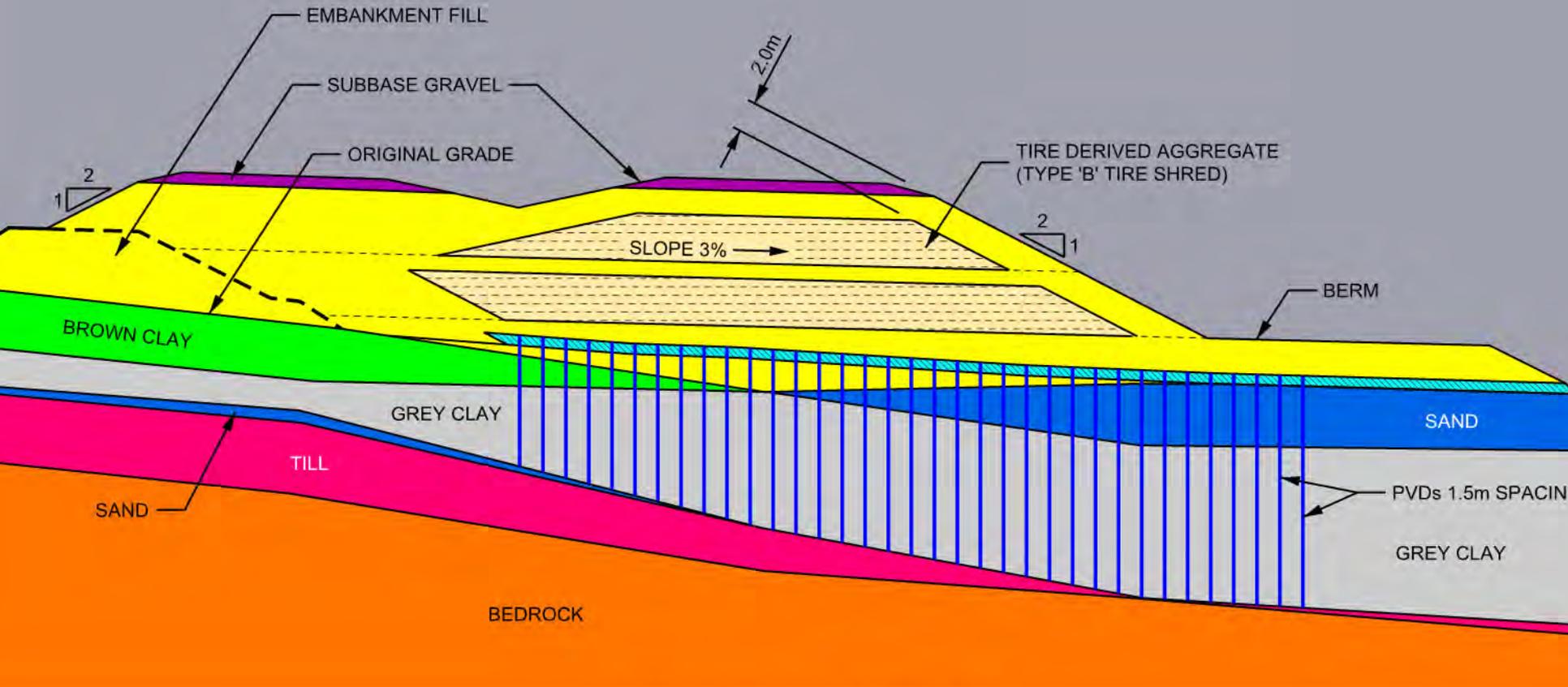
TDA Compaction



Soil Capping Layer ($>30\%$ Fines)



ST. STEPHEN EMBANKMENT RECONSTRUCTION PROJECT

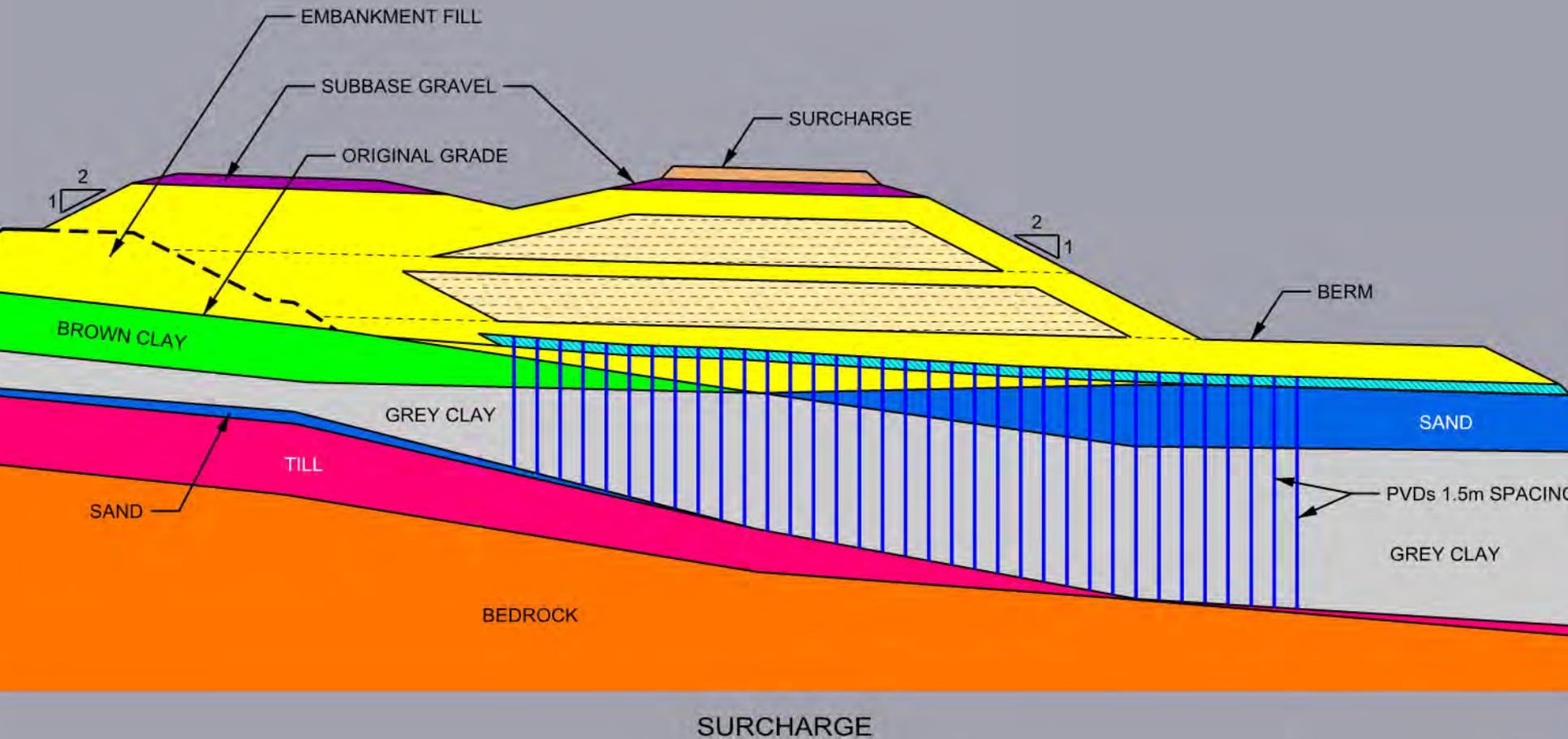


SECOND TDA CELL & SOIL CAP

2nd Layer of TDA



ST. STEPHEN EMBANKMENT RECONSTRUCTION PROJECT



Completed Embankment – December 5, 2008



Completed Embankment – December 5, 2008



Lessons Learned

- Supplying 14,000 tonnes of TDA (1.4 Million Tires) was a huge challenge for the supplier. Construction schedules should allow for and accommodate delays in the delivery of TDA, especially for facilities undertaking TDA production for the first time
- Steel tracked equipment was preferred for construction over TDA. The contractor experienced numerous flat tires initially when travelling over TDA using rubber tired equipment
- Floating floor trailers was the preferred method of transporting TDA from the recycling facility to the project site
- Due to the lightweight nature of TDA, the contractor was able to transport TDA during spring weight restrictions

Conclusions:

- NBDOT successfully used 1.4 million scrap tires to reconstruct the failed embankment. This quantity of tire is equivalent to approximately 2 years of scrap tires generated in NB.
- The low unit weight, proven track record in the USA, and the local availability resulted in the TDA option being selected.
- The TDA option has resulted in a net savings to NBDOT as compared to the next feasible repair option.
- This project (using TDA in a lightweight fill application) is the first in Atlantic Canada, and the second largest project in North America in terms of TDA volume.

Conclusions (Continued):

- In general, construction using TDA went according to plan. The TDA was relatively easy to load, transport, place, and compact using traditional earthmoving equipment. The use of trailers equipped with “floating” floors was very advantageous
- Results of the geotechnical instrumentation has shown that the in-place TDA is lightweight with internal temperatures within acceptable and predicted limits
- The Hwy was opened to the general public in early December 2008. The performance of the embankment is meeting the designer’s expectations.

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QUESTIONS ?