Case Study: Sulphate-Impacted Soils Used for a Highway Construction Project

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Matrix Solutions Inc., Calgary

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Environmentally Responsible Management of Industrial Waste

- Examples of sustainable waste management
  - soils with hydrocarbons aerated and re-used onsite
  - “soil-contaminated fertilizer” used to add nutrients to landfarming operation
  - sulphate-bearing soils used to construct a roadbed
- Case study was borne from *common sense* and *opportunity*

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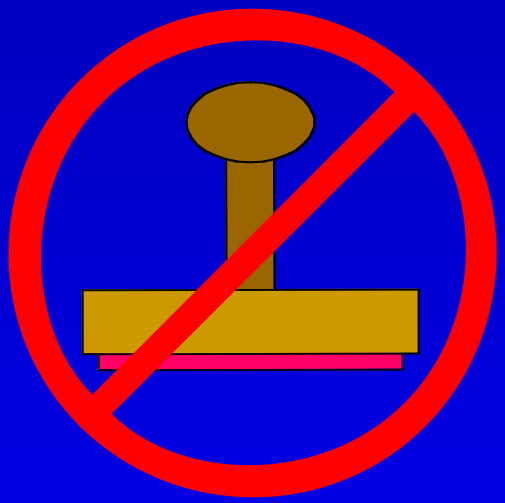
Case Study: Sulphate-Impacted Soils Used for Highway Construction Project

- Triggered by urban growth at Okotoks, Alberta
  - need for more industrial land
  - need for transportation upgrades
- Accomplished between July and October, 2000
- Matrix retained by Nexen Inc. (formerly Canadian Occidental Petroleum Ltd.)

Projects Like These Warrant Individual Assessment

- This case is not precedent-setting
  - other materials have been used in past for road construction
- All unusual approaches should be reviewed and assessed on a case-by-case basis
  - in this case, technical considerations and timing were good
  - all sulphate soils will not necessarily be suitable for future projects



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Program Rationale

Highway Construction Perspective

- fill required to raise roadbed 1.5m
- meets contract geotechnical requirements
- precludes need to find, test and exploit a borrow source
- available: won't affect deadlines
- soil type is superior to other available fill sources
- Ca and SO_4 seen as beneficial
- soil salinity not an issue in covered, "high and dry" roadbed

Site Remediation Perspective

- facilitates re-use of industrial land, rather than developing virgin lands to meet Town's need for industrial space
- doesn't require risk management of future industrial properties
- doesn't fill landfill space with marginally contaminated material
- soil washing would have consumed over 100,000 m^3 clean water

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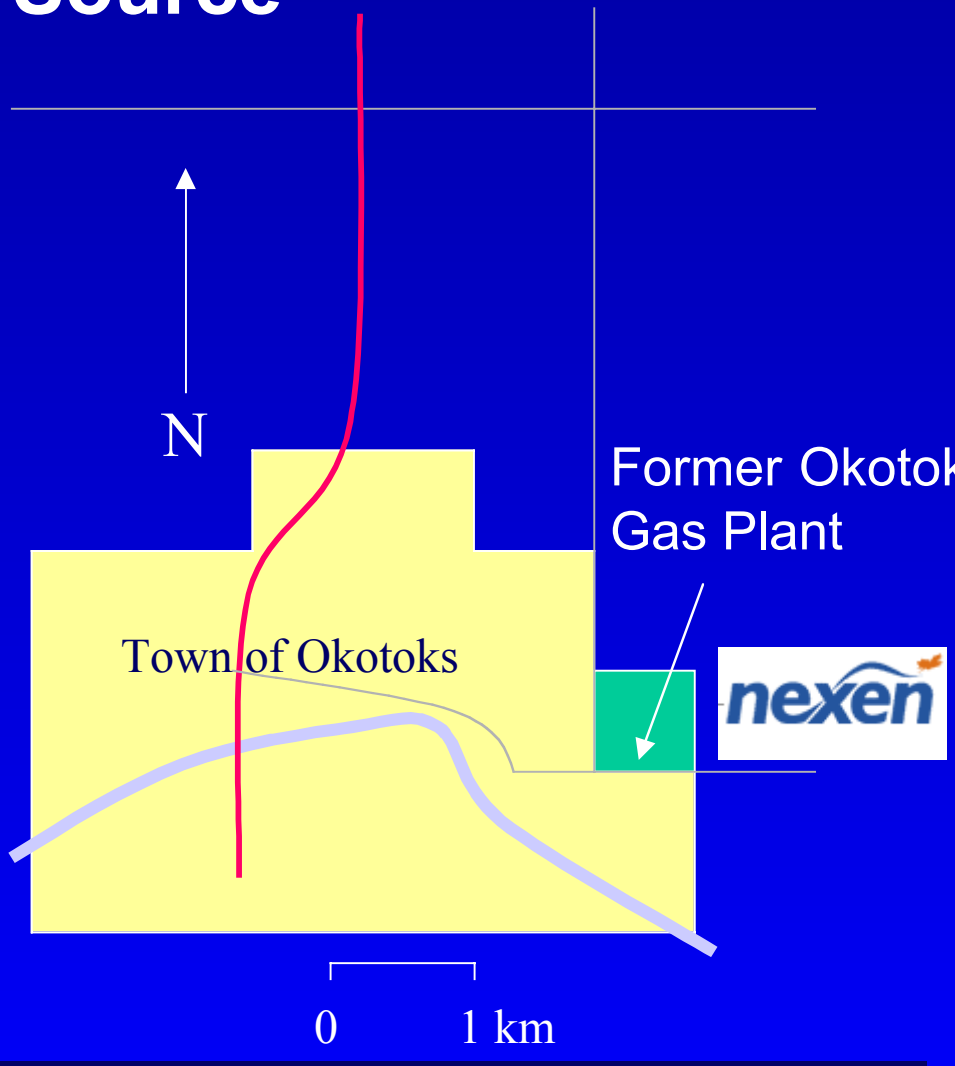
Soil Source

- Sulphur basepad area of former Okotoks Gas Plant
- Largely remediated; only “halo” remained
- Land proposed for industrial development
- Situated at eastern edge of Town of Okotoks



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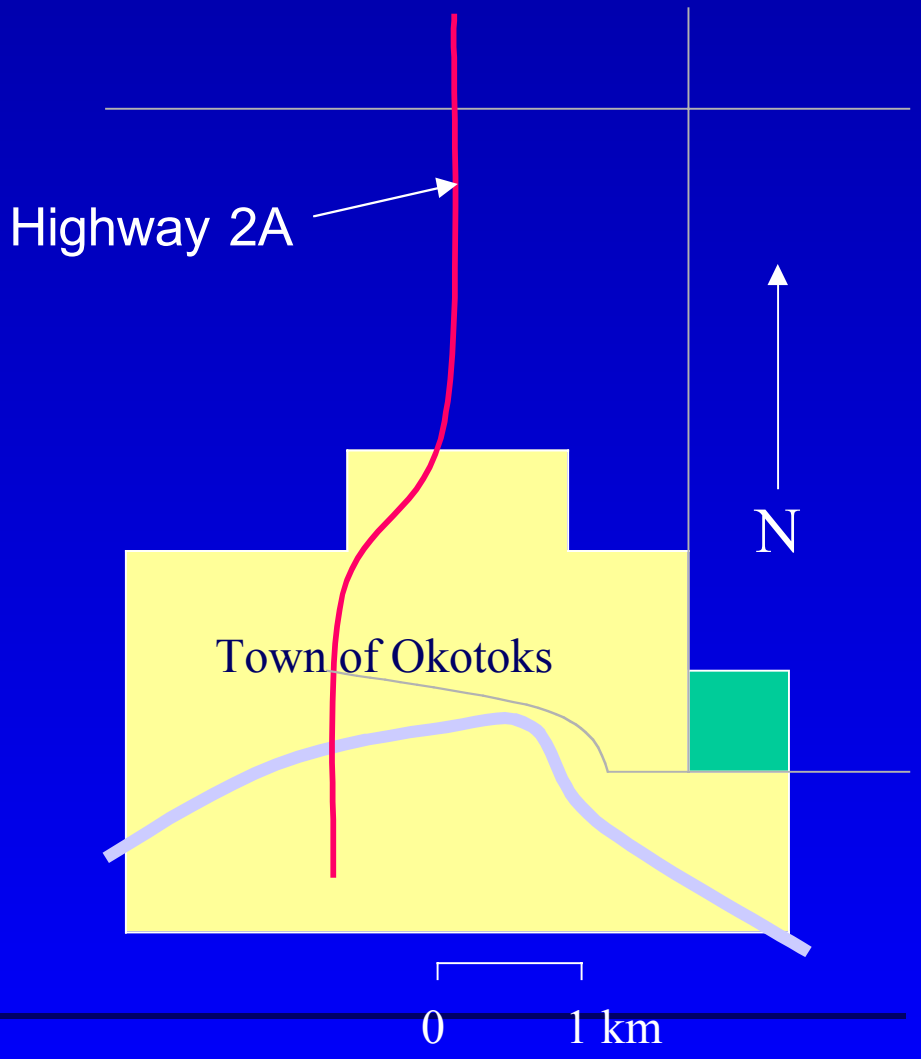
Okotoks Gas Plant Lower Terrace, 1999

The Highway Project

- Highway 2A through the Town of Okotoks
- Provincial highway upgrading project (twinning)
- Fill was needed to raise a section being twinned



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Characterization of the Basepad Soil

- Silty sand and gravel

- Met Alberta Tier I criteria except for:
  - average sulphur content <3%
  - pH 3-8; average 7.7
  - EC typically 5-8 dS/m

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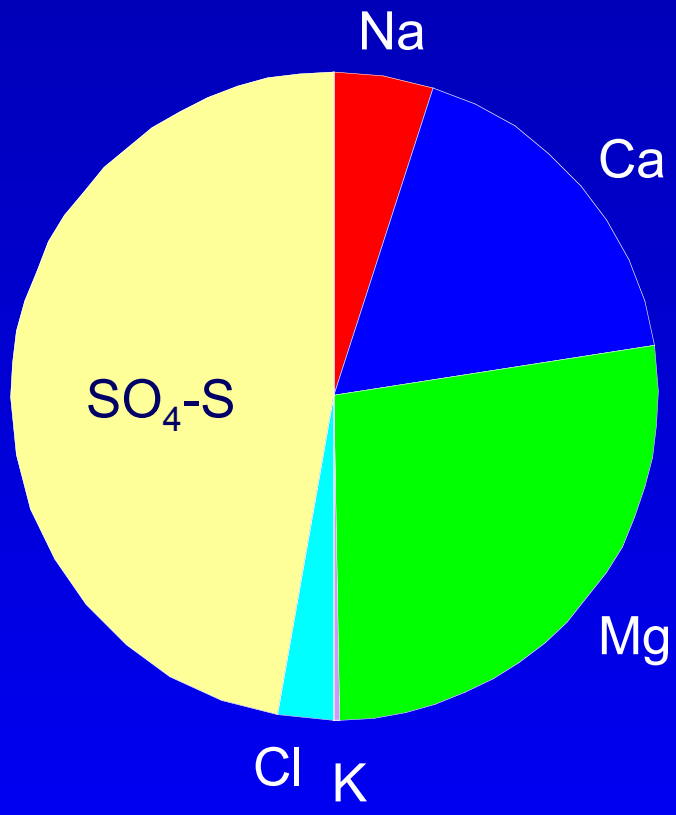
Nature of Soil Salinity

- Dominated by sulphate from sulphur oxidation
- Chief cations are magnesium and calcium
- SAR typically < 2



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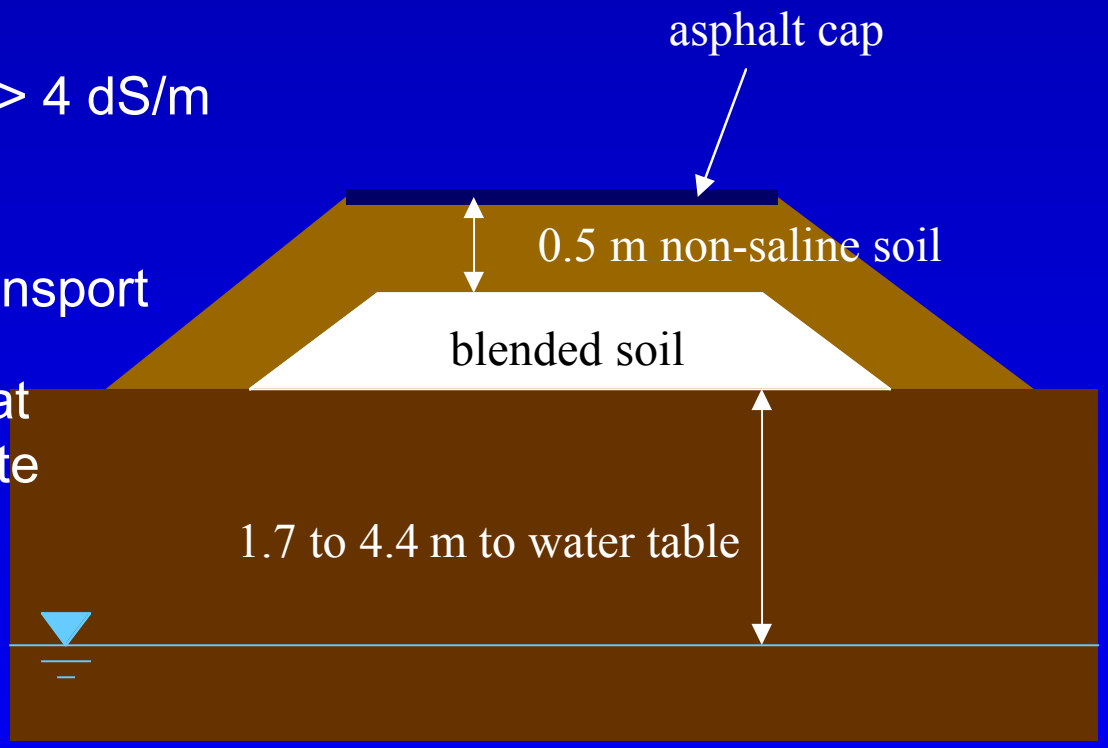
Work Plan

- Add crushed limestone onsite to soils with pH < 6
- Stockpile soils with EC > 4 dS/m
- Test EC in stockpile
- Load into trucks and transport
- Blend with low EC soil at highway construction site
- Test EC in roadbed
- Cap and pave



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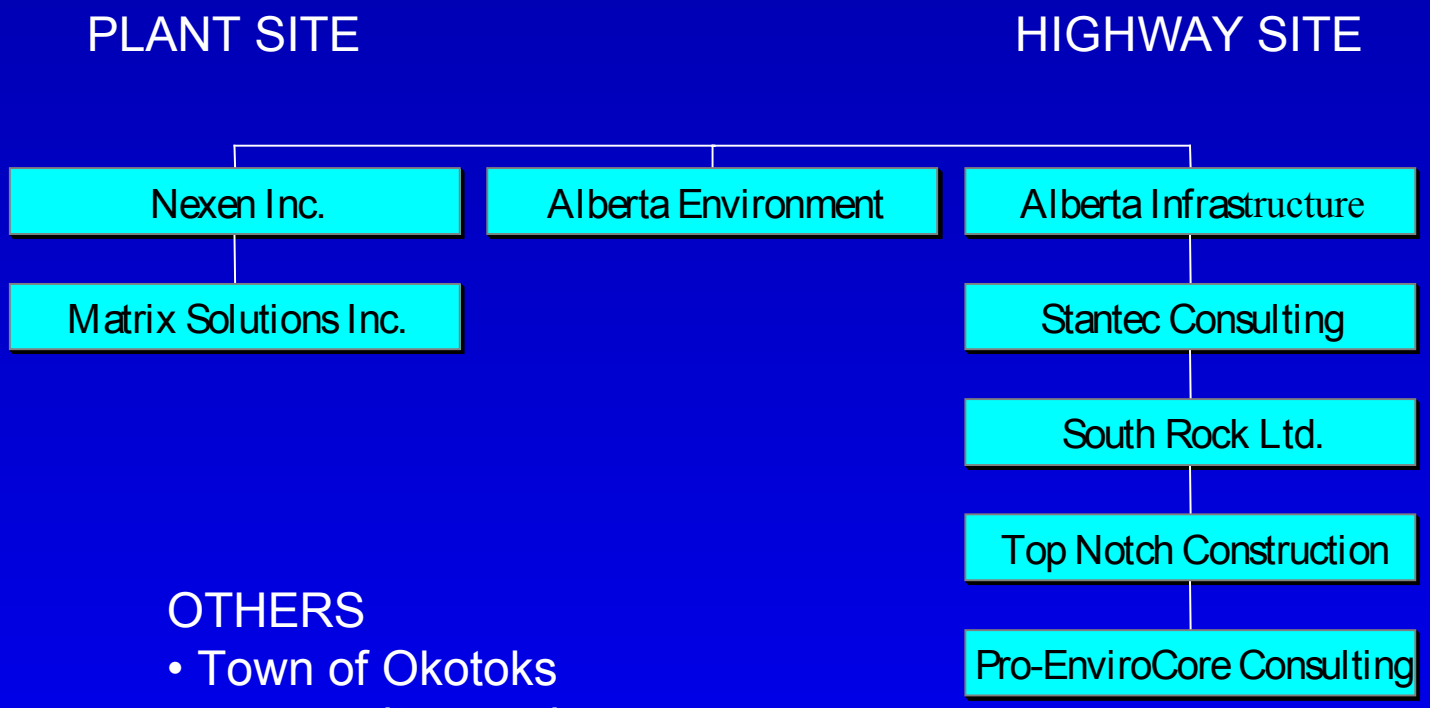
Project Organizational Structure



OTHERS
- Town of Okotoks
- community members

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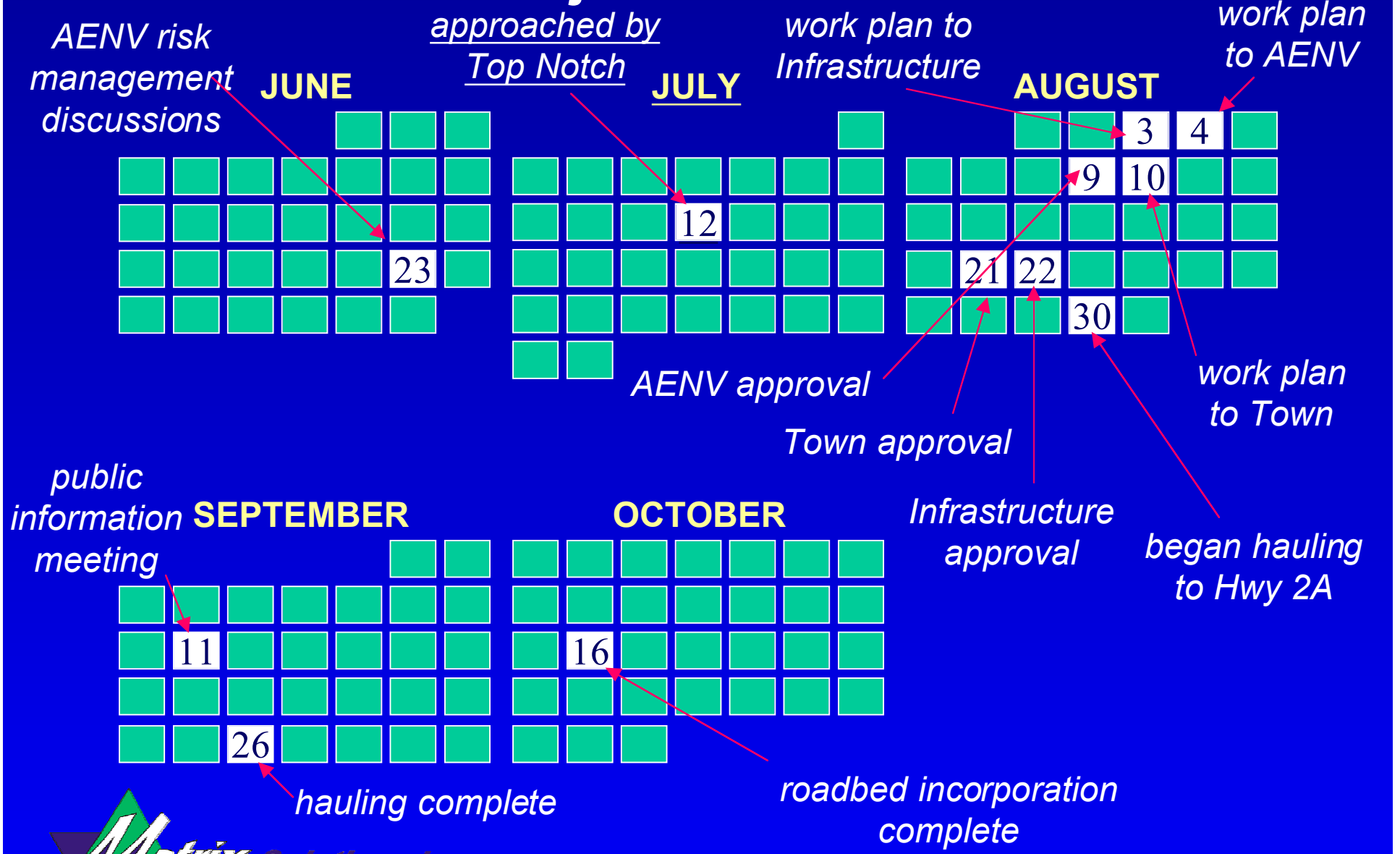
Project Schedule



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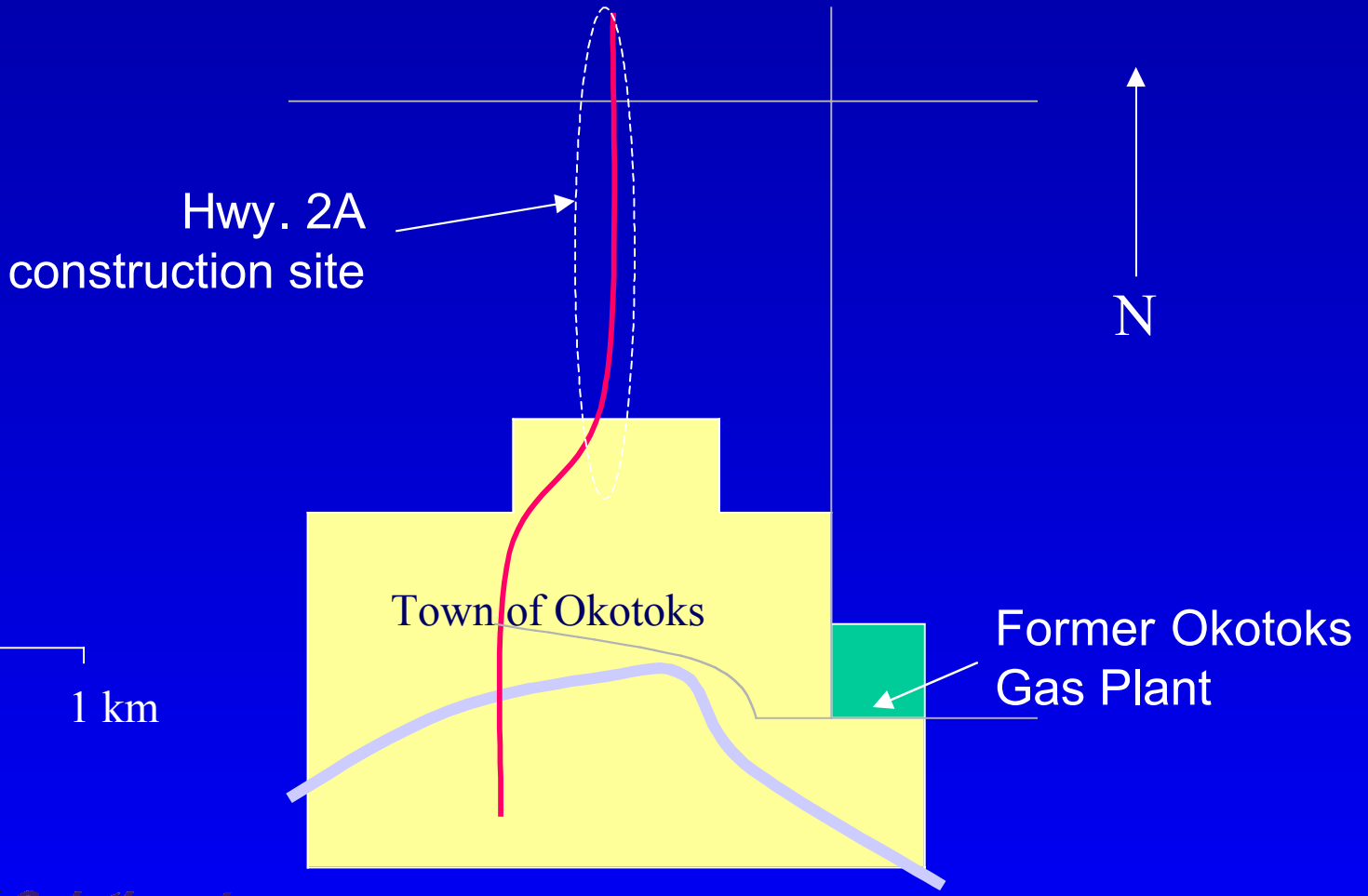
Alberta Environment Stipulations
August 9

- Written permission obtained from party with long-term ownership/care/control responsibilities for the road
- After incorporation, soil must have EC < 4 dS/m and meet Alberta Tier I criteria for all other parameters
- Covered top and sides with 0.5 m soil of EC < 2 dS/m
- Incorporated material at least 1 m above water table
- Placement north of Darcy Ranch turnoff
- Confirmatory sampling according to AENV plan
- Report submitted to Alberta Environment by March 30, showing all the above were met

Project Location



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Stantec (Alberta Infrastructure) Stipulations
August 22

- Must hold Alberta Infrastructure harmless
- Placement and testing must meet Alberta Environment requirements
- Results of testing made available to Stantec on request
- Alberta Infrastructure geotechnical requirements must be met
- No additional costs to Alberta Infrastructure for
  - different seed mix, if required
  - different concrete, if required
  - increased monitoring, testing, reporting costs

Town of Okotoks Stipulations
August 21

- Town's concerns relate to stripping/grading on plant site
- Surface water management to control runoff
- Site brought back up to grade
- Working area stabilized to prevent wind erosion
- If development is not imminent, may require topsoil and seed

Public Concerns - September 11, 2000

- Why weren't residents advised?
- Long-term effects on groundwater (water wells)
- Why couldn't some different soil be used in construction?
- How bad is the soil?
- The soil met acceptance criteria; no cause for concern
- Permeability 10^{-7} m/s
- Availability and quality; an alternative borrow source had EC 12-36 dS/m
- Test results posted

Public anger could have been avoided with prior communication

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Stripping Soils

Forming Stockpiles

Loading Trucks

Placing Soils at Hwy. 2A Site

Blending and Compacting the Roadbed

Close-up of Compacted Soils

Highway 2A, October 2000

Highway 2A, July 2002

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Lower Terrace, October 2000

Lower Terrace, June 2002

Results and Conclusions

- The former sulphur basepad soil was of good quality for use in highway roadbed construction.
  - well graded gravel; $CaSO_4$ improves strength, water tightness
- The highway was completed to specifications and on schedule. Using this material brought no increased costs.
- The former basepad area of the gas plant was remediated to allow for subsequent sale and use by others.
- Using the sulphur basepad soils saved over 30,000 m^3 of Alberta landfill space.
- No water contamination for soil washing was incurred.

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Recommendations

- Pursue opportunities for environmentally responsible management of resources
- Approach ALL stakeholders beforehand
- Prepare a MSDS for the material

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Thanks to All the Parties Who Made This Possible:

- Alberta Environment
- Alberta Infrastructure
- The Town of Okotoks
- Nexen Inc.
- Stantec Consulting
- South Rock Construction
- Top Notch Construction
- Pro-EnviroCore Consulting
- Matrix Solutions Inc.

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