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BUILDING ON THE PAST

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Alternate Dispute Resolution by Reverse Engineering – A Case History

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Introduction

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- “Changed Soil Conditions” occur at times despite precautions that might be taken in carrying out geotechnical studies.
- This is recognized on some projects by inclusion, in contract documents, of provisions for resolution by negotiation between the Owner and the Contractor.
- On some projects, provisions may be made to involve organizations such as the ADR Institute of Ontario, or the International Dispute Adjudication Board.
- On this project, geotechnical conditions were comparatively straight forward, although limited data was available. Changes were encountered in material characteristics and quantities which were well beyond reasonable expectations.
- They required modifications to the construction methodology and schedule, and had potentially serious consequences particularly to the Contractor.
- As construction progressed, positions of the Parties began to harden. Resolution by litigation loomed as a possibility. The project was on the brink of running “wild”.
- ADR to the rescue. An unusual approach, acceptable to all of the Parties, evolved during negotiations. The main purpose of the paper is to convey the lessons learned.

The Project

- Exploitation (for fertilizer production), of a phosphate rock orebody using an open pit mine. Other main facility components included the Mill, Tailings and Waste Water Clarification Ponds and associated Dams, various Stockpiles and infrastructure items.

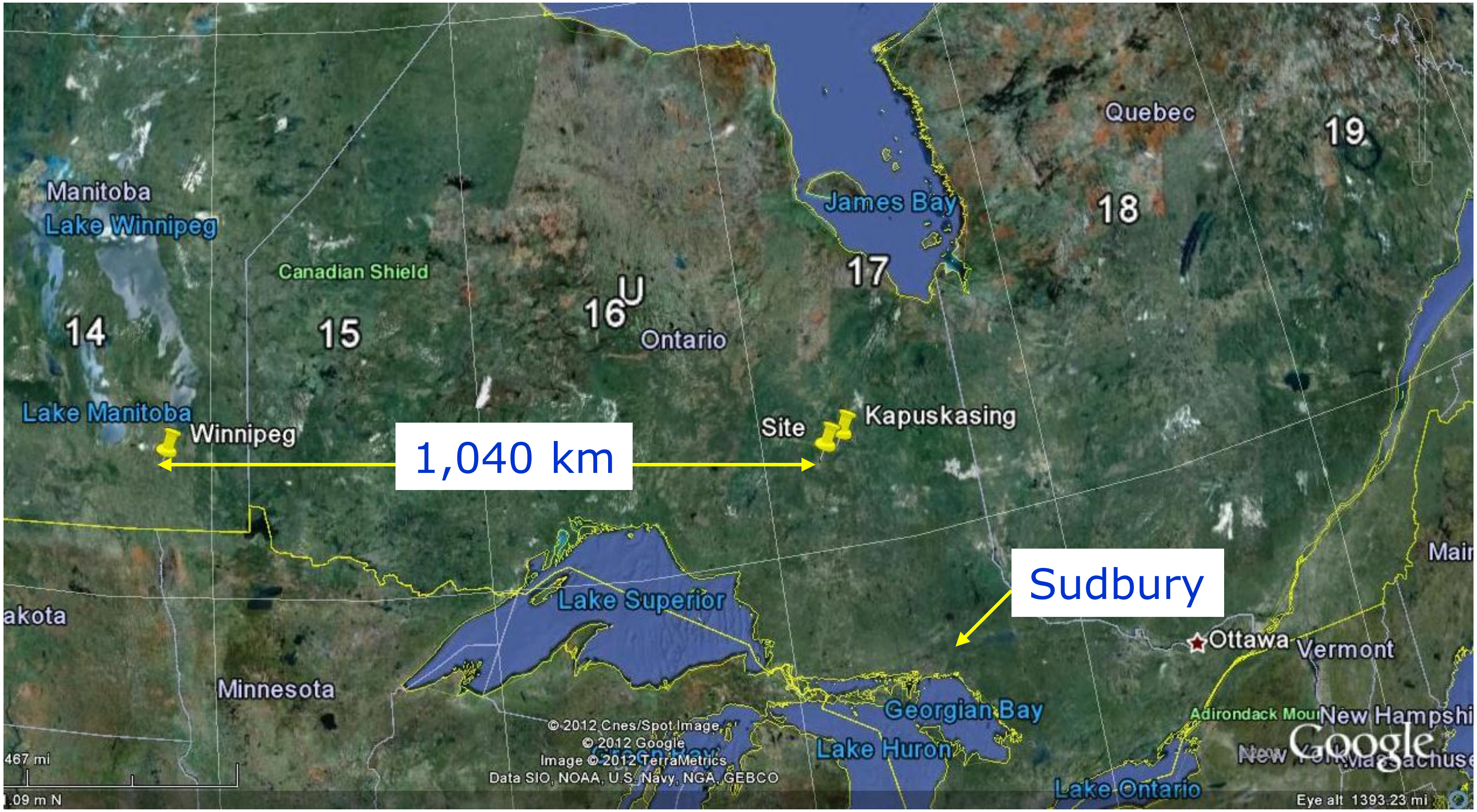
- The components of particular relevance to this paper are the pre-production stripping (pre-strip) operations at the Open Pit, the Tailings and Clarification Pond Dams, and the borrow materials for dam construction.

- Individual contract tasks included (amongst others):
  - removal of clay and glacial till overburden at the Open Pit and its use for Dam construction
  - utilization of waste rock from the pre-strip operations for access and haul roads.
  - construction of a Dam for containment of tailings and a similar Dam for clarification and reclaim of waste water. Both Dams were designed as zoned earth structures, up to 6m in height, to be built using overburden stripped from the Open Pit. The Tailings and Water Dams were 1.2km and 0.8km long, respectively.

- The Tailings Dam, in particular, was problematic during construction.

- The Project was carried out in 1998. As noted earlier, for a variety of reasons, limited geotechnical coverage of site conditions was available.

Site Location

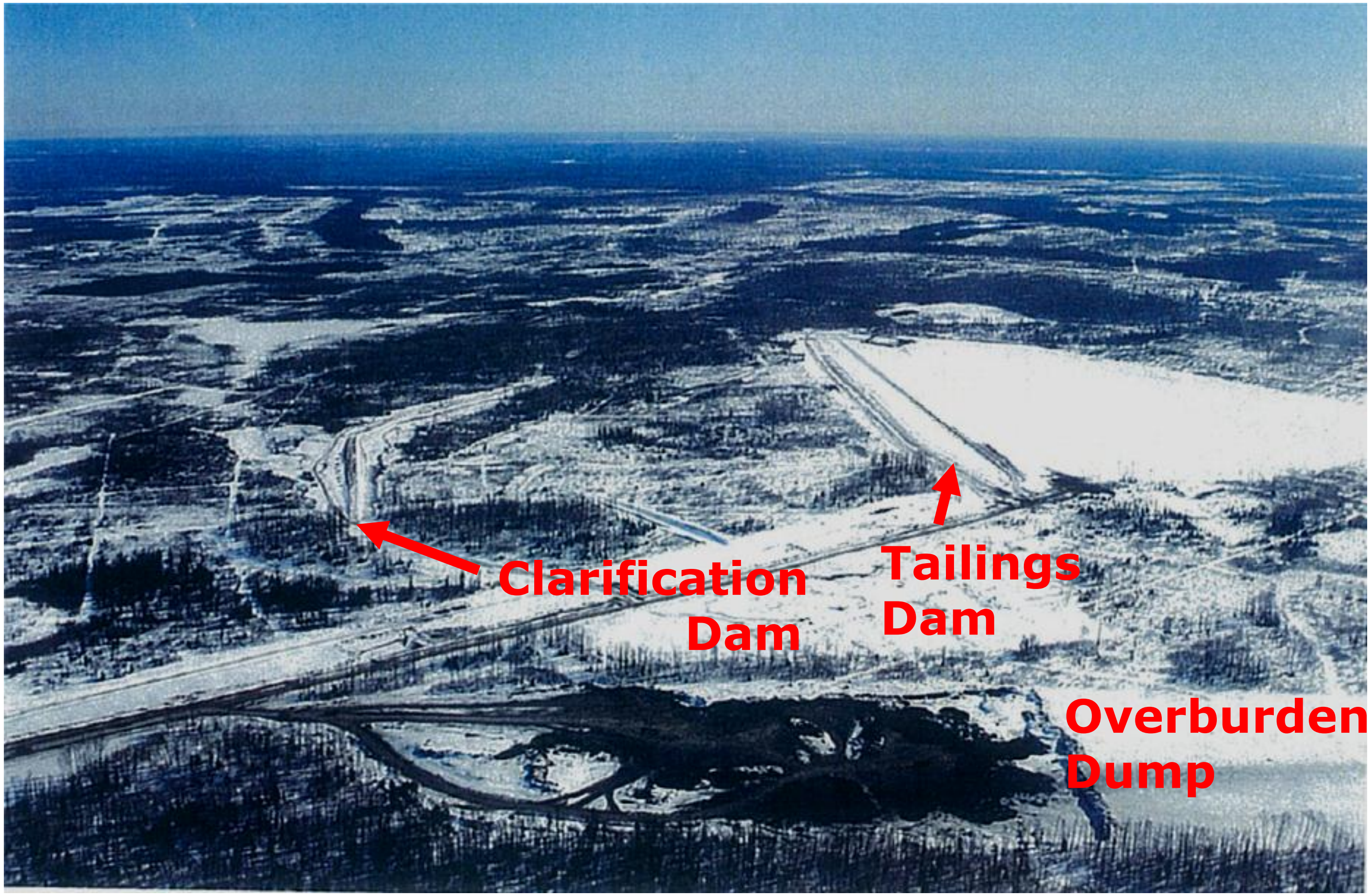


Site Setting

- Located near Kapuskasing in Northern Ontario, in flat, poorly drained terrain.
- Bedrock geology in the Open Pit area associated with the phosphate deposit is complex. The project area overburden consists of glacial till overlain by sensitive glacial lacustrine silty clay, overlain by peat/topsoil. The groundwater table is close to ground surface.
- Normal annual precipitation is about 850mm. Mean monthly high temperatures (-13°C to 30°C) and lows (-25°C to 10°C).
- Low seismic activity in the region.
- Tenderers were required to visit the site for a briefing. Were able to view a test excavation at the Open Pit. Were not provided with copies of geotechnical reports.

Project Site
Summer Conditions

Project Site
Winter Conditions



Contractual Terms of Reference

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- Lump sum for 3 items only, including mobilization and demobilization, and access road construction. Otherwise, payment on surveyed quantities and tendered unit prices.
- Contractor had no recourse for additional payment in the event that quantities differed from those estimated by the Owner.
- The unit prices would be all inclusive and would be the only payments made.
- The Construction Manager could instruct the Contractor to provide additional equipment and work additional shifts to meet the schedule, without additional payment.
- The "Site Conditions" clause in the Contract Documents stipulated (in summary) that:
  - the Contractor had satisfied himself before bidding, in respect to the site conditions and material quantities.
  - the records of investigations of soils or other conditions were not part of the contract.
  - The Contractor acknowledges that he has not relied upon any information given, and would not make a claim based on "changed conditions"
- The Contract Manager would be the interpreter of the contract and its performance.
- The Owner could make changes by altering, adding to or deducting from the Work, the contract price being adjusted accordingly.
- Inspection and testing to be done by both the Owner and Contractor.
- **"In the event of a dispute between the parties arising out of or relating to this Contract, the parties agree to attempt to resolve the dispute by good faith negotiation, failing which each party may resort to such remedies as may be available to it by law or in equity".**
- The question then arose (what does this mean in terms of resolution of the problem).

Geotechnical Data Base

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This was limited, partly because of problems of access during the site investigation, and policy regarding providing data to the Contractor.

- The geotechnical reports were not made available (initially). For tendering, the Contractor was only able to view reports at the Engineer's office.
- The basic soil stratigraphy was described briefly in the contract documents, namely peat over silty clay with a 2m to 3m stiff to firm crust, over compact silt till.
- The upper 2m to 3m of clay to be removed from the Open Pit was classified as a dry desiccated material suitable for dam construction. The glacial till was also indicated as suitable for this purpose.
- The peat at the proposed Dam sites was inferred to be up to about one metre thick.
- The contract documents provided specifications for compaction of the earth fill used in the Dams. However, the compaction characteristics of the fill were to be determined during construction.
- As the work progressed, the Contractor encountered significant difficulties particularly in the depths and excessive quantity of topsoil/peat which had to be removed; the unexpectedly high moisture content of the designated clay borrow; and the excessive quantity of clay fill actually required.

Tender for the Work

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The Contract Documents included items as follows:

- **Schedule:**

  For the Dams and stripping at the Open Pit. Between the beginning of June and end of September, 1998. i.e. during the good weather season.

Tailings and Clarification Dams Earthwork
Tender Volumes (m^3)

Description	Tailings Dam	Clarification Dam
Excavation and disposal of organic topsoil/peat	24,000	16,000
Haul and place clay/glacial till	113,700	78,300
Supply and place sand fill for the chimney and finger drains	7,800	6,700
Supply and place granular fill for the finger drain	1,500	1,000
Supply and place rip-rap	2,200	1,400

- **Topsoil/peat excavation**

  Based on the Tender quantity and excavation footprint, the average depth was inferred to be 0.3 to 0.5m
- **Bulk dam fill from the Open Pit Pre-strip.** The initial two to three metres was classified as a dry desiccated material suitable for dam construction.
- Below the upper two to three metres, the clay was described as generally high in moisture content and liquefiable. Removal and disposal of this clay under winter conditions was suggested.

  The Contractor selected a fleet of major equipment based on the given material descriptions and quantities, and also proposed construction methodologies for removal of the topsoil/peat and dam construction which were consistent with the information provided.

Problems Encountered in Practice

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Important problems included:

- **Increased depth of topsoil/peat**

  Instead of 0.3m to 0.5m, with some areas up to 1.2m deep, depths encountered were up to 3m with an average of 1.8m.

  (In addition to impacts on construction methodology and productivity, the increased depth also led to a routine check on the stability of the Tailings Dam).

- **Increased quantity of topsoil/peat.**

  The Tendered quantity was 24,000m^3. In practice, about 142,000m^3 had to be excavated.

  The Contractor had to mobilize additional resources and implement a second 12-hour shift. Notwithstanding, the work was delayed into the autumn season dominated locally by rainy weather. Placement of clay for Dam construction was adversely affected as well.

Problems Encountered in Practice (cont'd)

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- **Lack of suitable clay borrow**
  The designated borrow area at the Open Pit proved to be unsuitable. Only one metre of the two to three metres of upper clay met specifications. Borrow areas elsewhere had to be investigated and utilized, resulting in further delays.

- **Higher than anticipated moisture content of the clay**
  The high moisture content of the surficial clay not only affected its suitability for dam construction, its description as desiccated suggested more favourable trafficability characteristics than encountered in practice. This had a considerable impact on the efficiency of hauling units (despite use of off-road articulated haulers), and the number of dozers required.

- **Increased quantity of clay**
  The large increase in topsoil/peat excavation from the Tailings Dam foundation required a corresponding increase in clay fill – from 113,700m^3 tendered to 328,314m^3 actual, also instrumental in delaying construction into inclement weather.

Peat Formation During Excavation

Clay Formation After Stripping the Peat at the Pit

Clay Placement for Dam Construction

Difficult Trafficability on Roads to the Dam

Developments During Construction

- Problems arose due to "changed soil conditions" early in the construction phase. Important items included:
  - increased quantities of peat/topsoil (483%)
  - the designated clay borrow source was not suitable, requiring finding new borrow areas.
  - increased quantities of clay were required (339%)
  - earthwork construction was delayed into the winter despite efforts by the contractor to stay within the original schedule.
  - other significant changes (as in the paper)
- **Fortunately, design changes could be implemented where required. The delays did not adversely affect the schedule of the overall project.**
- The contract required independent inspection of construction, good QA/QC, as-builts, etc. **The Contractor completed it successfully notwithstanding the problems encountered**.
- **The Contractor was potentially in serious trouble**. Retained experts to assist. He maintained that the "changed conditions" could not have been reasonably anticipated at time of Tendering.

Developments During Construction (cont'd)

- During initial negotiations, the Owner and the Construction Manager were receptive to a claim providing it was acceptably structured and justified. **How to do it?**
- From the Contractor's standpoint, a key factor in formulating the claim was the provision in the contract documents to the effect that in the event of a dispute, the parties agreed to attempt to resolve the dispute by **good faith negotiation.**
- At the time, the original geotechnical data was available and comprehensive records were produced by both the Owner by contract and the Contractor in anticipation of a claim.
- Ultimately, the Contractor (with specialist assistance) concluded that the most equitable approach was to assume that the conditions encountered during construction had been available during design and at time of Tendering and produce a hypothetical "Revised Tender". In other words, to adopt a process of reverse engineering.
- To their credit the Owner, the Engineer of Record, and the Owner's Project Manager agreed to this approach and it formed the basis for the settlement.

Some Lessons Learned

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- The experience on this Project is presented as a case history of dispute resolution which may be of value to others (particularly geotechnical engineers) in comparable circumstances.
- The experience on the Project also attests to the merit of comprehensive geotechnical studies at design stage, which was recognized in this case but could not be acted on pre-tender.
- The learnings on the Project provide a reminder of the importance of a number of other items in a geotechnical context, including:

  (i) close interaction with the Designer in respect to utilization of geotechnical data in design and reference to it in contract documents

  (ii) effective transfer of relevant geotechnical data not only through comprehensive briefings on site, but through provision of geotechnical reports at time of Tendering and for direct reference during construction.

  (iii) adequately understanding practical construction issues which have to be contended with by the Contractor where earthwork operations are involved, and which are influenced by factors such as site preparation, material properties and quantities, weather conditions, temporary works, and trafficability.

  (iv) recognition at design stage of the need for careful control during construction and provision for adjustments in cases where it is necessary to proceed with limited geotechnical data.

Some Lessons Learned (cont'd)

(v) importance of assigning geotechnical risks to the Contractor in reasonable fashion, and recognition of the value of resolution of disputes, if they arise, by alternate dispute resolution methods.

(vi) the paramount value of experienced, independent review of geotechnical matters at design stage rather than during construction.

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Avoidance of Pitfalls

(Some Basic Precautions for Geotechnical Engineers)

(Adapted from Presentation by M.A.J. Matich at Plenary Session on Professional Practice. CGS Golden Jubilee Conference. Ottawa, 1997)

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1. **GOOD COMMUNICATIONS WITH END-USER**
   (Owner – Architect – Engineer – Contractor – Operator)

2. **RESEARCH SITE BACKGROUND**
   (Geological; Seismic; Historical; External influences)

3. **SCOPE OF SITE INVESTIGATION**
   (Appropriate Methodology; Flexible approach; New Techniques)

4. **KNOW END-USER REQUIREMENTS**
   (Owner; Designer; Contractor; Operator; End-use Applications; Risks)

5. **KNOWLEDGE OF SPECIALIZED TECHNOLOGIES**
   (Ground improvement; Special Foundations; Earthmoving; Tunnelling; Tailings Disposal; Geosynthetics; etc.)

Avoidance of Pitfalls

(Some Basic Precautions – Cont'd)

6. **MAXIMIZE INVOLVEMENT**
   (Member of design team; Construction inspection and supervision; Monitoring; Ongoing contact)

7. **ADEQUATE DOCUMENTATION**
   (Contract; Correspondence; Reports; Archives)

8. **TECHNICAL FINDINGS**
   (Adequacy and Accuracy of facts; carefully-considered recommendations; Effective follow-up)

9. **CHECKING AND REVIEW**
   (Internal policy; External peer review)

10. **ADMINISTRATIVE FACTORS**
    (Operating manuals; Established standards and guidelines; Staff training; Adjust to Corporate and personnel changes, Ensure continuity)

Avoidance of Pitfalls (Some Basic Precautions – Cont'd)

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11. **POTENTIAL PROBLEMS**
    (Preventative vigilance; prompt, constructive attention if they occur)

12. **ALTERNATE DISPUTE RESOLUTION METHODS**
    (Merits of Provision in contractual arrangements)

13. **EXPERT EVIDENCE**
    (Fair; Objective; "Best you can be")

14. **LEARNING**
    (Stay Abreast of Developments; Diversify experience)