# Beneficial Reuse of Excess Soil at Aggregate Pits and Quarries

ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

April 21, 12:00 - 1:30 PM ET

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ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

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# Summary

- Project Scope
- Project Deliverables
- Scientific Report
- Best Management Practice (BMP)
- Reports available at: https://ospe.on.ca/excess-soil-reports/

# Excess Soil Steering Committee

- Amarjit Sandhu, B.Sc: MHBC
- Ashlee Zelek:
  Ontario Stone, Sand & Gravel Association (OSSGA)
- Charles Priddle, Ph.D:
  Halton Region Conservation Authority (HRCA)
- Chi Hoang, Ph.D., P.Eng: MECP
- Grant Walsom, P. Eng, QP: XCG Consulting
- Ian McLaurin:
  Ontario Soil Regulation Task Force (OSRTF)
- Jason Belleghem: MNRF
- Jim Walls, P.Geo, QP: RJ Burnside & Associates
- Karan Jandoo: MECP
- Kirsten Groody: Lafarge Holcim
- Krista Barfoot, Ph.D, $QP_{RA}$: Stantec
- Leslie Rich, MES, RPP: Conservation Ontario
- Nafiseh Pourhassani, P.Eng: MECP
- Thomas Guoth, P. Eng., QP: GHD

# Project Scope

- 25,000,000 $m^3$ of excess soil in Ontario
- 5000 active pits and quarries
- 8000 abandoned pits and quarries

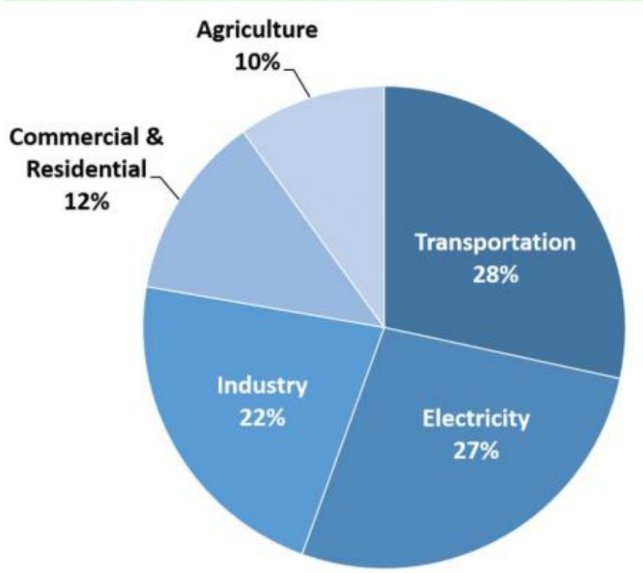
- Excess Soil Regulation (O. Reg. 406/19) by the MECP
- Pits and quarries are excluded.
- Can we use MECP standards for pits and quarries?

Source: Environmental Defence

# Project Importance

Proper reuse of excess soil for rehabilitation of pits and quarries has many benefits:

- ✓Minimizing safety issues
- ✓Eliminating aesthetic issues
- ✓Less truck traffic
  - Less greenhouse gas emission
  - Less congestion
  - Less road deterioration
- ✓Recreating/repairing wildlife habitats




Sources: EPA and BBC

# Project Main Tasks

| Mar- May 2020 | Jun - Aug 2020 | Aug - Nov 2020 | Dec 2020 - Mar 2021 |
|---|---|---|---|
| Forming the steering committee | Literature review<br>(Jurisdictional overview)<br>(Works in Ontario)<br>(Peer-reviewed literature) | Developing the Scientific Report and BMP | Addressing committee's comments |

# Scientific Report

# Scientific Report (Overview)

- Literature Review
  - Works Conducted in Ontario
  - Jurisdictional Overview
- Analysis of Options for Choosing Fill Quality Standards
  - Conceptual Site Model for Pit and Quarry
  - Options for Choosing Fill Quality Standards
  - The BRAT
  - Fate and Transport of Metals in Saturated Conditions
- Potential Adverse Impacts Not Considered by O. Reg. 406/19
  - Invasive species
  - Microbiological contaminants

# Scientific Report (Literature Review)

## MECP

- O. Reg 406/19
- O. Reg. 153/04
- Soil Rules
- Rationale Document
- **MECP BMP**
- **BRAT**

## MNRF

- Aggregate Resources Act
- **Aurora Fill Protocol**
- Policy A.R. 6.00.03
- **Application Standards**

## Others

- TOARC BMP
- CUI Excess Soil Tool
- **Peer-reviewed literature**

# Literature Review: Jurisdictional Overview

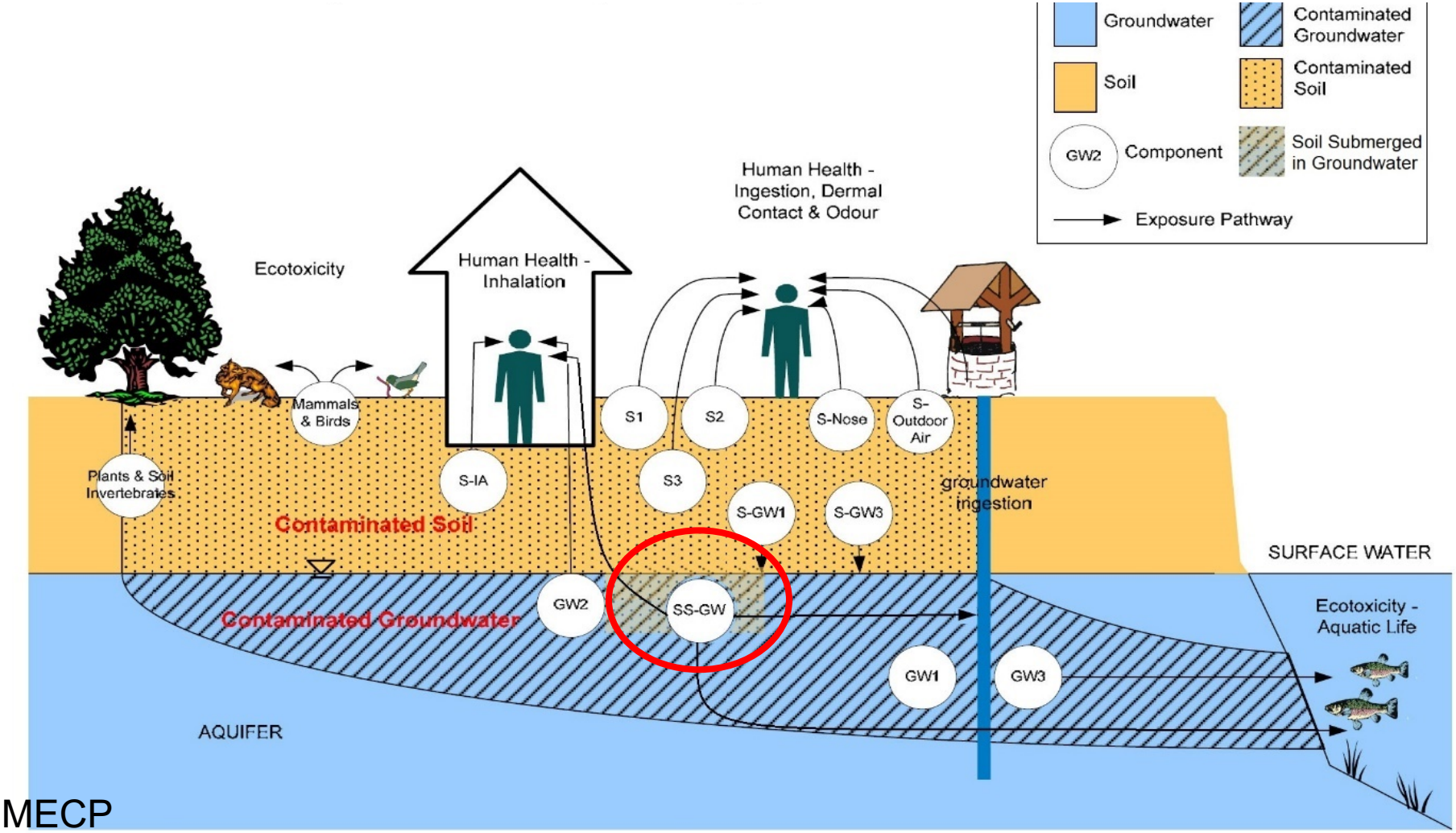
- Alberta
  - **A User Guide to Pit and Quarry Rehabilitation in Alberta**
- British Columbia
  - Reclamation and Environmental Protection Handbook for Sand, Gravel and Quarry
- Massachusetts
  - Interim Policy on the Re-Use of Soil for Large Reclamation Projects
- Minnesota
  - **Minnesota Handbook for Reclamation of Gravel Pits**
- New Jersey

# Jurisdictional Overview (Patterns)

- A flexible framework for the assessment of soil quality rather than one table or one set of values
- Recognition for the issue of variability in background concentrations
- More current excess soil regulations and older BMPs for pit and quarry rehabilitation
- No independent conceptual site model for pits and quarries
- Some jurisdictions require pits and quarries to register and submit information, including a detailed soil management plan

# Pit and Quarry Conceptual Model (Similarities with MECP Model)

- SS-GW pathway




Source: MECP

# Deviation from MECP Model

- Presence of SS-GW (saturated soil to groundwater) pathway

- The hydraulic conductivity of the aquifer is set to $3 \times 10^{-5}$ m/s
- (The BRAT covers $10^{-3}$ to $10^{-5}$ m/s)

- Aquifer recharge rate = 0.28 m/a
  - Aquifer recharge rate may be different

- MECP standards are valid for a pH range of 5 to 9 and 5 to11, respectively, for surface and subsurface soil
  - Groundwater pH  may be varied

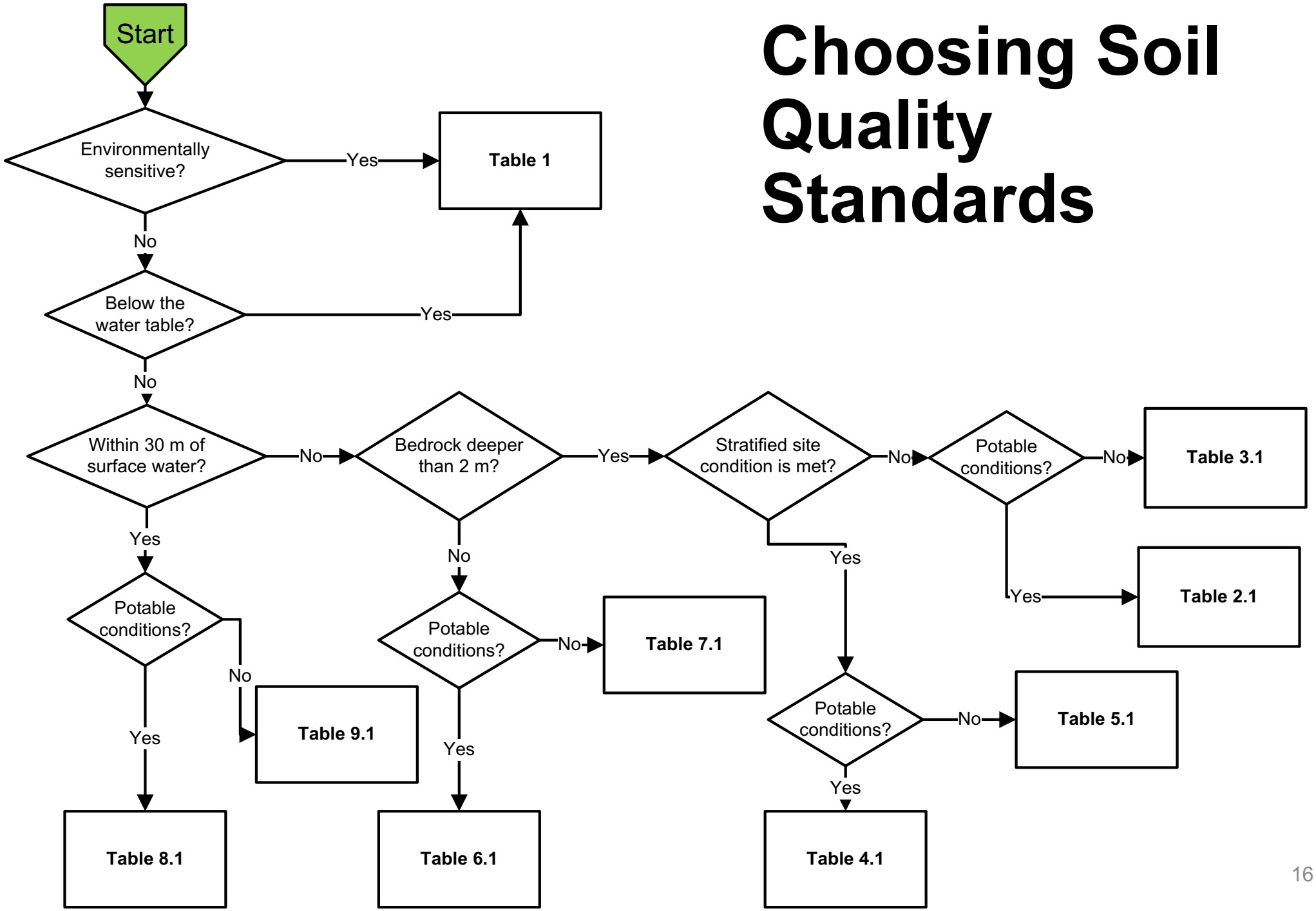
# Options for Choosing Soil Quality Standards

- MECP Background Conditions Table 1

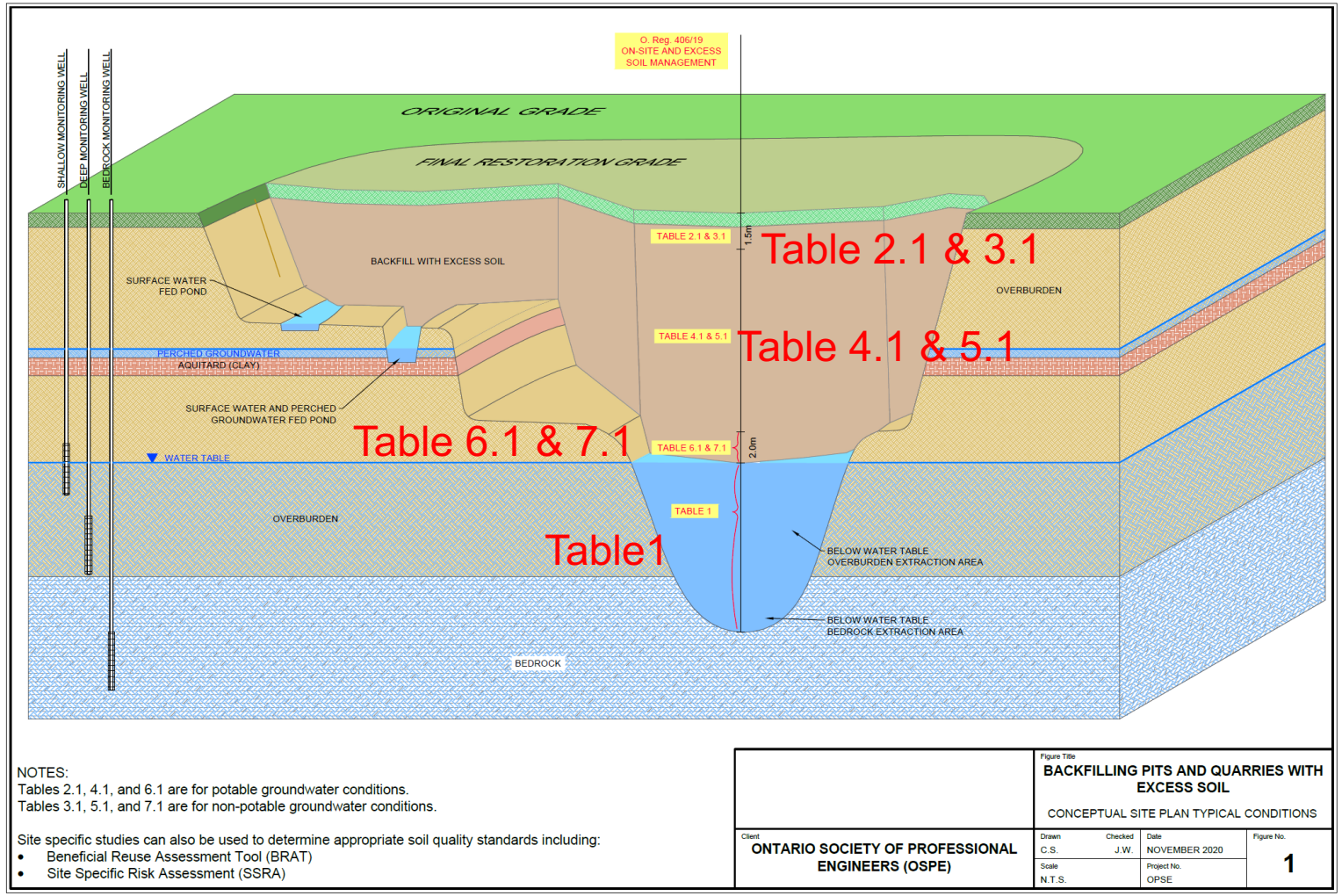
- MECP Excess Soil Tables (Tables 2.1 to 9.1)
  - Tables 2.1 and 3.1
  - Tables 4.1 and 5.1 (stratified conditions)
  - Tables 6.1 and 7.1 (shallow soil)
  - Tables 8.1 and 9.1 (near surface water body)

- Shore Infilling Standards

# Choosing Soil Quality Standards



# BMP: Layer-Cake Approach




NOTES:
Tables 2.1, 4.1, and 6.1 are for potable groundwater conditions.
Tables 3.1, 5.1, and 7.1 are for non-potable groundwater conditions.

Site specific studies can also be used to determine appropriate soil quality standards including:
- Beneficial Reuse Assessment Tool (BRAT)
- Site Specific Risk Assessment (SSRA)

Figure Title
**BACKFILLING PITS AND QUARRIES WITH EXCESS SOIL**
CONCEPTUAL SITE PLAN TYPICAL CONDITIONS

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# Potential Adverse Impacts Not Considered by Excess Soil Generic Standards

- Microbiological contaminants
- Invasive species
- Groundwater flow
- Noise and dust
- Soil erosion
- Climate change
  - Mitigation
  - Adaptation

# Climate Change: Adaptation and Mitigation

Mitigation: It is today's concern

- A goal of *O. Reg. 406/19* is the reduction of greenhouse gas (GHG) emission
- The close-to-market and dispersed pit/quarry sites that provide the benefit of reduced haul distance

Adaptation: Current and future planning; a long-term phenomenon

- Increase in precipitation may cause more erosion and change in water level table
- Changes in balance of native and invasive species
- Melting permafrost in North Ontario

# Best Management Practices (BMPs)

**Best Management Practices for Aggregate Pit and Quarry Rehabilitation in Ontario**

S. Madeh Piryonesi, PhD

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Lee Weissling, PhD

Ontario Society of Professional Engineers

# Best Management Practices (Overview)

- Purpose and Application of the BMP Document
- **Soil and Groundwater Quality Considerations**
  - **Soil quality**
  - **Groundwater quality**
- BMPs for Site Control and Approving Soil at the Reuse Sites
- Non-Chemical Contaminants and Other Issues
- Consultation and Engagement
- Climate Change

# Purpose and Application of the BMP Document

- The BMPs do not supersede the ARA (see Section 66)
  - Licenced sites may use the BMPs with MNRF approval

- The BMPs are developed based on O. Reg. 406/19 and associated rules
- MECP Excess Soil BMP (2016) was used in the development of the BMP document
- The BMPs recognize the benefits of using the BRAT or a risk assessment under certain circumstances

# BMPs for Licenced and Unlicenced Sites

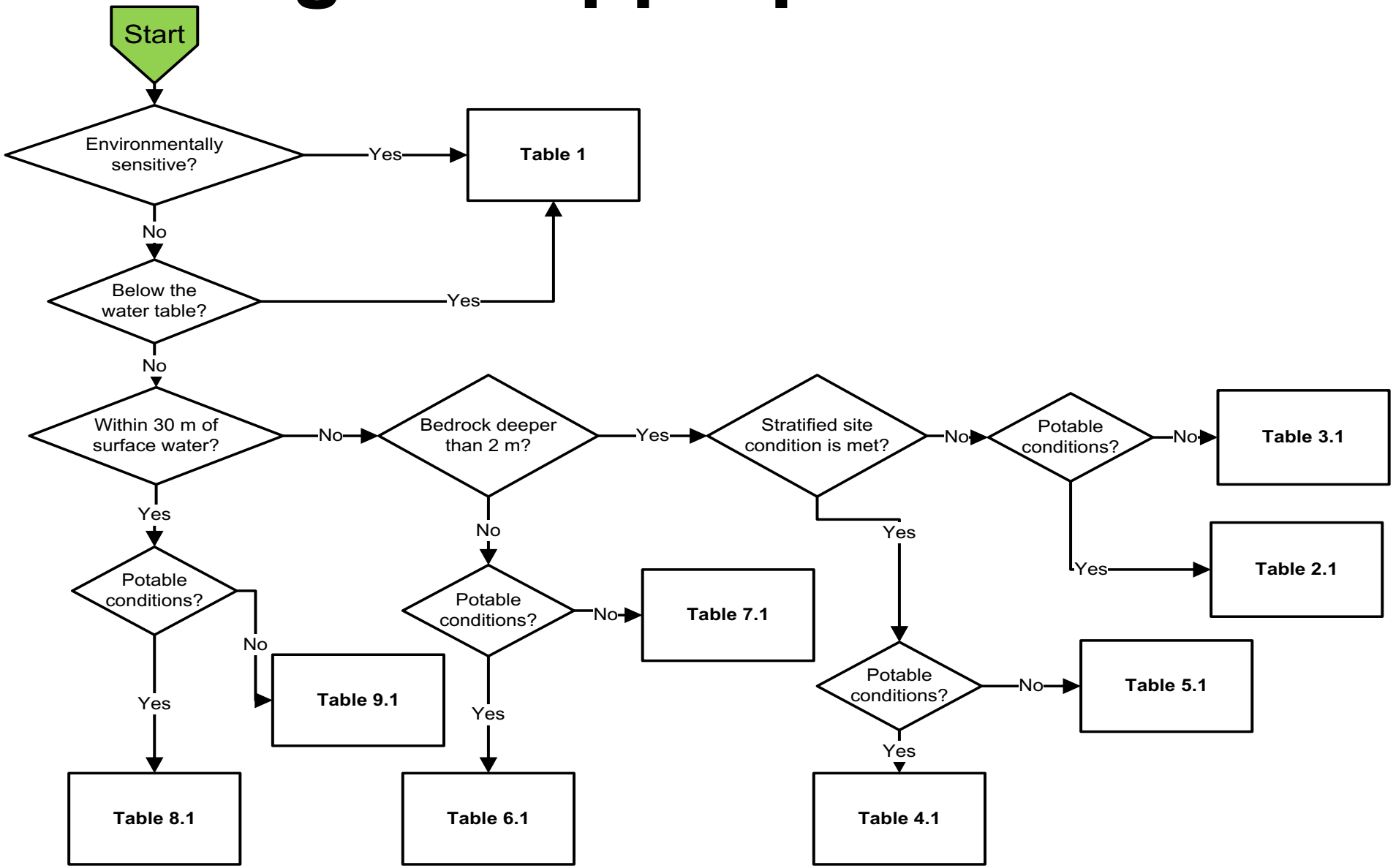
- Licenced sites are regulated under the Aggregate Resources Act (ARA)
  - Quality and quantity is determined by the site plan

- Unlicenced sites are regulated by a municipality
  - Legacy pits and quarries are an important category
  - Should comply with municipal bylaws

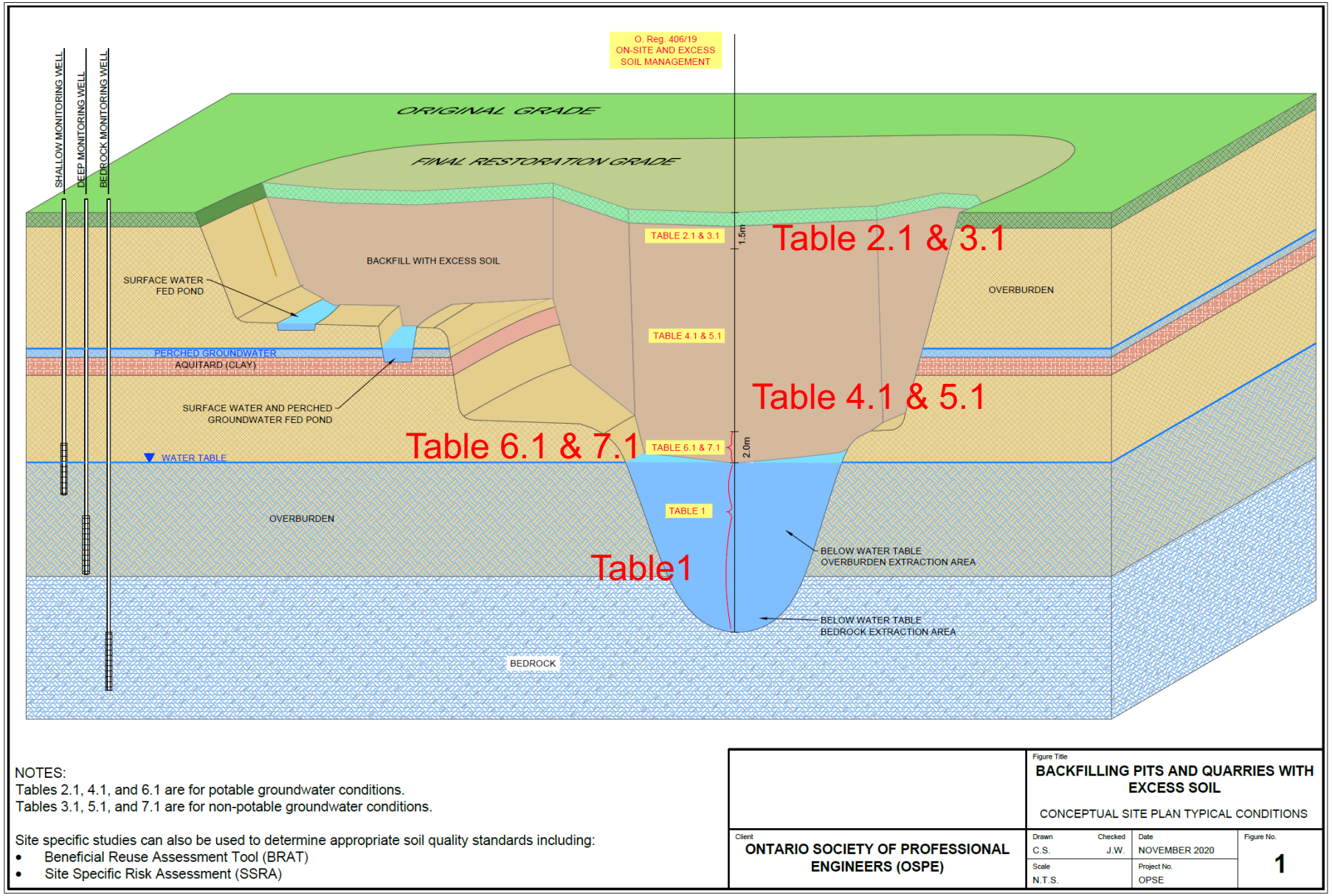
# Standards for Protecting Soil and Groundwater Quality

- Site end use (e.g., agricultural or residential)
- Groundwater potability
- Location with respect to closest surface water body
- Whether soil is placed in a shallow bedrock setting
- Whether the site is located in an environmentally sensitive area
- Other regulatory considerations: whether an RSC is required

# Choosing the Appropriate Standards



# Layer-Cake Approach: Setting 1

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# Layer-Cake Approach: Setting 2

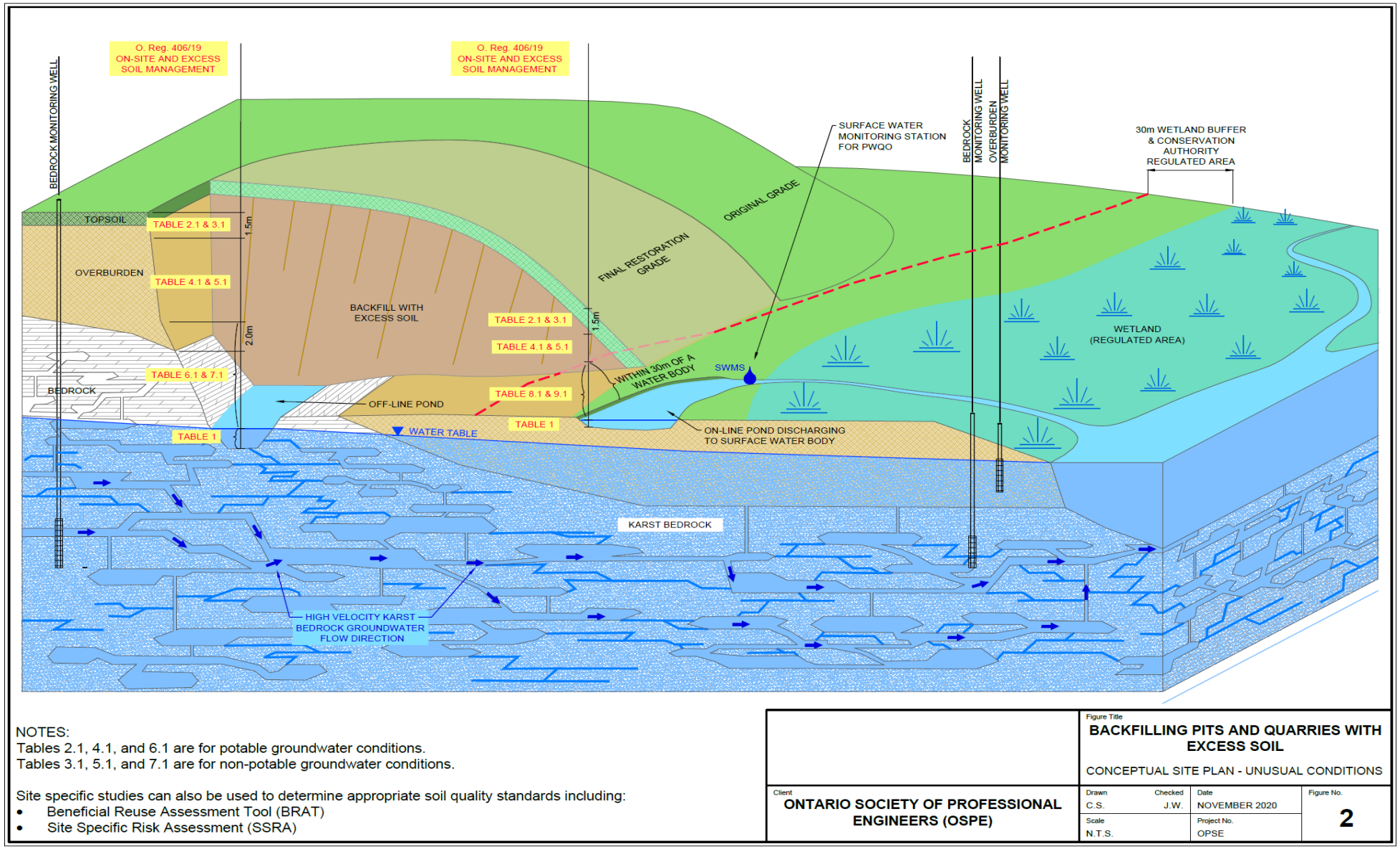


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Figure Title
**BACKFILLING PITS AND QUARRIES WITH EXCESS SOIL**
CONCEPTUAL SITE PLAN - UNUSUAL CONDITIONS

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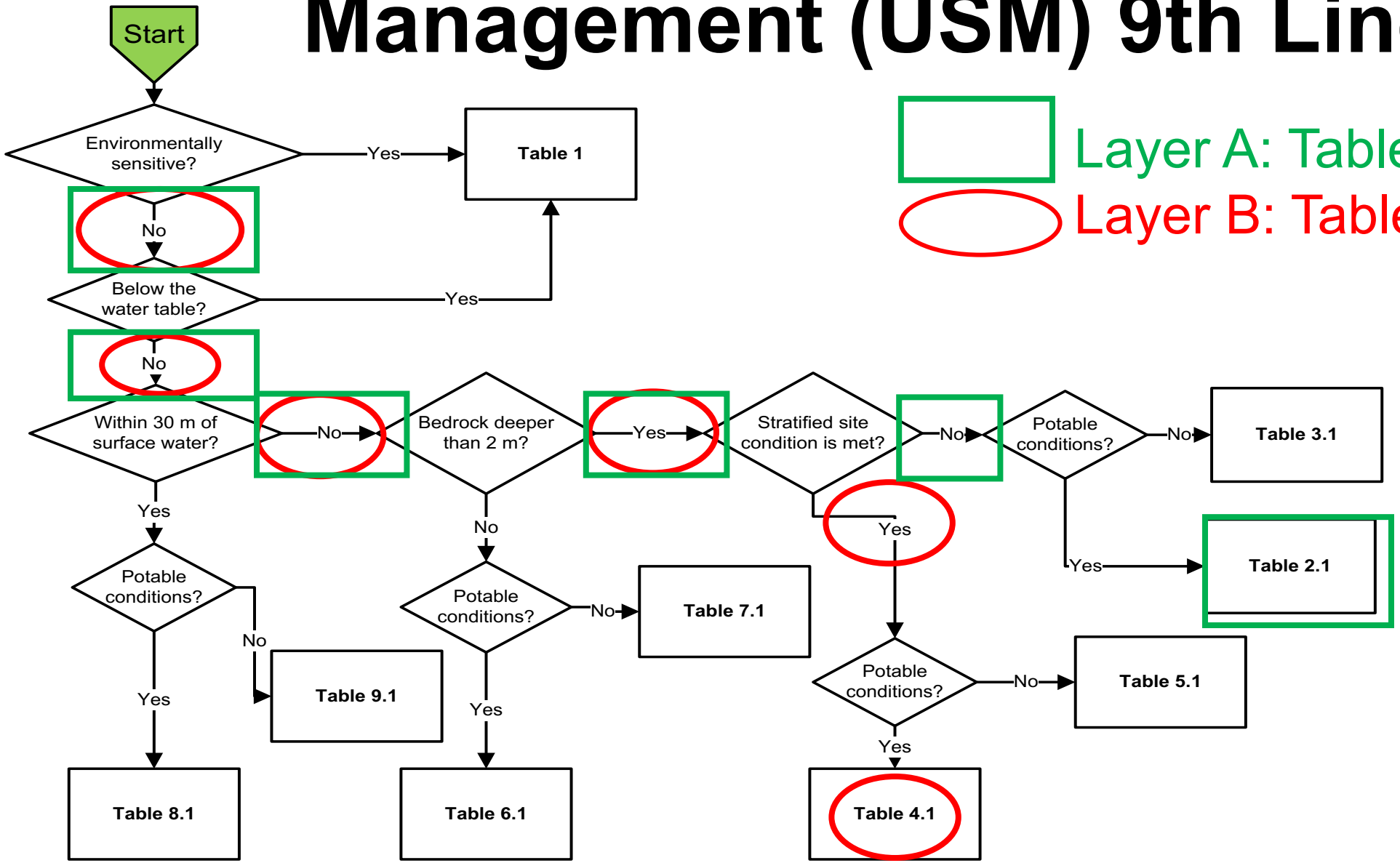
# Case Studies: Case 1, United Soil Management (USM) 9th Line

- Approved Fill Rate: 600 tri-axle trucks per day (approximately 6,000m3/day)
- Duration of Filling: approximately 25 years
- Fill Quality:
  - Table 2
- Groundwater: All filling above the water table
- Surface water: No surface water bodies
- Stratified site condition is met

# Case Studies: Case 1, United Soil Management (USM) 9th Line



# Groundwater Monitoring

- Three lines of evidence
  - Soil standards
  - Leachate analysis
  - On-site groundwater monitoring using monitoring wells (if present)
- Unlicenced sites must comply with existing municipal bylaws regarding groundwater monitoring

# BMPs for Approving Soil at the Reuse Site

- Information needed from the source site (according to Soil Rules):
  - Assessment of past uses
  - Sampling and analysis plan
  - Soil characterization report
  - Excess soil destination assessment report
- Application for shipment of fill material
  - Shipment is only allowed upon approval of the reuse site
  - Application should include quality and quantity of soil and info required by Soil Rules as well as the BMP
  - A list of hauling records (and/or bills of lading) should be kept at the reuse site

# BMPs for Approving Soil at the Reuse Site

- Quality Control and Assurance
- Screening of incoming loads (e.g., visual, olfactory) by the responsible person
- Retaining the service of a QP is recommended
- Developing sampling plans by the QP for imported soil
  - MNRF Protocol (Table 1): Sample be collected for every 10,000 $m^3$ of fill received
  - Soil Rules (Source site): Starts with a minimum of samples for less than 600 $m^3$

# Tracking and Operational Control at Reuse Site

- A locational tracking grid should be developed for the reuse site
- Unauthorized access locations should be prevented through signage, fencing and gates
- A Responsible Person should control authorized access, screen loads and check the hauling records
- Unmanifested loads should be rejected immediately
- After approving the load, it should be led to the appropriate location based on the locational tracking grid

# Tracking and Operational Control at Reuse Site

- Maintaining records
- A daily record should be maintained for cumulative record of import, loads shipped to the reuse site, including rejected loads.
- Every entry of this record should include at a minimum:
  - Date
  - Daily total number of trucks entering the site
  - Daily total number of trucks accepted and rejected (and the reason(s) for rejection)
  - For each source site the following information should be recorded:
    - ID number for each hauling record received on that date
    - Cumulative volume of fill received
    - Location fill was placed on the locational tracking grid
- Records should be retained by the project leader for seven years as prescribed by Section 28 of O. Reg. 406/19.

# Discovery of Non-Conformant Material

- Notifying the MNRF or the governing municipality (for unlicenced sites) in writing
- Locating non-conformant material using the site log and locational tracking grid and stockpiling it for removal
- Keeping a record of the actions taken as well as any applicable documentation
- Providing a copy of supporting documentation to the governing municipality (for unlicenced sites) or the MNRF.

# Non-Chemical Contaminants (Biological Contaminants)

- E. coli and other forms of coliform bacteria
- Proper site control measures (e.g. installing fence and gate)
- The source sites that have an increased risk of bacterial contaminants: farms, feedlots, rural areas with a history of livestock farming, sewage sludge (biosolids), and areas in the vicinity of sewer systems such as sewer pipes or septic tanks
- In areas with potable groundwater conditions, the soil should be screened for biological contaminants (e.g., soils containing biosolids) during the visual inspection

# Invasive Species

- Some invasive species in Ontario are:
  - European fire ants,
  - Russian olive,
  - Phragmites,
  - Giant hogweed
  - Garlic mustard,
  - Dog-strangling vine,
  - Certain species of nematodes

- A list of parasitic or invasive species of nematodes and plants in Ontario is given in the BMP document

# BMPs for Managing Invasive Species

- Soils with a history of invasive species, should be either avoided or sampled when imported.
- Sampling for nematodes in sites on agricultural land should be performed according to Ontario Ministry of Agriculture, Food and Rural Affairs guidelines.
- Identify any occurrences of invasive species before beginning any expansion of the operations.
- Report the identified invasive species to the MNRF.
- An annual invasive species assessment should be conducted.

# Operational Issues: Erosion and Dust

- Keep the roadways inside and near the site free of loose material.
- Water should be regularly applied to unpaved roads as a dust suppressant.
- Outgoing trucks should pass through mud mats or a tire wash
- Paved roads should be washed during summer
- Limiting the height from which material is dropped and limiting operation when conditions are unfavourable (e.g., high winds).
- Planting vegetation or placing mulch on topsoil stockpiles or slopes
- In windy areas, stockpiles of production material should be kept small to reduce the risk of wind erosion

# Operational Issues: Groundwater Turbidity and Flow

- Natural groundwater flow should not be disturbed:
  - Excavating or backfilling below the water table during seasonal low elevations (summer).
  - Backfilling with free-draining granular material before the peak water table season.
- For turbidity check if:
- There have been previous turbidity issues during the extraction phase.
- The pit or quarry is in a highly permeable material that cannot attenuate the turbidity
- The pit or quarry is a legacy pit or quarry, and the hydrogeology of the site and surroundings is poorly characterized.

# Operational Issues: Noise and Vibration

- Comply with local noise bylaws (For unlicenced sites)
- Limit work on weekends and evenings in an area with residential receptors
- Choose the quietest set of equipment
- Modification of equipment: e.g., standard engine exhaust mufflers can be replaced with more powerful models that offer additional silencing
- Skilled and well-trained drivers and operators who operate equipment to limit the generation of noise (e.g., by reducing tailgate slamming) can help.
- Roads leading to the site should be paved, regularly monitored and maintained
- Truck speed should be minimized when approaching the site

# BMPs for Community Consultation and Engagement

- Community consultation and engagement is especially important for legacy pits and quarries.
- Indigenous communities must be considered
- Some methods for community engagement include:
  - Door-to-door notices
  - Community consultation meetings
  - Engaging local Business Improvement Areas (BIAs)
  - Municipal council
  - Social media
  - Websites
  - Hotlines
  - Meetings at physical offices

# BMPs for Climate Change Mitigation

- Minimize generated excess soils at the source site by design and planning,
- The most climate-positive reuse is reusing the soil on the source site,
- Identify reuse sites that reduce the distance the soil travels,
- Choose routes and transport times of day that are the shortest
- Takes traffic and idling times into consideration,
- Control operational efficiency of the equipment on-site to reduce idle time, Revisit supply chain, and promote the use of local material and firms

# Thank you