Developing a Watershed Approach to Reclaiming Oil Sands Mine Sites

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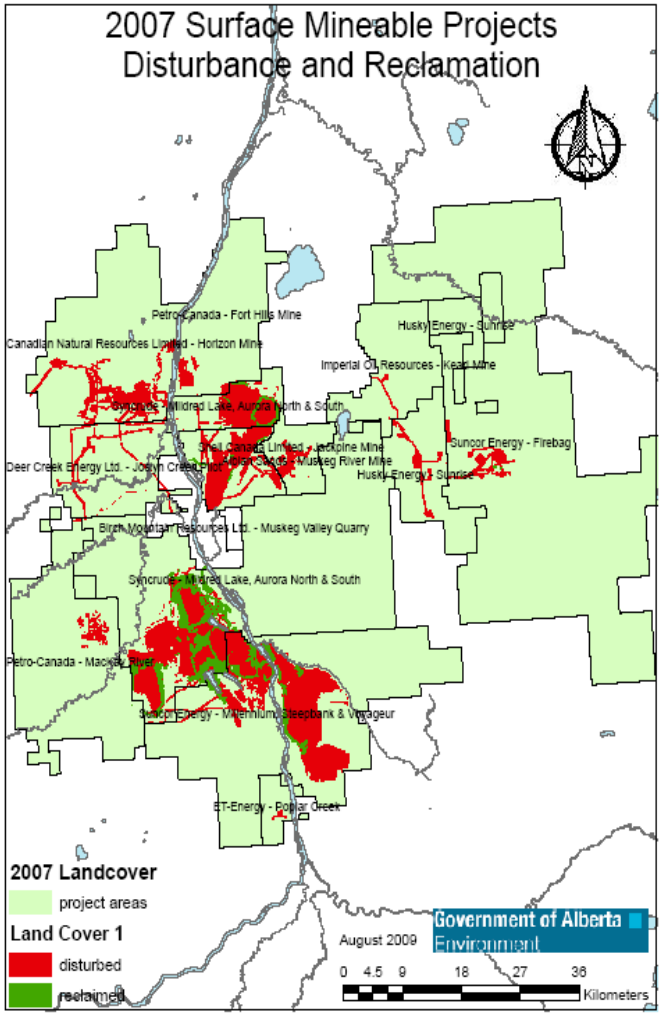
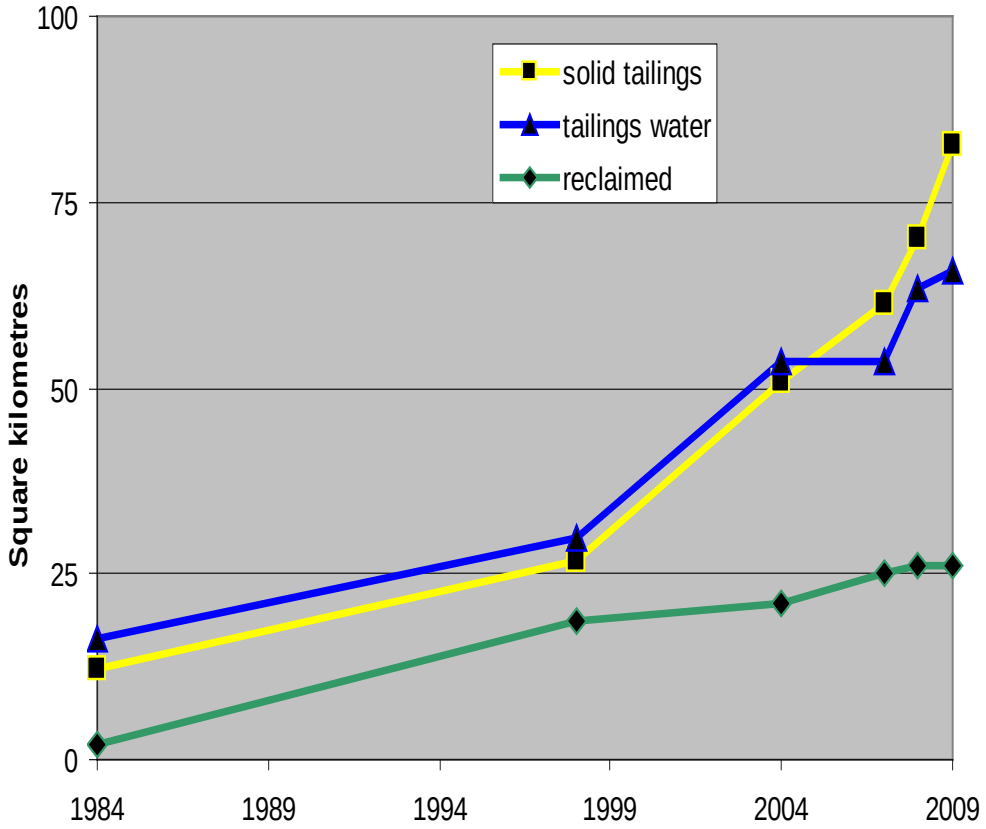
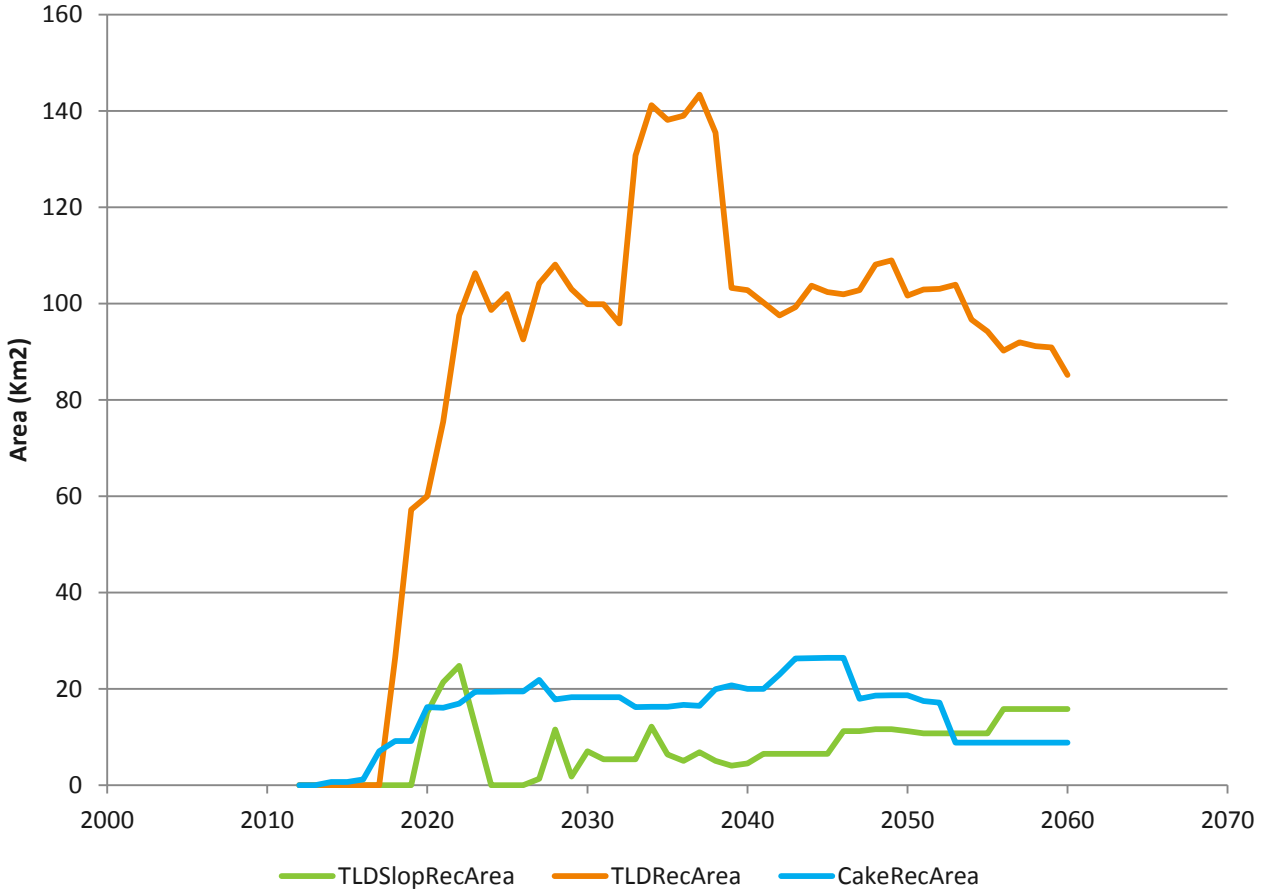
Issue 1: Space



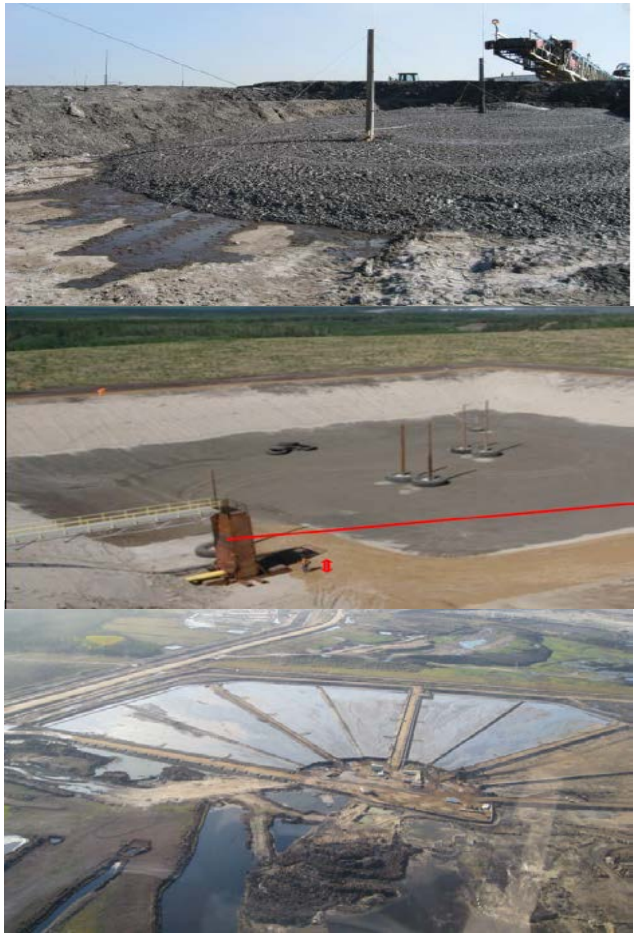


Area of treatment is additional

- Treating tailings takes time and space (E&P assumptions, 5 yr rotation)



Issue 2: Method cost & reliability



Brute force, chemical assist

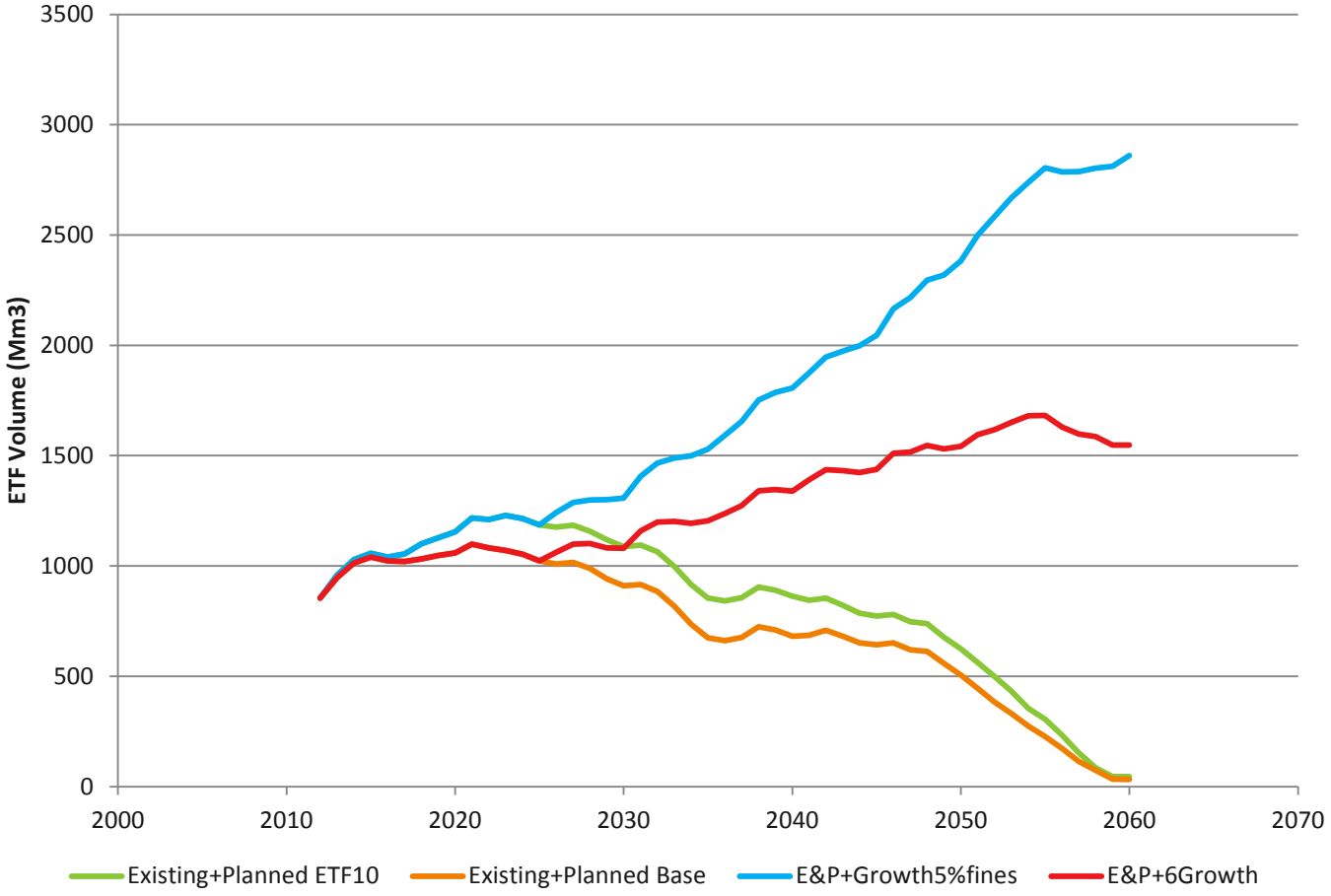
Deep deposit, chemical assist

Shallow deposit, chemical assist

- FFT(vol) = Legacy + New Production – ∑Treatment options

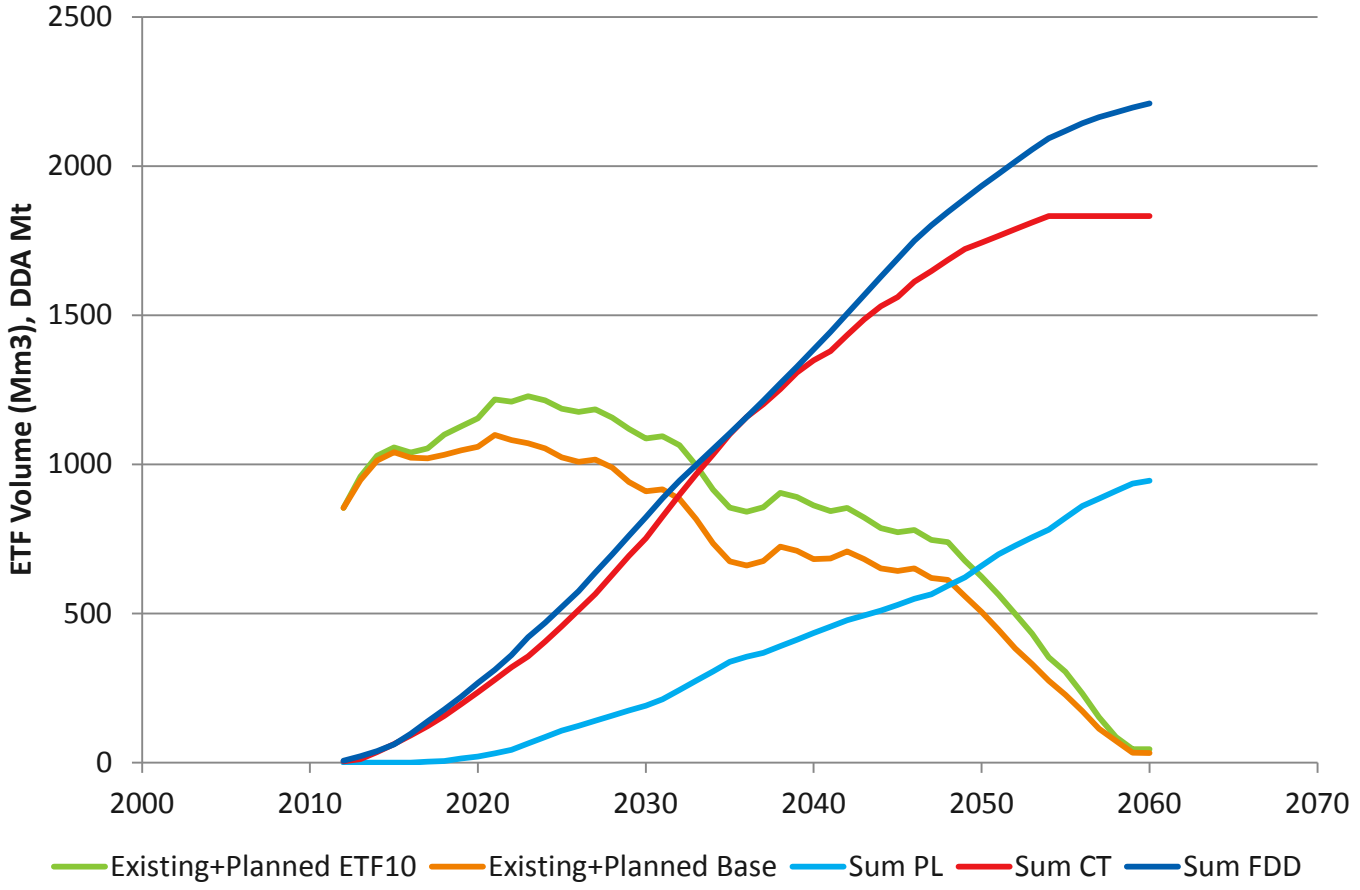
Growth & Uncertainty

- What does growth look like and the impact of high fines



Projected material to be reclaimed

- Strategies to turn “ready for reclamation” tailings material into watersheds not yet developed



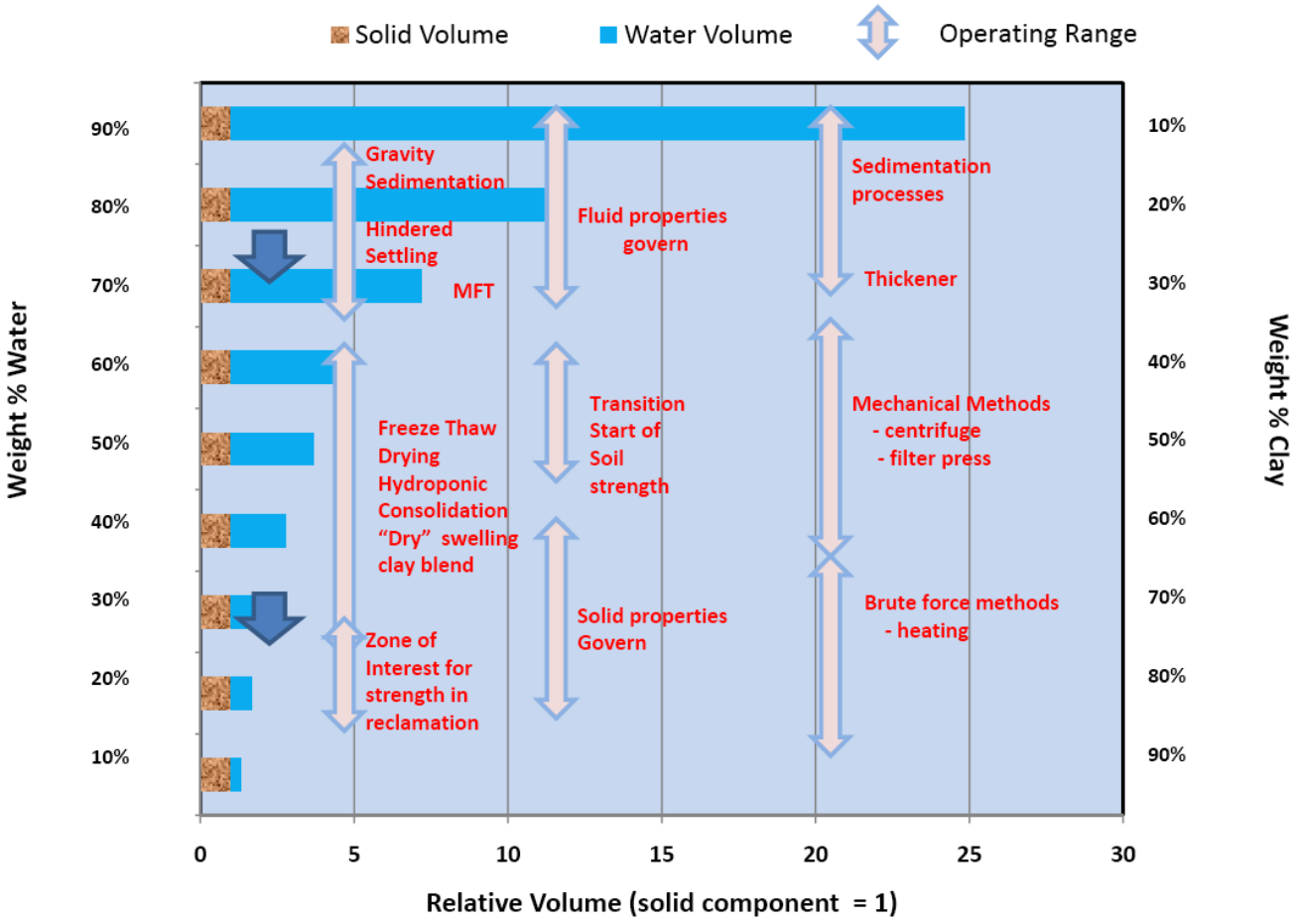
Issue 3: Water – Too much, not enough

- Water management is one of the most important yet poorly addressed problems
- Technical ability to manage water quantity and quality issues are available
- Public perceptions is not consistent with available solutions and with peoples energy use

Water in tailings

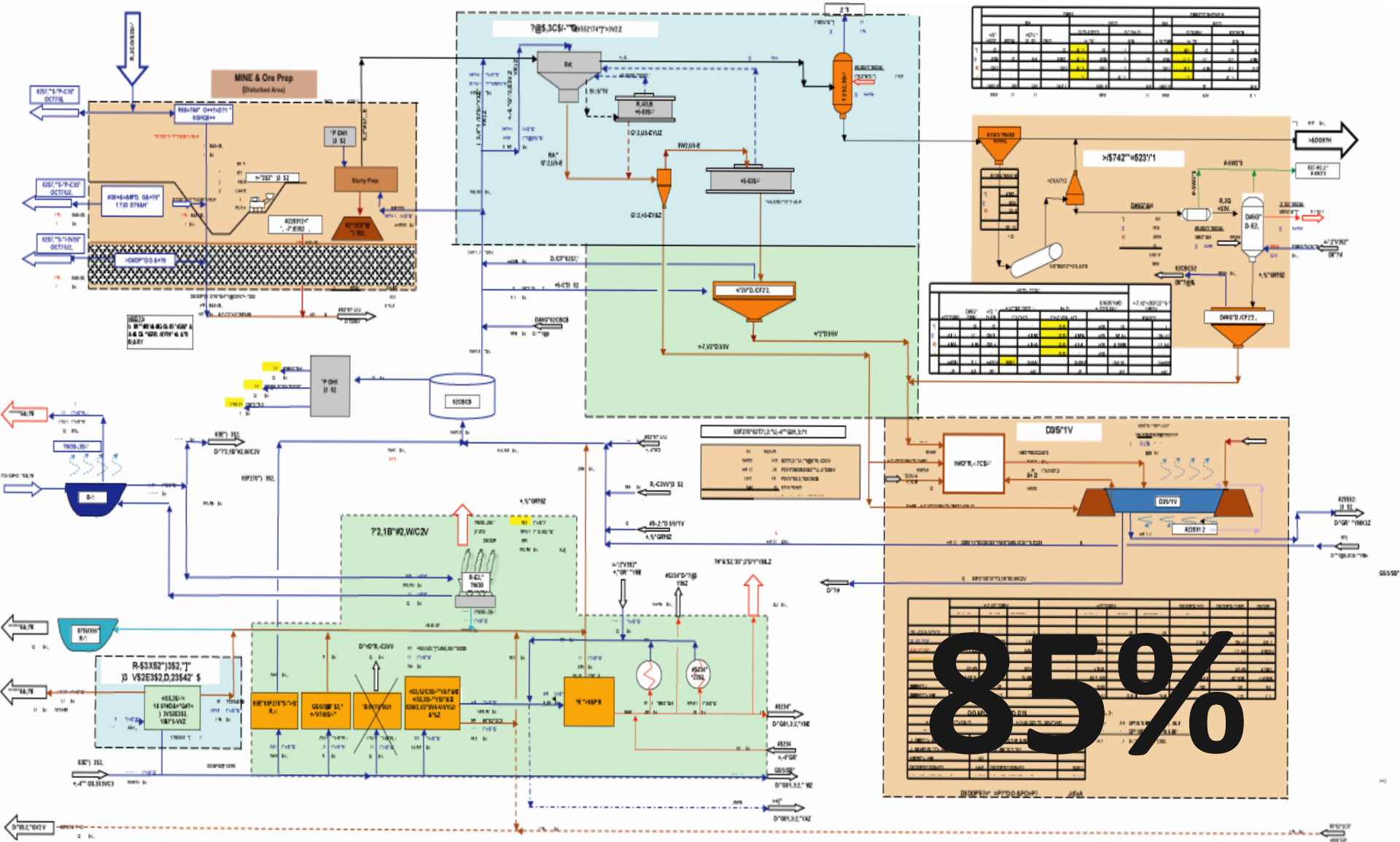
Water volumes are massive

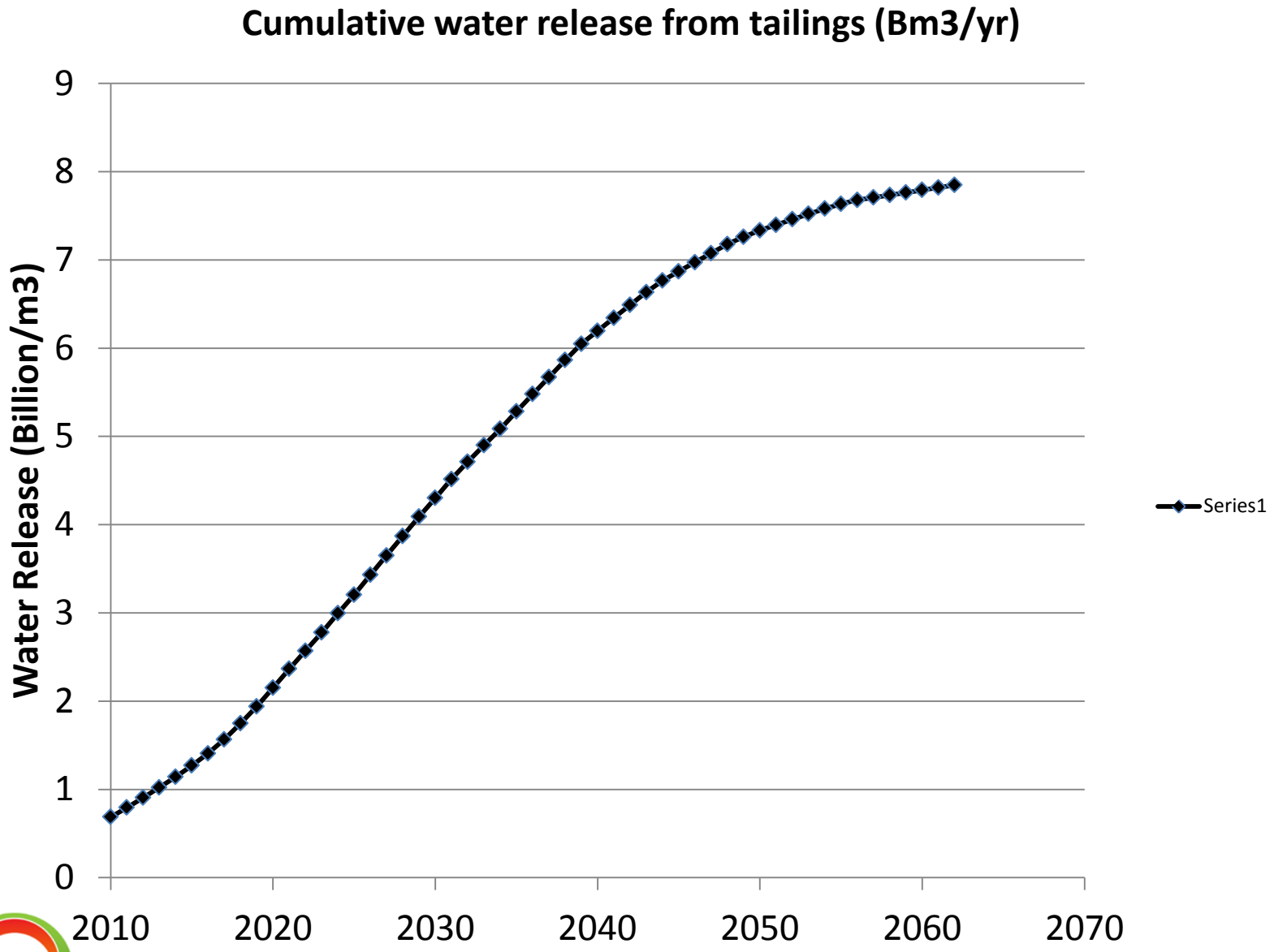
Figure 6.8 Relative volumes of mineral solid and water in MFT



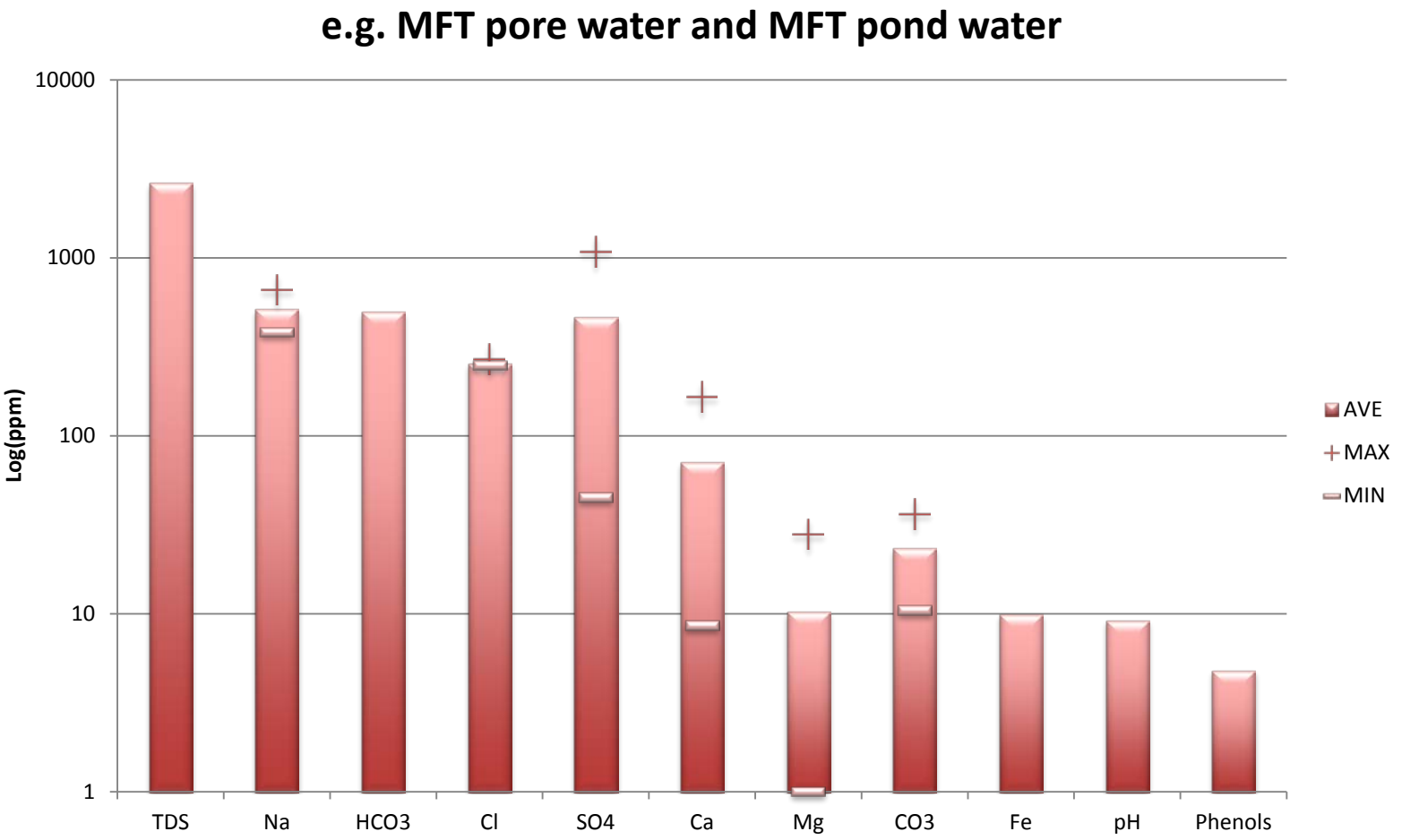
Source: Devenny 2009

Mine Tailings Example




Cumulative water release from tailings (Bm3/yr)
Water Release (Billion/m3)
0
1
2
3
4
5
6
7
8
9
2010
2020
2030
2040
2050
2060
2070
Series1

Tailings Water Chemistry

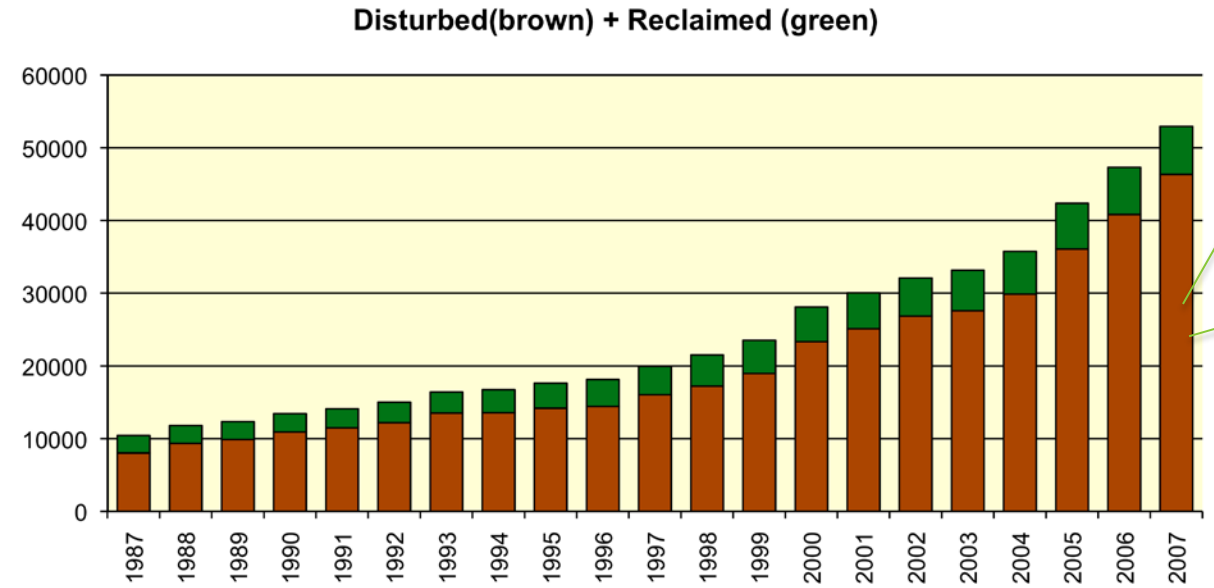


Issue 4: Building watersheds from mine waste

Source: Syncrude via Alberta Government

Mine Objectives

- Disturbed areas are returned to boreal forest ecosystems as expeditiously as possible.
  - Models and management systems are in place to track progress and ensure success.
  - The best available knowledge informs regulatory decisions



Need to understand the proportion that is on track to reclaimed

These watersheds will contribute ~15-20 m3/s to the Athabasca River. What will the chemistry be?

Key policies at criteria defining stages

Reclamation & LARP

- Landform design validation/ criteria
- Soil criteria e.g. est. of fungi and nutrient status
- Vegetation trajectories, equivalent capability
- Hydrologic sustainability

Tailings Management Framework

- Water quality of runoff
- Criteria for pit lakes & streams
- Use of wetland features

Water Management Framework

- Contaminant load
- Contaminant fate, risk and toxicity
- Criteria for approving a watershed as reclaimed

Progressive Reclamation critical to adaptive management

- Predictions for important ecosystem function are available and used as milestones for establishing incremental successes
  - Landform Design
  - Hydrology (rooting zone and source areas)
  - Vegetation and soil processes
  - Chemical export
  - Success of key biota

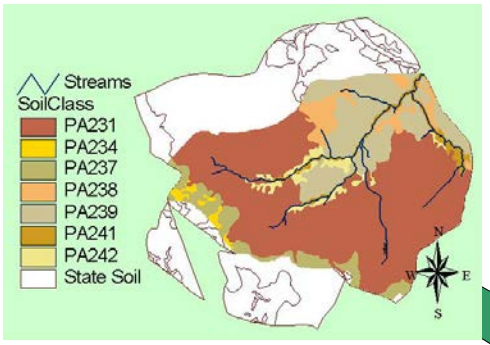
Regional Contaminant Issues

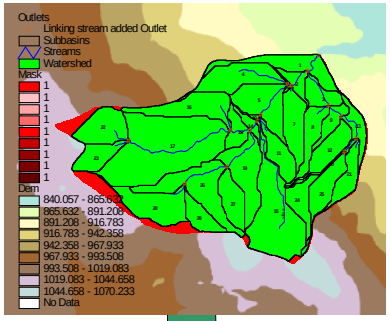
- Establish the load, transport and fate of contaminants from natural erosion of oil sands
- Predict loading from future reclaimed watersheds and evaluate potential for and risk of exceedances of water quality objectives given projected reclamation activities.
- Determine the ABILITY to receive additional contribution from licensed, accidental and future potential industrial discharges in the mine region
- Develop a risk-based assessment of contaminant fate in the oil sands region

$SWAT_{BF}$ - Data Requirements

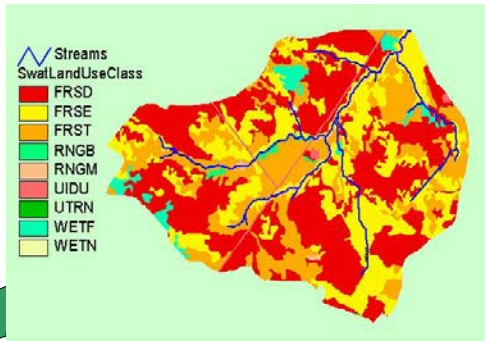
DEM and stream network

soils data





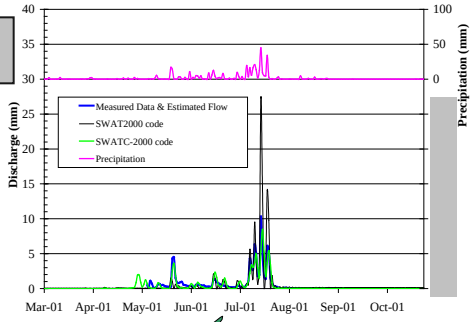
vegetation data



met. data

Spatial Processing

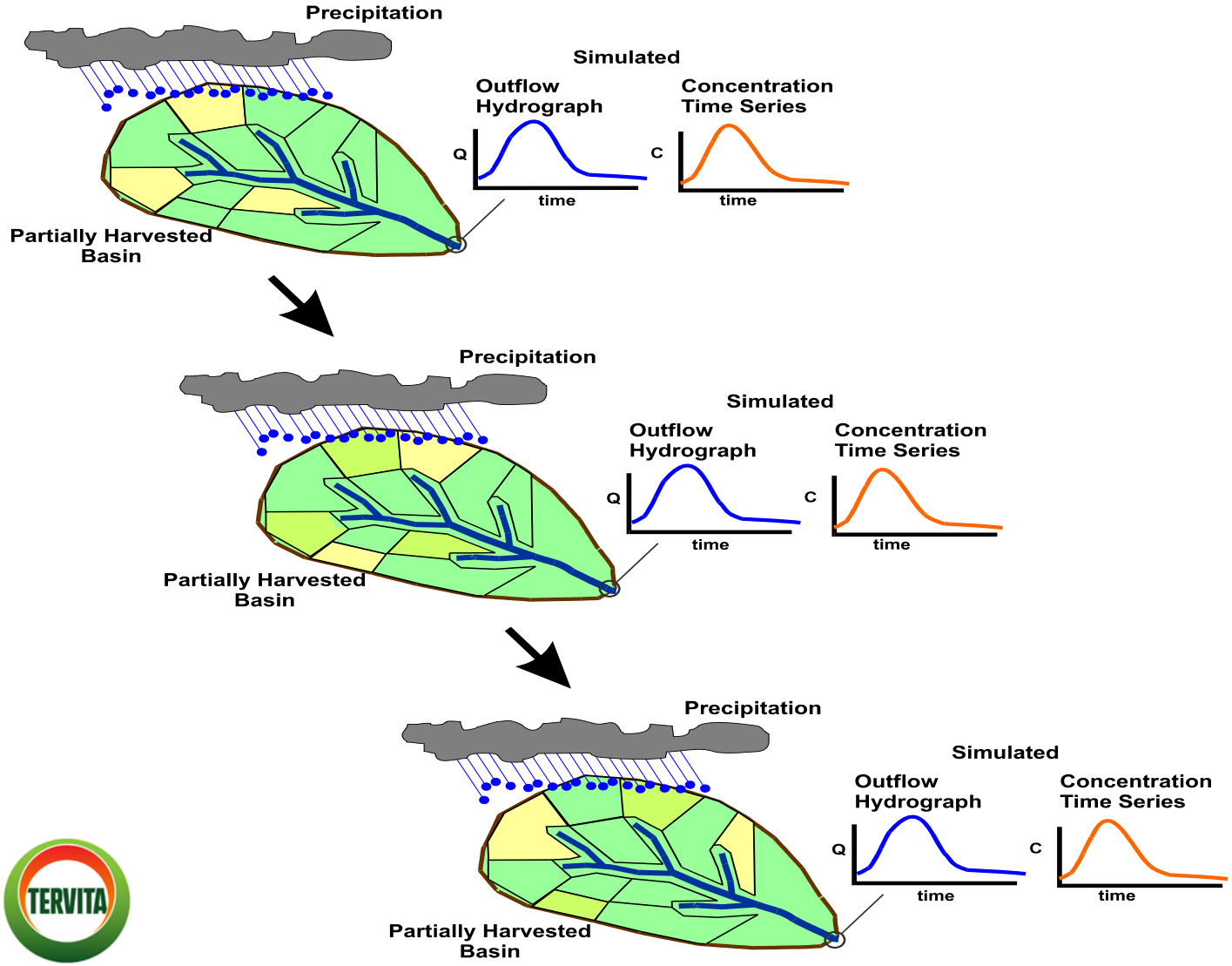
predicted hydrograph



$SWAT_{BF}$ hydrological simulation

TERVITA

Working with proven models in Alberta, changing for mine reclamation use



Tools required to achieve sustainable landscapes

- Watershed export model
  - For prediction of impacts to surface waters, design of mitigation (approval of wetland and pit lake designs and water licenses for capping/ dilution)
- Simplified forest/ vegetation growth model
  - For impact to hydrology and basin export
  - Applicable to incremental validation of progressive reclamation predictions
- Soil and vegetation models including wetlands
  - Reclaimed soils influence on water export and forest/ vegetation growth
  - Vegetation succession / community development following reclamation
  - Wetland component a mixed reactor for transformation based on retention and wetland type
- Biological indicators (ecosystem end point)

Watershed approach as a CEM tool

- Regulator: Tools that can be used to:
  - Predict outcomes, conduct scenario evaluation, optimize development vs reclamation strategies
  - Establish effective criteria for performance tracking (drive outcomes based approach)
  - Report to public, reduce uncertainty in achieving outcomes
- Industry: Tools for:
  - Planning most effective reclamation strategies and site closure design (multi-billion dollar decisions, e.g. pit lakes)
  - Reduce liability, provide greater financial security, free-up capital for investment
  - Better stakeholder relations