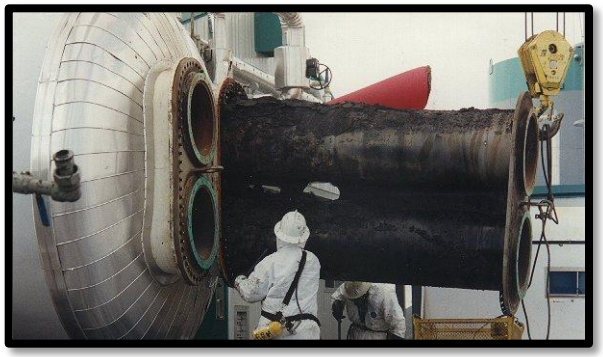
Soil or water?
Resource or waste?

Bridging Dichotomous Approaches to Manage Oil Sands Waste and Reclaim Landscapes

Dr. Preston McEachern
Director, Research and Development
Tervita Corporation

Tervita Manages Waste

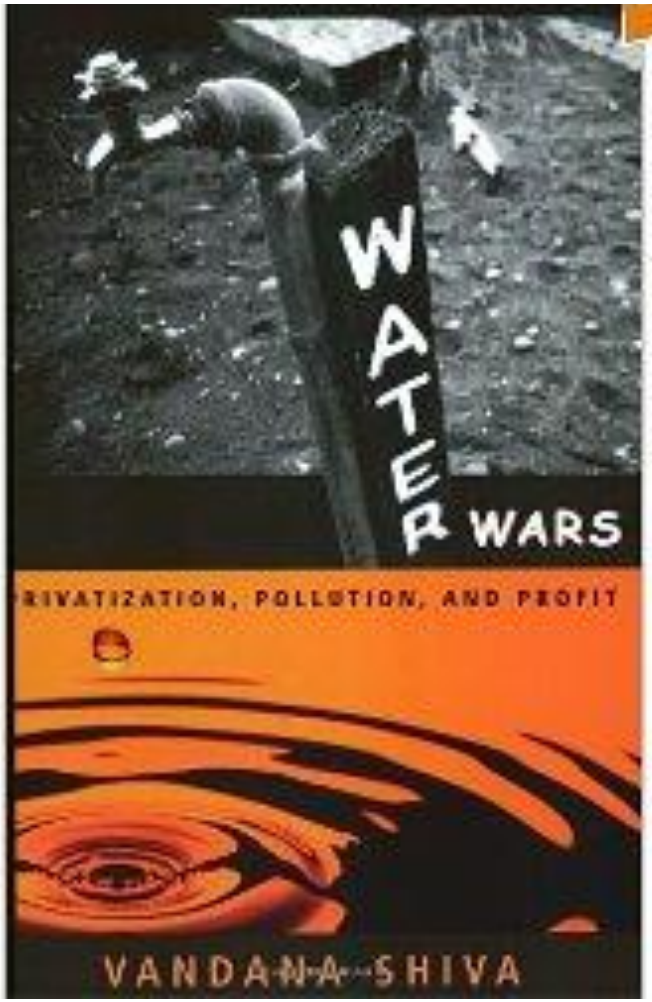


Tervita Facilities

Water - Energy

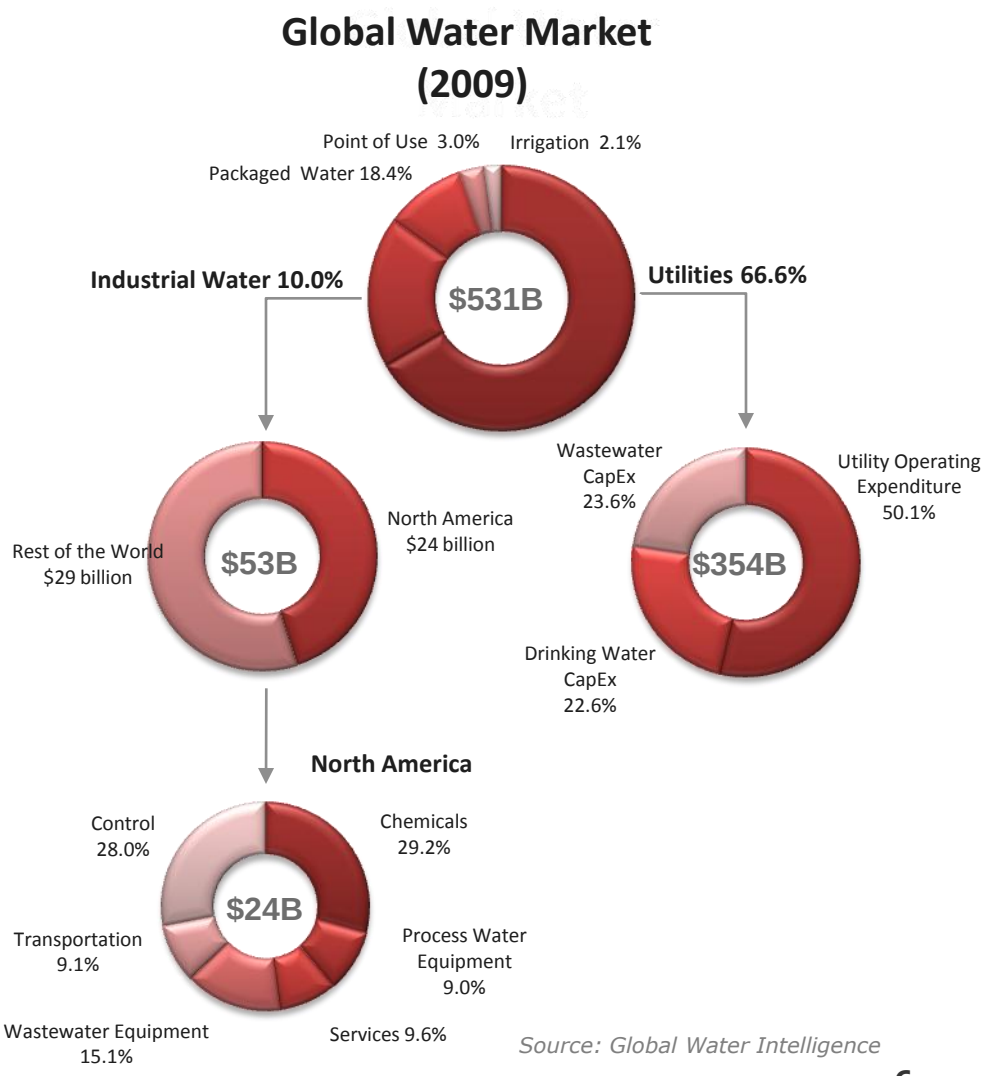
- Water is the universal solvent
- Essential to life, industry, economy. USEPA main focus
- Water management is one of the most important yet poorly addressed problems
- Technical ability to manage water is available
- Public perceptions is not consistent with available solutions and with energy reliance

Water Perspectives



Global Water Market

- Large global industry
- Protection of water resources and sustainable use is a major public concern
- Water is critical to the continued development of unconventional resources
- Unconventional resources are key to North American energy security
- Produced water expected to grow 32% by 2025 (Clark & Veil 2009)



Source: Global Water Intelligence

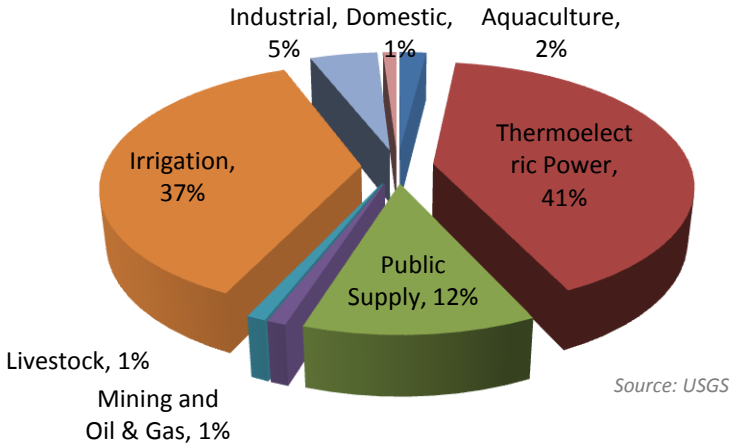
A Different Perspective on Water

- A majority of electricity is generated by thermal processes that require water.
- The US average is about 2.1 m^3 per Gj, in Canada the estimate is 20x higher.
  - A 60 W bulb consumes 11 to 24 m^3 per year
  - Electricity use consumes 100 m^3 per person/yr
  - Energy use consumes 630 m^3 per person/yr
- Water use consumes energy
  - California uses 8% of its total electricity to convey water[1]; 19% on its use cycle[2]

Water Supply & Use

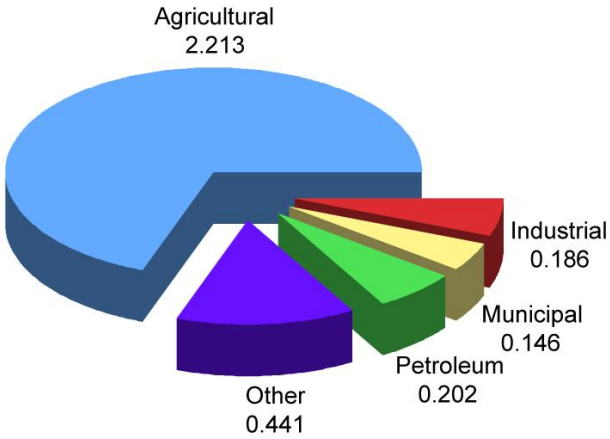
- Oil and gas sector:
  - A small user of water relative to other segments
  - A large recipient of attention and regulatory scrutiny
- Industry's water management and overall environmental performance impacts pubic perception & in turn regulatory agenda
- Regulations continue to tighten on industry & limit access
- Industry has an opportunity to show leadership through action

Percentage of Water Used by Market Segment in the U.S.



Source: USGS

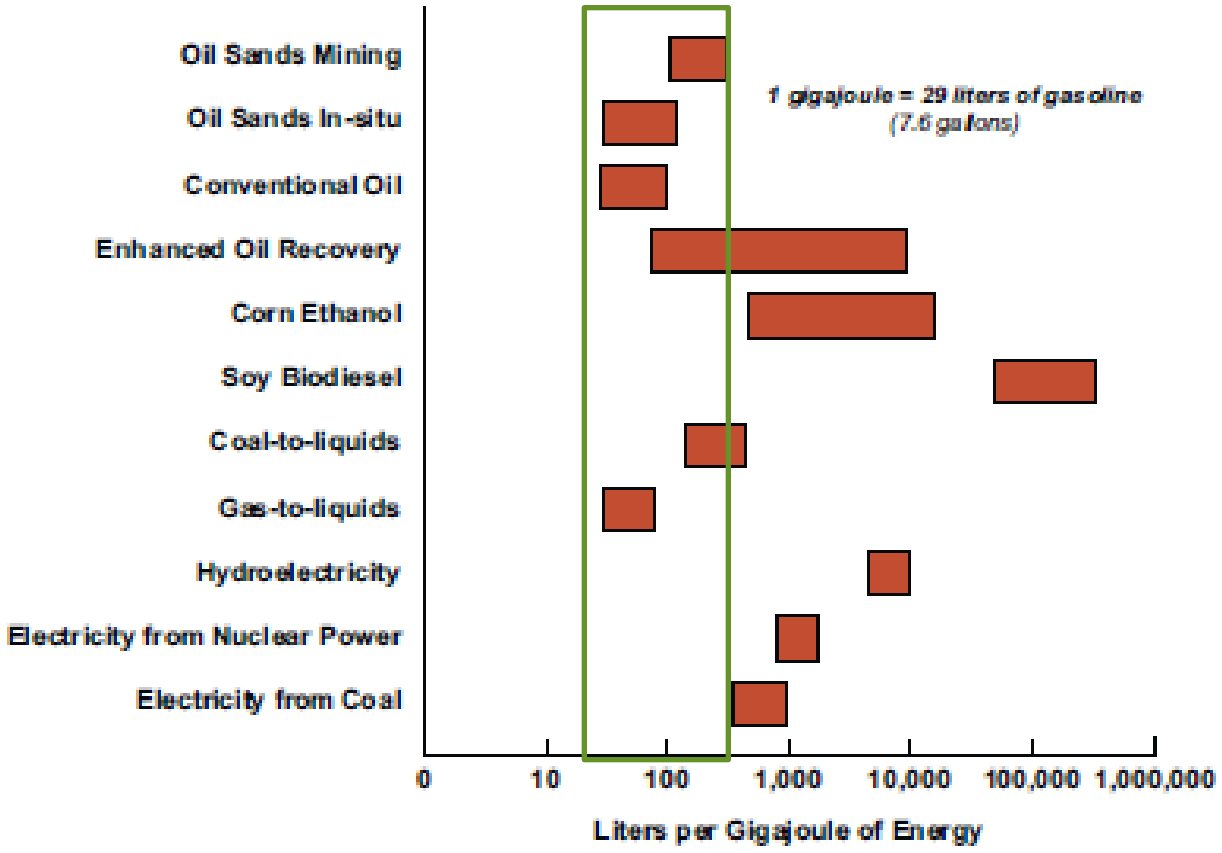
Cubic meters used in Alberta



Water Consumption & Energy

Figure III-4

Life-cycle Water Use of Various Energy Sources



Source: Cambridge Energy Research Associates, US Department of Energy.
90107-28

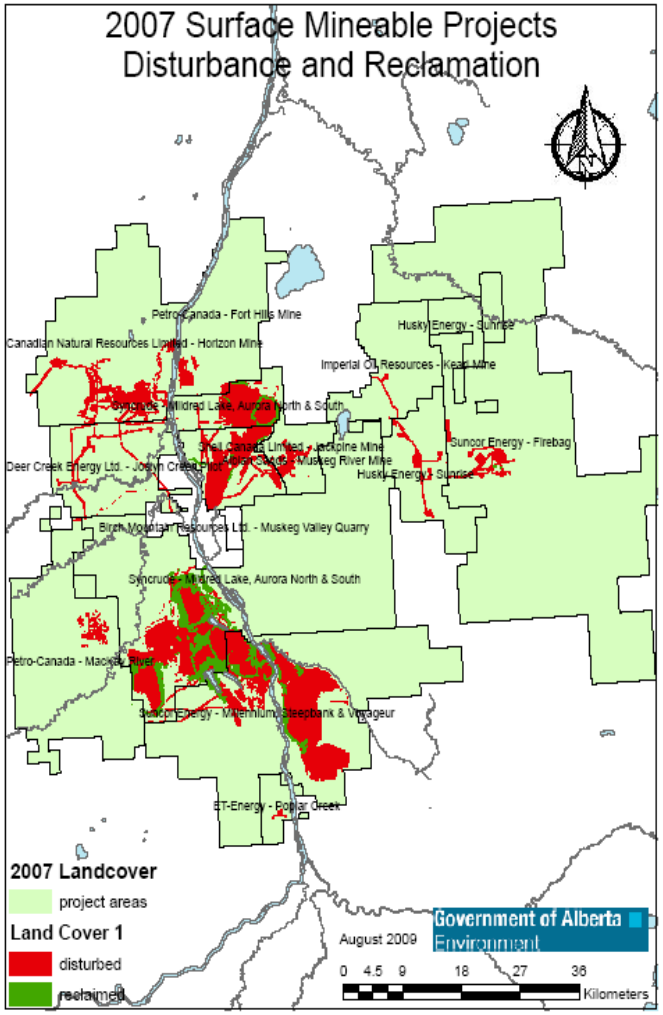
Water or Solids?

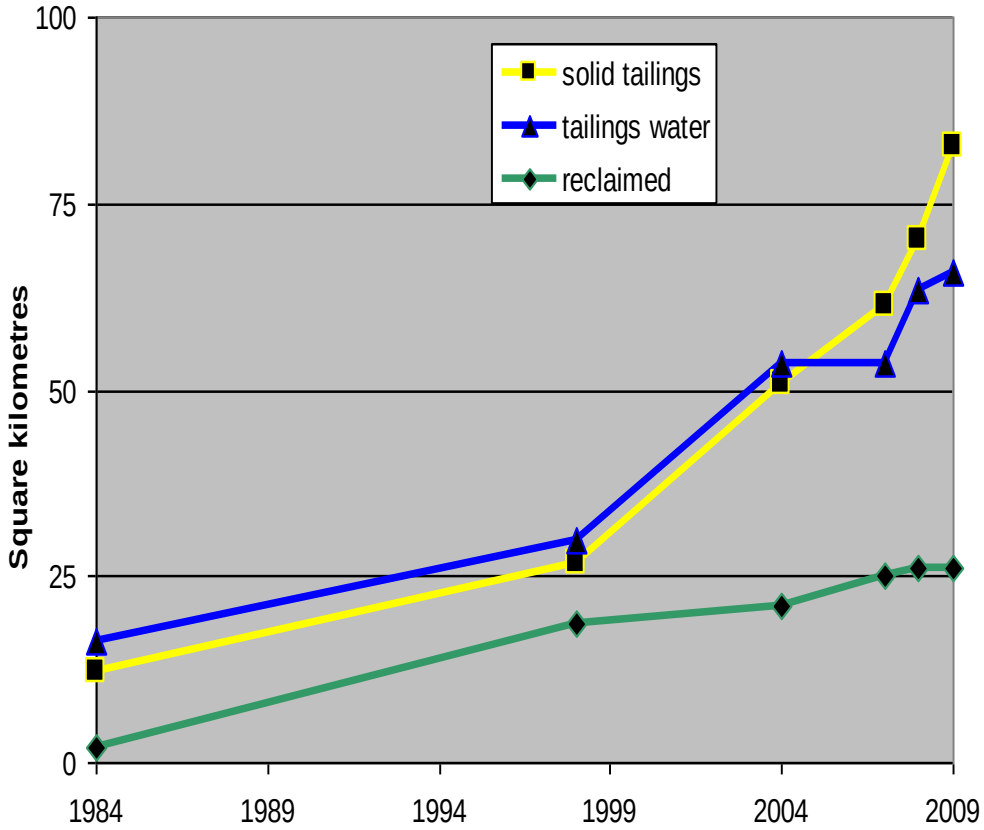
How do we turn this?

Into this?

Source: Syncrude and Alberta Government

A Space Issue

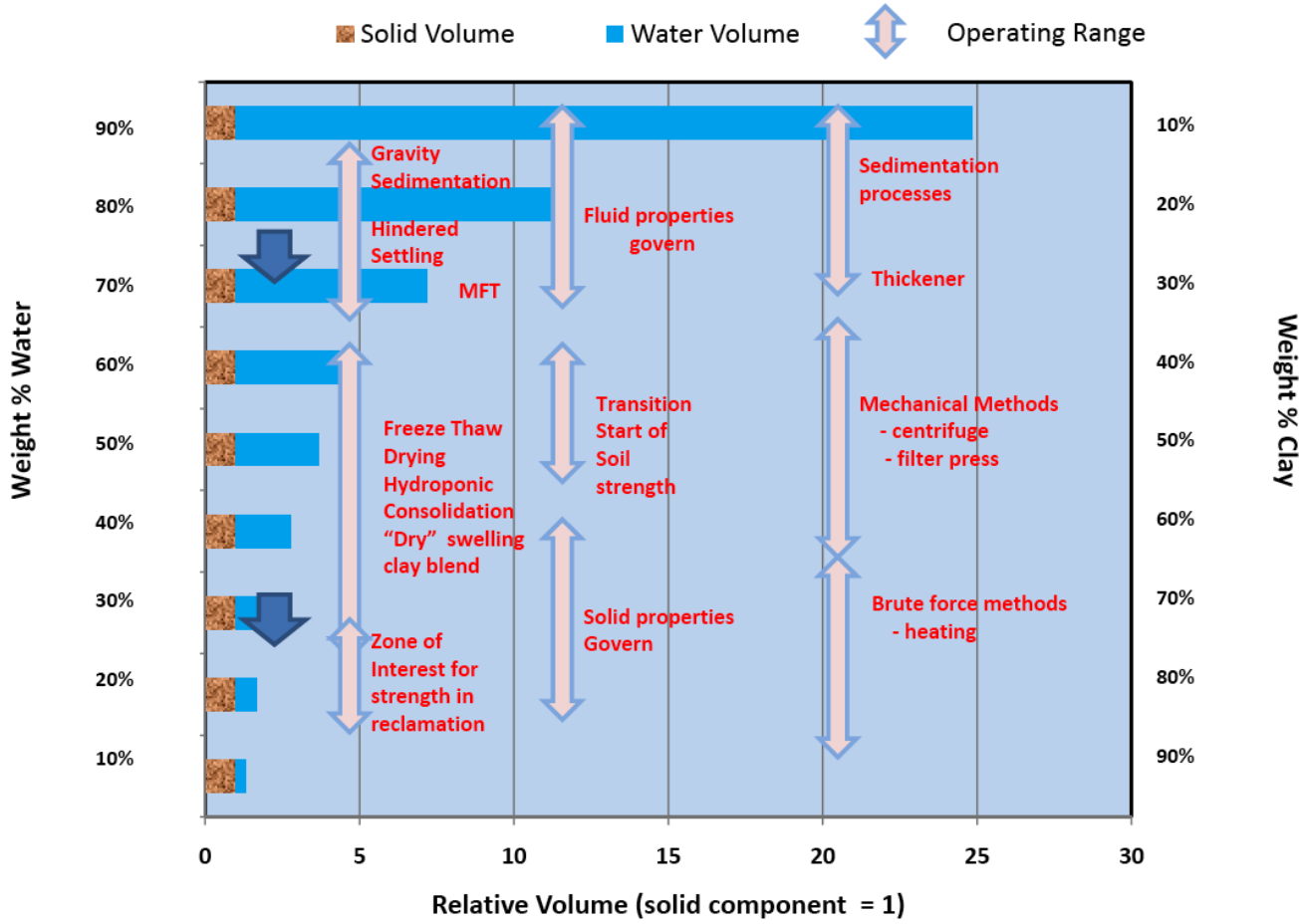




Solids Out of Water

Solids Out of Water – No Slam Dunk

Figure 6.8 Relative volumes of mineral solid and water in MFT



Source: Devenny 2009

Solids Out of Water – No Slam Dunk

$50/dry tonne?

$30/dry tonne?

$60/dry tonne?

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

Is The Recycle Concept Hurting Water Management?

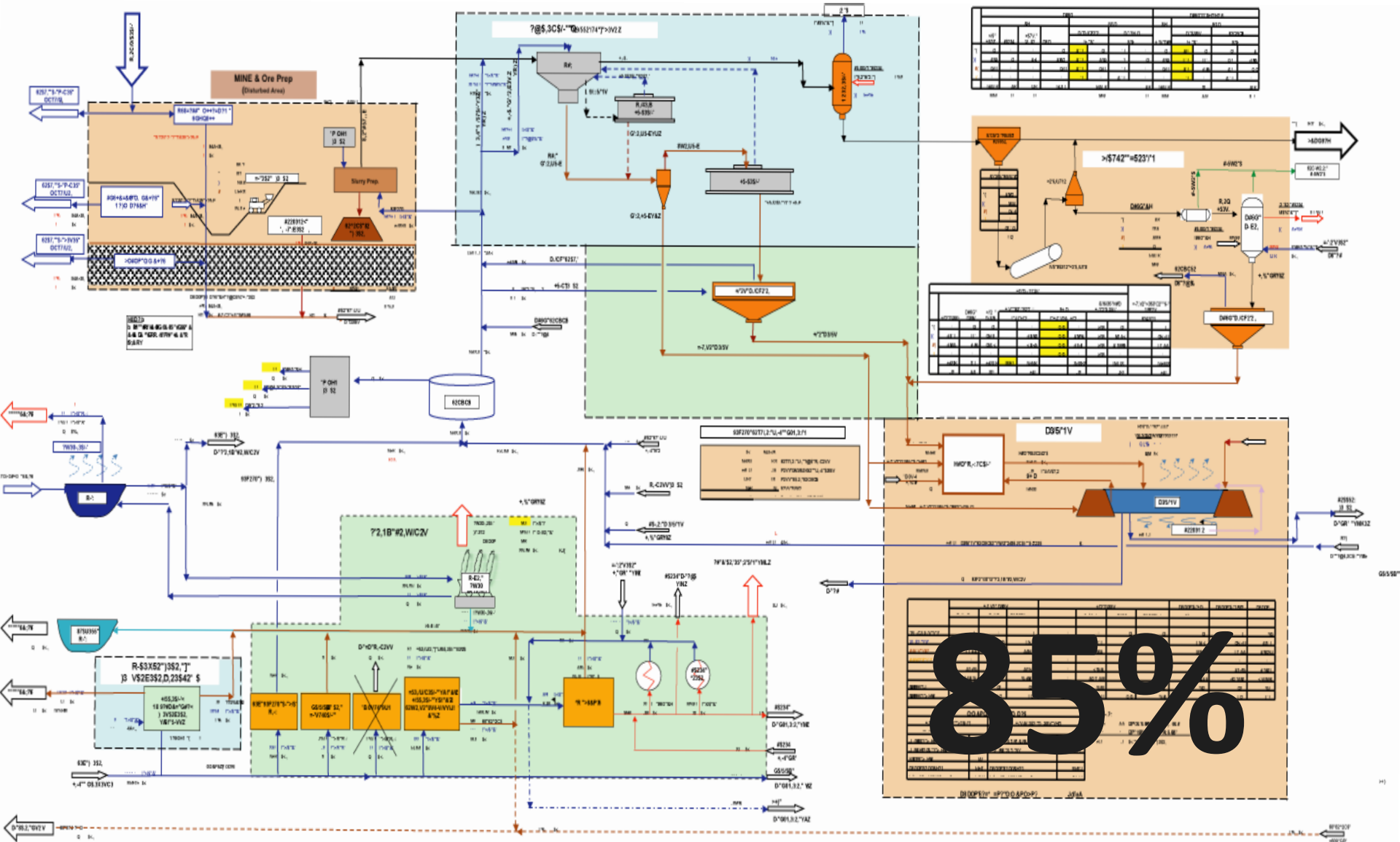
Water Efficiency Regulations

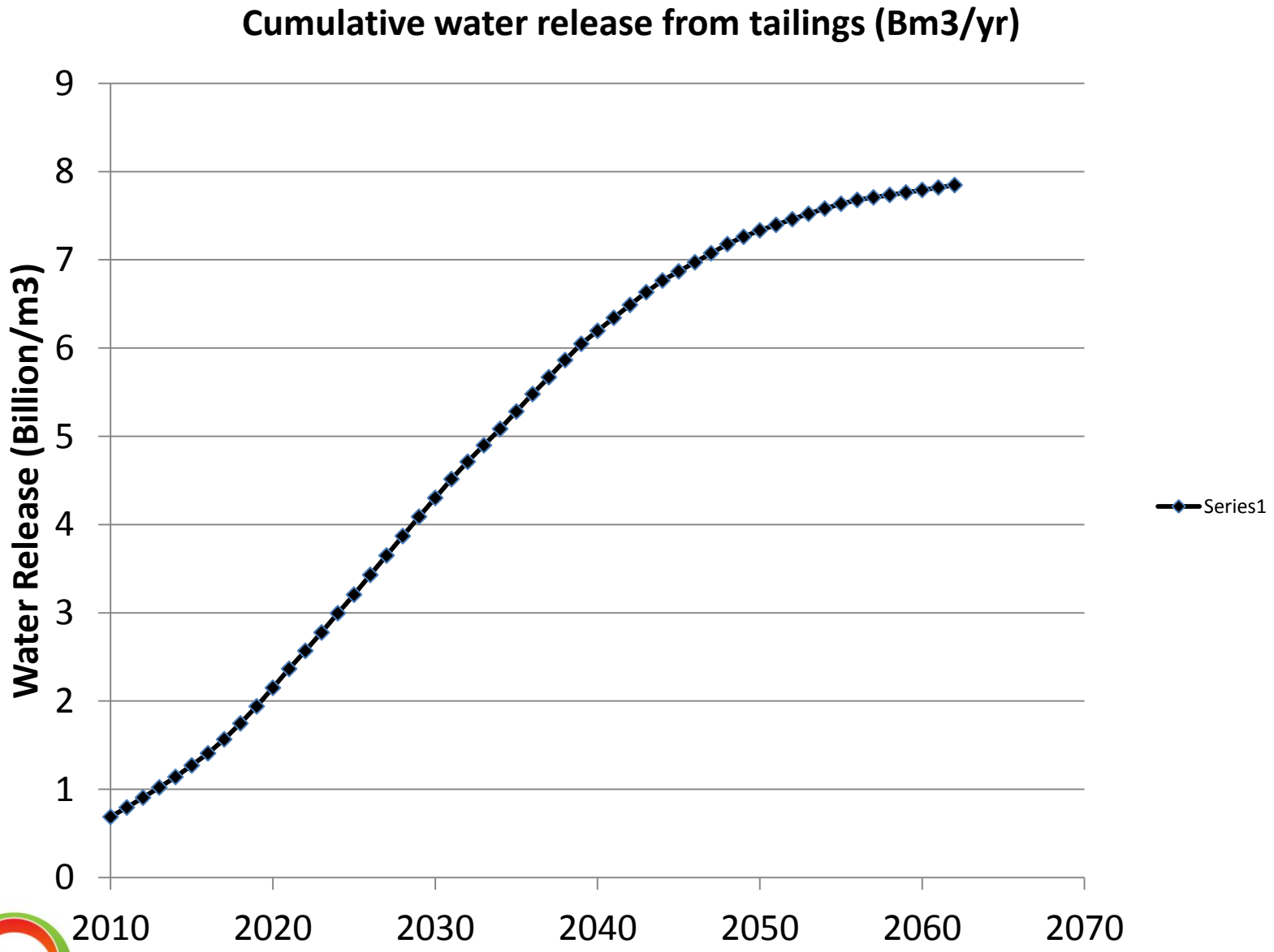
- US
  - Executive Order 13423 requires 2% reduction in use intensity per year to 2016
  - Energy Independence & Security Act requires water efficiency BMPs be implemented
  - Executive Order 13514 extends 13423 to broader water use (e.g landscaping) and reduction out to 2020
  - Application of Environmental Flow Maintenance in water licensing applications
- Canada
  - National Action Plan to Encourage Municipal Water Use Efficiency
  - Application of Environmental Flow Maintenance in water licensing applications (DFO process to evaluate HADD)
- Alberta
  - Water Act = Procedures for allocating water includes IFN (licenses), Basin restrictions (regulations) determined from a number of factors

Alberta: What is "Best use"

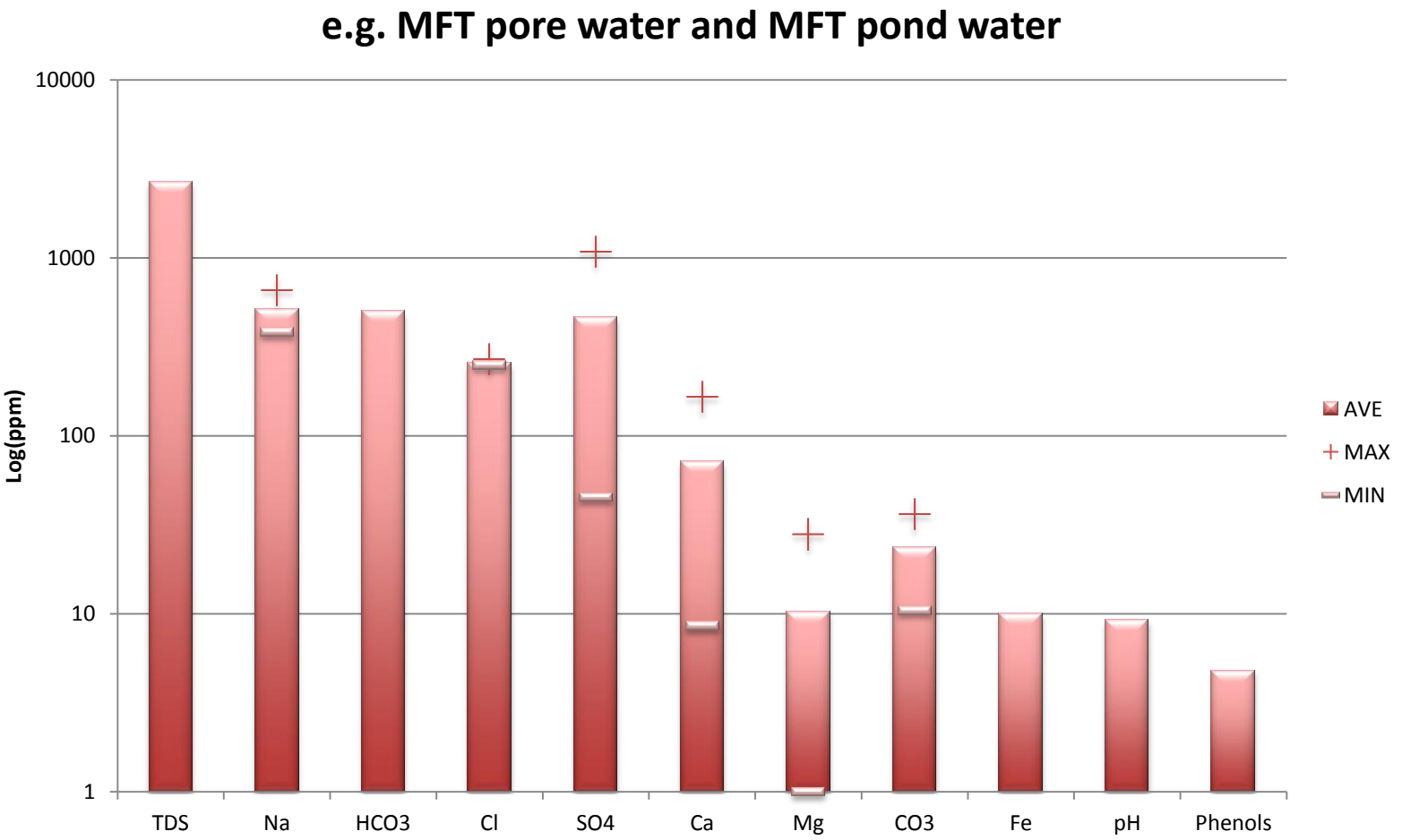
- Strong focus on recycling:
- Could this be alternative use, or
- Returning water to the hydrologic cycle?
- Alternative Use:
  - One users waste may be another users (relatively) clean water
  - OSLI is leading an initiative to examine the potential for maximizing water reuse
- Discharge in safe manner:
  - Discharge criteria for slow and managed release of non-toxic water

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



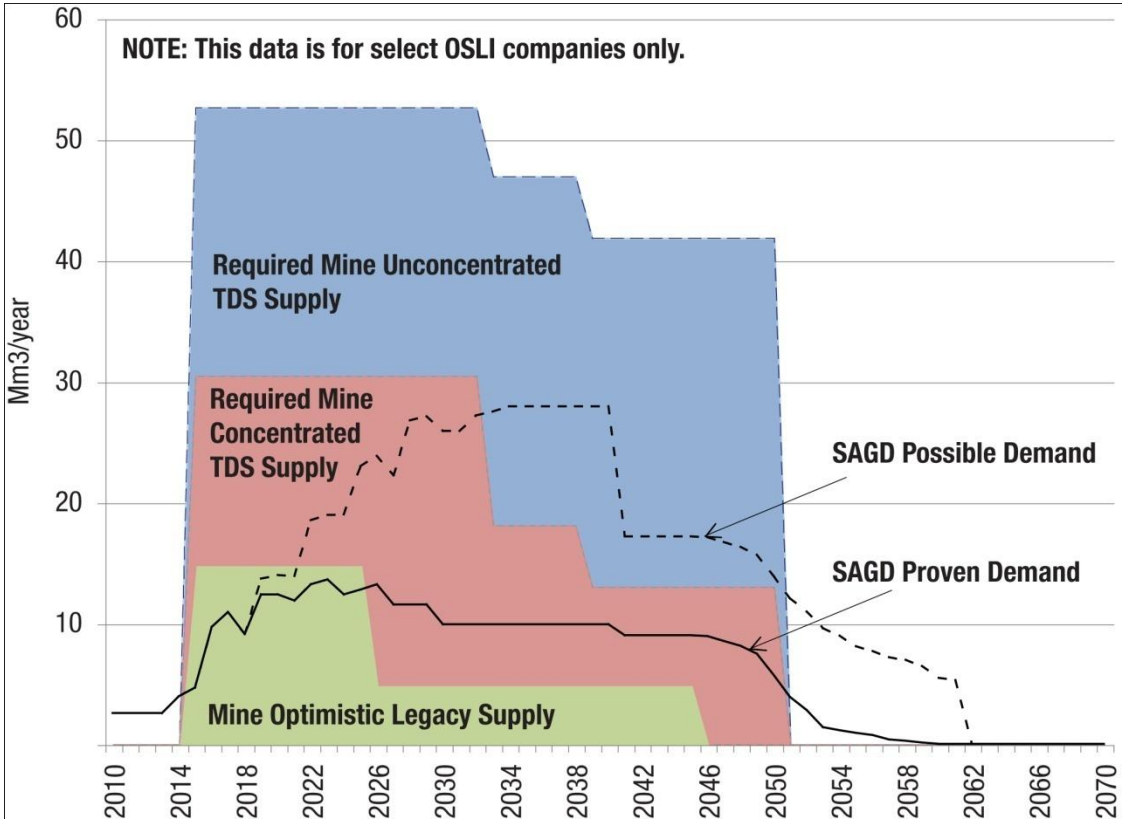
Water Will Return from Tailings

- Tailings need to be reclaimed
- 70% of volume will be released as water
- Industry needs to be committed to water treatment
- Waiting to deal with water issue has several consequences:
  - By 2025 the volume of water will have grown to 900 million m^3
  - If the Tailings Framework accomplishes its objectives there may be as much as 2.5 billion m^3 of water that needs an alternate use or a return to the environment
  - As water is recycled the concentration of solutes that are difficult to treat increases

The Water Treatment Problem

- 2.5 B m^3 water contains 0.1 to 1 B Kg each of Na, SO_4, and Cl
- To remain below the draft Athabasca Water Management Framework this water would require over 100 years of dilution, or
- The dilution scenario would require 200 to 500 km^2 of pit lakes and still require >40 years of retention time
- Cheap methods of treatment and / or disposal are required:
  - Planning reclamation features for dilution and retention in aquifers with similar chemistry
  - Treatment and disposal

Understanding Other Potential Uses



Supply Demand Curve

Source: OSLI

HYWARE System

H_2O In

Stablflote ®

Softened H_2O

Portable RO Unit (optional)

Clarifier

VRU (Vertical Reactor Unit)

Centrifuge

Centrate Re-Cycle

Dry Solids Out

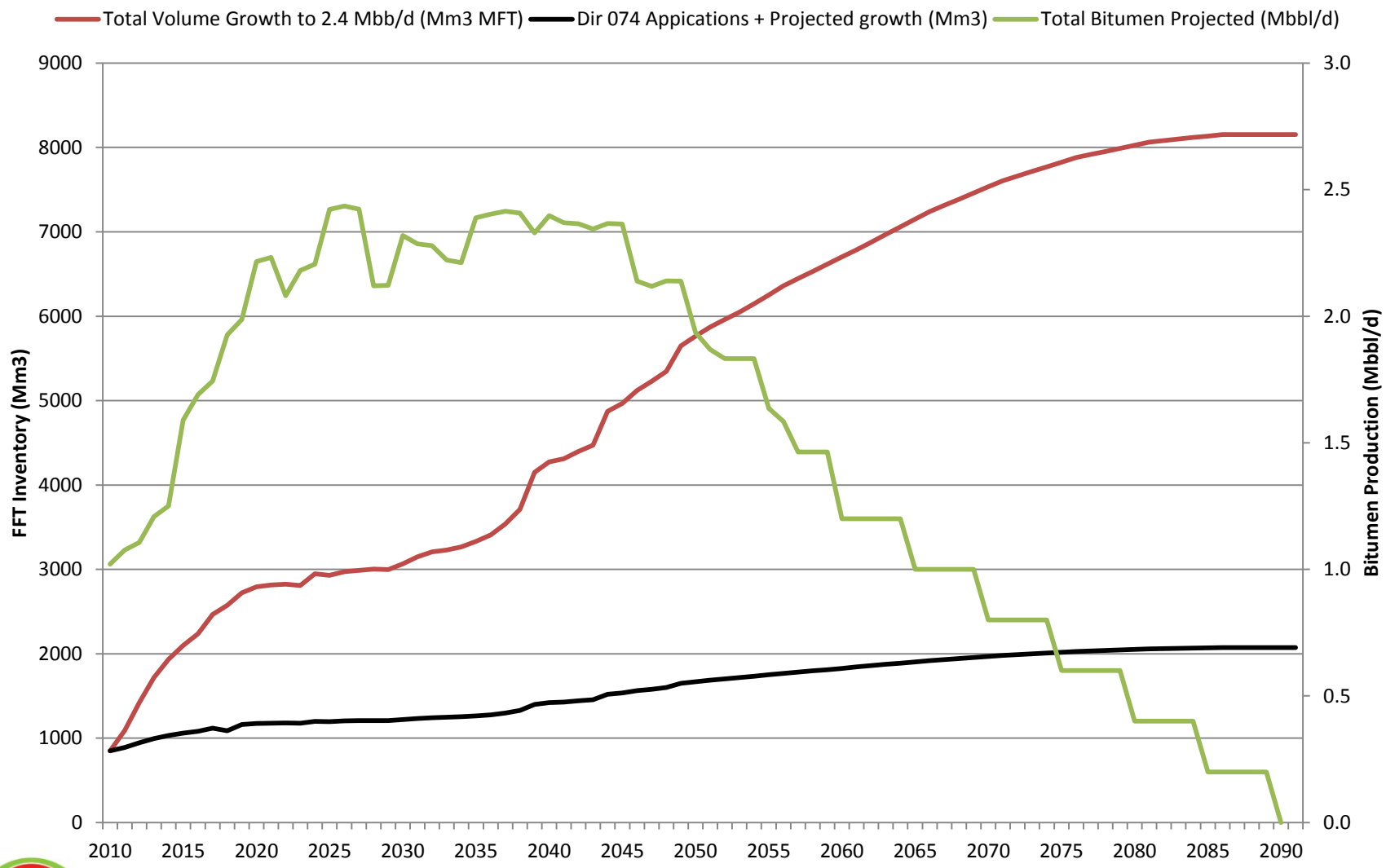
Haynesville Water

Flowback Water	Raw Water In	Product Water
Total Hardness (ppm)	10,200	40
Calcium (ppm)	3,780	16
Barium (ppm)	1,050	1
Strontium (ppm)	72	1
Magnesium (ppm)	178	ND
Iron (ppm)	93	0.3

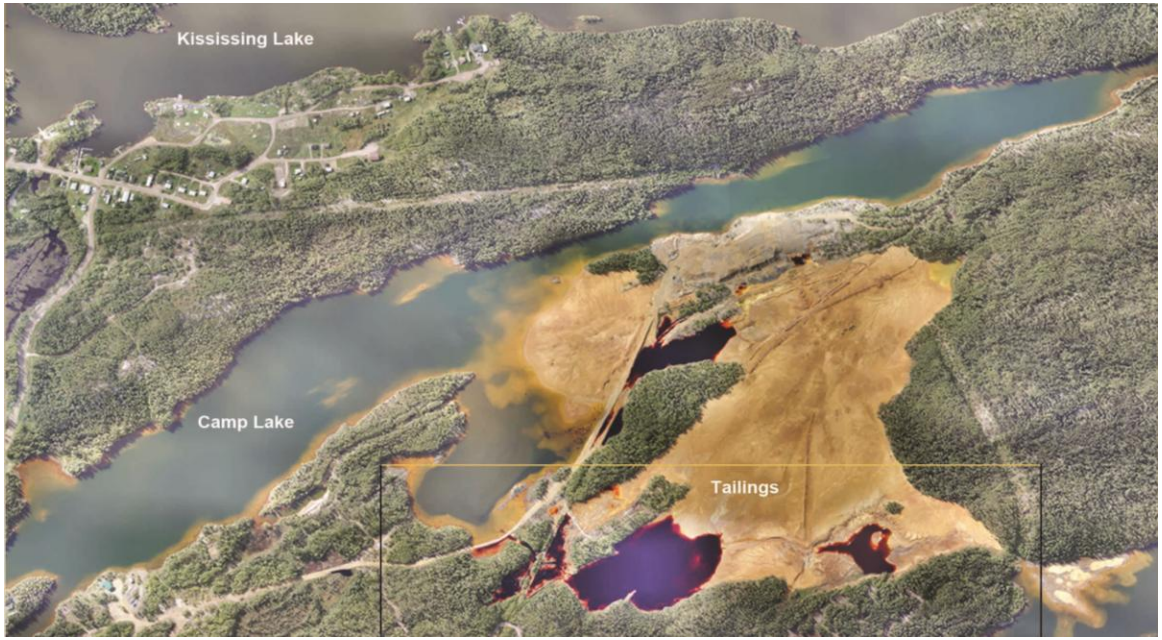
Solids Management

- Oil Sands Mine Fine Tailings Solids are > 44 µm
- About 340 Kt of fines/ day, enough to fill a city block (150 m square) 3 m deep every day
- Can be used in reclamation features

Fluid Fine Tailings Inventory and Bitumen Production



True Cost of Not Managing the Back End



- Tervita remediating Sherridon Mine
- Whole lake water treatment
- Stable hydrology
- Passive wetland treatment
- Appropriate boreal features

Intractable Problems = Expensive Solutions

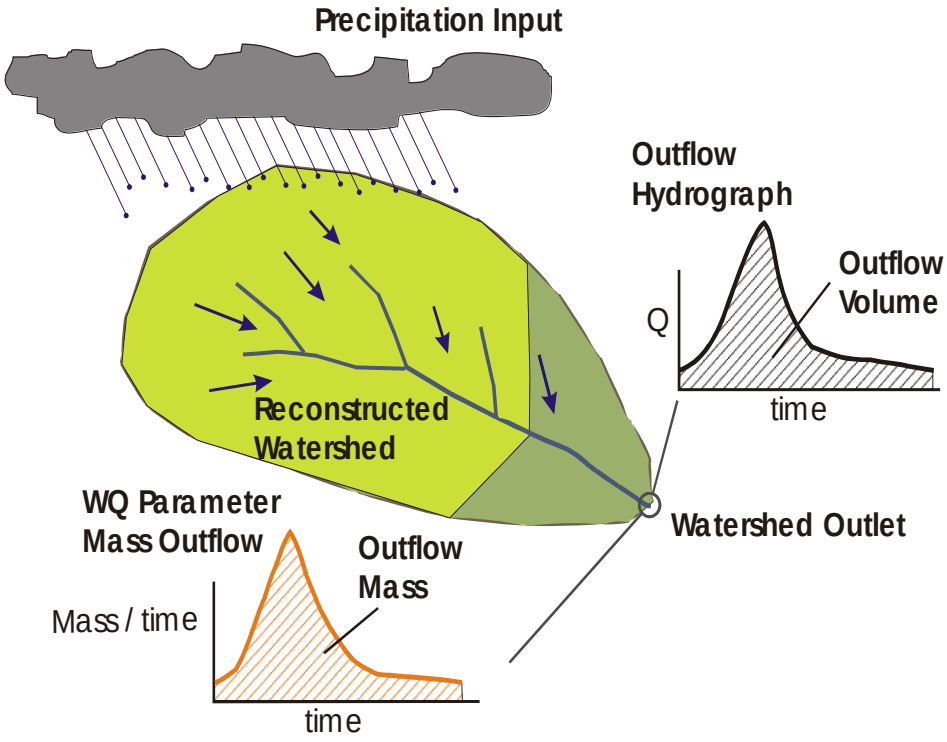
Kam Kotia

- 6 MT of tailings, water and soil treated

Putting Waste Solids to Good Use But There is More to Consider…

Source: Syncrude via Alberta Government

What Chemical Loads Are Expected?



- Sustainable? Hydrology
- Wetland treatment?

Set success criteria:

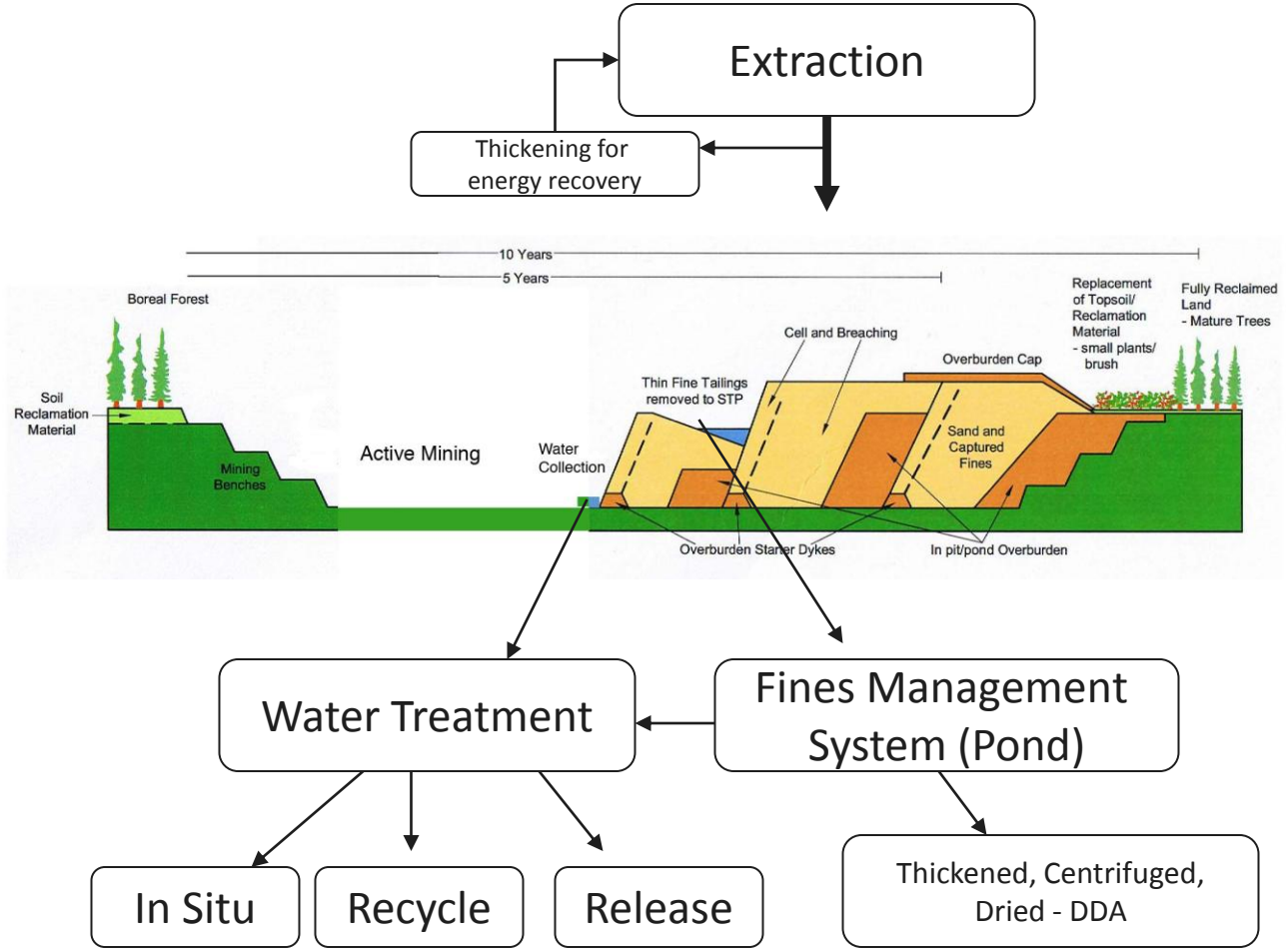
- Stream concentration
- Watershed load
- Without this there is no evaluation of cost = no planning to offset

Developing Planning Tools From A Waste Perspective

- Planning from production to reclamation
  - Material balance
  - Energy balance
  - Financial balance

- Get away from reacting to the waste we generate, manage the material balance
  - Are there opportunities in production to generate easier to treat waste?

Filling Active Pits?



Leadership In Watershed Reclamation

- Building industry best practices
- Developing knowledge systems to ensure success
  - Front to back
  - Integrated projects
- Developing experience for oilsands using past experience in mine reclamation
- Experience in reclamation using mining AND other sectors (e.g. forestry)

Conclusion

- The world view on aqueous waste needs to expand to its full energy, waste life-cycle
- Regulations that facilitate transfer of water among best uses should be examined
- Waste water and waste solids must be managed together
- Opportunities that generate more benign waste (but may reduce recycling of water) need a broader life-cycle assessment
- Passive treatment options can be promoted if well planned before the waste is generated

Questions or comments?

Dr. Preston McEachern
Director, Research and Development
Tervita Corporation
(403) 718-1266
pmceachern@tervita.com