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Wetland Reclamation in the Green Zone of Alberta

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Overview

- Physical setting
- Background
  - Wetland classes
  - Peatland vs. wetland
- Challenges
  - Geotechnical and engineering
  - Soil quality
  - Water quality and quantity
  - Plant communities
- Wetland reclamation success stories
- Conclusions

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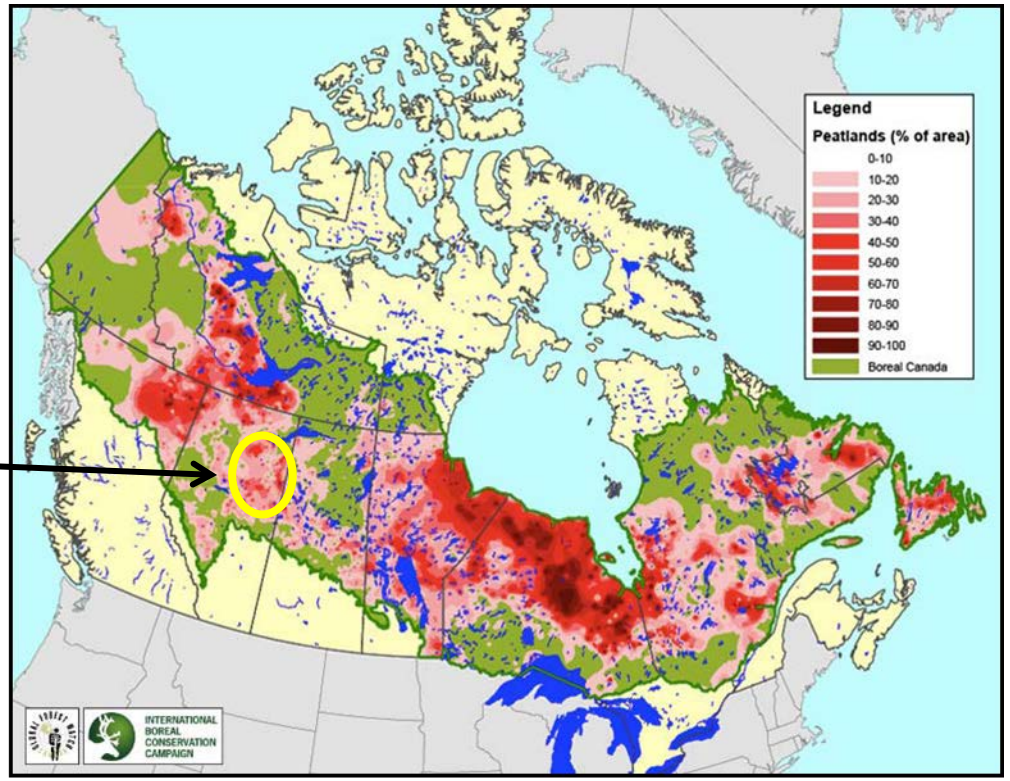
Oil Sands and Wetlands of Alberta



Global Forest Watch (2007)

Alberta

- 17.3% of the landscape is covered by wetlands.
- Mostly peatlands (bogs – 4.9%; fens – 11.4%), with few marshes and swamps (1%).

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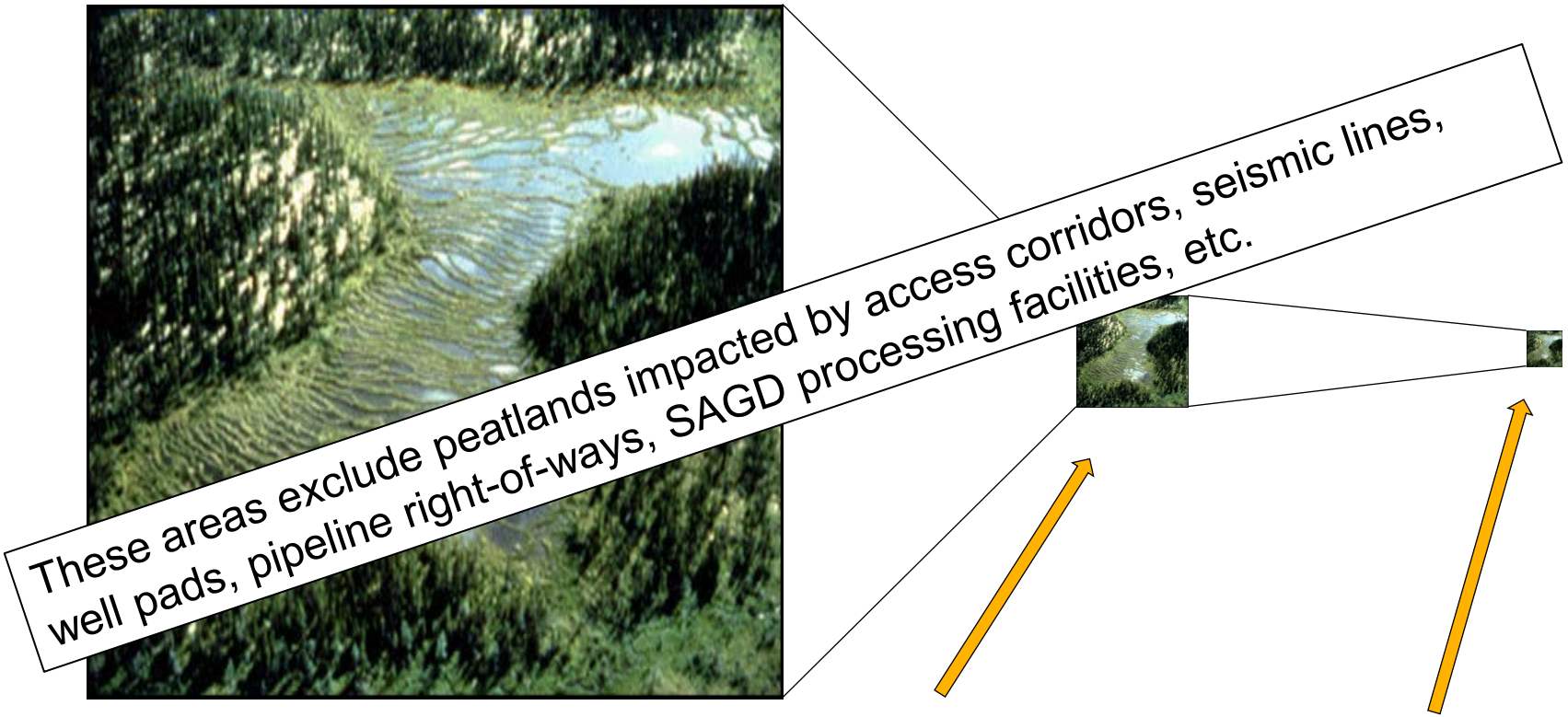
Wetlands in the Oil Sands – Area Perspective



Alberta peatland area
~ 10,300,000 ha
(Vitt et al. 1996)

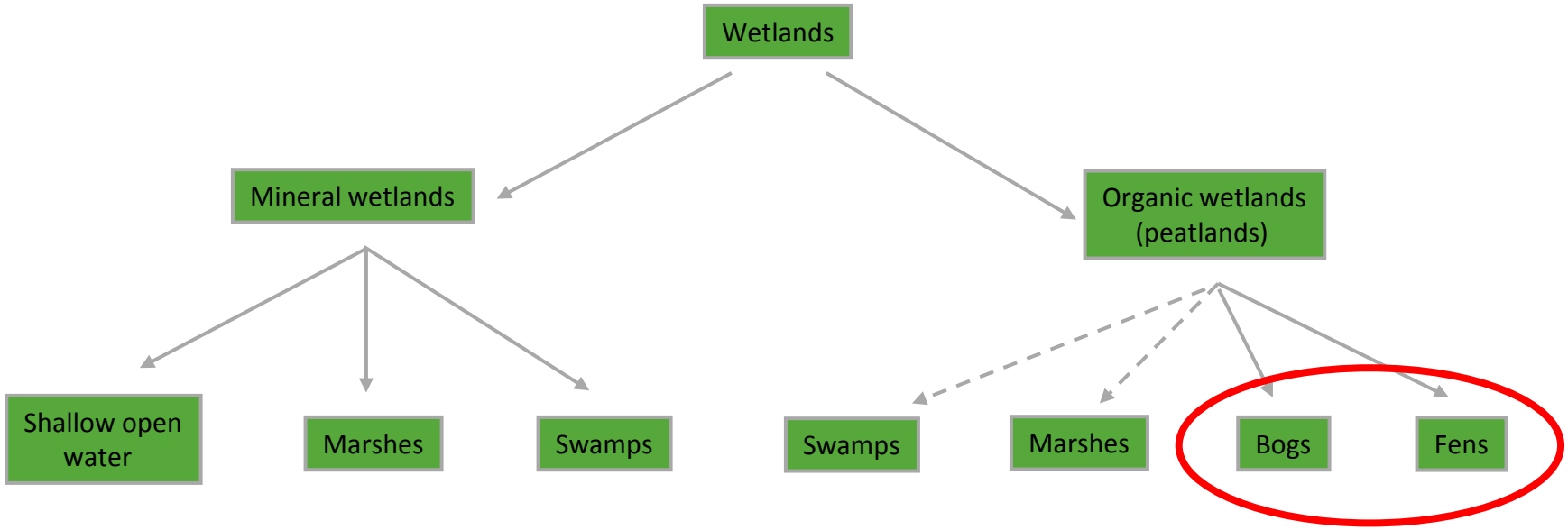
Oil Sands peatland area
~ 304,000 ha
(Rooney et al. 2012)

~ 3% of total peatland area in Alberta

Surface mining peatland area ~ 28,000 ha
(Rooney et al. 2012)

~ 0.3% of total peatland area in Alberta

Canadian Wetland Classification System



Class – 5 classes, e.g. *bog*
Form – 49 forms, 71 sub-forms, e.g. *palsa bog*
Type – many, e.g. *black spruce bog*

National Wetlands Working Group. 1997. The Canadian Wetland Classification System, 2nd Edition. Warner, B.G. and C.D.A. Rubec (eds.). Wetlands Research Centre, University of Waterloo, Waterloo, Ontario. 68 pp.

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Wetland Classes

Reclamation

- **Reclamation** – reconstructing a disturbed site to be habitable by similar organisms present before the disturbance in approximately the same composition and density.
- Requires considerable expertise in varying disciplines, including:
  - hydrogeologists, hydrologists, vegetation ecologists, wildlife ecologists, engineers, designers, geophysicist, etc.

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Peat Harvesting vs. Oil Sands Developments

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Challenges – Geotechnical and Engineering

- Composite tails (CT) – mixture of fine tails, gypsum, sand, and water; hydraulically placed on site (i.e. needs to drain)
- Mature fine tails (MFT) – mixture of silt, clay, hydrocarbons, and water; very fluid (very long settling times); not permitted in closed landscape
- Trafficability challenges in In-Pit features
- Physical dimension challenges
  - some In-Pit lakes are >1,000 ha in size

Challenges – Geotechnical and Engineering

- Physical dimension challenges – pouring CT and tailings sand in desired locations and into desired landforms
- Containment challenges
  - need dams
- Sequential closure of mine
  - hydrologic connectivity

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Challenges – "Soil" Characteristics

- CT covered by tailings sand covered by cover soil
- Tailings sand thickness at least 2 m over CT
- Cover soil thickness in wetlands at least 0.2 m

- Various approaches to establish plant communities in wetlands using soil
  - 100% cover with donor wetland soil
  - Donor wetland soil "islands"
  - 100% cover with a peat/mineral soil mix (salvaged, stored)
    - Planting/seeding with wetland plants
    - Natural re-vegetation

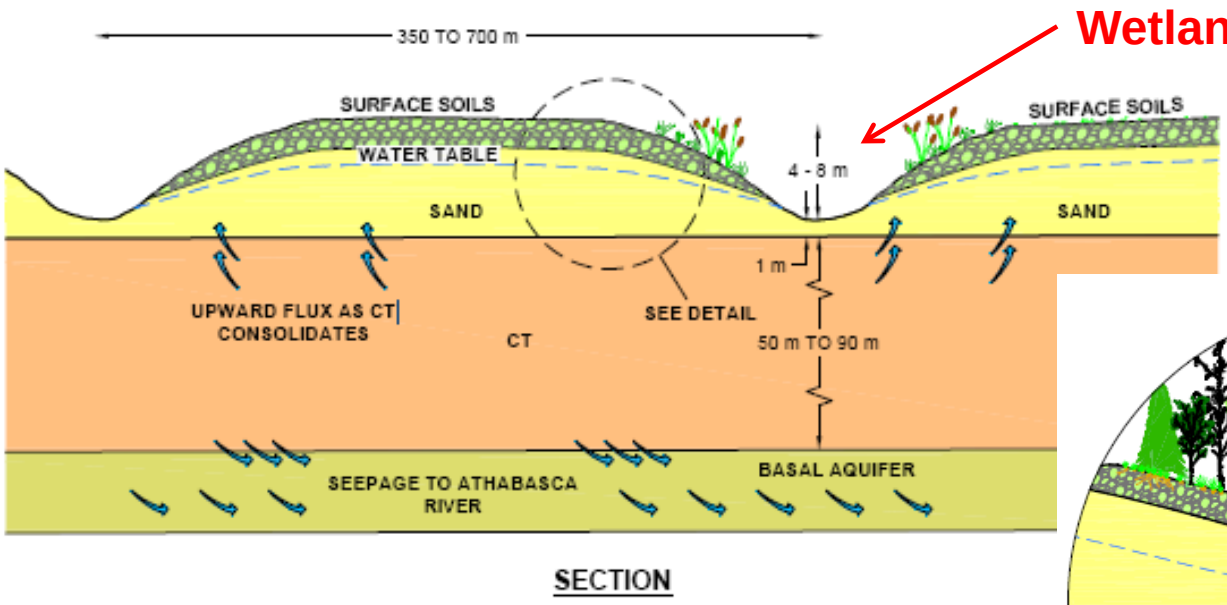
Challenges – Water Quality

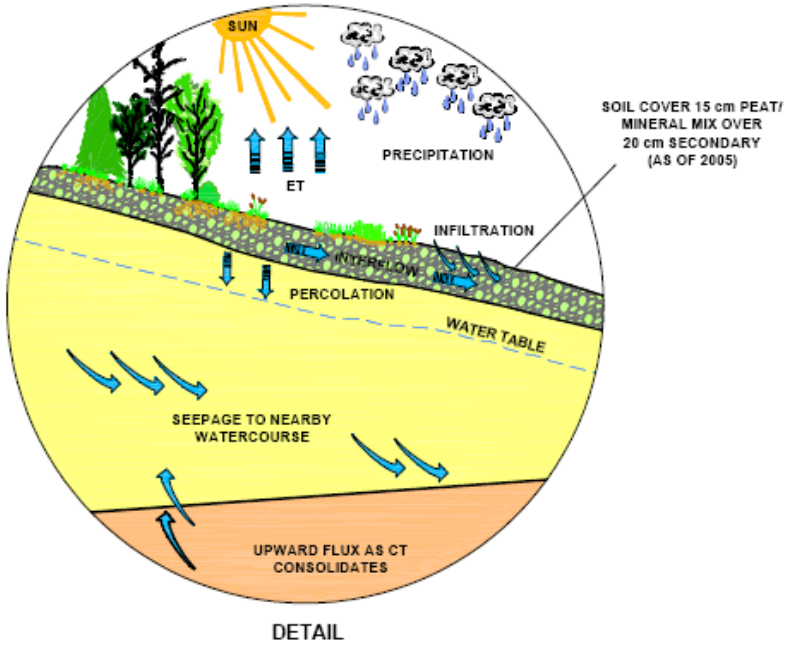
- Water quality managed by careful design of landforms
- Elevated areas (hummocks) facilitate flushing of tailings sand and CT with PPT and groundwater
- Primary issues around salinity, hydrocarbons, and some metals (e.g. B, Cr, Ni, Se, Zn, and others)

- Salt-crusting likely at hummock toes and in lowlands, including wetlands
- Concentration of undesirable compounds in some areas
  - Managed via biodegradation, flushing, plant uptake, etc.

Challenges – Water Quality

- Surface water quality managed by landform design, i.e. hummock dimensions (i.e. primarily height and slopes)

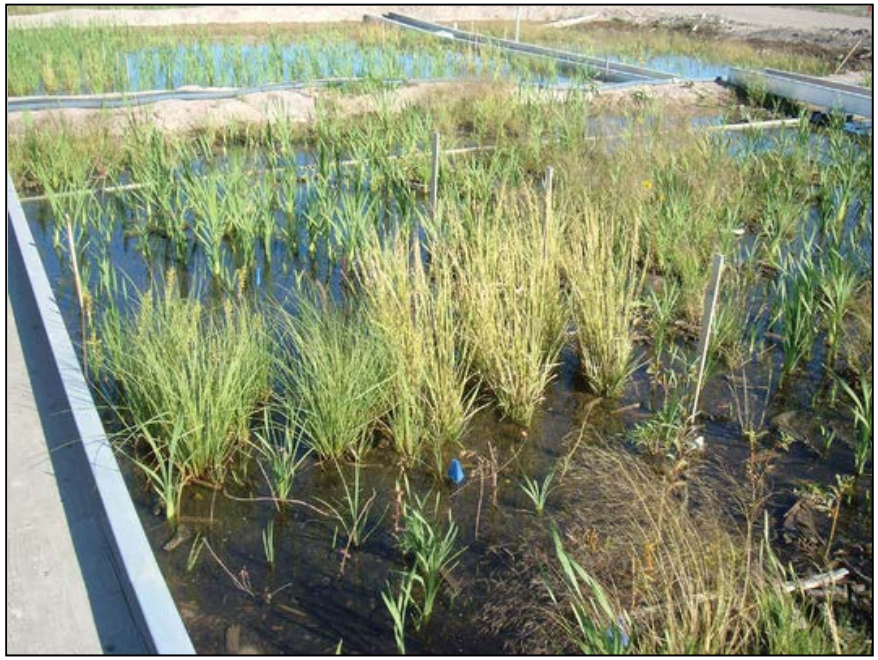




- Need separation of groundwater from surface water in uplands
  - Results in poorer water quality in wetlands

Challenges – Plant Communities

- Salinity likely greatest challenge for plant communities
  - Na^+, SO_4^{2-}, Cl^-, etc.
  - EC = 2,000 µS/cm and up
- In Wetlands, need to focus on salt-tolerant plant species
- Abundant research in area
- Many emergent wetland plants tolerant of elevated salinities
- Shrubs and trees less tolerant
- May take years/decades to achieve good ground cover, e.g. bryophytes



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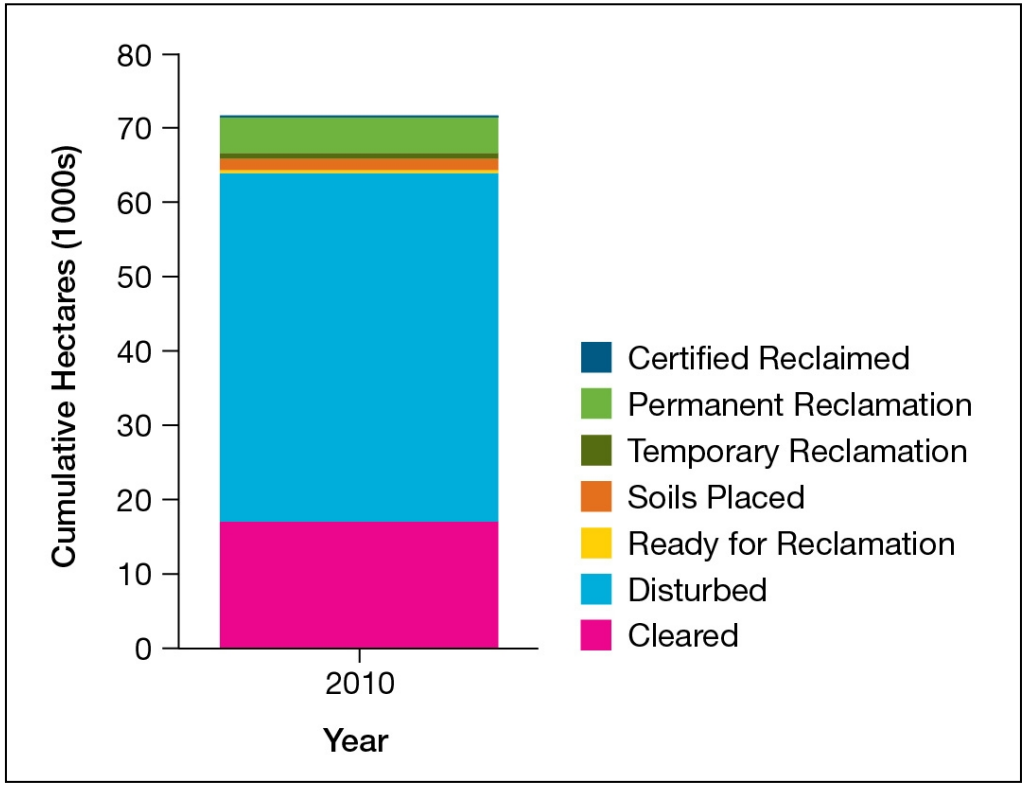
Potential Solutions to Reclamation Challenges

- Flushing
  - Underdrains, pumping fresh water into landscape, steeper slopes
- Plant communities
  - Salt-tolerant species, design for salt-tolerant communities, harvesting of salt-tolerant plants
- Rooting substrata
  - Increased soil cover to increase rooting depths, remove salts from sands, independent sand sources (not linked to operations), freshwater as transport medium for sands
- Landscape stability
  - Geotextiles/geogrid, even surface rather than topographic variability, “straight” drainage pathways

Oil Sands Region Wetland Reclamation



As of Dec. 31, 2010:

- Certified reclaimed ~ 104 ha
- Permanently reclaimed ~ 4,900 ha
- Temporary reclaimed ~ 780 ha

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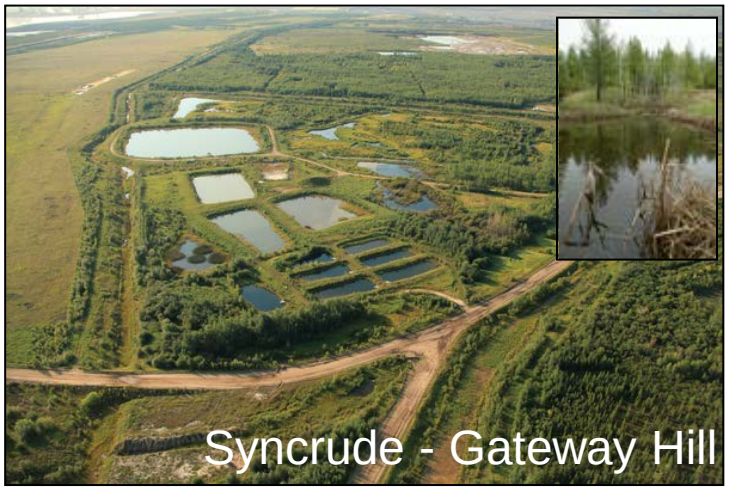
Wetland Reclamation Success Stories


Suncor – Crane Lake


Suncor wetland


Syncrude – Bills Lake


Syncrude - Gateway Hill

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Conclusions

- Peatland reclamation *cannot* be done (trajectory only)! Wetland reclamation *can* be done!
- Primary challenges in wetland reclamation are related to soil and water quality and suitable plants; also geotechnical and engineering constraints
- Industry is (and has been for many years) actively engaged in wetland reclamation research
- Several success stories around wetland reclamation
- Two pilot “peatland” reclamation projects are underway