NAIT 5th Field Tour

Reclamation Field Tour of Upland and Peatland Industrially-Disturbed Sites
Field Notes

Schedule	
6:30 - 7:00	Meet at the NAIT Boreal Research Institute, Peace River campus
7:00 - 7:45	**Drive to stop 1**
7:45 - 12:05	**Stop 1- Mineral soil reclamation upland & peatland research trials** **stop 1A- reclamation in the absence of topsoil** *Demonstration of vegetation development without topsoil application* **stop 1B- microsite development** *Site preparation for microsite development and targeted cover crop deployment* **stop 1C- timing of planting (dormant or not?)** *This study demonstrates the impact that planting timing has on survivorship and growth of deciduous tree and shrub species* **stop 1D- fen initiation on clay surface** *Wetland reclamation on clay surfaces* **stop 1E- hitchhiker planting** *Hitchhiking forbs with target woody species: when it works and when it doesn't* **stop 1F- re-filling borrow pits** *What happens when we refill borrow pits: challenges and learnings* **stop 1G- winter road reclamation** *Kickstarting woody vegetation development on linear disturbances* **stop 1H- moss establishment on buried peat (IPAD)** *Pad removal and revegetation within a peatland complex*
12:05 - 12:20	**Drive to stop 2**
12:20 - 13:25	**Stop 2- Leaving clay pads in reclamation sites**
13:25 - 13:50	**Drive to stop 3**
13:50 - 14:50	**Stop 3- Peat inversion technique to reclaim a temporary access road**
14:50 - 15:00	**Drive to stop 4**
15:00 - 16:00	**Stop 4- Upland mixedwood sump site**
16:00 - 17:00	**Return to Boreal Research Institute**

STOP 1: MINERAL SOIL RECLAMATION, UPLAND & PEATLAND RESEARCH TRIALS



Stop 1A | Reclamation in the absence of topsoil | Dr. Amanda Schoonmaker

Introduction on the history of the airstrip and the reclamation project.

Q. Was the site seeded in the first year after site preparation was done?
A. Yes, seeded brome and wheat grass first year. Although there was not a lot of grass seeded, it quickly spread to what you see now.

Q. Was there a flush of weedy annual species after site preparation?
A. No, because of the clay cap making the soil surface impermeable to weed barriers. This gave the site a break in the weed bank.

Q. Why did you choose to plant jack pine?
A. Since the site had limited topsoil to spread during site preparation, there was a high amount of mineral substrate. Knowing that pine have greater tolerances for poor soils, pine was easily chosen for the mixed bag of woody species.

Stop 1B | Microsite development | Dr. Amanda Schoonmaker

Explanation of the importance and types of site preparation using control and ripped strips by observing the vegetation. This location was chosen to show the 'best' example of ripping and control.

- Woody species responded most to soil decompaction. Conifers more sensitive to surface soil looseness than deciduous species.
- Site lost a lot of trees because of aggressive clover cover in the first few years.
- Aspen demonstrated variable growth, and was not a strong competitor with community vegetation.
- Small difference in bulk density between first and third year, overall entire site got less dense as time went on.
- Natural regeneration of vegetation occurred often in the ripping areas, especially allowing more native willow to emerge due to the availability of moisture. Surface drying differed in microsites more so in ripped areas compared to the control.
- Disking and ripping = doubled raspberry and rose natural regeneration.

Q. What do you mean by referring to your 'best' result?
A. 'Best' is regarding the woody survivorship and growth.

Q. Were there efforts to reduce agronomic species?
A. Yes, spray with post emergent herbicide.

Stop 1C | Timing of planting (dormant or not?) | Dr. Amanda Schoonmaker

Explanation of planting timing window (spring, hot planting, etc.) and recommend dormant deciduous stock.

- 2 years in: balsam poplar hotstock 20% survivorship, willow hotstock 60% survivorship.
- Spring stock (dormant) was the best approach. Summer planting white spruce – tolerates it well. Fall planting growth not as good.
- Deciduous- dormant stock with no leaves was best.
- Created conditions for native vegetation, but also woody canopy; the faster the woody canopy cover establishes, the better.
- Paper birch and balsam poplar tolerated competition – ridged stem and tolerated drought- aspen is bit more flimsy.
- Maybe look at paper birch more and balsam poplar.
- Maybe look at infiltration more for future studies.

Q. Did the grass establish prior to planting?
A. Grass establishment and planting occurred at about the same time. There was low water availability at this time and as a result the trees had a low chance of survival while simultaneously competing with the grass.

Q. Was there a difference in site prep via bulk density measurements?
A. No, there was no difference across site. However, the 25-30 cm range was slightly less dense than the upper 10-15 cm and 0-5 cm.

Stop 1D | Fen initiation on clay surface | Dr. Bin Xu

Introduction to wetland reclamation preparation and planting. Main challenges included creation of a wetland during initial drought conditions. This was an exercise of patience waiting for the hydrology to stabilize and appropriate wetland species to establish. Introduced microsites promoted diverse species establishment. Once adequate surface moisture established, little overall vegetative management was required compared to the uplands section.

- Goal to promote potential moss growth (leading to peat formation) on mineral substrate - can be useful/cost saving.
- Trying to imitate paludification processes – moss ingressing into vegetated areas, leading to peat formation.
- Summer 2014 – elevation lowered by some clay removal. Berm was removed and spread thinly across the site. Final trenching with a D7 dozer and ripper shanks to create channels criss crossing the site.
- Elevation increases from one end of the site to the other, variation in surface moisture due to gradient.
- In 2015 severely dry site infested with ruderal species such as clover. Following intense rain in 2016 site became a self-sustaining wetland.
- Some sedges (*Carex* spp.) and willows (*Salix* spp.) naturally regenerated the first year.
- Willows and birch (*Betula pumila*) planted the first year mostly died because of drought.
- Slough grass (*Beckmannia syzigachne*) came in early (not sure where came from) but has since fallen out.
- Diversity has changed over the years, more sedges and cattails (*Typha*) at this point.
- Some mosses are present.

Q. Is this the climax community?
A. Currently too hard to say. It is stable, but it could still further develop. Moss just started to ingress this year.

Q. Do you expect a willow canopy to develop?
A. Not anytime soon – very wet conditions. The current richness is 15-18 species though.

Q. How much longer is this permitted to be a research site?
A. The contract officially ends in 2019, but would like to get further permissions and funding to continue monitoring the sites.

Q. Was cattail management required?
A. Correct elevation was the most critical aspect of avoiding an abundance of cattails. One area is slightly lower with deeper standing water allowing substantial cattails to establish. Cattails are not viewed terribly here because the targeted ecosystem is a marsh community with the hope of transitioning into a fen.

Q. Is the area in the back a bog?
A. It may have been prior to the airstrip construction but now is more like a degraded fen due to upstream flooding (since remedied with removing the berm).

Q. What is the water flow direction?
A. From the degraded fen through the airstrip / towards the highway.

Q. Did you plant moss?
A. No, there was a natural spread of spores and fragments carried by the water from the degraded fen.

Stop 1E | Hitchhiker planting | Dr. Amanda Schoonmaker

Explained the hitchhiker planting concept starting with spruce/forb. "Two-for-one" planting.

The borrow pit did have good topsoil, low competition when the hitchhiker seedlings were planted, and soils were loosened (compared to strip 21). This resulted in better growth of the forb and spruce among the hitchhiker sow dates.

- Slow growing conifer is very compatible with herbaceous species.
- Fireweed/showy aster with white spruce growing in all conditions.
    - More tolerant of late sowing
    - Fireweed doesn't like heavy clay
- Herbaceous more sensitive than woody when sowing/competition.

Q. Were there concerns of hitchhiker forb competing with the spruce?
A. Of course, there was careful consideration of timing when the forb was added to the container resulting in hitchhiker seedlings with different stock types tested in the field.

Q. Were you not worried about sow thistle and Canada thistle?
A. Not at all on this level (not a lot of thistle present), because of so much other vegetation development it would eventually fall out of the site.

Stop 1F | Re-filling borrow pits | Dr. Amanda Schoonmaker

Clay was used from this borrow pit to construct the well pad at stop 1H.

- Biggest challenge - meters of frozen layers.
    - Put off planting site from mud/soupy conditions from ice melt
    - Came in later than spring for planting and seeding poplar
- Following year 2014 planting –competition high.
- Topsoil pile has tall vegetation.

- Lost buffalo berry/white spruce.
- Salix did really well.
- Site was very wet in 2013 made a good seed bed for Salix.
    - Intended for an apsen/poplar mixed wood, got a more Salix zone
    - Even moisture = good for Salix
- Lots of grass/clover, sow thistle eventually went away (spraying and hand pulling).

Q. How old was the borrow pit prior to reclamation?
A. About 4-5 years old.

Stop 1G | Winter road reclamation | Dr. Bin Xu

Discussed reclamation, mounding, and woody species development.

- Used to be wetter (could see flowing water).
- In 2014 winter road surface was raised help woody growth - material taken from adjacent natural areas as mounds or spread as carpets.
- Not typical mounding – didn't want pools on road.
- Introduced material brings in vascular and bryophyte diaspores - then woody species planted on top.
- Planting timing and microsite selection is critical for woody species.
- Created microsites set a path of trajectory for successful plant species development.
- Slow growing black spruce swallowed up by recovering moss layer, faster growing larch doing ok.

Stop 1H | Moss establishment on buried peat | Dr. Bin Xu

Discussed site preparation, revegetation strategy, and current vegetation development. Introduced moss fragments have formed moss carpet with impressive biomass accumulation in last 5 years.

- First full pad site aiming to restore peatland ecosystem. Studying recovery since 2012.
- Donor material from 3 sites introduced through the moss layer transfer technique, and donor site recovery is good.
- New moss carpet forming on restored peat surface now 5-10 cm deep in most areas after 6 years = good.
- *Sphagnum* moss dominated = acidifies site, limits weeds.
- Clay buried in some spots under peat - monitoring subsurface hydrological flow for impacts.
- Potential chemical influences from clay.
- Sloping elevation across site = intentionally done to match surrounding landscape.
- Limited woody species planted (most due to natural regeneration)

Q. When did the site preparation occur and the moss transfer?
A. Moss transfer in spring 2012, and site preparation in winter 2011.

Q. Was the site dry enough to do revegetation?
A. It was tricky - it was dry enough to support small equipment, but it was still very wet. Used an Argo towing a manure spreader to distribute the moss fragments – got stuck a couple of times.

STOP 2: LEAVING CLAY PADS IN PLACE



Dr. Amanda Schoonmaker and Dr. Bin Xu showed two reclamation sites and a comparison well site without pad removal. Facilitated a group discussion of well pad removal - how, what and when?

- Partial pad removal study:
  - 8 years post reclamation. Similar to airstrip and IPAD, *Sphagnum* moss present.
  - Half meter of clay with peat on top - partial pad removal, cheaper than removing all clay.
  - Introduced moss, sedges, and willows.
  - Adjacent bog provided additional seed source, speeding up recovery.
  - Tree species naturally ingressing into this trial.
- Site preparation study:
  - Natural recovery of woody species. Pad was neglected, aspen forest came up due to good conditions (moisture, good year for seed)
  - Mix of grass/clover and compaction on their pads
  - Aspen has done well here
  - Pulp matts were put down – helped reduce competition
  - Clay pad = you should do some sort of site preparation
  - Fireweed not good with clay (neither are goldenrod or aster)
  - 100% clay = white spruce growth is decent
  - Buffalo berry (6 years after site preparation) planted
  - If we don't restore hydrological functions what next/to do?

Q. How much clay content?
A. Mostly clay, some sand.

Q. Is this less expensive than removing the whole pad?
A. Yes, because then you would have to remove all the clay incurring machinery and labor costs.

Q. Was this reclamation done 8 years ago?
A. Yes, so the trees are 8 years old as well. The trial was done in 2010.

Q. Is an aspen stand an acceptable forest?
A. Yes, the spruce will come.

Q. Is outside the fence padded where there is a cluster of natural regeneration aspen?
A. Yes, but not sure about the soil texture.

Q. Are the pulp mats worth it for better success of plants competing with grass?
A. Would have to experiment with it because it is not only a cost for the pulp mats, but if the soil is good and loosened, then the trees can be alright.

STOP 3: PEAT INVERSION TECHNIQUE TO RECLAIM A TEMPORARY ACCESS ROAD

Discussion by Dr. Bin Xu of the peat inversion technique applied to a 1 m thick wood chipped winter road.

- Problem- what to do with wood chips? Dig up wood chips = moving problem elsewhere and creates trenches.
- Instead, buried wood chips under peat (peat inversion technique).
- December 2014 test run (quantify depth of peat).
- Expose the peat (like stop 1H).
- Allow for natural regeneration, other than planted larch & spruce on site.
- When do you introduce woody species? Let site stabilize first.
- Wood chips not causing hydrological problem, any leaching from wood chips likely gone.
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Q. How long did it take to site prep?
A. 2 days using a hoe working backwards out. \

STOP 4: UPLAND MIXEDWOOD SUMP SITE

Dr. Amanda Schoonmaker discussed remote sump site reclamation and the value of site preparation. Site preparation showed different tree growth compared to control. Low agronomic development by possibly planting / prepping close together in time may have made a difference.

- Rolled back (2010) topsoil/sub soil- maybe introduced some compaction.
- Seeded native grasses.
- 50% survivorship of balsam poplar.
    - Site was probably accidentally sprayed
    - Planted site right away, even with the chunky soil
    - If we waited to plant, competition would have time to establish
- Monitoring for this site stopped in 2017.
- Lots of tufted hair/tickle grass in some blocks here.
- White spruce survived the best - deciduous haven't tolerated as well.
- Grass took a bit of time to come back in some blocks – usually are very fast.
- Never had a major clover problem - maybe order of operations/spraying? Very different from other projects.
- Aspen did not do very well.
- Initial vegetation circumstances that determine final outcomes.

Q. What was planted?
A. Seedlings, cuttings of balsam, seeded tickle grass and hair grass.