CENTRE FOR BOREAL RESEARCH
TECHNICAL NOTE #43
PEATLAND RESTORATION - SYNTHESIS OF TECHNIQUE – MAY 2021

Initiating Wetland and Peat Formation on Residual Mineral Substrates

CONTEXT

In the traditional moss layer transfer technique (MLTT), donor *Sphagnum* moss is used to revegetate a flat, saturated peat surface. *Sphagnum* mosses are sensitive to base cation enriched groundwater, therefore pairing with acidic, nutrient-poor peat surfaces supports their establishment. However, recreating a peat surface is not always a viable strategy for reclaiming in-situ well pads and roads. Sites may have lost the underlying peat during construction, or a lack of a disposal site may prohibit the complete removal of mineral fill. In scenarios where creating a peat surface is not feasible, a saturated mineral surface can be targeted instead.

Previous reclamation trials have successfully created marsh wetlands dominated by herbs and graminoids on wet mineral substrates. But as marshes, these sites lack the bryophyte layer typical of most Alberta boreal peatlands. Moderate to rich fens can have similar enriched chemical conditions as those of the residual mineral fill, therefore, it should also be possible to initiate a fen-like community comprised of true mosses, sedges, and shrubs instead of a marsh.

Transferred fen moss growing directly on saturated residual mineral fill after partial pad removal.

Two field trials at the CNRL Peace River complex have demonstrated that fen true moss and vascular species can establish through donor introduction and natural ingression on residual mineral substrates. Both trials were prepared using partial fill removal to create a flat, saturated mineral surface. Applying a modified MLTT, donor material was collected from nearby moss dominated fens and transferred to the reclaimed surfaces. Additional desirable moss species also ingressed from the surrounding peatland. Both sites currently have well established, typical rich fen communities comprising moss and vascular species. New trials are producing similar early results.

HOW TO INITIATE WETLAND AND PEAT FORMATION ON RESIDUAL MINERAL SUBSTRATES

1. **Prepare a saturated surface** by partially removing the pad down **to an elevation similar** to the average of the **low points (hollows) in the adjacent peatland**.
2. Use the **MLTT to harvest donor material from moderate to extreme rich fens**. Existing cutlines can be used (see *Technical Note #42 Donor Moss Transfer: How and When to Use in Peatland Restoration*). **Ensure only the top 10 cm of moss is harvested** to prevent long term damage of the donor site. Follow the standard MLTT recommended guidelines of moss ratio, fertilization and mulch cover.
3. **Flat, saturated mineral surfaces** with fen moss MLTT **have been successful**. Trials pairing **texturized surfaces with fen MLTT are also promising**. Variable **microtopography** can **increase microsite** availability and **ecosystem resiliency**. **Texturizing should be introduced prior to MLTT**. Ensure the average site moisture is saturated for the full season and the depressions are not greater than 50 cm deep.
4. Moss can **ingress naturally** on saturated mineral surfaces in some cases **but is slow and unpredictable**. **Active introduction of donor fen moss is recommended**. It will accelerate moss establishment, bring in other desirable vascular species, reduce undesirable competition and lessen the chances of forming an alternate wetland such as a marsh.

KEY FINDINGS

- Residual mineral surface can be flat or rough but should be lightly decompacted to allow for root penetration and increased diversity.
- Sedges acted as a natural mulch preventing moss fragments from excessive drying during site infancy.
- Donor material with both hummock and hollow species increased onsite diversity.
- Final surface elevation and adequate moisture were critical to desirable vegetation establishment.
- Supplemental conifer planting such as larch or black spruce accelerated tree layer regeneration.

COST ANALYSIS

Most Cost-Efficient Creation of Mineral Surface

Partial mineral fill removal paired with donor fen moss transfer (see *Technical Note #42* for estimated cost)

Considerations: Thickness of the pad will determine volume of material to remove. Reduce costs by operating in frozen conditions and capitalize on reduced machine rates during offseason/downturn if possible.

Site: 0.8 ha, 1.5 m thick

Machines: 2 mid-sized dozers, 1 mid-sized excavator

Time:

- Feathering edges into natural area, breaking up frozen fill (1 excavator) – 3 days
- Partial fill removal (2 dozers) – 4 days

Cost: ~$50,000 - including mobilization and operators (based on a full pad trial under normal operational conditions), legal and permit fees not included.

PRACTICAL RECOMMENDATIONS

SITE PREPARATION

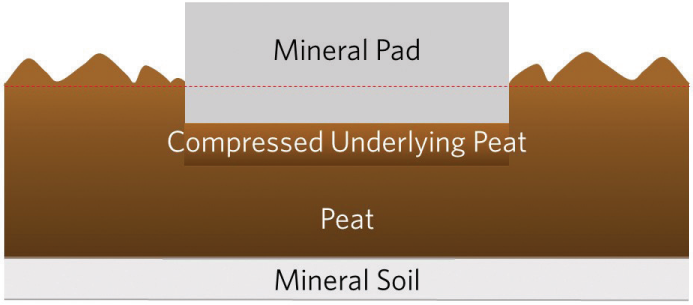
- Lower the mineral surface to target elevation. Aim 0-10 cm lower than the average of the low points in the adjacent peatland.
- Excess fill material can be moved back to the original borrow pit, to a new construction area or used to create an upland island near the site.
- The geotextile layer can be left in place between the residual fill and underlying peat.
- Add shallow microtopography through surface texturing (scraping with excavator bucket, shallow frozen ripping, modified mounding).

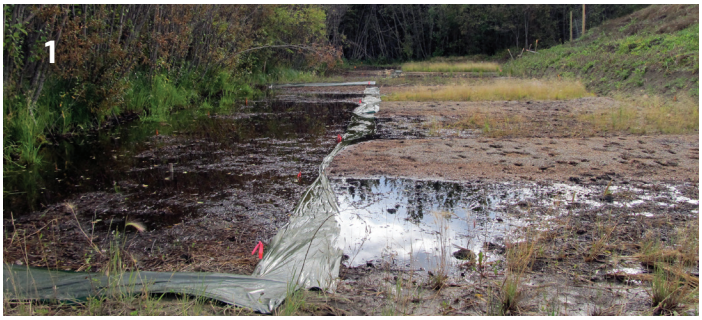
FEN DONOR MOSS TRANSFER

- Target a moderate or extreme rich fen donor community from natural areas or existing cutlines.
- Harvest only the top 10 cm of donor moss to avoid impairing donor site natural regeneration.
- Follow general MLTT guidelines for fertilizing and protective mulch application.

COMMUNITY DEVELOPMENT

- Expect some early cattail establishment. Cattails were eventually outcompeted by sedges at our trials, except in areas where standing water was greater than 50 cm for the entire season.



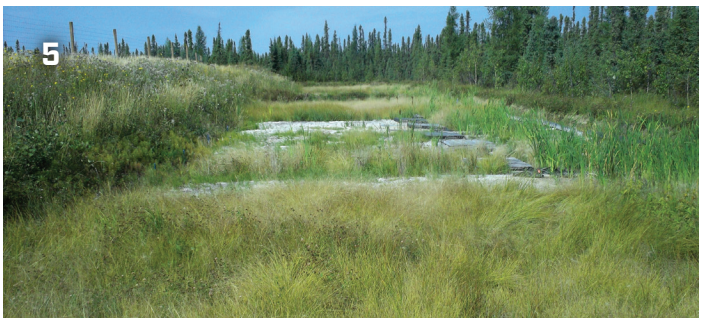


Completed soil preparation following partial pad removal (remaining pad on right) down to similar elevation as the peatland on left.

Examples of suitable moss species for transfer on saturated mineral soils. Fen *Sphagnum* species and true mosses.

Donor moss fragments and vascular species diaspores transferred onto frozen mineral substrate following partial fill removal.

True moss (*Tomenthypnum nitens*) growing the first season post transfer, sheltered by straw mulch, on saturated mineral fill.



Sedges and mosses growing on remnant mineral fill two seasons post partial pad removal. Remaining pad is on left, natural peatland on right.

True moss (*Drepanocladus aduncus*) growing at the base of sedges directly on residual mineral surface three years post donor transfer.

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