PEATLAND RESTORATION

TECHNICAL GUIDANCE DOCUMENT

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INTRODUCTION

The restoration of peatland is conducted in locations where peat has been mined or in sites where conditions are suitable for Sphagnum mosses and associated peatland plants to establish in restored plant communities. Sphagnum mosses are an important component of forested and open bog communities. In some restorations, sphagnum mosses may regenerate without introduction from donor sites, if conditions are favorable. But at highly disturbed sites or where rapid establishment is needed, sphagnum mosses must be introduced. This technical guidance document summarizes that process.

Peatland restoration with sphagnum, tamarack and sedges establishing from donor material

Equipment and materials needed to conduct large-scale peatland restoration includes: 1) an agricultural tractor, preferably with high flotation tires and four wheel drive, 2) a tractor-mounted rotovator, 3) a front-end loader, 4) an agricultural manure spreader, and 5) a bale processor/forage blower and weed free straw. A grader or peat profiler and a backhoe may be needed to level the surface and block ditches on previously-mined sites. A suitable donor site where Sphagnum moss and associated peatland plant materials can be collected is also needed, as is weed free straw to be used as mulch. On some sites, the addition of rock phosphorus fertilizer may help with moss establishment.

APPLICATION

Peatlands have water-saturated soils that are composed of partly decayed remains of plants. The plant material accumulates as a result of slowed bacterial and fungal action in the waterlogged environment. Different classifications of peatlands include non-forested bogs, forested bogs, rich fens, and poor fens (Tester 1995). Bogs and poor fens are characterized by acidic, low nutrient conditions. Vegetation on bogs and poor fens is dominated by Sphagnum and Polytrichum mosses, cottongrass, and low growing shrubs such as Labrador tea, leatherleaf, bog rosemary, and bog laurel. Black spruce and tamarack commonly occur on forested bogs. Rich fens have conditions such as higher pH and nutrient availability that favor the growth of a more diverse assemblage of wetland plants. Peatlands are found primarily in the boreal forest biome, which

has cool temperatures and short summers. The cool, wet climate in combination with poor drainage allows for the formation of peat.

Reliable, large-scale restoration techniques for in-kind restoration of Sphagnum dominated bogs have been developed at Laval University in Quebec and are described in the publication "Peatland Restoration Guide Second Edition" (Quinty and Rochefort, 2003). Similar research has been conducted in Minnesota with good results (Johnson, et al. 2000). These techniques are considered state-of-the-art for North America for restoring a Sphagnum-dominated Type 8 wetland, once peat mining is completed.

Spreading donor material over snow

This restoration method is based on research conducted to date on the restoration of Sphagnum dominated peatlands. The potential has been demonstrated for re-establishing native vegetation on bare, harvested or disturbed sites by spreading moss and other plant fragments collected from natural, undisturbed, "donor" sites,(Elling and Knighton,1984; Poschold and Pfadenhauer, 1989; Rochefort, et al. 1995, Campeau and Rochefort, 1996). This encourages the primarily vegetative reproduction of Sphagnum (Darlington, 1964; Cronberg, 1993) and allows associated peatland plant establishment from seeds, rhizomes, and other plant structures included with the donor vegetation.

The first step in any successful peatland restoration project is a thorough evaluation of the mined site including remaining peat thickness and chemistry, hydrology, and proximity to a suitable donor area. In order to re-establish Sphagnum-moss-dominated vegetation, a layer of acid, nutrient-poor peat, at least six inches thick overlying 12 inches of sedge peat should remain over the underlying mineral layer. The site must also be situated such that hydrology can be restored resulting in an increase in water level to provide moist conditions necessary for Sphagnum survival and growth. During peatland restorations, an existing area of natural undisturbed bog is used as a "donor site," at least one-tenth the size of the proposed restoration (Quinty and Hood 1998). Sphagnum to be spread on the mined site s should be set aside reasonably closeby. Enrichment of the proposed restoration site by high nutrient water, the mineral substrate, or peat other than Sphagnum moss peat can result in colonization by undesirable plant species. If any of these factors are present, it may be best to follow a different restoration strategy.

A critical step in restoring acid peatlands involves restoring wetland hydrology to the site. Saturated soil is essential for the reestablishment of Sphagnum mosses that are the primary plant species in acid peatlands (MCA 1999). Ideally, the water table should be restored to a level at or near the peat surface by blocking drainage ditches or using other water management techniques. Rochefort et al. (1997) found that in greenhouse conditions, Sphagnum species regenerated most rapidly when water levels were maintained at 0.2 inches below the peat. Other studies have found that the water table must be within 40 cm (~15 inches) of the peat surface in order for satisfactory Sphagnum regeneration to occur (Schouwenaars, 1988).

Modifying the production field topography to create a level or slightly concave surface has been shown to increase water availability and restoration success. Fields that have a crowned surface after harvesting should be flattened using a grader or peat profiler to ensure a better distribution of water (Quinty and Hood 1998). This work is best done during the fall prior to planned vegetation establishment. For intensively drained, mined peatland areas, substantial dams and diking are necessary to restore the site's hydrology. Field ditches in mined areas should be blocked at numerous locations (depending upon the surface gradient) to ensure that water is distributed evenly and that the mine site will be subjected to the natural peat accumulation and restoration processes. Ditches can be blocked with a backhoe using highly decomposed peat with low

hydraulic conductivity to insure optimum water retention. Ditches should be blocked only after all other restoration activities are completed, to allow for equipment operation.

When a suitable donor site has been selected, the bog surface must be chopped to provide moss fragments for restoration. This is best done in early spring (March or April) of the planned restoration year using a tractor-mounted rotovator. Timing for this operation is critical, as the bog surface should be free of snow, but there needs to be sufficient frost to support equipment (Quinty and Hood 1998). These conditions being met, the rotovator should be set to chop the top 10 cm of surface vegetation. The Sphagnum moss from the upper layer will have a greater regenerative capacity than moss from deeper layers. Several passes may be required to break up frozen pieces. The moss fragments are then loaded onto wagons or a manure spreader using a front end loader and transported to the restoration site. The shredded material should not be left on the borrow site as it will quickly dry. The materials can be kept for a few days in a pile at the restoration site (Quinty and Rochefort, 1997). Donor sites will regenerate in three to five years, allowing several collections and resulting in no-net-loss of peatland vegetation.

Mulching with straw after donor material is spread.

The moss fragments are spread on the bare peat surface of the restoration area using an agricultural manure spreader. Sphagnum should be spread at a ratio of 1:10 or one square foot of donor area to ten square feet of bare peat surface (Quinty and Rochefort, 2003). This should result in a layer one to two cm thick to completely cover the bare peat (Quinty & Rochefort 1997). Get uniform coverage at the proper ratio by adjusting the tractor speed and manure spreader application rate. Spreading is best done immediately after plant chopping, when there is still sufficient frost in the fields to support equipment.

Covering the reintroduced plant fragments is one of the most important steps in peatland re-vegetation. Mulch provides humid conditions that are necessary for plant establishment. Studies have shown that the use of straw mulch overwhelmingly improves Sphagnum moss establishment and survival (Quinty, 1996; Johnson, et al. 2000). Straw mulch has been successful for peatland restorations and is effectively applied to sites with a forage blower at a rate of 3000 kg per ha or 1.5 tons/acre (approximately two to three large round bales or 80 small square bales per acre) (Rochefort et.al. 2001) (Quinty and Hood 1998). Shrubs and other peatland species such as Carex oligosperma may also aid in the establishment of Sphagnum by providing shade and protection from wind (Boudreau and Rochefort 1998) (Johnson et al 2000). Seed of some herbaceous peatland species may be introduced to a site along with the donor material. If the restoration site retains the acidic, low nutrient qualities of a bog or poor fen, then invasive species are usually not a significant problem. If present, invasive species such as reed canary grass should be controlled with glyphosate.

Studies in Canada have shown a beneficial effect of phosphorus fertilization on Sphagnum bog restoration (Quinty and Rochefort 2003). Rather than directly affecting Sphagnum, phosphorus stimulates the growth of Polytrichum moss, which helps the Sphagnum to establish. Polytrichum not only serves as a companion species but also reduces frost heaving, a common problem on peatland restoration sites. Phosphorus fertilizer should be applied as granulated phosphate rock, a slow release form, at a rate of approximately 130 lbs/acre. Fertilizer is not recommended if reed canary grass is a threat.

OTHER CONSIDERATIONS

Maintaining water levels at or just below the soil surface, providing a weed free straw mulch, and controlling invasive species are particularly important in the restoration of peatlands.

COSTS

Costs for site preparation, donor material harvest, installation, and maintenance for peatland restoration costs from $1200- $3000 per acre.

ADDITIONAL REFERENCES

Peatland Restoration Guide, second edition. Quinty, F., Rochefort, L.

www.gnb.ca/0078/minerals/pdf/Peatland-Restoration-e.pdf

Effect of mulch, companion species, and planting time on restoration of post-harvested Minnesota peatlands, U.S.A., Johnson, K.W., Maly, C.C., Malterer, T.J.

Summary of Results of the Pool 5 and Pool 8 Drawdowns on the Upper Mississippi River, River Resources Forum Water Level Management Task Force.

Link to Appendix 5-B, Peatland Restoration Specifications