

Webequie Supply Road Project

Webequie First Nation

May 1, 2025

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APPENDIX K-3: WEBEQUIE SUPPLY ROAD CONCEPTUAL UPLAND AND WETLAND RESTORATION PLANS

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WSR
WEBEQUIE
SUPPLY ROAD



Appendix K– 3

Conceptual Upland and Wetland Restoration Plans

1.1 Introduction

The following section outline the conceptual process by which the Project will address the off-setting/restoration requirements of permanent removals resulting from the implementation of the Project. Restoration or reclamation of disturbed areas and clean up activities will occur progressively throughout the construction phase of the Project. These activities will include, but not be limited to, removing refuse, grading disturbed areas, contouring disturbed slopes to a stable profile, re-establishing natural drainage patterns and seeding to establish vegetation. Native seed mixes and approaches will be used to allow for natural regeneration to achieve the desirable groundcover, trees and/or shrubs with the goal to stabilize disturbed soils and minimize erosion potential within the road ROW and other areas, where applicable. Details of the restoration activities, along with guidance to the Proponent's contractor, will be documented in the Site Restoration and Monitoring Plan to be developed and implemented as part of the CEMP for the Project.

For permanent losses, upland, wetland and riparian area Ecological Restoration Plans will be developed in consultation with Local Rights Holders, Federal/Provincial Agencies, and other Stakeholders with the goal of providing in-kind compensation for the losses to the upland vegetation classes. The Plans will employ scientific Ecological Restoration (ER) Templates as a proven approach to the design and implementation of successful ecological restoration. The ER Templates are based on ecological land classification (ELC) models and/or site-specific reference (SSR) models, as determined on a site basis. ER Templates allow for the design and implementation of restoration projects in a systematic and efficient manner yet provide a practical and adaptive approach for implementing successful restoration of complex ecological systems. Though each of the Off-setting restoration plans developed will be site specific, the general approach for both upland and wetland restoration has been included in this Appendix. Please note that restoration plans developed for riparian areas have not been included since they will be a combination of the upland and wetland processes depending on the status of the lands adjacent to the waterbody.

1.2 Uplands

Based on the direct loss or alteration of vegetation and wetlands as result of the Project, it is proposed these removals be offset through restoring/enhancing/creating equivalent upland, riparian and wetland vegetation communities at ratio of 1:1 (i.e., vegetation compensation). This proposed vegetation compensation is also intended to off-set other key potential effects from the Project that include the loss or alteration of wetland function, and alteration or loss of plant species and communities of conservation concern and of traditional importance to Indigenous peoples. At this stage of the Project, the location of the restoration sites within the study area and broader region to achieve the recommended compensation requirements is unknown. The full scope of the vegetation compensation and selection of candidate restoration sites are proposed to be

assessed and developed in future development stages of the Project in consultation and partnership with First Nations in the project study area, provincial and federal authorities (e.g. MNR, Environment and Climate Change Canada) and other stakeholders. For the purpose of this EA/IA commitment to vegetation compensation, a conceptual compensation program and approach has been developed for further engagement and consultation with the goal to meet agreed upon established ecological restoration objectives for upland, riparian and wetland ecosystems. The following subsections outline the proposed conceptual compensation program that is further detailed in Appendix 11- X. Upland Restoration

If we assume a 1:1 compensation requirement, approximately 160 ha of upland vegetation class compensation, comprised of 150.8 ha of conifer Forest, 1.6 ha of Hardwood Forest, 4.2 ha of Mixedwood Forest, and 3.4 ha of Rock Barren classes, is required, (see **Table** below).

Table 1 Upland Removals

Upland Class	Removals (ha) – 1:1 Compensation
Conifer Forest	150.8
Hardwood Forest	1.6
Mixed Forest	4.2
Rock Barren	3.4
Total Upland Removals	160

It is unlikely that restoration site opportunities encompassing the areas described above are available within the local or regional study areas for this Project given the pristine and undisturbed nature of the area. That said, there may be some opportunities to be found within the region that would be suitable. According to the current vegetation mapping developed for the Project, there are about 554 ha of burned conifer forest, which are classified as upland which could provide the required restoration opportunities if deemed suitable. The same applies to the approximately 207 ha of developed/disturbed lands within or near the community of Webequie and at the western end of the study area in the mineral exploration areas proximal to the Noront Camp. These areas are known to also include mosaiced wet areas, too small to map at the scale used for the baseline studies. However, if we assume that only 90% of these areas have large enough wet inclusions suitable for restoration there would be a further 498.7 ha and 186.7 ha available for upland restoration within the RSA. This results in a rough total of 685.4 ha of area available for potential local upland restoration if the rehabilitation of these burned and developed areas within the RSA are found to be suitable for upland compensation through the consultation process with local rights holders, regulators and stakeholders.

1.2.1 Uplands Ecological Restoration Plan

The Uplands Ecological Restoration Plans will be developed in consultation with Local Rights Holders, Federal/Provincial Agencies, and other Stakeholders with the goal of providing in-kind compensation for the losses to the upland vegetation classes described above in **Table** . The Plan will employ scientific Ecological Restoration (ER) Templates as a proven approach to the design and implementation of successful ecological restoration. The ER Templates are based on ecological land classification (ELC) models and/or site-specific reference (SSR) models, as determined on a site basis. ER Templates allow for the design and implementation of restoration projects in a systematic and efficient manner yet provide a practical and adaptive approach for implementing successful restoration of complex ecological systems. The Plan development will include the following steps:

Background Information Gathering/Review and Field Investigation

Preliminary steps toward developing the plan will include:

- Consultation with Local Rights Holders, Federal/Provincial Agencies, and other Stakeholders;
- Finalization of restoration objectives;
- Review of WSR Natural Heritage Baseline Report (Appendix F);
- Review/gather further available background information from existing restoration activities in the area, literature search, information databases (e.g. MNRF's NHIC), review of aerial photography, and discussion with stakeholders;
- Establishing candidate reference sites;
- Determine and confirm restoration sites; and

Field Investigations/Site Assessment

- Conduct comprehensive baseline surveys on reference sites to inform future species selection and soils treatments;
- Conduct comprehensive baseline surveys on candidate restoration sites. Data collected includes but is not limited to:
 - Hydrological/Hydrogeological Conditions – identify current or potential source of water as well as the potential water loss via surface or subsurface drainage;
 - Topography – Assess the contribution of topography to the maintenance of a stable/even moisture regime and identify features that could result in variable moisture conditions such as drought conditions upslope and flooding downslope;
 - Chemical aspects – Analyze the chemistry of surface/sub-surface water and peat/soils sample to ensure that a site is appropriate for peat bog plant species;
 - Existing vegetation – Assess current status of vegetation within the site to determine if any natural colonization by plants has occurred; and
 - Surrounding environment – assess the status and usage of adjacent vegetation patches to determine any potential peatland plant sources, or conditions which may have a potential positive or detrimental effect on restoration goals (e.g., sphagnum moss source material, invasive species); and,
- Create detailed maps of the candidate restoration site, focusing on degraded areas, vegetation assemblages, and hydrological features.

Conceptual Restoration Plan

Based on initial field investigations, background review, and consultation, a Conceptual Restoration Plan will be developed. This will include:

- Preliminary grading/materials to reconstruct the remediated selected restoration site areas, including typical proposed structural elements (natural habitat features, topographic variability, hydraulic/stability analysis);
- Finalization of ecological classification (ELC) models and/or site-specific reference (SSR) models;
- Development of a conceptual ER Template including species composition of the proposed seed mix and plantings, as well as a conceptual layout of the site with species distribution matching the proposed preliminary grading of the site;

- The Conceptual Plan will be delivered to the Local Rights Holders, Federal/Provincial Agencies, and other Stakeholders for comment. Based on comments received the Conceptual Plan will be refined and used as the basis for the development of the Detailed Restoration Plan and the Contract Package;
- Preparation of the Detailed Restoration Plan will follow approval of the Conceptual Plan. It will build on the Conceptual Plan and specify the comprehensive restoration strategy for the site. Key elements will include;
 - Schedules outlining each major phase of the project (site preparation, planting, and maintenance);
 - Site preparation and grading, including layout and placement of fill materials to be used to construct the physical landscape of the restoration area;
 - Invasive species management (weeding, cutting, herbicide treatment) including edges surrounding the restoration area, if required;
 - Temporary treatments (e.g. cover nurse crop) or other stabilization techniques to prevent erosion and deter establishment of invasive/pest species prior to planting;
 - Timing/sequencing of restoration activities. Seasonal considerations for planting are critical to success, and not all planting species may fit the same time frame;
 - Delineation of planting zones required to create the components of the overall restoration (e.g. Shrub swamp, shallow marsh, deep marsh, open water);
 - Development of features to integrate the restoration into the surrounding area;
 - Final species lists for plantings, and seed mixtures;
 - Drawings defining planting layout and quantities for each zone, as well as typical details and planting requirements; and
 - Maintenance activities and schedule.

Other key elements to be finalized in conjunction with the Detailed Restoration Plan will include the contract documentation (specifications, operational constraints) for bid, and the post-construction monitoring program. Post construction monitoring will incorporate adaptive management strategies within the maintenance program to inform management actions and implement sensible adjustments to the plan based on observed outcomes along the vegetation restoration trajectory.

Detailed Restoration Plan - Plan - Preparation of the Detailed Restoration Plan will follow approval of the Conceptual Plan. It will build on the Conceptual Plan and specify the comprehensive restoration strategy for the site. Key elements will include;

- Incorporate relevant comments into overall restoration plan objectives;
- Finalization to restoration sites, the restoration objectives and reference sites solidified for each one, and the finalization of vegetation materials donor sites;
- Vegetation collection will take place in the spring during firmer ground conditions, when possible, to reduce unwanted impacts/damage to the site from machinery, reduce losses of plant material via gathering difficulties, and ensures that only the best regenerating plant material is collected;
- Schedules outlining each major phase of the project (site preparation, planting, and maintenance);
- Site preparation and grading, including layout and placement of fill materials to be used to construct the physical landscape of the restoration area to provide suitable hydrological and hydrogeological conditions upland species;
- Select and describe appropriate restoration methods such as re-vegetation strategies, or erosion control;
- Temporary treatments (e.g. cover nurse crop) or other stabilization techniques to prevent erosion and deter establishment of invasive/pest species prior to planting;

- Timing/sequencing of restoration activities. Seasonal considerations for planting are critical to success, and not all planting species may fit the same time frame;
- In very large sites may require the delineation of planting zones required to create the components of the overall restoration (e.g. tree/shrub mixes, wetland inclusions etc.);
- Development of features to integrate the restoration into adjacent wetland and upland areas;
- Final species lists for plantings, and seed mixtures;
- Drawings defining planting layout and quantities for each zone, as well as typical details and planting requirements;
- Invasive species management (weeding, cutting, herbicide treatment) including edges surrounding the restoration area, if required;
- Maintenance activities and schedule; and
- Develop a Timeline and Budget: Outline a realistic timeline for the restoration activities and estimate costs, securing funding as needed.

Implementation/Construction Oversight

Oversight of the restoration activities will be highly dependent on the overall construction schedule, including remediation activities, soil treatments, and other facets of the project. This will constitute an overall strategy to oversee contractor activities on-site during key phases of the program. It may be adjusted in light of the global project schedule, but as a representative level of effort site presence is planned for spring (site prep, nurse crop seeding), summer (deeper water plantings), and fall (planting/seeding for fall dormancy).

Management and Monitoring

The management and monitoring programs will be developed based on Adaptive Management principles. “Adaptive Management” is an iterative process for improving management practices and/or plans by learning from the outcomes of operational implementation (**Bunnell et al., 2009**). Based on our experience in ecological restoration, the benefit of employing adaptive management to achieving successful ecological restoration outcomes cannot be overemphasized. Implementation involves systematically reviewing restoration plans through all phases of the project.

A minimum of 70-75% success rate in terms of species richness and density of the planned material quantities for trees and shrubs is proposed as a restoration target. Where an herbaceous layer is proposed it should also provide sufficient cover to prevent erosion problems and limit the establishment of invasive species or weedy competition during the establishment phase. Establishment of at least 50% of the species specified in the herbaceous mixes as healthy reproducing populations is suggested as a target to provide a healthy foundation for the development of natural native plant communities.

The ultimate success of any ecological restoration is measured by the outcomes (plant survival, growth, vegetation establishment success) on an ecological timeframe, well after the installation (planting or seeding) of stock. Our proposed adaptive management approach will use site monitoring to inform management actions and sensible adjustments to the plan based on observed outcomes along the vegetation restoration trajectory. In this way, effort is not wasted trying to force narrowly planned outcomes, when alternate, often superior, outcomes can evolve as a result of the many environmental factors/influences and can be supported by adaptive management over time to achieve the project objectives. The adaptive management approach is consistent with our ecological restoration approach using

ecological restoration templates that, by design, allow for a variety of successful outcomes (which is an inherent feature of any natural ecosystem).

Adaptive management and monitoring of the restoration areas is proposed to be undertaken by representatives of the proponent. In general, ecological restoration is not a point-in-time exercise, but instead is a process that involves ongoing management, maintenance and monitoring, especially through the critical establishment phase. Once established (e.g., free-to-grow stage), restoration plantings typically become self-sustaining through the forces of nature (but remain influenced by natural disturbances, succession, and anthropogenic stressors).

A 5-year monitoring program is proposed following the implementation of the DFRP (upon completion of plantings) to be undertaken by an Ecological Restoration Specialist and/or Registered Professional Forester.

The monitoring program is proposed to include the following elements:

- Site visits to be conducted three times per year to detect seasonal variation;
- Assessment of species composition, including survival rates/densities;
- Assessment of competition by invasive species;
- Assessment of plant injury, dieback, mortality of plantings;
- Effectiveness of plantings in creating desired vegetation community/habitat and restoration targets;
- Suggested adaptive management recommendations/actions to address any deficiencies; and
- It is recommended that an annual report be prepared to document the results of the monitoring program, with the report provided to Local Rights Holders, Federal/Provincial Agencies, and other Stakeholders as applicable for their information.

1.3 Wetland Restoration

If we assume a 1:1 compensation requirement, approximately 380.34 ha of wetland compensation, comprised of 237.6 ha of swamp classes, 90.8 ha of bog classes, and 51.95 ha of fen classes, is required (see **Table** below).

Table 2: Wetland Removals

Wetland Class	Removals (ha)
Conifer Swamp\Organic Rich Conifer Swamp	155.58
Poor Conifer Swamp	80.04
Thicket Swamp	1.98
Open Bog	0.05
Low Treed Bog	61.12
Sparse Treed Bog	29.62
Organic Poor Fen	1.38
Sparse Treed Fen	43.47
Lake and River Shore Fen	7.1
Total Wetland Removals	380.34

It is unlikely that restoration site opportunities encompassing the areas describe above are available within the local or regional study areas for this project given the pristine and undisturbed nature of the area. That said there may be some opportunities to be found within the region that would be suitable. According to the current vegetation mapping developed for the project, there are 21 ha of burned areas that have been classified as wetland (swamp or treed peatlands). There are also the about 554 ha of burned conifer forest which though currently classified as upland but are known to also include mosaiced wet areas, too small to map at the scale used for the baseline, which could provide some restoration opportunities. The same applies to the approximately 207 ha of developed/disturbed lands within or near the community of Webequie and at the western end of the study area in the mineral exploration areas proximal to the Noront Camp. If we assume that only 10% of these areas have large enough wet inclusions suitable for restoration, there would be a further 55 ha and 21 ha available for restoration within the RSA. This results in a rough total of 97 ha if area available for potential local wetland restoration if the rehabilitation of these burned and developed areas within the RSA are found to be appropriate for wetland compensation through the consultation process with local rights holders, regulators and stakeholders. Compensation for the remaining 283 ha of wetland losses will need to be achieved through either restoration outside the RSA or via other mechanisms such as cash-in lieu, or possibly by means of commitments to fund further research on wetlands and their function within the Hudson and James Bay Lowlands.

1.3.1 Wetlands Ecological Restoration Plan

Restoration is quite specific when applied to wetland ecosystems. This is particularly applicable to peatlands given the complexity of these systems and the timescales involved in their original formation. For this reason, restoration approaches and detailed plans need to be developed during Detailed Design to compensate for these losses.

Wetlands are essential ecological assemblages that play major roles in ecosystem services, carbon sequestration, and the preservation of biodiversity. Numerous wetland types are found within the study area, these can be roughly divided into two general classifications of wetlands based on whether they occur on organic or mineral soils. These include bogs and fens with saturated organic soils (also known as peatlands, or muskeg), and marshes and swamps found in more mineralized better drained hydric soils (. Both general wetland types provide similar support of ecological processes, but they do differ in their structure, biological make up, and sensitivity to environmental changes. Marshes and swamps are distinct and diverse wetland ecosystems that play a fundamental role in carbon sequestration and biodiversity conservation, but they are generally less sensitive to environmental changes compared to peatlands.

Peatlands, on the other hand are thought to be very sensitive ecosystems due to their unique hydrological conditions and the extremely slow rate at which they develop peat accumulations substantial enough to drive the ecological processes of the site. Once established, peatlands are vulnerable due to their dependence on stable hydrological conditions, unique soil and chemical properties, slow recovery rates, and acidic and nutrient-poor conditions. As a result, these environments develop a specialized biodiversity composed of a few plant communities dominated by Sphagnum mosses that are specialized in colonizing these ecosystems. These characteristics make peatlands particularly susceptible to human caused environmental changes, requiring careful management and protection to maintain their ecological functions, water regulation and significant carbon storage capacity benefits. They also present significant challenges to restoration efforts within these environments. For example, research from a somewhat recent project in Canada, in which transplanted sphagnum moss was established on a mechanically milled compressed peat surface, suggests that it will take approximately twenty (20) years to develop microforms and natural ecosystem conditions comparable to those in natural bogs (**Pouliot et al. 2011**). Therefore, in some cases where the only available candidate restoration sites are located in severely disturbed peatlands (e.g., significant removal or long-term compression of peat deposits), restoration objectives may need to be

modified to establish a wetland type belonging to an earlier developmental stage bog to fen where removals allow for more minerotrophic as opposed to ombrotrophic conditions, or bog/fen to swamp/marsh removals have exposed mineral soils (**Graf et al. 2008, T. Minayeva et.al. 2017**).

The Wetlands Ecological Restoration Plan will be developed in consultation with Local Rights Holders, Federal/Provincial Agencies, and other Stakeholders with the goal of providing in kind compensation for the losses to the upland vegetation classes described above in **Table 2**. As with the approach used for the upland environments, the wetlands Ecological Restoration Plan will employ scientific Ecological Restoration (ER) Templates as a proven approach to the design and implementation of successful ecological restoration. The ER Templates are based on ecological classification (ELC) models and/or site-specific reference (SSR) models, as determined on a site basis. ER Templates allow for the design and implementation of restoration projects in a systematic, efficient manner, yet provide a practical and adaptive approach for implementing successful restoration of complex ecological systems. These processes will be informed by existing peatlands restoration methodologies such as the “Peatland Restoration Guide, Second Edition” (**Quinty et al. 2003**) and subsequent 2020 update for planning peatlands restoration projects, as well as the 2017 **T. Minayeva et al.** approach documented in the “Towards Ecosystem-Based Restoration of Peatland Biodiversity. Mires and Peat, Volume 19” publication. The approach described below is tailored to peatlands restoration since this objective is the most difficult and complex, but the plan outline presented would also be applicable to swamp and marsh restoration objectives with modifications to hydrological and species components. The Plan development will include the following:

Background Information Gathering/Review

- Consultation with Local Rights Holders, Federal/Provincial Agencies, and other Stakeholders to finalize restoration requirements and objectives;
- Review of WSR Natural Heritage Baseline;
- Review/gather further available background information from existing restoration activities in the area, literature search, information databases (e.g. MNR’s NHIC), review of aerial photography, and discussion with stakeholders;
- Review available documentation on previously conducted peatlands restoration programs;
- Finalize Level 3 (Detailed Assessment) wetlands function methodology and modelling process as applicable;
- Establish candidate reference sites;
- Field visits to review/confirm field conditions at the candidate reference sites;
- Conduct Level 3 Wetlands Function Assessment on candidate reference sites;
- Finalize wetland functional values objectives (e.g., carbon sequestration, nutrient cycling etc.); and
- Determine and confirm candidate restoration sites, plots and photo points.

Field Investigations/Site Assessment

- Conduct comprehensive baseline surveys on reference sites to inform future species selection and soils treatments;
- Conduct comprehensive baseline surveys on candidate restoration sites to meet requirements of the Level 3 Wetlands Function Assessment. Data collected includes but is not limited to:
 - Hydrological/Hydrogeological Conditions – identify current or potential source of water as well as the potential water loss via surface or subsurface drainage;

- Topography – Assess the contribution of topography to the maintenance of a stable/even moisture regime and identify features that could result in variable moisture conditions such as drought conditions upslope and flooding downslope. Identify areas where the construction of pools or water reservoirs is possible, and creation of microtopography (mounding/depressions) is possible;
 - Peat characteristics – assess peat thickness, type of peat (Sphagnum peat, sedge peat, etc.) and degree of decomposition of peat using an appropriate scale such as the von Post scale (**Von Post L, Granlund E., 1926**);
 - Chemical aspects – Analyze the chemistry of surface/sub-surface water and peat/soils sample to ensure that a site is appropriate for peat bog plant species;
 - Existing vegetation – Assess current status of vegetation within the site to determine if any natural colonization by plants has occurred; and
 - Surrounding environment – assess the status and usage of adjacent vegetation patches to determine any potential peatland plant sources, or conditions which may have a potential positive or detrimental effect on restoration goals (e.g., sphagnum moss source material, invasive species).
- Identify degradation sources and factors to determine the main causes of candidate restoration site (wetland/peatland) degradation (e.g., drainage issues, anthropomorphic disturbance such as peat compression/extraction, pollution, fire); and
 - Create detailed maps of the peatland, focusing on degraded areas, vegetation assemblages, and hydrological features.

Conceptual Restoration Plan - Based on field investigations, background review, and consultation with Local Rights Holders, Federal/Provincial Agencies, and other Stakeholders, a Conceptual Restoration Plan will be developed. This will include:

- Finalization of ecological classification (ELC) models and/or site-specific reference (SSR) models;
- Defining specific, measurable, achievable, relevant, and time-bound objectives for the restoration based on latest research (e.g., Peatland Restoration Guides, **Quinty et., al., 2003, and 2020**);
- Defining site specific restoration approaches such as the "Moss Layer Transfer Technique" (MLTT- Peatland Ecology Research Group and Canadian Sphagnum Peat Moss Association 1990) based on latest research (**G. Breton, et., al., 2021**);
- Selecting the most applicable objective and management option for each restoration site. For example, a thin layer of well-decomposed peat overlying the mineral subsoil will present difficulties for the restoration of a bog environment (**Quinty et., al., 2003, and 2020**). A shallow layer of peat could permit root mass contact with mineral subsoils and the enriched groundwater allowing for propagation of non-peatland plants which may out compete the desired peatland species, and well-decomposed peat has minimal capacity for water storage capacity resulting in dry surface conditions that are detrimental to the establishment of Sphagnum Moss. In restoration sites with these conditions, it may be more appropriate to aim for different wetland objectives such as swamp or marsh options;
- Ensuring that the chemistry of sub-surface water and peat at the selected sites is suitable for peatland plant species. For peatlands, low pH and electric conductivity are the main drivers of ombrotrophic conditions so a pH of 5.1 or lower and adjusted conductivity of less than 100 $\mu\text{S}/\text{cm}$ will form the upper limit for restoration to a peat bog class. If higher values are encountered fen, marsh, or swamp restoration objectives will be considered;
- Assessing the likelihood of nutrient enrichment (nitrogen or phosphorus) for external sources which may encourage the establishment of exotic species;

- Verifying the level of natural plant colonization to make an assessment of the viability of the site for the anticipated restoration objective. Colonizing species are excellent gauges of chemical conditions and water regime which can be used to determine the best restoration objective for the site;
- Identifying donor sites for native peatland or other wetland plant species sources, acquisition methods, and application processes;
- Preliminary grading/materials to reconstruct the remediated selected restoration site areas, including typical proposed structural elements (ground treatments, natural habitat features, soils treatments, topographic variability, hydraulic/stability analysis);
- Development of conceptual Restoration Template including species composition of the proposed seed mix and plantings, as well as a conceptual layout of the wetland with species distribution matching the proposed preliminary grading of the site; and
- Distribute conceptual plan to Local Rights Holders, Federal/Provincial Agencies, and other Stakeholders as applicable for their information and comment.

Detailed Restoration Plan - Preparation of the Detailed Restoration Plan will follow approval of the Conceptual Plan. It will build on the Conceptual Plan and specify the comprehensive restoration strategy for the site. Key elements will include;

- Incorporate relevant comments into overall restoration plan objectives;
- Finalization to restoration sites, the restoration objectives and reference sites solidified for each one, and the finalization of vegetation materials donor sites;
- The donor site will be of an appropriate size (i.e., must be at least one tenth of the size of the restoration site) with the right plant communities (i.e., full moss carpet with dominance of Sphagnum species);
- Vegetation collection will take place in the spring during firmer ground conditions, when possible, to reduce unwanted impacts/damage to the site from machinery, reduce losses of plant material via gathering difficulties, and ensures that only the best regenerating plant material is collected;
- Schedules outlining each major phase of the project (site preparation, planting, and maintenance);
- Site preparation and grading, including layout and placement of fill materials to be used to construct the physical landscape of the restoration area to provide suitable hydrological and hydrogeological conditions for diaspores;
- Layout plans will include the formation of microtopography elements and water retention basins, the re-shaping requirements for cutover or burned over blocks, and the potential restructuring of drainage patterns (dams, diversions etc.) to meet hydrologic requirements;
- Plan Hydrological Interventions: Design interventions to restore the natural hydrology, such as blocking drainage ditches, creating bunds, or installing water control structures;
- Select and describe appropriate restoration methods such as rewetting, top layer scraping, re-vegetation strategies, or erosion control;
- Temporary treatments (e.g. cover nurse crop) or other stabilization techniques to prevent erosion and deter establishment of invasive/pest species prior to planting;
- Timing/sequencing of restoration activities. Seasonal considerations for planting are critical to success, and not all planting species may fit the same time frame;
- In very large sites may require the delineation of planting zones required to create the components of the overall restoration (e.g. treed and open bog, fen, swamp, shallow marsh, deep marsh, open water etc.);
- Development of features to integrate the restoration into adjacent wetland and upland areas;
- Final species lists for plantings, and seed mixtures;

- Drawings defining planting layout and quantities for each zone, as well as typical details and planting requirements;
- Invasive species management (weeding, cutting, herbicide treatment) including edges surrounding the restoration area, if required;
- Maintenance activities and schedule; and
- Develop a Timeline and Budget: Outline a realistic timeline for the restoration activities and estimate costs, securing funding as needed.

Implementation

- Clear any obstacles, prepare equipment, and ensure safe access to the site;
- Site preparation and grading, including layout and placement of fill materials to be used to construct the physical landscape of the restoration area;
- Implement procedures to restore natural or desired hydrologic and hydrogeologic characteristics such as blocking drains or constructing dams;
- Soil Amendments: Apply soil amendments if necessary to improve soil conditions for vegetation growth;
- Invasive species management (weeding, cutting, herbicide treatment) including edges surrounding the restoration area, if required;
- Harvest restoration plant materials for identified donor bog sites and ensure that they contain a significant fraction of Sphagnum diaspores and other peatland pioneer species. Studies have indicated that sphagnum Moss fragments as small as 0.5 cm have the potential to grow a new plant;
- Collection will be done by mechanically skimming and shredding the plant carpet of the donor site to a depth of 10 cm using a rotovator. This will be done in defined and flagged sections of the surface vegetation of the donor site. These plant fragments are then gathered and loaded for immediate application or raked into windrows or piles to enable easy collection and transport when needed. Experimental evidence indicates that when these materials are kept cold and moist they can be stored in stockpiles for months, possibly a year. When this method of extraction is executed properly in previous restoration projects, it permits swift recovery of the surface plants carpet at donor sites with no permanent damage (**Quinty et.,al., 2003**);
- Following collection, the shredded surface vegetation is spread over the restoration site to form a new plant carpet;
- Introduce native plant species by planting seeds or seedlings and manage invasive species;
- Temporary treatments (e.g. cover nurse crop) or other stabilization techniques to prevent erosion and deter establishment of invasive/pest species prior to planting;
- Timing/sequencing of restoration activities. Seasonal considerations for planting are critical to success, and not all planting species may fit the same time frame;
- Drawings defining planting layout and quantities for each zone, as well as typical details and planting requirements; and
- Schedules outlining each major phase of the project (site preparation, planting, and maintenance).

Monitoring and Adaptive Management

- Develop a monitoring program to track the progress of the restoration;
- Ensure the monitoring program include the tracking of indicators such as surface and groundwater levels, water quality, cover, soil and water chemistry, soil moisture, and biodiversity metrics;

- Conduct regular adaptive management and general maintenance activities to ensure the success of restoration goals (e.g., repairing water retention mechanisms, invasive species management, supplemental planting etc.);
- Use results of monitoring program to develop adaptive management plans as required;
- Produce annual monitoring report detailing records of restoration activities, monitoring results, and proposed adaptive management requirements for subsequent year;
- Distribute monitoring report to Stakeholders;
- When applicable share findings with broader scientific community to contribute to the wider knowledge base of peatland restoration; and
- As part of the monitoring process, develop management plans for the continued management and protection of the restored peatland.

2.1 References

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