REHABILITATION AND INVASIVE SPECIES MANAGEMENT PLAN

MANITOBA-MINNESOTA TRANSMISSION PROJECT

Draft

PREFACE

MANITOBA HYDRO'S ENVIRONMENTAL COMMITMENT

Manitoba Hydro is committed to protect and preserve natural environments and heritage resources affected by its projects and facilities. This commitment and a commitment to continually improve environmental performance is demonstrated through the company's Environmental Management System, which is ISO 14001 certified.

Environmental protection can only be achieved with the engagement of Manitoba Hydro employees, consultants, local communities and contractors at all stages of projects from planning and design through construction and operational phases.

As stated in the Corporate Environmental Management Policy, Manitoba Hydro is committed to protecting the environment by:

- *preventing or minimizing any adverse impacts on the environment, and enhancing positive effects*
- *continually improving our Environmental Management System*
- *meeting regulatory, contractual and voluntary requirements*
- *considering the interests and utilizing the knowledge of our customers, employees, communities, and stakeholders who may be affected by our actions*
- *reviewing our environment objectives and targets annually to ensure improvement in our environmental performance*
- *documenting and reporting our activities and environmental performance*

Manitoba Hydro's environmental management policy has been used to guide the development of environmental protection programs for proposed projects. Implementation of the program is practical application of the policy and will demonstrate Manitoba Hydro's dedication to environmental stewardship. Part of Manitoba Hydro's commitment to environmental protection includes rehabilitation and invasive species management.

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1. Introduction

The purpose of this Rehabilitation and Invasive Species Management Plan is to provide information that will guide contractors and Manitoba Hydro staff project construction, maintenance, and decommissioning in a manner that meets the Manitoba Hydro's Environmental Management Policy and project commitments.

What is Rehabilitation and Invasive Species Management?

Rehabilitation is the process of returning the land in a project area to a condition compatible to its former state after development has disturbed the land. Invasive species management is the process of managing the invasive species growing in the project area through a variety of methods. Invasive species are plants, animals or other organisms that are growing outside of their country or region of origin and are out-competing or even replacing native organisms. Since they come from ecosystems in other parts of the world,"unwanted invaders" escape their natural enemies. They have a distinct advantage over our native species whose populations are kept in check by native predators, competitors, or disease.

Reasons for rehabilitation and invasive species management may include:

- reducing the risk of erosion
- controlling the spread of invasive plants
- reducing access
- reclaiming land
- improving aesthetics
- restoring ecosystem function

Project components that may require Rehabilitation and Invasive Species Management

The main project components that may require rehabilitation and invasive species management include the following:

- right-of-ways (RoWs)
- access trails and roads
- borrow pits and quarries
- material placement areas
- marshalling yards
- construction camps
- station sites

Potential disturbances that may require Rehabilitation and Invasive Species Management

Some potential disturbances that require rehabilitation and invasive species management include the following:

- vegetation clearing at stream crossing
- rutting of access trail or RoW
- erosion at stream bank or ditch
- hazardous releases
- invasive species

Tree control programs on transmission line RoWs, such as winter shearing, mowing, hand cutting, and herbicide treatments are not discussed in this document. Tree control programs are detailed in Manitoba Hydro's ***Transmission Line and Transmission Station Vegetation Management Practices*** publication.

2. Rehabilitation Methods

2.1 Erosion and Sediment Control

Project activities may result in the disturbance or removal of topsoil and modification of the landscape. Where possible, removal of ground plant cover and soil disturbance should be minimized during project activities. Vegetation provides a protective cover for underlying soil and reduces surface runoff. Removal of vegetation cover exposes soil and can result in soil losses from wind and water erosion. In locations of rapid run-off, runnels may develop. Soil erosion near watercourses can reduce water quality by causing sedimentation, resulting in a reduction of aquatic ecosystem health.

Erosion control of disturbance sites may be necessary prior to re-establishment of vegetation. Erosion control prescriptions will vary considerably based on the conditions found at the site. The goal of erosion and sediment control is to create a self-supporting habitat, which is resilient to natural disturbance without further assistance. Erosion control can exist in several forms**.**

Methods to reduce soil erosion include the following:

- **Mulch** - Finely chopped organic or biodegradable material (e.g. wood fibre, wood chips).
- **Fibre blanket** – Rolled blankets to assist vegetation establishment used commonly on channels and slopes.
- **Silt fence** - Permeable fabric barriers anchored into the ground to collect sediment.
- **Rip-rap** – Rock protection used to line channel banks and slopes.
- **Gabions** - Wire baskets filled with rock to protect slopes.
- **Check dams** - Small dams constructed across channels to reduce flow velocity (e.g. rock, wood, sand bag).
- **Barriers** - Straw bales, brush or rock secured to reduce storm water runoff.
- **Soil tackifier** – Adhesive spray to stabilize soils prone to erosion (e.g. stockpiles).
- **Cover crop** – Early crop planted to stabilize the ground.
- **Planting/seeding** – Vegetation to provide cover and stabilize the ground.

2.2 Site Preparation

Site preparation for rehabilitation may vary with site conditions. Site preparation methods will depend largely on the degree of disturbance, soil conditions, and existing vegetation remaining and regenerating in sites.

Site preparation options include the following:

- **Contouring** - Site preparation may involve contouring of an area where a disturbance has occurred (e.g. borrow pits) prior to implementing other efforts.
- **Addition or removal of topsoil** - Where topsoil has been removed for project activities, site preparation should involve the replacement of topsoil. The salvage of topsoil is a priority that should be considered in the planning stages of a project. Topsoil is the uppermost layer of soil that is important for nutrient cycling and is a source for native plants. The amount of topsoil required for replacement should ideally match the depth of topsoil as to what was there before, or a minimum depth of 30cm. Effective topsoil management is an essential component of rehabilitation success.
- **Grading of ground material** - Site preparation may involve grading of soils where a disturbance has occurred (e.g. rutting). On terrain with slopes, it is recommended that grading occur across a slope to reduce erosion, and grading of materials should not result in slopes steeper than a 5:1 ratio.
- **Soil de-compaction -** Equipment continually driving over an area may result in compaction. Soil compaction is the squeezing together of soil particles, reducing the space available for air and water. Site preparation may involve treatment for soil compaction prior to re-establishment of vegetation by light discing or tilling to avoid loss of soil moisture and soil structure.
- **Seedbed Preparation** – Site preparation may also include preparing the seedbed prior to revegetation to enhance germination success. Seeding options discussed below.

2.3 Revegetation

Revegetation is the process of plants growing again on land previously disturbed. This may be a natural process by plant colonization and succession or an artificial accelerated process (e.g. seeding, planting) designed to repair a disturbance to the landscape.

In some locations, natural regeneration is a viable means of rehabilitation by natural seeding, sprouting, suckering or layering of vegetation. Where conditions are ideal regarding topography, slope, moisture, time of year, and condition of surrounding vegetation, natural regeneration may be the preferred method. Where conditions are not ideal for natural recovery, rehabilitation should involve artificial regeneration by planting or seeding.

2.3.1 Planting Options

Options for rehabilitation by planting include the following:

- **Tree seedlings** – Tree seedlings may be obtained as either bare root or containerized stock. Bare root stock need to be handled carefully while in storage and during planting,

and exposed roots can dry out quickly. Containerized stock provides root protection and increased flexibility as to timing of planting. Spacing for seedlings can be variable. Seedlings are recommended for large-scale plantings. Common seedlings for rehabilitation may include jack pine, white and black spruce, and balsam fir.

- **Transplanting -** Transplanting is a form of artificial regeneration where plants are removed from one location and planted in another. Transplanting is a useful means of re-establishing native species quickly. Preferably, transplanting should occur from similar habitats and nearby sources to increase growing success. Vegetation transplanted in disturbed sites may increase the rate of natural regeneration by capturing seeds and organic material from surrounding plant cover. Transplanting is a recommended method for vegetation rehabilitation near watercourse crossings. Species such as hybrid poplar and willow cuttings are commonly planted because of their good rooting ability and fast growth rate.
- **Sprigging** - Plant sections cut from rhizomes or stolons that include the vegetation crowns and roots. Sprigging can be an effective method for disturbed and erodible stream crossing sites.

2.3.2 Seeding Options

Options for rehabilitation by seeding include the following:

- **Drill Seeding** - Drill seeding involves a tractor-pulled seed drill. In larger areas, equipment can furrow soil, plant seed and pack soil over seed in one pass. Native seed drills are most efficient and accurate at placing seed. Drill seeding should be done into well-cultivated soil, free of lumps and debris, and firmly roller packed.
- **Broadcast seeding** - Broadcast seeding is accomplished by dispersing seed by machine or hand. Broadcasting is effective where the access of large machinery is not possible or recommended, although requires the use of more seed. An attempt should be made to incorporate the seeds into the soil as an additional step after broadcasting.
- **Hydroseeding** - Hydroseeding is a method that uses a slurry of seed, mulch, water and tackifier which is transported by a water tank that may be mounted on a truck or trailer and sprayed over prepared ground. Hydroseeding is an alternative to traditional broadcasting or drilling seeding.

2.4 Other Important Considerations and Options

2.4.1 Ecological Context

Rehabilitation prescription needs to be appropriate for the site under consideration. Manitoba is comprised of six ecozones representing large generalized ecological units characterized by interactive and adjusting abiotic and biotic factors. Selecting vegetation for rehabilitation needs to be suitable to the site. Appendix D identifies characteristic vegetation of Manitoba's ecozones.

2.4.2 Using Native Species

Native species are plants occurring within their historic range bounded by the dispersal potential of the plant. These species are favoured for rehabilitation for several reasons, including ecological

compatibility, palatability, and adaptation to local soils and climate. Using local native species for rehabilitation is a well established method that makes ecological and economic sense. Native plant material should be used for rehabilitation of a disturbance area where the goal is to re-establish a native plant community.

2.4.3 Seed Mix Recommendations

It is more important to use the correct species, rather than the prescribed seed rates. This section identifies native seed mixes for disturbances in Manitoba. Establishing long-term plant communities requires forethought as to appropriate species to use. Actual amounts of species present in a seed mix may vary depending upon seed availability. The best adapted species will result from seed collections in the region. Species listed in Appendix E can be chosen as a baseline mix and are generally commercially available. Both upland and lowland mixes are provided for northern, west central, and southern Manitoba. Species listed in Appendix F are commercially available in Manitoba and may be added for diversity.

2.4.4 Commercial Seed and Plant Providers

Purchasing native seed from commercial providers is a practical option for large rehabilitation sites. In response to demand for genetically diverse native seed for rehabilitation projects, native seed producers have become increasingly common. Where seed will be purchased, the following information should be considered:

- Species selection for seeding should be undertaken in conjunction with recommended seed mixes, generally with a dominance of native graminoids and subdominant native broadleaf herbs.
- Seed acquisition should be determined through consultation with a vegetation specialist, using ready available native local seed, wherever possible.
- Forage grasses should not be seeded as they are developed for maximum forage production, and may destroy habitat by taking over native plant communities.
- The genetic origin of the seeds should be from Manitoba or nearby provinces, from a similar region.
- Commercial seed providers should produce certificates of analysis from an accredited laboratory that provides seed purity and germination values.

2.4.5 Seeding Dates

There are two timing windows for seeding. The preferred time to seed occurs during the spring as soon as the ground has reached a desirable temperature ($5^{o}C$) and the danger of a killing frost has past. The second and less successful time is dormant seeding in the fall once the ground temperature has lowered to $5^{o}C$, where seeds will germinate the following growing season. For sites with a high risk of erosion, seeding could occur at anytime.

2.4.6 Rates for Seeding

Seeding rates can vary depending on method of seeding and applicator. Seeding rates may need to be adjusted for wind loss, animal consumption, slope, seed weight, germination rate, annual survivorship, and intended density of mature plants. General seeding rates include the following:

- drill seeding <15 kg/ha
- broadcast seeding 30 to 85 kg/ha
  - broadcast seeding involves scattering of seed manually by hand (or hand-held seeder) or mechanically.
- hydroseeding 75 to 100 kg/ha
- cover crops 2.2 to 5.5 kg/ha (seeded lightly to reduce competition with native species)

The seeding rate calculation for a species that occupies 10% of a seed mix (e.g. 84 kg/ha) includes the following: 84 kg/ha x 0.10 = 8.4 kg/ha

2.4.7 Rates for Planting Tree Seedlings

Spacing of tree seedlings can be variable within disturbance areas. In general, spacing to achieve about 2,500 seedlings per hectare requires spacing of 2.1 m between rows and 1.8 m between seedlings. At this level of spacing, most equipment will be allowed to move between rows without damaging trees. Manitoba Sustainable Development should be consulted to determine spacing requirements for large scale rehabilitation.

Transplanting cuttings such as poplar or willow species can be used. Cuttings should be a minimum length of 30 cm and buried in the ground at least half its length. Cuttings are most successfully transplanted in the spring and fall. Both poplar and willow species have good propagation success because of their rooting ability and are desirable for erosion control.

2.4.8 Fertilizers

Fertilizers can be added to the soil to supply one or more plant nutrients essential to the growth of plants. Fertilization may improve productivity of a rehabilitation effort during early growth stages. Applying excessive amounts of fertilizer can have negative environmental effects (e.g. seed damage, run-off, encourage invasive species, etc.). The storage, handling, and application of fertilizers are legislated in Manitoba (The Water Protection Act, The Pesticides and Fertilizers Control Act). This legislation is intended to protect Manitoba's water quality. It is important to consult this legislation prior to applying nutrients to rehabilitation sites.

3. Invasive Species Management

Many species in Manitoba are so common now that they are often mistakenly considered native. These species have become widely naturalized through intentional and accidental introductions. Invasive species reduce biological diversity and threaten native ecosystems. Examples of invasive species in Manitoba include purple loosestrife, ox-eye daisy and leafy spurge. Plants listed by the Invasive Species Council of Manitoba are provided in Appendix G, and these species should be watched for closely.

Once invasive species become established control measures can be costly to implement. Therefore, a successful invasive species management should involve taking preventative measures, early detection, and rapid management response.

The management of invasive species must consider the ownership of the land. The responsibilities for management on different ownership types are described below:

ROW on private/municipal lands: As Manitoba Hydro has only an easement the responsibility of invasive species management lies with the landowner. If invasive weeds are introduced to the right of way as a direct result of Manitoba Hydro activities it will work with the landowner to implement control options.

ROW on railway, road allowance or highway lands: As Manitoba Hydro does not have an easement the responsibility of invasive species management lies with the landowner. If invasive weeds are introduced to the right of way as a direct result of Manitoba Hydro activities it will work with the landowner to implement control options.

ROW on Manitoba Hydro owned lands: Manitoba Hydro is responsible for invasive species management to be in compliance with the Manitoba Noxious Weeds Act.

ROW on Crown lands (including lands with third party interests): As Manitoba Hydro has only an easement the responsibility of invasive species management lies with the Crown (landowner) or the third party interest. If invasive weeds are introduced to the right of way as a direct result of Manitoba Hydro activities Manitoba Hydro would consult with local Weed Supervisors and Manitoba Agriculture and/or Sustainable Development departments to implement control options.

3.1 Prevention

An initial step in controlling invasive plant species is preventing their establishment. Prevention is relatively cost-effective when compared to invasive species control and management efforts. Preventative measures may include the following:

- Education on how to identify invasive species and infestations.
- Clean and wash equipment and boots before entering and leaving a site to prevent transport of seeds.
- Design seed mixes with species that have differing growth forms to occupy the variety of niches available, and seed native species known to be competitive.
- Record early detection of invasive species problem areas on adjacent lands.
- Avoid driving or walking through areas of invasive species.

3.2 Treatment Options

Treatment options to control invasive plant species include the following:

- **Manual control**, hand-pulling or hand-slashing weeds, can be effective for smaller infestations and in environmentally sensitive sites where herbicide use is not an option. Species should be placed in a tightly sealed bag and burned when conditions are appropriate.
- **Mechanical control**, such as mowing and burning, can be effective for larger infestations.

- **Chemical control** is often the most effective short-term management strategy for invasive species.
- **Cultural Control,** such as grazing or alternate land uses, can be effective depending on location.
- **Biological control**, can be an ecologically sustainable practice using insects and diseases but is considered a long-term management strategy.
- **Native species competition**, control by desirable plants through competition of resources.
- **No Control,** in some instances the implementation of a "no control" option and continuous monitoring is the most practical and environmentally responsible course of action. As an example while milkweed is listed as a noxious weed and can cause economic and health effects on cattle it is a vital part of the ecosystem for monarch butterflies. In situations outside of areas of cattle production where the control of milkweed would have greater adverse environmental effects, the "no control" course of action is warranted. In instances where "no control" is being considered as the treatment option, discussions with landowner and government regulators will take place.

3.3 Treatment Options for Common Species

The following identifies an overview of treatment options for some common invasive species.

Leafy Spurge

- Manual control (hand-pulling) is effective for small infestations.
- Mechanical control (mowing) will reduce the plants ability to seed but has little long-term effect on the plant.
- Chemical control is effective in spring and fall.
- Biological control is considered a long-term management strategy.
- A combination of control measures in an integrated approach is recommended for this species.

Common Tansy

- Manual control (hand-pulling) is effective for small infestations.
- Mechanical control (mowing) will reduce seed production but requires repeat treatment.
- Chemical control is effective.
- Biological control is anticipated to be an effective measure for this species in the future.
- Native species competition has been effective for small infestations.

Scentless Chamomile

- Manual control (hand-pulling) is effective for small infestations.
- Mechanical control (mowing) is effective but requires repeat treatment.
- Chemical control is effective. Earlier applications have greater success.
- Biological control has had some success.
- Native species competition has been effective.
- A combination of control measures in an integrated approach is recommended for this species.

Purple Loosestrife

- Manual control (hand-pulling) is effective for small infestations.
- Chemical control is effective in uplands. No herbicides are currently approved in Canada for treatment near or in water.
- Biological control is the most effective measure for large infestations near water.

Ox-eye Daisy

- Manual control (hand-pulling) is effective for small infestations, if the roots are removed.
- Mechanical control (mowing) stimulates shoot growth and requires repeat treatment.
- Chemical control is effective.

Sweetclover

- Manual control (hand-pulling) is effective for small infestations, if the roots are removed.
- Mechanical control (mowing) should occur before seed production.
- Chemical control is effective.
- Native species competition has been effective as part of a management strategy including native seeding, burning and mowing.

Canada Thistle

- Manual control (hand-pulling) is effective for small infestations, if the roots are removed.
- Mechanical control (mowing) is effective but requires repeat treatment.
- Chemical control is effective.

4. Environmental Monitoring

Environmental monitoring is an important component for rehabilitation and invasive species management. Monitoring will verify the implementation and effectiveness of rehabilitation measures and invasive species management. Successful rehabilitation of disturbed areas will be defined by the establishment of native species, no evidence of erosion, and resilience to the disturbance. The following should be completed during environmental monitoring of disturbance areas:

- Disturbance areas should be inspected frequently in the first year and monitored annually thereafter until vegetation re-established.
- Monitoring may include an assessment of erosion control.
- Monitoring will include an assessment of vegetation to measure plant growth.
- Monitoring will be conducted by Manitoba Hydro inspectors and/or vegetation specialists.

5. Maintenance

Environmental monitoring will determine if maintenance activities are required. Maintenance activities may include additional erosion control, re-seeding or further plantings, protection from browsing, and invasive species control. Maintenance activities will help to minimize damages and keep rehabilitation costs down.

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Appendix A. Rehabilitation Checklist

Date (yyyy mm dd)	
Name of recorder	Company (*if different from Manitoba Hydro*)
Location GPS	
Project	
Description of disturbance (*type*)	
Size of disturbance (m^2 *or ha*)	
Severity of disturbance *(e.g. erosion is occurring, disturbance is stable)*	
Slope of site (level 0-0.5%, nearly level 0.5-2.5%, very gentle to gentle 2-9%, moderate 10-15%, strong 16-30%, very strong to steep 31-100%)	
Moisture conditions (*dry, moist, wet*)	
Post disturbance soil conditions (*e.g. mineral soil is exposed*)	
Post disturbance vegetation conditions (*e.g. vegetation is removed or little is remaining*)	
Surrounding vegetation (*e.g. grassland, forest, riparian, wetland*) and species if known	
Adjacent land uses (*e.g. agriculture*)	
Photographs	
Remarks	

Appendix B. Manitoba Hydro's Agricultural Biosecurity Policy.

Manitoba Hydro's Agricultural Biosecurity Policy was created to prevent the introduction and spread of disease, pests and invasive plant species in agricultural land and livestock operations. Manitoba Hydro employees and contractors will follow this corporate policy and the Transmission Business Unit Agricultural Biosecurity Standard Operating Procedures (SOP).

Manitoba Hydro staff and contractors have the potential to impact agricultural biosecurity through construction and/or maintenance activities requiring access to agricultural land. Acknowledging this risk, the purpose of the Agricultural Biosecurity Policy is to ensure that Manitoba Hydro staff and contractors take necessary precautions to protect the health and sustainability of the agricultural sector.

The Transmission SOP and the training associated with it apply to all the employees of Transmission as well as external individuals such as contractors or consultants who conduct work on behalf of the Transmission Business Unit. The SOP also includes procedures to provide guidance and direction to staff and contractors/consultants who may be required to enter agricultural land and the levels of cleaning necessary to reduce the likelihood of transport of invasive species, pests or disease.

Appendix C. General Strategies for Sites Requiring Large Scale Rehabilitation.

Marshalling Yards, Construction Camps, and Station Sites

- Construction areas no longer required will be assessed for rehabilitation requirements immediately after demobilization and clean-up. Rehabilitation may not be required for areas that will return to original use or continue to be utilized by other entities (i.e. gravel pit used as a marshalling yard).
- Assess the site for potential contamination from hazardous substances (i.e. fuel and oils).
- If contamination is located, follow steps outlined below under contaminated sites.
- Implement erosion and sediment control as required.
- Implement measures of site preparation as required (e.g. topsoil replacement, grading).
- Use topsoil that has been stripped and stockpiled for site rehabilitation and seedbank.
- Where topsoil is required but unavailable, topsoil will be imported from clean sources.
- Where required, appropriate seed mixes and plantings should be used.
- Seed areas using appropriate seeding method (e.g. broadcasting, drill seeding).
- Implement preventative measures to reduce the spread of invasive species.
- Artificial revegetation should occur in spring or late fall.
- Sites will be monitored and maintained as required (e.g. erosion control, re-seeding, invasive species control etc.).

Borrow Pits, Quarries and Material Placement Areas

- Construction areas no longer required will be assessed for rehabilitation requirements. Rehabilitation may not be required for areas that will return to original use or continue to be utilized by other entities (i.e. quarry utilized by Gravel Contractor).
- Contour site to achieve desired slope no steeper than 5:1 ratio.
- Replace stockpiled overburden.
- Implement erosion and sediment control as required.
- Implement additional measures of site preparation as required (e.g. grading, de-compaction).
- Where topsoil is required but unavailable, topsoil will be imported from clean sources.
- Where required, appropriate seed mixes and plantings should be used.
- Seed areas using appropriate seeding method (e.g. broadcasting, drill seeding).
- Consult with the regional forest office if large scale imported seedling planting needs to occur to discuss species and planting requirements.
- Implement preventative measures to reduce the spread of invasive species.
- Artificial revegetation if required should occur in spring or late fall, where practical.

- Sites will be monitored and maintained as required (e.g. erosion, re-seeding, invasive species etc.).

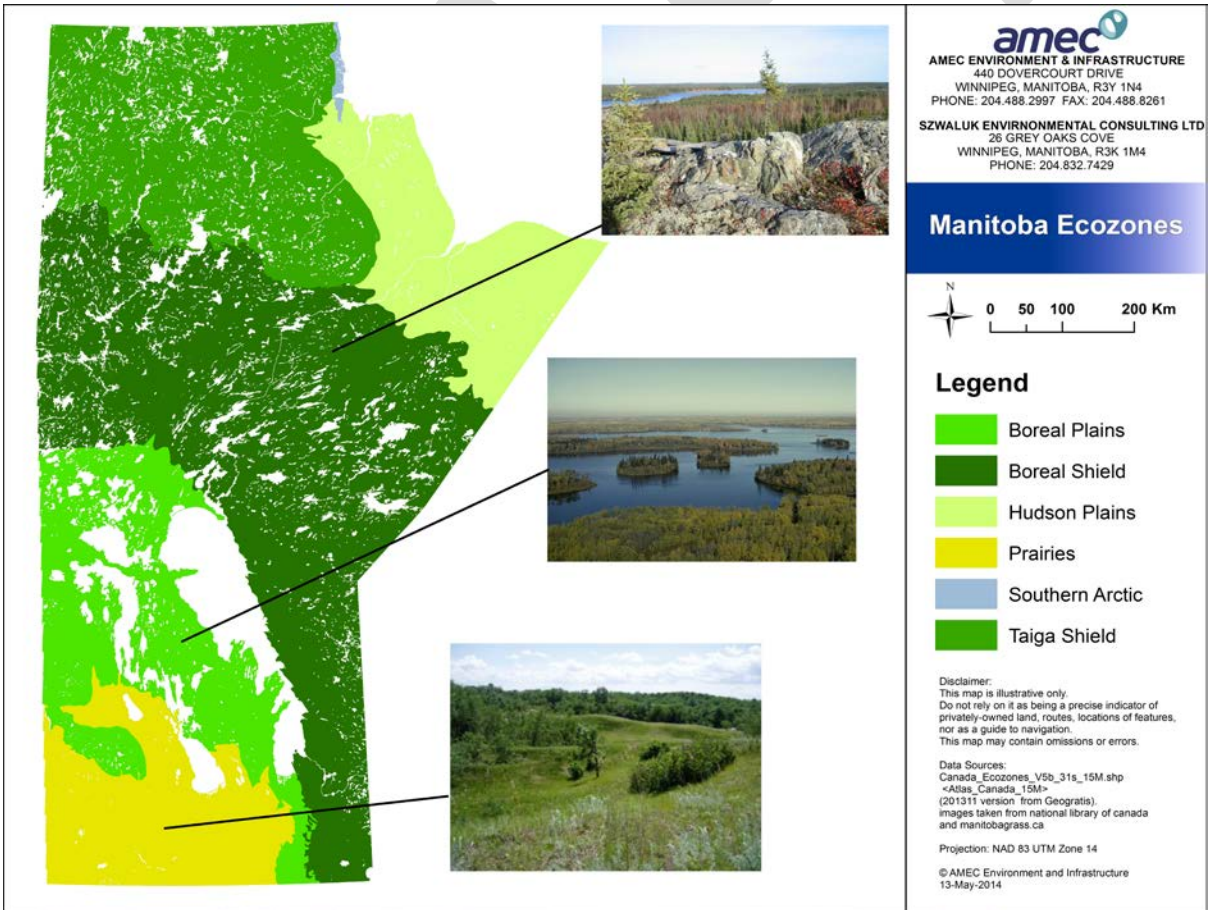
Contaminated Sites and Hazardous Releases

- Hazardous substances will be subject to provincial and federal workplace hazardous materials information system regulations and guidelines, the Manitoba Workplace Safety and Health Regulation, and will be managed in accordance with Manitoba Hydro's ***Hazardous Materials Management Handbook***.
- If a release occurs, releases are to be reported using the Hazardous Materials Incident Report (Form 2875) in accordance with the Manitoba Hydro reporting protocol (***Hazardous Materials Management Handbook***).
- An environmental specialist will determine the extent and type of contamination.
- Clean up all visible signs of the release by treatment on site or transportation to an approved location for remediation.
- Sampling results will indicate whether clean up is sufficient.
- Implement erosion and sediment control as required.
- Implement measures of site preparation as required (e.g. topsoil replacement, grading).
- Where topsoil is required but unavailable, topsoil will be imported from clean sources.
- Where required, appropriate seed mixes and plantings should be used.
- Seed areas using appropriate seeding method (e.g. broadcasting, drill seeding).
- Implement preventative measures to reduce the spread of invasive species.
- Artificial revegetation if required should occur in spring or late fall.
- Sites will be monitored and maintained as required (e.g. erosion control, re-seeding, invasive species control etc.).

Appendix D. Characteristic vegetation of Manitoba's ecozones.

Manitoba Ecozone	Characteristic Vegetation
Southern Arctic	Occasional forest stands, dwarf birch, willows, ericaceous species, various herbs, mosses and lichens.
Hudson Plains	Black spruce, white spruce, tamarack, ericaceous shrubs, sedges, mosses and lichens. Closer to the coast there are marine marshes, shallow fens, and extensive mud flats with little vegetation.
Taiga Shield	Black spruce, white spruce, tamarack, and ground cover of dwarf birch, willows, northern Labrador tea, cotton grass, mosses, and lichens. Paper birch, balsam poplar and trembling aspen may be found. Bog and fen complexes are present.
Boreal Shield	Single-species forest stands, or mixed stands of white and black spruce, balsam fir, tamarack and jack pine. White birch, trembling aspen, and balsam poplar can be found. Understory is dominated by shrubs, forbs and lichen cover over bedrock outcrops.
Boreal Plains	White spruce, black spruce, jack pine and tamarack are the main coniferous species, while deciduous trees include white birch, trembling aspen and balsam poplar
Prairies	Predominantly agricultural crops and rangeland. Stands of trembling aspen, balsam poplar and bur oak occur.

Source: Smith et al. (1998).



Appendix E. Recommended baseline native seed mixes.

Common Name	Scientific Name	Percent in Mix (Total 100%)
Northern Manitoba - upland mesic to dry soils		
Short-leaved Fescue	*Festuca brachyphylla*	10
Canada Wild Rye	*Elymus cananadensis*	20
Tickle-grass	*Agrostis scabra*	10
Hairy Wild Rye	*Leymus innovatus*	20
June Grass	*Koeleria macrantha*	10
Rocky Mountain Fescue	*Festuca saximontana*	10
Richadson Needle Grass	*Achnatherum richardsonii*	15
Common Vetch	*Vicia americana*	5
Northern Manitoba – lowland wet meadow soils		
Fowl Blue Grass	*Poa palustis*	30
Marsh or Northern Reed Grass	*Calamagrostis canadensis* or *C. stricta*	10
Slough Grass	*Beckmannia syzigachne*	50
Tufted Hairgrass	*Deschampsia caespitosa*	10
West Central Manitoba - upland mesic to dry soils		
Tickle-grass	*Agrostis scabra*	10
Big Bluestem	*Andropogon gerardii*	20
Purple Prairie Clover	*Dalea purpurea* var. *purpurea*	5
Canada Wild Rye	*Elymus canadensis*	30
Hairy Wild Rye	*Leymus innovatus*	10
Rocky Mountain Fescue	*Festuca saximontana*	5
Awned Wheatgrass	*Elymus trachycaulus* spp. *subsecundus*	10
June Grass	*Koeleria macrantha*	5
Common Vetch	*Vicia americana*	5
West Central Manitoba - lowland wet meadow soils		
Slough Grass	*Beckmannia syzigachne*	50
Marsh or Northern Reed Grass	*Calamagrostis canadensis* or *C. stricta*	5
Tufted Hairgrass	*Deschampsia caespitosa*	30
Baltic Rush	*Juncus arcticus* var. *balticus*	5
Fowl Blue Grass	*Poa palustis*	10
Southern Manitoba - upland mesic to dry soils		
Awned Wheatgrass	*Elymus trachycaulus* spp. *subsecundus*	10
Big Bluestem	*Andropogon gerardii*	30
White Prairie-clover	*Dalea candida*	5
Purple Prairie Clover	*Dalea purpurea* var. *purpurea*	5
Canada Wild Rye	*Elymus canadensis*	20
June Grass	*Koeleria macrantha*	5
Little Bluestem	*Schizachyrium scoparium*	10
Indian Grass	*Sorghastrum nutans*	10
Common Vetch	*Vicia americana*	5
Southern Manitoba – lowland wet meadow soils		
Slough Grass	*Beckmannia syzigachne*	50
Marsh or Northern Reed Grass	*Calamagrostis canadensis* or *C. stricta*	10
Tufted Hairgrass	*Deschampsia caespitosa*	10
Fowl Blue Grass	*Poa palustis*	10
Prairie Cord Grass	*Spartina pectinata*	20

Appendix F. Selection of plant species commercially available for rehabilitation.

Scientific Name	Common Name	Seed	Seedling
Abies balsamea	Balsam Fir		X
Achnatherum hymenoides	Indian Rice Grass	X	
Achnatherum richardsonii	Richardson Needle Grass	X	
Agrostis scabra	Tickle-grass	X	
Andropogon gerardii	Big Bluestem	X	
Arctagrostis latifolia	Polar Grass	X	
Astragalus canadensis	Canada Milkvetch	X	
Beckmannia syzigachne	Slough Grass	X	
Bouteloua curtipendula	Side-oats Grama	X	
Bouteloua gracilis	Blue Grama	X	
Bromus anomalus	Nodding Brome	X	
Bromus ciliatus	Fringed Brome	X	
Buchloe dactyloides	Buffalo Grass	X	
Calamagrostis canadensis	Marsh Reed Grass	X	
Calamagrostis stricta ssp. *inexpansa*	Northern Reed Grass	X	
Calamolvilfa longifolia	Sand Grass	X	
Carex bebbii	Bebb's Sedge	X	
Dalea candida	White Prairie-clover	X	
Dalea purpurea var. *purpurea*	Purple Prairie Clover	X	
Deschampsia caespitosa	Tufted Hairgrass	X	
Distichlis spicata	Alkali Grass	X	
Elymus alaskanus ssp. *latiglumus*	Alaska Wild Rye	X	
Elymus canadensis	Canada Wild Rye	X	
Elymus glaucus	Smooth Wild Rye	X	
Elymus lanceolatus ssp. *lanceolatus*	Thickspike Wheatgrass	X	
Elymus lanceolatus ssp. *psammophilus*	Sand-dune Wheatgrass	X	
Elymus trachycaulus	Slender Wheat Grass	X	
Elymus trachycaulus spp. *subsecundus*	Awned Wheatgrass	X	
Elymus virginicus	Virginia Wild Rye	X	
Festuca brachyphylla	Short-leaved Fescue	X	
Festuca halii	Plains Rough Fescue	X	
Festuca saximontana	Rocky Mountain Fescue	X	
Glyceria grandis	Tall Manna Grass	X	
Helianthus maximiliani	Narrow-leaved Sunflower	X	
Hesperostipa comata ssp. *comata*	Spear Grass	X	
Hesperostipa curtiseta	Western Porcupine Grass	X	
Juncus arcticus var. *balticus*	Baltic Rush	X	
Koeleria macrantha	June Grass	X	
Leymus innovatus	Hairy Wild Rye	X	
Nassella viridula	Green Needle Grass	X	
Panicum virgatum	Switch Grass	X	
Pascopyrum smithii	Western Wheat Grass	X	
Picea glauca	White Spruce		X
Picea mariana	Black Spruce		X
Pinus banksia	Jack Pine		X
Pinus resinosa	Red Pine		X
Pinus strobus	Eastern White Pine		X
Poa alpina	Alpine Blue Grass	X	

Scientific Name	Common Name	Seed	Seedling
Poa glauca	Glaucous Spear-grass	X	
Poa palustris	Fowl Blue Grass	X	
Poa secunda ssp. *secunda*	Curly Bluegrass	X	
Populus spp.	Hydbrid Poplar		X
Pseudoroegneria spicata ssp. *spicata*	Bluebunch Wheat Grass	X	
Quercus macrocarpa	Bur Oak		X
Salix spp.	Hybrid Willow		X
Schizachyrium scoparium	Little Bluestem	X	
Scolochloa festucacea	Sprangletop	X	
Sorgastrum nutans	Indian Grass	X	
Spartina gracilis	Alkali Cord Grass	X	
Spartina pectinata	Prairie Cord Grass	X	
Sporobolus cryptandrus	Sand Dropseed	X	
Thuja occidentalis	Eastern White Cedar		X
Trisetum spicatum	Spike Trisetum	X	
Vicia americana	Common Vetch	X	

Appendix G. Invasive species listed by the Invasive Species Council of Manitoba. Refer to Invasive Species Council of Manitoba Field Guide (2013) and website for identification.

Scientific Name	Common Name
Alliaria petiolata	Garlic Mustard
Arctium minus	Common Burdock
Berteroa incana	Hoary Alyssum
Bromus japonicus	Japanese Brome
Bromus tectorum	Downy Brome
Butomus umbellatus	Flowering Rush
Campanula rapunculoides	Creeping Bellflower
Carduus nutans	Nodding Thistle
Cirsium arvense	Canada Thistle
Cirsium vulgare	Bull Thistle
Convolvulus arvensis	Field Bindweed
Cynoglossum officinale	Hound's Tounge
Echium vulgar	Blue Weed
Eichhornia crassipes	Water Hyacinth
Euphorbia esula	Leafy Spurge
Fallopia japonica	Japanese Knotweed
Gypsophila paniculata	Baby's Breath
Heracleum mantegazzianam	Giant Hogweed
Hesperis matronalis	Dame's Rocket
Hieracium aurantiacum	Orange Hawkweed
Hypericum perforatum	St. John's Wort
Impatiens glandulifera	Himalayan Balsam
Jacobaea vulgaris	Tansy Ragwort
Knautia arvensis	Field Scabious
Leucanthemum vulgare	Ox-eye Daisy
Linaria dalmatica	Dalmatian Toadflax
Linaria vulgaris	Yellow Toadflax
Lychnis alba	White Cockle
Lythrum salicaria	Purple Loosestrife
Matricaria perforata	Scentless Chamomile
Odontites serotina	Red Bartsia
Onopordum acanthium	Scotch Thistle
Phalaris arundinacea	Reed Canary Grass
Phragmites australis spp. *australis*	Invasive Phragmites
Ranunculis acris	Tall Buttercup
Rhamnus cathartica	European Buckthorn
Saponaria officinalis	Bouncing Bet
Saponaria vaccaria	Cow Cockle
Sonchus arvensis	Perenial Sow Thistle
Tanacetum vulgare	Common Tansy
Tribulus terrestris	Puncture Vine
Typha angustifolia and *Typha x glauca*	Narrow-leaved and Hybrid Cattail
Vicia cracca	Bird Vetch

Note: Listed species are category 2 species (localized presence in Manitoba) listed by the Invasive Species Council of Manitoba. Invasive species also are listed under The Noxious Weeds Act of Manitoba.