BIPOLE III TERRESTRIAL ECOSYSTEMS AND VEGETATION ENVIRONMENTAL MONITORING
ANNUAL TECHNICAL REPORT – YEAR VI

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SUMMARY

Vegetation and terrestrial ecosystems were assessed for Year VI environmental monitoring. Surveys were completed for native grassland prairie, terrestrial vegetation (forested areas), wetlands, plants/communities important to Indigenous people, and invasive and non-native species, each with botanical summaries presented. The accuracy of effect predictions and the effectiveness of mitigation are discussed.

A single grassland prairie (PRA) site was surveyed for continued monitoring in 2019. Regeneration of tall shrub cover, primarily trembling aspen (*Populus tremuloides*) saplings, is intermittently dense at this previously open site. Post-construction, ongoing structural changes to vegetation are decreased grass cover and increased tall shrub cover. The proportion of non-native grass has gained dominance over native prairie grasses, since initial sampling. The total species cover in 2019 for this prairie site was 58.6%, up 5.4% from 2018, with 35 species observed within the survey plot. Vegetation cover in the understory is composed primarily of broad-leaved forbs (22%), grasses (16.4%) and regenerating aspen saplings (18.4%). Grasses are dominated by Kentucky blue grass (*Poa pratensis*), big blue stem (*Andropogon gerardii*), and sand grass (*Sporobolus rigida*). The most abundant forbs include smooth wild strawberry (*Fragaria virginiana*), leafy spurge (*Euphorbia virgata*), prairie sage (*Artemisia ludoviciana*) and hairy-golden aster (*Heterotheca villosa*). Six Imperilled to Vulnerable species were found in and adjacent to the monitoring plot. The effect predictions for prairie vegetation were determined to be accurate.

Twenty-six sites were revisited to sample terrestrial (TER) vegetation in Sections N1, N2, N3, N4 and along the northern AC collector lines and construction power line. Total species cover continues to be significantly lower ($p<0.001$) on the RoW. There were no significant differences detected for total number of species present ($p=0.116$), or for diversity ($p=0.551$), while species evenness was higher on the RoW ($p=0.022$). When comparing the mean values for vegetation measures of TER surveys from 2014 to 2019, a steady and marked rise in both species cover and species richness is noted in sites on the RoW. Species diversity values also appear to rise on the RoW, since initial sampling in 2014. Three community types were identified and broadly divided into regenerating hardwood or softwood types. The effect predictions for terrestrial vegetation were determined to be accurate.

Seven environmentally sensitive patterned fen wetlands (WET) were revisited in Sections N3 and N4. Since initial clearing there continues to be a trend of lower mean species cover and richness in sites on-RoW, when compared to off-Row sites. Lower vegetation cover values on-RoW is attributed to the removal of sparse tree cover and low growing woody species on the RoW. Species diversity index and evenness continue to have similar values

across all years and between paired surveys on and off RoW. Two community types were identified on the RoW based on regenerating vegetation cover and composition, and have remained distinguished since initial sampling. The effect predictions were determined to be accurate.

Ten sites were revisited to sample vegetation in the Cowan Blueberry Resource Area (ATK). This season, several Indigenous community members joined the vegetation monitoring team during the field surveys. Two species of blueberries (low sweet blueberry - *Vaccinium angustifolium,* and velvetleaf blueberry - *Vaccinium myrtilloides*) were recorded at seven of the 10 sites on the RoW. Since initial clearing, blueberry plants have been recorded at sample sites with varying presence. Low sweet blueberry continues to be recorded in five sites, and is generally the more prominent blueberry species, with an average cover of 16.3%, an increase of 3.8% from last season and over 2014 pre-clearing surveys (11.9%). Velvetleaf blueberry was observed in six sites (from three in 2018), with an average cover of 1.9% among sites. Total blueberry cover for sites supporting both blueberries on the RoW averaged 13.3% in 2019, an increase since initial RoW pre-clearing surveys in 2014 (12.1%). Other berry plants recorded in plots of the Resource Area include smooth wild strawberry, trailing dewberry (*Rubus pubescens*), raspberry (*Rubus idaeus*), Saskatoon (*Amelanchier alnifolia*), pin cherry (*Prunus pensylvanica*), and chokecherry (*Prunus virginiana*). Total species cover for vegetation surveys continues to be significantly lower on the RoW ($p=0.014$). No significant differences were detected in species richness ($p=0.307$), diversity ($p=0.076$) nor evenness ($p=0.114$), between paired surveys on and off the RoW. Three community type groupings were identified, based on the regenerating vegetation composition and structure. The effect predictions for ATK vegetation were determined to be accurate.

Fifty-seven noxious, invasive or non-native species were recorded project-wide in 2019 from plots and incidental observations in quantitative surveys, roadside sites, and rehabilitation monitoring sites. As with previous years, noxious/invasive and non-native species continue to occur with greatest frequency or cover in roadside S1, S2 sites and INV surveys. On the RoW, there are 23 species listed as noxious weeds, primarily Tier 3 but for four Tier 2 species, leafy spurge (*Euphorbia virgata*), ox-eye daisy (*Leucanthemum vulgare*), bladder campion (*Silene vulgaris*) and scentless chamomile (*Tripleurospermum inodorum*). Thirty-three species are considered invasive, with some overlap between noxious and invasive species, and an additional 17 species are considered non-native. Project-wide, the most commonly observed species were sweet clovers (*Melilotus* spp., 66 records). Forty quantitative monitoring sites were visited to sample noxious, invasive and non-native (INV) vegetation with paired samples conducted at each site, for a total of 80 surveys in Sections N1 to N4, C1, C2 and along the northern AC collector lines and construction power line. Consistent with previous years, total vegetation cover is lower on the RoW ($p<0.001$), while diversity ($p=0.002$) and evenness ($p<0.001$) remain significantly higher compared to

surveys off the RoW. The species richness on and off the RoW is similar (p=0.233). The effect predictions for invasive and non-native vegetation were determined to be accurate.

Sites where species of conservation concern were observed in previous seasons were not monitored in 2019 for presence/ absence of species. The monitoring duration for species of conservation concern has been completed (i.e., surveys during construction and 1-year post construction). During sampling in 2019, 35 species of conservation concern (S1 to S3S5) were recorded in plots and as incidentals from sampling, including quantitative surveys. Among the species of conservation concern rankings, two are Critically Imperilled (S1 to S1S2), seven are Imperilled (S2 to S2S4), while the remaining 26 species are ranked Vulnerable (S3 to S3S5).

Greater than 100 additional sites were visited to assess disturbances along the Bipole III RoW and project components for potential rehabilitation or weed management. Sites visited included tower foundations, snub sites, access trails, equipment paths and stream crossings. The majority of the sites visited were currently revegetating naturally from earlier disturbances. Fourteen sites visited were identified for rehabilitation, with suggested seeding at four other sites. Weed management was identified for 10 rehabilitation sites visited.

TABLE OF CONTENTS

Page No.

LIST OF TABLES

LIST OF MAPS

LIST OF PHOTOGRAPHS

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1.0 INTRODUCTION

On August 14, 2013, Manitoba Conservation and Water Stewardship granted an Environment Act Licence to Manitoba Hydro for the construction, operation, and maintenance of the Bipole III Transmission Project. Clearing and construction for the Project began in 2014 and was completed during the winter of 2017-2018 (2018 in-service date). In the summer of 2019, vegetation and terrestrial ecosystems were assessed for Year VI environmental monitoring (post-construction), within the Manitoba Hydro Bipole III Transmission Project area (Map 1-1, Appendix II).

Bipole III is a new high voltage direct current (HVDC) transmission project required to improve overall system reliability and dependability. The Bipole III Transmission Project involved the construction of a 500 kilovolt (kV) HVDC (high voltage direct current) transmission line that links the northern power generating complex on the Lower Nelson River with the conversion and delivery system in southern Manitoba. The project also involved construction of two converter stations (Keewatinohk in northern Manitoba and Riel east of Winnipeg), two ground electrodes, and additional 230 kV transmission line interconnections in the north to tie the new converter station into the existing northern AC (alternating current) system.

The Bipole III Transmission Project occurs over eight ecoregions. From the Hudson Bay Lowlands in the northeast part of the province, the transmission project crosses boreal forest and wetland habitat. In the west central region of the province, the vegetation transitions from boreal forest to mixed woods. The most southerly portion of the transmission line contains forests, wetlands, prairies and agricultural lands.

Over the six-year duration, this study involved pre-construction surveys along uncleared portions of the transmission project as well as environmental monitoring along cleared project areas. Potential environmental effects as a result of the project are listed in Appendix III, which were identified in the Terrestrial Ecosystems and Vegetation Assessment of the Bipole III Transmission Project (Szwaluk Environmental Consulting et al. 2011) and the project Environmental Impact Statement (Manitoba Hydro 2011). Project commitments for environmental monitoring of terrestrial ecosystems and vegetation are identified in Appendix IV. The specific objectives established for this study, based on The Environment Act Licence conditions, the report on Public Hearing recommendations, and Environmental Impact Statement commitments, were as follows:

- Pre-construction surveys and environmental monitoring of prairie sites;
- Environmental monitoring of terrestrial and wetland sites;
- Pre-construction surveys and environmental monitoring of the Cowan blueberry resource area;
- Environmental monitoring for invasive and non-native species;

- Pre-construction surveys and environmental monitoring for species of conservation concern; and
- Site visits for areas potentially requiring vegetation rehabilitation.

The following hypotheses were developed for environmental monitoring of terrestrial ecosystems and vegetation:

Hypothesis 1: *There are observed differences in species composition within sites being monitored over successive years along the transmission line right-of-way*.

Hypothesis 2: *Invasive and non-native species abundance is related to transmission clearing and construction activities along the right-of-way*.

Hypothesis 3: *There is a relationship between species abundance of blueberry plants along the transmission line right-of-way and clearing activities, in the Cowan resource area*.

2.0 BACKGROUND

The following section discusses the environmental monitoring background for native grassland prairie, terrestrial vegetation (forested areas), wetlands, plants/communities important to Indigenous people, invasive and non-native species, species of conservation concern, and rehabilitation monitoring.

2.1 Native Grassland/Prairie

There is potential for native grassland/prairie areas located in the southern portion of the Project within the HVDC transmission line right-of-way (RoW) to be disrupted by construction activities (e.g., heavy equipment use and grubbing activities).

Approximately 755 ha of the grassland cover type (considered agricultural pastureland) have the potential to be affected by construction activities. Less than 10 ha of dry upland prairie, which are part of grasslands and have been identified as environmentally sensitive sites, may be affected (Szwaluk Environmental Consulting et al. 2011). Another potential effect of the loss of native grassland/prairie areas is the loss of species of conservation concern, such as those listed by the federal Species at Risk Act (SARA), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), The Endangered Species and Ecosystems Act – Manitoba (ESEA), or the Manitoba Conservation Data Centre (MBCDC) as very rare to uncommon, within the HVDC transmission line RoW from construction activities.

Sparsely treed areas, which in some locations span the entire width of the HVDC transmission line RoW, were found in dry upland prairie areas during field assessments. Construction activities can result in the clearing of these treed areas. Native grasslands may potentially be disrupted during HVDC maintenance activities within the transmission line RoW.

Mitigation Measures Identified in the Construction Environmental Protection Plan

- Carry out construction activities on frozen or dry ground to minimize surface damage, rutting and erosion.
- Use existing access roads and trails to the extent possible.
- Remove trees by low-disturbance methods.
- Confine vehicle traffic to established trails to the extent possible.
- Stabilize sites immediately after construction and re-vegetate disturbed areas in accordance with the site Rehabilitation Plan.

Monitoring activities for native grassland/prairie areas are identified in Table 2-1.

Table 2-1. Monitoring activities for native grassland/prairie areas.

Phase	Task Description	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Pre-construction	Ground surveys to collect baseline data	NA	Prairie ESS	One-time	Once	Summer	Species composition and abundance
Construction /Post-construction	Ground surveys to identify changes not discernible from habitat mapping and to monitor protection measures	Prairie area change	Prairie ESS	During construction and 3 years post construction	Annual	Summer	Area affected (ha); species composition and abundance

2.2 Terrestrial Vegetation (Forested Areas)

The Bipole III Transmission Project will result in the loss of native forest vegetation during clearing and construction activities. It is estimated that 3,355 ha of upland forest vegetation will be affected from clearing of the 500 kV transmission line RoW (Szwaluk Environmental Consulting et al. 2011). Removal and long-term loss of forest cover as a result of RoW clearing as well as potential damage to adjacent forest vegetation during clearing and construction has been identified as an effect of transmission line development.

Many environmental effect predictions incorporate effects on the terrestrial vegetation. For these reasons, terrestrial vegetation monitoring provides an effective means for identifying both anticipated and unexpected effects on the terrestrial environment.

Mitigation Measures Identified in the Environmental Impact Statement

- Clearing and construction activities will be carried out during the winter months to minimize the effect on understory species and to minimize surface damage, rutting and erosion.
- Grubbing will be minimized within the RoW to reduce root damage except at foundation sites.
- Tree removal will be confined within the limits of the RoW, with the exception of danger trees located outside the RoW that can affect transmission lines.
- Trees will be felled into the RoW so as not to damage existing vegetation along RoW boundaries.

Monitoring activities for terrestrial vegetation are identified in Table 2-2.

Table 2-2. Monitoring activities for terrestrial vegetation.

Phase	Task Description	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Construction	Ground surveys to identify terrestrial changes not discernible from habitat mapping and to monitor protection measures	Species occurrence	Project Footprint	During construction	Annual	Summer	Species composition and abundance
Post-construction	Ground surveys to identify terrestrial changes not discernible from habitat mapping	Species occurrence	Project Footprint	2 yrs	Annual	Summer	Species composition and abundance

2.3 Wetlands

Bog, fen and marsh wetlands identified along the transmission line RoW cover approximately 1,456 ha (Szwaluk Environmental Consulting et al. 2011). Only bog and fen wetlands were identified for other Project components. Main effects include the potential disruption, alteration or loss of wetlands from Project activities for the transmission line RoW and other project components. Project activities may also affect species of concern that may be present in these areas; cause soil compaction; or change water flow, which may affect plant populations.

Environmentally sensitive areas identified along the transmission line RoW included patterned fen wetlands (Bipole III Environmental Protection Plan). Approximately 535 ha of patterned fen wetlands occur within the transmission line RoW. Main effects to these environmentally sensitive sites include potential site disturbance or loss of plants from construction, maintenance and decommissioning activities.

Mitigation Measures Identified in the Construction Environmental Protection Plan

- Carry out construction activities on frozen or dry ground to minimize surface damage, rutting and erosion.
- Use existing access roads and trails to the extent possible.
- Provide 30 m vegetated (shrub and herbaceous) buffer around site.

- Remove trees by low disturbance methods.
- Confine vehicle traffic to established trails to extent possible.
- Install erosion protection and sediment control measures in accordance with Erosion/Sediment Control Plan.

Monitoring activities for wetlands are identified in Table 2-3.

Table 2-3. Monitoring activities for wetlands.

Phase	Task Description	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Construction	Ground surveys to identify wetland changes not discernible from habitat mapping and to monitor wetland protection measures	Areas and locations of wetlands affected by the Project	Applicable Project Component Footprint and wetland ESS	During construction	Annual	Summer	Area affected (ha); species composition and abundance
Post-construction	Ground surveys to identify wetland changes not discernible from habitat mapping	Areas and locations of wetlands affected by the Project	Applicable Project Component Footprint and wetland ESS	2 yrs	Annual	Summer	Area affected (ha); species composition and abundance

2.4 Plants/Communities Important to Indigenous People

A number of plants and plant communities have been identified as being particularly important to Indigenous people (e.g., Cowan blueberry area, Assiniboine River). These areas are valued for their provision of resources used by Indigenous people including gathering of food and medicines and harvesting plants and trees.

Clearing and construction of transmission line RoW as well as the creation of new access roads/trails for the Project can allow increased access by non-community members to sensitive areas that have been identified by local Indigenous communities and can result in the potential loss of important vegetation resources found at these sites.

Although non-Indigenous people also have long-established traditional uses related to botanical resources, several locations along the preferred route have been identified that

support plants that are used by Indigenous people, including areas for berry picking, medicine gathering, and harvesting plants and trees for cultural purposes. The harvesting and profiting from non-timber resources by non-community members is a concern for local Indigenous communities.

Mitigation Measures Identified in the Construction Environmental Protection Plan

- Carry out construction activities on frozen or dry ground to minimize surface damage, rutting and erosion.
- Minimize surface disturbance around the site to the extent possible.
- Remove trees by low disturbance methods.
- No herbicide to be applied during construction.
- Confine vehicle traffic to established trails to extent possible.

Monitoring activities for Plants/Communities Important to Indigenous People areas are identified in Table 2-4.

Table 2-4. Monitoring activities for plants/communities important to Indigenous people.

Phase	Task Description	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Pre-construction	Ground surveys to collect baseline data	NA	Vegetation ESS	One -time	Once	Summer	Species composition and abundance
Construction	Ground surveys to identify changes not discernible from habitat mapping and to monitor protection measures	Species occurrence	Vegetation ESS	During construction	Annual	Summer	Species composition and abundance
Post-construction	Ground surveys to identify changes not discernible from habitat mapping	Species occurrence	Vegetation ESS	2yrs	Annual	Summer	Species composition and abundance

2.5 Invasive and Non-Native Species

The abundance of non-native or invasive plant species may increase as a result of the Project. Non-native species are plants that grow outside of their normal range while invasive species are plants that out-compete native species when introduced outside of their natural setting.

Construction equipment and vehicles can introduce non-native plants such as white sweetclover (*Melilotus albus*), a herbaceous perennial. During the field assessments in 2010, 27 non-native species were observed throughout the Project Study Area, five of which were invasive plants (Szwaluk Environmental Consulting et al. 2011).

Non-native species are problematic for one or a number of the following reasons: introduced plants are capable of growing under a wide range of climatic and soil conditions; they produce abundant seeds that are easily disseminated; their seeds are long lived or can remain dormant through the winter season; they persist even after the removal of vegetative portions of the plant; and they often have vigorous growth and produce seeds under conditions adverse for other plants. All or any of these factors can lead non-native and invasive species to outcompete native species, shifting the vegetation composition and community where they occur.

Mitigation Measures Identified in the Environmental Impact Statement

- Carry out construction activities during the winter months.
- Wash and inspect all construction equipment prior to working in new sites to reduce the spread of introduced species.
- Ensure that construction materials (i.e., gravel) will be taken from clean sources and ground cover materials will be weed free prior to use.

Monitoring activities for invasive and non-native species are identified in Table 2-5.

Table 2-5. Monitoring activities for invasive and non-native species.

Phase	Task Description	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Construction	Ground surveys to identify changes not discernible from habitat mapping and to monitor protection measures	Species occurrence	Project footprint	During construction	Annual	Summer	Species composition and abundance

Post-construction	Ground surveys to identify changes not discernible from habitat mapping	Species occurrence	Project footprint	2yrs	Annual	Summer	Species composition and abundance

2.6 Species of Conservation Concern

Species of conservation concern include species of plants that are protected under ESEA, SARA, COSEWIC, or that are listed as Imperilled to Vulnerable by the MBCDC. While these species generally exist in low numbers and/or have limited distributions, they play a role in helping to preserve species diversity and help create specialized habitats for other species (e.g., songbirds, invertebrates).

Fifteen locations for plant species of conservation concern were previously known to occur along the transmission RoW and project components (MBCDC records). Field assessments in 2010 identified species of concern along the transmission line RoW local study area (26 locations) and project components (three locations). In 2012, pre-construction botanical surveys conducted for the northern project components identified 42 locations for species of concern.

Construction activities that can negatively affect plant species of conservation concern include the removal of tree cover, the use of heavy equipment (crushing plants), and clearing and grubbing (removal of roots) of vegetation. Another potential effect is herbicide use (during maintenance activities), which not only inhibits the growth of undesirable species, but can also negatively affect desirable species.

Mitigation Measures Identified in the Construction Environmental Protection Plan

- Identify and flag prior to start of work.
- Carry out construction activities on frozen or dry ground to minimize surface damage, rutting and erosion.
- Provide 5 m vegetated (shrub and herbaceous) buffer around site.
- Remove trees by low disturbance methods.
- Confine vehicle traffic to established trails to extent possible.
- Use existing access roads and trails to the extent possible.
- Stabilize sites immediately after construction and re-vegetate disturbed areas in accordance with Site Rehabilitation Plan.

Monitoring activities for species of conservation concern are identified in Table 2-6.

2.7 Rehabilitation Monitoring

Rehabilitation can provide mitigation of adverse Project effects, by providing erosion control and invasive plant spread control, while restoring wildlife habitat and aesthetics. Disturbed habitat will be rehabilitated in all areas not required, and in some areas that are required, for Project operation. Monitoring is required to verify the implementation and effectiveness of rehabilitation measures, the locations and nature of which are presently unknown, but may include staging areas, construction camps and borrow sites.

Monitoring activities for sites rehabilitated are identified in Table 2-7.

Table 2-6. Monitoring activities for species of conservation concern.

Phase	Task Description	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Pre-construction	Ground surveys in areas that may support plant species of conservation concern	NA	Various sites within Project footprint	One-time	Once	Summer	NA
Construction/ Post Construction	Ground surveys to identify changes not discernible from habitat mapping and to monitor protection measures	Species occurrence	ESS sites	During construction and 1yr post construction	Annual	Summer	Presence/ absence

Table 2-7. Monitoring activities for rehabilitation sites.

Phase	Task Description	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Post-construction	Ground surveys will be used to identify the degree of implementation and the effectiveness of rehabilitation efforts	Areas affected by the Project requiring rehabilitation	Rehabilitation area	2 yrs	Annual	Summer	Area (ha) meeting rehabilitation targets

3.0 METHODS

The methods used to assess terrestrial ecosystems and vegetation can be divided into five general groups, those used for: i) project review and site selection; ii) pre-construction surveys; iii) environmental monitoring; iv) rehabilitation surveys; and v) data preparation and statistical analyses. The following sections summarize the specific techniques used in each of these five groups.

3.1 Project Review and Sample Site Selection

Previously collected information, from the Terrestrial Ecosystems and Vegetation Assessment for the Bipole III Transmission Project (Szwaluk Environmental Consulting et al. 2011) and the project Environmental Impact Statement (Manitoba Hydro 2011), was reviewed to identify predictions made in the assessment and recommended future fieldwork. Applicable regulatory documents were reviewed to determine environmental monitoring requirements for vegetation including: Manitoba Hydro – Bipole III Transmission Project, The Environment Act Licence (Manitoba Conservation and Water Stewardship 2013); and Bipole III Transmission Project, Report on Public Hearing (Manitoba Clean Environment Commission 2013).

Vegetation sites selected in previous years (e.g., 2014 and 2015) were visited to collect environmental monitoring information in Year VI. These included sites selected to monitor prairie and forest habitats, wetlands, invasive species, botanical resource areas, and potential rehabilitation sites along Sections N1, N2, N3, N4, C1, C2, S1, S2 and northern project components. Sites where species of conservation concern were observed in previous seasons were not monitored in 2019 for presence/ absence of species. The monitoring duration for species of conservation concern has been completed (i.e., surveys during construction and 1-year post construction). Available progress of project construction activities from Manitoba Hydro were previously reviewed.

To select potential sample sites for pre-construction surveys and environmental monitoring, Manitoba Hydro's Environmental Protection Information Management System (EPIMS) Map Viewer was used to view project footprint imagery (pre- and post-clearing digital ortho-rectified imagery). EPIMS Map Viewer imagery includes information on previously identified environmentally sensitive sites, former vegetation information collected, and vegetation cover from the biophysical land classification. The land classification used is a national landcover spatial database developed by the federal government. Twenty-three classes of native vegetation are identified. Broad classes include coniferous, deciduous, mixed forest, wetlands and grasslands. Each forest class is separated into dense (crown closure >60%), open (crown closure 26 to 60%), and sparse (crown closure 10 to 25%). Other information sources that were reviewed prior

to fieldwork included the terrestrial ecosystems and vegetation technical report prepared for the project (Szwaluk Environmental Consulting et al. 2011), Manitoba Hydro post-clearing geo-referenced digital video/photo products (low altitude) of the project RoW, and Google Earth imagery, which was used to produce fieldwork navigational maps.

Sites were selected based on vegetation type and environmentally sensitivity. Additional criteria included accessibility, disturbance, locations where invasive and non-native species may establish and proliferate, and landowner permission. Sites selected on private lands were submitted to Manitoba Hydro to determine property ownership and contact information. Landowners were contacted by telephone to request permission for access to their properties. Manitoba Hydro provided detailed field maps books of the Construction Environmental Protection Plan (Manitoba Hydro 2014a and 2014b).

Components of the biophysical environment to sample and monitor for the Bipole III Transmission Project were anticipated to include forest and prairie habitats, wetlands, botanical resource areas identified from Indigenous Traditional Knowledge (ATK), species of conservation concern, invasive and non-native species, and rehabilitation sites. These components are considered to be important based on scientific ecological interest, local Indigenous values, and public concern.

3.2 Pre-construction Surveys

Previous pre-construction surveys occurred on uncleared portions of the transmission line RoW. Pre-construction surveys were conducted in areas that were identified important through the environmental assessment process (i.e., prairies, Assiniboine River crossing, and Cowan blueberry resource area). Surveys in 2014 and 2015 focused on areas not previously sampled as a result of landowner permissions in Section S1 and adjustments to the Final Preferred Route at the Assiniboine River area and Moose Meadows. Pre-construction surveys involved native vegetation surveys (quantitative) and rare plant surveys (non-quantitative) in selected habitats along the transmission line RoW. Pre-construction surveys also involved roadside assessments for invasive and non-native species, where roads intersected the RoW primarily adjacent to agricultural land.

3.2.1 Native Vegetation Surveys

Sites previously selected for native vegetation surveys had plots established for future vegetation monitoring. The following method was used for pre-construction quantitative surveys (i.e., prairie and blueberry resource area). The native vegetation survey consisted of establishing sample plots on sites with relatively homogenous vegetation. Vegetation was sampled for composition, abundance and structure. Sampling of selected

sites followed methods outlined by Redburn and Strong (2008) and involved the establishment of five 2.5 m by 2.5 m quadrats with a 1 m by 1 m nested quadrat spaced at 5 m increments along a 30 m transect for shrubs 1 - 2.5 m tall and herbs and low shrubs ≤1 m tall, respectively. Transects were located on sites considered representative of the stand being sampled. The first quadrat was placed at the 5 m mark. The composition of tree cover >2.5 m tall was estimated using a 20 m by 30 m plot centered on each transect. Plant cover was estimated to the nearest 1% for species <15% cover and nearest 5% for those with higher cover. Other incidentally observed species were recorded. Ground cover estimates (percent) were recorded and included exposed soil, litter, rock, water and wood. Site condition measurements included percent slope and aspect. Plot locations were marked at the beginning of each transect with GPS coordinates, and staked with a 30 cm section of plastic conduit pipe driven into the ground with a pin flag inserted. Reference sites were established adjacent to the RoW.

3.2.2 Rare Plant Surveys

Species of conservation concern encompass plants ranked as rare elements by the Manitoba Conservation Data Centre (MBCDC 2018), and those listed under Manitoba's *Endangered Species and Ecosystems Act* (ESEA), the federal *Species at Risk Act* (SARA), or listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

The ranking of species used by the MBCDC according to a standardized procedure used by Conservation Data Centres and Natural Heritage Programs includes a series of ranks on a five-point scale from critically imperilled to secure. Listed below are definitions for interpreting conservation status ranks at the subnational or provincial (S) level. Ranks may also be intermediary between levels.

CRITICALLY IMPERILLED (S1): At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.

IMPERILLED (S2): At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.

VULNERABLE (S3): At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.

APPARENTLY SECURE (S4): At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.

SECURE (S5): At very low or no risk of extirpation in the jurisdiction due to a very extensive range, abundant populations or occurrences, with little to no concern from declines or threats.

Under ESEA, SARA and COSEWIC, species are designated into the following categories: Endangered, Threatened, Extirpated, and Special Concern (See Appendix I).

Species of conservation concern previously observed for the project were reviewed (e.g., Terrestrial Ecosystems and Vegetation Technical Report 2011, and Year I and II Annual Technical Reports 2015 and 2016). Flowering times and preferred habitat for species of conservation concern known to occur in the Project area were also reviewed. Areas with high potential to support species of conservation concern were identified for surveys.

In the field, a combination of meander and transect plant searches were used which followed methods outlined by the Alberta Native Plant Council (2012). Parallel transects were favoured in more open and homogenous landscapes such as prairies, while meander searches were conducted in areas of difficult terrain, unique habitats, and where unusual landscape features occur. Where rare plants were observed, the following information was recorded: GPS coordinates, associated plants and habitat, and photographs were taken.

3.3 Environmental Monitoring

Environmental monitoring occurred on cleared portions of the RoW and cleared Project components. Surveys in 2019 focused on the transmission line RoW in Sections N1, N2, N3, N4, C1 C2, S1 and S2, and the northern project components that included the northern AC collector lines (CL), construction power line (CP) and ground electrode line (GEL). Only the GEL was cleared prior to 2014, and re-cleared during the winter of 2016/2017. In 2019, environmental monitoring included sites for prairie (PRA), terrestrial (TER), wetlands (WET), blueberry resource area (ATK), and invasive and non-native species (INV). The monitoring schedule for species of conservation concern from pre-construction through one-year post-construction was completed in 2018. No further targeted monitoring of species of conservation concern occurred in 2019. Environmental monitoring involved quantitative vegetation surveys to evaluate Project effects. Roadside surveys in Sections S1 and S2 were conducted to record information on invasive and non-native species at road allowances intersecting the RoW. Observations were recorded on the presence of invasive species around towers visible from the roadside. Surveys were conducted mainly in agricultural areas.

3.3.1 Vegetation Monitoring

Sampling involved the methods described above under native vegetation survey. The vegetation survey consisted of establishing sample plots on relatively homogenous sites on the cleared RoW. The following method was used for prairie, terrestrial habitat, wetland, blueberry resource area, and invasive and non-native species sampling (i.e., monitoring). Transects were permanently located along the transmission line RoW, longitudinally, and approximately in the centre of the RoW, but generally off the equipment path. Reference sites that shared similar natural conditions were established adjacent to the RoW, approximately parallel to the RoW sample plot, and plots began approximately 5 m from the RoW edge (i.e., 15 m from RoW edge to the longitudinal transect), using identical quantitative sampling methods. Incidental species observations were recorded both on and off the transmission line RoW. Relative population densities and extent were recorded for incidental invasive species observed. Plot locations were marked at the beginning of each transect with GPS coordinates, and staked with a 30 cm section of plastic conduit pipe, with a pin flag inserted. Photographs were taken at each monitoring site.

For invasive and non-native off RoW sites revisited in 2015 through 2019, a belt transect was used to scan for species, without estimating species cover in quadrats. The belt transect overlaid the original 30 m transect established, with a swath of 2.5 m scanned on either side of the transect for invasive and non-native species (150 m^2). Observations included locations along transect and abundance of species from stem counts or estimates.

3.3.2 Rare Plant Monitoring

Rare plant monitoring for species of conservation concern initially involved the review of species previously observed along cleared portions of the RoW and northern project components (i.e., AC collector lines and construction power line). Monitoring occurred at selected sites to investigate their presence/ absence of species after RoW clearing activities. Species of concern re-assessed in the field had their GPS coordinates verified, abundance and extent estimated, and photographs were taken. In 2019, monitoring was not conducted for species of conservation concern.

3.4 Rehabilitation Surveys

Part of Manitoba Hydro's commitment to environmental protection includes the development of an Environmental Protection Program. Aspects of this program include vegetation rehabilitation and management. In 2018, a list of potential rehabilitation sites was identified by Manitoba Hydro for further site evaluation. In 2019, the RoW was re-evaluated during July and August.

The degree of disturbance was assessed at sites using parameters such as size of disturbance, soil disturbance (i.e., rutting, erosion) and vegetation composition. A site visit helped to determine whether natural re-vegetation would be feasible or if rehabilitation is required. Consideration was given to factors such as topography, slope, moisture, time of year, and post disturbance conditions. Photographs were taken at several sites visited. Rehabilitation activities will be guided by the Rehabilitation and Invasive Species Management Plan (Manitoba Hydro 2018).

Where rehabilitation occurs, monitoring will verify the implementation and effectiveness of rehabilitation measures. Post-construction rehabilitation surveys will record changes in vegetation composition and structure.

3.5 Data Preparation and Statistical Analyses

All vascular plants were recorded and only those unidentifiable in the field were collected as voucher specimens where the population size permits. Specimens were collected following the collection guidelines of the Alberta Native Plant Council (2006). Identification of vascular plants followed Flora of North America (1993+), and other flora as needed. Plant nomenclature follows that used by the Manitoba Conservation Data Centre.

After field sampling was completed, the data was digitized and verified for accuracy. For each plot with quantitative sampling, mean values for vegetation percent cover were calculated for plots with a tall shrub stratum, herb and low shrub stratum, non-vascular stratum, as well as inanimate ground cover. All sites were stratified by vegetation type.

Total species cover (summed % plant cover) and species richness (actual number of species present) were determined for each plot. Species diversity was calculated using the Shannon diversity index, which combines species richness with relative abundance. Equitability was calculated to determine the evenness of species in their distribution within the site.

The Shannon diversity index (1) and equitability (2) are calculated as shown below. The diversity index values fall generally between 1.5 (i.e. low diversity) and 3.5 (Kent and Coker 1996, p97). The equitability (or evenness) value, with an upper limit of 1, is a measure of whether species abundance in a community is evenly distributed.

$$(1) \qquad \text{Diversity } H' = -\sum_{i=1}^{s} p_i \ln p_i$$

where s = the number of species

p_i = the proportion of individuals or the abundance of the *i*th species expressed as a proportion of total cover

ln = log base$_n$

$$(2) \qquad \text{Equitability } J = \frac{H'}{H'_{max}} = \frac{\sum_{i=1}^{s} p_i \ln p_i}{\ln s}$$

where s = the number of species

p_i = the proportion of individuals of the *i*th species or the abundance of the *i*th species expressed as a proportion of total cover

ln = log base$_n$

Although recent research suggests that H' is becoming an expected standard for assessing biological diversity, Strong (2016) suggests that this measure be accompanied by independent analyses of richness and evenness to ensure proper representation of abundance data in ecology.

Wilcoxon tests were used to determine if significant ($P \leq 0.05$) differences occurred between paired sets of samples.

Sites were described by classifying community types based on plant species composition and abundances using hierarchical cluster analysis. Ward's method was used as the clustering algorithm, with squared Euclidean distance as the dissimilarity measure. Where vegetation community types are listed, naming was based on their structure and species dominance by stratum. Species separated by a slash (/) indicates a change in stratum, while co-dominant species are separated by a dash (-) indicating similar abundance within the stratum.

Statistical analyses were performed using R 3.6.1. (R Core Team 2019). Diversity and evenness measures were calculated in Excel.

4.0 RESULTS

The following section discusses the results for all site types: native grassland prairie (PRA); terrestrial vegetation (TER); wetlands (WET); blueberry resource area (ATK); invasive and non-native species (INV sites and invasive species presence recorded project wide); rehabilitation monitoring (RHB) surveys; and species of conservation concern presence recorded project wide. The botanical summary for each quantitative site includes total species cover, species richness, species diversity index, and species evenness, for all site types. The complete flora is provided in Appendix VII, with approximately 372 plant species recorded in 2019. The accuracy of effect predictions and the effectiveness of mitigation for site types are also presented for each site type.

4.1 Native Grassland

A single grassland prairie (PRA) site was surveyed for continued monitoring in 2019 (Map 4-1, Appendix II) (Field Activity ID BPIII_CON_FA487). This PRA site, located in the southern portion of the Bipole III RoW Section S1, was visited on July 9. No off-site survey was established as this patch was originally too small to allow a paired survey adjacent to the RoW, within the same habitat. This site is a dry sandy prairie, with trembling aspen (*Populus tremuloides*) and bur oak (*Quercus macrocarpa*) adjacent to the RoW and currently present as regenerating saplings within the RoW (Photograph 4-1a).

Photograph 4-1a. Regeneration on the RoW at S1-PRA-900.

Six Imperilled to Vulnerable species were found in and adjacent to the monitoring plot including Schweinitz's flatsedge (*Cyperus schweinitzii*, S2), hairy prairie-clover (*Dalea villosa*, S2S3), sand millet (*Dichanthelium wilcoxianum*, S2?), linear-leaved puccoon

(*Lithospermum incisum*, S3), skeletonweed (*Lygodesmia juncea*, S3S4), and sand grass (*Sporobolus rigidus*, S3S5). Prairie spike-moss (*Selaginella densa,* S3), has not been observed since clearing, and was last recorded at this site in 2015. Species of conservation concern from the PRA site are also discussed in Section 4.6.

4.1.1 Data Analysis of Grassland Areas

A summary of vegetation measures from pre-construction (2015) throughout monitoring is shown for the single PRA site in Table 4-1a.

Table 4-1a. Grassland site vegetation measures on RoW during pre-construction and monitoring, 2015 to 2019.

	Pre-Con	Construction			
	2015	2016	2017	2018	2019
Species Cover (%)	62.8	52.8	74.4	53.2	58.6
Species Richness	38	30	33	26	33
Diversity	2.65	2.54	2.27	2.65	2.53
Evenness	0.73	0.75	0.65	0.81	0.72
Number of Surveys	1	1	1	1	1

The total species cover in 2019 for this prairie site was 58.6%, with 35 species observed within the survey plot. Vegetation cover in the understory is composed of broad-leaved forbs (22%) and grasses (16.4%). Grasses are dominated by Kentucky blue grass (*Poa pratensis*, 7.6%), with big blue stem (*Andropogon gerardii*, 3%), sand grass (1.8%), and seven others. The most abundant forbs include smooth wild strawberry (*Fragaria virginiana*, 6%), leafy spurge (*Euphorbia virgata*, 4.8%), prairie sage (*Artemisia ludoviciana*, 3.6%), hairy-golden aster (*Heterotheca villosa*, 1.6%) and thirteen others. Regeneration of trembling aspen (<2m primarily) and occasional bur oak are encroaching into the original prairie opening. Regeneration is intermittently dense at this previously open site, with trembling aspen saplings dominating the cover in some plots, on average 18.4%.

The vegetation structure at a given site makes up specific microhabitats available for use by other species (e.g., birds, insects). After canopy clearing, a site is generally expected to recover to its dominant original vegetation composition, due to the seeds, roots, whole/parts of live plants that remain. While species composition has remained steady in this prairie site, a shift in vegetation structure is apparent when compared to the original pre-construction vegetation measures. Initially in 2015, the vegetation structure was dominated by grass cover (39%), very little low shrub cover (<1%), and no tree or shrub seedlings. There was a very sparse tree canopy (6%), and few tall shrubs (<1%). Ongoing structural changes to vegetation at this site, post-construction and in 2019 specifically, are decreased grass cover (16%) and increased tall shrub cover (19.6%, primarily trembling aspen saplings), when compared to original pre-construction values, Table 4-1b.

Table 4-1b. Changes to native prairie vegetation structure and cover (%) in a single site on RoW, during pre-construction and monitoring (2015-2019).

	2015	2016	2017	2018	2019
Grass/Sedges	39.2	15.6	45.8	19.4	16.4
Broadleaved herbs	17.6	29.2	22.4	18.8	21.6
Low shrubs, woody seedlings	0.4	7.4	5.8	3.6	0.8
Tall Shrubs/Saplings	0.4	-	0.4	11.4	19.6
Trees	6.0	-	-	-	-
Cumulative vegetation cover	63.2	52.2	74.4	53.2	58.4
Soil	1.0	51.4	14.6	8.0	4.0
Litter	84.0	38.2	79.4	91.4	94.4
Woody debris	0.4	6.8	5.4	0.6	1.4

While the number of noxious and invasives species has remained constant over time at this site, the proportion of native species in some instances has changed. Initially, during pre-construction grasses were equally co-dominated by the native big blue stem (13.4%) and the non-native Kentucky blue grass (13.0%). An overall reduction in grass coverage, and a decrease in cover of the native grass big blue stem (3% in 2019), which is now sub-dominant to the non-native Kentucky blue grass (7.6% in 2019) has been recorded since the site was cleared for construction.

4.1.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the Project area assessed in Section S1, the effect predictions from Appendix III for native grassland/prairie area were accurate for the following:

- Potential loss of plants of conservation concern
- Environmentally sensitive sites may be affected
- Loss of native forest vegetation

Mitigation measures identified in the Project Environmental Impact Statement (Manitoba Hydro 2011), the Terrestrial Ecosystems and Vegetation Assessment of the Bipole III Transmission Project (Szwaluk Environmental Consulting et al. 2011), and Annual Technical Reports (2015 and 2016) were initially assessed, after clearing (Table 4-1c). No new PRA sites were sampled in 2019.

Table 4-1c. Mitigation measures assessed at a site monitored for native grassland vegetation on the RoW.

Mitigation Measure
Carry out construction activities on frozen or dry ground to minimize surface damage, rutting and erosion.
Use existing access roads and trails to the extent possible.
Remove trees by low-disturbance methods.
Confine vehicle traffic to established trails to the extent possible.
Stabilize sites immediately after construction and re-vegetate disturbed areas in accordance with the site Rehabilitation Plan.

Recommended mitigation was previously implemented for native grassland/prairie vegetation. In the absence of mitigation, site disturbance likely would have increased. Activities appeared to occur on dry ground to minimize surface damage, rutting and erosion. Existing access roads and trails appeared to be used, and tree clearing occurred within the RoW.

In 2019, vegetation ground cover continues to show disturbance from previous construction activities at prairie monitoring site (S1-PRA-900) and surrounding area. Machinery used to establish anchor points has resulted in loss of vegetation cover around the tower footprint. The area is extremely sandy, and the ground vegetation is easily disturbed. Bare ground was observed around the tower footing area, where invasive species were again noted this year. ATV tracks elsewhere on the property (both on RoW and off site) have produced bare ground (i.e., sand) with very little vegetation regenerating.

Noxious and invasive species observed in S1-PRA-900 are discussed in Section 4.5.1. One species of conservation concern, prairie spike-moss (*Selaginella densa,* S3), has not been relocated in this area since 2015, prior to clearing. Photograph 4-1b shows hairy prairie-clover observed on the RoW.

Photograph 4-1b. Hairy prairie-clover on the RoW.

4.2 Terrestrial Vegetation (Forested Areas)

Twenty-six sites were revisited to sample terrestrial (TER) vegetation from July 5 to 31 (Field Activity ID BPIII_CON_FA487, 488 and 489) (Map 4-1, Appendix II). No other re-visiting of off-RoW sites was required. Five sites are located in each Section N4, N3 and

N2, six sites in Section N1, and five sites are located along the northern AC collector lines (CL) and construction power line (CP). No recent forest fires were observed in the vicinity of sampling sites this season.

4.2.1 Data Analysis of Terrestrial Vegetation

Twenty-six surveys were conducted for terrestrial vegetation. Results of a paired-sample Wilcoxon test for terrestrial vegetation surveys on (2019) and off the RoW (all years) show continued significantly lower values for total vegetation percent cover ($p<0.001$) on the RoW. There were no significant differences detected for total number of species present ($p=0.116$), or for diversity ($p=0.551$), while evenness was slightly higher ($p=0.022$) in surveys on the RoW (2019), versus off-site. Vegetation description measures for paired on- and off- RoW surveys are shown below for species cover, species richness (total number of species), species diversity and evenness, in Table 4-2a. Mean values of vegetation measures for all years of sampling are shown in Table 4-2b.

Table 4-2a. Terrestrial vegetation measures on-RoW (2019) and off-RoW.

	Species Cover (%)		Species Richness		Diversity		Evenness	
Site	**RoW[1]**	**off RoW**	**RoW[2]**	**off RoW**	**RoW[3]**	**off RoW**	**RoW[4]**	**off RoW**
N4TER10	64.2	126.0	29	34	2.2	2.3	0.7	0.7
N4TER20	88.0	138.6	20	27	2.1	2.1	0.7	0.6
N4TER30	125.4	96.8	21	21	1.7	1.6	0.6	0.5
N4TER40	89.6	68.0	45	31	3.0	2.4	0.8	0.7
N4TER50	50.6	158.4	31	28	2.6	2.0	0.8	0.6
N3TER10	96.8	127.2	37	38	3.0	2.9	0.8	0.8
N3TER20	73.4	115.0	18	34	1.6	2.7	0.6	0.8
N3TER30	52.0	145.0	32	31	2.6	2.3	0.8	0.7
N3TER40	139.6	151.8	31	27	2.3	2.1	0.7	0.6
N3TER50	129.2	111.0	25	18	1.6	2.1	0.5	0.7
N2TER10	123.4	140.6	26	22	2.3	1.9	0.7	0.6
N2TER20	155.0	105.0	28	28	2.3	2.1	0.7	0.6
N2TER30	195.4	114.8	29	21	2.7	2.0	0.8	0.7
N2TER40	66.2	129.6	22	18	2.2	1.4	0.7	0.5
N2TER50	9.8	124.2	15	15	2.4	1.2	0.9	0.4
N1TER10	97.4	118.0	34	28	2.5	2.1	0.7	0.6
N1TER20	21.0	154.2	13	23	1.9	1.9	0.8	0.6
N1TER30	40.6	157.6	28	32	2.6	1.9	0.8	0.5
N1TER40	31.6	99.4	16	31	1.9	2.7	0.7	0.8
N1TER50	53.8	120.0	29	37	2.5	2.7	0.7	0.7
N1TER60	50.8	157.8	15	44	1.7	2.7	0.6	0.7
CLTER10	15.8	120.4	12	16	1.9	2.2	0.8	0.8
CLTER20	14.2	129.6	10	14	1.9	1.9	0.8	0.7
CLTER30	45.4	127.0	11	16	1.9	2.1	0.8	0.8
CPTER10	21.8	120.2	10	18	1.6	2.0	0.7	0.7
CPTER20	3.2	127.0	8	16	1.7	2.2	0.8	0.8
Mean	**71.3**	**126.3**	**22.9**	**25.7**	**2.2**	**2.1**	**0.72**	**0.66**

[1] Total species cover (%) is significantly lower on the RoW (2019), $p<0.001$.
[2] No significant differences for species richness on (2019) and off RoW, $p=0.116$.
[3] No significant differences in diversity index on (2019) and off RoW, $p=0.551$.
[4] Species evenness is significantly higher on the ROW (2019), $p=0.022$.

Table 4-2b. Terrestrial site vegetation measures on RoW during pre-construction and monitoring, 2014 to 2019.

	On RoW						Off
	2014	2015	2016	2017	2018	2019	RoW
Species Cover (%)	23.3	21.4	24.0	46.2	52.8	71.3	126.3
Species Richness	12.3	13.1	16.3	19.3	20.8	22.9	25.7
Diversity	1.8	1.9	2.1	2.1	2.2	2.2	2.1
Evenness	0.7	0.8	0.8	0.7	0.8	0.72	0.7
Number of Surveys	15	22	26	26	26	26	26

Vegetation cover is likely to remain far lower on the RoW in TER sites, due to the elimination or reduction of original tall and mid canopies. However, when comparing the mean values for vegetation measures of TER surveys from 2014 to 2019, a steady and marked rise in both species cover and species richness is noted in sites on the RoW, suggesting increasing development of the mid- and low- canopy layers. Species diversity values also appear to rise on the RoW, since initial sampling in 2014, although this trend is not generally statistically significant between years. In the past, increased richness and diversity was partly attributed to non-native species (ranked SNA) that were not initially recorded in 2014, however in 2019 increase due to SNA is minimal (four species), see section 4.5. Species of conservation concern observed in TER plots are discussed in Section 4.6.

4.2.1.1 Cluster Analysis and Community Typing

Hierarchical cluster analyses are used to describe regenerating vegetation community types based on vegetation composition and structure at sites on the RoW. Approximately 171 plant species were observed in the 26 terrestrial vegetation surveys. In 2019, the tree stratum remains generally absent in TER sites sampled on the RoW, with tree canopy recorded in three sites (up from 0 sites in 2018). Regenerating saplings (<2.5 m height) were recorded in 10 sites (up from 8 sites in 2018), and tree seedlings were found across almost every site (21 sites, consistent with 2018). Consistently throughout monitoring, TER sites are roughly distinguished by moisture and past canopy type. The wetter sites generally include black spruce (*Picea mariana*) seedlings and may be divided based on the composition of mosses (i.e. sphagnum and non-sphagnum mosses). Drier sites with past hardwood or mixed wood canopies tend to be species rich and can be further distinguished by either the abundance of grasses or a regenerating shrub layer. Cluster analysis resulted in three community types, broadly divided into regenerating hardwood or softwood groups, Table 4-2c, below.

Table 4-2c. Community types for terrestrial vegetation surveys on the RoW, 2019.

Community Types	Surveys	Species
Aspen- Poplar saplings, Alder- Willow tall shrub/ Herb Rich/ Lichens	12	28.8
Black Spruce seedling – Herb, Sedge Rich/ Mosses	6	25.7
Black Spruce seedling - Labrador Tea– Cloudberry – Herb, Graminoid poor	8	12.1

The first community type is characterized by a well-developed tall shrub layer of regenerating trembling aspen or balsam poplar saplings, Bebb's willow (*Salix bebbiana*) and green alder (*Alnus viridis*). The diverse understory is co-dominated by herbs smooth wild strawberry, trailing dewberry (*Rubus pubescens*), fireweed (*Chamerion angustifolium*) and low shrubs raspberry (*Rubus idaeus*), prickly rose (*Rosa acicularis*), green alder, with trembling aspen and balsam poplar seedlings. Lichen cover is relatively high. Litter cover is high, with a moderate cover of woody debris and bare ground.

In the second community group, tall shrubs and saplings are generally absent. The moderately well-developed understory is co-dominated by a diversity of herbs horsetails (*Equisetum* spp.), three-leaved Solomon's-seal (*Maianthemum trifolium*), and graminoids, including water sedge (*Carex aquatilis*) and fowl manna grass (*Glyceria striata*), with regenerating black spruce seedlings. The cover of mosses is high. Litter cover is high and woody debris cover is low; surface water is present in two sites.

The third community type, tall shrubs are absent. The poorly developed herb and low shrub layer is dominated by Labrador tea (*Rhododendron groenlandicum*), cloudberry (*Rubus chamaemorus*) and lichens, with regenerating black spruce seedlings. Bare ground is generally high, with low litter cover.

4.2.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the Project areas cleared previously, the effect predictions from Appendix III for terrestrial vegetation were accurate for the following:

- Loss of native forest vegetation
- Fragmentation of vegetation communities will occur
- Vegetation diversity will be temporarily reduced on the Project site

Mitigation measures identified in the Project Environmental Impact Statement (Manitoba Hydro 2011), the Terrestrial Ecosystems and Vegetation Assessment of the Bipole III Transmission Project (Szwaluk Environmental Consulting et al. 2011), and Annual Technical Reports (2015 and 2016) were initially assessed, after clearing. Table 4-2d identifies the mitigation measures assessed at each site. In 2019, no new TER sites were sampled. Observations recorded in the field from 2019 are provided below.

Table 4-2d. Mitigation measures assessed at sites monitored for terrestrial vegetation on the RoW.

Mitigation Measure
Carry out construction activities during winter months to minimize the effect on understory species.
Tree removal will be confined within the limits of the RoW, with the exception of danger trees located outside the RoW that can affect transmission lines.
Trees will be felled into the RoW and other project component sites so as not to damage existing vegetation along the RoW.
Grubbing will be minimized within the RoW to reduce root damage except at foundation sites.

Terrestrial vegetation on the RoW continues to show recovery of vegetation after clearing and construction activities, with increasing cover and changing structure (Photograph 4-2a). Recommended mitigation was effective for terrestrial vegetation which minimized the disturbance from project activities. In the absence of mitigation, site disturbance likely would have increased.

Construction activities appeared to be carried out during winter months which minimized effects on understory species and reduced ground disturbance (e.g., rutting). Tree removal occurred in previous years, where trees were felled into the RoW, and grubbing occurred only at foundation sites.

Photograph 4-2a. Regeneration along the RoW at N2-TER-200.

At monitoring sites, signs of rutting and soil disturbance were less visible from previous construction activities. Vegetation cover of herbaceous plants and young shrubs has increased in many of these areas of the RoW, especially in areas with past hardwood and mixedwood forests. Tower foundations and the equipment path still show evidence of recent project activities with areas of exposed soil occasionally present.

Several sites supported an abundance of berry plants on the RoW, as regeneration is occurring. Notable berry plants with fruit included dewberry (*Rubus pubescens*), smooth wild strawberry (*Fragaria virginiana*) and wild red raspberry (*Rubus idaeus*) (e.g., N3-TER-300, N2-TER-200, N2-TER-300 and N1-TER-300).

Windthrow or blowdown (uprooted trees) was commonly observed north of The Pas, along the Wuskwatim transmission line (Photograph 4-2b). Both forest edges of the Bipole RoW (east and west) showed areas of windthrow. Along portions of the RoW, the

narrow buffer between the two RoW's no longer exists. Windthrow in this area of the project has been previously observed.

Photograph 4-2b. Windthrow observed along the RoW boundary.

Regeneration of vegetation along the AC collector lines and construction power line RoW has showed improvement this season. Low shrubs, herbaceous plants, and ground cover of non-vascular plants (i.e., peat mosses and lichens) has increased in areas, particularly in moister sites. Previously scraped areas with minimal amounts of vegetation growing were still observed this season. Drier sites and areas along the equipment path supported lower amounts of vegetation cover. Plot CP-TER-200 is located in an area that has been previously scraped during construction activities and shows slower vegetation recovery (Photograph 4-2c).

Photograph 4-2c. Plot CP-TER-200 with ground cover scraped.

During aerial inspection of the transmission RoW, it was observed that vegetation regeneration is continuing to improve, post clearing and construction activities. Areas of soil disturbance appeared to be less frequent along the RoW, similar to ground observations at monitoring plots. The equipment path remains recognizable on the RoW, from previous activity and travel. Rough bentgrass (*Agrostis scabra*) was observed to be a dominant colonizer of exposed soils along the equipment path in several areas of the RoW; rough cinquefoil (*Potentilla norvegica*) was also frequently observed in these areas. Tall shrub and young tree height growth has increased on the RoW, especially in areas adjacent to upland deciduous and mixedwood forests.

4.3 Environmentally Sensitive Wetlands

Seven environmentally sensitive sites were visited on July 13 to 15 to sample wetland (WET) vegetation in Sections N3 and N4, north and south of The Pas, respectively (Field Activity ID BPIII_CON_FA488) (Map 4-1, Appendix II). The sensitive sites are patterned fen wetlands, identified during the terrestrial ecosystems and vegetation assessment conducted for the Bipole III Transmission Project in 2010 and 2011.

Patterned fen wetland sites on the RoW in Section N3 included N3-WET-100 (identified as N3-ECO-102 in the Construction Environmental Protection Plan), and N3-WET-200 and N3-WET-300 (both identified as N3-ECO-100). In Section N4, patterned fens included N4-WET-100 (identified as N4-ECO-103 in the Construction Environmental Protection Plan), N4-WET-200 (identified as N4-ECO-102), N4-WET-300 (identified as N4-ECO-101) and N4-WET-400 (identified as N4-ECO-100).

Of the seven sites surveyed, four are paired sites, while three remain unpaired (RoW only) due to minor disturbance to ground vegetation on the RoW and unsafe sampling conditions (floating vegetation), determined during original sampling of WET sites. In total, seven surveys were completed for the monitoring of environmentally sensitive patterned fen wetlands on the RoW. Species of conservation concern observed in WET plots are provided in Section 4.6.

4.3.1 Data Analysis of Environmentally Sensitive Wetlands

Vegetation descriptions for seven environmentally sensitive wetlands include species cover, richness, diversity and evenness, Table 4-3a. Mean values for all years' monitoring on- and off-RoW are shown in Table 4-3b.

Table 4-3a. Environmentally sensitive wetland vegetation measures on-RoW (2019) and off-RoW.

	Species Cover (%)		Species Richness		Diversity		Evenness	
Site	**RoW**	**off RoW**	**RoW**	**off RoW**	**RoW**	**off RoW**	**RoW**	**off RoW**
N4WET10	118.2	81.6	28	24	2.04	2.09	0.61	0.66
N4WET20	55.8	70.0	30	32	2.55	2.22	0.75	0.64
N4WET30	69.2	-	25	-	1.93	-	0.60	-
N4WET40	25	-	11	-	1.70	-	0.71	-
N3WET10	76.2	-	26	-	1.86	-	0.57	-
N3WET20	34.4	119.8	23	24	2.24	1.88	0.71	0.59
N3WET30	75.4	147.4	26	35	2.25	2.18	0.69	0.61
Mean	64.9	104.7	24.1	28.8	2.08	2.09	0.66	0.62

Table 4-3b. Environmentally sensitive wetland vegetation measures during pre-construction and monitoring, 2014 to 2019.

	On RoW						Off
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**RoW**
Species Cover (%)	62.7	50.8	43.3	72.0	52.8	64.9	104.7
Species Richness	21	22.5	22.8	24.8	25.6	24.1	28.8
Diversity	1.9	2.0	2.2	2.1	2.2	2.08	2.1
Evenness	0.6	0.6	0.7	0.7	0.7	0.66	0.6
Number of Surveys	3	7	7	7	7	7	4

The number of paired surveys (four) is too small to reliably test for significant differences among environmentally sensitive wetland sites. However, since initial clearing there continues to be a trend of lower mean species cover and richness in sites on-RoW, when compared to off-Row sites. Lower vegetation cover values on-RoW is due to the removal of sparse tree and tree sapling cover, and other low growing woody species on the RoW. The off-Row sites in N3 are further distinguished from on-RoW sites by increased moss cover and much reduced surface water, which tends to allow for increased vegetation cover. Consequently, cover values on-RoW in N3 are unlikely to match those off-RoW. In N4, off-Row sites are distinguished by a very sparse tree and or sapling layer and increased moss cover. On the RoW, the average species cover is variable in any given year, perhaps due to fluctuating water levels. Species richness values tend to be lower in WET sites on-RoW, while the diversity index and species evenness continue to have similar values across all years and between paired surveys on and off RoW.

4.3.1.1 Cluster Analysis and Community Typing

Patterned fen wetland community types were identified on the RoW based on regenerating vegetation cover and composition. A total of 53 plant species were observed in environmentally sensitive wetland surveys. Hierarchical cluster analyses were performed for seven surveys on the RoW, resulting in two community types (Table 4-3c), generally consistent since 2017. Though quite similar in species composition, the

two communities have remained distinguished since initial sampling due to vegetation structure (i.e., presence of low shrubs), moss cover and composition, and the presence of surface water.

Table 4-3c. Community types for environmentally sensitive wetland surveys on the RoW, 2019.

Community Types	Surveys	Species
Sparse Dwarf Birch seedlings- Flat-leaved Bladderwort/ Moderate Mosses (non-Sphagnum)/ Surface water	3	37
Sparse Dwarf Birch Tall Shrub/ Dwarf Birch seedlings -Labrador Tea-Three-leaved Solomon's-seal/ Abundant Mosses (Sphagnum and other)	4	47

4.3.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the Project areas cleared previously (Sections N3 and N4), the effect predictions from Appendix III for environmentally sensitive wetland vegetation were accurate, and included the following:

- Environmentally sensitive sites may be affected
- Wetlands may be affected

Mitigation measures identified in the Construction Environmental Protection Plan for Section N3 and N4 (Manitoba Hydro 2014a) and supported by the Project Environmental Impact Statement (Manitoba Hydro 2011), the Terrestrial Ecosystems and Vegetation Assessment of the Bipole III Transmission Project (Szwaluk Environmental Consulting et al. 2011) and the Annual Technical Report (2015), were initially assessed (after clearing) at each wetland site visited along the RoW (Table 4-3d). In 2019, no new WET sites were sampled. Observations recorded in the field from 2019 are provided below.

Table 4-3d. Mitigation measures assessed at sites monitored for environmentally sensitive wetlands on the RoW.

Mitigation Measure
Use existing access roads and trails to the extent possible.
Provide 30 m vegetated (shrub, herbaceous) buffer around site.
Remove trees by low disturbance methods.
Confine vehicle traffic to established trails to extent possible.
Carry out construction activities on frozen/dry ground to minimize surface damage, rutting and erosion.
Install erosion protection/sediment control measures in accordance with Erosion/ Sediment control plan.

During ground surveys in Sections N3 and N4, the seven wetland sites showed relatively low disturbance in 2019 from the recent clearing and construction activities. Tree clearing was carried out in 2014, using methods with low disturbance to wetlands. Previous construction activities occurred on frozen ground conditions, minimizing surface damage, rutting and erosion. Vehicle traffic was confined to the access trails and

equipment paths on the RoW. Photograph 4-3a shows the equipment path in the centre of the RoW, seen at plot N4_WET_300. Recommended mitigation was effective for the patterned fen wetlands which minimized the disturbance from clearing and construction activities. In the absence of mitigation, surface disturbance (i.e., rutting, exposed soils) likely would have increased.

Photograph 4-3a. Previous equipment path used during construction activities.

Water levels in sampled wetland plots continue to be variable over monitoring seasons. Three sites with previous high-water levels (2018) showed a reduction this season in percent cover of surface water. In 2019, site N3-WET-200 changed from 90% to 41% open water; site N3-WET-300 changed from 100% to 5%; and N4-WET-400 went from 100% to 84%. This season a reduction in water levels could possibly be a result of lower precipitiation received in the region. In 2018, total precipitation received in The Pas region from January through July was 339.9 mm, while in 2019, 212.7 mm was received over the same months (Government of Canada 2019a) Photograph 4-3b shows regeneration at wetland plot N3-WET-300. Patterned fen wetlands continue to recover with no evidence of disrupted natural function along the RoW (e.g., erosion, flooding).

Elsewhere, generally low wetland disturbance was documented during aerial inspection of wetlands. Occassional areas of rutting through wetlands on the equipment path were observed, where natural revegetation was slow and exposed soil remained with tracks of water. Similarily, occasional tower foundations in wetlands showed evidence of previous construction activity. Remaining disturbances were however reduced in 2019 and areas are anticipated to naturally recover. No areas of wetland disturbance were identified for rehabilitation.

Photograph 4-3b. Wetland regeneration at N3-WET-300.

4.4 Plants/Communities Important to Indigenous People

Ten ATK sites in C1 were visited on July 6 to sample the vegetation on the RoW in the Cowan Blueberry Resource Area after clearing (Field Activity ID BPIII_CON_FA487) (Map 4-1, Appendix II). Vegetation composition, abundance and structure were recorded at all sites; paired sites adjacent to the RoW were not re-sampled. Species of conservation concern were recorded in and incidental to sites.

This season, Manitoba Hydro and several Indigenous community members joined the vegetation monitoring team during the field surveys. Individuals present included Norm Voth (Manitoba Hydro); Martin Ferland, Elie Genaille and Elaine Ferland (Duck Bay); Joseph Kayne (Camperville); Robert Church (Swan River) and Don Roulette (Winnipeg). The Resource Area was accessed by helicopter due to remoteness of the area. The vegetation monitoring methods were explained to the group and the sampling was demonstrated at plot C1-ATK-300, the southern most sampling plot in the Resource Area (Photograph 4-4a). Botanical information of the area was shared among the individuals present (e.g., plant species, berry harvesting). Several other vegetation monitoring sites were visited by the Indigenous community members in the Resource Area.

Photograph 4-4a. Blueberry monitoring plot C1-ATK-300.

Two species of blueberries (low sweet blueberry - *Vaccinium angustifolium,* and velvetleaf blueberry - *Vaccinium myrtilloides*) were recorded at seven of the 10 sites on the RoW in 2019 (C1-ATK-200, -300, -400, -500, -600, -800 and -950). Since initial clearing, blueberry plants have been recorded at sample sites with varying presence. In 2018, blueberry plants were recorded on the RoW at five sites, seven in 2017, five in 2016, two in 2015 and six in 2014 (Table 4-4a). Blueberry plants have not been recorded in either of sites C1-ATK-100, -700, or -900 throughout monitoring.

Table 4-4a. Resource Area species mean cover (%) for Low Sweet Blueberry (*Vaccinium angustifolium*) and Velvetleaf Blueberry (*V. myrtilloides*) during pre-construction and monitoring, 2014-2019.

Site C1-ATK	Low Sweet Blueberry *V. angustifolium* Average Cover (%)							Velvetleaf Blueberry *V. myrtilloides* Average Cover (%)						
	RoW						off RoW	RoW						off RoW
	2014	2015	2016	2017	2018	2019		2014	2015	2016	2017	2018	2019	
200	0.4	-	-	-	-	-	16.6	-	-	-	0.2	-	1.0	8.8
300	-	0.4	3.0	3.0	3.0	2.8	5.6	5.0	0.6	2.0	4.6	3.6	2.8	-
400	32.4	NS	43.0	66.0	39.0	58.0	35.4	8.0	NS	1.2	-	-	0.6	-
500	14.8	NS	1.0	3.4	18.0	20.0	8.0	-	NS	0.2	-	0.4	1.0	1.2
600	4.6	-	-	2.8	0.8	0.2	1.6	0.4	2.0	8.6	3.2	5.6	6.0	11.4
800	-	-	-	-	-	-	-	-	-	-	0.2	-	0.2	-
950	7.2	-	1.4	2.8	1.6	0.4	2.6	-	-	3.2	2.0	-	-	1.8
Mean	11.9	0.4	12.1	15.6	12.5	16.3	11.6	4.5	1.3	3.0	2.0	3.2	1.9	5.8

Note: NS = no sampling due to clearing activities (2015).

Low sweet blueberry continues to be recorded in five sites, and is generally the more prominent blueberry species, with an average cover of 16.3% (ranging from 0.2 to 58.0%, and up by 3.8% from last season). In 2019, low sweet blueberry was observed in the same sites as the previous season. When compared to the previous year's values,

blueberry cover is similar in two sites (C1-ATK-300, -500), increased in one site (C1-ATK-400) and decreased in two plots (C1-ATK-600, -950). The average cover of low sweet blueberry, while variable, appears to have somewhat recovered since clearing and is now higher than baseline (2014) on-site and off-RoW cover values, 11.9% and 11.6%, respectively. No new occurrences of low sweet blueberries were found in 2019.

Velvetleaf blueberry was observed in six sites (from three in 2018), with an average cover of 1.9% among sites, ranging from 0.2 to 6.0%. Species cover of velvetleaf blueberry was variable across sites, as in previous years. Velvetleaf blueberry cover was similar to last season's values in two sites (C1-ATK-500, 600), slightly decreased in one site (C1-ATK-300), and was again recorded from three sites where it was previously absent in 2018. The total average cover of velvetleaf blueberry in 2019 is within the range of cover from previous years' sampling, but is lower than 2014 baseline on and off-RoW values, 4.5% and 5.8%, respectively.

Total blueberry cover for sites supporting blueberries (both low sweet blueberry and velvetleaf blueberry) on the RoW (2019) averaged 13.3%, an increase since initial RoW pre-clearing surveys in 2014 (12.1%). Photograph 4-4b shows blueberry plants in the Cowan Blueberry Resource Area.

Photograph 4-4b. Blueberry plants in the Cowan Resource Area.

Other berry plants recorded in plots of the Resource Area in order of greatest cover include smooth wild strawberry (*Fragaria virginiana*), trailing dewberry (*Rubus pubescens*), raspberry (*Rubus idaeus*), Saskatoon (*Amelanchier alnifolia*), pin cherry (*Prunus pensylvanica*), and chokecherry (*Prunus virginiana*).

Surrounding vegetation in the Resource Area includes stands of jack pine (*Pinus banksiana*) and deciduous forest (e.g., *Populus tremuloides, P. balsamifera*). The RoW is very sandy with exposed soils in some areas. Originally sparsely treed with conifers, areas of open grassland remain with some vegetation characteristic of xeric native prairie. Species of conservation concern from ATK sites are discussed in Section 4.6.

4.4.1 Data Analysis of the Cowan Blueberry Resource Area

Ten surveys were conducted in the Cowan Blueberry Resource Area. Resulting vegetation descriptions are provided for species cover, richness, species diversity and evenness in Table 4-4b.

Table 4-4b. Blueberry Resource Area vegetation measures on-RoW (2019) and off-RoW.

	Species Cover (%)		Species Richness		Diversity		Evenness	
Site	**RoW[1]**	**off RoW**	**RoW[2]**	**off RoW**	**RoW[3]**	**off RoW**	**RoW[4]**	**off RoW**
C1ATK10	31.8	39.2	22	19	2.40	2.22	0.78	0.76
C1ATK20	94	99.8	50	26	2.99	2.26	0.76	0.69
C1ATK30	43.8	75.6	20	19	2.24	1.81	0.75	0.62
C1ATK40	98.2	116.6	15	17	1.39	1.79	0.51	0.63
C1ATK50	68.4	59.4	27	33	2.63	2.68	0.80	0.77
C1ATK60	80.6	151.8	27	23	2.76	2.00	0.84	0.64
C1ATK70	45.2	69.0	31	27	2.50	2.50	0.73	0.76
C1ATK80	48.2	65.8	37	24	2.94	2.30	0.82	0.72
C1ATK90	44.8	53.4	32	29	2.84	2.72	0.82	0.81
C1ATK95	110.8	132.8	31	36	2.59	2.56	0.75	0.71
Mean	**66.6**	**86.3**	**29.2**	**25.3**	**2.53**	**2.28**	**0.76**	**0.71**

[1] Total species cover (%) is significantly lower on the RoW (2019), p=0.014.
[2] No significant differences in species richness on (2019) and off RoW, p=0.307.
[3] No significant differences in diversity index on (2019) and off RoW, p=0.076.
[4] No significant differences in species evenness on (2019) and off RoW, p=0.114.

Results of a paired-sample Wilcoxon test for ATK vegetation surveys on (2019) and off the RoW show continued significantly lower values for total species cover (p=0.014) on the RoW, an expected result of tree canopy clearing. Also consistent with previous years, no other significant differences were detected in species richness (p=0.307), diversity (p=0.076) nor evenness (p=0.114), between paired surveys on (2019) and off the RoW.

As an indication of recovery of sites after construction, the mean values of vegetation measures from all years of RoW monitoring are shown with baseline values recorded off-Row in Table 4-4c. The pre-construction values measured in 2014 match the off-RoW measures. The first year (2015) post-clearing cover values have risen steadily over the course of monitoring, suggesting on-going development of mid and low vegetation canopies. Species richness in 2019 has increased from pre-construction (2014) and off-RoW measures. Diversity and evenness measures show some variability over the course of monitoring.

Table 4-4c. Blueberry Resource Area vegetation measures, during pre-construction and monitoring, 2014 to 2019.

	On RoW						Off
	2014	2015	2016	2017	2018	2019	RoW
Species Cover (%)	89.3	21.1	34.3	50.3	59.7	66.6	86.3
Species Richness	23.6	22.0	22.9	26.6	28.2	29.2	25.3
Diversity	2.15	2.61	2.43	2.55	2.44	2.53	2.28
Evenness	0.69	0.85	0.78	0.78	0.74	0.76	0.71
Number of Surveys	10	8	10	10	10	10	10

4.4.1.1 Cluster Analysis and Community Typing

Approximately 109 plant species were recorded across 10 surveys within the Blueberry Resource Area in 2019. The tree stratum was generally absent in all ATK sites on the RoW (but for the presence of aspen and jack pine in one site, C1ATK400). Eight sites had regenerating seedlings (<1m) of tall shrub or tree species. Tall shrubs and tree saplings were present in six sites. Cluster analysis of ten surveys on the RoW resulted in three community type groupings, based on the regenerating vegetation composition and structure at each site, see Table 4-4d.

Table 4-4d. Community types for Blueberry Resource Area surveys on the RoW, 2019.

2019	Surveys	Species
Green Alder, Aspen saplings/ Strawberry –dewberry –aspen seedling – marsh reedgrass	3	35.3
Bearberry – Little Blue Stem Grassland/ Lichens	4	29.0
Green alder, Aspen-Jack pine saplings/ Low Sweet Blueberry, Velvetleaf Blueberry/ Reindeer lichens	3	19.0

The first community type is characterized by regenerating trembling aspen saplings and seedlings, green alder and Bebb's willow. This group has a very well-developed and diverse herb and low shrub layer with herbaceous species dominating (e.g. strawberry, trailing dewberry), along with marsh reedgrass (*Calamagrostis canadensis*). Blueberries are present. Bare ground cover is none, woody debris has moderate cover, while litter cover is high.

The second community type is made up of sites with a moderate herbaceous cover dominated by little blue stem (*Schizachyrium scoparium*) and a diversity of other native prairie grasses, with bearberry (*Arctostaphylos uva-ursi*) and a diversity of herbs. Tall shrubs and tree saplings are generally absent. Cover of bare ground is moderate, woody debris are low, while litter cover is high.

The third community type is characterized by a moderate cover of regenerating green alder, trembling aspen and jack pine saplings. This group has a well-developed herb and low shrub layer, with woody species. Low sweet blueberry occurs as one of the frequent and often dominant species, along with two-leaved Solomon's-seal (*Maianthemum*

canadense) and green alder seedlings. Velvetleaf blueberry is also present. Bare ground cover is very low, woody debris has moderate cover, while litter cover is high.

4.4.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the Project areas cleared previously, the effect predictions from Appendix III for the environmentally sensitive blueberry resource area were accurate for the following:

- Environmentally sensitive sites may be affected
- Potential loss of habitat and plants used by Indigenous people as identified through the ATK process
- Loss of native forest vegetation

Mitigation measures identified in the Construction Environmental Protection Plan for Section C1 (Manitoba Hydro 2014a) and supported by the Project Environmental Impact Statement (Manitoba Hydro 2011), the Terrestrial Ecosystems and Vegetation Assessment of the Bipole III Transmission Project (Szwaluk Environmental Consulting et al. 2011), and Annual Technical Reports (2015 and 2016) were initially assessed (after clearing) at each site visited along the RoW (Table 4-4e). In 2019, no new ATK sites were sampled. Observations recorded in the field from 2019 are provided below.

Table 4-4e. Mitigation measures assessed at sites monitored for ATK vegetation on the RoW.

Mitigation Measure
Carry out construction activities on frozen or dry ground to minimize surface damage, rutting and erosion.
Minimize surface disturbance around the site to the extent possible.
Remove trees by low disturbance methods.
No herbicide to be applied during construction.
Confine vehicle traffic to established trails to extent possible.

The Cowan Blueberry Resource Area continues to show regeneration of vegetation after RoW clearing (i.e., change in structure). Recommended mitigation was effective for the Resource Area which minimized the disturbance from construction activities. Construction activities occurred on frozen or dry ground conditions, minimizing surface damage, rutting and erosion. Existing trails were used and traffic was mainly confined to the equipment path. Tree clearing in previous years used low disturbance methods. No evidence of herbicide use was found in the Resource Area. In the absence of mitigation, surface disturbance (i.e., rutting, exposed soils) likely would have increased.

This season, there was no evidence of new disturbance during operation of the transmission line. Reduced areas of exposed soil occurred along the RoW. The equipment path near monitoring plots C1-ATK-300 and C1-ATK-400 remains sparsley vegetated in areas with exposed sandy soil. Vulnerable false heather (*Hudsonia*

tomentosa, S3) was observed again in 2019. It is anticipated that this sensitive area will naturally revegetate and colonize with native species of shrubs, herbs and non-vascular plants. Similar sandy areas adjacent to the RoW support typical jack pine (*Pinus banksiana*) upland vegetation with an understory of low shubs and herbs and a ground cover of mosses and lichens.

In other parts of the RoW, tall shrub cover (>1m height) is dominating with species of trembling aspen and green alder. Also observed as tall shrubs on the RoW were Bebb's willow, pin cherry, Saskatoon, balsam poplar (*Populus balsamifera*) and jack pine. Photograph 4-4c shows the regeneration of tall shrub vegetation on the RoW, at plot C1-ATK_600. Elsewhere, open areas continue to support dominantly native grasses and forbs (e.g., C1-ATK-800).

Photograph 4-4c. Regeneration of tall shrub vegetation in the Resource Area.

No visible problem areas were identified for invasive and non-native species in plots. Low cover of common dandelion (*Taraxacum officinale*) was recorded at C1-ATK-900 (0.2%). An aerial assessment of the Resource Area was completed and no further RoW disturbances were observed.

Future vegetation management activities in the Cowan Resource Area should use low disturbance methods, and be confined to the equipment path, where possible. Productive blueberry habitat and other berry plant growth was observed in this sensitive area in 2019. Several species of conservation concern are also present in this area (Szwaluk Environmental consulting and Newman 2017 and 2018).

This season, the community members present in the field expressed concerns over construction and operation of the transmission line. Some members inquired about herbicides and treatment cycles in the area. They wanted to know if spraying was used to control tree growth and they wanted to know the vegetation management schedule for the immediate area. They were concerned that herbicides would be used to manage vegetation, and if so, they were worried about how this would negatively affect the blueberries and other plants that they harvest in the area. Community members indicated that they would strongly prefer that pesticides not be used to manage vegetation throughout C1, not just in the blueberry harvesting area. They suggested that they would prefer mechanical vegetation management methods be used in the region.

In addition, some community members present in the field this season felt that the transmission lines were adversely affecting the young trembling aspen growth, where black spots on the leaves were observed and that tree saplings were bending away from the transmission lines. Community members also inquired about the duration of vegetation monitoring in the Resource Area. They suggested that future monitoring would provide a better understanding of how the project would affect the vegetation over time (approximately 5-year intervals).

4.5 Invasive and Non-Native Species

Noxious, invasive or non-native species were recorded project-wide in 2019 from plots and incidental observations in quantitative surveys ATK, INV, PRA, TER and WET, and with presence in thirty-four roadside sites in RoW Sections S1 and S2, and 108 rehabilitation monitoring sites (RHB) (Field Activity ID BPIII_CON_FA487, 488, 489 and 490) (Map 4-1, Appendix II).

Fifty-seven species were recorded on the RoW, including noxious (23), invasive (32) or non-native (17) species, with some overlap between noxious and invasive species, see Table 4-5a. As with previous years, noxious/invasive and non-native species continue to occur with greatest cover and frequency in roadside S1, S2 sites and INV surveys. In addition, there is a notable absence of these species from environmentally sensitive wetlands (WET). Nearly half of all noxious, invasive and non-native species (28 species) are found uniquely in S1 and S2 segments, at roadsides or from tower footings, or RHB sites (Section 4.7).

Table 4-5a. Observations of noxious, invasive and non-native species found project-wide, 2019.

Species	Rank	Noxious Weed	Invasive Status	ATK	INV	PRA	TER	S1	S2	RHB
Agrostis gigantea	SNA							1		
Agrostis stolonifera	SNA				12					
Amaranthus blitoides	SNA							3		
Amaranthus retroflexus	SNA		CFIA					11	4	
Ambrosia artemisiifolia	S5	Tier 3						1	4	
Artemisia absinthium	SNA	Tier 3	CFIA		1			6		
Artemisia biennis	SNA							6		
Asclepias speciosa	S3S5	Tier 3						5	1	
Asclepias syriaca	S3S4	Tier 3						8	2	
Avena sativa	SNA		CFIA		1					
Bassia scoparia	SNA							4	1	
Brassica rapa	SNA								1	
Bromus inermis	SNA		CFIA		7			22	11	1
Capsella bursa-pastoris	SNA		CFIA						1	
Chenopodium album	SNA	Tier 3	CFIA		4		1	16	5	
Cirsium arvense	SNA	Tier 3	CFIA, ISCM		9		2	10	11	1
Cirsium vulgare	SNA	Tier 3	ISCM					2		
Cyclachaena xanthiifolia	SNA	Tier 3						10		
Descurainia sophia	SNA	Tier 3	CFIA					4		
Echinochloa crus-galli	SNA							4	3	
Elymus repens	SNA		CFIA		2			12	6	
Erigeron canadensis	S5	Tier 3						12		
Euphorbia virgata	SNA	Tier 2	CFIA, ISCM			1		7		4
Fallopia convolvulus	SNA		CFIA					2		
Hordeum jubatum	S5	Tier 3	CFIA					4	2	
Lactuca serriola	SNA	Tier 3			1			1	3	
Leucanthemum vulgare	SNA	Tier 2	CFIA, ISCM		9				1	15
Lotus corniculatus	SNA		CFIA		1			3	2	
Malva pusilla	SNA								2	
Matricaria discoidea	SNA				1			1	4	
Medicago lupulina	SNA				6			5		
Medicago sativa	SNA		CFIA		4			2	3	1
Melilotus albus	SNA		CFIA		8			19	9	1
Melilotus officinalis	SNA		CFIA		2			9	10	1
Melilotus spp.	SNA		CFIA		6			1		
Pastinaca sativa	SNA	Tier 3	CFIA						2	
Persicaria hydropiper	SNA							2		
Phalaris arundinacea	S5		CFIA		2	1				
Phleum pratense	SNA				4					
Plantago major	SNA		CFIA		5			2	1	
Poa annua	SNA							1		

Polygonum aviculare	SU		CFIA		4			12	8	
Portulaca oleracea	SNA							1		
Ranunculus acris	SNA		CFIA, ISCM		1					
Salsola tragus	SNA	Tier 3						1		
Setaria pumila	SNA							3	3	
Setaria viridis	SNA		CFIA					11	3	
Silene latifolia	SNA	Tier 3	CFIA					1		
Silene noctiflora	SNA	Tier 3			2			3	1	
Silene vulgaris	SNA	Tier 2	CFIA		2			3	1	2
Sonchus arvensis	SNA	Tier 3	CFIA, ISCM		18		3	10	9	2
Taraxacum officinale	SNA	Tier 3	CFIA	1	29		3	8	8	
Thlaspi arvense	SNA	Tier 3	CFIA					1	3	
Trifolium hybridum	SNA			1	3			2	3	
Trifolium pratense	SNA		CFIA	1	3					
Trifolium repens	SNA				3			4		
Tripleurospermum inodorum	SNA	Tier 2	CFIA, ISCM							1
Vicia cracca	SNA		ISCM		4				2	
			2019	ATK	INV	PRA	TER	S1	S2	RHB
			Noxious species only	1	9	1	4	20	14	6
			Total Species: Noxious, invasive and non-native	3	28	2	4	44	33	10
			Total Observations: Noxious, invasive, non-native	3	154	2	9	256	130	29

On the RoW, there are 23 species listed in the Manitoba Noxious Weed Act (2019) as noxious weeds harmful to livestock (may include native species) or as contaminants to agricultural crops (generally non-native species). Noxious weeds on the RoW are primarily Tier 3 but for four Tier 2 species, leafy spurge (*Euphorbia virgata*), ox-eye daisy (*Leucanthemum vulgare*), bladder campion (*Silene vulgaris*) and scentless chamomile (*Tripleurospermum inodorum*). On the RoW, noxious species include five native species. Two Tier 3 native species are milkweeds, an ecologically important food plant of the federally listed monarch butterfly larvae, (SARA- Special Concern; COSEWIC-Endangered). Both milkweeds are species of conservation concern ranked Vulnerable (*Asclepias syriaca* S3S4; and *A. speciosa*, S3S5).

Thirty-three species are considered invasive by the Canadian Food Inspection Agency (CFIA 2008) and the Invasive Species Council of Manitoba (ISCM 2019), due to their tendency to outcompete native species and dominate habitats once introduced. While some invasives are noxious (15 species), the remaining 18 species are invasive, non-noxious. Invasive species can pose a risk to native vegetation, but generally pose no risk to livestock or agricultural crops.

An additional 17 species are considered non-native (SNA), though non-invasive in Manitoba. Non-native species do not generally pose a risk to livestock or agricultural

crops nor are they necessarily all aggressively invasive in their growth habits, but by occupying a place in the plant community they can effectively reduce or exclude native species in their environments.

Project-wide, the most commonly observed species were sweet clovers (*Melilotus* spp., 66 records), common dandelion (*Taraxacum officinale*, 49 records), smooth brome (*Bromus inermis*, 41 records), field sow-thistle (*Sonchus arvensis*, 42 records), Canada thistle (*Cirsium arvense*, 33 records) and lamb's-quarters (*Chenopodium album*, 26 records). The greatest frequency of observation records and number of noxious, invasive and non-native species was found in surveys S1 and S2 (386 observations of 51 species), followed by the INV surveys (154 observations of 28 species). The S1, S2 and INV sites were identified as areas susceptible to increased spread of noxious/ invasive and non-native species, due to each site's location, sensitivity, and proximity to existing patches. The remainder of surveys (ATK, PRA, TER) continue to have far more modest records of non-native species occurrences at sites.

4.5.1 Data Analysis of Invasive and Non-Native Vegetation

Quantitative data on noxious, invasive and non-native (INV) vegetation was collected from 40 monitoring sites, July 3 to 31 (Field Activity ID BPIII_CON_FA487, 488 and 489) (Map 4-1, Appendix II). The on-RoW INV sites are paired with off-RoW belt-transect surveys used to monitor whether invasive species are gaining presence in adjacent habitats off-RoW. Paired sites are located Sections N1 and N3 (six sites each), N2 (eight sites), N4, C1, C2 (five sites each), with five additional sites located along the northern AC collector lines (CL sites) and construction power line (CP sites). Surveys were located at roads (e.g., provincial, forestry and access), rail lines and creek and river crossings that intersect the RoW.

Consistent with previous years, the results of a paired-sample Wilcoxon test show significantly lower values for total vegetation cover ($p<0.001$), yet with similar species richness among surveys on the RoW (2019), when compared to sites sampled pre-construction off-RoW. Diversity ($p=0.002$) and evenness ($p<0.001$) remain significantly higher on the RoW again in 2019, compared to surveys off the RoW.

Vegetation descriptions for paired on- and off-RoW surveys for total species cover, species richness, species diversity and evenness are shown below in Table 4-5b.

Table 4-5b. Invasive vegetation measures on-RoW (2019) and off-RoW.

	Species Cover (%)		Species Richness		Diversity		Evenness	
Site	**RoW[1]**	**off RoW**	**RoW[2]**	**off RoW**	**RoW[3]**	**off RoW**	**RoW[4]**	**off RoW**
N4INV10	114.8	112.4	51	37	3.36	1.82	0.86	0.50
N4INV20	84.2	146.4	31	22	2.24	1.89	0.65	0.61
N4INV30	96	126.0	20	15	2.04	1.74	0.68	0.64
N4INV40	95.6	104.0	36	22	2.98	2.09	0.83	0.68
N4INV50	133.2	119.4	28	28	2.41	2.36	0.72	0.71
N3INV10	126.2	135.8	30	27	2.08	1.88	0.61	0.57
N3INV20	95.2	87.4	36	39	2.61	2.99	0.73	0.82
N3INV30	53	112.0	24	34	2.31	2.57	0.73	0.73
N3INV40	31.6	85.2	35	39	3.24	2.47	0.91	0.67
N3INV50	128.4	104.8	34	8	2.72	1.21	0.77	0.58
N3INV60	74	153.0	38	24	3.07	1.51	0.84	0.48
N2INV10	25.4	84.8	28	33	2.81	2.71	0.84	0.77
N2INV20	141.2	115.8	33	42	2.53	2.68	0.72	0.72
N2INV30	99.2	94.4	36	28	2.89	2.10	0.81	0.63
N2INV40	30	152.6	20	16	1.98	1.32	0.66	0.48
N2INV50	32.2	130.0	26	25	2.72	1.55	0.84	0.48
N2INV60	62.2	99.2	31	22	2.27	1.71	0.66	0.55
N2INV70	91.2	135.4	31	31	2.40	2.07	0.70	0.60
N2INV80	112.6	129.0	44	43	2.61	2.65	0.69	0.70
N1INV10	81	136.0	28	24	1.86	2.00	0.56	0.63
N1INV20	94.6	48.6	33	21	2.36	2.35	0.68	0.77
N1INV30	66.4	107.4	35	24	2.96	2.15	0.83	0.68
N1INV40	56.6	41.8	16	15	1.81	2.10	0.65	0.77
N1INV50	97.6	67.8	27	28	2.64	2.68	0.80	0.80
N1INV60	34.8	144.2	23	33	2.25	2.61	0.72	0.75
CLINV10	79.8	130.6	29	31	1.99	1.59	0.59	0.46
CLINV20	54	104.0	32	44	2.82	2.62	0.81	0.69
CLINV30	10.8	131.0	10	24	1.77	1.67	0.77	0.53
CPINV10	109.4	108.4	43	43	2.97	2.79	0.79	0.74
CPINV20	109	120.2	30	28	2.55	2.12	0.75	0.64
C2INV10	76.4	100.4	38	42	2.52	2.45	0.69	0.65
C2INV20	51.2	60.4	51	50	3.12	3.20	0.79	0.82
C2INV30	69.4	149.8	48	40	3.45	2.48	0.89	0.67
C2INV40	49.8	87.4	32	30	2.29	2.47	0.66	0.73
C2INV50	96.4	69.0	47	43	2.52	2.77	0.66	0.74
C1INV10	144.6	183.8	51	26	2.74	1.80	0.70	0.55
C1INV20	94.2	155.8	32	39	2.63	2.58	0.76	0.71
C1INV30	89.8	157.0	48	47	3.23	2.51	0.84	0.65
C1INV40	93.6	112.4	43	51	3.17	3.09	0.84	0.79
C1INV50	58.2	132.6	42	47	2.86	3.21	0.77	0.83
Mean	**81.1**	**114.4**	**33.8**	**31.6**	**2.59**	**2.27**	**0.74**	**0.67**

[1] Total species cover (%) is significantly lower on the RoW (2019), p<0.001.
[2] No significant difference for species richness on (2019) and off RoW, p=0.233.
[3] The diversity value is significantly higher on the ROW (2019), p=0.002.
[4] Species evenness is significantly higher on the ROW (2019), p<0.001.

The INV sites are a diverse group of sites chosen based on their predicted susceptibility to introduction or spread of non-native or invasive species. Monitoring these sites tracks the presence and spread of invasive and noxious weeds on the RoW. Mean vegetation measures for all years on- and off-RoW are presented in Table 4-5c.

Table 4-5c. Invasive vegetation measures during pre-construction and monitoring, 2014-2019.							
	On RoW						Off
	2014	2015	2016	2017	2018	2019	RoW
Species Cover (%)	20.3	27.1	41.1	53.7	65.2	81.1	114.4
Species Richness	16.4	22.2	25.7	29.7	31.0	33.8	31.6
Diversity	2.2	2.4	2.4	2.5	2.6	2.6	2.3
Evenness	0.84	0.81	0.75	0.76	0.76	0.74	0.67
Number of Surveys	17	38	40	40	40	40	40

The cumulative cover of vegetation in INV sites in 2019 continues to increase from last year's values and shown steady increases since initial sampling in 2014. The number of species recorded in each site on the RoW has also increased consistently since initial clearing and has returned to richness values originally recorded off-RoW. However, some of this increase can be attributable to an increase in noxious, invasive and non-native species. Baseline vegetation sampling in each off-RoW site was collected once in either 2014, 2015 or 2016. During that time, quantitative cover values were collected in 40 off-RoW INV sites for 12 noxious/invasive or non-native species, while 29 species with cover values were recorded from INV sites on-RoW in 2019, (29 species in 2018). Species richness also shows a rise in INV sites on-RoW over successive years. Diversity and evenness remain similar across years.

Noxious/ invasive or non-native species cover on the RoW

Re-visiting sites provides an opportunity to compare abundance and frequency of invasive and non-native species on the RoW over time. Noxious/invasive or non-native species were recorded with cover in 29 of 40 INV sites on-RoW. Where species have repeat observations, there are variable trends. The presence of noxious/invasive or non-native species on-ROW jumped initially with construction and has continued to increase slightly during successive monitoring years. Species outbreaks have been recorded since clearing in single or successive years. In the current year, outbreaks were less common than in previous years. An extreme outbreak example was the invasive sweet clovers (*Melilotus* spp.) from certain sites after clearing. In N3-INV-100 sweet clover cover was recorded pre-construction (2%), increased in 2015 (62%) and again in 2016 (73%). In 2017, cover values were much reduced to 3%, a similar value as pre-construction, and in 2018 sweet clover cover in this site increased to 9% and decreased to 0.6% in 2019. All sites in 2019 continued to have a low abundance of sweet clovers, including sites N4-INV-100 and C1-INV-400 (2% in 2019), despite previous high cover (13% in 2018). It is apparent that the composition and domination of invasive species can be highly changeable from season to season.

The following tables show mean cover values for noxious weeds (Table 4-5d), invasive (Table 4-5e) and non-native (Table 4-5f) species recorded in quantitative plots in 2019, and the number of occurrences in sites on the RoW throughout monitoring. On the RoW,

there is a continued trend of increased number and frequency of noxious, invasive and non-native species in successive years since initial project sampling in 2014 or 2015.

In 2019, no noxious species have cover values >10%, and sites with previous high covers (e.g., *Sonchus arvensis, Taraxacum officiniale*) are decreased this year. No noxious species outbreaks were recorded, although increased noxious cover was noted in some instances. In the PRA site, leafy spurge (Tier 2) was present pre-construction (1.0% in 2015), although cover values during construction and monitoring have been recorded between 2.6 - 6.4% (2016-2019), Table 4-5d. Some high cover values seen in 2018 are reduced (-) in 2019, others have increased or remained the same (+ or *) since 2018.

Table 4-5d. Mean cover (%) of Tier 2 and 3 noxious species 2019, and number of occurrences on- RoW, 2014 to 2019.

Site	*Taraxacum officinale*	*Sonchus arvensis*	*Cirsium arvense*	*Chenopodium album*	*Hordeum jubatum*	*Silene noctiflora*	*Ambrosia artemisiifolia*	*Euphorbia virgata*	*Lactuca serriola*	*Leucanthemum vulgare*	*Silene vulgaris*
CLINV200											i
CPINV100	0.4										
N1INV300	1.4				0.6						
N1TER400	0.2										
N2INV100	0.6	1.6		1.6	0.8						
N2INV400	0.8	0.2		0.2							
N2INV500	1.0	0.2			2.6						
N2INV600	0.2	0.4									0.4
N2INV700	0.4										
N2INV800	0.4					0.2					
N2TER500					0.2						
N3INV100	0.2	8.6-	0.4		3.6*					i	
N3INV300				0.4						i	
N3INV400	0.6	0.4								2.4	
N3INV500	0.6	4.6-									
N3INV600										i	
N3TER100	0.2	1.4									
N4INV100	1.6	4.0-	0.6								
N4INV200		0.8									
N4INV300		2.8				0.4				i	
N4INV400	0.6									i	
N4INV500		8.2-	4.2+	0.2					0.4	i	

N4TER300		2.6-	2.6+	0.2							
N4TER400	0.8	1.8	1.8								
C1ATK900	0.2										
C1INV100	0.6	0.2									
C1INV200		1.6	6.2*								
C1INV300	1.0						0.4			i	
C1INV400	2.4	1.6	2.2							i	
C1INV500	3.6+	4.8-	0.4								
C2INV100	0.2										
C2INV200	0.6	0.4									
C2INV300	2.0	0.6									
C2INV400	0.4		0.2								
C2INV500	2.0-										
S1PRA900								4.8+			
Occurs on RoW 2019	26	20	9	5	5	2	1	1	1	9	2
2018	25	23	10	7	6		1	1		1	1
2017	22	18	12	10	3			1			
2016	18	14	7	12				1			
2015	16	10	7	4				1			
2014	6	3	2								

Note: In 2019, Tier 2 *Tripleurospermum inodorum* was an incidental species in N3INV600. Tier 3 species recorded on the RoW for a single year were *Crepis tectorum* and *Galeopsis tetrahit* (2018 only) and *Artemisia absinthium* and *Cicuta maculata* (2017 only).

There is also a reduction in cover for invasive species (non-noxious) such as sweet clovers (*Melilotus* spp.), with low values where it occurs, where previous cover (2018) was elevated. Cover of smooth brome (*Bromus inermis*) was not observed from one previously high cover site (N4INV100) but is dominating in another site in 2019 (N4INV500). On the RoW, there is a continued presence of invasive plants compared to pre-construction, although with a variable frequency of occurrence, Table 4-5e.

Table 4-5e. Mean cover (%) of invasive species 2019, and number of occurrences in sites on-RoW from pre-construction through monitoring, 2014 to 2019.

Site	*Melilotus* spp.[1]	*Bromus inermis*	*Plantago major*	*Polygonum aviculare*	*Vicia cracca*	*Medicago sativa*	*Phalaris arundinacea*	*Elymus repens*	*Trifolium pratense*	*Avena sativa*	*Lotus corniculatus*
N1INV300					0.2						

N1INV500			1.0								
N2INV100	0.6			0.2							
N2INV400	0.2			0.2							
N2INV500	0.4			0.8							0.8
N2INV600	0.4				0.4						
N2INV800					0.2						
N3INV100	0.6		0.6							0.2	
N3INV300				0.2							
N3INV400			1.2		0.4	0.4					
N4INV100	2.2		0.8				0.2		0.2		
N4INV300							4.0+	8.0+			
N4INV500		44.0+						5.0+			
C1ATK200									0.2		
C1INV200	0.4	2.4				1.4					
C1INV300		2.8									
C1INV400	2.0	0.4									
C1INV500	0.2	0.4									
C2INV300	0.2	2.0	0.4								
C2INV400	0.2										
C2INV500		1.2				0.2					
S1PRA900							0.2				
On-RoW 2019	11	7	5	4	4	3	3	2	2	1	1
2018	16	6	9	5		4	1		6		
2017	16	7	6	2	2	1	2	2	2		
2016	10	7	3	1							
2015	6	2	1				2				
2014	1	3		2							

[1] *Melilotus albus*, the dominant sweet clover is merged with *M. officinalis* and vegetative samples of *Melilotus* spp. for display.
Note: Non-noxious invasives *Amaranthus retroflexus*, *Fallopia convolvulus* and *Ranunculus acris* were seen on-RoW in one or more years between 2016-2018, but not recorded in 2019.

Non-native (and non-noxious) species are also a component of the vegetation of the RoW. While not considered invasive, creeping bentgrass (*Agrostis stolonifera*) and clovers (*Trifolium* spp.) were present as dominant cover in three sites, with increased cover (from 2018) in two sites. Elsewhere non-native species represent a small proportion of vegetation cover, Table 4-5f.

Table 4-5f. Mean cover (%) of non-native, non-invasive species in 2019, and number of occurrences in sites on RoW, 2015 to 2019.

Site	*Agrostis stolonifera*	*Trifolium* spp.	*Medicago lupulina*	*Phleum pratense*	*Matricaria discoidea*
CLINV200	1.4				
N2INV100	0.4	0.2			1.4
N2INV400	0.2				
N2INV500	0.6	6.0		2.2	
N3INV100	22.6+	54.0+			
N3INV300	7.4				
N3INV400		0.4			
N4INV300	29.6+				
C1ATK200		0.4			
C1INV100	1.6				
C1INV300	0.2		0.2		
C1INV400	0.4				
C1INV500	11.4-			1.2	
C2INV200			0.4		
C2INV300	4.4		0.6	2.0	
Occurs on RoW 2019	12	6	4	3	1
2018	4	5	4	5	1
2017	1	5	5	5	4
2016		7		4	1
2015		3	4	1	

Notes: *Amaranthus blitoides* and *Rumex crispus* were recorded on-RoW in 2018 only, and not observed cover in any other year. Cover of *Trifolium hybridum* and *T. repens* are combined for display.

Off-RoW Invasive monitoring

Each of the 40 INV sites are paired with a belt-transect scan off the RoW to track the presence or spread of noxious, invasive or non-native species adjacent to the RoW. This season, such species were recorded from nine off-site belt-transect scans (nine in 2018, twelve in 2017, nine in 2016, five in 2015). Nine non-native species were recorded off RoW, seven of which are invasive and/or noxious, Table 4-5g. As with the previous years, abundance was sparse for all species observed, with no major outbreaks found off-site. No observations were recorded in three off-RoW sites (N4-INV-101, N4-INV-501, C1-INV-501), where common dandelion or field sow-thistle were recorded in 2017 only.

Table 4-5g. Noxious, invasive and non-native species recorded in INV surveys off-RoW, 2019, with total number of site occurrences 2015 to 2019.

SITE	*Taraxacum officinale*	*Medicago lupulina*	*Melilotus albus*	*Trifolium pratense*	*Trifolium repens*	*Cirsium arvense*	*Cirsium vulgare*	*Leucanthemum vulgare*	*Medicago sativa*	*Sonchus arvensis*	*Vicia cracca*
N2INV801	S										
N3INV401								S			
C1INV201						S					
C1INV301	S										
C1INV401	S										
C2INV101	S		S	S							
C2INV201	S	S	S			S				S	
C2INV301	S										
C2INV501	S	S -M	S		S				S		
Occurs off- RoW 2019	7	2	3	1	2	2		1	1	1	
2018	6	2	3		2	1	1	1	1	1	2
2017	9	2	2		2	2		1		3	
2016	5	2	2		1	2		1	1	4	
2015	5		2		1				1	1	
Noxious, Tier	T3					T3	T3	T2		T3	
Invasive	x		x	x		x	x	x	x	x	x

S=sparse, M= moderate.

4.5.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the Project areas previously cleared, the effect predictions from Appendix III for invasive and non-native species were accurate for the following:

- Abundance of non-native species may increase

Mitigation measures identified in the Project Environmental Impact Statement (Manitoba Hydro 2011) and the Terrestrial Ecosystems and Vegetation Assessment of the Bipole III Transmission Project (Szwaluk Environmental Consulting et al. 2011) were initially assessed after clearing at each site visited along the RoW, see Table 4-5h. Observations documented in the field from 2019 are provided below.

Table 4-5h. Mitigation measures assessed at sites monitored for invasive and non-native species on the RoW.
Mitigation Measure
Carry out construction activities during winter months.
All equipment will be thoroughly washed and inspected prior to working in new sites to reduce the spread of introduced species.
Construction materials (i.e., gravel) will be taken from clean sources and ground cover materials will be weed free prior to use.
Maintain a minimum vegetation buffer width of 30 m from the high-water mark of water bodies.
Where a buffer zone will be disrupted, clearing and construction activities will occur during the winter months and activities will be minimized within the buffer zone.
Where clearing activities are necessary in riparian areas, grubbing will not occur.

Environmental monitoring determined that the recommended mitigation was effective where implemented. In the absence of mitigation, invasive and non-native species cover would likely be greater along the RoW. Previous clearing and construction activities appeared to be carried out mostly during winter months, where the spread of invasive and non-native species is reduced. It was assumed that all equipment was cleaned and inspected prior to working in the RoW, during construction activities.

In 2019 (Year VI), continued monitoring provided an opportunity to observe invasive and non-native species along the RoW in sample plots, as well as record information on new and remaining species problem areas during site visits and aerial inspections. Locations of plant species infestations are found under Recommendations, Section 5.0.

In Sections S1 and S2, non-native and invasive species were observed during all surveys, where the RoW intersected the roadways. Weed species here have already been established along the roadways, prior to construction activities, as observed in adjacent road ditches. Non-native and invasive species were also observed at access points and approaches, and nearby tower footings that were visible from the roadside. At survey sites, invasive species presence and distribution ranged from a single plant to several sporadically occurring plants or well-spaced patches. Where agricultural crops were sown on the RoW, infestations of invasive plant species were not observed. Common agricultural crops growing on the RoW included barley, soya bean, canola and oats. Bare soil on the RoW was infrequently observed at locations surveyed.

Species observed during surveys in Sections S1 and S2 with the highest threat (Tier II regulated under The Noxious Weeds Act) included leafy spurge (*Euphorbia virgata*), bladder campion (*Silene vulgaris*) and ox-eye daisy (*Leucanthemum vulgare*). Leafy spurge was observed at several locations during surveys, including one location where it was observed driving between monitoring sites, near Towers 6211 to 6212 (Photograph 4-5a). All observations of leafy spurge were in Section S1. Bladder campion and ox-eye daisy were less frequently observed.

Photograph 4-5a. Leafy spurge observed on the RoW.

In Sections C1, C2, and N4, invasive species were commonly observed in monitoring plots and occassionaly in noticeable patches during aerial inspections. While present on the RoW last year, ox-eye daisy has increased in abundance and distribution along the RoW. This species was observed spreading in areas of intersecting roadway ditches (e.g., C1-INV-300), adjacent fields (e.g., tower 4212) and also further into the RoW. The infestation recorded around Tower 4212 was one of the largest seen this season and estimated to cover an area of approximately 10,000m^2, overlapping the RoW and adjacent fields (Photograph 4-5b). Species management should occur in this area. New areas of species establishment included intersecting highway ditches, tower footings, and the equipment path. This species has the ability to spread rapidly in favorable habitats. Corner tower 3290 and the RoW immediately east of the tower was infested with invasive species including alfalfa (*Medicago sativa*), smooth brome (*Bromus inermis*), and white and yellow sweet clovers (*Melilotus* spp.).

Photograph 4-5b. Ox-eye daisy observed along the RoW at Tower 4212.

In Sections N1 to N3, The Pas to the Split Lake area (west of Hunting River), fewer sites were identified for potential weed management this year as compared to last season. Species that represent a threat according to regulation under The Noxious Weeds Act were observed at INV monitoring plots and at other locations along the RoW including areas of ox-eye daisy, bladder campion, and scentless false mayweed (*Tripleurospermum inodorum*).

The largest weed infestation observed in 2019 occurred in the area of plot N3-INV-400, with ox-eye daisy. This infestation occurred from Towers 2114 and 2120, and abundance ranged from sporadic to several large patches along this stretch of RoW (Photograph 4-5c). Ox-eye daisy was abundant along the Wekusko gravel road and spreading off-RoW, into adjacent forest cover near the monitoring plot. The previous off-site camp/staging area at this location was also infested with this plant (Photograph 4-5d). Species management should occur in this area. At monitoring site N3-INV-600, successful weed management was observed from the previous season at this site. However, several sporadically occurring individuals and small patches of ox-eye daisy and scentless false mayweed were observed again this season. It is recommended that only spot treatment management occur from Towers 2024 to 2025 for these individuals, to control species spread.

Photograph 4-5c. Ox-eye daisy infestation on RoW, at Wekusko Road (Tower 2118).

Photograph 4-5d. Ox-eye daisy infestation at previous construction camp and staging area.

Few non-native and invasive species (bladder campion, white sweet clover) were observed during surveys in Section N1, east of Hunting River to the Keewatinohk Converter Station, and along the northern AC collector and construction power lines. Species infestations were not problematic in this area of the Project in 2019. Control site at monitoring plot N1-INV-300 (-301) was disturbed due to the widening of the gravel Gillam Road #280. The site was still able to be monitored.

Several access trails were also inspected from the air to identify disturbance and weed establishment. No issues were observed along trails and the amount of bare ground was low. Monitoring invasives in 2019 provided an opportunity to re-assess species distribution and cover along the RoW. Invasive plants are capable of growing under a wide range of climatic and soil conditions, and produce abundant seeds that are easily disseminated. Recommendations for invasive and non-native species observed in Year VI are identified in Section 5.0.

4.6 Species of Conservation Concern

4.6.1 Monitoring for Species of Conservation Concern

During sampling in 2019, 35 species of conservation concern (S1 to S3S5) were recorded in plots and as incidentals from sampling, including quantitative surveys (e.g., ATK, INV, PRA, TER, and WET) (Field Activity ID BPIII_CON_ FA487, 488, and 489), and S1 and S2 invasive surveys (Field Activity ID BPIII_CON_ FA490). Monitoring for species of conservation concern off-RoW and SCC sites was completed in 2018. The greatest

number of species of conservation (26) and the most frequent number of observations (26) were recorded in Section C1 from the ATK sites, Table 4-6a.

Table 4-6a. Species of conservation concern: counts of species and total observations by project Section, 2019.

	S1	S2	C1	C2	N1	N2	N3	N4	CL	CP
Critically Imperilled to Imperilled: S1-S2S4	3	-	7	-	4	-	3	3	-	-
Vulnerable: S3-S3S5	5	4	19	3	4	-	7	6	2	1
Total # species, 2019	8	4	26	3	8	-	10	9	2	1
Total # observations, 2019	19	5	26	3	11	-	10	9	2	2

Among the species of conservation concern rankings, two are Critically Imperilled (S1 to S1S2), seven are Imperilled (S2 to S2S4), while the remaining 26 species are ranked Vulnerable (S3 to S3S5), Table 4-6b.

Table 4-6b. Species of conservation concern recorded on RoW, 2019.

Species	Common Name	Rank
Critically Imperilled and Imperilled Species (S1-S2S4)		
Arabidopsis lyrata	Lyre-leaved Rock Cress	S1S2
Caltha natans	Floating Marsh-marigold	S2S4
Carex inops ssp. *heliophila*	Sun Sedge	S1?
Cyperus schweinitzii	Schweinitz's Flatsedge	S2
Dalea villosa	Silky Prairie-clover	S2S3
Dichanthelium wilcoxianum	Sand Millet	S2?
Drosera linearis	Slender-leaved Sundew	S2?
Eriophorum scheuchzeri	Scheuchzeri's Cotton-grass	S2?
Salix arbusculoides	Little-tree Willow	S2S3
Vulnerable Species (S3-S3S5)		
Antennaria microphylla	Everlasting	S3S5
Arctous alpina	Alpine Bearberry	S3S4
Asclepias speciosa	Showy Milkweed	S3S5
Asclepias syriaca	Common Milkweed	S3S4
Asclepias verticillata	Whorled Milkweed	S3
Carex prairea	Prairie Sedge	S3S4
Dichanthelium leibergii	Leiberg's Panic-grass	S3S4
Drosera anglica	Oblong-leaved Sundew	S3S4
Euphorbia serpyllifolia	Thyme-leaved Spurge	S3
Houstonia longifolia	Long-leaved Bluets	S3S5
Hudsonia tomentosa	False Heather	S3
Lithospermum incisum	Linear-leaved puccoon	S3
Lonicera involucrata	Black Twinberry	S3S4

Lonicera oblongifolia	Swamp-fly-honeysuckle	S3S5
Lygodesmia juncea	Skeletonweed	S3S4
Marchantia polymorpha	Green-tongue Liverwort	S3
Melampyrum lineare	Cow-wheat	S3S5
Platanthera dilatata	Bog Candle	S3S4
Pyrola minor	Lesser Wintergreen	S3S4
Salix vestita	Rock Willow	S3
Schizachyrium scoparium	Little Bluestem	S3S4
Selaginella densa	Prairie Spike-moss	S3
Solidago mollis	Velvety Goldenrod	S3
Sporobolus rigidus	Sand Grass	S3S5
Streptopus lanceolatus	Rosy Twisted-stalk	S3?
Tofieldia pusilla	Bog Asphodel	S3S5

Southern Sections: S1 and S2

REDACTED

Central: C1 Blueberry Resource Area and C2

REDACTED

Northern Sections: N1 through N4

REDACTED

Northern Components: AC Collector Lines, and Construction Power Line

REDACTED

4.7 Rehabilitation Monitoring

In 2019, over 100 sites (RHB) were visited to assess disturbances along the Bipole III RoW and project components for potential rehabilitation or weed management (Field Activity ID BPIII_CON_FA487, 488, 489 and 490). Both ground visits and aerial assessments were conducted. Sites visited included tower foundations, snub sites, access trails, equipment paths and stream crossings.

During fieldwork, it was determined that most rehabilitation sites visited were currently revegetating naturally from earlier disturbances. Minor rutting along the equipment path or patches of exposed soil were visible at sites but these areas were showing improved vegetation growth from the previous monitoring season. Fourteen sites visited were identified for rehabilitation, either in the form of debris removal from creek crossings, installation of erosion control blankets, or suggested seeding of exposed soil. Four additional sites at towers locations were identified for possible seeding to increase the rate of revegetation at the site (Table 4-7).

Table 4-7. Additional sites visited along the RoW to assess project disturbance.		
Evaluation	**Field Observation**	**Number of Sites**
Weed Management	Weed infestations	10
Rehabilitation	Increased disturbance or need for rehabilitation (e.g., debris removal, seeding exposed soil, slope erosion).	18

Several sites were re-assessed for slope erosion, at or near foundation sites along the RoW. Tower sites 70 and 81 are located on sloping terrain with exposed sandy soils. Tower 70 was sparsely vegetated around the tower footing. The site has a moderate (10-15%) slope to the east and a strong (20%) slope to the west, with exposed soil on the sloping equipment path (Photograph 4-7a). At Tower site 81, the equipment path was located on a strong (20%) slope to the east, and has resulted in exposed soil (Photograph 4-7b). No infestation of species was observed in these areas at this time.

Photograph 4-7a. Exposed soil on sloping terrain at Tower 70.

Photograph 4-7b. Soil erosion observed at Tower 81.

Erosion control blankets were inspected at Towers 466, 516 and 517. Tower 466 is stable with vegetation colonizing the strong slope (16-30%). Species included wild red raspberry (*Rubus idaeus*), green alder (*Alnus viridis*), Bebb's willow (*Salix bebbiana*), pin cherry (*Prunus virginiana*), fireweed (*Chamerion angustifolium*), marsh reed grass (*Calamagrostis canadensis*), and hay sedge (*Carex foenea*). A patch of bladder campion (*Silene vulgaris* - Tier II noxious weed) occurs east of the tower at the base of the slope, and wild barley (*Hordeum jubatum* - Tier III noxious weed) was observed on the equipment path (Photograph 4-7c).

Photograph 4-7c. Bladder campion observed near Tower 466.

Natural regeneration is occurring slowly at both tower sites 516 and 517. Fibre blankets remain in areas of Tower site 516, but other areas of exposed sandy soil exist on the moderate slope (10-15%) with the potential for erosion. Tower 517 occurs on a strong slope but erosion was not observed at this site. Wood mulch from previous clearing activities has helped to protect the ground surface from erosion (Photograph 4-7d). At Tower site 1249, rill erosion was observed where sediment has been transported down slope in parallel channels.

Most disturbances along the RoW are expected to recover naturally from the existing rooting material present on the site, as well as seed sources present in the soil and those from nearby plants. Further activity in areas could result in increased disturbance and introduce unwanted species (i.e., invasives). Weed management was identified for 10 rehabilitation sites visited. Of these, Tier II noxious weed ox-eye daisy (*Leucanthemum vulgare*) occurred at seven sites. Other Tier II species recorded at problem sites included bladder campion, scentless false mayweed (*Tripleurospermum inodorum*) and one site with various invasive species.

Photograph 4-7d. Sparse regeneration at Tower 517, near the Odie River.

Continued environmental monitoring occurred at two water crossings where erosion control was previously established. At the Hunting River (Section N1), no measureable disturbance or erosion were visible, other than evidence of the equipment path. Banks were vegetated with Bebb's willow (*Salix bebbiana*) as a tall shrub, and various forbs and graminoids occupied the lower stratum. Other species included common horsetail (*Equisetum arvense* – a Pteridophyte), common mint (*Mentha arvensis*), Macoun's buttercup (*Ranunculus macounii*), water-parsnip (*Sium suave*), fowl bluegrass (*Poa palustris*), marsh reed grass (*Calamagrostis canadensis*) and water sedge (*Carex aquatilis*). Species cover was observed to be greater on the west bank compared to the east side. At the Mitishto River (Section N3), only an aerial evaluation could be conducted safely again this season as a result of tall shrubs growing on the RoW and high forest cover adjacent to the RoW, with conductors strung. Banks were vegetated with herbaceous plants and shrub cover and no disturbances were observed at this location (Photograph 4-7e).

Photograph 4-7e. Aerial view of Mitishto River crossing.

Other crossings assessed for stream bank erosion, near sampling plots, included the Missewaitay (Section N1), Halfway (Section N2) and a small unnamed tributary of Lake Winnipegosis in Section N4; no rehabilitation was required at any of the sites. This season, five additional water crossing sites (AQUA) were visited, identified for follow-up monitoring by Manitoba Hydro. Tree debris at crossings was visible, obscuring the waterways as seen in Photograph 4-7f, showing the crossing at N1-AQUA-169.

Photograph 4-7f. Woody debris remaining at stream crossing N1-AQUA-169.

In previous seasons, construction activities resulted in disturbance of vegetation and ground conditions at Slug Site (vicinity of Tower 4089), in Section C1. Ground disturbance included heavy rutting and a trench that was excavated to divert water flow during construction. Rehabilitation measures were recommended to stabilize the water course. A re-assessment in 2019 has showed that the site appears stable at this time, with no overland flooding or erosion on the RoW. The previous soil disturbance is naturally revegetating with low shrub and herb cover.

Several access trails in the northern sections were inspected for disturbance, exposed soils and invasive species, from previous construction activities. Only minor rutting was occasionally observed and the amount of exposed soil was low. Trails were vegetated and plant species infestations were not observed. Photograph 4-7g shows an access trail near Tower 214.

Photograph 4-7g. Access trail near Tower 214 with low disturbance.

Along the RoW for the northern AC Collector Lines, a lengthy trench was observed along the north side of the RoW. The ground material has been overturned reducing vegetation growth. The trench intersects the location of monitoring plot CL-INV-300. Sites visited along the RoW (both sample plots and rehabilitation sites) that require rehabilitation and/or weed management are identified in Section 5.0.

4.8 Hypothesis Testing

Three hypotheses were proposed for environmental monitoring of terrestrial ecosystems and vegetation. Their intent was to focus on the relationship between vegetation growth and clearing and construction activities.

Hypothesis 1 (*There are observed differences in species composition within sites being monitored over successive years along the transmission line right-of-way*) proved to be true in Year VI monitoring. In 2019, the single prairie (PRA) monitoring site showed an increase in species richness (number of species) from the previous season. Ongoing changes to vegetation at this site, are decreased grass cover and increased tall shrub cover. Terrestrial sites (TER) also showed an increase in mean species richness between Year V and Year VI monitoring, on the RoW. Mean species richness remains slightly lower in these sites when compared to the off-RoW value. Since initial clearing there continues to be a trend of lower mean species richness in WET sites on-RoW, when compared to off-Row sites. In the last three monitoring seasons, species richness of monitoring sites in the Resource Area (ATK) has exceeded off-RoW baseline values, with the highest value seen in 2019. In the invasive (INV) monitoring sites, the mean number of species recorded on the RoW has increased consistently since initial clearing,

exceeding values originally recorded off-RoW. However, some of this increase can be attributable to an increase in noxious, invasive and non-native species.

Hypothesis 2 (*Invasive and non-native species abundance is related to transmission clearing and construction activities along the right-of-way*) proved to be true in Year VI monitoring. The presence of noxious/invasive or non-native species on-ROW jumped initially with construction and has continued to increase slightly during successive monitoring years. During baseline vegetation sampling, quantitative cover values were collected in 40 off-RoW INV sites for 12 noxious/invasive or non-native species, while 29 species with cover values were recorded from INV sites on-RoW in 2019. Species outbreaks have been recorded since clearing in single or successive years.

Hypothesis 3 (*There is a relationship between species abundance of blueberry plants along the transmission line right-of-way and clearing activities, in the Cowan resource area*) appears to be true after Year VI monitoring. Since initial clearing, blueberry plants have been recorded at sample sites with varying presence. Low sweet blueberry continues to be recorded in five sites, and is generally the more prominent blueberry species, with an average cover up 3.8% from last season. Velvetleaf blueberry was observed in six sites, up from three in 2018. Total blueberry cover for sites supporting blueberries on the RoW averaged 13.3% in 2019, an increase since initial RoW pre-clearing surveys in 2014 (12.1%).

5.0 RECOMMENDATIONS

Based on the vegetation surveys conducted and observations recorded on the RoW, the following are recommendations for 2019. Site coordinates are provided in Appendix V.

1. Future vegetation management activities in the Cowan Resource Area should use low disturbance manual or mechanical methods, and be confined to the equipment path, where possible (between Towers 4024 to 4032). Herbicides should not be used in this area to manage vegetation along the RoW. This area is known to support blueberry picking and harvesting of other plants. The soils are sandy in areas and the ground cover is easily disturbed. Several species of conservation concern are also present in this area, and invasive species occurrence is low.

2. Some community members from the Cowan Resource Area surveys in 2019 indicated that they would like to see continued vegetation monitoring in the future (approximately 5-year intervals) to provide a better understanding of how the project affects the vegetation over time.

3. Ensure that any imported material or soil used to rehabilitate disturbance an area is weed free and that equipment is clean and free of weed species, to the extent possible.

4. To accelerate revegetation, recommended baseline native seed mixes from the Rehabilitation and Invasive Species Management Plan can be used for rehabilitation, or similar native species mixes. Preferably, native seed could be manually collected from local sites and dispersed over the exposed soils to help establish vegetation. Low shrubs (e.g., willows) could also be transplanted from adjacent sites, and to help stabilize slopes.

5. Rough bentgrass (*Agrostis scabra*) was observed to be a dominant colonizer of exposed soils along the equipment path in several areas of the RoW. Rough cinquefoil (*Potentilla norvegica*) was also frequently observed in these areas. These could be useful species for rehabilitation of northern disturbances.

6. It is recommended that invasive species control be implemented at select locations, where these species have become established. Species with the highest threat should be managed to reduce further species spread, according to responsibilities under the current Regulation of the Noxious Weeds Act. The risk of spread into adjacent sites or along the RoW may increase with each season. Where herbicides are used as control, only spot treatments are recommended. All regulatory requirements and license commitments should be met (Conditions 45, 48, 52, 60, 61 and 62). It is also recommended that management of weeds occur during the growing season, where species could be targeted rather than over treating the site.

7. The following table (Table 5.0) provides field observations of disturbance and suggested recommendations for selected sampled plots and rehabilitation sites.

Table 5-0. Observations of disturbance at sampled plots and rehabilitation sites along the RoW, with suggested recommendations.

Site	Field Observation	Recommendation
AQUA-135	Debris in creek	Debris removal
AQUA-161	Debris in creek	Debris removal
AQUA-167	Debris in creek	Debris removal
AQUA-169	Debris in creek	Debris removal
AQUA-172	Debris in creek	Debris removal
CL-INV-200	Weed presence (bladder campion), single plant	Possible weed management
CL-TER-100	Construction cable on ground	Cable removal
C1-INV-300	Weed infestation (ox-eye daisy) both sides of road and into RoW	Weed management
C1-INV-400	Weed presence (ox-eye daisy) observed on RoW	Weed management
GEL	Two excavated areas observed along the northern ground electrode line (~300m^2 each)	Fill with material from adjacent borrow source
N3-INV-100	Weed infestation (ox-eye daisy), in ditch 0 to 5 m along Hwy 384, south side	Weed management
N3-INV-300	Weed infestation (ox-eye daisy), one patch near crest	Weed management
N4-INV-300	Weed infestation (ox-eye daisy), in ditch along Hwy 10, both sides	Weed management
N4-INV-400	Weed presence (ox-eye daisy) on RoW	Weed management
N4-INV-500	Weed infestation (ox-eye daisy) in east ditch of PTH 10 and spreading into RoW	Weed management
RHB-70	Exposed soil ~800m^2, slope erosion	Natural revegetation, fibre blankets (seed upland mix?)
RHB-81	Exposed soil ~400m^2, slope erosion	Natural revegetation, fibre blankets
RHB-108	Exposed soil ~400m^2	Natural revegetation (seed upland mix?)
RHB-179	Exposed soil ~900m^2	Natural revegetation (seed upland mix?)
RHB-265	Exposed soil ~900m^2	Natural revegetation (seed upland mix?)
RHB-466	Exposed soil on slope with fibre blanket; weed infestation east (bladder campion) ~400m^2	Natural revegetation, weed management
RHB-516	Exposed soil on slope with fibre blanket, potential erosion ~200m^2	Natural revegetation, additional fibre blankets
RHB-1030	Rig mat	Rig mat removal
RHB-1066	Rig mat	Rig mat removal
RHB-1073	Rig mat	Rig mat removal
RHB-1133/ N2-INV-600	Weed infestation (bladder campion) from rail line ~2500m^2	Weed management
RHB-1249	Exposed soil on slope, rill erosion ~200m^2	Natural revegetation, fibre blankets
RHB-1355-1356	Several dugouts and slash pile	Natural revegetation, slash removal
RHB-1405-1406	Exposed soil ~7500m^2	Seed upland mix
RHB-2024-2025/ N3-INV-600	Weed presence (ox-eye daisy, scentless false mayweed) sporadic	Weed management
RHB-2114-2120/ N3-INV-400	Weed infestation (ox-eye daisy) sporadic and patches on RoW, previous camp and forest	Weed management
RHB-3099	Weed presence (ox-eye daisy) few patches, exposed soil	Seed upland mix, weed management

RHB-3100	Weed infestation (ox-eye daisy) ~7500m^2	Weed management
RHB-3260	Timber piles in RoW	Timber removal
RHB-3290	Weed infestation (various species) ~6000m^2	Weed management
RHB-4156	Exposed soil	Seed upland mix
RHB-4206	Exposed soil	Seed upland mix
RHB-4208-4210	Weed infestation (ox-eye daisy) ~1000m^2	Weed management
RHB-4212	Weed infestation (ox-eye daisy) ~10000m^2	Weed management
RHB-6211-6212	Weed presence (leafy spurge) sporadic at approach and RoW between towers, 900m^2	Weed management
S1-INV-006	Weed presence (redroot pigweed) extending into RoW ~40m	Weed management
S1-INV-007	Weed presence (leafy spurge) across road from RoW access, north side 30m length along road	Weed management
S1-INV-041	Weed presence (white sweet clover) at approach, north side, 200m^2	Weed management
S1-INV-046	Weed presence (leafy spurge and bladder campion) east and west side of road at approach, and leafy spurge sporadic down RoW, to Tower 6270	Weed management
S1-INV-048	Weed presence (leafy spurge) likely patch on RoW in distance near Tower 6281, 900m^2	Weed management
S1-INV-050	Weed presence (leafy spurge) east side of road, 100m^2	Weed management
S1-INV-051	Weed presence (leafy spurge) south side of road in ditch ~50m length and north side of road at approach ~900m^2, also extends into RoW and covers width of the RoW for ~500m at Towers 6294 to 6295	Weed management
S1-INV-052	Weed presence (bladder campion) east side of road, few plants	Weed management
S1-INV-053	Weed presence (leafy spurge) west side of road, several patches, 400m^2	Weed management
S1-INV-054	Weed presence (leafy spurge) west side of road in ditch, east side of road at south end of approach	Weed management
S1-INV-056	Weed presence (leafy spurge) west side of road on RoW along north property fence line, weed presence (bladder campion) west side of road at approach	Weed management
S2-INV-006	Weed presence (ox-eye daisy) east side of road, Hwy 75 ditch	Weed management
S2-INV-008	Weed presence (field sow-thistle) extending into RoW and around Tower 7216	Weed management
S2-INV-011	Weed presence (bladder campion) south side of road at approach, weed presence (field sow-thistle and Canada thistle) extending into RoW and around Tower 7276	Weed management

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APPENDIX I. Definitions of selected technical terms.

Abundance-Dominance – This term expresses the number of individuals of a plant species and their coverage in a phytosociological survey; it is based on the coverage of individuals for classes with a coverage higher than 5% and on the abundance for classes with a lower percentage (Cauboue et al. 1996).

Activity – Activity in relation to a project means actions carried out for construction, operation and eventual decommissioning; and in relation to human presence, actions carried out for domestic and commercial purposes including hunting, fishing, trapping, forestry, mining etc (Manitoba Hydro 2011).

Angiosperm – A seed borne in a vessel (carpel); thus one of a group of plants whose seeds are borne within a mature ovary or fruit (Raven et al. 1992).

Bog – Ombrotrophic peatlands generally unaffected by nutrient-rich groundwater that are acidic and often dominated by heath shrubs and Sphagnum mosses and that may include open-growing, stunted trees (Cauboue et al. 1996).

Boreal – Pertaining to the north; a climatic and ecological zone that occurs south of the subarctic, but north of the temperate hardwood forests of eastern North America, the parkland of the Great Plains region, and the montane forests of the Canadian cordillera (Cauboue et al. 1996).

Bryophyte – A plant of the group Bryophyta; a liverwort, moss or hornwort (Johnson et al. 1995).

Canopy – The more or less continuous cover of branches and foliage formed by the crowns of trees (Cauboue et al. 1996).

Canopy Closure – The degree of canopy cover relative to openings (Cauboue et al. 1996).

Classification – The systematic grouping and organization of objects, usually in a hierarchical manner (Cauboue et al. 1996).

Cluster Analysis – A multidimentional statistical technique used to group samples according to their degree of similarity (Cauboue et al. 1996).

Community-Type – A group of vegetation stands that share common characteristics, an abstract plant community (Cauboue et al. 1996).

Coniferous – A cone-bearing plant belonging to the taxonomic group Gymnospermae (Cauboue et al. 1996).

Cover – The area of ground covered with plants of one or more species, usually expressed as a percentage (Cauboue et al. 1996).

Deciduous – Refers to perennial plants from which the leaves abscise and fall off at the end of the growing season (Cauboue et al. 1996).

Dicotyledon – One of the two divisions of the Angiosperms; the embryo has two cotyledons, the leaves are usually net-veined, the stems have open bundles, and the flower parts are usually in fours or fives (Usher 1996).

Ecoregion – An area characterized by a distinctive regional climate as expressed by vegetation (Cauboue et al. 1996).

Endangered Species - A species that is facing imminent extirpation or extinction (Government of Canada 2019b).

Environmental Effect – Any change in biophysical or socio-economic environment caused by a project or its components or activities (Manitoba Hydro 2011).

Ericaceous – Ericaceae family, heather-like (Usher 1996).

Extirpated Species - A species that no longer exists in the wild in Canada, but exists elsewhere in the wild (Government of Canada 2019b).

Fen – Wetland with a peat substrate, nutrient-rich waters, and primarily vegetated by shrubs and graminoids (Cauboue et al. 1996).

Flora – A list of the plant species present in an area (Cauboue et al. 1996).

Forb – A broad-leaved, non-woody plant that dies back to the ground after each growing season (Johnson et al. 1995).

Forest – A relatively large assemblage of tree-dominated stands (Cauboue et al. 1996).

Graminoid – A narrow-leaved plant that is grass-like; the term refers to grasses and plants that look like grasses (Cauboue et al. 1996).

Grassland – Vegetation consisting primarily of grass species occurring on sites that are arid or at least well drained (Cauboue et al. 1996).

Grubbing – Removal of roots and other ground vegetation (Manitoba Hydro 2006).

Gymnosperm – A seed plant with seeds not enclosed in the ovary; the conifers are the most familiar group (Raven et al. 1992).

Habitat – The place in which an animal or plant lives; the sum of environmental circumstances in the place inhabited by an organism, population or community (Cauboue et al. 1996).

Herb (Herbaceous) – A plant without woody above-ground parts, the stems dying back to the ground each year (Johnson et al. 1995).

Invasive – Invasive species are plants that are growing outside of their country or region of origin and are out-competing or even replacing native plants (Invasive Species Council of Manitoba 2019).

Mitigation – Often the process or act of minimizing the negative effects of a proposed action (Cauboue et al. 1996).

Mixedwood – Forest stands composed of conifers and angiosperms each representing between 25 and 75% of the cover (Cauboue et al. 1996).

Monocotyledon – A class of the Angiosperms; the seeds have a single cotyledon, the floral parts are in three or multiples of three, and the leaves have parallel veins (Usher 1996).

Non-vascular Plant – A plant without a vascular system (eg. mosses and lichens).

Noxious Weed – A plant that is designated as a tier 1, tier 2 or tier 3 noxious weed in the regulations and includes the seed of a noxious weed, whether it is still attached to the noxious weed or is separate from it (Manitoba Government 2019).

Plot – A vegetation sampling unit used to delineate a fixed amount of area for the purpose of estimating plant cover, biomass, or density (Cauboue et al. 1996).

Pteridophyte – A division of the plant kingdom including ferns and their allies (horsetails and clubmosses).

Rare Species – Any indigenous species of flora that, because of its biological characterisitics, or because it occurs at the fringe of its range, or for some other reasons, exists in low numbers or in very restricted areas of Canada but is not a threatened species (Cauboue et al. 1996).

Riparian – Refers to terrain, vegetation or simply a position adjacent to or associated with a stream, flood plain, or standing body of water (Cauboue et al. 1996).

Shrub – A perennial plant usually with a woody stem, shorter than a tree, often with a multi-stemmed base (Cauboue et al. 1996).

Site – The place or category of places, considered from an environmental perspective, that determines the type and quality of plants that can grow there (Cauboue et al. 1996).

Species – A group of organisms having a common ancestry that are able to reproduce only among themselves; a general definition that does not account for hybridization (Cauboue et al. 1996).

Species of Special Concern – A species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats (Government of Canada 2019b).

Stand – A collection of plants having a relatively uniform composition and structure, and age in the case of forests (Cauboue et al. 1996).

Stratum – A distinct layer within a plant community, a component of structure (Cauboue et al. 1996).

Terrestrial – Pertaining to land as opposed to water (Cauboue et al. 1996).

Threatened Species - A species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction (Government of Canada 2019b).

Understory – Vegetation growing beneath taller plants such as trees or tall shrubs (Cauboue et al. 1996).

Vascular Plant – A plant having a vascular system (Usher 1996).

Vegetation – The general cover of plants growing on a landscape (Cauboue et al. 1996).

Vegetation Type – In phytosociology, the lowest possible level to be described (Cauboue et al. 1996).

Wetland – Land that is saturated with water long enough to promote hydric soils or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological acivity that are adapted to wet environments (Cauboue et al. 1996).

APPENDIX II. Report maps.

Coordinate System: UTM Zone 14 NAD 83
Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan
Date Created: October 23, 2019

0 50 100 Kilometres
0 25 50 Miles

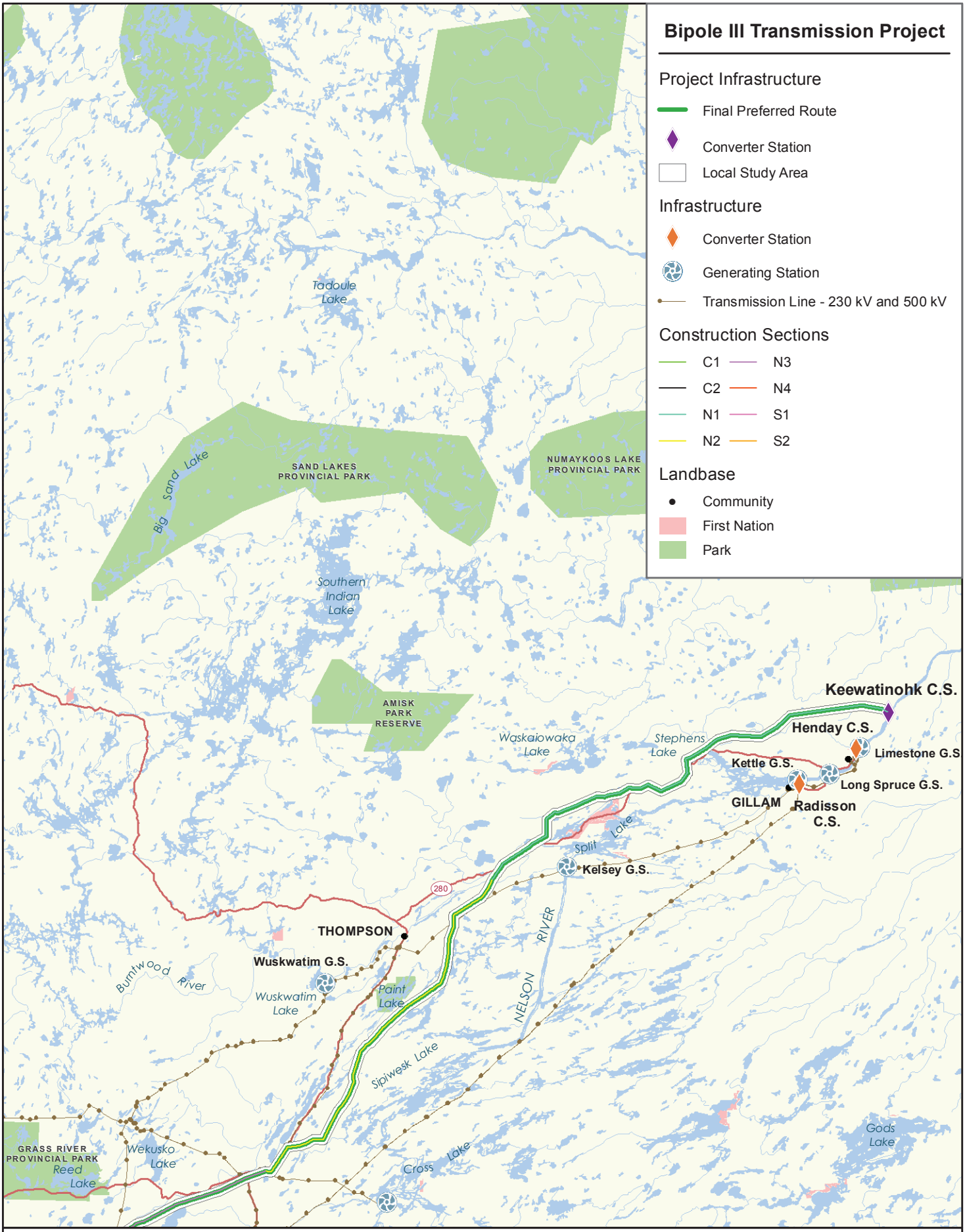
N

1:2,500,000

Bipole III Transmission Project Area

Map 1-1

File Location: I:\CLIENTS\MANITOBA_HYDRO\1404220\Mapping\MXD\VegetationISzwaluk\20191023\BPIII_TECHREP_TransmissionProjectArea_2_5m_A_20191023.mxd


Bipole III Transmission Project
Project Infrastructure
Final Preferred Route
Converter Station
Local Study Area
Infrastructure
Converter Station
Generating Station
Transmission Line - 230 kV and 500 kV
Construction Sections
C1
C2
N1
N2
N3
N4
S1
S2
Landbase
Community
First Nation
Park
Tadoule Lake
Big Sand Lake
SAND LAKES PROVINCIAL PARK
NUMAYKOOS LAKE PROVINCIAL PARK
Southern Indian Lake
AMISK PARK RESERVE
Waskaiowaka Lake
Stephens Lake
Keewatinohk C.S.
Henday C.S.
Limestone G.S
Kettle G.S.
Long Spruce G.S.
GILLAM
Radisson C.S.
Split Lake
Kelsey G.S.
280
THOMPSON
Wuskwatim G.S.
Burntwood River
Wuskwatim Lake
Paint Lake
NELSON RIVER
Sipiwesk Lake
Cross Lake
Gods Lake
GRASS RIVER PROVINCIAL PARK
Reed Lake
Wekusko Lake
Coordinate System: UTM Zone 14 NAD 83
Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan
Date Created: October 23, 2019
0 50 100 Kilometres
0 25 50 Miles
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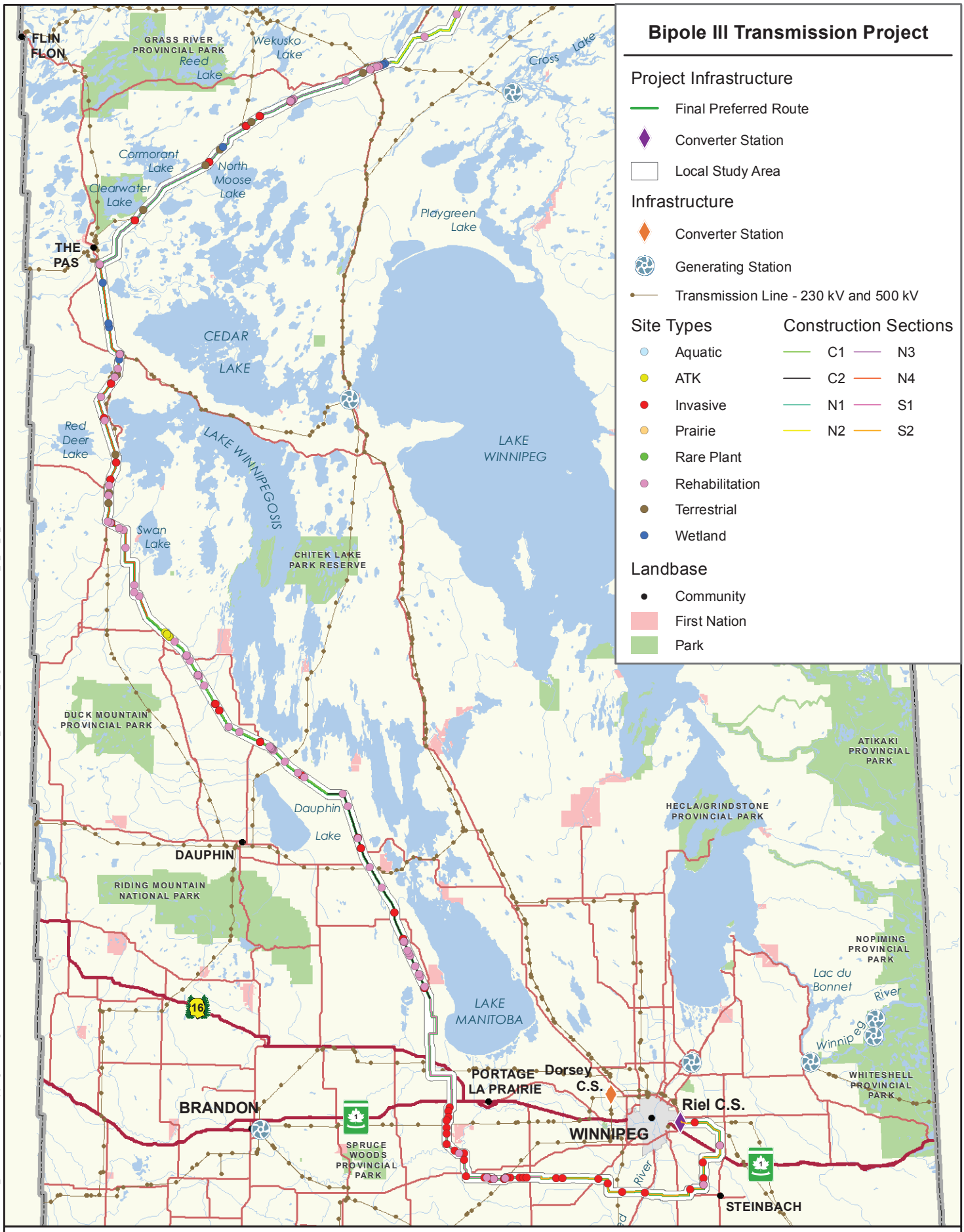
1:2,500,000
Manitoba Hydro
Bipole III Transmission Project Area
Map 1-1
File Location: I:\CLIENTS\MANITOBA_HYDRO\1404220\Mapping\MXD\VegetationISzwaluk\EnvironmentalConsulting\KevinSzwaluk\20191023\BPIII_TECHREP_TransmissionProjectArea_2_5m_A_20191023.mxd



Manitoba Hydro

Coordinate System: UTM Zone 14 NAD 83
Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan, SEC
Date Created: October 28, 2019

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0 25 50 Miles

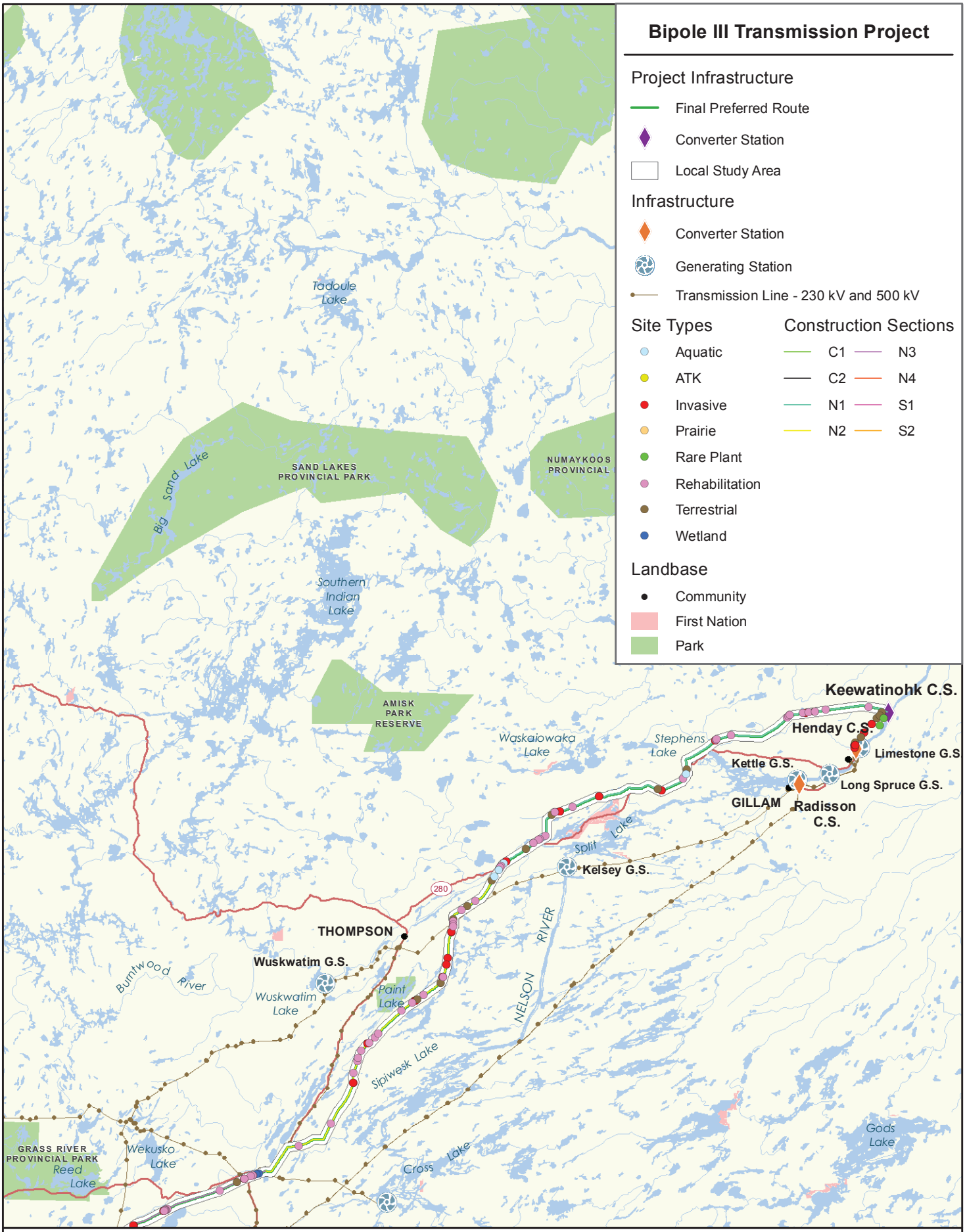
N

1:2,500,000

Distribution of Vegetation Sites

Map 4-1

File Location: I:\CLIENTS\MANITOBA_HYDRO\1404220\Mapping\MXD\VegetationSzwaluk\Kevin\Szwaluk\20191023\BPIII_TECHREP_VegetationDistributionSites_2_5m_A_20191023.mxd


Bipole III Transmission Project
Project Infrastructure
Final Preferred Route
Converter Station
Local Study Area
Infrastructure
Converter Station
Generating Station
Transmission Line - 230 kV and 500 kV
Site Types
Aquatic
ATK
Invasive
Prairie
Rare Plant
Rehabilitation
Terrestrial
Wetland
Construction Sections
C1
C2
N1
N2
N3
N4
S1
S2
Landbase
Community
First Nation
Park
Tadoule Lake
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Keewatinohk C.S.
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Kettle G.S.
Long Spruce G.S.
GILLAM
Radisson C.S.
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Burntwood River
Wuskwatim Lake
Paint Lake
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Sipiwesk Lake
Cross Lake
Gods Lake
GRASS RIVER PROVINCIAL PARK
Reed Lake
Wekusko Lake
Manitoba Hydro
Coordinate System: UTM Zone 14 NAD 83
Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan, SEC
Date Created: October 28, 2019
0 50 100 Kilometres
0 25 50 Miles
N
1:2,500,000
Distribution of Vegetation Sites
Map 4-1
File Location: I:\CLIENTS\MANITOBA_HYDRO\1404220\Mapping\MXD\VegetationSzwaluk\EnvironmentalConsulting\KevinSzwaluk\20191023\BPIII_TECHREP_VegetationDistributionSites_2_5m_A_20191023.mxd

APPENDIX III. Potential environmental effects on terrestrial ecosystems and vegetation as a result of the project. Effects were identified in the project Environmental Impact Statement (Manitoba Hydro 2011) and the Terrestrial Ecosystems and Vegetation Technical Report (Szwaluk Environmental Consulting et al. 2011).

Number	Potential Environmental Effect
1	Potential loss of plants of conservation concern
2	Environmentally sensitive sites may be affected
3	Potential loss of habitat and plants used by Indigenous people as identified through the ATK process
4	Loss of native forest vegetation
5	Riparian areas may be disrupted
6	Vegetation diversity will be temporarily reduced on the Project site
7	Abundance of non-native species may increase
8	Vegetation composition and structure may be modified adjacent to the disturbance zone
9	Fragmentation of vegetation communities will occur
10	Wetlands may be affected
11	Potential effect to vegetation from the release of fuels and hazardous substances
12	Potential effect of dust from project activities on the health of plants
13	Use of herbicides may affect desirable vegetation
14	Increased risk of wildfire
15	Potential for increased access by non-Indigenous people to vegetation resources used by Indigenous people as identified through the ATK process

APPENDIX IV. Project commitments for environmental monitoring of terrestrial ecosystems and vegetation. Documents referred to include the Environment Act Licence (Manitoba Conservation and Water Stewardship 2013), the report on Public Hearing (Manitoba Clean Environment Commission 2013), the project Environmental Impact Statement (Manitoba Hydro 2011), and the Terrestrial Ecosystems and Vegetation Assessment of the Bipole III Transmission Project (Szwaluk Environmental Consulting et al. 2011).

Commitment Document	Page/Section or Clause	Environmental Component	Commitment Description Summary	Objectives to meet intent of Commitment
Licence	Clause 57	Mitigation	The Licencee shall, during construction of the Development, submit annual reports to the Director on the success of the mitigation measures employed during construction, a description of the adaptive management measures undertaken to address issues, and recommendations for improvements of mitigation in future projects. The reports shall include a progressive assessment of the accuracy of predictions made in the EIS and supporting information, including those relating to domestic use of resources.	Submit annual technical report identifying success of mitigation measures, and recommendations for improvements where required.
Licence	Clause 36	Forests	The Licencee shall, in consultation with the Forestry Branch, manage vegetation along the transmission RoW in coniferous dominated forest to retain the coniferous character.	Monitor transmission line RoW in coniferous dominated forest.
Licence	Clause 46	Invasives and non-natives	The Licencee shall, during construction and maintenance of the Development, prevent the introduction and spread of foreign aquatic and terrestrial biota (e.g., weeds, non-native species) to surface waters and in native habitats and prevent invasive species to agricultural lands.	Monitor transmission line RoW for invasives and non-natives.

Licence	Clause 48	Environmental sensitive sites	The Licencee shall, during maintenance of the Development in ESSs identified in the EPP related to traditional plant harvesting: a) clear vegetation using only low impact methods including hand clearing; b) not apply herbicides in the ESSs and within a buffer from the sites, unless a vegetation management agreement stating otherwise is developed with the First Nations, Metis communities and local Indigenous communities that utilize the specific sites; and c) post signs indicating herbicides have been applied in areas along the transmission line right of-way when and where herbicides have been applied in the vicinity of the ESSs.	Monitor transmission line RoW during maintenance activities.
Licence	Clause 52	Wetlands	To ensure no net loss of wetlands, the Licencee shall, during construction and maintenance of the development, maintain a minimum 30 meter riparian buffer zone immediately adjacent to wetlands and the shoreline of lakes, rivers, creeks, and streams.	Visual observations during monitoring of the transmission line RoW wetlands and river crossings.
Licence	Clause 53	Prairies	The Licencee shall, where native prairie habitat is disturbed during construction of the Development, retain a native prairie re-vegetation specialist to plan and oversee reclamation of these areas.	Monitor transmission line RoW prairies; develop and implement vegetation rehabilitation plan.
Licence	Clause 60	Vegetation control	The Licencee shall, for approval of the Director, submit a vegetation control plan for line maintenance.	Manitoba Hydro to develop and implement vegetation control plan.

EIS	EIS Commitment Table	Native Grasslands/Prairie Areas	Existing access roads and trails will be used to the extent possible; construction activities will be carried out during the winter months; where disturbance has occurred in areas prone to increased erosion, vegetation will be re-established using native species appropriate for the site; trees will be removed by low ground disturbance methods; where trees do not pose a threat to the operations of the transmission line, clearing will be reduced in these areas; where maintenance activities do not occur during winter months, soil and vegetation disturbance will be minimized in the prairie areas.	Monitor transmission line RoW in prairies.
EIS	EIS Commitment Table	Plant Species of Conservation Concern	Existing access roads and trails will be used to the extent possible; locations of species will be marked prior to construction activities; activities will be carried out during the winter months; where activities do not occur over winter months, disturbance to the shrub and herb layers will be minimized where species of concern have been observed; a non-herbicide method will be used to control vegetation, such as hand cutting, mechanical cutting or winter shearing.	Pre-construction surveys and monitor transmission line RoW during construction and maintenance activities.
EIS	EIS Commitment Table	Dust	Construction and maintenance activities for many areas will be carried out during the winter months; water or approved dust suppression agents that will not negatively affect surrounding vegetation will be used for dust abatement where and when necessary.	Visual observations during monitoring of the transmission line RoW.
EIS	EIS Commitment Table	Herbicides	Clearing of the transmission line RoW and other sites, will employ a nonherbicide method such as hand cutting, mechanical cutting or winter shearing; if herbicides are required, all applicable permits and provincial regulations will be followed.	Visual observations during monitoring of the transmission line RoW.

EIS	EIS Commitment Table	Invasives and non-natives	Construction and maintenance activities will be carried out during the winter months where possible.	Monitor transmission line RoW for invasives and non-natives.
EIS	EIS Commitment Table	Modification of vegetation composition	Construction activities will be carried out during the winter months to minimize removal of shrub and understory species; grubbing will be minimized within the RoW to reduce root damage except at foundation sites.	Monitor transmission line RoW for vegetation composition.
EIS	EIS Commitment Table	Non-VEC plants and communities	Existing access roads and trails will be used to the extent possible; tree removal will be confined within the limits of the RoW; trees will be felled into the RoW; clearing and construction activities will be carried out during the winter months; in wetlands, clearing, construction and maintenance activities will be carried out during the winter months; where transmission structures will be sited in areas of increased erosion potential, planting or seeding these areas with native species will occur; during construction, measures will be implemented to manage storm water runoff to reduce the potential for erosion; where activities, do not occur during winter months, soil and vegetation disturbance will be minimized; a minimum vegetation buffer width of 30 m of the high water mark will be maintained for waterbodies such as lakes, ponds and streams.	Visual observations during monitoring of the transmission line RoW.
EIS	EIS Commitment Table	Vegetation diversity	Construction activities will be carried out during the winter months; grubbing will be minimized within the RoW to reduce root damage except at foundation sites; native plant species will be used for revegetation of disturbed areas.	Monitor transmission line RoW for vegetation diversity.

EIS	EIS Commitment Table	Wildfire risks	The removal of slash and other tree maintenance activities will be scheduled to avoid the forest fire season, and burning should occur in the winter months; where practical, slash piles will be located on sites with mineral soils; slash piles will be placed away from the RoW edges to reduce the potential for scorching of standing vegetation.	Visual observations during monitoring of the transmission line RoW.
EIS	Draft EnvPP Appendix H	Species of conservation concern	Pre-clearing surveys for rare plants will be focused in areas of the Project Footprint likely to support species of concern (including the small white lady's slipper) but not previously assessed.	Pre-construction surveys and monitor transmission line RoW during construction and maintenance activities.
EIS	Draft EnvPP Appendix H	Prairies	Monitoring native grassland/prairie areas will occur as part of the overall monitoring program.	Monitor transmission line RoW in prairies; develop and implement vegetation rehabilitation plan.
EIS	Draft EnvPP Appendix H	Plants important to Indigenous people	In summer construction areas pre-clearing surveys for plants and plant communities identified in the EIS as being important to Indigenous communities will occur in areas of the Project Footprint not previously assessed; surveys of plants and plant communities identified in the EIS as being important to Indigenous communities will focus on identifying any changes in plant community composition and productivity (e.g., berries, medicinal plants) due to Project development.	Monitor transmission line RoW for plants important to Indigenous people.
EIS	Draft EnvPP Appendix H	Invasives and non-natives	Permanently located sampling units located at representative sites will be used to record any changes in vegetation resulting from Project construction (i.e., introduction of non-native and invasive species).	Monitor transmission line RoW for invasives and non-natives.

CEC Report	Page 83	Plants important to Indigenous people	Conduct vegetation clearing by hand in identified ESS related to traditional plant harvesting; provide a buffer between herbicide application areas and ESS related to traditional plant harvesting; post areas that have been actively herbicided in the vicinity of plant harvesting areas.	Visual observations during monitoring of the transmission line RoW.
CEC Report	Page 122	Herbicides	No herbicide use in bog areas	Visual observations during monitoring of the transmission line RoW.
CEC Report	Page 122	Forests	Manitoba Hydro leave wildlife trees throughout the project RoW where they do not pose a hazard; retain coniferous character by using such techniques as topping conifers.	Visual observations during monitoring of the transmission line RoW.

APPENDIX V. Location of vegetation sample plots and sites visited in 2019.

Site	Section/Component	UTM Zone	Easting	Northing
AQUA-161	N1	14 U	641779	6227876
AQUA-167	N1	14 U	621912	6215061
AQUA-169	N1	14 U	619430	6211532
AQUA-172	N1	14 U	617340	6208378
AQUA-135	N1	15 U	343930	6257279
C1-ATK-100	C1	14 U	388879	5771333
C1-ATK-200	C1	14 U	389135	5771103
C1-ATK-300	C1	14 U	390193	5770124
C1-ATK-400	C1	14 U	390144	5770173
C1-ATK-500	C1	14 U	389944	5770397
C1-ATK-600	C1	14 U	387873	5772269
C1-ATK-700	C1	14 U	388842	5771385
C1-ATK-800	C1	14 U	388809	5771421
C1-ATK-900	C1	14 U	388913	5771289
C1-ATK-950	C1	14 U	388956	5771275
C1-INV-100	C1	14 U	413214	5736318
C1-INV-101	C1	14 U	413248	5736326
C1-INV-200	C1	14 U	415313	5732754
C1-INV-201	C1	14 U	415327	5732791
C1-INV-300	C1	14 U	435939	5717157
C1-INV-301	C1	14 U	435943	5717111
C1-INV-400	C1	14 U	442329	5713130
C1-INV-401	C1	14 U	442319	5713178
C1-INV-500	C1	14 U	456833	5700234
C1-INV-501	C1	14 U	456837	5700293
C2-INV-100	C2	14 U	507939	5617871
C2-INV-101	C2	14 U	507896	5617866
C2-INV-200	C2	14 U	485099	5668778
C2-INV-201	C2	14 U	485135	5668777
C2-INV-300	C2	14 U	486683	5663797
C2-INV-301	C2	14 U	486638	5663800
C2-INV-400	C2	14 U	503574	5630853
C2-INV-401	C2	14 U	503610	5630854
C2-INV-500	C2	14 U	518882	5593323
C2-INV-501	C2	14 U	518844	5593324
CL-INV-100	AC Collector Line	15 U	429351	6263150
CL-INV-101	AC Collector Line	15 U	429294	6263142
CL-INV-200	AC Collector Line	15 U	429646	6264309
CL-INV-201	AC Collector Line	15 U	429482	6264289
CL-INV-300	AC Collector Line	15 U	434736	6270314
CL-INV-301	AC Collector Line	15 U	434730	6270356
CL-TER-100	AC Collector Line	15 U	444699	6279727
CL-TER-200	AC Collector Line	15 U	441910	6277124
CL-TER-300	AC Collector Line	15 U	430017	6265684
CP-INV-100	Construction Power Line	15 U	429927	6264437

Site	Section/Component	UTM Zone	Easting	Northing
CP-INV-101	Construction Power Line	15 U	429888	6264417
CP-INV-200	Construction Power Line	15 U	439016	6274030
CP-INV-201	Construction Power Line	15 U	439078	6274015
CP-TER-100	Construction Power Line	15 U	443457	6278245
CP-TER-200	Construction Power Line	15 U	432907	6268153
GEL-SCC-100, KW-ECO-319	Northern Ground Electrode Line	15 U	445251	6276654
GEL-SCC-200, KW-ECO-325	Northern Ground Electrode Line	15 U	442897	6272941
N1-INV-100	N1	14 U	670081	6248601
N1-INV-101	N1	14 U	670086	6248624
N1-INV-200	N1	14 U	650359	6240892
N1-INV-201	N1	14 U	650391	6240873
N1-INV-300	N1	14 U	623260	6215908
N1-INV-301	N1	14 U	623309	6215912
N1-INV-400	N1	15 U	330724	6250164
N1-INV-401	N1	15 U	330744	6250156
N1-INV-500	N1	15 U	359811	6272718
N1-INV-501	N1	15 U	359818	6272694
N1-INV-600	N1	15 U	406148	6282707
N1-INV-601	N1	15 U	406149	6282681
N1-TER-100	N1	14 U	646024	6239472
N1-TER-200	N1	14 U	633076	6222270
N1-TER-300	N1	14 U	619843	6212151
N1-TER-400	N1	15 U	328929	6250914
N1-TER-500	N1	15 U	344352	6259571
N1-TER-600	N1	15 U	410680	6282956
N2-INV-100	N2	14 U	595548	6180196
N2-INV-101	N2	14 U	595513	6180218
N2-INV-200	N2	14 U	593703	6167484
N2-INV-201	N2	14 U	593745	6167480
N2-INV-300	N2	14 U	593122	6163747
N2-INV-301	N2	14 U	593085	6163776
N2-INV-400	N2	14 U	577340	6145650
N2-INV-401	N2	14 U	577334	6145689
N2-INV-500	N2	14 U	577535	6145769
N2-INV-501	N2	14 U	577473	6145770
N2-INV-600	N2	14 U	591352	6157388
N2-INV-601	N2	14 U	591329	6157449
N2-INV-700	N2	14 U	553573	6124046
N2-INV-701	N2	14 U	553581	6124010
N2-INV-800	N2	14 U	546315	6104417
N2-INV-801	N2	14 U	546276	6104398
N2-TER-100	N2	14 U	615850	6206194
N2-TER-200	N2	14 U	603753	6193292
N2-TER-300	N2	14 U	596633	6186775

Site	Section/Component	UTM Zone	Easting	Northing
N2-TER-400	N2	14 U	578679	6146503
N2-TER-500	N2	14 U	590289	6154658
N3-INV-100	N3	14 U	372809	5979985
N3-INV-101	N3	14 U	372787	5980018
N3-INV-200	N3	14 U	410128	6009548
N3-INV-201	N3	14 U	410195	6009568
N3-INV-300	N3	14 U	435832	6032716
N3-INV-301	N3	14 U	435772	6032727
N3-INV-400	N3	14 U	451029	6040069
N3-INV-401	N3	14 U	451038	6040028
N3-INV-500	N3	14 U	428778	6027547
N3-INV-501	N3	14 U	428844	6027556
N3-INV-600	N3	14 U	491652	6056251
N3-INV-601	N3	14 U	491677	6056230
N3-TER-100	N3	14 U	376909	5985410
N3-TER-200	N3	14 U	408181	6007830
N3-TER-300	N3	14 U	415512	6015685
N3-TER-400	N3	14 U	431478	6029646
N3-TER-500	N3	14 U	487589	6054372
N3-WET-100	N3	14 U	417198	6017184
N3-WET-200	N3	14 U	498745	6058859
N3-WET-300	N3	14 U	497455	6058400
N4-INV-100	N4	14 U	360575	5827359
N4-INV-101	N4	14 U	360593	5827388
N4-INV-200	N4	14 U	357123	5880370
N4-INV-201	N4	14 U	357162	5880374
N4-INV-300	N4	14 U	360550	5897888
N4-INV-301	N4	14 U	360546	5897827
N4-INV-400	N4	14 U	363099	5858125
N4-INV-401	N4	14 U	363122	5858123
N4-INV-500	N4	14 U	360325	5849418
N4-INV-501	N4	14 U	360284	5849383
N4-TER-100	N4	14 U	362886	5861976
N4-TER-200	N4	14 U	354948	5957785
N4-TER-300	N4	14 U	363801	5902453
N4-TER-400	N4	14 U	359454	5837353
N4-TER-500	N4	14 U	359589	5842897
N4-WET-100	N4	14 U	364795	5910113
N4-WET-200	N4	14 U	359710	5926198
N4-WET-300	N4	14 U	359413	5928279
N4-WET-400	N4	14 U	356515	5948514
RHB-29	N1	15 U	438230	6283091
RHB-70	N1	15 U	416363	6283204
RHB-81	N1	15 U	411191	6282994
RHB-88	N1	15 U	407828	6282844
RHB-94	N1	15 U	404851	6282670

Site	Section/Component	UTM Zone	Easting	Northing
RHB-108	N1	15 U	398259	6282366
RHB-110	N1	15 U	397650	6281879
RHB-112	N1	15 U	396977	6281340
RHB-179	N1	15 U	367915	6274887
RHB-199	N1	15 U	360568	6273232
RHB-200	N1	15 U	360269	6273036
RHB-265	N1	15 U	342119	6255134
RHB-403	N1	14 U	656521	6243293
RHB-424	N1	14 U	647810	6240563
RHB-458	N1	14 U	642957	6228541
RHB-465	N1	14 U	640051	6226900
RHB-466	N1	14 U	639625	6226660
RHB-473	N1	14 U	636934	6225139
RHB-516	N1	14 U	620609	6213390
RHB-517	N1	14 U	620182	6212692
RHB-1030	N2	14 U	607761	6195797
RHB-1048	N2	14 U	600709	6191363
RHB-1066	N2	14 U	596659	6185637
RHB-1070	N2	14 U	596706	6184163
RHB-1073	N2	14 U	596643	6183111
RHB-1133	N2	14 U	591383	6157433
RHB-1164	N2	14 U	581654	6148477
RHB-1180	N2	14 U	575919	6144700
RHB-1196	N2	14 U	570518	6140595
RHB-1234	N2	14 U	558819	6129244
RHB-1240	N2	14 U	557199	6127356
RHB-1249	N2	14 U	554420	6124395
RHB-1262	N2	14 U	550343	6120586
RHB-1272	N2	14 U	548831	6116943
RHB-1276	N2	14 U	548274	6115198
RHB-1290	N2	14 U	546375	6109247
RHB-1355-1356	N2	14 U	535039	6083907
RHB-1405-1406	N2	14 U	518923	6072747
RHB-2014	N3	14 U	495977	6057853
RHB-2015	N3	14 U	495524	6057688
RHB-2017	N3	14 U	494622	6057357
RHB-2024-2025	N3	14 U	491417	6056190
RHB-Mitishto River	N3	14 U	479170	6050339
RHB-2114-2115	N3	14 U	452841	6041029
RHB-2115-2116	N3	14 U	452391	6040810
RHB-2116-2117	N3	14 U	452042	6040628
RHB-2117-2118	N3	14 U	451766	6040468
RHB-2118-2119	N3	14 U	451577	6040361
RHB-2119-2120	N3	14 U	451135	6040133
RHB-Camp-Trail	N3	14 U	451899	6040538
RHB-3000	N4	14 U	354918	5957921

Site	Section/Component	UTM Zone	Easting	Northing
RHB-3099	N4	14 U	365053	5912705
RHB-3099	N4	14 U	365053	5912705
RHB-3100	N4	14 U	365025	5912447
RHB-3100	N4	14 U	365025	5912447
RHB-3115	N4	14 U	364276	5905169
RHB-3125	N4	14 U	362721	5900954
RHB-3150-3152	N4	14 U	355603	5890935
RHB-3178	N4	14 U	357465	5879268
RHB-3250	N4	14 U	359848	5846564
RHB-3260	N4	14 U	359565	5841607
RHB-3290	N4	14 U	358987	5828191
RHB-3293	N4	14 U	360308	5827487
RHB-3304-3305	N4	14 U	364972	5825005
RHB-3309-3310	N4	14 U	367139	5824170
RHB-3331	N4	14 U	367871	5815215
RHB-3382	N4	14 U	372386	5796100
RHB-3389	N4	14 U	372339	5792647
RHB-3399	N4	14 U	374951	5790293
RHB-4039	C1	14 U	392698	5767898
RHB-4060	C1	14 U	398650	5760970
RHB-4061	C1	14 U	398906	5760535
RHB-4067	C1	14 U	400332	5758118
RHB-4088-4089	C1	14 U	404589	5750912
RHB-4089-4090	C1	14 U	404638	5750772
RHB-4091-4092	C1	14 U	405013	5750175
RHB-4103	C1	14 U	407805	5745454
RHB-4156	C1	14 U	420000	5724784
RHB-4169-4170	C1	14 U	425347	5722240
RHB-4206	C1	14 U	440680	5714657
RHB-4208	C1	14 U	441250	5714049
RHB-4209	C1	14 U	441538	5713740
RHB-4210	C1	14 U	441883	5713469
RHB-4212	C1	14 U	442575	5712938
RHB-4230	C1	14 U	448376	5707051
RHB-4250	C1	14 U	454915	5701582
RHB-4259	C1	14 U	458228	5699247
RHB-5016	C2	14 U	477542	5690953
RHB-5031	C2	14 U	479929	5684789
RHB-5069-5070	C2	14 U	485215	5668371
RHB-5103	C2	14 U	491322	5653883
RHB-5129-5130	C2	14 U	497154	5643673
RHB-5194-5195	C2	14 U	508425	5616809
RHB-5195-5196	C2	14 U	508566	5616497
RHB-5197-5198	C2	14 U	508744	5615999
RHB-5206-5207	C2	14 U	510296	5611917
RHB-5209-5210	C2	14 U	510899	5610605

Site	Section/Component	UTM Zone	Easting	Northing
RHB-5212-5213	C2	14 U	511444	5609461
RHB-5225-5226	C2	14 U	513909	5604115
RHB-5235-5236	C2	14 U	515933	5599724
RHB-5237-5238	C2	14 U	516459	5598630
RHB-5248	C2	14 U	518706	5593727
RHB-6211-6212	S1	14 U	536187	5509778
RHB-6270	S1	14 U	550331	5497552
RHB-6281	S1	14 U	553662	5496643
RHB-6294-6295	S1	14 U	559467	5496958
RHB-7216	S2	14 U	659540	5493829
RHB-7276	S2	14 U	667595	5513760
S1-INV-001	S1	14 U	531541	5532716
S1-INV-002	S1	14 U	530735	5531012
S1-INV-003	S1	14 U	530760	5527730
S1-INV-004	S1	14 U	529814	5526129
S1-INV-005	S1	14 U	529829	5522822
S1-INV-006	S1	14 U	529845	5519529
S1-INV-007	S1	14 U	529881	5514598
S1-INV-040	S1	14 U	533953	5510892
S1-INV-041	S1	14 U	538827	5509743
S1-INV-042	S1	14 U	538854	5506474
S1-INV-043	S1	14 U	539835	5498282
S1-INV-045	S1	14 U	548841	5497536
S1-INV-046	S1	14 U	550477	5497549
S1-INV-047	S1	14 U	552187	5496743
S1-INV-048	S1	14 U	553768	5496639
S1-INV-050	S1	14 U	558684	5496599
S1-INV-051	S1	14 U	559223	5496685
S1-INV-052	S1	14 U	561952	5497615
S1-INV-053	S1	14 U	566892	5497729
S1-INV-054	S1	14 U	568551	5497755
S1-INV-055	S1	14 U	570185	5497776
S1-INV-056	S1	14 U	560302	5497551
S1-PRA-900	S1	14 U	536436	5509796
S2-INV-001	S2	14 U	585016	5497215
S2-INV-002	S2	14 U	588323	5497272
S2-INV-003	S2	14 U	606346	5496717
S2-INV-004	S2	14 U	611301	5494389
S2-INV-005	S2	14 U	618351	5490374
S2-INV-006	S2	14 U	629891	5490023
S2-INV-007	S2	14 U	652722	5491514
S2-INV-008	S2	14 U	659535	5493813
S2-INV-009	S2	14 U	659451	5497052
S2-INV-010	S2	14 U	659294	5505304
S2-INV-011	S2	14 U	667597	5513715
S2-INV-012	S2	14 U	655011	5525091

APPENDIX VI. Species of conservation concern recorded during sampling in 2019.

Site	Species	MBCDC Rank	UTM Zone	Easting	Northing
C1-ATK-100	*Arabidopsis lyrata*	S1S2	14 U	388879	5771333
C1-ATK-100	*Sporobolus rigidus*	S3S5	14 U	388879	5771333
C1-ATK-100	*Carex inops ssp. heliophila*	S1?	14 U	388879	5771333
C1-ATK-900	*Houstonia longifolia*	S3S5	14 U	388913	5771289
C1-ATK-100	*Schizachyrium scoparium*	S3S4	14 U	388879	5771333
C1-ATK-100	*Selaginella densa*	S3	14 U	388879	5771333
C1-ATK-300	*Melampyrum lineare*	S3S5	14 U	390193	5770124
C1-ATK-500	*Melampyrum lineare*	S3S5	14 U	389944	5770397
C1-ATK-700	*Arabidopsis lyrata*	S1S2	14 U	388842	5771385
C1-ATK-100	*Dichanthelium wilcoxianum*	S2?	14 U	388879	5771333
C1-ATK-700	*Dichanthelium wilcoxianum*	S2?	14 U	388842	5771385
C1-ATK-700	*Sporobolus rigidus*	S3S5	14 U	388842	5771385
C1-ATK-700	*Houstonia longifolia*	S3S5	14 U	388842	5771385
C1-ATK-700	*Schizachyrium scoparium*	S3S4	14 U	388842	5771385
C1-ATK-700	*Selaginella densa*	S3	14 U	388842	5771385
C1-ATK-800	*Schizachyrium scoparium*	S3S4	14 U	388809	5771421
C1-ATK-900	*Arabidopsis lyrata*	S1S2	14 U	388913	5771289
C1-ATK-900	*Schizachyrium scoparium*	S3S4	14 U	388913	5771289
C1-ATK-900	*Selaginella densa*	S3	14 U	388913	5771289
C2-INV-500	*Dichanthelium leibergii*	S3S4	14 U	518882	5593323
N1-INV-100	*Arctous alpina*	S3S4	14 U	670081	6248601
N1-INV-200	*Arctous alpina*	S3S4	14 U	650359	6240892
N1-INV-200	*Salix arbusculoides*	S2S3	14 U	650359	6240892
N1-INV-500	*Salix arbusculoides*	S2S3	14 U	359811	6272718
N1-INV-500	*Salix vestita*	S3	14 U	359811	6272718
N1-INV-600	*Salix arbusculoides*	S2S3	14 U	406148	6282707
N3-TER-400	*Caltha natans*	S2S4	14 U	431478	6029646
N3-TER-200	*Caltha natans*	S2S4	14 U	408181	6007830
N3-TER-400	*Lonicera oblongifolia*	S3S5	14 U	431478	6029646
N3-TER-500	*Eriophorum scheuchzeri*	S2?	14 U	487589	6054372
N3-WET-100	*Drosera anglica*	S3S4	14 U	417198	6017184
N3-WET-200	*Drosera anglica*	S3S4	14 U	498745	6058859
N3-WET-300	*Platanthera dilatata*	S3S4	14 U	359413	5928279
N4-WET-200	*Platanthera dilatata*	S3S4	14 U	359710	5926198
N4-WET-200	*Lonicera oblongifolia*	S3S5	14 U	359710	5926198
N4-WET-300	*Caltha natans*	S2S4	14 U	359413	5928279
N4-WET-300	*Drosera linearis*	S2?	14 U	359413	5928279
N4-WET-400	*Drosera linearis*	S2?	14 U	356515	5948514
S1-PRA-900	*Sporobolus rigidus*	S3S5	14 U	536436	5509796
S1-PRA-900	*Cyperus schweinitzii*	S2	14 U	536466	5509781
S1-PRA-900	*Dalea villosa*	S2S3	14 U	536520	5509790
S1-PRA-900	*Lithospermum incisum*	S3	14 U	536469	5509789

Site	Species	MBCDC Rank	UTM Zone	Easting	Northing
S1-PRA-900	*Lygodesmia juncea*	S3S4	14 U	536460	5509780
S1-PRA-900	*Dichanthelium wilcoxianum*	S2?	14 U	536436	5509796
N4-TER-100	*Carex prairea*	S3S4	14 U	362886	5861976
N4-TER-500	*Carex prairea*	S3S4	14 U	359589	5842897
C2-INV-300	*Solidago mollis*	S3	14 U	486683	5663797
N4-INV-400	*Streptopus lanceolatus*	S3?	14 U	363099	5858125
CL-INV-100	*Tofieldia pusilla*	S3S5	14 U	429351	6263150
N1-INV-100	*Salix arbusculoides*	S2S3	14 U	670081	6248601
C1-ATK-950	*Melampyrum lineare*	S3S5	14 U	388956	5771275
C1-ATK-200	*Carex inops ssp. heliophila*	S1?	14 U	389135	5771103
CL-INV-200	*Houstonia longifolia*	S3S5	14 U	429646	6264309
C1-ATK-600	*Lonicera involucrata*	S3S4	14 U	387873	5772269
CP-INV-100	*Antennaria microphylla*	S3S5	14 U	429927	6264437
N4-TER-500	*Marchantia polymorpha*	S3	14 U	359589	5842897
N3-TER-100	*Melampyrum lineare*	S3S5	14 U	376909	5985410
N3-TER-300	*Pyrola minor*	S3S4	14 U	415512	6015685
C2-INV-500	*Schizachyrium scoparium*	S3S4	14 U	518882	5593323
C1-ATK-200	*Selaginella densa*	S3	14 U	389135	5771103
C1-INV-100	*Solidago mollis*	S3	14 U	413214	5736318
N1-INV-600	*Solidago mollis*	S3	14 U	406148	6282707
N3-TER-100	*Solidago mollis*	S3	14 U	376909	5985410
C1-ATK-600	*Lonicera oblongifolia*	S3S5	14 U	387873	5772269

APPENDIX VII. Flora recorded from surveys in 2019.

Family/Species	Common Name	MB Rank
VASCULAR SPECIES		
PTERIDOPHYTES	**FERNS AND ALLIES**	
DRYOPTERACEAE	WOOD FERN FAMILY	
Matteuccia struthiopteris	Ostrich Fern	S5
EQUISETACEAE	HORSETAIL FAMILY	
Equisetum arvense	Common Horsetail	S5
Equisetum fluviatile	Swamp Horsetail	S5
Equisetum hyemale	Common Scouring-rush	S5
Equisetum pratense	Meadow Horsetail	S4S5
Equisetum scirpoides	Dwarf Scouring-rush	S4S5
Equisetum sylvaticum	Wood Horsetail	S5
SELAGINELLACEAE	SPIKEMOSS FAMILY	
Selaginella densa	Prairie Spike-moss	S3
Gymnosperms		
PINACEAE	PINE FAMILY	
Larix laricina	Tamarack	S5
Picea mariana	Black Spruce	S5
Pinus banksiana	Jack Pine	S5
Angiosperms - Monocotyledons		
CYPERACEAE	SEDGE FAMILY	
Carex aquatilis	Water Sedge	S5
Carex atherodes	Awned Sedge	S5
Carex aurea	Golden Sedge	S5

Family/Species	Common Name	MB Rank
Carex bebbii	Bebb's Sedge	S5
Carex buxbaumii	Buxbaum's Sedge	S4S5
Carex canescens	Grey Sedge	S5
Carex capillaris	Hair-like Sedge	S5
Carex chordorrhiza	Prostrate Sedge	S4S5
Carex concinna	Beautiful Sedge	S4S5
Carex deweyana	Dewey's Sedge	S5
Carex diandra	Two-stamened Sedge	S4S5
Carex disperma	Two-seeded Sedge	S5
Carex foenea	Hay Sedge	S5
Carex granularis	Granular Sedge	S4?
Carex gynocrates	Bog Sedge	S5
Carex houghtoniana	Sand Sedge	S5
Carex inops ssp. *heliophila*	Sun Sedge	S1?
Carex interior	Inland Sedge	S4?
Carex lasiocarpa	Woolly Sedge	S5
Carex leptalea	Bristle-stalked Sege	S5
Carex limosa		
Carex magellanica	Bog Sedge	S5
Carex media	Intermediate Sedge	S4S5
Carex prairea	Prairie Sedge	S3S4
Carex rostrata	Beaked Sedge	S4
Carex siccata	Dry-spike Sedge	S4S5
Carex spp.	Sedge	
Carex tenuiflora	Thin-flowered Sedge	S4S5
Carex trisperma	Three-seeded Sedge	S4S5
Carex vaginata	Sheathed Sedge	S5
Cyperus schweinitzii	Schweinitz's Flatsedge	S2
Eleocharis palustris	Creeping Spike-rush	S5

Family/Species	Common Name	MB Rank
Eriophorum angustifolium	Tall Cotton-grass	S5
Eriophorum chamissonis	Russett Cotton-grass	S4S5
Eriophorum scheuchzeri	Scheuchzeri's Cotton-grass	S2?
Scirpus sp.	A Bulrush	
Trichophorum alpinum	Alpine Cotton-grass	S5
IRIDACEAE	IRIS FAMILY	
Sisyrinchium montanum	Blue-eyed Grass	S5
JUNCACEAE	RUSH FAMILY	
Juncus alpinoarticulatus spp. *americanus*	Alpine Rush	S5
Juncus arcticus var. *balticus*	Baltic Rush	S5
Juncus bufonius	Toad Rush	S5
Juncus nodosus	Knotted Rush	S5
Juncus tenuis	Slender Rush	S4S5
Juncus sp.	A Rush	
Luzula sp.	A Woodrush	
JUNCAGINACEAE	ARROW-GRASS FAMILY	
Triglochin maritima	Seaside Arrow-grass	S5
Triglochin palustris	Marsh Arrow-grass	S4S5
LILIACEAE	LILY FAMILY	
Anticlea elegans	White Camas	S5
Lilium philadelphicum	Wood Lily	S4
Maianthemum canadense	Canada May Flower	S5
Maianthemum stellatum	Star-flowered Solomon's Seal	S5
Maianthemum trifolium	Three-leaved Solomon's Seal	S5

Family/Species	**Common Name**	**MB Rank**
Smilax lasioneura	Carrion Vine	S4S5
Streptopus lanceolatus	Rosy Twisted-stalk	S3?
Tofieldia pusilla	Bog Asphodel	S3S5
Triantha glutinosa	Sticky False Asphodel	S4S5
Trillium cernuum	Nodding Trillium	S4S5
ORCHIDACEAE	ORCHID FAMILY	
Cypripedium reginae	Showy Lady's-slipper	S4
Platanthera dilatata	Bog Candle	S3S4
Spiranthes romanzoffiana	Hooded Ladies'-tresses	S5
POACEAE	GRASS FAMILY	
Agrostis scabra	Rough Bentgrass	S5
Agrostis stolonifera	Creeping Bent	SNA
Andropogon gerardii	Big Bluestem	S5
Avena sativa	Oats	SNA
Beckmannia syzigachne	Slough Grass	S5
Bromus ciliatus	Fringed Brome	S5
Bromus inermis	Smooth Brome	SNA
Calamagrostis canadensis	Marsh Reed Grass	S5
Calamagrostis sp.	Reed Grass	
Calamagrostis stricta	Northern Reed Grass	S5
Danthonia spicata	Poverty Oat Grass	S4S5
Deschampsia cespitosa	Tufted Hairgrass	S4S5
Dichanthelium leibergii	Leiberg's Panic-grass	S3S4
Dichanthelium wilcoxianum	Sand Millet	S2?
Echinochloa crus-galli	Barnyard Grass	SNA
Elymus canadensis	Canada Wild-rye	S4S5
Elymus repens	Quack-grass	SNA

Family/Species	**Common Name**	**MB Rank**
Elymus spp.	A Wheatgrass	
Elymus trachycaulus	Slender Wheatgrass	S5
Elymus trachycaulus ssp. *subsecundus*	Slender Wheat Grass	S5
Festuca saximontana	Rocky Mountain Fescue	S4S5
Glyceria striata	Fowl Manna Grass	S5
Hordeum jubatum	Wild Barley	S5
Koeleria macrantha	June Grass	S5
Leymus innovatus	Hairy Wild Rye	S5
Muhlenbergia glomerata	Bog Muhly	S4
Muhlenbergia sp.	Muhly	
Oryzopsis asperifolia	White-grained Mountain Rice Grass	S5
Phalaris arundinacea	Reed Canarygrass	S5
Phleum pratense	Timothy	SNA
Phragmites australis ssp. *americanus*	American Reedgrass	S5
Piptatheropsis pungens	Northern Rice Grass	SS45
Poa annua	Annual Bluegrass	SNA
Poa palustris	Fowl Bluegrass	S5
Poa pratensis	Kentucky Bluegrass	S5
Poa spp.	Bluegrass	
Schizachne purpurascens	Purple Oat Grass	S5
Schizachyrium scoparium	Little Bluestem	S3S4
Setaria pumila	Yellow Foxtail	SNA
Setaria viridis	Green Foxtail	SNA
Sporobolus rigidus	Sand Grass	S3S5
TYPHACEAE	CAT-TAIL FAMILY	
Typha latifolia	Common Cat-tail	S5

Family/Species	Common Name	MB Rank
Angiosperms – Dicotyledons		
ACERACEAE	MAPLE FAMILY	
Acer negundo	Manitoba Maple	S5
Acer spicatum	Mountain Maple	S5
AMARANTHACEAE	AMARANTH FAMILY	
Amaranthus retroflexus	Redroot Pigweed	SNA
ANACARDIACEAE	SUMAC FAMILY	
Toxicodendron rydbergii	Poison Ivy	S5
APIACEAE	CARROT FAMILY	
Heracleum maximum	Cow Parsnip	S4S5
Pastinaca sativa	Wild Parsnip	SNA
Sanicula marilandica	Seneca Snakeroot	S5
Sium suave	Water Parsnip	S5
Zizia aptera	Heart-leaved Alexanders	S5
Zizia aurea	Golden Alexanders	S4S5
APOCYNACEAE	DOGBANE FAMILY	
Apocynum androsaemifolium	Spreading Dogbane	S5
ARALIACEAE	GINSENG FAMILY	
Aralia hispida	Bristly Sarsaparilla	S4S5
Aralia nudicaulis	Wild Sarsaparilla	S5
ASCLEPIADACEAE	MILKWEED FAMILY	
Asclepias ovalifolia	Dwarf Milkweed	S4S5

Family/Species	**Common Name**	**MB Rank**
Ascelpias speciosa	Showy Milkweed	S3S5
Asclepias syriaca	Common Milkweed	S3S4
Asclepias verticillata	Whorled Milkweed	S3
ASTERACEAE	ASTER FAMILY	
Achillea alpina	Many-flowered Yarrow	S4S5
Achillea millefolium	Yarrow	S5
Ambrosia artimisiifolia	Common Ragweed	S5
Antennaria microphylla	Everlasting	S3S5
Antennaria sp.	Pussytoes	
Artemisia absinthium	Wormwood	SNA
Artemisia biennis	Biennial Wormwood	SNA
Artemisia campestris	Sage	S4S5
Artemisia ludoviciana	Prairie Sage	S5
Cirsium arvense	Canada Thistle	SNA
Cirsium vulgare	Bull Thistle	SNA
Cirsium sp.	A Thistle	
Cyclachaena xanthiifolia	Marsh-elder	SNA
Erigeron canadensis	Canada Horse-weed	S5
Erigeron glabellus	Smooth Fleabane	S5
Erigeron philadelphicus	Philadelphia Fleabane	S5
Euthamia graminifolia	Flat-topped Goldenrod	S5
Heterotheca villosa	Hairy Golden-aster	S5
Hieracium umbellatum	Northern Hawkweed	S5
Lactuca biennis	Tall Blue Lettuce	S4
Lactuca serriola	Prickly Lettuce	SNA
Lactuca sp.	A Lettuce	
Leucanthemum vulgare	Ox-eye Daisy	SNA
Liatris punctata	Dotted Blazing Star	S4

Family/Species	**Common Name**	**MB Rank**
Lygodesmia juncea	Skeletonweed	S3S4
Matricaria discoidea	Pineapple Weed	SNA
Nabalus spp.	Lettuce	
Packera paupercula	Balsam Groundsel	S5
Petasites frigidus var. *palmatus*	Palmate-leaved Coltsfoot	S5
Petasites frigidus var. *sagittatus*	Arrow-leaved Coltsfoot	S5
Rudbeckia hirta	Black-eyed Susan	S5
Solidago canadensis	Canada Goldenrod	S5
Solidago hispida	Hairy Goldenrod	S5
Solidago missouriensis	Missouri Goldenrod	S5
Solidago mollis	Velvety Goldenrod	S3
Solidago multiradiata	Alpine Goldenrod	S4S5
Solidago nemoralis	Showy Goldenrod	S5
Solidago sp.	Goldenrod	
Sonchus arvensis	Field Sow-thistle	SNA
Symphyotrichum boreale	Northern Bog Aster	S4S5
Symphyotrichum ciliolatum	Lindley's Aster	S5
Symphyotrichum laeve	Smooth Aster	S5
Symphyotrichum sp.	An Aster	
Taraxacum officinale	Common Dandelion	SNA
Tripleurospermum inodorum	Scentless False Mayweed	SNA
Xanthium strumarium	Cocklebur	S4
BETULACEAE	BIRCH FAMILY	
Alnus incana	Speckled Alder	S5
Alnus viridis	Green Alder	S5
Betula papyrifera	Paper Birch	S5
Betula pumila	Dwarf Birch	S5
Corylus cornuta	Beaked Hazelnut	S5

Family/Species	Common Name	MB Rank
Corylus sp.	A Hazelnut	
BORAGINACEAE	BORAGE FAMILY	
Lithospermum canescens	Hoary Puccoon	S5
Lithospermum incisum	Linear-leaved Puccoon	S3
Mertensia paniculata	Tall Lungwort	S5
BRASSICACEAE	MUSTARD FAMILY	
Arabidopsis lyrata	Lyre-leaved Rock Cress	S1S2
Capsella bursa-pastoris	Shepherd's Purse	SNA
Descurainia sophia	Flixweed	SNA
Lepidium densiflorum	Common Pepper-grass	S5
Thlaspi arvense	Field Pennycress	SNA
CAMPANULACEAE	BELLFLOWER FAMILY	
Campanula aparinoides	Marsh Bellflower	S5
Campanula rotundifolia	Harebells	S5
CAPRIFOLIACEAE	HONEYSUCKLE FAMILY	
Diervilla lonicera	Bush-honeysuckle	S5
Linnaea borealis	Twinflower	S5
Lonicera dioica	Twining Honeysuckle	S5
Lonicera involucrata	Black Twinberry	S3S4
Lonicera oblongifolia	Swamp-fly Honeysuckle	S3S5
Symphoricarpos albus	Snowberry	S5
Viburnum edule	Mooseberry	S5
Viburnum lentago	Nannyberry	S4
Viburnum opulus	High-bush Cranberry	S5
Viburnum rafinesquianum	Downy Arrowwood	S4S5

Family/Species	Common Name	MB Rank
CARYOPHYLLACEAE	PINK FAMILY	
Moehringia lateriflora	Blunt-leaved Sandwort	S5
Silene latifolia	White Cockle	SNA
Silene noctiflora	Night-flowering Catchfly	SNA
Silene vulgaris	Bladder Campion	SNA
Stellaria spp.	A Stitchwort	
CHENOPODIACEAE	GOOSEFOOT FAMILY	
Bassia scoparia	Summer Cypress	SNA
Brassica rapa	Bird's Rape	SNA
Chenopodium album	Lamb’s-quarters	SNA
Salsola tragus	Russian Thistle	SNA
CORNACEAE	DOGWOOD FAMILY	
Cornus canadensis	Bunchberry	S5
Cornus sericea	Red-osier Dogwood	S5
DROSERACEAE	SUNDEW FAMILY	
Drosera anglica	Oblong-leaved Sundew	S3S4
Drosera linearis	Slender-leaved Sundew	S2?
Drosera rotundifolia	Round-leaved Sundew	S4S5
ELAEAGNACEAE	OLEASTER FAMILY	
Shepherdia canadensis	Canada Buffaloberry	S5
ERICACEAE	HEATH FAMILY	
Andromeda polifolia	Bog-rosemary	S5
Arctostaphylos uva-ursi	Common Bearberry	S5

Family/Species	Common Name	MB Rank
Arctous alpina	Alpine Bearberry	S3S4
Arctous rubra	Alpine Bearberry	S4S5
Chamaedaphne calyculata	Leatherleaf	S5
Gaultheria hispidula	Creeping Snowberry	S4S5
Hudsonia tomentosa	False Heather	S3
Kalmia polifolia	Pale Laurel	S5
Rhododendron groenlandicum	Labrador Tea	S5
Vaccinium angustifolium	Low Sweet Blueberry	S4
Vaccinium myrtilloides	Velvetleaf Blueberry	S5
Vaccinium oxycoccus	Bog Cranberry	S5
Vaccinium uliginosum	Tall Sweet Blueberry	S5
Vaccinium vitis-idaea	Dry-ground Cranberry	S5
EUPHORBIACEAE	SPURGE FAMILY	
Euphorbia serpyllifolia	Thyme-leaved Spurge	S3
Euphorbia virgata	Leafy Spurge	SNA
FABACEAE	PEA FAMILY	
Dalea villosa	Hairy Prairie-clover	S2S3
Lathyrus ochroleucus	Cream-coloured Vetchling	S5
Lathyrus palustris	Marsh Vetchling	S5
Lathyrus venosus	Wild Peavine	S5
Lotus corniculatus	Bird's-foot Trefoil	SNA
Medicago lupulina	Black Medic	SNA
Medicago sativa	Alfalfa	SNA
Melilotus albus	White Sweetclover	SNA
Melilotus officinalis	Yellow Sweetclover	SNA
Trifolium hybridum	Alsike Clover	SNA
Trifolium pratense	Red Clover	SNA

Family/Species	Common Name	MB Rank
Trifolium repens	White Clover	SNA
Vicia americana	American Vetch	S5
Vicia cracca	Tufted Vetch	SNA
FAGACEAE	BEECH FAMILY	
Quercus macrocarpa	Bur Oak	S5
FUMARIACEAE	FUMITORY FAMILY	
Capnoides sempervirens	Pink Corydalis	S5
Corydalis aurea	Golden Corydalis	S5
GENTIANACEAE	GENTIAN FAMILY	
Gentianella amarella	Northern Gentian	S5
Gentiana spp.	A Gentian	
GERANIACEAE	GERANIUM FAMILY	
Geranium bicknellii	Bicknell's Geranium	S5
GROSSULARIACEAE	CURRANT FAMILY	
Ribes americanum	Wild Black Currant	S5
Ribes glandulosum	Skunk Currant	S5
Ribes lacustre	Swamp Gooseberry	S4
Ribes oxyacanthoides	Northern Gooseberry	S5
Ribes triste	Swamp Red Currant	S5
HYDROPHYLLACEAE	WATERLEAF FAMILY	
Phacelia franklinii	Franklin's Scorpionweed	S4S5
LAMIACEAE	MINT FAMILY	

Family/Species	Common Name	MB Rank
Dracocephalum parviflorum	American Dragon-head	S5
Lycopus uniflorus	Northern Bugleweed	S4S5
Mentha arvensis	Common Mint	S5
Monarda fistulosa	Wild Bergamot	S5
Prunella vulgaris	Heal-all	S4
Scutellaria galericulata	Marsh Skullcap	S5
Stachys palustris	Marsh Hedge-nettle	S5
LENTIBULARIACEAE	BLADDERWORT FAMILY	
Utricularia intermedia	Flat-leaved Bladderwort	S4S5
MALVACEAE	MALLOW FAMILY	
Malva pusilla	Running Mallow	SNA
MENYANTHACEAE	BOG BEAN FAMILY	
Menyanthes trifoliata	Bog Bean	S5
OLEACEAE	OLIVE FAMILY	
Fraxinus pennsylvanica	Green Ash	S4S5
ONAGRACEAE	EVENING PRIMROSE FAMILY	
Chamerion angustifolium	Fireweed	S5
Circaea alpina	Small Enchanter's Nightshade	S4S5
Epilobium ciliatum ssp. *ciliatum*	Hairy Willowherb	S5
Epilobium ciliatum ssp. *glandulosum*	Northern Willowherb	S5
Epilobium palustre	Marsh Willowherb	S5
Oenothera biennis	Evening-primrose	S5

Family/Species	**Common Name**	**MB Rank**
PLANTAGINACEAE	PLANTAIN FAMILY	
Plantago major	Common Plantain	SNA
POLYGALACEAE	MILKWORT FAMILY	
Polygala senega	Seneca Root	S4
POLYGONACEAE	SMARTWEED FAMILY	
Fallopia convolvulus	Black Bindweed	SNA
Persicaria amphibia	Water Smartweed	S5
Persicaria hydropiper	Common Smartweed	SNA
Polygonum aviculare	Prostrate Knotweed	SU
Polygonum spp.	Smartweed	
Rumex fueginus	Golden Dock	S4S5
Rumex occidentalis	Western Dock	S4S5
PORTULACAEAE	PURSLANE FAMILY	
Portulaca oleracea	Common Purslane	SNA
PRIMULACEAE	PRIMROSE FAMILY	
Androsace septentrionalis	Pygmyflower	S5
Lysimachia borealis	Northern Starflower	S5
Lysimachia ciliata	Fringed Loosestrife	S5
Lysimachia thyrsiflora	Tufted Loosestrife	S5
PYROLACEAE	WINTERGREEN FAMILY	
Orthilia secunda	One-sided Wintergreen	S5
Pyrola asarifolia	Pink Wintergreen	S5
Pyrola minor	Lesser Wintergreen	S3S4
Pyrola sp.	Wintergreen	

Family/Species	Common Name	MB Rank
RANUNCULACEAE	CROWFOOT FAMILY	
Actaea rubra	Red Baneberry	S5
Anemone canadensis	Canada Anemone	S5
Anemone cylindrica	Thimbleweed	S5
Anemone multifida	Cut-leaved Anemone	S5
Anemone patens	Prairie crocus	S4
Aquilegia brevistyla	Small-flowered Columbine	S4
Aquilegia canadensis	Wild Columbine	S5
Caltha natans	Floating Marsh Marigold	S2S4
Caltha palustris	Marsh Marigold	S5
Coptidium lapponicum	Lapland Buttercup	S4S5
Ranunculus abortivus	Kidneyleaf Buttercup	S5
Ranunculus macounii	Macoun's Buttercup	S5
Ranunculus spp.	A Buttercup	
Thalictrum dasycarpum	Hairy Meadowrue	S5
Thalictrum venulosum	Veiny Meadowrue	S5
RHAMNACEAE	BUCKTHORN FAMILY	
Rhamnus alnifolia	Alder-leaved Buckthorn	S5
ROSACEAE	ROSE FAMILY	
Amelanchier alnifolia	Saskatoon	S5
Comarum palustre	Marsh Cinquefoil	S5
Crataegus chrysocarpa	Round-leaved Hawthorn	S4S5
Dasiphora fruticosa	Shrubby Cinquefoil	S5
Fragaria virginiana	Smooth Wild Strawberry	S5
Geum aleppicum	Yellow Avens	S5
Potentilla anserina ssp. *anserina*	Silverweed	S5

Family/Species	Common Name	MB Rank
Potentilla norvegica	Rough Cinquefoil	S5
Prunus pensylvanica	Pin Cherry	S5
Prunus virginiana	Chokecherry	S5
Rosa acicularis	Prickly Rose	S5
Rubus arcticus	Stemless Raspberry	S5
Rubus chamaemorus	Cloudberry	S5
Rubus idaeus	Raspberry	S5
Rubus pubescens	Trailing Dewberry	S5
Spiraea alba	Meadowsweet	S5
RUBIACEAE	MADDER FAMILY	
Galium boreale	Northern Bedstraw	S5
Galium labradoricum	Northern Bog Bedstraw	S4S5
Galium trifidum	Three-petal Bedstraw	S5
Galium triflorum	Sweet-scented Bedstraw	S5
Houstonia longifolia	Long-leaved Bluets	S3S5
SALICAEAE	WILLOW FAMILY	
Populus balsamifera	Balsam Poplar	S5
Populus tremuloides	Trembling Aspen	S5
Salix arbusculoides	Shrubby Willow	S2S3
Salix bebbiana	Bebb's Willow	S5
Salix candida	Hoary Willow	S5
Salix famelica	Starved Willow	S4
Salix glauca	Smooth Willow	S4
Salix interior	Sandbar Willow	S5
Salix myrtillifolia	Myrtle-leaved Willow	S5
Salix pedicellaris	Bog Willow	S5
Salix planifolia	Flat-leaved Willow	S5

Family/Species	Common Name	MB Rank
Salix pseudomonticola	False Mountain Willow	S4S5
Salix spp.	Willow	
Salix vestita	Rock Willow	S3
SANTALACEAE	SANDALWOOD FAMILY	
Comandra umbellata	Bastard Toadflax	S5
Geocaulon lividum	Northern Comandra	S5
SARRACENIACEAE	PITCHER PLANT FAMILY	
Sarracenia purpurea	Pitcher Plant	S4S5
SAXIFRAGACEAE	SAXIFRAGE FAMILY	
Mitella nuda	Mitrewort	S5
Parnassia palustris	Grass of Parnassus	S5
Saxifraga tricuspidata	Three-toothed Saxifrage	S4S5
SCROPHULARIACEAE	FIGWORT FAMILY	
Melampyrum lineare	Cow-wheat	S3S5
URTICACEAE	NETTLE FAMILY	
Urtica dioica	Stinging Nettle	S5
VIOLACEAE	VIOLET FAMILY	
Viola canadensis	Canada Violet	S5
Viola spp.	Violet	
NON-VASCULAR SPECIES		
Mosses and Liverworts		
Dicranum spp.	Dicranum Moss	

Family/Species	Common Name	MB Rank
Hylocomium splendens	Stairstep Moss	S4S5
Marchantia polymorpha	Green-tongue Liverwort	S3
Pleurozium schreberi	Red-stemmed Feather Moss	S4S5
Polytrichum spp.	A Hair Cap Moss	
Ptilium crista-castrensis	Knight's Plume Moss	S4S5
Sphagnum spp.	Peat Moss	
Unknown mosses		
Lichens		
Cladonia arbuscula ssp. *mitis*	Green Reindeer Lichen	S4
Cladonia rangiferina	Grey Reindeer Lichen	S5
Cladonia uncialis	Thorn Pixie Lichen	S5
Cladonia sp.	Cladonia	
Peltigera sp.	Pelt Lichen	
Unknown Lichens		