BIPOLE III TERRESTRIAL ECOSYSTEMS AND VEGETATION ENVIRONMENTAL MONITORING

ANNUAL TECHNICAL REPORT – YEAR IV

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SUMMARY

Vegetation and terrestrial ecosystems were assessed for Year IV environmental monitoring. Surveys were completed for native grassland prairie, terrestrial vegetation (forested areas), wetlands, plants/communities important to aboriginal people, invasive and non-native species and species of conservation concern, 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 2017. The total species cover in 2017 of this prairie site has increased from 2016 values (previously 53%) to 74%, with 33 species observed within the survey plot. Vegetation cover is dominated by Kentucky blue grass (*Poa pratensis*) and big blue stem (*Andropogon gerardii*). 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 and richness were significantly different ($p \leq 0.002$) between surveys on and off the RoW. These sites continued to show lower average values for total vegetation cover and number of species present on the RoW. There were no significant differences detected for diversity, however the evenness of species distribution between surveys on and off the RoW was significantly different. Since initial clearing, a general trend of increase is seen in average values of species cover and richness, at sites on the RoW. The effect predictions for terrestrial vegetation were determined to be accurate.

Seven environmentally sensitive sites (patterned fens) were revisited in Sections N3 and N4 to sample wetland vegetation (WET). There continues to be a trend of lower mean species cover and richness in sites on the RoW. The average total percent species cover in paired surveys on the RoW increased from previous years to 72.0%, while the average species richness is 24.8, slightly lower than off-RoW. The diversity index and species evenness continue to have similar values between surveys on and off RoW. When comparing species cover between years for surveys on the RoW, this year, there is a marked increase in vegetation cover compared with previous years. Species richness on the RoW shows a slight increase, but overall is similar among years. The effect predictions were determined to be accurate.

Ten sites were revisited to sample vegetation in the Cowan blueberry resource area (ATK). This season, blueberry plants were recorded at seven sites on the RoW, more sites than all previous years. Two species of blueberry plants were observed again during surveys and include velvetleaf blueberry (*Vaccinium myrtilloides*) and low sweet blueberry (*Vaccinium angustifolium*). Cover for low sweet blueberry averaged 15.6% and ranged from 2.8 to 66.0% in sites surveyed, while cover of velvetleaf blueberry averaged 2.0%, ranging from

0.2 to 4.6%. Total blueberry cover for sites supporting blueberries on the RoW (2017) averaged 12.6%, an increase since initial pre-clearing surveys in 2014 (11.6%). Total species cover for vegetation surveys on and off the RoW continued to show significantly lower values on the RoW (p=0.004). No other significant differences in species richness, diversity indices or evenness occurred between paired on and off RoW samples. The effect predictions for ATK vegetation were determined to be accurate.

Forty sites were visited to sample 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. A total of 50 noxious, invasive or non-native species were recorded across all vegetation surveys. Fifteen species are listed as noxious weeds, while 20 species are considered invasive. The most commonly observed non-native species were field sow-thistle (*Sonchus arvensis*, 40 records), common dandelion (*Taraxacum officinale*, 38 records), and sweet clovers (*Melilotus* spp., 35 records). The greatest frequency of records was found in the S2 surveys (roadside) followed by the INV vegetation surveys (quantitative). Both INV and S2 survey areas were identified by the susceptibility to increased spread of invasive and non-native species, due to each site's location or proximity to existing patches. In vegetation surveys, all species measures showed significant differences between samples on and off the RoW, except for species richness (p=0.121). The effect predictions for invasive and non-native vegetation were determined to be accurate.

Fifty species of conservation concern (ranking S1 through S3S5) were recorded during surveys and sampling in 2017. Seventeen species are ranked very rare to rare, (S1 through S2S4), with the remaining 33 species ranked uncommon (S3 though S3S5). The most frequent number of observations, and the greatest number of species of conservation concern were recorded in the SCC surveys in Section S1, near the Assiniboine River crossing. Silky prairie-clover (*Dalea villosa*), is listed as Threatened under *The Endangered Species and Ecosystems Act* – Manitoba and the *Species at Risk Act*, and Special Concern under the Committee on the Status of Endangered Wildlife in Canada. Silky prairie-clover was first observed in 2010. The effect prediction for species of conservation concern was determined to be accurate.

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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 is anticipated to be completed during the winter of 2017-2018. In 2017, vegetation and terrestrial ecosystems were assessed for Year IV environmental monitoring, 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. Projected in-service date for this project is anticipated for 2018. The Bipole III transmission project involves 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 involves 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.

This study involved pre-construction surveys along uncleared portions of the transmission project as well as environmental monitoring along cleared portions of the project. 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 for prairie sites;
- Environmental monitoring for terrestrial and wetland sites;
- Pre-construction surveys and environmental monitoring for 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 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 aboriginal 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 Aboriginal People

A number of plants and plant communities have been identified as being particularly important to Aboriginal people (e.g., Cowan blueberry area, Assiniboine River). These areas are valued for their provision of resources used by Aboriginals 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 Aboriginal communities and can result in the potential loss of important vegetation resources found at these sites.

Although non-Aboriginal 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 Aboriginal 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 Aboriginal people.

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 Aboriginal People areas are identified in Table 2-4.

Table 2-4. Monitoring activities for plants/communities important to Aboriginal 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 very rare to uncommon 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 (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. Terrestrial 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 2014 and 2015 were revisited in 2017, to collect environmental monitoring information in Year IV. These included sites selected to monitor prairie and forest habitats, wetlands, invasive species, and botanical resource areas along Sections N1, N2, N3, N4, C1, C2, S1, and northern project components. Sites where species of conservation concern were observed in previous seasons were monitored again in 2017 for presence/ absence of species. Updates from Manitoba Hydro on the progress of construction activities for segments were 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 included information on previously identified environmentally sensitive sites, former vegetation information collected, and vegetation cover from the biophysical land classification. The land classification 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.

Previously identified environmentally sensitive sites from the Project Environmental Assessment were considered for potential sampling locations. Suitable sites were also selected based on vegetation type, accessibility, disturbance, sites 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 Aboriginal 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 interest, public concern, and aboriginal values.

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 also 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, in Section S2. This Section of the Project was primarily 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 the prairie and blueberry resource area surveys. 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 includes species that are rare, disjunct, or at risk throughout their range or in Manitoba. Species of conservation concern encompasses plants ranked very rare to uncommon by the MBCDC, and those listed under ESEA (Manitoba), SARA (federal) and COSEWIC.

The global (G) and sub-national (S) rarity ranking of species used by the MBCDC, according to a standardized procedure used by all Conservation Data Centres and Natural Heritage Programs is as follows:

1: Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

2: Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

3: Uncommon throughout its range or in the province (21 to 100 occurrences).

4: Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).

5: Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.

The conservation status categories for ESEA, SARA and COSEWIC are as follows:

SPECIAL CONCERN: A species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

THREATENED: A species likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

ENDANGERED: A species facing imminent extirpation or extinction.

EXTIRPATED: A species no longer existing in the wild in Canada but exists elsewhere.

EXTINCT: A species that no longer exists.

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 reviewed. Areas with high potential to support species of conservation concern were identified for surveys.

In the field, a combination of meander and transect searches (SCC surveys) 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 2017 focused on the transmission line RoW in Sections N1, N2, N3, N4, C1 C2, S1 and S2, and the northern project components that include the northern AC collector lines (CL), construction power line (CP) and ground electrode line (GEL). Only the GEL was cleared prior to 2014. In 2017, environmental monitoring included sites for prairie (PRA), terrestrial (TER), wetlands (WET), blueberry resource area (ATK), invasive and non-native species (INV), and species of conservation concern (SCC). Environmental monitoring involved vegetation monitoring (quantitative) and rare plant monitoring (non-quantitative) to evaluate Project effects. Surveys in Section S2 were conducted roadside to record information on invasive and non-native species, adjacent to agricultural land.

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. 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, 2016 and 2017, 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 and photographs were taken.

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.

The degree of disturbance will be assessed at required sites (identified by Manitoba Hydro) using parameters such as size of disturbance, soil disturbance (i.e., rutting, erosion) and vegetation composition. A site visit using professional judgement will determine whether natural re-vegetation will be feasible or if rehabilitation is required. Consideration will be given to factors such as topography, slope, moisture, time of year, and post disturbance conditions. Photographs will be taken at each disturbed site visited. Rehabilitation activities will be guided by the Vegetation Rehabilitation and Management Plan (Manitoba Hydro 2016).

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 over time.

3.5 Data Preparation and Statistical Analyses

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.

Species richness was 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 3.1.1. (R Core Team 2016). Diversity and evenness measures were calculated in Excel.

4.0 RESULTS

The following section discusses the results for all site types as follows: native grassland prairie (PRA), terrestrial vegetation (TER), wetlands (WET), blueberry resource area (ATK), invasive and non-native species (INV), species of conservation concern (SCC), and rehabilitation monitoring. Included within the botanical summary for each site are values for: total species cover (summed % plant cover), species richness (actual number of species present), species diversity index, and species evenness, for all species recorded in plots. The accuracy of effect predictions and the effectiveness of mitigation for site types are also presented.

4.1 Native Grassland/Prairie

A single grassland/prairie (PRA) site was surveyed for continued monitoring in 2017 (Map 4-1, Appendix II) (Field Activity ID BPIII_CON_FA321). The PRA site is located in the southern portion of the Bipole III RoW, in Section S1, and visited on August 1. A search for incidental species of conservation concern was also undertaken. 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 a regenerating layer within the RoW (Photograph 4-1a).

Photograph 4-1a. Regenerating aspen along the RoW.

Five rare and uncommon species were found in or incidental to plots (Sand grass – *Calamovilfa longifolia*, S3S5; Schweinitz's flatsedge - *Cyperus schweinitzii,* S2; silky prairie-clover - *Dalea villosa,* S2?; linear-leaved puccoon – *Lithospermum incisum,* S3;

skeletonweed - *Lygodesmia juncea*, S3S4) and are discussed in Section 4.6. Prairie spike-moss (*Selaginella densa,* S3), has not been observed since clearing, and was last recorded at this site in 2015.

4.1.1 Data Analysis of Grassland/Prairie Areas

One native vegetation survey was conducted in a grassland/prairie area, site S1-PRA-900. Species cover, richness, diversity and evenness of the understory vegetation is provided in Table 4-1a.

Table 4-1a. Grassland/prairie descriptions: total species cover, richness, diversity and evenness.

Year	Total Cover (%)	Richness	Diversity	Evenness
2017	74.4	33	2.27	0.65
2016	52.8	30	2.54	0.75
2015	134.7	38	2.90	0.80

The total species cover in 2017 of this prairie site increased to 74%, with 33 species observed within the survey plot. Vegetation cover is dominated by grasses: Kentucky blue grass (*Poa pratensis*, 27%), big blue stem (*Andropogon gerardii*, 13%), and sand grass (4%); and forbs: leafy spurge (*Euphorbia esula*, 6.4), hairy-golden aster (*Heterotheca villosa*, 5%) and prairie sage (*Artemisia ludoviciana*, 3.6%). Species diversity and evenness were slightly lower than last year's values at 2.3 and 0.7, respectively. Regeneration of aspen (<1m primarily) and some oak are encroaching into the original prairie opening, while regeneration was intermittently shrubby at this site. Aspen seedlings (5%) accounted for more cover than saplings (0.4%).

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 4-1b). No new PRA sites were sampled in 2017. Observations recorded in the field from 2017 are provided below.

Table 4-1b. Mitigation measures assessed at a site monitored for native grassland/prairie 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.

From fieldwork conducted, it was determined that the recommended mitigation was implemented and effective for native grassland/prairie vegetation which minimized the disturbance from construction activities. 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. Tree clearing occurred in previous years.

Although mitigation was implemented at the prairie monitoring site (S1-PRA-900), vegetation ground cover showed disturbance from construction activities. Tower placement is located close to site S1-PRA-900. Machinery used here to establish anchor points has resulted in loss of vegetation cover around and on the tower footprint. The area is extremely sandy, and the ground vegetation is easily disturbed. Clearing equipment has also likely scraped away some vegetation. Elsewhere on this property (both on RoW and off site), ATV tracks have produced bare ground (i.e., sand) with very little vegetation in vehicle tracks. Photograph 4-1b shows exposed soils along the RoW.

Photograph 4-1b. Exposed soils along the RoW.

Prairie spike-moss (*Selaginella densa,* S3) has not been relocated at sites in this area since 2015, prior to clearing. Four invasive or non-native species were observed in S1-PRA-900, further discussed in Section 4.5.1.

4.2 Terrestrial Vegetation (Forested Areas)

Twenty-six sites were revisited to sample terrestrial (TER) vegetation from July 8 to August 5 (Field Activity ID BPIII_CON_FA318, 319 and 322) (Map 4-1, Appendix II). No other re-visiting of off-RoW sites was required, resulting in a total of 26 surveys completed for terrestrial vegetation in 2017. Five sites are located in each of Sections 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 active or recent forest fires were observed during TER sampling this season. Species of conservation concern observed in TER plots will be discussed in Section 4.6.

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 (2017) and off the RoW (all years) show continued significantly lower values for total vegetation percent cover ($p<0.001$) on the RoW, as well as for total number of species present ($p=0.002$). While there were no significant differences detected for diversity ($p=0.666$), evenness was slightly higher ($p=0.020$) in surveys on the RoW. Vegetation descriptions for paired on and off RoW surveys are shown below for species cover and species richness (total number of species) in Table 4-2a, and for species diversity and evenness in Table 4-2b.

When comparing 2017 species measures on the RoW to those of the previous year, both species cover and richness were again higher than in 2016. Since initial clearing, a general trend of increase is seen in mean measures of vegetation cover and richness of species, at sites on the RoW. While vegetation cover is likely to remain far lower on the RoW, due to the elimination or reduction of tall canopies, species richness is approaching off-RoW numbers, and diversity measures in the current year are similar among on-RoW sites and the uncleared, off-RoW sites.

Table 4-2a. Terrestrial vegetation descriptions: cover and richness.

Site	Total Species Cover (%)					Species Richness				
	RoW				off RoW	RoW				off RoW
	2014	2015	2016	2017[1]		2014	2015	2016	2017[2]	
N4TER10	-	12.6	38.8	108.2	126.0	-	18	30	28	34
N4TER20	-	8.8	13.2	36.0	138.6	-	12	17	19	27
N4TER30	-	11.6	16.2	57.8	96.8	-	12	17	19	21
N4TER40	-	-	48.6	94.0	68.0	-	-	28	35	31
N4TER50	-	-	15.8	99.6	158.4	-	-	21	39	28
N3TER10	15.2	25.0	31.6	77.4	127.2	27	27	35	39	38
N3TER20	24.6	28.4	16.0	35.4	115.0	17	22	13	18	34
N3TER30	12.4	37.6	46.4	40.8	145.0	16	25	27	24	31
N3TER40	23.4	59.0	75.2	111.4	151.8	15	20	24	28	27
N3TER50	2.0	13.6	37.6	83.8	111.0	4	14	16	22	18
N2TER10	6.6	14.2	30.2	55.6	140.6	10	13	19	23	22
N2TER20	9.2	35.0	56.0	83.4	105.0	14	17	27	28	28
N2TER30	19.0	50.6	96.4	126.4	114.8	19	20	27	27	21
N2TER40	1.4	3.8	16.6	29.0	129.6	5	5	12	10	18
N2TER50	0.4	0.0	1.2	4.4	124.2	1	-	4	8	15
N1TER10	-	0.8	6.2	21.6	118.0	-	3	13	22	28
N1TER20	-	0.0	1.8	6.8	154.2	-	-	6	12	23
N1TER30	-	1.2	5.4	15.0	157.6	-	4	13	20	32
N1TER40	-	32.0	10.8	21.0	99.4	-	15	13	15	31
N1TER50	-	2.8	5.0	13.4	120.0	-	10	12	16	37
N1TER60	-	8.4	9.8	12.0	157.8	-	15	14	12	44
CLTER10	40.0	71.6	4.2	9.8	120.4	15	15	6	10	16
CLTER20	46.8	2.4	2.4	3.8	129.6	7	2	4	5	14
CLTER30	43.0	38.8	27.6	48.4	127.0	13	11	12	12	16
CPTER10	73.4	6.4	6.6	4.6	120.2	11	5	8	5	18
CPTER20	31.6	6.2	4.4	2.0	127.0	10	4	5	6	16
Mean	23.3	21.4	24.0	46.2	126.3	12.3	13.1	16.3	19.3	25.7

Note: [1] Total species cover (%) on (2017) and off RoW is significantly different, $p<0.001$.
[2] Species richness on (2017) and off RoW is significantly different, $p=0.002$.

Table 4-2b. Terrestrial vegetation descriptions: diversity and evenness.

Site	Diversity					Evenness				
	RoW				off RoW	RoW				off RoW
	2014	2015	2016	2017[1]		2014	2015	2016	2017[2]	
N4TER10	-	2.5	2.5	1.5	2.3	-	0.9	0.7	0.5	0.7
N4TER20	-	2.1	2.6	2.2	2.1	-	0.8	0.9	0.7	0.6
N4TER30	-	2.1	2.4	1.8	1.6	-	0.8	0.8	0.6	0.5
N4TER40	-	-	2.7	2.3	2.4	-	-	0.8	0.7	0.7
N4TER50	-	-	2.7	2.2	2.0	-	-	0.9	0.6	0.6
N3TER10	2.7	2.9	3.0	2.8	2.9	0.8	0.9	0.9	0.8	0.8
N3TER20	1.8	2.1	1.8	1.9	2.7	0.6	0.7	0.7	0.7	0.8
N3TER30	2.3	2.4	2.7	2.6	2.3	0.8	0.7	0.8	0.8	0.7
N3TER40	2.0	2.1	2.3	2.2	2.1	0.7	0.7	0.7	0.6	0.6
N3TER50	0.9	1.8	1.7	1.6	2.1	0.7	0.7	0.6	0.5	0.7
N2TER10	1.8	1.9	2.0	2.5	1.9	0.8	0.7	0.7	0.8	0.6
N2TER20	2.4	1.9	2.1	2.6	2.1	0.9	0.7	0.6	0.8	0.6
N2TER30	2.5	2.4	2.6	2.8	2.0	0.9	0.8	0.8	0.9	0.7
N2TER40	1.5	1.3	1.4	1.6	1.4	0.9	0.8	0.5	0.7	0.5
N2TER50	0	-	1.2	1.7	1.2	-	-	0.9	0.8	0.4
N1TER10	-	1.0	2.1	2.6	2.1	-	1.0	0.8	0.9	0.6
N1TER20	-	-	1.6	2.0	1.9	-	-	0.9	0.8	0.6
N1TER30	-	1.3	2.4	2.6	1.9	-	1.0	0.9	0.9	0.5
N1TER40	-	2.1	2.1	2.0	2.7	-	0.8	0.8	0.7	0.8
N1TER50	-	2.1	2.2	2.3	2.7	-	0.9	0.9	0.8	0.7
N1TER60	-	2.4	2.2	2.2	2.7	-	0.9	0.8	0.9	0.7
CLTER10	1.9	2.0	1.5	1.6	2.2	0.7	0.7	0.8	0.7	0.8
CLTER20	1.4	0.5	1.1	1.0	1.9	0.7	0.7	0.8	0.7	0.7
CLTER30	1.9	1.9	2.1	2.0	2.1	0.8	0.8	0.8	0.8	0.8
CPTER10	1.4	1.4	1.7	1.3	2.0	0.6	0.9	0.8	0.8	0.7
CPTER20	1.7	1.0	1.3	1.7	2.2	0.7	0.7	0.8	1.0	0.8
Mean	1.8	1.9	2.1	2.1	2.1	0.7	0.8	0.8	0.7	0.7

Note: [1] No significant differences in diversity index on (2017) and off RoW, p=0.666.
[2] Species evenness on (2017) and off RoW is significantly different, p=0.020.

4.2.1.1 Cluster Analysis and Community Typing

A total of 167 plant species were observed in plots within sampling of the terrestrial vegetation surveys. The tree stratum was absent in surveys sampled on the RoW, while regenerating woody species were commonly found as saplings and seedlings.

Hierarchical cluster analyses were performed for surveys on the RoW. Based on vegetation composition present in 26 sites on the RoW, cluster analysis resulted in three community type groupings, broadly dived into regenerating hardwood, or softwood groups, Table 4-2c, below.

Table 4-2c. Community types for terrestrial vegetation surveys on the RoW, 2017.

2017	Surveys	Species
Regenerating saplings Balsam Poplar - Trembling Aspen - Green Alder/ Herb Rich	15	73
Black Spruce seedling- Labrador Tea – Cloudberry- Herb, Sedge Rich/ Mosses	5	43
Black Spruce seedling - Labrador Tea – Herb, Graminoid poor	6	29

The first community type is characterized by regenerating hardwood saplings in the tall shrub layer. The herb and low shrub layer is well-developed with a high degree of cover, aspen and occasional black spruce seedlings. These sites are herb rich, including prickly rose, wild raspberry and fireweed.

The next two community types are regenerating black spruce seedlings: one with an open relatively well-developed understory characterized by Labrador tea, cloudberry, sedges and mosses; the other with very sparse understory, characterized by Labrador tea.

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 2017, no new TER sites were sampled. Observations recorded in the field from 2017 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.

From fieldwork conducted, it was determined that the recommended mitigation was implemented and effective for terrestrial vegetation which minimized the disturbance from construction activities. In the absence of mitigation, site disturbance likely would have increased.

Construction activities appeared to be carried out mostly during winter months (or dry ground conditions) to minimize effects on understory species and reduce ground disturbance (e.g., rutting). Tree removal occurred in previous years, during project clearing activities. Grubbing occurred only at foundation sites.

Tower erection in 2017 occurred in many areas of the RoW; other areas had towers on the ground, ready to be errected. Portions of Section N1 had only footing installed. Stringing of conductors occurred along portions of Sections N2 and N3.

During aerial inspections of Sections N4, C1 and C2, vegetation regeneration of herbaceous plants and young shrubs was occurring throughout the RoW, from the Red Deer River to the Langruth area. Construction traffic and activity appeared to be mostly confined to the centerline equipment path in these sections, with minimal surface disturbance to the centre line. No major rutting problems were observed on the RoW during the aerial inspections and ground surveys except at one location in Section C1 (Slug Site). Early in spring 2017, construction activities resulted in the disturbance of ground conditions and vegetation at Slug Site, near Tower 4088. Rehabilitation recommendations were provided to Manitoba Hydro. This site was visited in July 2017 and will be discussed in Rehabilitation Monitoring, Section 4.7.

During the aerial inspections and ground surveys of other Sections (N1, N2, N3, and N4 north of the Red Deer River), regeneration of vegetation was observed to be occurring largely throughout the RoW (Photograph 4-2a). Generally, low disturbance to the soils was observed off the equipment path, except for a few detected areas where construction equipment and materials were likely stored, as a staging area. The equipment path showed areas of obvious travel but rutting observed was minor and infrequent. Vegetation cover was generally less abundant at these locations. From the

Split Lake area east to the Keewatinohk converter station, in Section N1, occasional rutting was detected along the equipment path and an access trail.

Several borrow areas (dig-outs) were observed along the RoW in N1 and N2. These appeared to be used for providing additional granular material around tower footings, where required. These areas were approximately 5 m^2, with a depth of 1 to 3 m.

The RoW for the AC collector lines and construction power line (and occasionally along Section N1) again had visible bladed or scraped areas, as a result of construction activities and access in 2017. These areas were observed at the tower locations, occasionally along the equipment path, and other areas of the RoW (Photograph 4-2b). Vegetation regeneration was reduced or non-existant in these bladed areas.

This season, several berry plants were observed with abundant fruit in portions of the RoW, along Sections N2 and N3 (e.g., N2-TER-200 and 300, N3-TER-100 and 300). Berry plant frequently observed in 2017 included dewberry (*Rubus pubescens*) and smooth wild strawberry (*Fragaria virginiana*).

Photograph 4-2a. Regeneration of vegetation along the RoW.

Photograph 4-2b. Areas of bladed ground vegetation along the RoW.

4.3 Environmentally Sensitive Wetlands

Seven environmentally sensitive sites were visited on July 15 to 17 to sample wetland (WET) vegetation in Sections N3 and N4, north and south of The Pas, respectively (Field Activity ID BPIII_CON_FA319) (Map 4-1, Appendix II). The sensitive sites were patterned fen wetlands identified during the terrestrial ecosystems and vegetation assessment conducted for the Bipole III Transmission Project in 2010 and 2011. A search for incidental species of conservation concern was undertaken at all sites.

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). In total, seven surveys were completed for monitoring environmentally sensitive patterned fen wetlands on the RoW. Species of conservation concern observed in WET sites will be discussed in Section 4.6.

4.3.1 Data Analysis of Environmentally Sensitive Wetlands

Seven surveys were conducted for environmentally sensitive wetlands on the RoW. Vegetation descriptions are provided for species cover and richness in Table 4-3a, and species diversity and evenness in Table 4-3b.

Table 4-3a. Environmentally sensitive wetland descriptions: cover and richness.

Site	Total Species Cover (%)					Species Richness				
	RoW				off RoW	RoW				off RoW
	2014	2015	2016	2017		2014	2015	2016	2017	
N4WET10	-	61.0	48	97.6	81.6	-	17	18	22	24
N4WET20	-	16.6	33	57.6	70.0	-	24	28	26	32
N4WET30	-	47.4	19	58.0	-	-	25	19	27	-
N4WET40	-	16.3	8.6	13.8	-	-	8	7	9	-
N3WET10	81.4	79.8	44	121.4	-	23	28	26	27	-
N3WET20	56.8	54.0	26	40.2	119.8	21	23	18	25	24
N3WET30	68.6	71.8	66	92.4	147.4	21	26	27	26	35
Paired Mean	62.7	50.8	43.3	72.0	104.7	21	22.5	22.8	24.8	28.8

Table 4-3b. Environmentally sensitive wetland descriptions: diversity and evenness.

Site	Diversity					Evenness				
	RoW				off RoW	RoW				off RoW
	2014	2015	2016	2017		2014	2015	2016	2017	
N4WET10	-	1.4	2.1	2.0	2.1	-	0.5	0.7	0.7	0.7
N4WET20	-	2.8	2.6	2.3	2.2	-	0.9	0.8	0.7	0.6
N4WET30	-	2.1	2.3	2.1	-	-	0.6	0.8	0.6	-
N4WET40	-	1.7	1.6	1.8	-	-	0.8	0.8	0.8	-
N3WET10	2.1	1.8	2.1	1.5	-	0.7	0.5	0.7	0.4	-
N3WET20	1.7	1.5	1.8	2.0	1.9	0.6	0.5	0.6	0.6	0.6
N3WET30	2.1	2.1	2.1	2.2	2.2	0.7	0.7	0.6	0.7	0.6
Paired Mean	1.9	2.0	2.2	2.1	2.1	0.6	0.6	0.7	0.7	0.6

The number of paired surveys (four) is too small to reliably test for significant differences for environmentally sensitive wetland sites. However, there continues to be a trend of lower mean species cover and richness in sites on the RoW. This may be due to the removal of sparse tree and shrub cover, and other low growing woody species on the RoW. Nevertheless, the average total percent species cover in paired surveys on the RoW increased from previous years to 72.0%, while the average number of species (richness) is 24.8, slightly lower than off-RoW. The diversity index and species evenness continue to have similar values across all years and between paired surveys on and off RoW, suggesting that vegetation clearing in wetland sites has not affected these species measures.

When comparing species measures between years for surveys on the RoW, there had been a general trend of decreased total species cover value for surveys on the RoW from clearing in 2014 until 2016. However, this year, there is a marked increase in vegetation cover compared with previous years. Species richness on the RoW shows a slight

increase, but overall is similar among years from 21.7 species (2014) to 24.8 species (2017). The measures of diversity and evenness on the RoW continue to be comparable over all years.

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 plots within sampling of the environmentally sensitive wetland surveys. Hierarchical cluster analyses were performed for the seven surveys on the RoW, resulting in two community types (Table 4-3c). Though quite similar in species composition, the communities are distinguished by moss cover and composition, vegetation structure (i.e., presence of low shrubs), and degree of ground litter. One site did not group with others due to higher water levels (98% in plots), which in turn resulted in very little emergent vegetation present accounting for its outlier status.

Table 4-3c. Community types for environmentally sensitive wetland surveys on the RoW, 2017.

2017	Surveys	Species
Bog Bean - Hairy-fruited Sedge / moderate Mosses	3	42
Low shrub - Bog Bean - Hairy-fruited Sedge / abundant Sphagnum - Mosses	3	40
High water site	1	9

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 2017, no new sites were sampled. Observations recorded in the field from 2017 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.

Tower erection occurred in all wetlands surveyed (Sections N3 and N4). Stringing of conductors was observed at N3-WET-200 and N3-WET-300.

From fieldwork conducted, it was determined that wetlands sampled showed low disturbance (physical appearance) from construction activities, in 2017. Vehicle traffic appeared to utilize existing trails mostly under frozen ground conditions. In several wetland locations, the RoW showed little evidence of construction activities (Photograph 4-3a). In other areas, the equipment path displayed light travel or minor rutting, on the RoW (e.g., N4-WET-200; N3-WET-200). Natural re-vegetation is occurring throughout previously disturbed wetland sites.

Photograph 4-3a. Patterned fen wetland with low disturbance.

In Sections N2 and N3, an aerial assessment was conducted to document wetland disturbance, along the RoW. Except for initial clearing in 2014 where wetland disturbance was reported (e.g., tamarack and black spruce tree removal), overall wetland disturbance in 2017 was low. Other than wetland area displacement as a result of tower foundations, the only evidence of wetland disturbance was occasional rutting from use of the equipment path (Photograph 4-3b). Noticable rutting was observed in three wetland areas along the RoW, in Section N3:

1) From approximately UTM 14U 363431 E, 5962393 N to 363536 E, 5966665 N. This is a stretch of approximately 4.0 km, with the rutting disturbance contained to the centre of the RoW.
2) From approximately UTM 14U 389671 E, 5998468 N to 391500 E, 5999369 N. This is a stretch of approximately 2.0 km, with rutting primarily restricted to the centre of the RoW.
3) At approximately 14U 445063 E, 6036953 N. There is a stretch of approximately 200m of rutting leading up to a water crossing along the west side of a creek. This rutting started at the centre line and veered to the northern edge of the RoW.

Photograph 4-3b. Rutting in wetlands from construction activities.

In 2016, patterned fen N4-WET-300 was observed with high water levels, with most of the vegetation submergered. Cover of surface water increased from 0.6% in 2015 to 97% in 2016. In 2017, cover of surface water at this site was reduced to 21%. Some wetlands experienced drier conditions this season, however N4-WET-400 had a high cover of surface water (98%), similar to conditions in 2016 (99%).

4.4 Plants/Communities Important to Aboriginal People

Ten ATK sites were visited on July 6 to sample the vegetation in the Cowan blueberry resource area after clearing (Field Activity ID BPIII_CON_FA318) (Map 4-1, Appendix II). Sampling in 2017 occurred in Section C1, on the RoW. Vegetation composition, abundance and structure were recorded at all sites, while paired sites adjacent to the RoW were not re-sampled. A search for incidental species of conservation concern was undertaken at all sites. This season, local community members were not present for the surveys with the vegetation team.

Two species of blueberries (low sweet blueberry - *Vaccinium angustifolium,* and velvetleaf blueberry - *Vaccinium myrtilloides*) were observed at seven sites on the RoW

(C1-ATK-200, 300, 400, 500, 600, 800 and 950), more sites than all previous years, 2016 (five sites), 2015 (two sites) and 2014 (six sites) (Table 4-4a).

Low sweet blueberry was found in five sites, and is generally the more prominent blueberry, with an average cover of 15.6% (ranging from 2.8 to 66.0%). The cover for low sweet blueberry increased (four sites) or remained unchanged (one site), from previous years sampling. Steady increases each year from 32.4% (2014) to a maximum of 66.0% (2017) are seen in site C1-ATK-400. While cover in site C1-ATK-600 was noted this year for the first season since 2014.

Velvetleaf blueberry, also found in five sites in 2017, averaged 2.0% cover, (ranging from 0.2 to 4.6%). Species cover of velvetleaf blueberry was variable across sites, as compared to previous years. Increased cover was seen in one site, with newly established cover seen in two sites. Decreased cover was seen in two plots, and no cover was found in two sites that had velvetleaf blueberry cover in previous years. Photograph 4-4a shows blueberry plants in the Cowan blueberry resource area.

Total blueberry cover for sites supporting blueberries (both low sweet blueberry and velvetleaf blueberry) on the RoW (2017) averaged 12.6%, an increase since initial RoW pre-clearing surveys in 2014 (11.6%).

Table 4-4a. Resource Area species cover (%) for two blueberry species.

Site	Low Sweet Blueberry *V. angustifolium* Total Cover (%)					Velvetleaf Blueberry *V. myrtilloides* Total Cover (%)				
	RoW				off RoW	RoW				off RoW
	2014	2015	2016	2017		2014	2015	2016	2017	
C1-ATK-20	0.4	-	-	-	16.6	-	-	-	0.2	8.8
C1-ATK-30	-	0.4	3.0	3.0	5.6	5.0	0.6	2.0	4.6	-
C1-ATK-40	32.4	NS	43.0	66.0	35.4	8.0	NS	1.2	-	-
C1-ATK-50	11.8	NS	1.0	3.4	8.0	-	NS	0.2	-	1.2
C1-ATK-60	4.6	-	-	2.8	1.6	0.4	2.0	8.6	3.2	11.4
C1-ATK-80	-	-	-	-	-	-	-	-	0.2	-
C1-ATK-95	7.2	-	1.4	2.8	2.6	-	-	3.2	2.0	1.8
Mean	11.3	0.4	12.1	15.6	11.6	4.5	1.3	3.0	2.0	5.8

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

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

Surrounding vegetation in the resource area includes stands of jack pine (*Pinus banksiana*) and deciduous forest (e.g., *Populus tremuloides*). The RoW is very sandy with exposed soils in some areas, such as the previously sparsely treed conifer sites, where

characteristic prairie vegetation (grasses and forbs) is found. Species of conservation concern observed are discussed in Section 4.6.

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

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 in Table 4-4b, for species cover and richness, and Table 4-4c for species diversity and evenness.

Table 4-4b. Blueberry resource area vegetation descriptions: cover and richness.

Site	Total Species Cover (%)					Species Richness				
	RoW				off RoW	RoW				off RoW
	2014	2015	2016	2017[1]		2014	2015	2016	2017[2]	
C1-ATK-10	40.4	12.2	14.0	20.2	39.2	17	24	23	28	19
C1-ATK-20	109.2	32.8	54.0	63.6	99.8	32	28	32	40	26
C1-ATK-30	55.2	18.4	24.0	34	75.6	17	13	17	19	19
C1-ATK-40	116.2	-	82.9	122	116.6	19	-	15	15	17
C1-ATK-50	93	-	6.5	35.6	59.4	17	-	11	25	33
C1-ATK-60	138.2	23.8	47.8	61.6	151.8	23	19	20	23	23
C1-ATK-70	79.4	20.2	20.2	30.2	69	28	20	28	28	27
C1-ATK-80	58.2	19	27.4	28	65.8	31	24	31	31	24
C1-ATK-90	53.8	22.6	26.2	41.6	53.4	25	26	29	30	29
C1-ATK-95	149.8	20	40.2	66.2	132.8	27	22	23	27	36
Mean	89.3	21.1	34.3	50.3	86.3	23.6	22.0	22.9	26.6	25.3

Note: [1] Total species cover (%) on (2017) and off RoW is significantly different, p=0.004.
[2] No significant differences in species richness on (2017) and off RoW, p=0.674.

Table 4-4c. Blueberry resource area vegetation descriptions: diversity and evenness.

Site	Diversity					Evenness				
	RoW				off RoW	RoW				off RoW
	2014	2015	2016	2017[1]		2014	2015	2016	2017[2]	
C1-ATK-10	2.26	2.93	2.78	2.97	2.22	0.80	0.92	0.89	0.89	0.76
C1-ATK-20	2.09	2.70	2.43	2.97	2.26	0.60	0.81	0.70	0.80	0.69
C1-ATK-30	1.62	1.63	2.04	1.83	1.81	0.57	0.63	0.72	0.62	0.62
C1-ATK-40	2.11	-	1.50	1.34	1.79	0.72	-	0.55	0.50	0.63
C1-ATK-50	1.98	-	1.65	2.30	2.68	0.70	-	0.69	0.72	0.77
C1-ATK-60	1.73	2.59	2.38	2.48	2.0	0.55	0.88	0.79	0.79	0.64
C1-ATK-70	2.47	2.64	3.01	3.00	2.5	0.74	0.88	0.90	0.90	0.76
C1-ATK-80	2.59	2.83	3.04	3.14	2.3	0.75	0.89	0.88	0.92	0.72
C1-ATK-90	2.68	2.90	3.05	2.76	2.72	0.83	0.89	0.90	0.81	0.81
C1-ATK-95	1.94	2.67	2.48	2.66	2.56	0.59	0.86	0.79	0.81	0.71
Mean	2.15	2.61	2.43	2.55	2.28	0.69	0.85	0.78	0.78	0.71

Note: [1] No significant differences in diversity index on (2017) and off RoW, p=0.064.
[2] No significant differences in species evenness on (2017) and off RoW, p=0.092.

Results of a paired-sample Wilcoxon test for ATK vegetation surveys on (2017) and off the RoW show continued significantly lower values for total species cover (p=0.004) on the RoW. Consistent with last year, no other significant differences were detected in species richness (p=0.674), diversity (p=0.064) nor evenness (p=0.092), between paired surveys on (2017) and off the RoW.

Both vegetation cover (p=0.006) and species richness (p=0.022) measures on the RoW showed significant increases in 2017 when compared to values from the previous year (2016). As with last year, there were no statistically significant differences detected for diversity and evenness when comparing on-RoW measures with the previous year.

4.4.1.1 Cluster Analysis and Community Typing

A total of 111 plant species were recorded across ten surveys within the blueberry resource area in 2017. The tree stratum is generally absent in surveys sampled on the RoW, although trees were present in one site (C1-ATK-400). Approximately half the sites had regenerating woody species, more commonly found as saplings and seedlings.

Cluster analysis of 10 surveys on the RoW resulted in two community type groupings, based on the vegetation composition and structure regenerating at each site, Table 4-4d, below. The first community type is made up of sites that are open, grassy, herb rich, with no tall shrubs present and no regenerating tree species. The second community type has regenerating trembling aspen saplings, green alder and willows. These sites are herb

rich with blueberries present, where low sweet blueberry occurs as one of the frequent or dominant species.

Table 4-4d. Community types for blueberry resource area surveys on the RoW, 2017.

2017	Surveys	Species
Bearberry – Little Blue Stem/ Reindeer lichen	4	53
Green Alder Tall Shrub/ Trembling Aspen seedling –Low Sweet Blueberry	6	72

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 Aboriginal 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 2017, no new ATK sites were sampled. Observations recorded in the field from 2017 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.

Through fieldwork, it was determined that the recommended mitigation was implemented and effective for ATK vegetation (resource area) which minimized the disturbance from construction activities. In 2017, tower erection and stringing of conductors had not yet occurred along this portion of the RoW; only tower footings were installed. In the absence of mitigation, site disturbance (for footing installation and equipment travel) likely would have increased.

Construction activities appeared to occur on frozen or dry dround to minimize surface damage, rutting and erosion. Existing roads and trails appeared to be used, and traffic was confined largely to the equipment path. Tree clearing occurred in previous years.

Vegetation cover along the equipment path is sparse in areas, with exposed sand. Heavy equipment and vehicle travel can easily remove vegetation in these sandy sites. Exposed soil and other disturbance from construction activities was minimal off the equipment path, except at foundation sites. Future construction activities for tower erection and stringing of conductors could be monitored in this sensitive habitat for blueberries and other important plants.

No problem areas were identified for invasive and non-native species at this time, but species such as common dandelion (*Taraxacum officinale*) and Canada thistle (*Cirsium arvense*) were recorded in plots (e.g., C1-ATK-200; C1-ATK-500). It is assumed that construction equipment was cleaned and inspected prior to construction activities of tower footings.

An aerial investigation of the resource area identified that regeneration is occurring throughout the RoW, and in some locations, shrub cover (e.g., green alder - *Alnus viridis* balsam poplar - *Populus balsamifera;* trembling aspen - *Populus tremuloides;* Bebb's willow - *Salix bebbiana*) is exceeding 1 m height. Photograph 4-4b is an aerial view of the RoW showing regeneration of vegetation.

Photograph 4-4b. Aerial view of the Cowan Resource Area.

4.5 Invasive and Non-Native Species

Forty sites were visited to sample invasive and non-native (INV) vegetation from July 5 to August 5 (Field Activity ID BPIII_CON_FA318, 319, 320, 321, and 322) (Map 4-1, Appendix II). A total of 80 surveys were revisited: 40 on-RoW sites, paired with 40 belt-

transect surveyed off -RoW to scan for invasive species. Six sites are located in each Section N1 and N3, eight sites in N2, five in each of N4, C1, C2, and five additional sites are located along the northern AC collector lines (CL sites) and construction power line (CP sites). Sites surveyed included roads (e.g., provincial, forestry and access), rail lines and creek and river crossing that intersected the RoW.

Twelve additional sites were visited along the RoW in Section S2 on July 24 (Field Activity ID BPIII_CON_FA320) to record information on invasive and non-native species (Map 4-1, Appendix II). Surveys were conducted roadside in agricultural areas where species composition was recorded, and problem areas were noted (e.g., areas where construction activities may risk the spread of non-native species).

4.5.1 Data Analysis of Invasive and Non-Native Vegetation

Forty quantitative surveys were conducted for invasive and non-native vegetation on the RoW. The total percent cover and species richness was recorded at each site, while the diversity index and evenness measures were calculated based on the mean value of cover and count of species.

Results of a paired-sample Wilcoxon test show significantly lower values for total vegetation percent cover ($p<0.001$), yet with similar species richness among surveys on the RoW (2017), when compared to those off the RoW. Diversity ($p=0.005$) and evenness ($p<0.001$) are significantly higher on the RoW in 2017, compared to surveys off the RoW.

When surveys on the RoW are compared between years, a significant increase is observed for species cover ($p=0.002$) and species richness ($p<0.001$), as compared to previous years post-clearing. Again, no associated statistical difference was detected between years for species diversity or evenness.

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

Table 4-5a. Invasive and non-native vegetation descriptions: cover and richness.

Site	Total Species Cover (%)					Species Richness				
	RoW				off	RoW				off
	2014	2015	2016	2017[1]	RoW	2014	2015	2016	2017[2]	RoW
N4INV10	-	28.4	65.8	74.8	112.4	-	36	40	50	37
N4INV20	-	4.2	13.0	74.0	146.4	-	7	17	28	22
N4INV30	-	5.0	6.6	14.6	126.0	-	10	13	22	15
N4INV40	-	-	96.8	15.6	104.0	-	-	25	40	22
N4INV50	-	-	79.2	99.0	119.4	-	-	29	30	28
N3INV10	8.4	77.6	93.4	79.6	135.8	15	22	15	30	27
N3INV20	24.2	43.6	41.2	77.8	87.4	22	30	32	38	39
N3INV30	31.2	20.0	19.4	20.0	112.0	26	25	27	26	34
N3INV40	3.8	10.0	13.2	12.6	85.2	10	20	25	29	39
N3INV50	12.4	31.4	56.2	94.0	104.8	17	27	24	38	8
N3INV60	18.4	12.2	29.2	60.4	153.0	20	21	33	30	24
N2INV10	2.4	3.4	5.0	9.8	84.8	6	6	9	11	33
N2INV20	5.8	11.8	29.4	61.4	115.8	12	15	27	26	42
N2INV30	9.6	28.6	45.0	73.6	94.4	16	22	26	29	28
N2INV40	1.0	6.2	3.6	6.0	152.6	4	9	7	14	16
N2INV50	0.6	2.0	14.8	19.2	130.0	3	5	22	20	25
N2INV60	6.4	16.8	32.4	51.8	99.2	12	16	21	22	22
N2INV70	-	2.0	17.4	43.0	135.4	-	7	20	24	31
N2INV80	-	9.6	42.6	88.8	129.0	-	17	28	35	43
N1INV10	-	37.2	56.2	37.4	136.0	-	26	27	18	24
N1INV20	-	25.4	56.6	40.4	48.6	-	22	26	30	21
N1INV30	-	7.8	15.6	38.8	107.4	-	17	26	32	24
N1INV40	-	59.6	29.8	43.0	41.8	-	17	18	19	15
N1INV50	-	18.8	15.0	16.0	67.8	-	17	13	17	28
N1INV60	-	8.8	11.8	19.8	144.2	-	11	12	20	33
CLINV10	37.2	67.2	47.2	69.2	130.6	16	25	21	28	31
CLINV20	31.2	26.6	20.0	21.4	104.0	24	17	20	30	44
CLINV30	82.4	99.0	26.4	64.6	131.0	17	18	15	13	24
CPINV10	32.4	43.2	48.8	96.2	108.4	32	36	31	39	43
CPINV20	37.8	56.0	53.6	95.6	120.2	26	26	26	27	28
C2INV10	-	22.2	37.8	45.2	100.4	-	35	32	41	42
C2INV20	-	21.0	54.8	40.0	60.4	-	41	52	50	50
C2INV30	-	21.0	81.2	38.2	149.8	-	38	46	45	40
C2INV40	-	36.4	36.2	53.0	87.4	-	24	16	22	30
C2INV50	-	24.6	47.8	55.2	69.0	-	36	41	45	43
C1INV10	-	33.6	60.0	116.4	183.8	-	28	34	31	26
C1INV20	-	29.0	78.8	63.6	155.8	-	27	34	32	39
C1INV30	-	36.6	45.0	72.0	157.0	-	34	32	36	47
C1INV40	-	17.4	70.8	53.4	112.4	-	25	32	36	51
C1INV50	-	26.2	46.6	92.2	132.6	-	29	32	34	47
Mean	20.3	27.1	41.1	53.7	114.4	16.4	22.2	25.7	29.7	31.6

Note: [1] Total species cover (%) on (2017) and off RoW is significantly different, $p<0.001$.

[2] No significant difference for species richness on (2017) and off RoW, $p=0.121$.

Table 4-5b. Invasive and non-native vegetation descriptions: diversity and evenness.

Site	Diversity					Evenness				
	RoW				off	RoW				off
	2014	2015	2016	2017[1]	RoW	2014	2015	2016	2017[2]	RoW
N4INV10	-	3.0	2.5	3.1	1.8	-	0.8	0.7	0.8	0.5
N4INV20	-	1.8	2.1	1.7	1.9	-	0.9	0.7	0.5	0.6
N4INV30	-	2.0	2.3	2.8	1.7	-	0.9	0.9	0.9	0.6
N4INV40	-	-	2.2	3.4	2.1	-	-	0.7	0.9	0.7
N4INV50	-	-	1.8	2.6	2.4	-	-	0.5	0.8	0.7
N3INV10	2.4	1.0	0.9	1.9	1.9	0.9	0.3	0.3	0.6	0.6
N3INV20	2.7	2.7	2.8	2.6	3.0	0.9	0.8	0.8	0.7	0.8
N3INV30	2.6	2.8	3.0	2.9	2.6	0.8	0.9	0.9	0.9	0.7
N3INV40	2.1	2.6	3.0	3.2	2.5	0.9	0.9	0.9	1.0	0.7
N3INV50	2.5	2.7	2.3	2.4	1.2	0.9	0.8	0.7	0.7	0.6
N3INV60	2.5	2.5	2.7	2.7	1.5	0.8	0.8	0.8	0.8	0.5
N2INV10	1.7	1.7	2.0	1.9	2.7	1.0	1.0	0.9	0.8	0.8
N2INV20	2.1	2.2	2.4	2.4	2.7	0.9	0.8	0.7	0.7	0.7
N2INV30	2.5	2.6	2.6	2.7	2.1	0.9	0.8	0.8	0.8	0.6
N2INV40	1.3	1.7	1.6	2.3	1.3	1.0	0.8	0.8	0.9	0.5
N2INV50	1.1	1.6	2.5	2.2	1.6	1.0	1.0	0.8	0.7	0.5
N2INV60	1.9	2.4	2.4	2.4	1.7	0.8	0.9	0.8	0.8	0.6
N2INV70	-	1.8	2.7	2.5	2.1	-	0.9	0.9	0.8	0.6
N2INV80	-	2.4	2.5	2.8	2.6	-	0.8	0.7	0.8	0.7
N1INV10	-	2.0	2.1	2.0	2.0	-	0.6	0.6	0.7	0.6
N1INV20	-	2.5	2.3	2.5	2.3	-	0.8	0.7	0.7	0.8
N1INV30	-	2.8	3.0	3.1	2.1	-	1.0	0.9	0.9	0.7
N1INV40	-	1.9	2.1	2.0	2.1	-	0.7	0.7	0.7	0.8
N1INV50	-	2.3	2.2	2.5	2.7	-	0.8	0.9	0.9	0.8
N1INV60	-	2.1	1.7	1.8	2.6	-	0.9	0.7	0.6	0.7
CLINV10	1.9	1.9	1.8	2.0	1.6	0.7	0.6	0.6	0.6	0.5
CLINV20	2.5	2.2	2.2	2.8	2.6	0.8	0.8	0.7	0.8	0.7
CLINV30	1.4	1.6	2.0	1.9	1.7	0.5	0.6	0.8	0.7	0.5
CPINV10	3.0	2.9	2.6	2.8	2.8	0.9	0.8	0.7	0.8	0.7
CPINV20	2.4	2.5	2.6	2.5	2.1	0.7	0.8	0.8	0.8	0.6
C2INV10	-	3.3	3.1	3.2	2.4	-	0.9	0.9	0.9	0.7
C2INV20	-	3.3	3.1	3.2	3.2	-	0.9	0.8	0.8	0.8
C2INV30	-	3.3	2.8	3.3	2.5	-	0.9	0.7	0.9	0.7
C2INV40	-	2.2	1.5	1.8	2.5	-	0.7	0.5	0.6	0.7
C2INV50	-	2.9	3.1	3.1	2.8	-	0.8	0.8	0.8	0.7
C1INV10	-	2.6	2.7	2.0	1.8	-	0.8	0.8	0.6	0.6
C1INV20	-	2.7	1.7	2.4	2.6	-	0.8	0.5	0.7	0.7
C1INV30	-	3.0	2.9	3.0	2.5	-	0.9	0.8	0.8	0.7
C1INV40	-	3.0	2.0	3.1	3.1	-	0.9	0.6	0.9	0.8
C1INV50	-	3.1	2.8	2.7	3.2	-	0.9	0.8	0.8	0.8
Mean	2.2	2.4	2.4	2.5	2.5	0.84	0.81	0.75	0.76	0.67

Note: [1] Diversity index on (2017) and off RoWis significantly different, p=0.005.

[2] Species evenness on (2017) and off RoW is significantly different, p<0.001.

Noxious, Invasive, Non-invasive SNA species throughout the RoW

Fifty noxious, invasive or non-native species were recorded across all vegetation surveys (Field Activity ID BPIII_CON_FA318, 319, 320, 321 and 322). The noxious, invasive and

non-native species recorded include fourteen families; most prominently represented are species from Asteraceae (12), Fabaceae (9), and Poaceae (12). All noxious, invasive and non-native species encountered throughout all surveys (ATK, INV, SCC, TER, WET, S2 roadside) including incidental observations, are shown in Table 4-5c.

Fifteen species are listed as noxious weeds harmful to livestock or agricultural crops, including Tier 3 (thirteen species) and Tier 2 (two species) under the Manitoba Noxious Weeds Regulation (Manitoba Government 2017). Tier 1 noxious weeds include the most threatening species. Noxious weeds include species that are invasive, non-invasive, or native species. For example, some native species (e.g., milkweeds, water hemlock) may be harmful to livestock if ingested. Milkweed, one of four native species listed as noxious, is also an ecologically important food plant of the monarch butterfly larvae, listed federally as Special Concern (SARA) and as Endangered (COSEWIC). Furthermore, the Tier 3 showy milkweed (*Asclepias speciosa*) is also tracked as a species of conservation concern, ranked S3S5.

Noxious species include: giant ragweed *(Ambrosia trifida)*, wormwood *(Artemisia absinthium)*, showy milkweed *(Asclepias speciosa)*, lamb's-quarters *(Chenopodium album)*, spotted water-hemlock *(Cicuta maculata)*, Canada thistle *(Cirsium arvense)*, leafy spurge *(Euphorbia esula)*, wild barley *(Hordeum jubatum)*, prickly lettuce *(Lactuca serriola)*, ox-eye daisy (*Leucanthemum vulgare*), parsnip *(Pastinaca sativa)*, field sow-thistle *(Sonchus arvensis)*, common tansy *(Tanacetum vulgare)*, common dandelion (*Taraxacum officinale*), and field pennycress *(Thlaspi arvense)* (Manitoba Government 2017).

Twenty species are considered invasive due to their tendency to outcompete native species, and dominate habitats once introduced (Canadian Food Inspection Agency 2008; Invasive Species Council of Manitoba 2017): wormwood *(Artemisia absinthium),* smooth brome *(Bromus inermis),* lamb's-quarters *(Chenopodium album),* Canada thistle *(Cirsium arvense)*, quackgrass *(Elymus repens)*, leafy spurge *(Euphorbia esula)*, black bindweed *(Fallopia convolvulus)*, bristly stickseed *(Lappula squarrosa)*, ox-eye daisy (*Leucanthemum vulgare*), bird's-foot trefoil *(Lotus corniculatus)*, alfalfa *(Medicago sativa)*, sweet clovers (*Melilotus albus, M. officinalis*), reed canarygrass *(Phalaris arundinacea)*, common buttercup *(Ranunculus acris)*, green foxtail *(Setaria viridis)*, field sow-thistle *(Sonchus arvensis)*, common tansy *(Tanacetum vulgare)*, red clover *(Trifolium pratense)*, and tufted vetch *(Vicia cracca)*, (Invasive Species Council of Manitoba 2017; Canadian Food Inspection Agency 2008). Note some invasive species are also listed as noxious weeds.

Table 4-5c. Observations of noxious, invasive and non-native species found in surveys project wide, 2017.

Species	Rank	Noxious Weed	Invasive Status	ATK	INV	PRA	TER	SCC	S2
Agrostis stolonifera	SNA				1				
Ambrosia trifida	S4	Tier 3							1
Artemisia absinthium	SNA	Tier 3	CFIA		1				
Artemisia biennis	SNA								1
Asclepias speciosa	S3S5	Tier 3							4
Avena sativa	SNA								3
Brassica napus	SNA								1
Brassica rapa	SNA								8
Bromus inermis	SNA		CFIA		7			1	12
Chenopodium album	SNA	Tier 3	CFIA		10			1	2
Chenopodium leptophyllum	SNA			1					
Cicuta maculata	S4S5	Tier 3			1				
Cirsium arvense	SNA	Tier 3	CFIA, ISCM	1	11		2	1	11
Convolvulus arvensis	SNA								1
Echinochloa crus-galli	SNA								1
Elymus repens	SNA		CFIA		2				5
Euphorbia esula	SNA	Tier 2	CFIA			1		1	
Fallopia convolvulus	SNA		CFIA			1			1
Hordeum jubatum	S5	Tier 3			5		1		7
Lactuca serriola	SNA	Tier 3			1				2
Lappula squarrosa	SNA		CFIA					1	
Leucanthemum vulgare	SNA	Tier 2	CFIA, ISCM		1				
Lotus corniculatus	SNA		CFIA		2				4
Matricaria discoidea	SNA				5				6
Medicago lupulina	SNA				6	1		1	2
Medicago sativa	SNA		CFIA		2			1	4
Melilotus albus	SNA		CFIA		10		1	1	12
Melilotus officinalis	SNA		CFIA		1				10
Pastinaca sativa	SNA	Tier 3							2
Petasites frigidus var. *x vitifolius*	SNA						1		
Phalaris arundinacea	S5		CFIA		2				4
Phleum pratense	SNA				7				3
Plantago major	SNA				6				3
Polygonum aviculare	SNA				3				6
Puccinellia distans	SNA				2				
Ranunculus acris	SNA		CFIA, ISCM		1				
Rumex crispus	SNA								9
Setaria pumila	SNA							1	1

Setaria viridis	SNA		CFIA		1			1	2
Silene latifolia	SNA				4				
Sonchus arvensis	SNA	Tier 3	CFIA, ISCM		22		4	2	12
Tanacetum vulgare	SNA	Tier 3	CFIA, ISCM					1	
Taraxacum officinale	SNA	Tier 3		2	27		3		6
Thlaspi arvense	SNA	Tier 3							3
Tragopogon dubius	SNA				2				1
Trifolium hybridum	SNA				5				6
Trifolium pratense	SNA		CFIA		3				1
Trifolium repens	SNA				4	1			3
Triticum sp.	SNA							1	
Vicia cracca	SNA		ISCM		2				5

An additional twenty-two species are considered non-native, ranked as SNA, although non-invasive in Manitoba: creeping bent grass *(Agrostis stolonifera)*, biennial wormwood *(Artemisia biennis)*, oats *(Avena sativa)*, turnip *(Brassica napus)*, bird's rape *(Brassica rapa)*, narrow-leaved goosefoot *(Chenopodium leptophyllum)*, Common Tansy (*Convolvulus arvensis*), barnyard grass *(Echinochloa crus-galli)*, pineapple weed *(Matricaria discoidea)*, black medick *(Medicago lupulina)*, vine-leaved colt's-foot *(Petasites frigidus* var. x *vitifolius)*, common timothy *(Phleum pratense)*, common plantain *(Plantago major)*, oval-leaf knotweed *(Polygonum aviculare* ssp*. depressum)*, slender salt-meadow grass *(Puccinellia distans)*, curled dock *(Rumex crispus)*, yellow foxtail *(Setaria pumila)*, white cockle *(Silene latifolia)*, goat's-beard *(Tragopogon dubius)*, clovers *(Trifolium hybridum* and *T. repens)*, and wheat (*Triticum* sp.) (Manitoba Conservation Data Center 2017; Scoggan 1957). The most commonly observed non-native species were field sow-thistle (*Sonchus arvensis*, 40 records), common dandelion (*Taraxacum officinale*, 38 records), and sweet clovers (*Melilotus* spp., 35 records). The greatest frequency of records was found in the S2 surveys (165 observations of 37 species) followed by the INV surveys (157 observations of 31 species). Both INV and S2 survey areas were identified by the susceptibility to increased spread of invasive and non-native species, due to each site's location or proximity to existing patches. The remainder of surveys (ATK, PRA, TER, SCC) had more modest records, (from four to 14 observations of three to 13 species). As with previous years, there is a notable absence of these species from environmentally sensitive wetlands surveyed (WET), Table 4-5c.

Changes to this year's list of invasive and non-native species were due in part due to newly included information on noxious weeds, changes to species found in S2 surveys, or simply a newly observed species on the RoW. Some species seen in 2016 were not observed in the current year. Where species have repeat observations, there are variable trends. An extreme example was the explosion of cover values for invasive sweet clovers (*Melilotus* spp.) in certain sites, after clearing. For example, 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. Most sites this year also had low distribution of sweet clovers. The highest sweet clover cover value (12%) was found in a single site, N4-INV-100. However, this cover is due to the presence of sweet clover seedlings only; mature plants represented <1% of plant cover at this site. Invasion may be mediated by moisture, or regenerating vegetation on the RoW at these sites may have provided enough shade at a critical time to hinder the advancement and domination of sweet clovers this season. It is apparent that the domination of invasive species can be highly changeable from season to season.

Re-visiting sites will provide an opportunity to compare abundance and frequency of invasive and non-native species on the RoW over time. Project-wide, mean cover values for all non-native species remain low, generally <2%. Cover values higher than 10% were uncommon, occurring in just four INV sites, and for only six species: smooth brome (*Bromus inermis),* lamb's-quarters (*Chenopodium album*), black medick (*Medicago lupulina*), sweet clovers (*Melilotus* spp.), field sow-thistle (*Sonchus arvensis*), and red clover (*Trifolium pratense*). 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 2017, and their occurrence on the RoW in previous years where recorded. Incidentally occurring species are marked (i).

While the number of occurrences on the RoW for some non-native species appears to have remained similar since 2015, there is a trend of increased occurrences of high frequency noxious species (common dandelion, field sow-thistle, Canada thistle and lamb's quarters), invasives (sweet clovers, smooth brome) and non-native species (common plantain, timothy grass) since this time.

Consistently, invasives and non-native species are occurring with greatest frequency in the INV surveys, areas chosen because of a susceptibility to increased spread of invasive and non-native species due to the site location or proximity to existing patches.

Each of the 40 INV sites are paired with a belt-transect scan off the RoW to track the presence of noxious, invasive or non-native species. This season, such species were recorded from 12 off-site belt-transect scans, up from five off-site scans in 2016. Non-native species included five invasive or noxious species (three Tier 3, and one Tier 2), and two non-native species (non-invasive), Table 4-5g. While numbers of off-row scans with noxious, invasive and non-native species present has increased over the previous year, both abundance and distribution were generally sparse for all species observed, with no major outbreaks found off-site. For example, the highly abundant sweet clovers seen in the previous year (2016) at one site (C2-INV-101) were only sparsely present at that site in the current year.

Table 4-5d. Mean cover (%) of noxious/ invasive species 2017, and their occurrence in sites on the RoW, 2014-17.

Site	*Taraxacum officinale*	*Sonchus arvensis+*	*Cirsium arvense+*	*Chenopodium album+*	*Hordeum jubatum**	*Artemisia absinthium+*	*Cicuta maculata**	*Euphorbia esula+*
CLINV100	0.2							
CPINV100	0.4							
N1INV300	1.8				0.4			
N2INV100	0.6	i		4.2	i			
N2INV400	0.2	0.2		0.2				
N2INV500	1.6	0.8		0.4	0.2			
N2INV600	0.2	i						
N2INV700	0.6	i						
N3INV100		33.2	0.8	15.4				
N3INV300		0.4		1.0				
N3INV400		0.8		0.2				
N3INV500	0.8	6.6	0.8					
N3TER100	0.6	2.2						
N4INV100	1.8	5.4	0.6					
N4INV300			0.8	0.4				
N4INV400	0.4							
N4INV500		2.8	2.8					
N4TER300		1.4	0.8					
N4TER400	0.4	0.6	1.0					
C1ATK200	0.4							
C1ATK500	0.2		0.2					
C1INV100		0.2						
C1INV200		1.2	4.6	0.2			0.2	
C1INV300	1.0					0.2		
C1INV400	2.2	0.6	3.6	0.4				
C1INV500	0.4	12.6	0.6					
C2INV100	0.6							
C2INV200	0.6	0.6						
C2INV300	1.4	1.0	0.2	0.6				
C2INV400		0.4						
C2INV500	1.2				0.2			
S1PRA900								6.4
Occurs on RoW								
2017	22	18	12	10	3	1	1	1
2016	18	14	7	12				1
2015	16	10	7	4				1
2014	6	3	2					

Note: + Also considered invasive species (CFIA 2008; ISCM 2017); * ranked as native species (MB CDC 2017)

Table 4-5e. Mean cover (%) of other invasive species 2017, and their occurrence in sites on the RoW, 2014-17.

Site	*Melilotus spp**	*Bromus inermis*	*Elymus repens*	*Medicago sativa*	*Trifolium pratense*	*Vicia cracca*	*Fallopia convolvulus*	*Phalaris arundinacea*	*Ranunculus acris*	*Setaria viridis*
N1INV300		0.6								
N2INV100	0.6									
N2INV400	0.2									
N2INV500	0.2							0.2		
N2TER500	0.2									
N3INV100	3.2		0.2							
N3INV400	0.4					0.2				
N4INV100	12.0	0.2			1					
N4INV400					0.8				0.2	
N4INV500	3.0	23.6	1.8							
C1INV200	3.4	1.4				0.2				
C1INV300	1.2	0.4								
C1INV400	4.2	0.2								
C1INV500	1.0			0.4						1.0
C2INV100	0.2									
C2INV200	0.2									
C2INV300	0.4									
C2INV500	0.2	0.2		0.6						
S1PRA900							0.2			
Occurs on RoW 2017	16	7	2	2	2	2	1	1	1	1
2016	10	7				1	3			
2015	6	2		2						
2014	1	3				2				

Note: * Melilotus albus, M. officinale are merged with vegetative samples of *Melilotus* spp.

Table 4-5f. Mean cover (%) of non-native, non-invasive species 2017, and their occurrence in sites on RoW, 2015-17.

Site	*Plantago major*	*Medicago lupulina*	*Phleum pratense*	*Trifolium* spp.[1]	*Matricaria discoidea*	*Polygonum aviculare*	*Agrostis stolonifera*	*Chenopodium leptophyllum*	*Petasites frigidus* var. *x vitifolius*	*Puccinellia distans*	*Tragopogon dubius*
CLINV200					0.2						
N2INV100					0.4					0.8	
N2INV500			i			0.2					
N2INV700							1.4				
N3INV100	0.2			0.6	0.2						
N3INV400	0.8				0.4	0.2					
N3TER400									0.4		
N4INV100	1.4										
N4INV400	0.2		0.4								
N4INV500				13.6							0.4
C1ATK100								0.2			
C1INV300		0.2									
C1INV500	0.4	10.6	0.8	3.4							
C2INV200		0.2	0.2								
C2INV300			2								
C2INV500	1.6	4.8	0.2	8.8							
S1PRA900		0.2		0.2							
Occurs on RoW 2017	6	5	5	5	4	2	1	1	1	1	1
2016	3		4	7							
2015	1	4	1	3							

Note: [1] The clovers (*Trifolium hybridum* and *T. repens*) are merged for display.

Table 4-5g. Noxious, invasive and non-native species recorded in INV surveys off-RoW, 2017. S=sparse, M= moderate, SO=single occurrence.

SITE	*Cirsium arvense*	*Leucanthemum vulgare*	*Medicago lupulina*	*Melilotus* spp.	*Sonchus arvensis*	*Taraxacum officinale*	*Trifolium spp.*[1]
N2INV801*						S	
N3INV401		S					
N4INV101*						SO	
N4INV501*					S		
C1INV201	S				S	S	
C1INV301						S	
C1INV401	S					S	
C1INV501						S	
C2INV101				S			S
C2INV201			SO		S	S	SO
C2INV301						S	
C2INV501			S-M	S		S	S-M
Noxious, Tier	T3	T2			T3	T3	
Invasive	x	x		x	x		x

Note: [1]*Trifolium pratense* and *T. repens* have been merged for display. Sites marked * have new observations of non-native species, not previously recorded.

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 2017 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.

From fieldwork conducted, it was determined that the recommended mitigation was effective where implemented. In the absence of mitigation, invasive and non-native species cover would likely be higher along the RoW. The majority of clearing and construction activities appeared to be carried out during winter months, where the spread of invasive and non-native species is reduced. It is assumed that all equipment was thoroughly washed and inspected prior to working in the RoW, during construction activities. This season, many INV sites were observed with towers erected and conductors strung, while other sites were without conductors or towers were yet to be erected. Re-visiting these sites will provide an opportunity to compare species abundance on the RoW over time.

Survey locations previously established along the RoW included roads, rail lines and watercourse crossings. Surveys in Year IV environmental monitoring have detected a trend of increased occurrences of some noxious species, invasives, and non-native species from previous years.

In Section S2, non-native and invasive species were observed at all sites investigated where the RoW intersected roadways. Species here have already been established along the roadways prior to construction activities. Several sites in agricultural land with tower locations close to roadsides appeared to support species such as Canada thistle (*Cirsium arvense*) and field sow-thistle (*Sonchus arvensis*), viewed roadside. Thistles were also observed in other fields, along the RoW (e.g., S2-INV-012). Bare soil and minor rutting was observed in areas of Section S2, along the equipment path and near access points. In other areas, rig matting was observed which mitigated rutting from heavy equipment use (e.g., S2-INV-001; S2-INV-003). Four invasive and non-native species were observed within the S1 PRA survey.

In Sections C1, C2, and N4 (south of the Red Deer River), non-native and invasive species were observed during ground surveys, but were less abundant when compared to 2016

observations. Most sites this year had low distribution of sweet clovers (*Melilotus* spp.), as compared to the previous season. No large outbreaks of invasive and non-native species were observed during aerial inspections of these Sections. At one site, near sampling plot C1-INV-300 (other side of road), ox-eye daisy (*Leucanthemum vulgare*) was observed to be spreading into the RoW (Photograph 4-5a). Ox-eye daisy is designated as a Tier 2 noxious weed.

Photograph 4-5a. Ox-eye daisy observed along the RoW.

North of the Red Deer River, rutting was observed again at N4-INV-200, adjacent to the equipment path, near the water crossing. Minor rutting was occasionally observed at other sites along the RoW. Plot N4-INV-300 was partially disrupted from RoW clearing activities, where woody debris was placed in the plot. This site was still able to be sampled.

In Sections N2 and N3, non-native and invasive species such as common dandelion (*Taraxacum officinale*), ox-eye daisy (*Leucanthemum vulgare*), tufted vetch (*Vicia cracca*) and white sweetclover (*Melilotus albus*) were observed during several INV surveys along the RoW. These species are established at many roads and rail lines that intersect the RoW. Locations where species are showing an increase in distribution (vicinity of site) include plots N3-INV-100, N3-INV-400, N2-INV-100, N2-INV-500 and N2-INV-600 (see Section 5.0).

Many tower foundations in Sections N2 and N3 were observed to support non-native and invasive species. With exposed soil from construction activities and low competition from other species, tower foundations can have favorable ground conditions to support these plants. To reduce species spread, construction equipment and materials should be free of invasive species.

Few non-native and invasive species were observed during surveys in Section N1 (east of Hunting River) and along the northern AC collector lines and construction power line. These species were not problematic in this area of the Project in 2017. Common dandelion and pineapple weed (*Matricaria discoidea*) were observed only in a few plots. Plot N1-INV-500 experienced high-water levels from spring flooding at the Limestone River. Here, sediment (silt and clay) was deposited upslope and throughout the site (Photograph 4-5b). Depth of sediment deposited exceeded 20 cm in areas. Debris from flooding was observed in the low shrub layer, indicating high spring water levels.

Select access trails in Sections N1 and N2 were inspected from the air to identify potential problems. Access trails in Section N2 were observed to support minimal areas of white sweet clover cover. Minor rutting was observed along an access trail in N1. Equipment should be free of invasive species when accessing the RoW from trails to reduce the species spread to these exposed soils.

Future environmental monitoring will 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. The removal of native vegetation on the RoW and areas of exposed soil from construction activities provide an opportunity for invasive and non-native species to establish and proliferate. Recommendations for invasive and non-native species in Year IV of environmental monitoring are identified in Section 5.0.

Photograph 4-5b. Sediment deposited at Limestone River monitoring site.

4.6 Species of Conservation Concern

4.6.1 Monitoring for Species of Conservation Concern

During sampling in 2017, 50 species of conservation concern (ranking S1 through S3S5) were recorded in 160 observations across all types of surveys (Field Activity ID BPIII_CON_ FA318, 319, 320, 321 and 322) and in each section of the RoW. The most frequent number of observations (60), and the greatest number of species of conservation concern (17) were recorded in the SCC surveys in S1, near the Assiniboine River crossing. Table 4-6a.

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

	S1	S2	C1	C2	N1	N2	N3	N4	CL	CP	GE
Very Rare – Rare: S1-S2S4	9	0	2	0	2	1	2	3	2	1	3
Uncommon: S3-S3S5	8	2	7	1	5	1	10	2	5	3	2
Total # species	17	2	9	1	7	2	12	5	7	4	5
Total # observations	60	5	21	1	17	2	16	9	19	5	5

Among these 50 species of conservation concern listed in Table 4-6b, 17 are ranked very rare to rare, (S1 through S2S4), with the remaining 33 species are ranked uncommon (S3 through S3S5) (MBCDC 2017). Locations of rare plant surveys (SCC) are shown in Map 4-1 (Appendix II).

Table 4-6b. Species of conservation concern recorded during Bipole III monitoring, 2017.

Very Rare to Rare Species (S1-S2S4)	Common Name	Rank
Agrimonia gryposepala	Common Agrimony	S1S2
Arabidopsis lyrata	Lyre-leaved Rock Cress	S1S2
Astragalus americanus	American Milkvetch	S2S3
Caltha natans	Floating Marsh-marigold	S2S4
Circaea lutetiana	Large Enchanter’s Nightshade	S2
Cryptotaenia canadensis	Honewort	S1
Cyperus schweinitzii	Schweinitz’s Flatsedge	S2
Dalea villosa	Silky Prairie-clover	S2?
Desmodium canadense	Beggar's-lice	S2
Dichanthelium wilcoxianum	Sand Millet	S2?
Drosera linearis	Slender-leaved Sundew	S2?
Eriophorum scheuchzeri	Scheuchzeri's Cotton-grass	S2?
Impatiens noli-tangere	Western Jewelweed	S1
Osmorhiza claytonii	Hairy Sweet Cicely	S2?

Pedicularis macrodonta	Muskeg Lousewort	S2S3
Salix arbusculoides	Little-tree Willow	S2S3
Sanguinaria canadensis	Blood-root	S2
Uncommon Species (S3-S3S5)	**Common Name**	**Rank**
Arctous alpina	Alpine Bearberry	S3S4
Asclepias speciosa	Showy Milkweed	S3S5
Botrychium lunaria	Common Moonwort	S3S4
Calamovilfa longifolia	Sand Grass	S3S5
Cynoglossum virginianum var. *boreale*	Northern Wild Comfrey	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
Iva axillaris	Poverty-weed	S3
Liparis loeselii	Yellow Twayblade	S3S4
Lithospermum incisum	Linear-leaved puccoon	S3
Lonicera involucrata	Black Twinberry	S3S4
Lonicera oblongifolia	Swamp-fly-honeysuckle	S3S5
Lygodesmia juncea	Skeletonweed	S3S4
Melampyrum lineare	Cow-wheat	S3S5
Onosmodium molle	Marble-seed	S3S4
Pedicularis labradorica	Labrador Lousewort	S3S4
Phryma leptostachya	Lopseed	S3
Pinguicula villosa	Small Butterwort	S3S4
Platanthera dilatata	Bog Candle	S3S4
Platanthera orbiculata	Round-leaved Bog Orchid	S3
Rhododendron tomentosum	Dwarf Labrador-tea	S3S5
Rhynchospora alba	White Beakrush	S3
Rudbeckia laciniata	Tall Coneflower	S3S4
Salix vestita	Rock Willow	S3
Scheuchzeria palustris	Podgrass	S3S4
Schizachyrium scoparium	Little Bluestem	S3S4
Selaginella densa	Prairie Spike-moss	S3
Selaginella selaginoides	Northern Spike-moss	S3S4
Vaccinium caespitosum	Dwarf Bilberry	S3
Vitis riparia	Riverbank Grape	S3S4

Southern: S1 Assiniboine Crossing and S2 surveys

In Section S1, near the Assiniboine River crossing (Field Activity ID BPIII_CON_FA321), eight monitoring surveys for species of conservation concern (SCC) were completed from July 31 to August 1, with all populations of previously recorded species revisited. The route both north and south of the Assiniboine River, passes through mature deciduous forest with canopies of bur oak (*Quercus macrocarpa*), black ash (*Fraxinus nigra*), and trembling aspen (*Populus tremuloides*), with some younger open trembling aspen forests found in the north. Some steep sloped areas occur both north and south of the Assiniboine crossing, although most sites on the south side of and adjacent to the Assiniboine River were nearly level, with corn, bean/ potato crops surrounded by mature deciduous forest (black ash, oak, trembling aspen). The areas of mature bur oak and black ash forest are exceptional areas, as their locations, slopes and soils, have generally prevented any previous clearing, cultivation or development. During agricultural settlement of this region, these mature forests remained refuges for diverse species assemblages that include species of conservation concern.

On the RoW, species of conservation concern were observed in 2017 under open conditions, as well as more favourable shady conditions (e.g., at the cleared edge, or under the cover of other broadleaved herbs and regenerating woody species). This season, frequent observations of species of conservation concern were again found along the cleared route. Observation points had single stems, multiple stems or large patches of each species present.

A total of 17 species of conservation concern were recorded in eight SCC surveys, near the Assiniboine crossing. Nine species ranked very rare to rare (S1 to S2S4) are honewort (*Cryptotaenia canadensis*, S1), western jewelweed (*Impatiens noli-tangere*, S1), common agrimony (*Agrimonia gryposepala*, S1S2), large enchanter's-nightshade (*Circaea lutetiana*, S2), Schweinitz's flatsedge (*Cyperus schweinitzii*, S2), hairy sweet cicely (*Osmorhiza claytonia*, S2?), blood-root (*Sanguinaria canadensis*, S2), silky prairie-clover (*Dalea villosa*, S2?), and beggar’s-lice (*Desmodium canadense*, S2). Eight additional species ranked uncommon (S3 to S3S5) are sand grass (*Calamovilfa longifolia*, S3S5), poverty-weed (*Iva axillaris*, S3), linear-leaved puccoon (*Lithospermum incisum*, S3), skeletonweed (*Lygodesmia juncea*, S3S4), marble-seed (*Onosmodium molle,* S3S4), lopseed (*Phryma leptostachya*, S3), tall coneflower (*Rudbeckia laciniata,* S3S4) and riverbank grape (*Vitis riparia,* S3S4). No new species were found, although tall coneflower is now a tracked species of conservation concern, due to an update in subnational ranks.

At the single prairie monitoring site (S1-PRA-900), four species of conservation concern were relocated in and incidental to plots, including silky prairie-clover, Schweinitz's

flatsedge, linear-leaved puccoon and skeletonweed. Prairie spike-moss (*Selaginella densa*) has not been observed in S1-PRA-900 nor the near-by S1-SCC-700, since 2015.

Silky prairie-clover, is listed as Threatened under *The Endangered Species and Ecosystems Act* – Manitoba and the *Species at Risk Act*, and Special Concern under the Committee on the Status of Endangered Wildlife in Canada. Silky prairie-clover was first observed in 2010, during rare plant surveys for the Bipole III Environmental Assessment, and has been observed each year at the same locations during monitoring (2014 through 2017).

In Section S2, a single species of conservation concern, showy milkweed (*Asclepias speciosa*, S3S5), was recorded in four surveys, S2-7, 8, 10 and 12 on July 24 (Field Activity ID BPIII_CON_FA320). Showy milkweed is also listed in the Noxious Weeds Regulation (Tier 3), due to its toxicity to livestock.

Central: C1 Blueberry Resource Area and C2

In the Cowan resource area (Section C1), surveys were conducted July 6 to monitor species of conservation concern previously observed (Field Activity ID BPIII_CON_FA318). Nine rare and uncommon species were recorded. Rare species include lyre-leaved rock cress (*Arabidopsis lyrata*, S1S2) and sand millet (*Dichanthelium wilcoxianum*, S2?), recorded in three sites and one site, respectively. The rock cress populations were in full flower and readily observed, though sparsely distributed, throughout three sites. When vegetative, this plant is very inconspicuous, so may be underrepresented if sites are not visited during flowering times. Seven additional uncommon species were also recorded, including Leiberg's panic-grass (*Dichanthelium leibergii*, S3S4), long-leaved bluets (*Houstonia longifolia*, S3S5), false heather (*Hudsonia tomentosa,* S3), black twinberry (*Lonicera involucrata*, S3S4), cow-wheat (*Melampyrum lineare*, S3S5), little bluestem (*Schizachyrium scoparium*, S3S4) and prairie spike-moss (*Selaginella densa*, S3). All previous observed species were again recorded this year, with the addition of the newly recorded Lieberg's panic-grass in C1 as well as at one site in C2 (C2-INV-500).

Recent changes to subnational ranks have increased the number of species tracked (S3 – S3S5) as species of conservation concern (e.g., long-leaved bluets, black twinberry, little bluestem). Velvety goldenrod (*Solidago mollis*, S3), last seen in 2015, was not observed on the RoW in 2017. Off-site, and immediately adjacent to the RoW, lyre-leaved rock cress (*Arabidopsis lyrata*, S1S2) and false heather (*Hudsonia tomentosa*, S3) were relocated again in 2017, at two locations each, at four sites. Photograph 4-6a shows lyre-leaved rock cress along the RoW.

Photograph 4-6a. Lyre-leaved rock cress observed along the RoW.

Northern: N1 through N4

From the Gillam area south to the Swan River area, in Sections N1 to N4, 22 species of conservation concern ranked rare (S2? to S2S4) to uncommon (S3 to S3S5) were recorded during surveys from July 7 to August 5 (Field Activity ID BPIII_CON_FA318, 319, 322). Six rare species include American milkvetch (*Astragalus americanus*, S2S3), floating marsh-marigold (*Caltha natans*, S2S4), slender-leaved sundew (*Drosera linearis*, S2?), Scheuchzeri's cotton-grass (*Eriophorum scheuchzeri*, S2?), hairy sweet cicely (*Osmorhiza claytonii*, S2?) and little-tree willow (*Salix arbusculoides,* S2S3). An additional 16 species ranked uncommon (S3 to S3S5) were also recorded, including alpine bearberry (*Arctous alpina*, S3S4), northern wild comfrey (*Cynoglossum virginianum* var. *boreale*, S3S4), oblong-leaved sundew (*Drosera anglica*, S3S4), yellow twayblade (*Liparis loeselii*, S3S4), swamp-fly-honeysuckle (*Lonicera oblongifolia*, S3S5), cow-wheat (*Melampyrum lineare*, S3S5), Labrador lousewort (*Pedicularis labradorica*, S3S4), small butterwort (*Pinguicula villosa*, S3S4), bog candle (*Platanthera dilatata*, S3S4), round-leaved bog orchid (*Platanthera orbiculata*, S3), white beakrush (*Rhynchospora alba*, S3), rock willow (*Salix vestita*, S3), podgrass (*Scheuchzeria palustris*, S3S4), little bluestem (*Schizachyrium scoparium*, S3S4), low spike-moss (*Selaginella selaginoides*, S3S4) and dwarf bilberry (*Vaccinium caespitosum*, S3). New locations for species of conservation concern were observed incidentally this season (e.g., oblong-leaved sundew, slender-leaved sundew, bog candle). Not observed this season were small butterwort from N1-INV-400 and white beakrush from N4-WET-400.

Adjacent to the RoW, nine species were relocated in five monitored sites (four INV sites in Sections N1, N2 and N3, as well as one WET site in N4), including two rare species and seven uncommon species, each also found in sites on the RoW (mentioned above). A

single species, teaberry (*Gaultheria procumbens*, S3S4), has not been re-located since 2015, when it was recorded adjacent to the RoW (N3-TER-201).

Northern Components

In the northeastern portion of the Project, monitoring surveys were conducted on August 4 and 5, for species of conservation concern located along the northern AC collector lines, construction power line, and northern ground electrode line (Field Activity ID BPIII_CON_FA322). A total of 19 monitoring surveys for SCC were conducted along the northern project components.

Nine species of conservation concern were observed, ranked rare (S2S3) to uncommon/widespread (S3-S3S5). Three species are rare: American milkvetch (*Astragalus americanus*, S2S3); muskeg lousewort (*Pedicularis macrodonta*, S2S3); and little-tree willow (*Salix arbusculoides,* S2S3). Six species are uncommon: common moonwort (*Botrychium lunaria*, S3S4), oblong-leaved sundew (*Drosera anglica*, S3S4), small butterwort (*Pinguicula villosa*, S3S4), dwarf Labrador-tea (*Rhododendron tomentosum*, S3S5), white beakrush (*Rhynchospora alba*, S3) and rock willow (*Salix vestita*, S3). All species of concern previously observed at monitoring sites were re-located except for small butterwort which was absent again from plot CL-TER-100, and oblong-leaved sundew, absent again from CP-ECO-300; new clearing along the northern ground electrode line has also resulted in the recent removal of the little-tree willow and rock willow from GEL-SCC-200. A single plant, common moonwort, is a newly observed species on the RoW in 2017 (at CP-INV-100). Species previously observed, but found growing in new locations (new occurrences) in 2017 included little-tree willow (CP-INV-100), small butterwort (CP-TER-100), and another population of oblong-leaved sundew (CL-SCC-100).

At locations along the northern AC collector lines labeled CL-SCC-100 and CL-SCC-200, white beakrush was previously abundant in this area of the RoW. In 2016, surveys identified a reduced presence of this species during construction activities, with site conditions observed as drier. Surveys in 2017 noted that white beakrush increased in abundance at CL-SCC-200, but plant numbers were again sparse in the CL-SCC-100 patches previously known supporting this species. Site conditions in the RoW again ranged from dry areas to wet sites, where the wetter depressions are preferred habitat. Approximately 10 other surface depressions were observed supporting this plant when surveying between sites CL-SCC-100 and CL-SCC-200. Numbers of white beakrush were also known to decrease at site CL-ECO-300, where condition were drier this season. Photograph 4-6b shows white beakrush along the RoW.

Photograph 4-6b. White beakrush observed along the RoW.

4.6.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the Project areas previously cleared, the effect predictions from Appendix III for species of conservation concern were accurate for the following:

- Potential loss of plants of conservation concern

Mitigation measures identified in the Construction Environmental Protection Plan (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 along the RoW. Table 4-6c identifies the mitigation measures assessed at each site.

Table 4-6c. Mitigation measures assessed at sites monitored for species of conservation concern on the RoW.

Mitigation Measure	GEL-SCC-100	GEL-SCC-200
Identify and flag prior to start of work.	Y	Y
Carry out construction activities on frozen or dry ground to minimize surface damage, rutting and erosion.	Y	Y
Provide 5 m vegetated (shrub and herbaceous) buffer around site.	N	N
Remove trees by low disturbance methods.	Y	Y
Confine vehicle traffic to established trails to extent possible.	Y	Y
Use existing access roads and trails to the extent possible.	Y	Y
Stabilize sites immediately after construction and re-vegetate disturbed areas.	-	-

Note: Y/N (yes/no) denotes whether mitigation measure was implemented. A dash (-) means not applicable.

In 2017, the only new clearing for the Project, where species of conservation concern were previously observed, occurred along the northern ground electrode line, where the RoW was re-cleared. Construction activities also occurred on the RoW with towers erected and stringing completed. Although site GEL-SCC-200 along the northern ground electrode RoW was staked and flagged prior to clearing and construction activities, no vegetated buffer remained at the site this season, with clearing occurring to the ground stratum. Project activities resulted in the loss of little-tree willow and rock willow on the RoW. Off the RoW, both shrub species were observed. At site GEL-SCC-100, two species previously observed, muskeg lousewort and oblong-leaved sundew, were relocated again in 2017. Although, blading of ground vegetation and minor rutting was noted at this site.

Elsewhere, it was determined that recommended mitigation was implemented at SCC sites during construction activities, where aplicable. Mitigation was initially assessed at SCC sites after clearing activities. Construction activities appeared to occur on frozen or dry ground to minimize surface damage, rutting and erosion. Existing buffers were unaltered, construction traffic was confined to established trails and existing access roads appeared to be used. Mitigation was determined to be effective where implemented. In the absence of mitigation during construction activities, increased disturbance or loss to species of conservation concern may have resulted. Nearly all known locations for species of conservation concern (pre-clearing) were observed again after construction activities. Sites off the RoW were not monitored for mitigation.

4.7 Rehabilitation Monitoring

Rehabilitation

The Bipole III transmission line RoW and several access roads were inspected to identify vegetation issues or disturbance areas requiring rehabilitation. In the north, the Project RoW was flown and included Sections N1 to N4, AC collector lines, construction power line, and the ground electrode line. In the south, Sections C1 and C2 were also flown, while S1 and S2 were accessed by road.

In 2015, two water crossings were observed to have established erosion control, using fibre blankets. One location was at the Mitishto River (479170 E and 6050339 N) in Section N3 and the other was at the Hunting River (670030 E, 6248581 N), in Section N1. Follow-up monitoring occurred to identify the erosion control and rehabilitation success. At the Mitishto River in 2017, fibre blankets were observed again on the bank slopes. Most of the installed blankets were still in place but in some areas the material has rolled back along the rivers edge, possibly from ice scouring. Natural re-vegetation was observed growing through the blankets, however some areas were still without emerging vegetation. No erosion was evident at this site. Vegetation colonizing the banks

were mostly shrub cover of red-osier dogwood (*Cornus sericea*), prickly rose (*Rosa acicularis*), Saskatoon (*Amelanchier alnifolia*), balsam poplar (*Populus balsamifera*), willow species (*Salix* spp.) and alder-leaved buckthorn (*Rhamnus alnifolia*). Grasses such as hairy wild rye (*Leymus innovatus*) and Canada reed grass (*Calamagrostis canadensis*) were estabalished. At this time, no additional rehabilitation is required for the Mitishto River crossing. Photograph 4-7a shows the Mitishto River in 2017.

Photograph 4-7a. Mitishto River in 2017.

At the Hunting River in 2017, the water level was high at the time of the survey and the fibre blankets were no longer visible. No soil erosion was observed at the site. The equipment path was vegetated with mostly graminoid species at the crossing. Further up slope, evidence of silt has been deposited over the ground cover from high river water levels; the equipment path at this location is sparse to non-vegetated. Adjacent to the crossing, along the shore, occurs mainly shrub and graminoid species. Species observed included tea-leaved willow (*Salix planifolia*), water sedge (*Carex aquatilis*), Canada reed grass (*Calamagrostis canadensis*), water-hemlock (*Cicuta maculata*) and common mint (*Mentha arvensis*). Photograph 4-7b shows the Hunting River in 2017.

In the spring of 2017, construction activities resulted in disturbance of the vegetation and ground conditions at Slug Site (404388 E, 5751244 N) in Section C1, near Tower 4088. Photographs of this site revealed that a ditch was excavated to divert water flow away from the construction site. Non-frozen ground conditions resulted in heavy rutting and removal of vegetation in the area from construction activities.

Preliminary recommendations for Slug Site were provided to Manitoba Hydro. These included: removal of equipment from soft ground where possible; stabilize the watercourse (e.g., silt fence, straw bales or brush) to reduce water movement towards the construction site; conduct construction activities during frozen ground conditions; and use rig mats where required. Following construction, the rutting should be graded

when conditions are suitable and allow the site to re-vegetate naturally where existing seed sources in the soils can be allowed to germinate. The site can be re-assessed after one growing season.

On July 6, Slug Site was visited, but only assessed from the air due to nearby construction activities. Helicopters were in the immediate vicinity stringing conductors, so a ground assessment could not be conducted. From the air, rutting from activities was evident but soil erosion was unable to be accurately assessed. A constructed ditch was still in place, used to divert water. Natural revegetation appeared to be occurring around the construction site and along the equipment path, although species composition was unable to be determined. The immediate equipment staging area showed little recovery of vegetation at this time. The site will be re-assessed in 2018 for native vegetation recovery, soil erosion and invasive species establishment. Photograph 4-7b. shows vegetation recovery at Slug Site.

Photograph 4-7b. Vegetation recovery at Slug Site.

In Section N1, fibre blankets were installed at two tower locations along the RoW. These areas have sandy soils that could erode as a result of the surrounding terrain and strong slopes. These areas will be inspected in 2018.

No other sites requiring rehabilitation for the Project were observed during aerial inspections or road surveys in 2017, and no other locations were identified by Manitoba Hydro to investigate. In 2018, rehabilitation areas will be re-visited to monitor soil erosion and establishment of natural re-vegetation.

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 IV monitoring. Terrestrial sites (TER) showed an increase in species richness (73% of sites) between Year III and Year IV environmental monitoring. Similarily, wetland (WET), resource area (ATK) and invasive (INV) sites showed increases in species richness between the growing seasons (71%, 70% and 75% of sites, respectively). The single prairie (PRA) site monitored also showed an increase in species richness in 2017.

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 IV monitoring. Surveys in 2017 revealed that 31 invasive and non-native species occurred along the RoW. Adjacent to the RoW (off site surveys), fewer invasive and non-native species occurred (nine species present). Where these species occurred prior to clearing and construction activities (e.g., roadside, rail line), invasive and non-native species have the ability to spread quickly on disturbed ground in the RoW.

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 IV monitoring. While species numbers have shown both increases and decreases since surveys commenced in 2014, the number of sites supporting blueberries this season has increased to seven, more sites than all previous years. Furthermore, total blueberry cover for sites only supporting blueberries on the RoW averaged 12.6% in 2017, an increase since initial RoW pre-clearing surveys in 2014 (11.6%).

5.0 RECOMMENDATIONS

Based on the 2017 vegetation surveys conducted and observations recorded on the RoW, the following are recommendations for future Project construction activities. Plot coordinates are provided in Appendix V.

Cowan Blueberry Resource Area

As transmission towers have not yet been erected in the Cowan resource area, future construction activities should be confined to the equipment path (Towers 4024 to 4032), where possible. The area is known to support blueberry picking and harvesting of other plants. Blueberries have shown increased cover after clearing in some locations. Several species of conservation concern are also present. In some areas, vegetation cover along the equipment path is sparse and the soils are very sandy. Adjacent sites to the equipment path would be easily disturbed. Where possible, avoid equipment placement off of the equipment path, and it is recommended that activities occur on frozen ground (with snow cover) in this location.

Rutting and Other Ground Disturbances

Rutting was observed occasionally along the RoW, during aerial and ground surveys, in both upland and lowland sites. Most rutting observed was minor along the RoW equipment path. Some areas experienced heavier rutting such as Slug Site in Section C1 (404388 E, 5751244 N). Increased rutting was observed along an access trail in Section N1 (640517 E, 6226875 N). Where possible, construction activities on ground easily disturbed should occur during frozen ground conditions, to reduce rutting and soil disturbance.

At river crossings, vehicle travel should occur during frozen ground conditions, to reduce site disturbance. Rig mats should also be used where possible. In 2017, rig mats were observed in a creek and should be removed when no longer required (462267 E, 6044870 N).

A breached channel was observed north of The Pas (363527 E, 5969243 N). This site was heavily flooded and the channel appeared to be disturbed from construction activities and nearby staging.

Several borrow areas (dig-outs) were observed along the RoW, in Sections N1 and N2. These areas appeared to be used for providing additional soil for construction activities (i.e., tower footings), where required. The borrow areas are generally <5m^2 and about 1-3 m in depth. These locations have the potential to support invasive and non-native species as a result of the exposed soil. Where possible, borrow areas along the RoW

should be re-contoured in order to allow the naturally occurring vegetation to re-establish.

The RoW for the northern components (e.g., AC collector lines, construction power line) and occasionally along Section N1 was bladed or scraped as a result of recent construction activities. These areas were observed at tower locations, adjacent sites, and occasionally along the equipment path. Vegetation regeneration was low in these bladed areas. Where possible, future blading of the ground cover in Section N1 and northern components should be reduced along the equipment path and areas adjacent to tower foundations. Heavily bladed areas require time to recover in northern environments as a result of slower glowing vegetation (e.g., moss and lichen ground cover).

Invasive and Non-native Species

Non-native and invasive species were observed during surveys along the RoW. Sites where these species were spreading included the following:

- N3-INV-100 (white sweetclover, field sow-thistle, ox-eye daisy, reed canarygrass) 372809 E, 5979985 N. This location has white sweetclover established around the tower site and has moved northwards into the RoW from the road. Management 0 to 300 m from roadside.
- N3-INV-400 (ox-eye daisy, white sweetclover, tufted vetch) 451029 E, 6040069 N. This location previously was a staging area for construction equipment and materials; a construction camp is nearby. Management 0 to 100 m from roadside.
- N2-INV-100 (white sweetclover, common dandelion, lamb's quarters) 595548 E, 6180196 N. Species are beginning to spread into the RoW, northwards. South of the access road, invasive species are present and occur around the construction camp. Management 0 to 100 m from roadside, both sides.
- N2-INV-600 (white sweetclover) 591352 E, 6157388 N. Species have spread northwards into the RoW from the rail line. Management 0 to 100 m from rail line.
- N2-INV-500 (white sweetclover, reed canarygrass, common dandelion) 577535 E, 6145769 N. The roadside ditch is full of invasive species and are spreading into the RoW. Management 0 to 100 m from roadside.
- C1-INV-300 (ox-eye daisy) 435925 E, 5717173 N. The species was observed on the west side of the road, spreading into the RoW. Management 0 to 50 m from roadside.
- Many tower foundations in northern Sections N1, N2 and N3 supported non-native and invasive species. Tower foundations in agricultural settings also

frequently supported these plants (e.g., towers near sites S2-INV-008, S2-INV-009, S2-INV-011, S2-INV-012). Ground conditions were favorable with exposed soil from construction activities and low competition from native species. Future project activities should ensure clean construction equipment and activities should be conducted on frozen or dry ground conditions.

Vegetation management for invasive and non-native species is recommended. The risk of spread into adjacent sites or further along the RoW may increase with each growing season. Management could include manual, mechanical or chemical control. Refer to treatment options for select species in the Manitoba Hydro Rehabilitation and Invasive Species Management Plan (Manitoba Hydro 2016). Where possible, use of chemical control should be minimized to reduce adverse effects on the environment, and environmentally sensitive sites should be avoided. Where chemical control is used as management, all regulatory requirements (The Noxious Weed Act, The Pesticides and Fertilizers Control Act) and Licence Conditions should be met (Conditions 45, 48, 52, 60, 61 and 62).

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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).

Closed – see canopy closure.

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).

Disjunct – Marked by separation of or from usually contiguous parts or individuals (Merriam-Webster).

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

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).

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 plant that is grass-like; the term refers to grasses and plant that look like grasses, i.e., only narrow-leaved herbs; in the strictest sense, it includes plants belonging only to the family *Graminaceae* (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).

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, the leaves have parallel veins, and the vascular bundles of the stem are scattered and closed (Usher 1996).

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

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).

Pteriodophyte – A division of the plant kingdom; the sporophyte is vascular and independent of the gametophyte at maturity; generally they have stems, leaves and roots (Usher 1996).

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).

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).

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

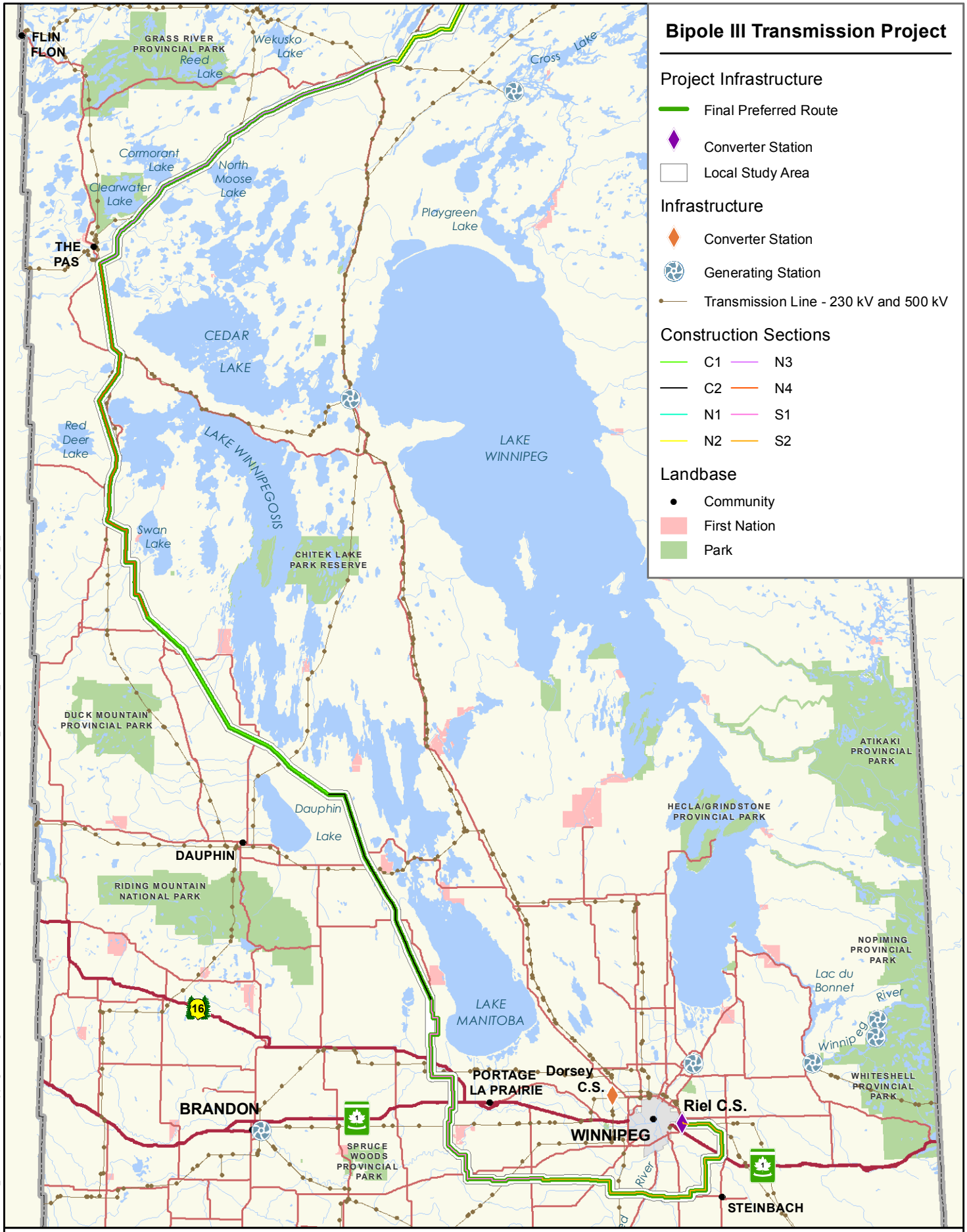
Vascular Plant – A plant having a vascular system (Usher 1996).

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 30, 2017

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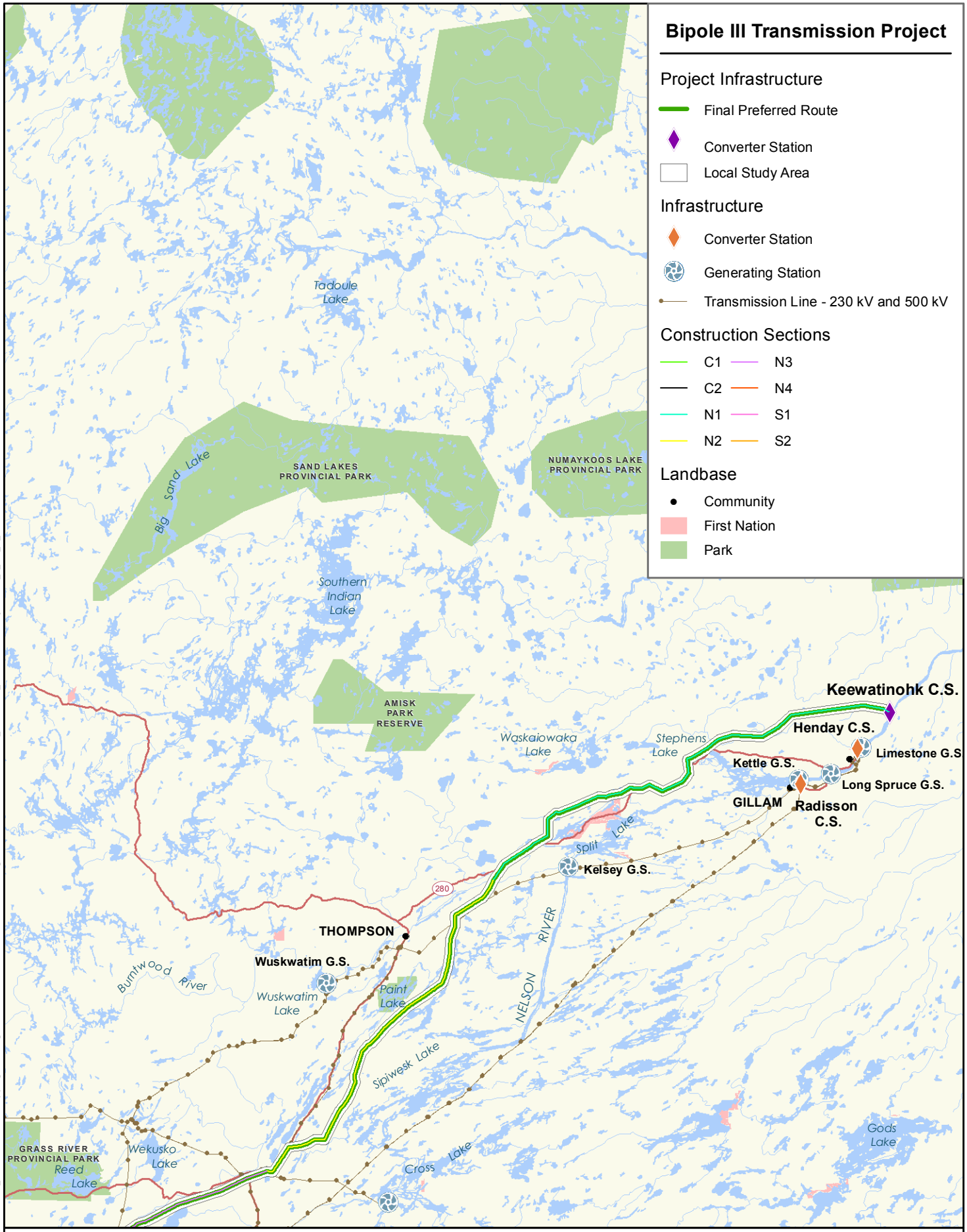
N

1:2,500,000

Bipole III Transmission Project Area

Map 1-1

File Location: I:\CLIENTS\MANITOBA_HYDRO\1404220\Mapping\MXD\Vegetation\SzwalukEnvironmentalConsulting\KevinSzwaluk\20171030\BPIII_TECHREP_TransmissionProjectArea_2_5m_A_20171030.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 30, 2017
0 50 100 Kilometres
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1:2,500,000
Manitoba Hydro
Bipole III Transmission Project Area
Map 1-1
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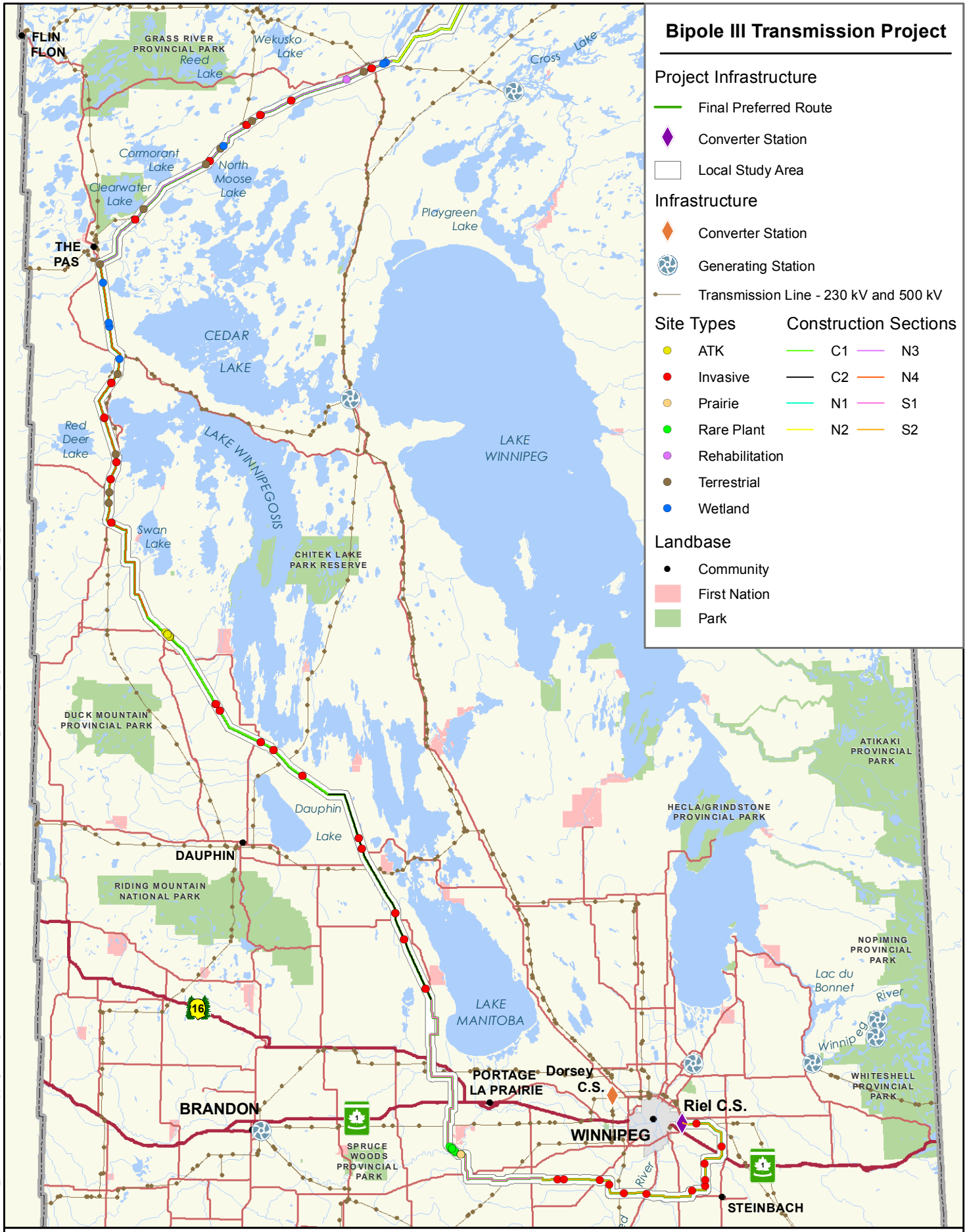

Manitoba Hydro

Coordinate System: UTM Zone 14 NAD 83
Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan, SEC
Date Created: October 30, 2017

0 50 100 Kilometres
0 25 50 Miles

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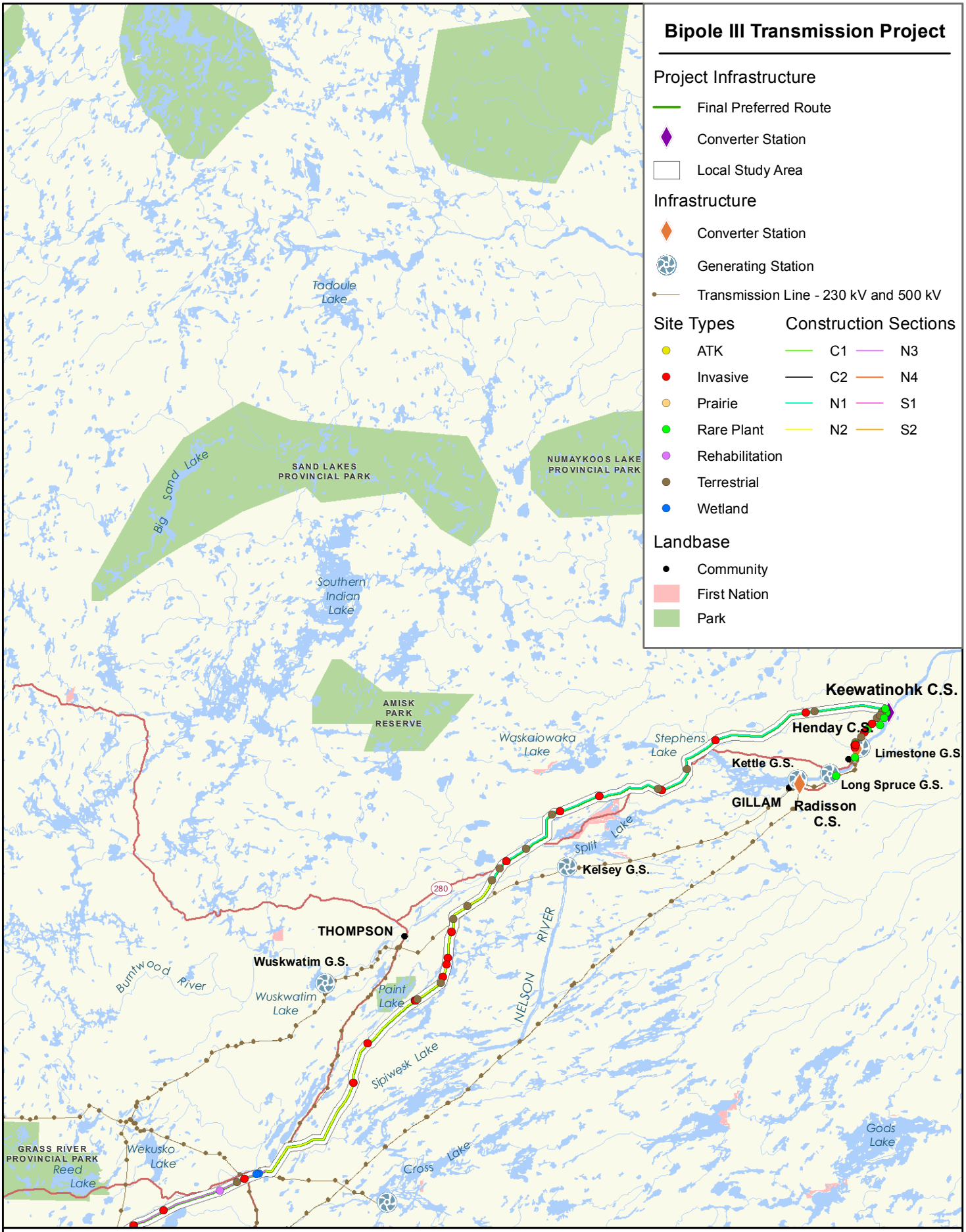
Distribution of Vegetation Sites

Map 4-1

File Location: I:\CLIENTS\MANITOBA_HYDRO\1404220\Mapping\MXD\Vegetation\SzwalukEnvironmentalConsulting\KevinSzwaluk\20171030\BPIII_TECHREP_VegetationDistributionSites_2_5m_A_20171030.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
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
SAND LAKES PROVINCIAL PARK
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Coordinate System: UTM Zone 14 NAD 83
Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan, SEC
Date Created: October 30, 2017
0 50 100 Kilometres
0 25 50 Miles
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1:2,500,000
Distribution of Vegetation Sites
Map 4-1
File Location: I:\CLIENTS\MANITOBA_HYDRO\1404220\Mapping\MXD\Vegetation\SzwalukEnvironmentalConsulting\KevinSzwaluk\20171030\BPIII_TECHREP_VegetationDistributionSites_2_5m_A_20171030.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 Aboriginal 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-Aboriginal people to vegetation resources used by Aboriginal 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 Aboriginal 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 Aboriginal people	In summer construction areas pre-clearing surveys for plants and plant communities identified in the EIS as being important to Aboriginal 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 Aboriginal 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 Aboriginal 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 Aboriginal 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, 2017.

Site	Section/Component	UTM Zone	Easting	Northing
C1-ATK-100	C1	14 U	388879	5771333
C1-ATK-101	C1	14 U	388845	5771292
C1-ATK-200	C1	14 U	389135	5771103
C1-ATK-300	C1	14 U	390193	5770124
C1-ATK-301	C1	14 U	390232	5770173
C1-ATK-400	C1	14 U	390144	5770173
C1-ATK-500	C1	14 U	389944	5770397
C1-ATK-501	C1	14 U	389958	5770416
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-801	C1	14 U	388839	5771429
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-ECO-300	AC Collector Line	15 U	436473	6271853
CL-ECO-301	AC Collector Line	15 U	429707	6264325
CL-ECO-302	AC Collector Line	15 U	429708	6264317
CL-ECO-303	AC Collector Line	15 U	429721	6264365
CL-ECO-304	AC Collector Line	15 U	429092	6258136
CL-ECO-305	AC Collector Line	15 U	418520	6249769
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

Site	Section/Component	UTM Zone	Easting	Northing
CL-INV-301	AC Collector Line	15 U	434730	6270356
CL-SCC-100	AC Collector Line	15 U	446264	6279361
CL-SCC-200	AC Collector Line	15 U	446608	6279124
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-ECO-300	Construction Power Line	15 U	446377	6280992
CP-ECO-301	Construction Power Line	15 U	429862	6264576
CP-INV-100	Construction Power Line	15 U	429927	6264437
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

Site	Section/Component	UTM Zone	Easting	Northing
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
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

Site	Section/Component	UTM Zone	Easting	Northing
N4-WET-300	N4	14 U	359413	5928279
N4-WET-400	N4	14 U	356515	5948514
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
Mitishto River	N3	14 U	479170	6050339
S1-SCC-110	S1	14 U	532591	5512050
S1-SCC-110	S1	14 U	532602	5512038
S1-SCC-200	S1	14 U	534167	5510705
S1-SCC-310	S1	14 U	533463	5511283
S1-SCC-400	S1	14 U	536470	5509788
S1-SCC-500	S1	14 U	531957	5512597
S1-SCC-530	S1	14 U	531819	5512907
S1-SCC-530	S1	14 U	531736	5513000
S1-SCC-530	S1	14 U	531724	5513008
S1-SCC-530	S1	14 U	531481	5513365
S1-SCC-530	S1	14 U	530938	5513685
S1-SCC-600	S1	14 U	532090	5512521
S1-SCC-600	S1	14 U	532093	5512519
S1-SCC-700	S1	14 U	536553	5509796
S1-SCC-700	S1	14 U	536519	5509799
S1-SCC-700	S1	14 U	536466	5509781
S1-SCC-700	S1	14 U	536571	5509796
S1-PRA-900	S1	14 U	536436	5509796

APPENDIX VI. Species of conservation concern recorded at or near surveys, 2017.

Redacted

APPENDIX VII. Flora recorded from native plant and rare plant surveys (2017). Introduced species are ranked SNA.

Family/Species	Common Name	MBCDC Rank
VASCULAR SPECIES **Pteridophytes – Ferns and Allies**		
DRYOPTERACEAE	WOOD FERN FAMILY	
Dryopteris carthusiana	Spinulose Wood Fern	S5
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
OPHIOGLOSSACEAE	ADDER'S TONGUE FAMILY	
Botrychium lunaria	Common Moonwort	S3S4
SELAGINELLACEAE	SPIKEMOSS FAMILY	
Selaginella densa	Prairie Spike-moss	S3
Selaginella selaginoides	Northern Spike-moss	S3S4
Gymnosperms		
CUPRESSACEAE	CYPRESS FAMILY	
Juniperus communis	Common Juniper	S5
Juniperus horizontalis	Creeping Juniper	S5
PINACEAE	PINE FAMILY	
Larix laricina	Tamarack	S5
Picea mariana	Black Spruce	S5

Family/Species	Common Name	MBCDC Rank
Picea spp.	Spruce	
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
Carex bebbii	Bebb's Sedge	S5
Carex brunescens	Brownish Sedge	S5
Carex buxbaumii	Brown 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 interior	Inland Sedge	S4?
Carex lasiocarpa	Woolly Sedge	S5
Carex leptalea	Bristle-stalked Sege	S5
Carex limosa	Mud Sedge	S5
Carex magellanica	Bog Sedge	S5
Carex pellita	Wooly Sedge	S5
Carex sartwellii	Sartwell's Sedge	S4?
Carex scirpoidea	Rush-like Sedge	S4S5

Family/Species	**Common Name**	**MBCDC Rank**
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
Eriophorum scheuchzeri	Scheuchzeri's Cotton Grass	S2?
Eriophorum spp.	Cotton Grass	
Eriophorum viridicarinatum	Thin-leaved Cotton Grass	S4
Rhynchospora alba	White Beakrush	S3
Scirpus microcarpus	Small-fruited Bulrush	S5
Trichophorum alpinum	Alpine Bulrush	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 sp.	A Rush	
Luzula multiflora	Many-flowered Woodrush	S4
Luzula parviflora	Small-flowered Woodrush	S5
JUNCAGINACEAE	ARROW-GRASS FAMILY	
Triglochin maritima	Seaside Arrow-grass	S5
Triglochin palustris	Marsh Arrow-grass	S4S5
LILIACEAE	LILY FAMILY	
Lilium philadelphicum	Wood Lily	S4

Family/Species	**Common Name**	**MBCDC Rank**
Maianthemum canadense	Canada May Flower	S5
Maianthemum stellatum	Star-flowered Solomon's Seal	S5
Maianthemum trifolium	Three-leaved Solomon's Seal	S5
Smilax lasioneura	Carrion Vine	S4S5
Zigadenus elegans	White Camas	S5
ORCHIDACEAE	ORCHID FAMILY	
Cypripedium parviflorum var. *pubescens*	Large Yellow Lady's-slipper	S5?
Cypripedium reginae	Showy Lady's-slipper	S4
Liparis loeselii	Yellow Twayblade	S3S4
Platanthera aquilonis	Tall Northern Green Orchid	S4S5
Platanthera dilatata	Bog Candle	S3S4
Platanthera huronensis	Huron Fringed-orchid	S4S5
Platanthera obtusata	Small Northern Bog Orchid	S5
Platanthera orbiculata	Round-leaved Bog Orchid	S3
Spiranthes romanzoffiana	Hooded Ladies'-tresses	S5
POACEAE	GRASS FAMILY	
Agrostis scabra	Ticklegrass	S5
Agrostis spp.		
Agrostis stolonifera	Creeping Bent	SNA
Andropogon gerardii	Big Bluestem	S5
Avena sativa	Oats	SNA
Bouteloua gracilis	Blue Gramma	S4
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
Calamovilfa longifolia	Prairie Sandreed	S3S5

Family/Species	Common Name	MBCDC Rank
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 repens	Quackgrass	SNA
Elymus spp.	A Wheatgrass	
Elymus trachycaulus	Slender Wheatgrass	S5
Festuca saximontana.	Rocky Mountain Fescue	S4S5
Festuca spp.	Fescue	
Glyceria grandis	Tall Manna Grass	S5
Glyceria striata	Fowl Manna Grass	S5
Hierochloe odorata	Sweet 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
Piptatheropsis pungens	Northern Rice Grass	SS45
Poa palustris	Fowl Bluegrass	S5
Poa pratensis	Kentucky Bluegrass	S5
Poa spp.	Bluegrass	
Puccinellia distans	Slender Salt-meadow Grass	SNA
Schizachne purpurascens	Purple Oat Grass	S5
Schizachyrium scoparium	Little Bluestem	S3S4
Setaria pumila	Yellow Foxtail	SNA
Setaria viridis	Green Foxtail	SNA

Family/Species	Common Name	MBCDC Rank
Triticum sp.	Wheat	SNA
TYPHACEAE	CAT-TAIL FAMILY	
Typha latifolia	Common Cat-tail	S5
	Angiosperms – Dicotyledons	
ACERACEAE	MAPLE FAMILY	
Acer negundo	Manitoba Maple	S5
Acer spicatum	Mountain Maple	S5
ANACARDIACEAE	SUMAC FAMILY	
Toxicodendron rydbergii	Poison Ivy	S5
APIACEAE	CARROT FAMILY	
Cicuta maculata	Spotted Water Hemlock	S4S5
Cryptotaenia canadensis	Honewort	S1
Heracleum maximum	Cow parsnip	S4S5
Osmorrhiza claytonii	Hairy Sweet Cicely	S2?
Pastinaca sativa	Parsnip	SNA
Sanicula marilandica	Seneca Snakeroot	S5
Sium suave	Water Parsnip	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	

Family/Species	Common Name	MBCDC Rank
Asclepias ovalifolia	Dwarf Milkweed	S4S5
Asclepias speciosa	Showy Milkweed	S3S5
ASTERACEAE	ASTER FAMILY	
Achillea alpina	Many-flowered Yarrow	S4S5
Achillea millefolium	Yarrow	S5
Ambrosia artemisiifolia	Common Ragweed	S5
Ambrosia trifida	Giant Ragweed	S4
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 spp.	A Thistle	
Doellingeria umbellata	Flat-topped White Aster	S5
Erigeron canadensis	Canada Horse-weed	S5
Erigeron hyssopifolius	Hyssop-leaved Fleabane	S4
Erigeron philadelphicus	Philadelphia Fleabane	S5
Euthamia graminifolia	Flat-topped Goldenrod	S5
Grindelia squarrosa	Curly-cup Gumweed	S5
Heterotheca villosa	Hairy Golden-aster	S5
Hieracium umbellatum	Northern Hawkweed	S5
Iva axillaris	Poverty-weed	S3
Lactuca biennis	Tall Blue Lettuce	S4
Lactuca serriola	Prickly Lettuce	SNA
Leucanthemum vulgare	Ox-eye Daisy	SNA
Liatris punctata	Dotted Blazing Star	S4
Lygodesmia juncea	Skeletonweed	S3S4
Matricaria discoidea	Pineapple Weed	SNA

Family/Species	**Common Name**	**MBCDC Rank**
Nabalus spp.	Lettuce	
Packera paupercula	Balsam Groundsel	S5
Petasites frigidus var. *palmatus*	Palmate-leaved Coltsfoot	S5
Petasites frigidus var. *sagittatus*	Arrow-leaved Coltsfoot	S5
Petasites frigidus var. *x vitifolius*	Vine-leaved Coltsfoot	SNA
Rudbeckia laciniata	Tall Coneflower	S3S4
Solidago canadensis	Canada Goldenrod	S5
Solidago gigantea	Tall Goldenrod	S5
Solidago hispida	Hairy Goldenrod	S5
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 puniceum	Purple-stemmed Aster	S5
Symphyotrichum sp.	An Aster	
Tanacetum vulgare	Common Tansy	SNA
Taraxacum officinale	Common Dandelion	SNA
Tragopogon dubius	Goat's-beard	SNA
BALSAMINACEAE	TOUCH-ME-NOT FAMILY	
Impatiens capensis	Jewelweed	S5
Impatiens noli-tangere	Western Jewelweed	S1
BETULACEAE	BIRCH FAMILY	
Alnus incana	Speckled Alder	S5
Alnus viridis	Green Alder	S5
Betula papyrifera	Paper Birch	S5

Family/Species	**Common Name**	**MBCDC Rank**
Betula pumila	Dwarf Birch	S5
Corylus americana	American Hazelnut	S4
Corylus cornuta	Beaked Hazelnut	S5
BORAGINACEAE	BORAGE FAMILY	
Cynoglossum virginianum var. *boreale*	Northern Wild Comfrey	S3S4
Lappula squarosa	Bristly Stickseed	SNA
Lithospermum canescens	Hoary Puccoon	S5
Lithospermum incisum	Linear-leaved Puccoon	S3
Mertensia paniculata	Tall Lungwort	S5
Onosmodium molle	Marble-seed	S3S4
BRASSICACEAE	MUSTARD FAMILY	
Arabidopsis lyrata	Lyre-leaved Rock Cress	S1S2
Brassica napus	Turnip	SNA
Brassica rapa	Bird's Rape	SNA
Cardamine spp.	Cress	
Thlaspi arvense	Field Pennycress	SNA
CAMPANULACEAE	BELLFLOWER FAMILY	
Campanula aparinoides	Marsh Bellflower	S5
Campanula rotundifolia	Harebells	S5
CANNABACEAE	HEMP FAMILY	
Humulus lupulus	Common Hop	S4
CAPRIFOLIACEAE	HONEYSUCKLE FAMILY	
Linnaea borealis	Twinflower	S5
Lonicera dioica	Twining Honeysuckle	S5
Lonicera involucrata	Black Twinberry	S3S4

Family/Species	**Common Name**	**MBCDC Rank**
Lonicera oblongifolia	Swamp-fly Honeysuckle	S3S5
Lonicera villosa	Mountain Fly Honeysuckle	S4S5
Symphoricarpos albus	Snowberry	S5
Symphoricarpos occidentalis	Western Snowberry	S5
Viburnum edule	Mooseberry	S5
Viburnum opulus	High-bush Cranberry	S5
Viburnum rafinesquianum	Downy Arrowwood	S4S5
CARYOPHYLLACEAE	PINK FAMILY	
Cerastium arvense	Field Chickweed	S5
Moehringia lateriflora	Blunt-leaved Sandwort	S5
Silene latifolia	White Cockle	SNA
Stellaria longifolia	Long-leaved Stitchwort	S5
Stellaria longipes	Long-stalked Stitchwort	S5
Stellaria spp.	Stitchwort	
CHENOPODIACEAE	GOOSEFOOT FAMILY	
Blitum capitatum	Strawberry Blite	S4S5
Chenopodiastrum simplex	Maple-leaved Goosefoot	S5
Chenopodium album	Lamb's-quarters	SNA
Chenopodium leptophyllum	Narrow-leaved Goosefoot	SNA
Chenopodium spp.	Goosefoot	
CISTACEAE	ROCK ROSE FAMILY	
Hudsonia tomentosa	False Heather	S3
CONVOLVULACEAE	CONVOLVULUS FAMILY	
Calystegia sepium	Hedge Bindweed	S4S5
Convolvulus arvensis	Field Bindweed	SNA

Family/Species	Common Name	MBCDC Rank
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
Arctous alpina	Alpine Bearberry	S3S4
Chamaedaphne calyculata	Leatherleaf	S5
Kalmia polifolia	Pale Laurel	S5
Rhododendron groenlandicum	Labrador Tea	S5
Rhododendron tomentosum	Trapper's Tea	S3S5
Vaccinium angustifolium	Low Sweet Blueberry	S4
Vaccinium caespitosum	Dwarf Bilberry	S3
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 esula	Leafy Spurge	SNA
Euphorbia serpyllifolia	Thyme-leaved Spurge	S3

Family/Species	Common Name	MBCDC Rank
FABACEAE	PEA FAMILY	
Astragalus americanus	American Milkvetch	S2S3
Dalea villosa	Hairy Prairie-clover	S2?
Desmodium canadense	Beggar's-lice	S2
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
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	
Gentiana spp.	A Gentian	
GERANIACEAE	GERANIUM FAMILY	

Family/Species	**Common Name**	**MBCDC Rank**
Geranium bicknellii	Bicknell's Geranium	S5
GROSSULARIACEAE	CURRANT FAMILY	
Ribes americanum	Wild Black Currant	S5
Ribes hudsonianum	Northern Black 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	
Dracocephalum parviflorum	American Dragon-head	S5
Lycopus americanus	Water Hore-hound	S5
Lycopus uniflorus	Northern Bugleweed	S4S5
Mentha arvensis	Common Mint	S5
Monarda fistulosa	Wild Bergamot	S5
Physostegia virginiana	False Dragonhead	S4
Prunella vulgaris	Heal-all	S4
Scutellaria galericulata	Marsh Skullcap	S5
Stachys palustris	Marsh Hedge-nettle	S5
LENTIBULARIACEAE	BLADDERWORT FAMILY	
Pinguicula villosa	Small Butterwort	S3S4
Utricularia intermedia	Flat-leaved Bladderwort	S4S5
MENYANTHACEAE	BOG BEAN FAMILY	
Menyanthes trifoliata	Bog Bean	S5

Family/Species	**Common Name**	**MBCDC Rank**
NYCTAGINACEAE	FOUR O'CLOCK FAMILY	
Mirabilis sp.	Umbrellawort	
OLEACEAE	OLIVE FAMILY	
Fraxinus pennsylvanica	Green Ash	S4S5
ONAGRACEAE	EVENING PRIMROSE FAMILY	
Chamerion angustifolium	Fireweed	S5
Circaea alpina	Small Enchanter's Nightshade	S4S5
Circaea lutetiana	Large Enchanter's Nightshade	S2
Epilobium ciliatum ssp. *ciliatum*	Hairy Willowherb	S5
Epilobium ciliatum ssp. *glandulosum*	Northern Willowherb	S5
Epilobium palustre	Marsh Willowherb	S5
PAPAVERACEAE	POPPY FAMILY	
Sanguinaria canadensis	Blood-root	S2
PLANTAGINACEAE	PLANTAIN FAMILY	
Plantago major	Common Plantain	SNA
POLEMONIACEAE	PHLOX FAMILY	
Collomia linearis	Narrow-leaved Collomia	S5
POLYGALACEAE	MILKWORT FAMILY	
Polygala senega	Seneca Root	S4
POLYGONACEAE	SMARTWEED FAMILY	
Fallopia convolvulus	Black Bindweed	SNA
Persicaria lapathifolia	Pale Smartweed	S5
Polygonum achoreum	Leathery Knotweed	S4

Family/Species	**Common Name**	**MBCDC Rank**
Polygonum amphibium	Water Smartweed	S5
Polygonum aviculare ssp. *depressum*	Oval-leaf Knotweed	SNA
Polygonum spp.	Smartweed	
Rumex crispus	Curly Dock	SNA
Rumex spp.	Dock	
PRIMULACEAE	PRIMROSE FAMILY	
Androsace septentrionalis	Pygmyflower	S5
Lysimachia ciliata	Fringed Loosestrife	S5
Lysimachia thyrsiflora	Tufted Loosestrife	S5
Trientalis borealis	Northern Starflower	S5
PYROLACEAE	WINTERGREEN FAMILY	
Orthilia secunda	One-sided Wintergreen	S5
Pyrola asarifolia	Pink Wintergreen	S5
Pyrola sp.	Wintergreen	
RANUNCULACEAE	CROWFOOT FAMILY	
Anemone canadensis	Canada Anemone	S5
Anemone cylindrica	Thimbleweed	S5
Anemone multifida	Cut-leaved Anemone	S5
Anemone patens	Prairie Crocus	S4
Anemone sp.	An Anemone	
Aquilegia brevistyla	Small-flowered Columbine	S4
Caltha natans	Floating Marsh Marigold	S2S4
Caltha palustris	Marsh Marigold	S5
Coptidium lapponicum	Lapland Buttercup	S4S5
Ranunculus acris	Common Buttercup	SNA
Ranunculus scleratus	Cursed Crowfoot	S5
Ranunculus spp.	Buttercup	

Family/Species	**Common Name**	**MBCDC Rank**
Thalictrum dasycarpum	Hairy Meadowrue	S5
Thalictrum venulosum	Veiny Meadowrue	S5
RHAMNACEAE	BUCKTHORN FAMILY	
Rhamnus alnifolia	Alder-leaved Buckthorn	S5
ROSACEAE	ROSE FAMILY	
Agrimonia gryposepala	Common Agrimony	S1S2
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
Geum macrophyllum	Large-leaved Avens	S4S5
Potentilla anserina ssp. anserina	Silverweed	S5
Potentilla norvegica	Rough Cinquefoil	S5
Prunus pensylvanica	Pin Cherry	S5
Prunus pumila	Sand Cherry	S4S5
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

Family/Species	**Common Name**	**MBCDC Rank**
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 glauca	Smooth Willow	S4
Salix myrtillifolia	Myrtle-leaved Willow	S5
Salix pedicellaris	Bog Willow	S5
Salix planifolia	Flat-leaved Willow	S5
Salix pseudomonticola	False Mountain Willow	S4S5
Salix serissima	Autumn 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	
Heuchera richardsonii	Alumroot	S5
Mitella nuda	Mitrewort	S5
Parnassia palustris	Grass of Parnassus	S5

Family/Species	Common Name	MBCDC Rank
SCROPHULARIACEAE	FIGWORT FAMILY	
Euphrasia frigida	Northern Eyebright	S4S5
Melampyrum lineare	Cow-wheat	S3S5
Pedicularis labradorica	Labrador Lousewort	S3S4
Pedicularis macrodonta	Muskeg Lousewort	S2S3
SOLANACEAE	POTATO FAMILY	
Physalis virginiana	Prairie Ground-cherry	S4
ULMACEAE	ELM FAMILY	
Ulmus americana	American Elm	S4S5
URTICACEAE	NETTLE FAMILY	
Urtica dioica	Stinging Nettle	S5
VERBENACEAE	VERVAIN FAMILY	
Phryma leptostachya	Lopseed	S3
VIOLACEAE	VIOLET FAMILY	
Viola pedatifida	Purple Prairie Violet	S4
Viola spp.	Violet	
VITACEAE	GRAPE FAMILY	
Vitis riparia	Riverbank Grape	S3S4
NON-VASCULAR SPECIES **Bryophytes**		
Dicranum spp.	Dicranum Moss	
Hylocomium splendens	Splendid Feather Moss	

Family/Species	Common Name	MBCDC Rank
Marchantia polymorpha	Green-tongue Liverwort	
Pleurozium schreberi	Schreber's Moss	
Polytrichum spp.	Polytrichum Moss	
Sphagnum spp.	Peat Moss	
Lichens		
Cladina mitis	Green Reindeer Lichen	
Cladina rangiferina	Grey Reindeer Lichen	
Cladina stellaris	Northern Reindeer Lichen	
Cladonia sp.	Cladonia	

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