BIPOLE III TERRESTRIAL ECOSYSTEMS AND VEGETATION PRE-CONSTRUCTION AND ENVIRONMENTAL MONITORING

ANNUAL TECHNICAL REPORT – YEAR III

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SUMMARY

Vegetation and terrestrial ecosystems were assessed during Year III pre-construction surveys and environmental monitoring within the Manitoba Hydro Bipole III Transmission Project area.

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 also presented.

A single grassland/prairie (PRA) site was surveyed for continued monitoring in 2016. No new sites were located as clearing is complete at this time. The total species cover in 2016 of this prairie site has decreased from 2015 values (previously 135%) to 53%, with 30 species observed within the survey plot. The effect predictions for prairie vegetation were determined to be accurate.

Twenty-six sites were visited to sample terrestrial (TER) vegetation for a total of 28 surveys in Sections N1, N2, N3, N4 and northern AC collector lines and construction power line. Paired sampling (on and off the RoW) only occurred at new sites (two sites) established in 2016. Total species cover, richness and evenness were significantly different between surveys on and off the RoW. Only diversity showed no significant difference between surveys ($p=0.764$). The effect predictions for terrestrial vegetation were determined to be accurate.

Seven environmentally sensitive sites (patterned fens) were visited in Sections N3 and N4 to sample wetland vegetation (WET). There continues to be a trend of greater average species cover and richness off the RoW. The average total percent species cover in paired surveys on the RoW is 43.3% and surveys adjacent to the RoW is 104.7%, while average species richness is 20.4 on the RoW and 28.8 off the RoW. The diversity index and species evenness have similar ranges in value between paired surveys on and off RoW. When comparing species cover between years for surveys on the RoW, there was a trend of decreased total species cover value from initial clearing to present.

Ten sites were visited to sample vegetation in the Cowan Blueberry Resource Area (ATK). This season, blueberry plants were recorded at five sites on the RoW. Two species of blueberry plants were observed during surveys and include velvetleaf blueberry (*Vaccinium myrtilloides*) and low sweet blueberry (*Vaccinium angustifolium*). Many plants supported ripe berries, ready to consume. Cover for low sweet blueberry ranged from 1.0 to 43.0% in sites surveyed, while cover of velvetleaf blueberry ranged from 0.2 to 8.6%. Total blueberry cover for sites supporting blueberries (2016) averaged 12.7%. Total

species cover for vegetation surveys on and off the RoW continued to show significantly lower values on the RoW ($p<0.002$). 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 201 plant species were recorded on the RoW during sampling of invasive and non-native vegetation surveys. Twenty-four invasive and non-native species were recorded across all quantitative vegetation surveys. Nine species are considered invasive and 15 are non-native. All species measures (vegetation surveys) were significantly different between samples on and off the RoW, except for species diversity. Results show significantly lower values for total vegetation percent cover ($p<0.001$), richness ($p=0.001$), as well as for evenness of species distribution ($p<0.006$) for surveys on the RoW (2016), when compared to those off the RoW. A total of 40 invasive and non-native species were recorded in 2016 as qualitative observations, where species presence was measured, rather than mean percent cover on the RoW. The effect predictions for invasive and non-native vegetation were determined to be accurate.

Forty-three species of conservation concern (ranking S1 through S3S5) were recorded during surveys and sampling in 2016. Sixteen species are ranked very rare to rare, (including S1 through S2S4), with the remaining species ranked uncommon (including S3 though S3S5). One species observed (silky prairie-clover - *Dalea villosa,* S2?) is listed as threatened under The Endangered Species and Ecosystems Act – Manitoba, the Species at Risk Act, and as special concern under the Committee on the Status of Endangered Wildlife in Canada. The effect prediction for species of conservation concern was determined to be accurate.

TABLE OF CONTENTS

Page No.

1.0 INTRODUCTION 1
2.0 BACKGROUND 3
2.1 NATIVE GRASSLAND/PRAIRIE 3
2.2 TERRESTRIAL VEGETATION (FORESTED AREAS) 4
2.3 WETLANDS 5
2.4 PLANTS/COMMUNITIES IMPORTANT TO ABORIGINAL PEOPLE 6
2.5 INVASIVE AND NON-NATIVE SPECIES 8
2.6 SPECIES OF CONSERVATION CONCERN 9
2.7 REHABILITATION MONITORING 10
3.0 METHODS 12
3.1 PROJECT REVIEW AND SAMPLE SITE SELECTION 12
3.2 PRE-CONSTRUCTION SURVEYS 13
3.2.1 Native Vegetation Surveys 13
3.2.2 Rare Plant Surveys 14
3.3 ENVIRONMENTAL MONITORING 15
3.3.1 Vegetation Monitoring 15
3.3.2 Rare Plant Monitoring 16
3.4 REHABILITATION SURVEYS 16
3.5 DATA PREPARATION AND STATISTICAL ANALYSES 17
4.0 RESULTS 19
4.1 NATIVE GRASSLAND/PRAIRIE 19
4.1.1 Data Analysis of Grassland/Prairie Areas 20
4.1.2 Accuracy of Effect Predictions and Effectiveness of Mitigation 20
4.2 TERRESTRIAL VEGETATION (FORESTED AREAS) 22
4.2.1 Data Analysis of Terrestrial Vegetation 22
4.2.1.1 Cluster Analysis and Community Typing 25
4.2.2 Accuracy of Effect Predictions and Effectiveness of Mitigation 25
4.3 ENVIRONMENTALLY SENSITIVE WETLANDS 29
4.3.1 Data Analysis of Environmentally Sensitive Wetlands 29
4.3.1.1 Cluster Analysis and Community Typing 30
4.3.2 Accuracy of Effect Predictions and Effectiveness of Mitigation 31
4.4 PLANTS/COMMUNITIES IMPORTANT TO ABORIGINAL PEOPLE 33
4.4.1 Data Analysis of the Cowan Blueberry Resource Area 36
4.4.1.1 Cluster Analysis and Community Typing 37
4.4.2 Accuracy of Effect Predictions and Effectiveness of Mitigation 37
4.5 INVASIVE AND NON-NATIVE SPECIES 39

4.5.1 Data Analysis of Invasive and Non-Native Vegetation....40
4.5.2 Accuracy of Effect Predictions and Effectiveness of Mitigation....48
4.6 SPECIES OF CONSERVATION CONCERN....53
4.6.1 Monitoring for Species of Conservation Concern....53
4.6.2 Accuracy of Effect Predictions and Effectiveness of Mitigation....60
4.7 REHABILITATION MONITORING....63
4.8 HYPOTHESIS TESTING....65
5.0 RECOMMENDATIONS....67

APPENDIX I. Definitions of selected technical terms.
APPENDIX II. Report maps.
APPENDIX III. Potential environmental effects on terrestrial ecosystems and vegetation as a result of the project.
APPENDIX IV. Project commitments for environmental monitoring of terrestrial ecosystems and vegetation.
APPENDIX V. Location of vegetation sample plots and sites visited.
APPENDIX VI. Species of conservation concern recorded at or near surveys.
APPENDIX VII. Flora recorded from native plant and rare plant surveys, 2016. Introduced species are ranked SNA, invasive species are indicated (*).

LIST OF TABLES

Table 2-1. Monitoring activities for native grassland/prairie areas.
Table 2-2. Monitoring activities for terrestrial vegetation.
Table 2-3. Monitoring activities for wetlands.
Table 2-4. Monitoring activities for plants/communities important to Aboriginal people.
Table 2-5. Monitoring activities for invasive and non-native species.
Table 2-6. Monitoring activities for species of conservation concern.
Table 2-7. Monitoring activities for rehabilitation sites.
Table 4-1a. Grassland/prairie descriptions: total species cover, richness, diversity and evenness.
Table 4-1b. Mitigation measures assessed at a site monitored for native grassland/prairie vegetation on the RoW.
Table 4-2a. Terrestrial vegetation descriptions: cover and richness.
Table 4-2b. Terrestrial vegetation descriptions: diversity and evenness.
Table 4-2c. Community types for terrestrial vegetation surveys on the RoW, 2016.
Table 4-2d. Mitigation measures assessed at sites monitored for terrestrial vegetation on the RoW.
Table 4-3a. Environmentally sensitive wetland descriptions: cover and richness.
Table 4-3b. Environmentally sensitive wetland descriptions: diversity and evenness.

Table 4-3c. Community types for environmentally sensitive wetland surveys on the RoW, 2016.
Table 4-3d. Mitigation measures assessed at sites monitored for environmentally sensitive wetlands on the RoW.
Table 4-4a. Resource Area species cover for blueberries.
Table 4-4b. Blueberry resource area vegetation descriptions: cover and richness.
Table 4-4c. Blueberry resource area vegetation descriptions: diversity and evenness.
Table 4-4d. Community types for blueberry resource area surveys on the RoW, in 2016.
Table 4-4e. Mitigation measures assessed at sites monitored for ATK vegetation on the RoW.
Table 4-5a. Invasive and non-native vegetation descriptions: cover and richness.
Table 4-5b. Invasive and non-native vegetation descriptions: diversity and evenness.
Table 4-5c. Part A: Sites with occurrences of invasive species in plots (mean % cover), 2016.
Table 4-5c. Part B: Sites with occurrences of non-native species in plots (mean % cover), 2016.
Table 4-5d. Invasive and non-native species occurrences, as observations in rare plant surveys, or as incidental observations.
Table 4-5e. Surveys with occurrences of invasive and/ or non-native species (presence values), sampled in 2016.
Table 4-5f. Mitigation measures assessed at sites monitored for invasive and non-native species on the RoW.
Table 4-6a. Species of conservation concern recorded during Bipole III monitoring, 2016.
Table 4-6b. Mitigation measures assessed at sites monitored for species of conservation concern on the RoW.

LIST OF MAPS

MAP 1-1. Bipole III Transmission Project area.
MAP 4-1. Distribution of vegetation sites.

LIST OF PHOTOGRAPHS

Photograph 4-1a. Mixed-grass prairie post-clearing.
Photograph 4-1b. Rutting and ground disturbance along the RoW.
Photograph 4-1c. Mixed-grass prairie along the RoW.
Photograph 4-2a. Dig-out areas observed along the RoW.
Photograph 4-2b. Scraping of vegetation.
Photograph 4-2c. Spreading of mulched material and debris.
Photograph 4-3a. Patterned fen wetland with low disturbance.

Photograph 4-3b. Patterned fen wetland with increased water level.
Photograph 4-4a. Blueberry sample plot in the Cowan Resource Area.
Photograph 4-4b. Blueberry plants observed during sampling.
Photograph 4-4c. Aerial view of blueberry sites in the Resource Area.
Photograph 4-4d. Aerial view of the Cowan Resource Area.
Photograph 4-5a. Incomplete clearing along the RoW.
Photograph 4-5b. White sweet clover observed along the RoW in Section C1.
Photograph 4-5c. Logs used at water crossing to reduce surface erosion.
Photograph 4-5d. Trees felled into the forest at Halfway River.
Photograph 4-6a. Relief encountered along the RoW in Section S1.
Photograph 4-6b. Trembling aspen regeneration along the RoW in Section S1.
Photograph 4-6c. Round-leaved bog orchid observed in Section N3.
Photograph 4-6d. White beakrush observed along the AC collector lines.
Photograph 4-6e. Muskeg lousewort observed along the ground electrode line.
Photograph 4-6f. Large enchanter's-nightshade (pale green plants at center).
Photograph 4-7a. Erosion control at Mitishto River.
Photograph 4-7b. Erosion control at Hunting River.

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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 for the Project began in 2014 and will be completed during the winter of 2016-2017. In 2016, vegetation and terrestrial ecosystems were assessed for Year III 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 2017. 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 for prairie sites;
- Environmental monitoring for terrestrial and wetland sites;
- Pre-construction surveys 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 2016 to collect environmental monitoring information in Year III. 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 2014 and 2015 were monitored again in 2016 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 2014, 2015 and 2016 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, vegetation information collected during 2010 and 2012, 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 compiled in the spring of 2014, 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.

In 2016, pre-construction surveys involved roadside assessments for invasive and non-native species in Section S2. This Section, which is primarily agricultural land, was without tower construction in several surveyed locations.

3.2.1 Native Vegetation Surveys

Sites previously selected for native vegetation surveys had plots established for future vegetation monitoring. 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 2016 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 2016, environmental monitoring included sites for prairie (PRA), terrestrial (TER), wetlands (WET), botanical resource areas (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 (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. 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 and 2016, 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 = $\log \text{base}_n$

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

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 = $\log \text{base}_n$

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), plants/communities important to aboriginal people (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 (recently cleared) are also presented.

4.1 Native Grassland/Prairie

A single grassland/prairie (PRA) site was surveyed for continued monitoring in 2016 (Map 4-1, Appendix II) (Field Activity ID BPIII_CON_FA239). No new sites were located as clearing is complete at this time. The PRA site is located in the southern portion of the Bipole III RoW, in Section S1, and visited on July 27. A search for incidental species of conservation concern was also undertaken.

This site is a dry sandy prairie, with trembling aspen (*Populus tremuloides*) and bur oak (*Quercus macrocarpa*) along the RoW, and currently present as a regenerating layer within the RoW (Photograph 4-1a). Four rare and uncommon species were found in or incidental to site plots (Schweinitz's flatsedge - *Cyperus schweinitzii,* S2; silky prairie-clover - *Dalea villosa,* S2?; linear-leaved puccoon – *Lithospermum incisum,* S3; skeletonweed - *Lygodesmia juncea*, S3S4) and will be discussed in Section 4.6. Prairie spike-moss (*Selaginella densa,* S3), was not observed again during field sampling in 2016.

Photograph 4.1a. Mixed-grass prairie post-clearing.

4.1.1 Data Analysis of Grassland/Prairie Areas

One native vegetation survey was conducted in a grassland/prairie area. 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.

Site	Total Cover (%)		Richness		Diversity		Evenness	
	2015	2016	2015	2016	2015	2016	2015	2016
S1-PRA-900	134.7	53.0	38	30	2.9	2.5	0.8	0.7

The total species cover in 2016 of this prairie site has decreased from 2015 values to 53%, with 30 species observed within the survey plot. Species diversity and evenness were similar to last year's values at 2.5 and 0.7, respectively. This survey occurred on the RoW, where intermittent regeneration of aspen and oak were apparent. 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.

4.1.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the Project areas cleared during 2015/2016 (Sections 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 Year I and II Annual Technical Reports (2015 and 2016) were assessed at the PRA site visited along the RoW. Table 4-1b identifies the mitigation measures assessed.

From fieldwork conducted, it was determined that the recommended mitigation was implemented and effective for native grassland/prairie vegetation which minimized the disturbance from clearing activities. In the absence of mitigation, site disturbance likely would have increased. Observations recorded in the field are provided below.

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

Mitigation Measure	S1-PRA-900
Carry out construction activities on frozen or dry ground to minimize surface damage, rutting and erosion.	Y
Use existing access roads and trails to the extent possible.	Y
Remove trees by low-disturbance methods.	Y
Confine vehicle traffic to established trails to the extent possible.	Y
Stabilize sites immediately after construction and re-vegetate disturbed areas in accordance with the site Rehabilitation Plan.	-

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

Although mitigation was implemented at the prairie monitoring site (S1-PRA-900), vegetation ground cover showed disturbance from clearing activities. Some rutting and ground disturbance was also observed in the vicinity of the monitoring site (Photograph 4-1b). The site is located along a sand ridge, where vegetation may be very sensitive to ongoing disturbance (Photograph 4-1c). ATV tracks elsewhere on the property (both on RoW and off site) have produced bare ground (i.e., sand) with very little vegetation in vehicle tracks. Clearing equipment has also likely scraped away some vegetation. Six invasive and non-native species were observed in S1-PRA-900 in 2016, and a seventh was observed in the vicinity of the plot, further discussed in Section 4.5.1.

Photograph 4.1b. Rutting and ground disturbance along the RoW.

Photograph 4.1c. Mixed-grass prairie along the RoW.

4.2 Terrestrial Vegetation (Forested Areas)

Twenty-four sites were revisited to sample terrestrial (TER) vegetation from July 6 to August 6 (Field Activity ID BPIII_CON_FA236, 237 and 238) (Map 4-1, Appendix II). Two new sites were added in 2016, consisting of two paired sampling surveys both on and adjacent to (off) the RoW, for a total of four new surveys. No other re-visiting of off-RoW sites is generally required, resulting in a total of 28 surveys completed for terrestrial vegetation in 2016.

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 sites) and construction power line (CP sites), for twenty-six paired sites.

Forest tent caterpillar activity was observed in the vicinity of plot N2-TER-200. 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-eight surveys were conducted for terrestrial vegetation. Results of a paired-sample Wilcoxon test for terrestrial vegetation surveys on (2016) 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 ($p<0.003$).

However, there were no significant differences detected for diversity indices between surveys on (2016) and off the RoW (p=0.764), while the evenness of species distribution at these sites is significantly different (p<0.001). Vegetation descriptions for paired on and off RoW surveys are shown below for total 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 all species diversity measures on the RoW between 2015 and 2016, only species richness was significantly higher in 2016 (p<0.008). No significant differences were detected between years for species cover (p>0.076), diversity (p> 0.015) or evenness (p>0.595).

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

Site	Total Species Cover (%)[1]				Species Richness[2]			
	RoW			off RoW	RoW			off RoW
	2014	2015	2016	all years	2014	2015	2016	all years
N4-TER-10	-	12.6	38.8	126.0	-	18	30	34
N4-TER-20	-	8.8	13.2	138.6	-	12	17	27
N4-TER-30	-	11.6	16.2	96.8	-	12	17	21
N4-TER-40	-	-	48.6	68.0	-	-	28	31
N4-TER-50	-	-	15.8	158.4	-	-	21	28
N3-TER-10	15.2	25.0	31.6	127.2	27	27	35	38
N3-TER-20	24.6	28.4	16.0	115.0	17	22	13	34
N3-TER-30	12.4	37.6	46.4	145.0	16	25	27	31
N3-TER-40	23.4	59.0	75.2	151.8	15	20	24	27
N3-TER-50	2.0	13.6	37.6	111.0	4	14	16	18
N2-TER-10	6.6	14.2	30.2	140.6	10	13	19	22
N2-TER-20	9.2	35.0	56.0	105.0	14	17	27	28
N2-TER-30	19.0	50.6	96.4	114.8	19	20	27	21
N2-TER-40	1.4	3.8	16.6	129.6	5	5	12	18
N2-TER-50	0.4	0.0	1.2	124.2	1	-	4	15
N1-TER-10	-	0.8	6.2	118.0	-	3	13	28
N1-TER-20	-	0.0	1.8	154.2	-	-	6	23
N1-TER-30	-	1.2	5.4	157.6	-	4	13	32
N1-TER-40	-	32.0	10.8	99.4	-	15	13	31
N1-TER-50	-	2.8	5.0	120.0	-	10	12	37
N1-TER-60	-	8.4	9.8	157.8	-	15	14	44
CL-TER-10	40.0	71.6	4.2	120.4	15	15	6	16
CL-TER-20	46.8	2.4	2.4	129.6	7	2	4	14
CL-TER-30	43.0	38.8	27.6	127.0	13	11	12	16
CP-TER-10	73.4	6.4	6.6	120.2	11	5	8	18
CP-TER-20	31.6	6.2	4.4	127.0	10	4	5	16

Note: [1] Total species cover (%) on (2016) and off RoW is significantly different, p<0.000.
[2] Species richness on (2016) and off RoW is significantly different, p= 0.003.

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

Site	Diversity[1]				Evenness[2]			
	RoW			off RoW	RoW			off RoW
	2014	2015	2016	all years	2014	2015	2016	all years
N4-TER-10	-	2.5	2.5	2.3	-	0.9	0.7	0.7
N4-TER-20	-	2.1	2.6	2.1	-	0.8	0.9	0.6
N4-TER-30	-	2.1	2.4	1.6	-	0.8	0.8	0.5
N4-TER-40	-	-	2.7	2.4	-	-	0.8	0.7
N4-TER-50	-	-	2.7	2.0	-	-	0.9	0.6
N3-TER-10	2.7	2.9	3.0	2.9	0.8	0.86	0.9	0.8
N3-TER-20	1.8	2.1	1.8	2.7	0.6	0.68	0.7	0.8
N3-TER-30	2.3	2.4	2.7	2.3	0.8	0.74	0.8	0.7
N3-TER-40	2.0	2.1	2.3	2.1	0.7	0.7	0.7	0.6
N3-TER-50	0.9	1.8	1.7	2.1	0.7	0.67	0.6	0.7
N2-TER-10	1.8	1.9	2.0	1.9	0.8	0.74	0.7	0.6
N2-TER-20	2.4	1.9	2.1	2.1	0.9	0.67	0.6	0.6
N2-TER-30	2.5	2.4	2.6	2.0	0.9	0.81	0.8	0.7
N2-TER-40	1.5	1.3	1.4	1.4	0.9	0.79	0.5	0.5
N2-TER-50	0	-	1.2	1.2	-	-	0.9	0.4
N1-TER-10	-	1.0	2.1	2.1	-	0.95	0.8	0.6
N1-TER-20	-	-	1.6	1.9	-	-	0.9	0.6
N1-TER-30	-	1.3	2.4	1.9	-	0.96	0.9	0.5
N1-TER-40	-	2.1	2.1	2.7	-	0.76	0.8	0.8
N1-TER-50	-	2.1	2.2	2.7	-	0.93	0.9	0.7
N1-TER-60	-	2.4	2.2	2.7	-	0.88	0.8	0.7
CL-TER-10	1.9	2.0	1.5	2.2	0.7	0.74	0.8	0.8
CL-TER-20	1.4	0.5	1.1	1.9	0.7	0.65	0.8	0.7
CL-TER-30	1.9	1.9	2.1	2.1	0.8	0.79	0.8	0.8
CP-TER-10	1.4	1.4	1.7	2.0	0.6	0.86	0.8	0.7
CP-TER-20	1.7	1.0	1.3	2.2	0.7	0.73	0.8	0.8

Note: [1] No significant differences in diversity index on (2016) and off RoW, p=0.764.
[2] Species evenness on (2016) and off RoW is significantly different, p<0.000.

4.2.1.1 Cluster Analysis and Community Typing

A total of 126 plant species were observed in plots within sampling of the terrestrial vegetation surveys. The tree stratum is absent in surveys sampled on the RoW, while regenerating woody species appeared in the tall shrub stratum in some sites, and as seedlings in the low shrub and herb layer.

Hierarchical cluster analyses were performed for surveys on the RoW. Based on vegetation composition present in twenty-six sites on the RoW, cluster analysis resulted in three community type groupings, Table 4-2c, below. Community types were broadly divided into regenerating hardwood and softwoods. The first community type is relatively species rich, with regenerating hardwood seedlings, and sparse hardwood saplings in the tall shrub layer. The mean cover in the herb and low shrub layer is high, and is dominated by prickly rose, fireweed, and bunchberry.

The next two community types are regenerating black spruce: one with very sparse understory, characterized by three-leaved Solomon's-seal and horsetails; the other with an open understory characterized by Labrador tea, cloudberry and mosses.

Table 4-2c. Community types for terrestrial vegetation surveys on the RoW, 2016.

2016	Surveys	Species
Balsam Poplar seedlings - Trembling Aspen seedlings - Prickly Rose	8	96
Three-leaved Solomon's-seal - Horsetail/ (Reindeer Lichens)	15	62
Labrador Tea - Cloudberry/ Mosses	3	26

4.2.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the Project areas cleared during 2015/2016 and where new sites were visited (Sections N4), 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 Year I and II Annual Technical Reports (2015 and 2016) were assessed at each site visited along the RoW. Table 4-2d identifies the mitigation measures assessed at each site.

From fieldwork conducted, it was determined that the recommended mitigation was implemented and effective for terrestrial vegetation which minimized the disturbance from clearing activities. In the absence of mitigation, site disturbance likely would have increased. Observations recorded in the field are provided below.

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

Mitigation Measure	N4-TER-400	N4-TER-500
Carry out construction activities during winter months to minimize the effect on understory species.	Y	Y
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.	Y	Y
Trees will be felled into the RoW and other project component sites so as not to damage existing vegetation along the RoW.	Y	Y
Grubbing will be minimized within the RoW to reduce root damage except at foundation sites.	Y	Y

Note: Y/N (yes/no) denotes whether mitigation measure was implemented.

In Section N4 (the newly cleared sites), vegetation ground cover on the RoW was disturbed from winter clearing activities and mostly removed. Sites sampled appeared to be shear bladed with abundant fine woody material covering the ground surface. Herbs and low shrubs were emerging in the RoW in both sample plots (N4-TER-400 and N4-TER-500). Tree removal was confined to the limits of the RoW and trees were felled into the RoW, so as not to damage existing forest vegetation. Tree rooting material did not appear to be exposed on the RoW.

In Section N1, the remaining RoW was cleared (winter 2015/2016) with no issuses recorded during aerial inspections; no detailed sampling was initiated in this cleared portion as a result of N1 sites established in 2015.

During aerial inspections of the entire RoW (during sampling), vehicle traffic appeared to be confined to the centreline equipment path, in all sections (N1 to C2). The equipment path showed areas of obvious travel but any rutting observed was minor and occasional along the centre line trail. Vegetation cover was less abundant and often discontinuous in this area. Off the equipment path, no major rutting problems were observed on the RoW and low disturbance to the soils occurred. An exception was in Section N1, where dig-out areas were occasionally observed near the tower footing locations (Photograph 4-2a). These dig-outs were generally <5m^2 and about 1m in depth, and were likely a result of tower construction. Vegetation regeneration (young shrub and herb) was observed throughout most of the RoW, in all sections.

Photograph 4-2a. Dig-out areas observed along the RoW.

The RoW for the collector lines and construction power line (and occasionally along Section N1) contained newly scraped areas, as a result of tower construction and access. These areas were observed at the tower locations and occasionally along the equipment path (Photograph 4-2b). Vegetation regeneration was reduced in these newly scraped areas. Minor rutting was observed occasionally along the RoW for the collector lines and construction power line.

In 2016, some terrestrial plots were disrupted from RoW tower construction activities and forest slash dispersal. As an example, Plot N1-TER-500 had additional clearing for tower construction and slash material was distributed over a portion of the plot. Foundation drilling also deposited surficial materials along the end of the plot transect. Plot N2-TER-500 was disrupted from the spreading of newly mulched woody debris (Photograph 4-2c).

Photograph 4-2b. Scraping of vegetation.

Photograph 4-2c. Spreading of mulched material and debris.

4.3 Environmentally Sensitive Wetlands

Seven environmentally sensitive sites were visited on July 16 to 18 to sample wetland (WET) vegetation in Sections N3 and N4, north and south of The Pas, respectively (Field Activity ID BPIII_CON_FA237) (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 in 2016, four are paired sites, while three remain unpaired (RoW only) due to minor disturbance to ground vegetation on the RoW and unsafe sampling conditions (i.e., sampling on floating vegetation). In total, seven surveys were completed for monitoring environmentally sensitive patterned fen wetlands on the RoW.

Forest tent caterpillar activity was observed at plots N4-WET-100 and N4-WET-400. Species of conservation concern 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.

The number of paired samples (i.e. four) is too small to reliably test for significant differences. However, there continues to be a trend of greater mean species cover and richness off the RoW. This may be due to the removal of sparse tree and shrub cover, and other low growing woody species on the RoW. The average total percent species cover in paired surveys on the RoW is 43.3%, and surveys adjacent to the RoW is 104.7%, and the average number of species (richness) is 22.8 on the RoW and 28.8 off the RoW. The diversity index and species evenness have similar ranges in value between paired surveys on and off RoW, suggesting that vegetation clearing in wetland sites is not affecting these species measures at this time.

When comparing species measures between years for surveys on the RoW, there was, a continued general trend of decreased total species cover value for surveys on the RoW

from clearing (2014) to present. Species richness on the RoW is similar among years from 21.7 species (2014) to 20.4 species (2016). No trend is observed for diversity and evenness on the RoW among years.

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	all years	2014	2015	2016	all years
N4-WET-10	-	61.0	48	81.6	-	17	18	24
N4-WET-20	-	16.6	33	70.0	-	24	28	32
N4-WET-30	-	47.4	19	-	-	25	19	-
N4-WET-40	-	16.3	8.6	-	-	8	7	-
N3-WET-10	81.4	79.8	44	-	23	28	26	-
N3-WET-20	56.8	54.0	26	119.8	21	23	18	24
N3-WET-30	68.6	71.8	66	147.4	21	26	27	35
Paired Survey Mean	62.7	50.8	43.3	104.7	21	22.5	22.8	28.8

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

Site	Diversity				Evenness			
	RoW			off RoW	RoW			off RoW
	2014	2015	2016	all years	2014	2015	2016	all years
N4-WET-10	-	1.4	2.1	2.1	-	0.5	0.7	0.7
N4-WET-20	-	2.8	2.6	2.2	-	0.9	0.8	0.6
N4-WET-30	-	2.1	2.3	-	-	0.6	0.8	-
N4-WET-40	-	1.7	1.6	-	-	0.8	0.8	-
N3-WET-10	2.1	1.8	2.1	-	0.7	0.5	0.7	-
N3-WET-20	1.7	1.5	1.8	1.9	0.6	0.5	0.6	0.6
N3-WET-30	2.1	2.1	2.1	2.2	0.7	0.7	0.6	0.6
Paired Survey Mean	1.9	2.0	2.2	2.1	0.6	0.6	0.7	0.6

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 51 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). The communities are distinguished by presence of open water, moss cover and both the cover and richness of herb and low shrub layers.

Table 4-3c. Community types for environmentally sensitive wetland surveys on the RoW, 2016.		
2016	**Surveys**	**Species**
Bog Birch – Three-leaved Solomon's-seal/ Sphagnum	3	44
Hairy-fruited Sedge - Bog Bean	4	28

4.3.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the project areas cleared prior to 2016 (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 Year I Annual Technical Report (2015) were previously assessed (year after clearing) at each wetland site visited along the RoW (Table 4-3d).

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.

In 2016, no new sites were sampled and mitigation was not re-assessed at sites established in previous years. Observations recorded in the field from 2016 are provided below.

All wetlands sampled showed low disturbance (physical appearance) from construction activities, in 2016. Vehicle traffic appeared to utilize existing trails under frozen ground conditions; in several locations, the equipment path could not be identified as a result of abundant vegetation cover on the RoW (Photograph 4-3a). Natural re-vegetation is occurring in previously disturbed wetland sites.

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

In patterned fen N4-WET-300, it was observed that the water level was higher this year, with much vegetation submergered as compared to last years growing season (Photograph 4-3b). Average cover of surface water increased from 0.6% in 2015 to 97% in 2016. This could be a natural fluctuation in water level or, possibly a result of nearby tower construction (footings) and a change in water movement, either from compaction by equipment or flow impediment caused from project drilling and exposed parent materials. Future monitoring will re-assess vegetation and ground cover conditions in this wetland site.

Photograph 4-3b. Patterned fen wetland with increased water level.

4.4 Plants/Communities Important to Aboriginal People

Ten ATK sites were visited on July 5 to sample the vegetation in the Cowan Blueberry Resource Area after clearing (Field Activity ID BPIII_CON_FA236) (Map 4-1, Appendix II). Sampling in 2016 occurred in Section C1 and only on the RoW. Paired sites adjacent to the RoW were not re-sampled. A search for incidental species of conservation concern was undertaken at all sites. Local community members were present for sampling in 2016.

During the morning of July 5, the vegetation team met with Manitoba Hydro staff (Kris Watts, Norm Voth, and Geoff Nolette) and local community members (Jason Chartrand of Pine Creek First Nation and Richard Genaille of Duck Bay Community) in the Town of Cowan. The Resource Area was accessed by helicopter due to remoteness of the area, although some ATV trails were observed from the air. After arriving on the Bipole III RoW in the Resource Area, the vegetation monitoring methods were explained to the group and demonstrated for plot C1-ATK-300, the southern most sampling plot in the Resource Area (Photograph 4-4a). Here, botanical information was shared among the individuals present (e.g., berry picking). Two species of blueberries were observed at this location (velvetleaf blueberry - *Vaccinium myrtilloides* and low sweet blueberry - *Vaccinium angustifolium*), and many plants supported ripe berries, ready to consume. Plot C1-ATK-400 was in close proximity and the group also visited this location. At these two plots, blueberries were plentiful and the local community members noted that the berry plants did really well and exceeded their expectations (Photograph 4-4b). It was also noted by a community member that increased sunlight (i.e., RoW clearing) is required for better plant growth and from what they observed in the field, this area will provide good blueberry picking.

Photograph 4-4a. Blueberry sample plot in the Cowan Resource Area.

Photograph 4-4b. Blueberry plants observed during sampling.

Eight other ATK sites were visited and vegetation composition, abundance and structure were recorded at all sites. Not all sampled sites supported blueberry plants, which was similar to data collected in 2014 and 2015. This was a result of selecting sites from desktop activities for preferred blueberry habitat, prior to fieldwork sampling.

This season, blueberry plants were observed at five sites on the RoW (C1-ATK-300, 400, 500, 600 and 950), compared to two sites in 2015. Total blueberry cover for these five sites (2016) averaged 12.7%. In 2014, six sites (twelve surveys, on and off RoW) supported blueberry plants (Table 4-4a).

Plots C1-ATK-300 and 400 both increased in species cover for low sweet blueberry, from previous years sampling. Plot C1-ATK-300 increased from 0.4% in 2015 to 3.0% in 2016, while plot C1-ATK-400 increased from 32.4% to 43.0%. Plots C1-ATK-500 and C1-ATK-950 had a decrease in cover and low sweet blueberry was absent from plots C1-ATK-200 and C1-ATK-600, in 2016. Of note, plants of low sweet blueberry have newly established in C1-ATK-300, after clearing activities. Cover for low sweet blueberry ranged from 1.0 to 43.0% in all sites surveyed.

Table 4-4a. Resource Area species cover for blueberries.

Site	Low Sweet Blueberry Total Species Cover (%)				Velvetleaf Blueberry Total Species Cover (%)			
	RoW			off RoW	RoW			off RoW
	2014	2015	2016	(2014)	2014	2015	2016	(2014)
C1-ATK-20	0.4	-	-	16.6	-	-	-	8.8
C1-ATK-30	-	0.4	3.0	5.6	5.0	0.6	2.0	-
C1-ATK-40	32.4	NS	43.0	35.4	8.0	NS	1.2	-
C1-ATK-50	11.8	NS	1.0	8.0	-	NS	0.2	1.2
C1-ATK-60	4.6	-	-	1.6	0.4	2.0	8.6	11.4
C1-ATK-95	7.2	-	1.4	2.6	-	-	3.2	1.8

Note: NS means no survey that year because of clearing activities.

Species cover of velvetleaf blueberry increased in plots C1-ATK-300 and C1-ATK-600, and have newly established in C1-ATK-500 and C1-ATK-950. In plot C1-ATK-300, cover increased from 0.6% in 2015 to 2.0% this season, while cover consecutively increased in plot C1-ATK-600 from 0.4% in 2014 to 2.0% in 2015 and 8.6% in 2016. A reduction in cover was observed in C1-ATK-400. In 2016, cover of velvetleaf blueberry ranged from 0.2 to 8.6%, in sites surveyed. Photograph 4-4c shows an aerial view of blueberry sites in the Resource Area.

Photograph 4-4c. Aerial view of blueberry sites in the Resource Area.

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 in some areas is very sandy with exposed soils, such as the previously sparsely treed conifer sites, and is characteristic of prairie vegetation (grasses and forbs). Species of concervation concern observed are discussed in Section 4.6.

4.4.1 Data Analysis of the Cowan Blueberry Resource Area

Ten surveys were conducted in the Cowan Blueberry Resource Area. Resulting vegetation descriptions are provided 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 (%)[1]				Species Richness[2]			
	RoW			off RoW	RoW			off RoW
	2014	2015	2016	(2014)	2014	2015	2016	(2014)
C1-ATK-10	40.4	12.2	14.0	39.2	17	24	23	19
C1-ATK-20	109.2	32.8	54.0	99.8	32	28	32	26
C1-ATK-30	55.2	18.4	24.0	75.6	17	13	17	19
C1-ATK-40	116.2	-	82.9	116.6	19	-	15	17
C1-ATK-50	93	-	6.5	59.4	17	-	11	33
C1-ATK-60	138.2	23.8	47.8	151.8	23	19	20	23
C1-ATK-70	79.4	20.2	20.2	69	28	20	28	27
C1-ATK-80	58.2	19	27.4	65.8	31	24	31	24
C1-ATK-90	53.8	22.6	26.2	53.4	25	26	29	29
C1-ATK-95	149.8	20	40.2	132.8	27	22	23	36

Note: [1] Total species cover (%) on (2016) and off RoW is significantly different, p= 0.002.
[2] No significant differences in species richness on (2016) and off RoW, p= 0.722.

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

Site	Diversity[1]				Evenness[2]			
	RoW			off Row	RoW			off RoW
	2014	2015	2016	(2014)	2014	2015	2016	(2014)
C1-ATK-10	2.26	2.93	2.8	2.22	0.8	0.92	0.9	0.76
C1-ATK-20	2.09	2.70	2.4	2.26	0.6	0.81	0.7	0.69
C1-ATK-30	1.62	1.63	2.0	1.81	0.57	0.63	0.7	0.62
C1-ATK-40	2.11	-	1.5	1.79	0.72	-	0.6	0.63
C1-ATK-50	1.98	-	1.7	2.68	0.7	-	0.7	0.77
C1-ATK-60	1.73	2.59	2.4	2	0.55	0.88	0.8	0.64
C1-ATK-70	2.47	2.64	3.0	2.5	0.74	0.88	0.9	0.76
C1-ATK-80	2.59	2.83	3.0	2.3	0.75	0.89	0.9	0.72
C1-ATK-90	2.68	2.90	3.0	2.72	0.83	0.89	0.9	0.81
C1-ATK-95	1.94	2.67	2.5	2.56	0.59	0.86	0.8	0.71

Note: [1] No significant differences in diversity index on (2016) and off RoW, p=0.275.
[2] Species evenness on (2016) and off RoW is significantly different, at p=0.025.

Results of a paired-sample Wilcoxon test for ATK vegetation surveys on (2016) and off the RoW show continued significantly lower values for total species cover ($p<0.002$) on the RoW. No other significant differences in species richness ($p=0.722$) occurred between paired on and off RoW samples. No significant differences were detected between surveys on (2016) and off the RoW at this time for diversity indices ($p>0.275$) nor evenness ($p>0.024$).

When comparing surveys on the RoW after clearing, between 2015 and 2016, there were no statistically significant differences detected for any species measure: cover ($p>0.022$), richness ($p=0.029$), diversity ($p=0.888$), and evenness ($p=0.483$). However, there is a trend for increasing mean cover values seen between paired surveys in 2015 (21.1%) and 2016 (31.7%).

4.4.1.1 Cluster Analysis and Community Typing

This season, a total of 92 species were observed within surveys sampled on the RoW, in the Blueberry Resource Area. Cluster analysis of ten surveys on the RoW resulted in two community type groupings, based on the vegetation composition and structure regenerating at each site (Table 4-4d). Both communities have blueberries present, with velvetleaf blueberry occurring as one of the dominant species in the trembling aspen community. A single outlying site in the jack pine community is dominated by low sweet blueberry this season (mean cover 43%) and tall shrub cover, with very few other vascular species present.

Table 4-4d. Community types for blueberry resource area surveys on the RoW, in 2016.

2016	Sites	Species
Trembling Aspen seedling – Dewberry – Velvetleaf blueberry	3	45
Jack Pine seedling - Two-leaved Solomon's-seal – Bearberry - Blue Stem/ Reindeer lichen	7	73

4.4.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the project areas cleared during the winter of 2015/2016 (C1-ATK-400 and C1-ATK-500), the effect predictions from Appendix III for 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 Year I and II Annual Technical Reports (2015 and 2016) were assessed at each site visited along the RoW. Table 4-4e identifies the mitigation measures assessed at each site.

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

Mitigation Measure	C1-ATK-400	C1-ATK-500
Carry out construction activities on frozen or dry ground to minimize surface damage, rutting and erosion.	Y	Y
Minimize surface disturbance around the site to the extent possible.	Y	Y
Remove trees by low disturbance methods.	Y	Y
No herbicide to be applied during construction.	Y	Y
Confine vehicle traffic to established trails to extent possible.	Y	Y

Note: Y/N (yes/no) denotes whether mitigation measure was implemented.

Through fieldwork, it was determined that the recommended mitigation was implemented and effective for ATK vegetation (resource area) which minimized the disturbance from clearing activities. In the absence of mitigation, site disturbance likely would have increased. However, even with mitigation, the level of disturbance varied among sites in the resource area. Observations recorded in the field are provided below.

To minimize surface damage, rutting and erosion, construction activities were carried out on frozen or dry ground conditions. Both sites visited (C1-ATK-400 and C1-ATK-500) had vegetation remaining after clearing, but with different cover amounts. Surface disturbance was low for C1-ATK-400. Here, tall shrubs (1-2.5m) of green alder (*Alnus viridis*), pin cherry (*Prunus pensylvanica*), jack pine (*Pinus banksiana*) and Bebb's willow (*Salix bebbiana*) remain, and species richness was also higher. Plot C1-ATK-500 had less shrub and herb vegetation remain, and overall species cover was lower.

Trees at these sites were removed by feller buncher and equipment travel was confined largely to the centreline trail. In many areas, the centreline trail consisted of exposed sand, disturbed from vehicle travel. However, overturned roots and exposed soil from rutting and moving equipment was minimal off the equipment path.

No problem areas were identified for invasive and non-native species at this time, but common dandelion (*Taraxacum officinale*) was observed in the RoW. It is assumed that construction equipment were cleaned and inspected prior to clearing activities, as well as herbicides not applied in the Resource Area, as recommended.

An aerial investigation of the Resource Area identified that regeneration is occurring throughout the RoW, and in some locations, shrub cover (e.g., *Populus* spp.) is approaching 1m height. Photograph 4-4d is an aerial view of the RoW showing regeneration, the equipment path and an ATV access trail.

Photograph 4-4d. 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 4 to August 6 (Field Activity ID BPIII_CON_FA236, 237 and 238) (Map 4-1, Appendix II). Two new sites consisted of sampling on the RoW with paired samples off the RoW, while 38 on-RoW sites were revisted (with 38 off-RoW belt-transect invasive species scans) for a total of 80 surveys. Six sites are located in each of Sections 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. These sites were sampled post-clearing. A total of 201 plant species were recorded on the RoW plots during sampling of invasive and non-native vegetation surveys.

Twelve additional sites were visted along the RoW in Section S2 on July 25 (Field Activity ID BPIII_CON_FA240) to record information on invasive and non-native species (Map 4-1, Appendix II). Surveys were conducted roadside in agricultural areas where information on species composition was recorded and problem areas noted (i.e., species spread) as a result of construction activities.

4.5.1 Data Analysis of Invasive and Non-Native Vegetation

Forty-two quantitative surveys were conducted for invasive and non-native vegetation, including 38 surveys revisited on RoW, and two new paired sites (four surveys). For sampling, 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 ($p<0.001$), as well as for total number of species present ($p=0.001$) for surveys on the RoW (2016), when compared to those off the RoW. While no significant differences were detected for the diversity index, the evenness of species distribution was significantly different ($p<0.006$) between surveys on and off the RoW.

However, when surveys on the RoW were compared between years (38 sites), a significant increase is observed for species cover ($p<0.001$) and species richness ($p<0.003$). There was no associated statistical difference between year data for species diversity at this time, although evenness was significantly different ($p<0.001$), and generally decreased in 2016.

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.

Twenty-four invasive and non-native species were recorded across all quantitative vegetation surveys (Field Activity ID BPIII_CON_FA236, 237, 238 and 239). Nine species are considered invasive: burdock (*Arctium minus*), Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), ox-eye daisy (*Leucanthemum vulgare*), sweet clovers (*Melilotus albus, M. officinalis*), sow thistle (*Sonchus arvensis*), narrow-leaved cat-tail (*Typha angustifolia*) and tufted vetch (*Vicia cracca*), (Invasive Species Council of Manitoba 2016). Fifteen species are considered non-native: Russian pigweed (*Axyris amaranthoides*), smooth brome (*Bromus inermis*), lamb's-quarters (*Chenopodium album*), narrow-leaved goosefoot (*Chenopodium leptophyllum*), black bindweed (*Fallopia convolvulus*), common hemp-nettle *(Galeopsis tetrahit),* pineapple weed *(Matricaria discoidea),* black medick (*Medicago lupulina*), timothy (*Phleum pratensis*), common plantain (*Plantago major*), yellow foxtail (*Setaria pumula*), common dandelion (*Taraxacum officinale*), alsike clover (*Trifolium hybridum*), red clover (*T. pratense*) and white clover (*T. repens*), (Manitoba Conservation Data Center 2016; Scoggan 1957).

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

Site	Total Species Cover (%)[1]				Species Richness[2]			
	RoW			off RoW	RoW			off RoW
	2014	2015	2016	all years	2014	2015	2016	all years
N4-INV-10	-	28.4	65.8	112.4	-	36	40	37
N4-INV-20	-	4.2	13.0	146.4	-	7	17	22
N4-INV-30	-	5.0	6.6	126.0	-	10	13	15
N4-INV-40	-	-	96.8	104.0	-	-	25	22
N4-INV-50	-	-	79.2	119.4	-	-	29	28
N3-INV-10	8.4	77.6	93.4	135.8	15	22	15	27
N3-INV-20	24.2	43.6	41.2	87.4	22	30	32	39
N3-INV-30	31.2	20.0	19.4	112.0	26	25	27	34
N3-INV-40	3.8	10.0	13.2	85.2	10	20	25	39
N3-INV-50	12.4	31.4	56.2	104.8	17	27	24	8
N3-INV-60	18.4	12.2	29.2	153.0	20	21	33	24
N2-INV-10	2.4	3.4	5.0	84.8	6	6	9	33
N2-INV-20	5.8	11.8	29.4	115.8	12	15	27	42
N2-INV-30	9.6	28.6	45.0	94.4	16	22	26	28
N2-INV-40	1.0	6.2	3.6	152.6	4	9	7	16
N2-INV-50	0.6	2.0	14.8	130.0	3	5	22	25
N2-INV-60	6.4	16.8	32.4	99.2	12	16	21	22
N2-INV-70	-	2.0	17.4	135.4	-	7	20	31
N2-INV-80	-	9.6	42.6	129.0	-	17	28	43
N1-INV-10	-	37.2	56.2	136.0	-	26	27	24
N1-INV-20	-	25.4	56.6	48.6	-	22	26	21
N1-INV-30	-	7.8	15.6	107.4	-	17	26	24
N1-INV-40	-	59.6	29.8	41.8	-	17	18	15
N1-INV-50	-	18.8	15	67.8	-	17	13	28
N1-INV-60	-	8.8	11.8	144.2	-	11	12	33
CL-INV-10	37.2	67.2	47.2	130.6	16	25	21	31
CL-INV-20	31.2	26.6	20	104.0	24	17	20	44
CL-INV-30	82.4	99.0	26.4	131.0	17	18	15	24
CP-INV-10	32.4	43.2	48.8	108.4	32	36	31	43
CP-INV-20	37.8	56.0	53.6	120.2	26	26	26	28
C2-INV-10	-	22.2	37.8	100.4	-	35	32	42
C2-INV-20	-	21.0	54.8	60.4	-	41	52	50
C2-INV-30	-	21.0	81.2	149.8	-	38	46	40
C2-INV-40	-	36.4	36.2	87.4	-	24	16	30
C2-INV-50	-	24.6	47.8	69.0	-	36	41	43
C1-INV-10	-	33.6	60	183.8	-	28	34	26
C1-INV-20	-	29.0	78.8	155.8	-	27	34	39
C1-INV-30	-	36.6	45	157.0	-	34	32	47
C1-INV-40	-	17.4	70.8	112.4	-	25	32	51
C1-INV-50	-	26.2	46.6	132.6	-	29	32	47

Note: [1] Total species cover (%) on (2016) and off RoW is significantly different, $p<0.000$.

[2] Species richness on (2016) and off RoW is significantly different, $p=0.001$.

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

Site	Diversity[1]				Evenness[2]			
	RoW			off RoW	RoW			off RoW
	2014	2015	2016	all years	2014	2015	2016	all years
N4-INV-10	-	3.0	2.5	1.8	-	0.8	0.7	0.5
N4-INV-20	-	1.8	2.1	1.9	-	0.9	0.7	0.6
N4-INV-30	-	2.0	2.3	1.7	-	0.9	0.9	0.6
N4-INV-40	-	-	2.2	2.1	-	-	0.7	0.7
N4-INV-50	-	-	1.8	2.4	-	-	0.5	0.7
N3-INV-10	2.4	1.0	0.9	1.9	0.9	0.3	0.3	0.6
N3-INV-20	2.7	2.7	2.8	3.0	0.9	0.8	0.8	0.8
N3-INV-30	2.6	2.8	3.0	2.6	0.8	0.9	0.9	0.7
N3-INV-40	2.1	2.6	3.0	2.5	0.9	0.9	0.9	0.7
N3-INV-50	2.5	2.7	2.3	1.2	0.9	0.8	0.7	0.6
N3-INV-60	2.5	2.5	2.7	1.5	0.8	0.8	0.8	0.5
N2-INV-10	1.7	1.7	2.0	2.7	1.0	1.0	0.9	0.8
N2-INV-20	2.1	2.2	2.4	2.7	0.9	0.8	0.7	0.7
N2-INV-30	2.5	2.6	2.6	2.1	0.9	0.8	0.8	0.6
N2-INV-40	1.3	1.7	1.6	1.3	1.0	0.8	0.8	0.5
N2-INV-50	1.1	1.6	2.5	1.6	1.0	1.0	0.8	0.5
N2-INV-60	1.9	2.4	2.4	1.7	0.8	0.9	0.8	0.6
N2-INV-70	-	1.8	2.7	2.1	-	0.9	0.9	0.6
N2-INV-80	-	2.4	2.5	2.6	-	0.8	0.7	0.7
N1-INV-10	-	2.0	2.1	2.0	-	0.6	0.6	0.6
N1-INV-20	-	2.5	2.3	2.3	-	0.8	0.7	0.8
N1-INV-30	-	2.8	3.0	2.1	-	1.0	0.9	0.7
N1-INV-40	-	1.9	2.1	2.1	-	0.7	0.7	0.8
N1-INV-50	-	2.3	2.2	2.7	-	0.8	0.9	0.8
N1-INV-60	-	2.1	1.7	2.6	-	0.9	0.7	0.7
CL-INV-10	1.9	1.9	1.8	1.6	0.7	0.6	0.6	0.5
CL-INV-20	2.5	2.2	2.2	2.6	0.8	0.8	0.7	0.7
CL-INV-30	1.4	1.6	2.0	1.7	0.5	0.6	0.8	0.5
CP-INV-10	3.0	2.9	2.6	2.8	0.9	0.8	0.7	0.7
CP-INV-20	2.4	2.5	2.6	2.1	0.7	0.8	0.8	0.6
C2-INV-10	-	3.3	3.1	2.4	-	0.9	0.9	0.7
C2-INV-20	-	3.3	3.1	3.2	-	0.9	0.8	0.8
C2-INV-30	-	3.3	2.8	2.5	-	0.9	0.7	0.7
C2-INV-40	-	2.2	1.5	2.5	-	0.7	0.5	0.7
C2-INV-50	-	2.9	3.1	2.8	-	0.8	0.8	0.7
C1-INV-10	-	2.6	2.7	1.8	-	0.8	0.8	0.6
C1-INV-20	-	2.7	1.7	2.6	-	0.8	0.5	0.7
C1-INV-30	-	3.0	2.9	2.5	-	0.9	0.8	0.7
C1-INV-40	-	3.0	2.0	3.1	-	0.9	0.6	0.8
C1-INV-50	-	3.1	2.8	3.2	-	0.9	0.8	0.8

Note: [1] No significant differences in diversity index on (2016) and off RoW, $p=0.320$.

[2] Species evenness on (2016) and off RoW is significantly different, $p<0.006$.

One or more invasive or non-native species were recorded in 34 surveys throughout the project area. The most common invasive species throughout were sow-thistle, sweet clovers and Canada thistle, while the most common non-native species were common dandelion and lamb's-quarters. Three species were not recorded in plots in 2016, the invasive reed canary grass (*Phalaris arundinaceae*), and the non-native common caragana (*Caragana arborescens*) and alfalfa (*Medicago sativa*).

Re-visiting sites will provide an opportunity to compare abundance and frequency of invasive and non-native species on the RoW between years. The following tables (Table 4-5c) show mean cover values for invasive (part A) and non-native (part B) species recorded in 2016.

This year in sites, there were many new observations of both invasive and non-native species. In repeat observations in some sites, there appears to be a trend of increased cover values, while in other sites, cover values remain unchanged, have decreased, or are absent. Cover values for invasive sweet clovers (*Melilotus* spp.) provide an extreme example. Sweet clover was recorded in ten sites, six observations are new to this year, three sites have increased values, and one site remains unchanged. In a single site (N3-INV-100), the change in mean cover values of sweetclover is extreme from pre-construction (2%), increasing in 2015 (62%) to this season's high (73%) in 2016. Notably, despite extreme cover values for this invasive species on the RoW, no invasive/non-native species were present in the off-RoW invasive scan for this site.

Mean cover values for non-native species remain low, generally <2%. The common dandelion increased in a single survey, decreased in three surveys, and showed no change in three surveys. Lamb's-quarters decreased and showed no change in cover values in two surveys each (Table 4-5c). Furthermore, 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.

A total of 40 invasive and non-native species were recorded in 2016 as qualitative observations, where species presence was measured, rather than mean percent cover on the RoW (e.g., in rare plant (SCC) surveys). Elsewhere, incidental observations were noted in sites, on or in close proximity to the RoW, but outside the plot range of surveys.

Table 4-5c. Part A: Sites with occurrences of invasive species in plots (mean % cover), 2016.

Site	Sow Thistle	Sweetclovers[1]	Canada Thistle	Narrow-leaved Cattail	Burdock	Leafy Spurge	Ox-eye Daisy	Tufted Vetch
N4-TER-500	0.2							
N4-TER-100				0.4				
N4-INV-501	0.4		0.8					
N4-INV-500	0.2	0.4	8.6					
N4-INV-300	0.2							
N4-INV-200				0.2				
N4-INV-100	1.2+	3.2+	0.6+					
N3-TER-100	0.6							
N3-INV-500	11.4+		1.2					
N3-INV-400		2.0					0.2*	0.6
N3-INV-300	0.6+							
N3-INV-100	6.8+	73+	(-)					
N2-INV-400	0.2							
C2-INV-500	0.6	1.2+	0.2					(-)
C2-INV-200	0.6*	0.2*						
C1-INV-500	10.6+	3.0	0.4*		1.8			
C1-INV-400	0.2-	40.6						
C1-INV-300	0.2	0.4						
C1-INV-200	3.6+	48.8	5.4+					
S1-PRA-900						4.8+		
Occurs On RoW	16	10	7	2	1	1	1	1

Note: [1] Cover values for sweet clover (i.e. *Melilotus albus* and *M. officinalis*) are merged into a single value (*Melilotus* spp.), to include instances where field identification was not possible due to absence of flowers. In 2016 data, white sweet clover (*Melilotus albus*) was most frequently recorded. Species cover has increased (+), decreased (-), or remained unchanged (*) since previous year.

Table 4-5c. Part B: Sites with occurrences of non-native species in plots (mean % cover), 2016.

Site	Common Dandelion	Lamb's Quarters	Smooth Brome	Clovers[1]	Black Medick	Timothy	Black Bindweed	Common Plantain	Russian Pigweed	Narrow-leaved Goosefoot	Common Hemp-nettle	Pineapple Weed	Yellow Foxtail
N4-TER-400											0.2		
N4-INV-500		1.8	0.8	1.0	0.8								
N4-INV-300			0.2										
N4-INV-100	1.2			0.8	1.2								
N3-TER-100	1.0*						0.2						
N3-INV-500	(-)	0.2					0.2						
N3-INV-400								0.4				0.2	
N3-INV-300		0.2											
N3-INV-100		1.2											
N2-INV-700	0.2												
N2-INV-600	0.4												
N2-INV-500	2.8	0.2		0.4*		0.6							
N2-INV-100	0.2												
N1-INV-300	0.6		0.2										
CP-INV-100	0.6*												
CL-INV-100	0.2												
C2-INV-500	3.0+		0.6	1.8	1.8-	0.2		2.6+					
C2-INV-300	0.6-			0.2	0.2	0.8							
C2-INV-200	0.4				0.2								
C2-INV-100	0.4												
C1-INV-500	0.4	0.2-		1.2	0.4-	0.4-							
C1-INV-400	0.6	0.2	0.4		(-)								
C1-INV-300	0.8-	0.2*	0.2*										
C1-INV-200	0.6	0.4-	0.2	0.2	(-)			2.6					
C1-INV-100	0.2*	0.2*											
C1-ATK-100		0.6											
S1-PRA-900		0.4					0.4		0.4	1.8			0.4
Occurs on RoW	18	12	7	7	6	4	3	3	1	1	1	1	1

Note: [1] The clovers (*Trifolium hybridum*, *T. pratense* and *T. repens*) have been combined into one mean cover value for display. Species cover has increased (+), decreased (-), or remained unchanged (*) since previous year.

The 12 invasive and 28 non-native species encountered in 2016, throughout the S2 segment, in SCC plant surveys, and as incidental observations throughout all other sites are shown in Table 4-5d. Those found uniquely in segment S2 are indicated (*).

Table 4-5d. Invasive and non-native species occurrences, as observations in rare plant surveys, or as incidental observations.

Invasive Species		Rank
Arcticum spp.	Burdock	SNA
Cirsium arvense	Canada Thistle	SNA
Euphorbia esula	Leafy Spurge	SNA
Leucanthemum vulgare	Ox-eye Daisy	SNA
Linaria vulgaris	Butter-and-eggs	SNA
Medicago sativa	Alfalfa	SNA
Melilotus albus	White Sweetclover	SNA
Melilotus officinalis	Yellow Sweetclover	SNA
Phalaris arundinacea	Reed Canarygrass	S5
Sonchus arvensis	Field Sow-thistle	SNA
Tanacetum vulgare	Common Tansy	SNA
Vicia cracca	Tufted Vetch	SNA
Non-Native Species		**Rank**
Agropyron cristatum	Crested Wheat-grass	SNA*
Amaranthus albus	Tumble Pigweed	SNA*
Avena sativa	Oats	SNA*
Axyris amaranthoides	Russian pigweed	SNA
Brassica napus	Turnip	SNA*
Bromus inermis	Smooth Brome	SNA
Chenopodium album	Lamb's Quarters	SNA
Chenopodium leptophyllum	Narrow-leaved Goosefoot	SNA
Echinochloa crus-galli	Barnyard Grass	SNA*
Elymus repens	Quack grass	SNA
Fallopia convolvulus	Black Bindweed	SNA
Galeopsis tetrahit	Common Hemp-nettle	SNA
Lotus corniculatus	Bird's-foot Trefoil	SNA
Matricaria discoidea	Pineapple weed	SNA
Medicago lupulina	Black Medic	SNA
Pastinaca sativa	Parsnip	SNA*
Phleum pratense	Timothy	SNA
Plantago major	Common Plantain	SNA
Rumex crispus	Curly Dock	SNA*
Setaria pumila	Yellow Foxtail	SNA
Setaria viridis	Green Bristlegrass	SNA*
Sinapis arvensis	Charlock	SNA*
Taraxacum officinale	Common Dandelion	SNA
Thlaspi arvense	Field Pennycress	SNA
Tragopogon dubius	Goat's-beard	SNA*
Trifolium hybridum	Alsike Clover	SNA
Trifolium pratense	Red Clover	SNA
Trifolium repens	White Clover	SNA

The presence of these 12 invasive and 28 non-native species were observed in vegetation surveys for rare plants (four SCC surveys), Section S2 (12 surveys), and elsewhere through incidental observations of invasive and non-native species (20 surveys), shown in Table 4-5e. Notably, the majority of incidental observations were collected from INV surveys, areas considered susceptible to increased spread of non-native and invasive species.

Within INV sites, thirty-eight belt transect scans were completed to track any appearance of invasive/non-native species off the RoW. While recorded in nine off-site belt transect scans, observations were restricted to six invasive and five non-native species, Table 4-5e. Both abundance (<10%) and distribution were generally sparse for all invasive/non-native species observed, in off-site scans, with the exception of occasionally abundant white sweet clover cover and moderate black medick cover observed in one site (C2-INV-101).

Table 4-5e. Surveys with occurrences of invasive and/ or non-native species (presence values), sampled in 2016.

Incidentals	Invasives	Non-natives	Total
N4-WET-400	2	0	2
N4-TER-500	1	0	1
N4-INV-401	3	3	6
N4-INV-300	2	2	4
N4-INV-100	5	3	8
N3-INV-600	1	2	3
N3-INV-500	1	0	1
N3-INV-400	0	1	1
N3-INV-401	2	0	2
N3-INV-300	1	2	3
N2-INV-800	2	0	2
N2-INV-700	1	1	2
N2-INV-500	2	3	5
N2-INV-200	2	1	3
N2-INV-100	0	1	1
CL-INV-200	0	1	1
C2-INV-500	2	0	2
C2-INV-100	1	0	1
C1-INV-100	1	1	2
S1-PRA-900	1	1	2
S1-SCC-100	5	2	7
S1-SCC-110	4	1	5
S1-SCC-200	1	1	2
S1-SCC-700	2	6	8
S2-INV-001	3	8	11

S2-INV-002	4	3	7
S2-INV-003	3	8	11
S2-INV-004	6	8	14
S2-INV-005	5	6	11
S2-INV-006	6	7	13
S2-INV-007	5	9	14
S2-INV-008	4	5	9
S2-INV-009	4	6	10
S2-INV-010	3	9	12
S2-INV-011	3	8	11
S2-INV-012	4	7	11
Off-RoW Scans	**Invasives**	**Non-natives**	**Total**
N3-INV-401	1	0	1
C2-INV-101	2	1	3
C2-INV-201	1	1	2
C2-INV-301	0	1	1
C2-INV-501	2	4	6
C1-INV-201	2	0	2
C1-INV-301	0	1	1
C1-INV-401	2	2	4
C1-INV-501	1	0	1

4.5.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the Project areas cleared during 2015/2016 and where new sites were visited (Sections N4), 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 assessed at each site visited along the RoW, see Table 4-5f.

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. Observations documented in the field are provided below.

Table 4-5f. Mitigation measures assessed at sites monitored for invasive and non-native species on the RoW.

Mitigation Measure	N4-INV-400	N4-INV-500
Carry out construction activities during winter months.	Y	Y
All equipment will be thoroughly washed and inspected prior to working in new sites to reduce the spread of introduced species.	Y	Y
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.	-	-

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

New survey sites were located at an access road (N4-INV-400) and Provincial Trunk Highway 10 (N4-INV-500). Clearing and construction activities were carried out during winter months, where the spread of invasive species is reduced. It is assumed that all equipment was thoroughly washed and inspected prior to working in these new sites, to reduce the spread of introduced species. However, in plot N4-INV-500 invasive species were observed, likely introduced from the highway ditch. At plot N4-INV-400, it was observed that incomplete clearing on the RoW occurred immediately north of the sample plot (Photograph 4-5a) and only centre line clearing occurred to the south of the access road.

Other survey locations previously established along the RoW included roads, rail lines and watercourse crossings. Surveys in Year III environmental monitoring have detected an increase in non-native and invasive species spread.

Non-native and invasive species were observed during several ground surveys in Sections C1 and C2. White sweet clover (*Melilotus albus*) was observed in high abundance throughout the RoW at plots C1-INV-200 and C1-INV-400 (Photograph 4-5b). White sweet clover was also abundant at sites C1-INV-100, C1-INV-300 and C1-INV-500, but mainly occurred in ditches and along the equipment path. Sweet clover species (*Melilotus* spp.) were observed in the RoW of Section C2, at sampling plots C2-INV-100, C2-INV-300 and C2-INV-500.

Photograph 4-5a. Incomplete clearing along the RoW.

Photograph 4-5b. White sweet clover observed along the RoW in Section C1.

During aerial inspections of Sections N4, C1 and C2, from the Red Deer River south to the Langruth area, several occurrences of sweet clover were recorded. In sections C1 and C2, 45 occurrences of sweet clover were marked by GPS from the air. Many are likely pre-existing patches introduced from a fence line, a road or track, or adjacent/within pasture land. In some locations, white sweet clover plants were observed as confined to the equipment path and appears as though these are new introductions. Yellow sweet clover (*M. officinalis*) was also present at times, although less abundant. Section C1 had 25 occurrences of sweet clover, eight of which were restricted to the equipment path and appear to be recent introductions as a result of clearing activities. Section C2 had 20 occurrences of sweet clover, three of which were restricted to the equipment path and appear to be recent introductions as a result of clearing activities. Coordinates of these locations are provided in Section 5.0 of this report. In Section N4, no large outbreaks of sweet clover were noted at this time.

North of the Red Deer River, plot N4-INV-200 was observed to have a reduced buffer after additional clearing at this waterway last winter (2015/2016). Rutting was also observed adjacent to the equipment path for a short distance. At this location, logs were used at the water crossing to provide river bank stability for vehicle and equipment crossing. This appeared to be a practical and good measure for reducing surface disturbance (Photograph 4-5c).

In Sections N1 to N3, non-native and invasive species were observed during several INV surveys along the RoW. In some areas, species are spreading into the RoW. At plot N3-INV-100, white sweet clover and field sow-thistle (*Sonchus arvensis*) were abundant species. At this location last season, white sweet clover also had high percent cover but plants appeared to achieve greater height growth. At plot N3-INV-400, RoW activities have increased cover of white sweet clover and ox-eye daisy (*Leucanthemum vulgare*). This location was observed as a staging area for construction equipment and materials, and is with frequent travel. Existing invasive species have the potential to spread here rapidly due to exposed soil. Field sow-thistle and butter-and-eggs (*Linaria vulgaris*) are extending into the RoW from the rail line at plot N3-INV-500. In Section N2, two access trails were observed to support high cover of white sweet clover. Coordinates of these locations are provided in Section 5.0.

At Halfway River two very large spruce trees were recently felled into the forest (winter 2015/2016), across plot N2-INV-701. One tree felled was aged at 108 years based on growth ring counts from the stump (Photograph 4-5d). Dwarf bilberry (*Vaccinium caespitosum*), a species of conservation concern was previously located at this site. For additional clearing, the trees should have been felled into the RoW, as per mitigation recommended. The removal of forest slash, previously existing on the RoW, disrupted vegetation cover at Plot N2-INV-400.

Photograph 4-5c. Logs used at water crossing to reduce surface erosion.

Photograph 4-5d. Trees felled into the forest at Halfway River.

Few non-native and invasive species were observed during surveys in Section N1 and along the northern AC collector lines and construction power line. These species were not problematic in this area of the project in 2016.

In Section S2, non-native and invasive species were observed at all 12 sites investigated where the Bipole III RoW intersected roadways. Species here have already been established along the roadways prior to Bipole III construction activities, but did not appear to extend into the fields where construction activities have begun. Tower footings at site S2-INV-011 (north side of the road) appeared to support invasive species of Canada thistle (*Cirsium arvense*), alfalfa (*Medicago sativa*) and smooth brome (*Bromus inermis*). At this location, the area was viewed at a distance from the roadside (private land) so species composition could not be accurately confirmed. No other problem areas along the RoW were observed, at sites investigated.

Environmental monitoring in Year IV will determine if species cover is increasing or other areas are beginning to support these plants. 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 clearing activities provide an opportunity for invasive and non-native species to establish and proliferate. Recommendations for control of invasive and non-native species in Year III of environmental monitoring are identified in Section 5.0 of this monitoring report.

4.6 Species of Conservation Concern

4.6.1 Monitoring for Species of Conservation Concern

Forty-three species of conservation concern (ranking S1 through S3S5) were recorded during surveys and sampling in 2016, Table 4-6a (Field Activity ID BPIII_CON_ FA236, 237, 238 and 239). Sixteen species are ranked very rare to rare, (including S1 through S2S4), with the remaining species ranked uncommon (including S3 though S3S5). Locations of rare plant surveys (SCC) are shown in Map 4-1 (Appendix II).

In 2016, several plant species had their species rank updated in the province. Plants observed during 2016 monitoring that have increased ranks to uncommon status, and not previously monitored, include: alpine bearberry (*Arctous alpina*), sand grass (*Calamovilfa longifolia*), soft millet (*Dichanthelium acuminatum* var. *fasciculatum*), long-leaved bluets (*Houstonia longifolia*), swamp-fly-honeysuckle (*Lonicera oblongifolia*), skeletonweed (*Lygodesmia juncea*), cow-wheat (*Melampyrum lineare*), bog candle (*Platanthera dilatata*), dwarf Labrador-tea (*Rhododendron tomentosum*), sand dropseed (*Sporobolus cryptandrus*), fleshy stichwort (*Stellaria crassifolia*), bog asphodel (*Tofieldia pusilla*) and narrow-leaved cat-tail (*Typha angustifolia*).

Table 4-6a. Species of conservation concern recorded during Bipole III monitoring, 2016.		
Very Rare to Rare Species (S1-S2S4)	**Common Name**	**Rank**
Agrimonia gryposepala	Common Agrimony	S1S2
Arabis 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
Drosera linearis	Slender-leaved Sundew	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
Streptopus amplexifolius	Clasping Twisted-stalk	S2?
Uncommon Species (S3-S3S5)	**Common Name**	**Rank**
Amphicarpaea bracteata	Hog-peanut	S3S5
Arctous alpina	Alpine Bearberry	S3S4
Calamovilfa longifolia	Sand Grass	S3S5
Cynoglossum virginianum var. *boreale*	Northern Wild Comfrey	S3S4
Dichanthelium acuminatum var. *fasciculatum*	Soft Millet	S3
Drosera anglica	Oblong-leaved Sundew	S3S4
Houstonia longifolia	Long-leaved Bluets	S3S5
Hudsonia tomentosa	False Heather	S3
Lithospermum incisum	Linear-leaved puccoon	S3
Lonicera oblongifolia	Swamp-fly-honeysuckle	S3S5
Lygodesmia juncea	Skeletonweed	S3S4
Melampyrum lineare	Cow-wheat	S3S5
Onosmodium molle	Marble-seed	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
Salix vestita	Rock Willow	S3
Selaginella densa	Prairie Spike-moss	S3

Selaginella selaginoides	Northern Spike-moss	S3S4
Sporobolus cryptandrus	Sand Dropseed	S3S5
Stellaria crassifolia	Fleshy Stitchwort	S3S4
Tofieldia pusilla	Bog Asphodel	S3S5
Typha angustifolia	Narrow-leaved Cat-tail	S3S4
Vitis riparia	Riverbank Grape	S3S4

Note: The question mark (?) following a numeric rank denotes inexact or uncertain ranking (MBCDC 2016).

Eleven monitoring surveys for species of conservation concern (SCC) were completed from July 25 to July 27 in Section S1, near the Assiniboine River crossing (Field Activity ID BPIII_CON_FA239). Here, 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 (Photograph 4-6a), 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 due to their locations, slopes and soils, which have generally prevented any previous clearing, cultivation or development. These mature forests remain refuges for diverse species assemblages that include species of conservation concern. Photograph 4-6b shows an area of trembling aspen regeneration along the RoW, after clearing in the vicinity of the Assiniboine River.

On July 27, a member of Swan Lake First Nation (Travis Bird) was able to join the field team for a brief site visit to generally discuss the surveys and clearing to date. A member of Long Plain First Nation (Dave Daniels) also was available one morning for a brief meeting (off site) and was interested in whether certain species were still seen along the RoW. Both meetings were positive.

On the RoW, species of conservation concern were both re-identified and newly located, under open conditions as well as more favourable shady conditions, e.g. at the cleared edge, or under the cover of other broadleaved herbs. Frequent observations of species of conservation concern were found along the cleared route, and observation points had single stems, multiple stems or often large patches of each species present. In four surveys north of the Assiniboine crossing, 87 GPS recordings were made for species of conservation concern, including 56 recordings representing species ranking S1 to S2. In seven surveys on the south side of the Assiniboine crossing, there were 121 GPS recordings for species of conservation concern, of which 59 recordings represent species ranking S1 to S2.

Photograph 4-6a. Relief encountered along the RoW in Section S1.

Photograph 4-6b. Trembling aspen regeneration along the RoW in Section S1.

A total of 15 species of conservation concern were recorded in 2016, in the vicinity of the Assiniboine crossing. Eleven species of conservation concern were observed again, and four SCC were newly recorded on the RoW this year, which were not found in 2015. These species are ranked very rare (S1) to uncommon (S3) by the Manitoba Conservation Data Centre (MBCDC). Very rare to rare species include 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?), clasping twisted-stalk (*Streptopus amplexifolius*, S2?), and beggar's-lice (*Desmodium canadense*, S2). Species ranked uncommon included lopseed (*Phryma leptostachya*, S3), marble-seed (*Onosmodium molle*, S3S4), riverbank grape (*Vitis riparia*, S3S4), skeletonweed (*Lygodesmia juncea*, S3S4), and hog-peanut (*Amphicarpaea bracteata*, S3S5). Newly recorded species in 2016 include western jewelweed, beggar's-lice, clasping twisted-stalk, and skeletonweed.

A single monitoring prairie site (S1-PRA-900) is a dry sandy prairie, shrubby in places with regenerating trembling aspen (*Populus tremuloides*) (<1 m) primarily, and some oak (*Quercus macrocarpa*). Linear-leaved puccoon (*Lithospermum incisum*, S3) was located again in the monitoring plot. Three other rare and uncommon species were found in the RoW (*Dalea villosa*, *Cyperus schweinitzii* and *Lygodesmia juncea*), and were incidental to the PRA survey (S1-SCC-700 survey). Prairie spike-moss (*Selaginella densa*) was not observed again in 2016, in either S1-PRA-900 nor S1-SCC-700 surveys.

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 recorded during sampling of prairie vegetation. Silky prairie-clover was first observed in 2010, in the vicinity of the 2016 observations, during rare plant surveys for the Bipole III environmental assessment, and has been observed each year in the same general location during monitoring.

In the Cowan Resource Area (Section C1), surveys were conducted July 5 to monitor species of conservation concern previously observed in 2014 and 2015 (Field Activity ID BPIII_CON_FA236). Species of concern were observed again in 2016 at four sites immediately adjacent to the RoW. Plants included two locations of lyre-leaved rock cress (*Arabis lyrata,* S1S2) and two locations of false heather (*Hudsonia tomentosa,* S3). New locations for lyre-leaved rock cress, false heather and prairie spike-moss (*Selaginella densa*, S3) were also observed on the RoW, during monitoring surveys. Velvety goldenrod (*Solidago mollis,* S3) was not observed on the RoW, in 2016.

Generally from Swan River to the Thompson area, in Sections N4 to N1, (Field Activity ID BPIII_CON_FA237), four species of conservation concern previously observed, were located again during 2016 surveys, from July 16 to 21. These species are ranked rare to uncommon and include slender-leaved sundew (*Drosera linearis*, S2?) in N4-WET-300, oblong-leaved sundew (*Drosera anglica*, S3S4) and white beakrush (*Rhynchospora alba,* S3) in N3-WET-100, oblong-leaved sundew in N4-WET-201, and round-leaved bog orchid (*Platanthera orbiculata*, S3) near N3-INV-301. All of these plants were observed in patterned fen wetlands except for round-leaved bog orchid which was observed adjacent to the RoW, in mixedwood forest. Species of concern previously observed (2014 and 2015) but not located in 2016 included oblong-leaved sundew in N4-WET-300, dwarf bilberry (*Vaccinium caespitosum*, S3) in plot N2-INV-701, and teaberry (*Gaultheria procumbens*, S3S4) in N3-TER-201.

New observations for species of concern in 2016 include round-leaved bog orchid - a new occurrence near N3-INV-301, floating marsh-marigold (*Caltha natans*, S2S4) at N4-WET-300, oblong-leaved sundew and white beakrush at plot N4-WET-400, and little-tree willow (*Salix arbusculoides*, S2S3) at plots N1-INV-200 and N2-TER-200. Photograph 4-6c shows round-leaved bog orchid observed in Section N3, immediately adjacent to the RoW.

Photograph 4-6c. Round-leaved bog orchid observed in Section N3.

In the northeastern portion of the Project, monitoring surveys were conducted August 5 to 7 for species of conservation concern located along Section N1, the northern collector lines, construction power line and northern ground electrode line (Field Activity ID

BPIII_CON_FA238). Sixteen monitoring surveys were conducted along the northern project components. Eight species of conservation concern were observed again, and these species are ranked rare to uncommon/widespread (American milkvetch - *Astragalus americanus*, S2S3; muskeg lousewort - *Pedicularis macrodonta*, S2S3; rock willow - *Salix vestita*, S3; northern spike-moss - *Selaginella selaginoides*, S3S4; small butterwort - *Pinguicula villosa*, S3S4; oblong-leaved sundew; little-tree willow; white beakrush). All species of concern previously observed (at sites) were located again in 2016 except for small butterwort which was absent from Plots CL-TER-100 and N1-INV-400, and oblong-leaved sundew, absent from CP-ECO-300. New observations for species of conservation concern occurred along the Section N1 RoW. Little-tree willow was observed at two new locations, N1-TER-600 and N1-INV-600.

At two locations along the northern AC collector lines labeled CL-SCC-100 and CL-SCC-200, white beakrush previously was abundant in this area of the RoW (five known populations). Surveys in 2016 have identified a reduced presence of this species (Photograph 4-6d). Many plants appeared shorter in height compared to previous years' observations. Although white beakrush does appear in other patches occasionally in this area of the RoW, it's numbers have declined overall from previous growing seasons. Recent RoW activities in this area include vegetation clearing and construction activities for tower placement which could cause surface compaction and alter drainage. The surface moisture in this area now appears to range from increasingly dry conditions to areas of standing water. While this species occurs in wet habitats, a change in moisture regime may potentially affect species numbers. Future monitoring of this area will determine the success of this species due to changes in site conditions.

Photograph 4-6d. White beakrush observed along the AC collector lines.

Sites monitored along the ground electrode line (GEL-SCC-100 and GEL-SCC-200) again supported four species of conservation concern including muskeg lousewort, oblong-leaved sundew, little-tree willow and rock willow. American milkvetch was observed in a clearing adjacent to the ground electrode line. Photographs 4-6e shows muskeg lousewort observed along the ground electrode line, in a wet area.

Photographs 4-6e. Muskeg lousewort observed along the ground electrode line.

4.6.2 Accuracy of Effect Predictions and Effectiveness of Mitigation

For the project areas cleared during 2015/2016 (i.e., Section S1), the effect predictions from Appendix III for species of conservation concern were accurate for the following:

- Potential loss of plants of conservation concern

This prediction was accurate for monitoring activities where species of conservation concern could be lost from clearing activities. Nearly all known locations for species of conservation concern (S1 to S3) prior to clearing, supported these plants post clearing. A single species, prairie spike-moss (*Selaginella densa*), was not located after RoW clearing (S1-SCC-700, S1-PRA-900). All other species of conservation concern appeared to be growing on the RoW.

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

Year I and II Annual Technical Reports (2015 and 2016) were assessed at each site visited along the RoW. Table 4-6b identifies the mitigation measures assessed at each site.

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

Mitigation Measure	S1-SCC-100	S1-SCC-110	S1-SCC-200	S1-SCC-300	S1-SCC-310	S1-SCC-400	S1-SCC-500	S1-SCC-530	S1-SCC-600	S1-SCC-610	S1-SCC-700	S1-PRA-900
Identify and flag prior to start of work.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Carry out construction activities on frozen or dry ground to minimize surface damage, rutting and erosion.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Provide 5 m vegetated (shrub and herbaceous) buffer around site.	?	?	?	?	?	?	?	?	?	?	?	?
Remove trees by low disturbance methods.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Confine vehicle traffic to established trails to extent possible.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Use existing access roads and trails to the extent possible.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Stabilize sites immediately after construction and re-vegetate disturbed areas.	-	-	-	-	-	-	-	-	-	-	-	-

Note: Y/N (yes/no) denotes whether mitigation measure was implemented. Question mark (?) means uncertainty and a dash (-) means not applicable.

Only newly cleared sites that were previously known to support species of concern were monitored for mitigation. Sites off the RoW are not monitored for mitigation.

Through fieldwork, it was determined that most recommended mitigation was implemented during clearing activities. Mitigation was determined to be effective where implemented. In the absence of mitigation, increased disturbance to species of conservation concern may have resulted. Observations recorded in the field are provided below.

All sites were identified prior to the start of fieldwork (GPS locations), although not all sites appeared to be flagged prior to the start of clearing activities. Construction activities occurred on frozen or dry ground to minimize surface damage, rutting and erosion. Some rutting and ground disturbance was observed in the vicinity of S1-PRA-900 and S1-SCC-700. These surveys are located along a sand ridge, where vegetation may be very sensitive to ongoing disturbance. ATV tracks elsewhere on the property (both on RoW and off site) have produced bare ground (i.e., sand) with very little vegetation in vehicle tracks. Clearing equipment has also likely scraped away some vegetation.

The 5m vegetation buffer around the SCC sites was difficult to determine in the field, in Section S1. The vegetated buffer was generally not noted. In some SCC locations, the

ground was covered with a thick layer of mulch, with few herbs and shrubs regenerating. In other places, regeneration was well underway with tree and shrub species growing to approximately 1m height. It was difficult to determine which areas were given a 5 m buffer, as a result of the numerous SCC throughout the RoW. Trees appeared to be removed by hand or other low disturbance methods. Vehicle traffic was confined to established trails to the extent possible and existing access roads appeared to be used.

Clearing of the RoW in the Assiniboine crossing vicinity has created new conditions that may not be able to support the perserverance of shade requiring species. For example, most blood-root plants located on the RoW occurred close to the remaining forested edge, or under thick cover of shade providing herbs. However, all plants observed in the open (direct sun) were yellowed and had begun to die back. While leaves of blood-root do begin to senesce roughly around the time fieldwork was undertaken, other plants observed off site (i.e., under forest canopy) were still primarily green. Furthermore, the leaf colouration of lopseed and large enchanter's nightshade was also noted as more pale than commonly observed, possibly due to increased light from canopy clearing. Photograph 4-6f shows rare plant large enchanter's-nightshade, observed near the Assiniboine River crossing.

Photograph 4-6f. Large enchanter's-nightshade (pale green plants at center).

4.7 Rehabilitation Monitoring

Rehabilitation

The Bipole III 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, C1, C2, AC collector lines and the construction power line. In the south, Sections S1 and S2, as well as some areas of N4, C1 and C2 were accessed by road.

In 2015, two water crossings were observed to have already 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 rehabitation and erosion control success.

At the Mitishto River (479170 E and 6050339 N) in 2016, rehabitation and erosion control appeared to be successful. No evidence of ongoing erosion was visible at the time of the survey in July. The erosion control blanket was observed to be intact, but not visible throughout the entire banks of river as a result of vegetation re-establishing (Photograph 4-7a). At some locations, the shrubs were pushing up the blanket while in other areas the vegetation was growing through the blanket. The re-establishment of natural vegetation was mostly continuous in distribution with abundant cover (>50%); few areas with sparse (<10%) vegetation were observed. Vegetation colonizing the banks was mostly shrub cover of red-osier dogwood (*Cornus sericea*), prickly rose (*Rosa acicularis*), Saskatoon (*Amelanchier alnifolia*), balsam poplar (*Populus balsamifera*), and willow species (*Salix* spp.). Grasses such as hairy wild rye (*Leymus innovatus*) and Canada reed grass (*Calamagrostis canadensis*) were also observed. At this time, no additional rehabilitation is being recommended for the Mitishto River crossing.

At the Hunting River (670030 E, 6248581 N) in 2016, no visible signs of ongoing erosion were observed at the time of the survey (July). The previously installed fibre blanket was not visible for most of the river bank, only remnants of the blank were observed. The fibre blanket has either begun to discintigrate or was removed by vehicles and heavy equipment during construction activity. Along the east side of the river at the centerline access trail crossing, the mineral soil material was exposed with sparse (<10%) graminoid cover (Photograph 4-7b). In comparison, the west bank had greater cover of vegetation (10-50%) and was more continuous in distribution. Species included water sedge (*Carex aquatilis*), Canada reed grass (*Calamagrostis canadensis*), water-hemlock (*Cicuta maculata*), and mare's-tail (*Hippuris vulgaris*). Here, the remaining fibre blanket supported emerging vegetation but also retained the litter layer for additional ground cover and support.

Photograph 4-7a. Erosion control at Mitishto River.

Photograph 4-7b. Erosion control at Hunting River.

Although there was no evidence of erosion or rutting of soil material, a fibre blanket could be re-installed (or other measure) along the east side of the river to help promote surface stability for re-establishing natural vegetation. Rigmats could also be used at this location, when crossing. The river bank slope was 15 to 20% and the width of the crossing was approximately 10 m.

In Section N4, a stream crossing was observed without a buffer at the intersection with the RoW (14U 359634, 5845876). Erosion was observed at and downstream of the crossing. Tree trunks were seen down the stream away from the crossing, but not caused by clearing. As erosion control has not been implemented, the installation of fibre blankets would be a measure that could be used to reduce erosion at the stream crossing.

Access trails in Sections N1 and N2 were inspected from the air to identify areas that may require rehabilitation measures, as a result of equipment travel for construction activities. No major rutting issues were observed or any evidence of erosion. Two access trails in Section N2 were observed to support high cover of white sweet clover. These areas are identified in the Recommendations Section 5.0 for invasive species control.

On other access trails and areas of the RoW (e.g., prairie), minor rutting was observed from local use of trails, and appeared not to be a result of construction activities. In some areas, ATV tracks have resulted in little amounts of vegetation and bare ground.

No additional sites requiring rehabilitation were observed during aerial inspections or road surveys, and no specific locations were identified by Manitoba Hydro that required site investigation for potential rehabilitation, in 2016.

In 2017, all rehabilitation areas, or areas in need of rehabilitation will be visited to inspect the area for soil erosion and monitor the re-establishment of natural 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 III monitoring. Nearly all terrestrial sites (TER) showed an increase in species richness (83% of sites) between Year II and Year III environmental monitoring. Similarily, both resource area (ATK) and invasive (INV) sites showed increases in species richness over two growing seasons (88% and 71% of sites, respectively). The single praire (PRA) site monitored showed a decrease species richness, while wetlands

(WET) showed approximately the same amount of both increases and decreases in number of species present between Year II and Year III environmental monitoring.

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 III monitoring. 2016 plot surveys for invasive and non-native species revealed that 24 invasive and non-native species occurred along the RoW. Adjacent to the RoW (off site surveys), fewer invasive and non-native species occurred. Where these species are initially present (e.g., roadside, rail line) or introduced to a site by construction equipment, invasive and non-native species have the ability to proliferate on disturbed ground conditions.

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*) could not be clearly proven or rejected after Year III monitoring. Although low sweet blueberry increased in abundance in some sites, it decreased in abundance in others since surveys were initiated in 2014. Similarily, velvetleaf blueberry has both increased and decreased at different sites surveyed. However, since clearing of the RoW, blueberry plants have newly established at some sites that are monitored annually. Future monitoring of the resource area will provide further data to better assessed and test the hypothesis that there is a relationship between the abundance of blueberry plants and clearing activities.

5.0 RECOMMENDATIONS

Based on the 2016 vegetation surveys conducted and observations recorded on the RoW, the following are recommendations for future project clearing and construction activities. Plot coordinates are provided in Appendix V.

Cowan Blueberry Resource Area

Future travel and construction activities in the Cowan Resource Area should be confined to the equipment path, where possible. Some areas support good blueberry recovery and species of conservation concern have also been observed. The Resource Area RoW also has areas with erodible sandy soils and caution with vehicle traffic and equipment should be taken in this location.

In many areas, vegetation cover along the equipment path is sparse and the sandy soils are easily disturbed. It is recommended that construction activities occur on frozen ground conditions with snow cover. For additional protection in this area, the equipment path could be mulched to reduce erosion and provide ground protection.

Rutting and Other Ground Disturbances

Rutting was observed occasionally along the RoW during aerial and ground surveys in both upland and lowland sites (e.g., S1-PRA-900 and S1-SCC-700). Most rutting observed was minor along the centre line trail. At, plot N4-INV-200, deep ruts from construction activities occurred adjacent to the equipment path for a short distance. Any future occurrence of rutting along the RoW should be graded to pre-existing conditions at the time of the effect or when conditions are suitable.

In Section N1, dig-out areas were occasionally observed near the tower footing locations. These dig-outs were generally <5m^2 and about 1m in depth. These locations have the potential to support invasive and non-native species as a result of the exposed soil. Where possible, these areas should be filled in and leveled if no longer required.

The RoW for the collector lines, construction power line and occasionally along Section N1 contain newly scraped areas, as a result of tower construction and access. These areas were observed at the tower locations and occasionally along the equipment path. Vegetation regeneration cover decreased in these newly scraped areas. Where possible, for future construction and stringing activities under frozen ground conditions, scraping of the ground cover should be limited to the tower footing locations and reduced along the equipment path and adjacent areas. Heavily scraped areas will require time to recover as northern vegetation is slow glowing.

At the Hunting River (670030 E, 6248581 N), a fibre blanket could be re-installed along the east side of the river to promote natural re-vegetation. Similarily, fibre blankets could be installed at the Missewaitay River (650359 E, 6240892 N) where exposed banks were observed. Rig mats could also be used at both locations, when crossing these rivers.

Invasive and Non-native Species

Non-native and invasive species were observed during ground surveys and aerial investigations along the RoW. Sites (plots and access roads) where these species are spreading along the RoW include the following:

- N4-INV-500, Canada thistle, management 0 to 100 m from roadside
- N3-INV-100, white sweet clover and field sow-thistle, management 0 to 200 m from roadside
- N3-INV-400, white sweet clover and ox-eye daisy, management 0 to 100 m from roadside
- N3-INV-500, field sow-thistle and butter-and-eggs, management 0 to 100 m from railline
- C1-INV-100, white sweet clover, management 0 to 100 m from roadside
- C1-INV-200, white sweet clover, management 0 to 100 m from roadside
- C1-INV-300, white sweet clover, management 0 to 100 m from roadside
- C1-INV-400, white sweet clover, management 0 to 100 m from roadside
- C1-INV-500, white sweet clover, management 0 to 100 m from roadside
- N2 access road, white sweet clover, management from (14U) 565869E, 6136768N to 554253E, 6124377N
- N2 access road, white sweet clover, management at (14U) 548798E, 6117420N

In Sections C1 and C2, white sweet clover patches were observed along the RoW during the aerial investigation at the following locations:

UTM E	UTM N	UTM E	UTM N
Section C1		**Section C2**	
412745	5737097	470318	5690934
413309	5736085	471485	5690927
413784	5735302	478037	5690802
414775	5733571	487740	5660358
415249	5732774	516410	5598819
416011	5731462	514857	5602160

419888	5724840	514447	5603051
424182	5722736	511003	5610499
424875	5722404	508300	5617113
427187	5721285	508156	5617410
431097	5719437	508026	5617711
435040	5717549	505246	5624139
435784	5717196	504996	5624675
440287	5714851	503299	5633629
440844	5714409	502578	5635101
442260	5713105	502274	5635749
443095	5712450	500511	5638204
451198	5704149	497651	5642826
452165	5703476	496984	5644019
457199	5699917	493177	5650706
465399	5694137		
465737	5693900		
466017	5693698		
468216	5692149		
468899	5691670		

In Sections S1 and S2, non-native and invasive species were observed in several locations where the RoW intersects roadside ditches. Access to the RoW should occur at established approaches to agricultural fields, where present, to reduce the spread of these species.

Vegetation management for invasive species in all of these areas is recommended. Sections C1 and C2 had an observable increase in invasive species cover in 2016, from the previous year. The risk of spread into adjacent sites or further along the RoW may increase with each season. Management may include manual control, mowing or spraying. For sweet clover, manual control (hand-pulling) is effective for small infestations, if the roots are removed. Mechanical control (mowing) should occur before seed production, and chemical control is effective. Refer to treatment options for select species in the Manitoba Hydro Rehabilitation and Invasive Species Management Plan (Manitoba Hydro 2016). Where herbicides are 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). Where possible, herbicide control should be minimized to reduce adverse impacts on the environment.

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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).

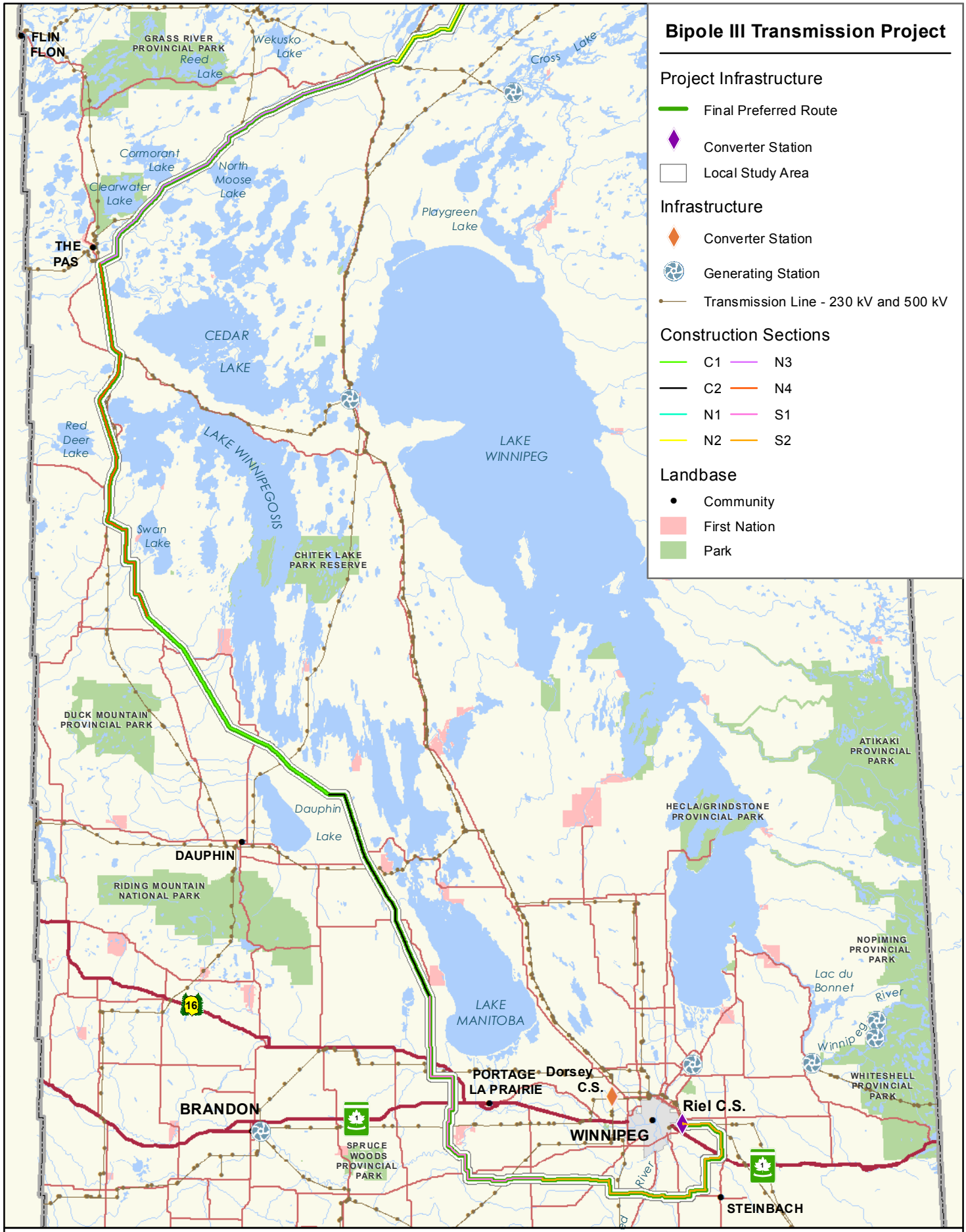
Vascular Plant – A plant having a vascular system (Usher 1996).

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.



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Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan
Date Created: September 14, 2016

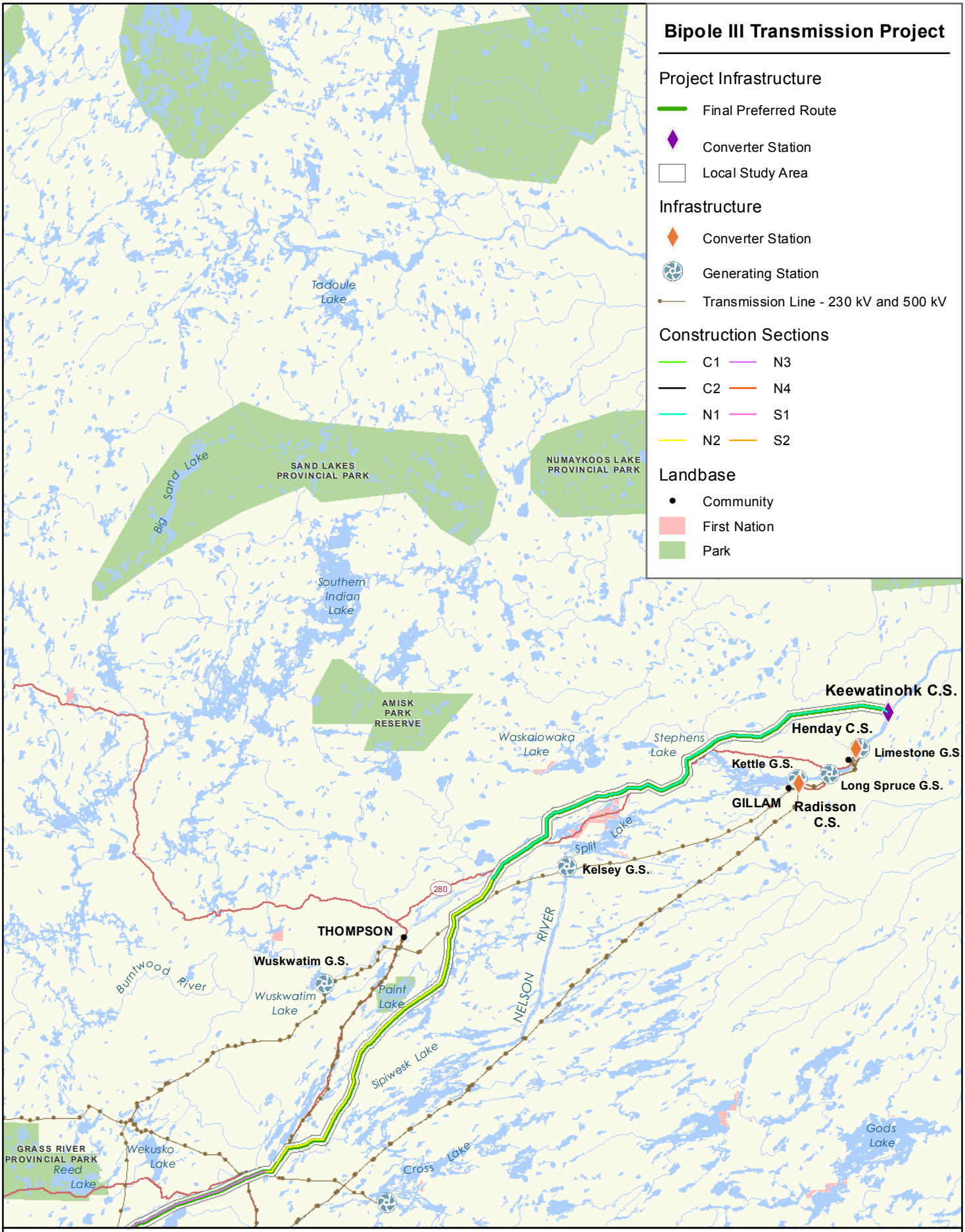
0 50 100 Kilometres
0 25 50 Miles

1:2,500,000

Bipole III Transmission Project Area

Map 1-1

File Location: I:\CLIENTS\MANITOBA_HYDRO\1404220\Mapping\MXD\Vegetation\SzwalukEnvironmentalConsulting\KevinSzwaluk\20160914\BPIII_TECHREP_TransmissionProjectArea_2_5m_A_20160914_Map1_1_DRAFT.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
SAND LAKES PROVINCIAL PARK
Big Sand Lake
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
GRASS RIVER PROVINCIAL PARK
Reed Lake
Wekusko Lake
Cross Lake
Gods Lake
Coordinate System: UTM Zone 14 NAD 83
Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan
Date Created: September 14, 2016
0 50 100 Kilometres
0 25 50 Miles
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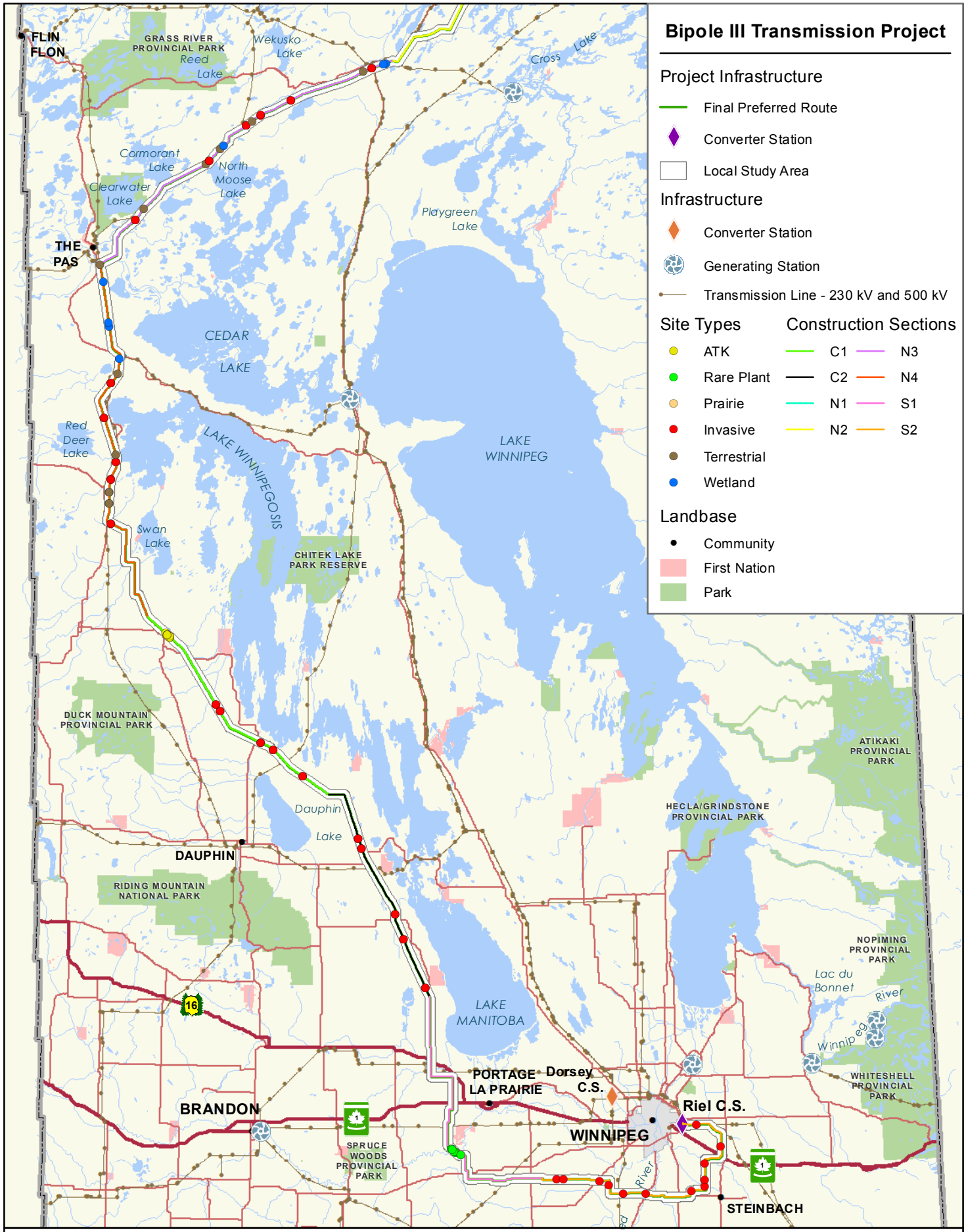
1:2,500,000
Manitoba Hydro
Bipole III Transmission Project Area
Map 1-1
File Location: I:\CLIENTS\MANITOBA_HYDRO\1404220\Mapping\MXD\Vegetation\SzwalukEnvironmentalConsulting\KevinSzwaluk\20160914BPIII_TECHREP_TransmissionProjectArea_2_5m_A_20160914_Map1_1_DRAFT.mxd



Manitoba Hydro

Coordinate System: UTM Zone 14 NAD 83
Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan, SEC
Date Created: September 14, 2016

0 50 100 Kilometres
0 25 50 Miles

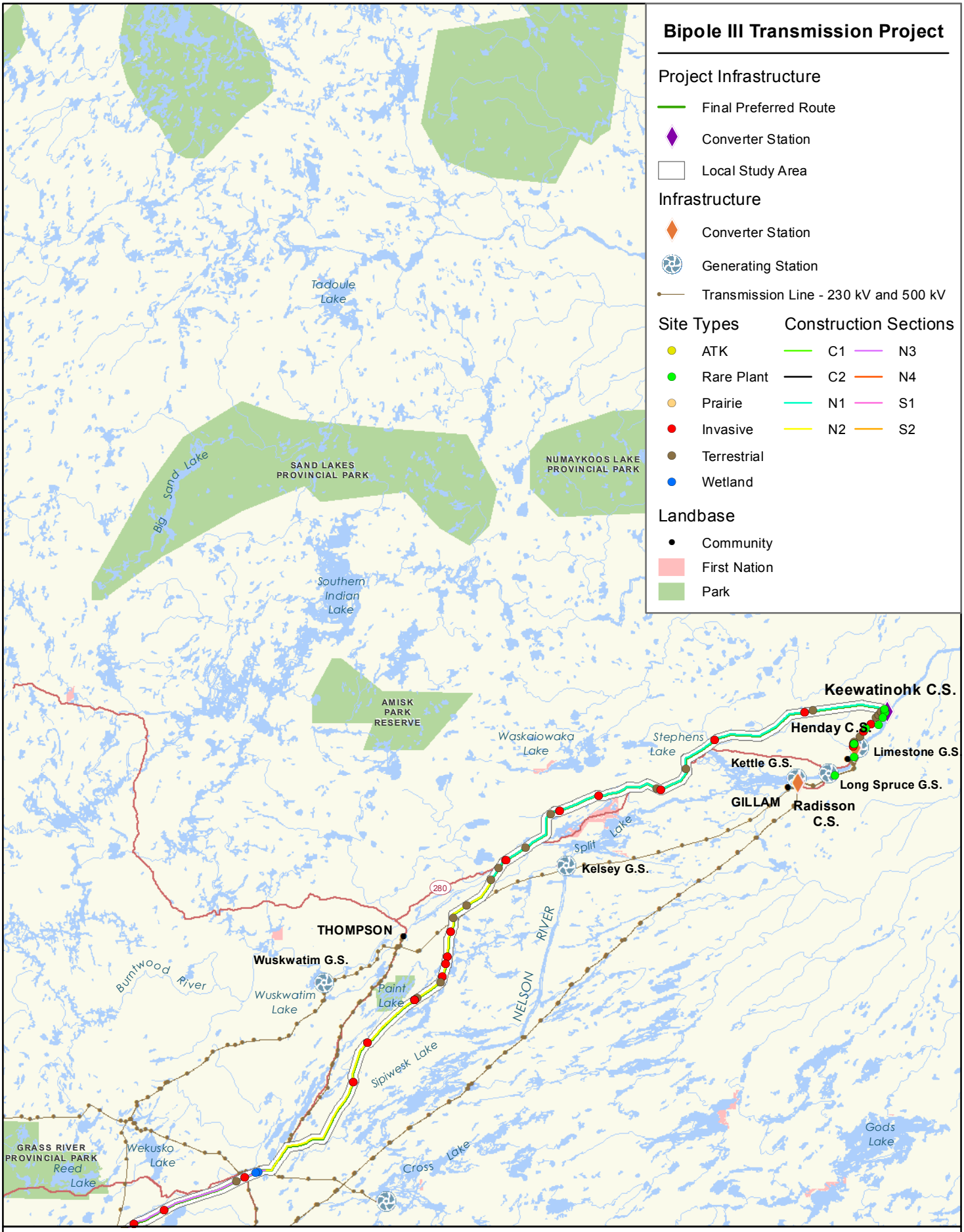
N

1:2,500,000

Distribution of Vegetation Sites

Map 4-1

File Location: I:\CLIENTS\MANITOBA_HYDRO\1404220\Mapping\MXD\Vegetation\SzwalukEnvironmentalConsulting\KevinSzwaluk\20160914\BPIII_TECHREP_VegetationDistributionSites_2_5m_A_20160914_Map4_1_DRAFT.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
Rare Plant
Prairie
Invasive
Terrestrial
Wetland
Construction Sections
C1
C2
N1
N2
N3
N4
S1
S2
Landbase
Community
First Nation
Park
Tadoule Lake
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Burntwood River
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GRASS RIVER PROVINCIAL PARK
Reed Lake
Wekusko Lake
Cross Lake
Gods Lake
Coordinate System: UTM Zone 14 NAD 83
Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan, SEC
Date Created: September 14, 2016
0 50 100 Kilometres
0 25 50 Miles
1:2,500,000
N
Distribution of Vegetation Sites
Map 4-1
File Location: I:\CLIENTS\MANITOBA_HYDRO\1404220\Mapping\MXD\Vegetation\SzwalukEnvironmentalConsulting\KevinSzwaluk\20160914BPIII_TECHREP_VegetationDistributionSites_2_5m_A_20160914_Map4_1_DRAFT.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, 2016.

Site	Section/Component	UTM Zone	Easting	Northing
C1-ATK-100	C1	14		
C1-ATK-101	C1	14		
C1-ATK-200	C1	14		
C1-ATK-300	C1	14		
C1-ATK-301	C1	14		
C1-ATK-400	C1	14		
C1-ATK-500	C1	14		
C1-ATK-501	C1	14		
C1-ATK-600	C1	14		
C1-ATK-700	C1	14		
C1-ATK-800	C1	14		
C1-ATK-801	C1	14		
C1-ATK-900	C1	14		
C1-ATK-950	C1	14		
C1-INV-100	C1	14		
C1-INV-101	C1	14		
C1-INV-200	C1	14		
C1-INV-201	C1	14		
C1-INV-300	C1	14		
C1-INV-301	C1	14		
C1-INV-400	C1	14		
C1-INV-401	C1	14		
C1-INV-500	C1	14		
C1-INV-501	C1	14		
C2-INV-100	C2	14		
C2-INV-101	C2	14		
C2-INV-200	C2	14		
C2-INV-201	C2	14		
C2-INV-300	C2	14		
C2-INV-301	C2	14		
C2-INV-400	C2	14		
C2-INV-401	C2	14		
C2-INV-500	C2	14		
C2-INV-501	C2	14		
CL-ECO-300	AC Collector Line	15		
CL-ECO-301	AC Collector Line	15		
CL-ECO-302	AC Collector Line	15		
CL-ECO-303	AC Collector Line	15		
CL-ECO-304	AC Collector Line	15		
CL-ECO-305	AC Collector Line	15		
CL-INV-100	AC Collector Line	15		
CL-INV-101	AC Collector Line	15		
CL-INV-200	AC Collector Line	15		
CL-INV-201	AC Collector Line	15		

Site	Section/Component	UTM Zone	Easting	Northing
CL-INV-300	AC Collector Line	15		
CL-INV-301	AC Collector Line	15		
CL-SCC-100	AC Collector Line	15		
CL-SCC-200	AC Collector Line	15		
CL-TER-100	AC Collector Line	15		
CL-TER-200	AC Collector Line	15		
CL-TER-300	AC Collector Line	15		
CP-ECO-300	Construction Power Line	15		
CP-ECO-301	Construction Power Line	15		
CP-INV-100	Construction Power Line	15		
CP-INV-101	Construction Power Line	15		
CP-INV-200	Construction Power Line	15		
CP-INV-201	Construction Power Line	15		
CP-TER-100	Construction Power Line	15		
CP-TER-200	Construction Power Line	15		
GEL-SCC-100	Northern Ground Electrode Line	15		
GEL-SCC-200	Northern Ground Electrode Line	15		
N1-INV-100	N1	14		
N1-INV-101	N1	14		
N1-INV-200	N1	14		
N1-INV-201	N1	14		
N1-INV-300	N1	14		
N1-INV-301	N1	14		
N1-INV-400	N1	15		
N1-INV-401	N1	15		
N1-INV-500	N1	15		
N1-INV-501	N1	15		
N1-INV-600	N1	15		
N1-INV-601	N1	15		
N1-TER-100	N1	14		
N1-TER-200	N1	14		
N1-TER-300	N1	14		
N1-TER-400	N1	15		
N1-TER-500	N1	15		
N1-TER-600	N1	15		
N2-INV-100	N2	14		
N2-INV-101	N2	14		
N2-INV-200	N2	14		
N2-INV-201	N2	14		
N2-INV-300	N2	14		
N2-INV-301	N2	14		
N2-INV-400	N2	14		
N2-INV-401	N2	14		
N2-INV-500	N2	14		
N2-INV-501	N2	14		

Site	Section/Component	UTM Zone	Easting	Northing
N2-INV-600	N2	14		
N2-INV-601	N2	14		
N2-INV-700	N2	14		
N2-INV-701	N2	14		
N2-INV-800	N2	14		
N2-INV-801	N2	14		
N2-TER-100	N2	14		
N2-TER-200	N2	14		
N2-TER-300	N2	14		
N2-TER-400	N2	14		
N2-TER-500	N2	14		
N3-INV-100	N3	14		
N3-INV-101	N3	14		
N3-INV-200	N3	14		
N3-INV-201	N3	14		
N3-INV-300	N3	14		
N3-INV-301	N3	14		
N3-INV-400	N3	14		
N3-INV-401	N3	14		
N3-INV-500	N3	14		
N3-INV-501	N3	14		
N3-INV-600	N3	14		
N3-INV-601	N3	14		
N3-TER-100	N3	14		
N3-TER-200	N3	14		
N3-TER-300	N3	14		
N3-TER-400	N3	14		
N3-TER-500	N3	14		
N3-WET-100	N3	14		
N3-WET-200	N3	14		
N3-WET-300	N3	14		
N4-INV-100	N4	14		
N4-INV-101	N4	14		
N4-INV-200	N4	14		
N4-INV-201	N4	14		
N4-INV-300	N4	14		
N4-INV-301	N4	14		
N4-INV-400	N4	14		
N4-INV-401	N4	14		
N4-INV-500	N4	14		
N4-INV-501	N4	14		
N4-TER-100	N4	14		
N4-TER-200	N4	14		
N4-TER-300	N4	14		
N4-TER-400	N4	14		
N4-TER-401	N4	14		
N4-TER-500	N4	14		

Site	Section/Component	UTM Zone	Easting	Northing
N4-TER-501	N4	14		
N4-WET-100	N4	14		
N4-WET-200	N4	14		
N4-WET-300	N4	14		
N4-WET-400	N4	14		
S1-PRA-900	S1	14		
S1-SCC-100	S1	14		
S1-SCC-110	S1	14		
S1-SCC-200	S1	14		
S1-SCC-300	S1	14		
S1-SCC-310	S1	14		
S1-SCC-400	S1	14		
S1-SCC-500	S1	14		
S1-SCC-530	S1	14		
S1-SCC-600	S1	14		
S1-SCC-610	S1	14		
S1-SCC-700	S1	14		
S2-INV-001	S2	14		
S2-INV-002	S2	14		
S2-INV-003	S2	14		
S2-INV-004	S2	14		
S2-INV-005	S2	14		
S2-INV-006	S2	14		
S2-INV-007	S2	14		
S2-INV-008	S2	14		
S2-INV-009	S2	14		
S2-INV-010	S2	14		
S2-INV-011	S2	14		
S2-INV-012	S2	14		

APPENDIX VI. Species of conservation concern recorded at or near surveys, 2016.

Site	Species	MBCDC Rank	UTM Zone	Easting	Northing
S1-SCC-530	*Agrimonia gryposepala*	S1S2	14		
S1-SCC-530	*Agrimonia gryposepala*	S1S2	14		
S1-SCC-530	*Agrimonia gryposepala*	S1S2	14		
S1-SCC-600	*Agrimonia gryposepala*	S1S2	14		
S1-SCC-600	*Agrimonia gryposepala*	S1S2	14		
S1-SCC-530	*Agrimonia gryposepala*	S1S2	14		
S1-SCC-530	*Amphicarpaea bracteata*	S3S5	14		
S1-SCC-110	*Amphicarpaea bracteata*	S3S5	14		
C1-ATK-100	*Arabis lyrata*	S1S2	14		
C1-ATK-101	*Arabis lyrata*	S1S2	14		
C1-ATK-801	*Arabis lyrata*	S1S2	14		
GEL-SCC-200	*Astragalus americanus*	S2S3	15		
N1-INV-601	*Astragalus americanus*	S2S3	15		
N4-WET-300	*Caltha natans*	S2S4	14		
S1-SCC-500	*Circaea lutetiana*	S2	14		
S1-SCC-530	*Circaea lutetiana*	S2	14		
S1-SCC-530	*Circaea lutetiana*	S2	14		
S1-SCC-530	*Circaea lutetiana*	S2	14		
S1-SCC-530	*Circaea lutetiana*	S2	14		
S1-SCC-600	*Circaea lutetiana*	S2	14		
S1-SCC-600	*Circaea lutetiana*	S2	14		
S1-SCC-600	*Circaea lutetiana*	S2	14		
S1-SCC-110	*Circaea lutetiana*	S2	14		
S1-SCC-530	*Circaea lutetiana*	S2	14		
S1-SCC-530	*Circaea lutetiana*	S2	14		
S1-SCC-600	*Circaea lutetiana*	S2	14		
S1-SCC-110	*Circaea lutetiana*	S2	14		
S1-SCC-530	*Cryptotaenia canadensis*	S1	14		
S1-SCC-500	*Cryptotaenia canadensis*	S1	14		
S1-SCC-530	*Cyperus schweinitzii*	S2	14		
S1-SCC-530	*Cyperus schweinitzii*	S2	14		
S1-SCC-530	*Cyperus schweinitzii*	S2	14		
S1-SCC-530	*Cyperus schweinitzii*	S2	14		
S1-SCC-700	*Cyperus schweinitzii*	S2	14		
S1-SCC-700	*Cyperus schweinitzii*	S2	14		
S1-SCC-700	*Cyperus schweinitzii*	S2	14		
S1-SCC-700	*Cyperus schweinitzii*	S2	14		
S1-SCC-700	*Dalea villosa*	S2?	14		
S1-SCC-700	*Dalea villosa*	S2?	14		
S1-SCC-100	*Desmodium canadense*	S2	14		
S1-SCC-100	*Desmodium canadense*	S2	14		
CL-ECO-300	*Drosera anglica*	S3S4	15		

Site	Species	MBCDC Rank	UTM Zone	Easting	Northing
CL-SCC-100	*Drosera anglica*	S3S4	15		
GEL-SCC-100	*Drosera anglica*	S3S4	15		
N3-WET-100	*Drosera anglica*	S3S4	14		
N4-WET-201	*Drosera anglica*	S3S4	14		
N4-WET-400	*Drosera anglica*	S3S4	14		
N4-WET-300	*Drosera linearis*	S2?	14		
C1-ATK-301	*Hudsonia tomentosa*	S3	14		
C1-ATK-400	*Hudsonia tomentosa*	S3	14		
C1-ATK-501	*Hudsonia tomentosa*	S3	14		
S1-SCC-200	*Impatiens noli-tangere*	S1	14		
S1-SCC-200	*Impatiens noli-tangere*	S1	14		
S1-PRA-900	*Lithospermum incisum*	S3	14		
S1-SCC-700	*Lygodesmia juncea*	S3S4	14		
S1-SCC-500	*Onosmodium molle*	S3S4	14		
S1-SCC-600	*Onosmodium molle*	S3S4	14		
S1-SCC-310	*Onosmodium molle*	S3S4	14		
S1-SCC-310	*Onosmodium molle*	S3S4	14		
S1-SCC-310	*Onosmodium molle*	S3S4	14		
S1-SCC-310	*Onosmodium molle*	S3S4	14		
S1-SCC-310	*Onosmodium molle*	S3S4	14		
S1-SCC-310	*Onosmodium molle*	S3S4	14		
S1-SCC-310	*Onosmodium molle*	S3S4	14		
S1-SCC-400	*Onosmodium molle*	S3S4	14		
S1-SCC-400	*Onosmodium molle*	S3S4	14		
S1-SCC-400	*Onosmodium molle*	S3S4	14		
S1-SCC-400	*Onosmodium molle*	S3S4	14		
S1-SCC-400	*Onosmodium molle*	S3S4	14		
S1-SCC-310	*Onosmodium molle*	S3S4	14		
S1-SCC-400	*Onosmodium molle*	S3S4	14		
S1-SCC-400	*Onosmodium molle*	S3S4	14		
S1-SCC-500	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-600	*Osmorhiza claytonii*	S2?	14		
S1-SCC-600	*Osmorhiza claytonii*	S2?	14		
S1-SCC-610	*Osmorhiza claytonii*	S2?	14		

Site	Species	MBCDC Rank	UTM Zone	Easting	Northing
S1-SCC-600	*Osmorhiza claytonii*	S2?	14		
S1-SCC-600	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-310	*Osmorhiza claytonii*	S2?	14		
S1-SCC-310	*Osmorhiza claytonii*	S2?	14		
S1-SCC-310	*Osmorhiza claytonii*	S2?	14		
S1-SCC-400	*Osmorhiza claytonii*	S2?	14		
S1-SCC-500	*Osmorhiza claytonii*	S2?	14		
S1-SCC-500	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-530	*Osmorhiza claytonii*	S2?	14		
S1-SCC-600	*Osmorhiza claytonii*	S2?	14		
S1-SCC-600	*Osmorhiza claytonii*	S2?	14		
S1-SCC-600	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		
S1-SCC-200	*Osmorhiza claytonii*	S2?	14		

Site	Species	MBCDC Rank	UTM Zone	Easting	Northing
S1-SCC-310	*Osmorhiza claytonii*	S2?	14		
S1-SCC-310	*Osmorhiza claytonii*	S2?	14		
S1-SCC-310	*Osmorhiza claytonii*	S2?	14		
S1-SCC-310	*Osmorhiza claytonii*	S2?	14		
S1-SCC-400	*Osmorhiza claytonii*	S2?	14		
CL-ECO-300	*Pedicularis macrodonta*	S2S3	15		
GEL-SCC-100	*Pedicularis macrodonta*	S2S3	15		
S1-SCC-500	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-600	*Phryma leptostachya*	S3	14		
S1-SCC-200	*Phryma leptostachya*	S3	14		
S1-SCC-200	*Phryma leptostachya*	S3	14		
S1-SCC-200	*Phryma leptostachya*	S3	14		
S1-SCC-200	*Phryma leptostachya*	S3	14		
S1-SCC-200	*Phryma leptostachya*	S3	14		
S1-SCC-310	*Phryma leptostachya*	S3	14		
S1-SCC-310	*Phryma leptostachya*	S3	14		
S1-SCC-310	*Phryma leptostachya*	S3	14		
S1-SCC-310	*Phryma leptostachya*	S3	14		
S1-SCC-310	*Phryma leptostachya*	S3	14		
S1-SCC-400	*Phryma leptostachya*	S3	14		
S1-SCC-400	*Phryma leptostachya*	S3	14		
S1-SCC-400	*Phryma leptostachya*	S3	14		
S1-SCC-400	*Phryma leptostachya*	S3	14		
S1-SCC-400	*Phryma leptostachya*	S3	14		
S1-SCC-400	*Phryma leptostachya*	S3	14		
S1-SCC-110	*Phryma leptostachya*	S3	14		
S1-SCC-110	*Phryma leptostachya*	S3	14		
S1-SCC-110	*Phryma leptostachya*	S3	14		
S1-SCC-500	*Phryma leptostachya*	S3	14		
S1-SCC-500	*Phryma leptostachya*	S3	14		
S1-SCC-500	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-530	*Phryma leptostachya*	S3	14		

Site	Species	MBCDC Rank	UTM Zone	Easting	Northing
S1-SCC-530	*Phryma leptostachya*	S3	14		
S1-SCC-600	*Phryma leptostachya*	S3	14		
S1-SCC-200	*Phryma leptostachya*	S3	14		
S1-SCC-200	*Phryma leptostachya*	S3	14		
S1-SCC-200	*Phryma leptostachya*	S3	14		
S1-SCC-200	*Phryma leptostachya*	S3	14		
S1-SCC-310	*Phryma leptostachya*	S3	14		
S1-SCC-310	*Phryma leptostachya*	S3	14		
S1-SCC-310	*Phryma leptostachya*	S3	14		
S1-SCC-310	*Phryma leptostachya*	S3	14		
S1-SCC-400	*Phryma leptostachya*	S3	14		
S1-SCC-110	*Phryma leptostachya*	S3	14		
S1-SCC-110	*Phryma leptostachya*	S3	14		
S1-SCC-100	*Phryma leptostachya*	S3	14		
CL-ECO-304	*Pinguicula villosa*	S3S4	15		
N1-INV-601	*Pinguicula villosa*	S3S4	15		
N3-INV-301	*Platanthera orbiculata*	S3	14		
N3-INV-301	*Platanthera orbiculata*	S3	14		
CL-ECO-300	*Rhynchospora alba*	S3	15		
CL-SCC-100	*Rhynchospora alba*	S3	15		
CL-SCC-100	*Rhynchospora alba*	S3	15		
CL-SCC-100	*Rhynchospora alba*	S3	15		
CL-SCC-100	*Rhynchospora alba*	S3	15		
CL-SCC-200	*Rhynchospora alba*	S3	15		
N3-WET-100	*Rhynchospora alba*	S3	14		
N4-WET-400	*Rhynchospora alba*	S3	14		
CL-ECO-301	*Salix arbusculoides*	S2S3	15		
CL-ECO-302	*Salix arbusculoides*	S2S3	15		
CL-ECO-303	*Salix arbusculoides*	S2S3	15		
CL-ECO-305	*Salix arbusculoides*	S2S3	15		
CL-INV-100	*Salix arbusculoides*	S2S3	15		
CP-ECO-301	*Salix arbusculoides*	S2S3	15		
GEL-SCC-200	*Salix arbusculoides*	S2S3	15		
N1-INV-200	*Salix arbusculoides*	S2S3	14		
N1-INV-500	*Salix arbusculoides*	S2S3	15		
N1-INV-501	*Salix arbusculoides*	S2S3	15		
N1-INV-600	*Salix arbusculoides*	S2S3	15		
N1-TER-600	*Salix arbusculoides*	S2S3	15		
N2-TER-200	*Salix arbusculoides*	S2S3	14		
CL-ECO-301	*Salix vestita*	S3	15		
GEL-SCC-200	*Salix vestita*	S3	15		
N1-INV-500	*Salix vestita*	S3	15		
N1-INV-501	*Salix vestita*	S3	15		
N1-INV-600	*Salix vestita*	S3	15		
N1-INV-601	*Salix vestita*	S3	15		

Site	Species	MBCDC Rank	UTM Zone	Easting	Northing
S1-SCC-530	*Sanguinaria canadensis*	S2	14		
S1-SCC-310	*Sanguinaria canadensis*	S2	14		
S1-SCC-310	*Sanguinaria canadensis*	S2	14		
S1-SCC-400	*Sanguinaria canadensis*	S2	14		
S1-SCC-400	*Sanguinaria canadensis*	S2	14		
S1-SCC-310	*Sanguinaria canadensis*	S2	14		
S1-SCC-400	*Sanguinaria canadensis*	S2	14		
S1-SCC-400	*Sanguinaria canadensis*	S2	14		
C1-ATK-700	*Selaginella densa*	S3	14		
N1-INV-601	*Selaginella selaginoides*	S3S4	15		
S1-SCC-200	*Streptopus amplexifolius*	S2?	14		
S1-SCC-200	*Streptopus amplexifolius*	S2?	14		
S1-SCC-200	*Streptopus amplexifolius*	S2?	14		
S1-SCC-200	*Streptopus amplexifolius*	S2?	14		
S1-SCC-530	*Vitis riparia*	S3S4	14		
S1-SCC-530	*Vitis riparia*	S3S4	14		
S1-SCC-530	*Vitis riparia*	S3S4	14		
S1-SCC-530	*Vitis riparia*	S3S4	14		
S1-SCC-600	*Vitis riparia*	S3S4	14		
S1-SCC-610	*Vitis riparia*	S3S4	14		
S1-SCC-200	*Vitis riparia*	S3S4	14		
S1-SCC-300	*Vitis riparia*	S3S4	14		
S1-SCC-310	*Vitis riparia*	S3S4	14		
S1-SCC-400	*Vitis riparia*	S3S4	14		
S1-SCC-110	*Vitis riparia*	S3S4	14		
S1-SCC-110	*Vitis riparia*	S3S4	14		
S1-SCC-110	*Vitis riparia*	S3S4	14		
S1-SCC-100	*Vitis riparia*	S3S4	14		
S1-SCC-310	*Vitis riparia*	S3S4	14		

APPENDIX VII. Flora recorded from native plant and rare plant surveys (2016). Introduced species are ranked SNA, invasive species are indicated (*).

Family/ Species	Common Name	MBCDC S Rank
	VASCULAR PLANTS	
	Pteridophytes - Ferns and Allies	
DRYOPTERACEAE	WOOD FERN FAMILY	
Gymnocarpium dryopteris	Common Oak Fern	S4S5
Matteuccia struthiopteris	Ostrich Fern	S5
EQUISETACEAE	HORSETAIL FAMILY	
Equisetum arvense	Field 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	Woodland Horsetail	S5
LYCOPODIACEAE	CLUB-MOSS FAMILY	
Lycopodium dendroideum	Ground-pine	S4
SELAGINELLACEAE	SPIKEMOSS FAMILY	
Selaginella densa	Prairie Spike-moss	S3
	Gymnosperms	
CUPRESSACEAE	CYPRESS FAMILY	
Juniperus communis	Common Juniper	S5
PINACEAE	PINE FAMILY	
Abies balsamea	Balsam Fir	S5
Larix laricina	Tamarack	S5
Picea glauca	White Spruce	S5
Picea mariana	Black Spruce	S5
Pinus banksiana	Jack Pine	S5
	Angiosperms - Monocotyledons	
CYPERACEAE	SEDGE FAMILY	
Carex aquatilis	Water Sedge	S5
Carex atherodes	Awned Sedge	S5
Carex aurea	Golden Sedge	S5
Carex buxbaumii	Buxbaum's Sedge	S4S5
Carex capillaris	Hair-like Sedge	S5
Carex chordorrhiza	Prostrate 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	Northern Bog Sedge	S5
Carex interior	Inland Sedge	S4?
Carex leptalea	Bristle-stalked Sedge	S5
Carex magellanica	Bog Sedge	S5
Carex pellita	Woolly Sedge	S5
Carex trisperma	Three-seeded Sedge	S4S5
Carex vaginata	Sheathed Sedge	S5
Carex sp.	A Sedge	
Cyperus schweinitzii	Schweinitz's Flatsedge	S2
Eleocharis palustris	Creeping Spike-rush	S5
Eriophorum viridicarinatum	Thin-leaved Cotton-grass	S4
Eriophorum sp.	A Cotton-grass	
Rhynchospora alba	White Beakrush	S3
Scirpus sp.	A Bulrush	
JUNCACEAE	RUSH FAMILY	
Juncus arcticus var. *balticus*	Baltic Rush	S5
Juncus sp.	A Rush	
JUNCAGINACEAE	ARROW-GRASS FAMILY	
Luzula multiflora	Many-flowered Woodrush	S4
Luzula parviflora	Small-flowered Woodrush	S4S5
Triglochin maritima	Seaside Arrow-grass	S5
LILIACEAE	LILY FAMILY	
Maianthemum canadense	Two-leaved Solomon's-seal	S5
Maianthemum stellatum	Star-flowered Solomon's-seal	S5
Maianthemum trifolium	Three-leaved Solomon's-seal	S5
Smilax lasioneura	Carrion Flower	S4S5
Streptopus amplexifolius	White Mandarin	S2?
Tofieldia pusilla	Bog Asphodel	S3S5
Zigadenus elegans	White Camas	S5
ORCHIDACEAE	ORCHID FAMILY	
Cypripedium reginae	Showy Lady's-slipper	S4
Goodyera repens	Lesser Rattlesnake Plantain	S4S5
Platanthera dilatata	Bog Candle	S3S4
Platanthera orbiculata	Round-leaved Bog Orchid	S3
Spiranthes romanzoffiana	Hooded Ladies'-tresses	S5
POACEAE	GRASS FAMILY	
Agropyron cristatum	Crested Wheat-grass	SNA

Agrostis scabra	Tickle-grass	S5
Andropogon gerardii	Big Bluestem	S5
Avena sativa	Oats	SNA
Bouteloua gracilis	Blue Grama	S4
Bromus ciliatus	Fringed Brome	S5
Bromus inermis	Smooth Brome	SNA
Calamagrostis canadensis	Marsh Reed Grass	S5
Calamagrostis stricta	Northern reed grass	S5
Calamagrostis sp.	A Reed Grass	
Calamovilfa longifolia	Sand Grass	S3S5
Cinna latifolia	Slenderwood Grass	S4S5
Danthonia spicata	Poverty Oat Grass	S4S5
Deschampsia cespitosa	Tufted Hairgrass	S4S5
Dichanthelium acuminatum var. *fasciculatum*	Soft Millet	S3
Echinochloa crus-galli	Barnyard Grass	SNA
Elymus repens	Quackgrass	SNA
Elymus trachycaulus	Slender Wheat Grass	S5
Elymus sp.	A Wheatgrass	
Festuca sp.	A Fescue	
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
Oryzopsis asperifolia	White-grained Mountain Rice Grass	S5
Phalaris arundinacea	Reed Canarygrass	S5*
Phleum pratense	Common Timothy	SNA
Piptatheropsis pungens	Northern Rice Grass	S4S5
Poa palustris	Fowl Bluegrass	S5
Poa pratensis	Kentucky Bluegrass	S5
Poa sp.	A bluegrass	
Schizachne purpurascens	Purple Oat Grass	S5
Schizachyrium scoparium	Little Bluestem	S3S4
Setaria pumila	Yellow Foxtail	SNA
Setaria viridis	Green Foxtail	SNA
Sporobolus cryptandrus	Sand Dropseed	S3S5
Triticum sp.	Wheat	SNA
TYPHACEAE	CAT-TAIL FAMILY	
Typha angustifolia	Narrow-leaved Cat-tail	S3S4

Angiosperms - Dicotyledons

ACERACEAE	MAPLE FAMILY

Acer negundo	Manitoba Maple	S5
AMARANTHACEAE	AMARANTH FAMILY	
Amaranthus albus	Tumble Pigweed	SNA
ANACARDIACEAE	SUMAC FAMILY	
Toxicodendron rydbergii	Poison-ivy	S5
APIACEAE	CARROT FAMILY	
Cicuta maculata	Spotted Water-hemlock	S4S5
Cryptotaenia canadensis	Honewort	S1
Osmorrhiza claytonii	Hairy Sweet Cicely	S2?
Osmorrhiza longistylis	Sweet Cicely	S5
Pastinaca sativa	Parsnip	SNA
Sanicula marilandica	Snakeroot	S5
Sium suave	Water-parsnip	S5
Zizia aptera	Heart-leaved Alexanders	S5
Zizia aurea	Golden Alexanders	S4S5
APOCYNACEAE	DOGBANE FAMILY	
Apocynum cannabinum	Indian-hemp	S4S5
Apocynum sp.	A Dogbane	
ARALIACEAE	GINSENG FAMILY	
Aralia nudicaulis	Wild Sarsaparilla	S5
ASCLEPIADACEAE	MILKWEED FAMILY	
Asclepias ovalifolia	Dwarf Milkweed	S4S5
ASTERACEAE	ASTER FAMILY	
Achillea alpina	Many-flowered Yarrow	S4S5
Achillea millefolium	Common Yarrow	S5
Ambrosia psilostachya	Perennial Ragweed	S5
Antennaria umbrinella	Brown Pussytoes	SNA
Antennaria sp.	A Pussytoes	
Arcticum minus	Lesser Burdock	SNA*
Arctium lappa	Great Burdock	SNA*
Arnica chamissonis	Leafy Arnica	S4
Artemisia campestris	Field sagewort	S4S5
Artemisia ludoviciana	Prairie Sage	S5
Cirsium arvense	Canada Thistle	SNA*
Cirsium flodmanii	Flodman's Thistle	S4
Cirsium sp.	A Thistle	
Erigeron glabellus	Smooth Fleabane	S5
Erigeron philadelphicus	Philadelphia Fleabane	S5

Erigeron sp.	A Fleabane	
Grindelia squarrosa	Curly-cup Gumweed	S5
Heterotheca villosa	Hairy Golden-aster	S5
Hieracium umbellatum	Umbellate Hawkweed	S5
Lactuca biennis	Tall Blue Lettuce	S4
Lactuca tatarica	Wild Lettuce	S5
Leucanthemum vulgare	Ox-eye Daisy	SNA*
Liatris ligulistylis	Meadow Blazingstar	S4
Lygodesmia juncea	Skeletonweed	S3S4
Matricaria discoidea	Pineapple Weed	SNA
Packera paupercula	Balsam Groundsel	S5
Petasites frigidus var. *palmatus*	Palmate-leaved Colt's-foot	S5
Petasites frigidus var. *sagittatus*	Arrow-leaved Colt's-foot	S5
Petasites frigidus var. *x vitifolius*	Vine-leaved Colt's-foot	SNA
Rudbeckia hirta	Black-eyed Susan	S5
Solidago canadensis	Canada Goldenrod	S5
Solidago hispida	Hairy Goldenrod	S5
Solidago multiradiata	Alpine Goldenrod	S4S5
Solidago nemoralis	Field Goldenrod	S5
Solidago simplex	Sticky Goldenrod	S3
Solidago sp.	A Goldenrod	
Sonchus arvensis	Field Sow-thistle	SNA*
Symphyotrichum boreale	Boreal Aster	S4S5
Symphyotrichum ciliolatum	Lindley's Aster	S5
Symphyotrichum laeve	Smooth Aster	S5
Symphyotrichum lateriflorum	Calico or Wood Aster	S4
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	Spotted Touch-me-not	S5
Impatiens noli-tangere	Western Jewelweed	S1
BETULACEAE	BIRCH FAMILY	
Alnus incana	Speckled Alder	S5
Alnus viridis	Green Alder	S5
Betula papyrifera	White Birch	S5
Betula pumila	Dwarf Birch	S5
Corylus cornuta	Beaked Hazel	S5
BORAGINACEAE	BORAGE FAMILY	
Cynoglossum virginianum var. *boreale*	Northern Wild Comfrey	S3S4

Lithospermum canescens	Hoary Puccoon	S5
Lithospermum incisum	Narrow-leaved Puccoon	S3
Mertensia paniculata	Tall Lungwort	S5
Onosmodium molle	Marble-seed	S3S4
BRASSICACEAE	MUSTARD FAMILY	
Arabis lyrata	Lyre-leaved Rock Cress	S1S2
Brassica napus	Turnip	SNA
Sinapis arvensis	Charlock	SNA
Thlaspi arvense	Field Pennycress	SNA
CAMPANULACEAE	BELLFLOWER FAMILY	
Campanula aparinoides	Marsh Bellflower	S5
Campanula rotundifolia	Harebell	S5
CANNABACEAE	HEMP FAMILY	
Humulus lupulus	Common Hop	S4
CAPRIFOLIACEAE	HONEYSUCKLE FAMILY	
Diervilla lonicera	Bush-honeysuckle	S5
Linnaea borealis	Twinflower	S5
Lonicera dioica	Limber or Twining Honeysuckle	S5
Lonicera oblongifolia	Swamp-fly-honeysuckle	S3S5
Lonicera villosa	Mountain-fly-honeysuckle	S5
Symphoricarpos albus	Snowberry	S4S5
Symphoricarpos occidentalis	Western Snowberry	S5
Viburnum edule	Mooseberry	S5
Viburnum opulus	Highbush-cranberry	S5
Viburnum rafinesquianum	Downy Arrow-wood	S4S5
CARYOPHYLLACEAE	PINK FAMILY	
Moehringia lateriflora	Grove Sandwort	S5
Stellaria crassifolia	Fleshy Stitchwort	S3S4
Stellaria longifolia	Long-leaved Stitchwort	S5
Stellaria longipes	Long-stalked Stitchwort	S5
CHENOPODIACEAE	GOOSEFOOT FAMILY	
Axyris amaranthoides	Russian Pigweed	SNA
Blitum capitatum	Strawberry Blite	S4S5
Chenopodium album	Lamb's-quarters	SNA
Chenopodium leptophyllum	Narrow-leaved Goosefoot	SNA
CISTACEAE	ROCK ROSE FAMILY	
Hudsonia tomentosa	False Heather	S3

CONVOLVULACEAE	CONVOLVULUS FAMILY	
Calystegia sepium	Hedge Bindweed	S4S5
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	Soapberry	S5
EMPETRACEAE	CROWBERRY FAMILY	
Empetrum nigrum	Black Crowberry	S5
ERICACAEA	HEATH FAMILY	
Andromeda polifolia	Bog rosemary	S5
Arctostaphylos uva-ursi	Common Bearberry	S5
Arctous alpina	Alpine Bearberry	S3S4
Arctous rubra	Alpine Bearberry	S4S5
Chamaedaphne calyculata	Leather-leaf	S5
Gaultheria hispidula	Creeping Snowberry	S4S5
Kalmia polifolia	Bog-laurel	S5
Rhododendron groenlandicum	Labrador-tea	S5
Rhododendron tomentosum	Dwarf Labrador-tea	S3S5
Vaccinium angustifolium	Low Sweet Blueberry	S4
Vaccinium myrtilloides	Velvet-leaf Blueberry	S5
Vaccinium oxycoccos	Small Cranberry	S5
Vaccinium uliginosum	Bog Whortleberry	S5
Vaccinium vitis-idaea	Bog Cranberry	S5
EUPHORBIACEAE	SPURGE FAMILY	
Chamaesyce glyptosperma	Ridge-seeded Spurge	S4
Euphorbia esula	Leafy Spurge	SNA*
FABACEAE	PEA FAMILY	
Amphicarpaea bracteata	Hog-peanut	S3S5
Astragalus americanus	American Milkvetch	S2S3
Dalea villosa	Hairy Prairie-clover	S2?
Desmodium canadense	Beggar's-lice	S2
Lathyrus ochroleucus	Pale Vetchling	S5
Lathyrus palustris	Marsh Vetchling	S5

Lathyrus venosus	Wild Peavine	S5
Lotus corniculatus	Bird's-foot Trefoil	SNA
Medicago lupulina	Black Medick	SNA
Medicago sativa	Alfalfa	SNA*
Melilotus albus	White Sweet Clover	SNA*
Melilotus officinalis	Yellow Sweet Clover	SNA*
Trifolium hybridum	Alsike Clover	SNA
Trifolium pratense	Red Clover	SNA
Trifolium repens	White Clover	SNA
Vicia americana	American Purple Vetch	S5
Vicia cracca	Tufted Vetch	SNA*
FAGACEAE	BEECH FAMILY	
Quercus macrocarpa	Bur Oak	S5
FUMARIACEAE	FUMITORY FAMILY	
Corydalis aurea	Golden Corydalis	S5
Corydalis sempervirens	Pink Corydalis	S5
GENTIANACEAE	GENTIAN FAMILY	
Halenia deflexa	Spurred Gentian	S5
GERANIACEAE	GERANIUM FAMILY	
Geranium bicknellii	Bicknell's Geranium	S5
GROSSULARIACEAE	CURRANT FAMILY	
Ribes americanum	Wild Black Currant	S5
Ribes glandulosum	Skunk Currant	S5
Ribes lacustre	Bristly Black Currant	S4
Ribes oxyacanthoides	Canada Wild Gooseberry	S5
Ribes triste	Wild Red Currant	S5
HYDROPHYLLACEAE		
Phacelia franklinii	Franklin's Scorpionweed	S4S5
IRIDACEAE	IRIS FAMILY	
Sisyrinchium montanum	Common Blue-eyed Grass	S5
LAMIACEAE	MINT FAMILY	
Dracocephalum parviflorum	American Dragon-head	S5
Galeopsis tetrahit	Common Hemp-nettle	SNA
Lycopus asper	Western Water-horehound	S4
Lycopus uniflorus	Northern Bugleweed	S4S5
Mentha arvensis	Common Mint	S5
Monarda fistulosa	Wild Bergamot	S5

Prunella vulgaris	Heal-all	S4
Scutellaria galericulata	Hooded Skullcap	S5
Stachys palustris	Marsh Hedge-nettle	S5
LENTIBULARIACEAE	BLADDERWORT FAMILY	
Pinguicula villosa	Small Butterwort	S3S4
Utricularia intermedia	Flat-leaved Bladderwort	S4S5
MENYANTHACEAE		
Menyanthes trifoliata	Bogbean	S5
MYRSINACEAE	MYRSINE FAMILY	
Lysimachia ciliata	Fringed Loosestrife	S5
Lysimachia thyrsiflora	Tufted Loosestrife	S5
Trientalis borealis	Northern Starflower	S5
NYCTAGINACEAE	FOUR O'CLOCK FAMILY	
Mirabilis sp.	An Umbrellawort	
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 Willow-herb	S5
Epilobium ciliatum ssp. *glandulosum*	Willow-herb	S5
Epilobium leptophyllum	Linear-leaf Willowherb	S4S5
Oenothera biennis	Evening-primrose	S5
PAPVERACEAE	POPPY FAMILY	
Sanguinaria canadensis	Blood-root	S2
PLANTAGINACEAE	PLANTAIN FAMILY	
Hippuris vulgaris	Common Mare's-tail	S5
Plantago major	Common Plantain	SNA
POLEMONIACEAE	PHLOX FAMILY	
Collomia linearis	Narrow-leaved Collomia	S5
POLYGALACEAE	MILKWORT FAMILY	
Polygala senega	Seneca Snakeroot	S4
POLYGONACEAE	SMARTWEED FAMILY	
Fallopia convolvulus	Black Bindweed	SNA
Polygonum amphibium	Water Smartweed	S5
Polygonum aviculare	Prostrate Knotweed	SU

Rumex crispus	Curled Dock	SNA
Rumex occidentalis	Western Dock	S4S5
PRIMULACEAE	PRIMROSE FAMILY	
Androsace septentrionalis	Pygmyflower	S5
PYROLACEAE	WINTERGREEN FAMILY	
Orthilia secunda	One-sided Wintergreen	S5
Pyrola asarifolia	Pink Pyrola	S5
Pyrola sp.	A Wintergreen	
RANUNCULACEAE	CROWFOOT FAMILY	
Actaea rubra	Red Baneberry	S5
Anemone canadensis	Canada Anemone	S5
Anemone cylindrica	Thimbleweed	S5
Anemone multifida	Cut-leaved Anemone	S5
Anemone patens	Prairie crocus	S4
Anemone sp.	An Anemone	
Aquilegia brevistyla	Small-flowered Columbine	S4
Caltha natans	Floating Marsh-marigold	S2S4
Caltha palustris	Marsh marigold	S5
Ranunculus lapponicus	Lapland Buttercup	S4S5
Thalictrum venulosum	Veiny Meadow-rue	S5
Thalictrum sp.	A Meadow-rue	
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
Dasiphora fruticosa	Shrubby Cinquefoil	S5
Fragaria virginiana	Smooth Wild Strawberry	S5
Geum aleppicum	Yellow Avens	S5
Potentilla norvegica	Rough Cinquefoil	S5
Potentilla sp.	A Cinquefoil	
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	Wild Red Raspberry	S5
Rubus pubescens	Dewberry	S5

Spiraea alba	Meadowsweet	S5
RUBIACEAE	MADDER FAMILY	
Galium boreale	Northern Bedstraw	S5
Galium labradoricum	Ladie's Bedstraw	S4S5
Galium trifidum	Small Bedstraw	S5
Galium triflorum	Sweet-scented Bedstraw	S5
Houstonia longifolia	Long-leaved Bluets	S3S5
SALICACEAE	WILLOW FAMILY	
Populus balsamifera	Balsam Poplar	S5
Populus tremuloides	Trembling Aspen	S5
Salix arbusculoides	Shrubby Willow	S2S3
Salix bebbiana	Bebb's or Beaked Willow	S5
Salix candida	Hoary Willow	S5
Salix exigua	Sandbar Willow	S5
Salix maccalliana	Velvet-fruited Willow	S4
Salix myrtillifolia	Myrtle-leaved Willow	S5
Salix pedicellaris	Bog Willow	S5
Salix planifolia	Tea-leaved Willow	S5
Salix vestita	Rock Willow	S3
Salix sp.	A Willow	
SANTALACEAE	SANDALWOOD FAMILY	
Geocaulon lividum	Northern Comandra	S5
SARRACENIACEAE	PITCHER PLANT FAMILY	
Sarracenia purpurea	Pitcher Plant	S4S5
SAXIFRAGACEAE	SAXIFRAGE FAMILY	
Mitella nuda	Mitrewort	S5
Parnassia palustris	Grass of Parnassus	S5
SCROPHULARIACEAE	FIGWORT FAMILY	
Euphrasia frigida	Northern Eyebright	S4S5
Linaria vulgaris	Yellow Toadflax	SNA*
Melampyrum lineare	Cow-wheat	S3S5
Pedicularis labradorica	Labrador Lousewort	S4
Pedicularis macrodonta	Muskeg Lousewort	S2S3
URTICACEAE	NETTLE FAMILY	
Urtica dioica	Stinging Nettle	S5
VERBENACEAE	VERVAIN FAMILY	
Phryma leptostachya	Lopseed	S3

VIOLACEAE	VIOLET FAMILY	
Viola pedatifida	Purple Prairie Violet	S4
VITACEAE	GRAPE FAMILY	
Parthenocissus quinquefolia	Virginia Creeper	S4
Vitis riparia	Riverbank Grape	S3S4

NON-VASCULAR PLANTS

Bryophytes

Dicranum spp.	Broom moss
Hylocomium splendens	Stairstep Moss
Marchantia polymorpha	Green-tongue Liverwort
Pleurozium schreberi	Red-stemmed Feather Moss
Polytrichum spp.	A Hair Cap moss
Sphagnum spp.	Peat Moss

Lichens

Cladina mitis	Green Reindeer Lichen
Cladina rangiferina	Gray Reindeer Lichen
Cladina stellaris	Northern Reindeer Lichen
Icmadophila ericetorum	Spraypaint
Peltigera spp.	Pelt Lichen

Available in accessible formats upon request