VEGETATION CHARACTERIZATION AND EFFECTS ASSESSMENT

OF THE PROPOSED ALL-SEASON ROAD PROJECT 6

INTERIM REPORT

Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation

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SUMMARY

This report provides a characterization of vegetation and an assessment of effects for the proposed P6 All-Season Road Project connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation. The characterization of vegetation included a description of ecological land classification, physical environment, landscape level vegetation, local flora, and Aboriginal traditional knowledge.

The proposed Project is located in the Hayes River Upland Ecoregion, and almost entirely in the God's Lake and Knee Lake Ecodistricts. The landscape consists largely of coniferous forests on both upland and organic sites. Areas of rocky outcrops support jack pine, while mixed stands of conifer and deciduous species are generally restricted to favorable sites along lakes and rivers. Low growing black spruce occurs in bogs and tamarack is found in fens.

Valued Components for the study included plant species of conservation concern (those listed by the federal Species at Risk Act, the Manitoba Endangered Species and Ecosystems Act, the Committee on the Status of Endangered Wildlife in Canada, and those listed as very rare to rare by the Manitoba Conservation Data Centre) and key community harvest areas/ plant species of interest (those identified through traditional knowledge studies and other engagement activities).

There are an estimated 14 species of conservation concern that occur within the P6 regional assessment area and surroundings. Information on plant species important to the people in the region for sustenance and cultural practices are identified. Common food plants include blueberry, raspberry, strawberry, cloudberry, cranberry, cherry and Saskatoon. Medicinal plants including black spruce, sweet flag and Labrador tea were identified.

Potential environmental effects of the proposed Project on vegetation and soils include the following:

- Loss of species of conservation concern.
- Disturbance to or removal of key community harvest areas of plant species of interest (medicinal and cultural species).
- Disturbance to or removal of native vegetation.
- Disturbance or loss to species composition and ecology of wetlands (bogs and fens).
- Fragmentation of the local and regional vegetation communities.
- Modification of vegetation composition and structure adjacent to the disturbance zone.
- Introduction and spread of invasive and non-native species.

- Loss/impairment of vegetation from accidental releases of fuels or hazardous substances.
- Loss/impairment of desirable plant species from herbicide application.
- Impairment of vegetation in the project assessment area from dust.
- Increased risk of forest fire from clearing and construction.
- Increased access to botanical resources used by non-community members.
- Reduced floristic diversity immediately adjacent to the road.
- Loss of soil from clearing, stripping and construction.
- Compaction of soil during construction.
- Loss of soil due to erosion of cleared sites and stockpiles.
- Modification of soil moisture regime.
- Impaired soil quality from accidental releases of fuels and hazardous substances.
- Impaired soil quality from herbicide application.

Measures to address potential effects are discussed. The assessment found no likely significant effects to valued vegetation components in this study.

Additional information gathered on vegetation and soils in the assessment area from fieldwork completed in 2016 will be provided in the Project Field Report.

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1.0 INTRODUCTION

1.1 Background

The First Nation communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation rely primarily on winter road and air travel to transport people and goods. In 2008, the Government of Manitoba announced a strategic initiative to provide improved, safer and more reliable transportation services to connect the remote communities on the east side of Lake Winnipeg with the rest of Manitoba. Manitoba East Side Road Authority (MESRA), formerly Manitoba Floodway and East Side Road Authority (MFESRA), was established as a provincial Crown Agency to manage the East Side Transportation Initiative with the intent of increasing transportation opportunities for communities on the east side of Lake Winnipeg. This task has since been transferred to Manitoba Infrastructure (MI).

As part of the East Side Transportation Initiative, MESRA is proposing the construction of an all-season road northeast of Lake Winnipeg between Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation, Project 6 (P6). The proposed P6 All-Season Road will occur at the northeastern extent of the Transportation Initiative network.

1.2 Project Overview

The proposed P6 All-Season Road will consist of approximately 137 km of two-lane gravel highway on new right-of-way (ROW) on provincial Crown land, connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation (Map 1).

The P6 All-Season Road will be a gravel-surface public highway, with a design width of 10 m. The P6 All-Season Road will intersect two major water crossings over God's River and Magill Creek. The components of the Project include the following:

- All-Season Road on new ROW;
- Up to two bridges at water crossings (bridge replacement at God's River, possible bridge construction at Magill Creek);
- Culverts for stream crossings and drainage equalization;
- Rock quarries and granular borrow areas; and
- Temporary access trails, bridges, staging areas and camps.

The portion of the Project located on Provincial Crown Land requires an Environmental Impact Assessment under the Manitoba Environment Act as a Class II development and under the Canadian Environmental Assessment Act.

The specific objectives established for this study were:

- provide an understanding of the baseline vegetation conditions to support the effects assessment and project planning;
- contribute to the identification of the potential environmental effects of road development on vegetation species and communities; and
- contribute to the identification and implementation of environmental protection measures to avoid or minimize effects to vegetation, particularly species of conservation concern and key community harvest areas (plant species of interest).

2.0 STUDY AREA

The proposed P6 All-Season Road Project is located northeast of Lake Winnipeg, near Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation, approximately 950 km northeast of Winnipeg (by air). The P6 All-Season Road extends from Bunibonibee Cree Nation southeast to God's Lake First Nation, and approximately midway is intersected to extend northeast to Manto Sipi Cree Nation. The total distance is approximately 137 km of proposed All-Season Road. For this study, the P6 segment from Bunibonibee Cree Nation to God's Lake First Nation is referred to as P6a and the segment from the junction to Manto Sipi Cree Nation as P6b.

2.1 Spatial Boundaries

The spatial boundaries for the assessment consist of project, local and regional assessment areas and are described below, and illustrated in Map 1.

Project Assessment Area (PAA) – Footprint of the proposed P6 All-Season Road Project, including rock quarries, borrow areas and access roads. The proposed P6 All-Season Road will be centered on a 100 m ROW with a typical clearing width of 60 m and additional clearing as required at horizontal curves to maintain sight distances.

Local Assessment Area (LAA) – One km on either side of the proposed P6 All-Season Road Project, including rock quarries, borrow areas and access roads.

Regional Assessment Area (RAA) – Five km on either side of the proposed P6 All-Season Road Project.

3.0 METHODS

3.1 Desktop Methods

Existing biophysical information (e.g., Geology of Manitoba 2016; Matile and Keller 2006; Smith et al. 1998) was used to describe the environment, regionally and across all areas of assessment for the P6 All-Season Road, including available information provided by MESRA (e.g., project imagery and shapefiles). Literature searches for relevant studies in the vicinity of the Project (e.g., Terraform Environmental Consulting 1999a and 1999b; Manitoba Hydro 2000a and 2000b) and environmental assessments (e.g., MFESRA 2010 and 2011; MESRA 2016a and 2016b) were also completed.

Data Sources

The National Stratification Working Group ecological framework database (Smith et al. 1998) was used to identify and describe the ecological land classification, to the ecodistrict scale. Within the P6 assessment areas (project, local, regional), the Land Cover Classification (LCC) was used to determine vegetation cover classes (Natural Resources Canada, through 2000). The LCC is a national vector database mapping layer that has been harmonized across the major federal departments involved in land management or land change detection (Agriculture and Agri-Foods Canada, Canadian Forest Service, and Canadian Centre for Remote Sensing). The LCC consists of remotely sensed imagery (Landsat data) as part of the Earth Observation for Sustainable Development of Forests Program.

The burn history of the area was determined from provincial fire data (Manitoba Conservation 2014). Other available data sources used included soils (Agriculture and Agri-Food Canada 2013), water crossings (Natural Resources Canada 1999 to 2010) and wetland features (Halsey et al. 1997). Key community harvest areas (plant species of interest) as identified through traditional knowledge studies and engagement activities were provided by MESRA through shapefiles.

The available datasets were clipped to the three assessment areas, and for each resulting shapefile, the area of polygons was calculated. Intersecting stream and river crossings were buffered at 10 m, to account for width. Values calculated for water crossings and waterbodies were approximate.

Species of Conservation Concern

MESRA has stated that plant species of concern relevant to the proposed P6 project are:

- Species listed as Schedule 1 under the Species at Risk Act (SARA),

- Species listed as extirpated, endangered, threatened, or of special interest by The Committee on the Status of Endangered Wildlife in Canada (COSEWIC),
- Species listed as extirpated, endangered, or threatened under the Endangered Species and Ecosystems act of Manitoba (ESEA), and
- Species ranked as Very Rare (S1) and Rare (S2) by the Manitoba Conservation Data Centre (MBCDC).

A database search of the MBCDC provincial records for known locations of species of conservation concern in the vicinity of the Project was requested in March 2016.

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.

An element with a range between two numeric ranks (e.g., S2S3) denotes a range of uncertainty about the exact rarity of the species. A question mark following the rank (e.g., S2?) denotes inexactness or uncertainty of the numeric rank.

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.

Plant nomenclature for species discussed in this report will follow the MBCDC provincial species list.

4.0 EXISTING ENVIRONMENT

4.1 Ecological Land Classification

Ecological classification in Canada is a hierarchical designation describing ecologically distinct areas based on interrelationships of geology, landform, soil, water, vegetation, and human factors, with the ecozone at the coarsest level. The Boreal Shield Ecozone, the largest in Canada, stretches from northern Saskatchewan to Newfoundland, and also covers much of Manitoba (Smith et al. 1998). Within this ecozone, the Hayes River Upland Ecoregion extends from the Grass River Basin in east-central Manitoba to northwestern Ontario. The proposed All-Season Road Project connecting the communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation occurs mainly within the God's Lake Ecodistrict and the Knee Lake Ecodistrict, see Map 2. The Island Lake Ecodistrict occurs at the northeastern portion of the study area. In absence of specific and detailed vegetation and soil studies for the P6 study area, the ecodistrict is used here as a detailed level of ecological reference, to describe the existing environment.

Among assessment areas (project, local and regional), the God's Lake Ecodistrict occupies the greatest area as identified in Table 4.1. The Knee Lake Ecodistrict occupies much smaller areas, and the Island Lake Ecodistrict only occurs at the regional level.

Table 4.1. Area (km²) and percent of land within ecodistricts among assessment areas.

	Project		Local		Regional	
Ecodistrict	**Area (km²)**	**%**	**Area (km²)**	**%**	**Area (km²)**	**%**
God's Lake	22.8	80.8	228.9	80.6	1,150.2	80.4
Knee Lake	5.4	19.2	55.2	19.4	277.5	19.4
Island Lake	-	-	-	-	2.9	0.3

Source: Smith et al. 1998.

4.2 Physical Environment

4.2.1 Geology and Surficial Geology

The geology of the area consists of Precambrian rock from the Archean era (Geology of Manitoba 2016). In the Oxford Lake area, the lithotec consists of late metasedimentary and metavolcanic rocks (Oxford Lake Group, Island Lake Series, San Antonio formation). The unit consists of greywacke, conglomerate, arkose and arenite, as well as mafic and felsic fragmental volcanic rocks, and porphyritic mafic to felsic flows. In the vicinity are late intrusive rocks of granodiorite, minor tonalite, migmatite and granite. In the God's Lake area, the lithotec dominantly consists of metamorphosed early intrusive rocks, gneisses and migmatites. Early metavolcanic and metasedimentary rocks (Rice Lake Group, Hayes River Group) occur at the north and south ends of the lake. The unit consists of basalt, minor andesite, minor sedimentary and mafic intrusive rocks, ultra mafic rocks and

differentiated ultramafic/mafic intrusions. Metamorphic supracrustal rocks with amphibolite also occur (Geology of Manitoba 2016).

The surficial geology of the area is characterized by discontinuous till deposits over bedrock outcrops, organic deposits and glaciolacustrine sediments (Smith et al. 1998). Till deposits are of silt diamicton, largely derived from Phanerozoic carbonate rocks from the Hudson Bay Lowland, and are generally of low-relief. Organic deposits, in low-lying areas, are from <1 – 5 m thick and accumulate in fen, bog, swamp and marsh settings. In permafrost areas, patterned ground and peat palsas are common. The glaciolacustrine sediments are low relief, massive and laminated deposits of clay, silt and minor sand, deposited by deep water of glacial Lake Agassiz. Deposits were commonly scoured and homogenized by icebergs. Glaciofluvial sediments range from fine sand, minor gravel, thin silt and clay interbeds deposited as subaqueous outwash fans to sand and gravel complex deposits with esker ridges and kames. The bedrock outcrops are generally subglacially eroded and unweathered intrusive, metasedimentary and metavolcanic rocks with a glacially scoured irregular surface with high local relief. In areas of permafrost, frost shattered, angular boulder fields occur (Matile and Keller 2006).

4.2.2 Soils

Soils are similar across ecodistricts, with mineral soils developed on till, glaciolacustrine or glaciofluvial sediments and non-frozen and frozen organic soils found in peatlands and depressions. In the God's Lake Ecodistrict, mineral soils are characterized as being dominantly well to imperfectly drained Eluviated Eutric Brunisols that have developed on loamy to sandy till deposits and Gray Luvisols that have developed on both loamy to sandy till deposits and upland clayey glaciolacustrine deposits. Vast areas of peat filled depressions form a poorly drained bog and fen complex. Soils found in poorly drained bogs are characterized as Fibrisols, with slightly decomposed sphagnum and feather moss peat and Mesisols with moderately decomposed moss and forest peat. Soils found in fens vary with slightly decomposed to moderately well decomposed peat, with deeper peat more decomposed that peat found at the surface. Organic Cryosols are found in the northern section of the ecodistrict and in peatlands where permafrost is present. To the north within the Knee Lake Ecodistrict, dominant soils are Organic which include Organic Cryosols generally found in peatland areas that contain permafrost. Organic soils that are non-frozen include both Fibrisols and Mesisols found in shallow bogs, and patterned fens comprised of woody, forest peat and sedge peat. Mineral soils found in the ecodistrict include Eluviated Eutric Brunisols that have developed on loamy to sandy calcareous till and sandy gravelly fluvioglacial deposits, and Gray Luvisols found on well to imperfectly drained clayey deposits (Smith et al. 1998).

The general distribution of the main soil classification types for the greater region of the P6 study area is shown in Map 3. The area (km^2) and percent cover of soil types within all assessment areas is shown in Table 4.2.2. Brunisols are the dominant soils among the assessment areas, followed by Cryosols and Organics.

Table 4.2.2. Area (km^2) and percent of soil classes among assessment areas.

Soil Classification	Project		Local		Regional	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
Brunisolic	13.6	48.2	135.2	47.6	695.8	48.6
Cryosolic	8.8	31.1	89.6	31.6	460.6	32.2
Luvisolic	1.4	4.8	14.4	5.1	58.3	4.1
Organic	4.5	15.8	44.8	15.8	210.6	14.7
Unclassified	-	-	-	-	5.3	0.4

Source: National Soils Database, Agriculture and Agri-food Canada 2013.

4.2.3 Topography and Drainage

Topography of the area ranges from undulating to ridged morainal plain comprised of sandy to loamy till deposits. In areas of lower slopes and depressions, bogs and fens comprised of both shallow and deep peat material are found overlying clayey glaciolacustrine deposits. Inclusions of kettled fluvioglacial deposits, in the form of eskers and esker aprons, can also be found. Elevations range from 150 m above sea level (masl), to 274 masl (Smith et al. 1998).

Two drainage systems, the Nelson River and Hayes are found in the area, and the many small, medium and large sized lakes drain north-northeastward through a network of rivers and secondary streams.

The major lakes in the area include God's Lake, Oxford Lake and Knee Lake while major rivers of the area include the Hayes and God's Rivers. Based on existing data, the P6 project assessment area is intersected by numerous streams, creeks, and rivers, shown in Map 4. The water crossings and bodies of water account for roughly 1% of the total project assessment area, of which rivers and stream crossings (buffered by 10 m) account for 0.24 km^2, or 0.9%, while other waterbodies account for approximately 0.03 km^2, or 0.1%, shown in Table 4.2.3. North/South Consultants report 54 watercourse crossings in their project assessment.

Table 4.2.3. Water crossings in the project assessment area.

Category	Crossings	Area (km^2)	%
Rivers and streams	44	0.24	0.9
Waterbody	2	0.03	0.1
No water crossing activity	-	27.95	99.0

Source: Natural Resources Canada 1999-2010.

4.2.4 Climate

This area falls within both the warmer and more humid, and colder subdivisions of the High Boreal Ecoclimatic Region (Smith et al. 1998). Short, cool summers and long, very cold winters are characteristic of this ecoclimatic region. Local climate normals recorded from the Island Lake station (1981-2010) to the south, show a mean annual temperature of -0.7˚C, with a July mean of 17.9˚C and a January mean of -21.5˚C. The average annual precipitation is 555 mm, one third of which falls as snow (Environment Canada 2015).

4.3 Fire and the Boreal Forest

In the boreal forest, fire is an important natural disturbance that drives vegetation dynamics at the landscape, stand and species levels. Forest diversity is a result of the variation of fires in frequency, intensity, severity, size, shape and season of burn (Natural Resources Canada 2016). The area burned varies greatly, and fire activity is influenced by weather and climate, fuels, ignition agents, and humans (Brandt et al. 2013). High intensity fire rejuvenates boreal ecosystems, and is the major stand renewing agent, affecting stand life cycles, patchiness and regeneration (Stocks et al. 2003). Fires improve soil conditions for germination by releasing nutrients and minerals into soils, removing live vegetation and litter matter, and increasing availability of sunlight at the forest floor (Brandt et al. 2013; Stocks et al. 2003). A mosaic of vegetation at different stages of succession from fire in the ecosystem results in greater landscape diversity and provides an array of habitats for flora and fauna (Perry 1994).

Seasons play a role in fire frequency and intensity and can affect re-growth of the ecosystem, while temperature changes and soil moisture content also affect fire intensity (Weber and Flannigan 1997). The boreal forest fire season is April through October. Lightning fires occur generally in late spring/ summer, while human caused fires tend to occur in early spring and fall (Stocks et al. 2003). In the boreal forest, lightning strikes account for about 35% of fires, although are responsible for about 85% of the total area burned (Brandt et al. 2013).

4.3.1 Fire History

The boreal forest tends to burn at different intervals. The fire cycle for jack pine is approximately 15 to 35 years, while spruce stands cycle every 50 to 100 years (Natural Resources Canada 2016). Stand-destroying crown fires occur at approximately 50 to 200 year intervals, and can reach 500 years on very moist sites. The coniferous forests (e.g., spruce, pine) of this region experience more frequent crown fires than deciduous dominated forests (Perry 1994).

The provincial fire history data available for the P6 study area dates back to the 1940s. Fire history shown is calculated for each decade by area (km^2) and percent of land, within project, local, and regional levels of assessment, in Table 4.3.

Table 4.3. Area (km^2) and percent of land burned by decade among assessment areas.

Fires by Decade	Project		Local		Regional	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
1940-1949	0.6	2.2	5.2	1.8	8.3	0.6
1950-1959	4.8	17.2	42.7	15.0	181.1	12.7
1960-1969	0.4	1.6	2.5	0.9	15.0	1.0
1970-1979	0.6	2.0	3.2	1.1	18.5	1.3
1980-1989	<0.001	<0.01	0.4	0.2	11.7	0.8
1990-1999	0.4	1.6	3.8	1.3	54.8	3.8
2000-2009	-	-	0.1	<0.1	2.2	0.2
2010-2014	-	-	<0.01	<0.01	0.2	<0.1

Source: Manitoba Conservation and Water Stewardship, through 2014.

The greatest fire activity in this area occurred during the 1950s, with 12.7% of the land within the regional assessment area cumulatively burned between 1950 and 1959. During the same time period, cumulative fire activity appears slightly more concentrated in the local (15.0%) and project (17.2%) assessment areas. From the 1960s to the present, comparatively less fire activity has been documented, with fires affecting between 0-2% of the land base in the project, local, and regional assessment areas. An exception is the slight rise in fire activity (to 3.8% seen at the regional scale during the 1990s. Although after the year 2000, there is a marked reduction in fire activity across the project, local, and regional assessment areas, according to available information. The history of fire distribution by decade is shown in Map 5.

4.4 Landscape Level Vegetation

The vegetation across this region of Manitoba is primarily black spruce on both upland and organic sites. Canopies are often more open, and of medium height compared to areas further south. Forest fire has replaced some upland spruce with jack pine, often the dominant species on regenerating sites, while trembling aspen occurs occasionally. Mixed stands of white spruce, balsam fir, trembling aspen and balsam poplar are generally restricted to favorable sites along lakes and rivers. Areas of rocky outcrops favour jack pine, with an understory of ericaceous shrubs, herbs and mosses and lichens. Low growing black spruce in open canopies grow in bogs, along with ericaceous shrubs and sphagnum and other mosses. Tamarack is found in fens, and is mixed with black spruce in transitional peatlands (Smith et al. 1998).

4.4.1 Land Cover Classification

The Land Cover Classification, generated from Landsat satellite data, details twenty-one vegetation classes, ranging in dates from 1999 to 2000 (Natural Resources Canada, through 2000). Eleven vegetation classes (plus one unclassified class) occur within the project, local and regional assessment areas, including tall shrub, wetlands, and coniferous, broadleaf and mixedwood forests. The water class includes lakes and rivers and streams. Map 6 illustrates the distribution of the land cover classes for the P6 study area and surrounding region.

The area (km^2) and percentage of land cover classes found in the project, local, and regional assessment areas is shown below in Table 4.4.1a. Much of the P6 study area is represented by coniferous growth, covering 82.8% of the RoW. Stand canopy cover is predominantly dense (38.1%) or open (31.8%), with sparse canopies occurring over 12.9% of the RoW. Coniferous cover figures are similar at the local and regional assessment scales, although the percent covers are slightly less.

Wetlands occur over 12.4-19.2% of the project, local, and regional assessment areas, and support primarily shrubby vegetation growth. Dense hardwood or mixedwood stands are relatively rare, occurring over 0.1-1.2% of all assessment areas. Water features, such as lakes and streams are present over the regional assessment area (19.8%) and local (8.9%) assessment areas, although less frequent water cover is seen on the ROW (0.6%).

Table 4.4.1a. Area (km^2) and percent cover of vegetation classes by assessment area.

Land Cover Classification	Project		Local		Regional	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
Water	0.2	0.6	25.3	8.9	283.9	19.8
Exposed Land	0.7	2.5	7.3	2.6	16.9	1.2
Shrub Tall	-	-	0.8	0.3	23.0	1.6
Wetland Treed	0.4	1.3	5.4	1.9	24.9	1.7
Wetland Shrub	3.0	10.6	46.2	16.3	193.5	13.5
Wetland Herb	0.2	0.5	2.8	1.0	12.1	0.8
Coniferous Dense	10.7	38.1	82.6	29.1	382.4	26.7
Coniferous Open	9.0	31.8	81.8	28.8	351.4	24.6
Coniferous Sparse	3.6	12.9	29.4	10.4	126.1	8.8
Broadleaf Dense	0.4	1.2	1.7	0.6	9.2	0.6
Mixedwood Dense	<0.1	0.2	0.4	0.1	6.8	0.5
Unclassified	0.1	0.3	0.2	0.1	0.4	<0.1

Source: Natural Resources Canada, through 2000.

The anticipated percent of vegetation removal from the local and regional assessment areas, due to project clearing of the ROW, is shown for each vegetation class, in Table 4.4.1b. Figures presented are calculated based on the overall percent cover for each

vegetation class that occurs directly on the ROW, as a percentage of the local and the regional assessment areas. Areas of open water and exposed land area also included, as an indication of disturbance through construction activities, rather than vegetation removal.

Table 4.4.1b. Percent (%) of vegetation removal from local and regional assessment areas due to clearing on the ROW.

Land Cover Classification	Local removal (%)	Regional removal (%)
Water	0.7	0.1
Exposed Land	9.7	4.2
Wetland Treed	6.5	1.4
Wetland Shrub	6.5	1.5
Wetland Herb	5.4	1.3
Coniferous Forest Dense	13.0	2.8
Coniferous Forest Open	11.0	2.6
Coniferous Forest Sparse	12.4	2.9
Broadleaf Forest Dense	21.1	3.8
Mixedwood Forest Dense	10.8	0.7
Tall Shrub	-	-
Unclassified	37.2	22.2

Within the local assessment area, the effect of clearing will result in a removal of an estimated total of 18.4% of local area wetland vegetation, from shrubby (6.5%), treed (6.5%) and herbaceous (5.4%) wetlands that occur on the ROW. An estimated total of 36.3% of the coniferous forest vegetation cover (dense, open and sparse) in the local assessment area will be removed due to clearing of the ROW. An estimated 21.1% of dense broadleaf forests and 10.8% of dense mixedwood forests at the local scale occur on the project RoW. The tall shrub vegetation cover class does not occur in the project assessment area.

Within the regional assessment area, an anticipated 4.2% of wetland vegetation will be removed by project clearing of the ROW. Of the regional forest types, an estimated 8.2% of the coniferous forests (dense, open and sparse cover), 3.8% of dense broadleaf forests, and 0.7% of dense mixedwood forests at the regional assessment scale occur on the RoW, and would be removed during project clearing.

4.4.2 Quarry and Borrow Areas

The construction of the P6 All-Season Road will require additional aggregate that is beyond what will be obtained from cuts from within the alignment/project footprint. Twenty-nine potential rock quarry and borrow sites have been identified along the alignment, ranging in size from 0.01 km^2 to 0.47 km^2. Quarry sites will be preferentially developed in or adjacent to the ROW, within approximately 500 m of centreline (MESRA 2016c). A total of 2.51 km^2

will be cleared for quarry development, primarily within the local assessment area (2.49 km^2), including 0.70 km^2 in the project area, and an additional 0.03 km^2 beyond the local assessment area. The area and percent of land cover classes that occur within potential quarries are shown for all levels of assessment, in Table 4.4.2a.

Table 4.4.2a. Area (km^2) and percent of land cover classes for potential quarry sites within all assessment areas.

Land Cover Class	Project		Local		Regional	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
Exposed Land	-	-	0.09	3.71	0.09	3.67
Water	-	-	0.01	0.33	0.01	0.35
Wetland Treed	<0.01	0.64	<0.01	0.19	<0.01	0.19
Wetland Shrub	0.01	1.45	0.15	5.98	0.15	5.91
Wetland Herb	-	-	0.01	0.27	0.01	0.26
Coniferous Dense	0.49	70.44	1.45	58.05	1.45	57.43
Coniferous Open	0.12	17.51	0.58	23.34	0.59	23.26
Coniferous Sparse	<0.01	0.65	0.03	1.32	0.05	2.17
Broadleaf Dense	0.06	9.18	0.17	6.76	0.17	6.69
Mixedwood Dense	<0.001	0.14	<0.01	0.07	<0.01	0.06
Total quarry clearing (km^2)	0.70	100%	2.49	100%	2.52	100%

Clearing for quarry development will occur primarily in the local assessment area, covering 2.49 km^2, or approximately 0.88% of the total local assessment area. Quarry development at the project scale amounts to 0.70 km^2, or approximately 2.49% of the total project assessment area. Dense coniferous forest is the dominant land cover throughout, and at the local scale accounts for 58.05%. Other prominent land covers are open coniferous (23.34%) and dense broadleaf (6.76%) forests. These remain the dominant forest types at all assessment scales. Exposed land accounts for <4.0% across all scales, while water accounts for <0.4% of potential quarry areas at both the local and regional scale.

The development of potential quarry sites will generally require the removal of vegetation. The anticipated percentage of vegetation removal for quarry development is shown by land cover class, as a percentage of total assessment area, in Table 4.4.2b. The overall percentage of exposed land and water that will be altered by quarry development is also included, for local and regional assessment areas.

Table 4.4.2b Percent (%) of vegetation removal from potential quarries for all assessment areas.			
	Vegetation Removal (%)		
Land Cover Class	**Project**	**Local**	**Regional**
Exposed Land	-	1.27	0.55
Water	-	0.03	<0.01
Wetland Treed	1.26	0.09	0.02
Wetland Shrub	0.34	0.32	0.08
Wetland Herb	-	0.23	0.05
Coniferous Dense	4.59	1.75	0.38
Coniferous Open	1.37	0.71	0.17
Coniferous Sparse	0.13	0.11	0.04
Broadleaf Dense	18.31	10.14	1.82
Mixedwood Dense	2.09	0.39	0.02
Total quarry clearing (%)	2.49%	0.88%	0.18%

In consulting both tables 4.4.2a and 4.4.2b, note that in proposed quarry areas, while the dominant forest cover is coniferous, the greatest percent of vegetation removal occurs for dense broadleaf forest. For example, for dense coniferous forests at the local scale, 1.45 km^2 cleared represents 1.75% of all local area dense coniferous forests. However, for dense broadleaf forests, 0.17 km^2 cleared represents 10.14% of all dense broadleaf forest that occurs in the local assessment area.

Due to the nature of wetland soils, this land cover class will be minimally affected by clearing for quarry purposes. Within the local assessment area, half of the wetlands in potential quarry areas are shrubby (0.32%), with herbaceous (0.23%) and treed (0.09%) wetlands making up the remainder of wetland cover. Within the regional assessment area, 0.59% of the coniferous forests (primarily dense, 0.38%), 1.82% of dense broadleaf forests, and 0.02% of dense mixedwood forests occur within potential quarry areas. Regionally, 0.15% of wetlands occur within potential quarry sites.

Access Roads

For eleven potential quarries (38%) situated directly on the ROW, additional access is not required. Access to 18 potential quarries (62%) is between approximately 27 and 797 m (mean distance 309 m) from center line. All access roads are located wholly within the local assessment area. Straight line access was assumed with a road width of 30 m. The area and percent of land cover classes affected by potential access roads, is shown in Table 4.4.2c, by level of assessment.

Table 4.4.2c. Area (km²) and percent of land cover classes for potential access roads within all assessment areas.				
	Project		Local	
Land Cover Class	**Area (km²)**	**%**	**Area (km²)**	**%**
Exposed Land	<0.001	1.58	<0.01	0.93
Water	-	-	<0.001	0.38
Wetland Treed	-	-	-	-
Wetland Shrub	<0.01	5.63	0.01	6.47
Wetland Herb	-	-	-	-
Coniferous Dense	0.04	66.00	0.10	55.53
Coniferous Open	0.02	26.79	0.06	31.54
Coniferous Sparse	-	-	<0.01	4.34
Broadleaf Dense	-	-	<0.01	0.81
Mixedwood Dense	-	-	-	-
Total access road clearing (km²)	0.06	100%	0.18	100%

As few potential access road sites occur on exposed land (<2%), most access roads will require further vegetation removal. Clearing for quarry access road development (0.06 km²) in the project assessment area will generally overlap clearing for the ROW. Most access roads occur within the local assessment area (0.18 km²), primarily in locations of coniferous forest with dense (55.53%) and open (31.54%) cover. Shrubby wetland accounts for 6.47% of access road area, and 4.34% is represented by sparse coniferous forest cover.

The anticipated vegetation removal for potential access roads by land cover class, as a percent of total land cover for each assessment area is shown in Table 4.4.2d. The overall percentage of exposed land and water that will be altered by access road development is also included. No access roads are placed beyond the local assessment area.

Within the local assessment area, 0.22% of the coniferous forests (primarily dense, 0.12%), and 0.09% of the dense broadleaf forests occur within potential access road sites. Shrubby wetlands account for 0.03% of potential access roads, at the local scale.

Table 4.4.2d. Vegetation removal (%) from all assessment areas on potential access roads.		
	Vegetation Removal (%)	
Land Cover Class	**Project**	**Local**
Exposed Land	0.13	0.02
Water	-	<0.01
Wetland Treed	-	-
Wetland Shrub	0.11	0.03
Wetland Herb	-	-
Coniferous Dense	0.35	0.12
Coniferous Open	0.17	0.07
Coniferous Sparse	-	0.03
Broadleaf Dense	-	0.09
Mixedwood Dense	-	-
Total access road clearing (%)	0.20%	0.06%

4.4.3 Wetlands

In Canada, approximately 85% of wetlands are located in the boreal forest (Ducks Unlimited Canada 2015). In Manitoba, Halsey et al. (1997) estimates that wetlands cover 233,340 km^2 or 43% of the terrestrial landscape, with peatlands representing 90% of all wetlands. It is well documented that boreal wetlands are ecologically important (Bond et al. 1992, Locky et al. 2005, Ducks Unlimited Canada 2015). Foster et al. (2004) noted the importance of calcareous wetlands (e.g., fens) and their potential to support species of conservation concern. Threats to wetlands include agricultural runoff, drainage, forestry activities, off-road vehicles, peat extraction, and right-of-way activities (Foster et al. 2004).

According to the Canadian Wetland Classification System (CWCS), wetlands are separated into five classes including bog, fen, marsh, swamp and shallow water (National Wetlands Working Group 1997). Ducks Unlimited Canada (2015) further identifies 19 minor wetland classes based on an enhanced wetland classification system of the five major wetland classes, which considers moisture, water movement and nutrients, as well as plant structure and cover (e.g., trees, shrubs, grasses, sedges, and mosses) to differentiate wetland sites using field-collected data.

The CWCS defines fens as peatlands with a fluctuating water table, rich in dissolved minerals due to ground and surface water movement. The greater nutrient availability in fens supports unique vegetation, related to the depth of the water table. The vegetation of nutrient poor fens, with waters low in dissolved minerals, is characterized by *Sphagnum* mosses and ericaceous shrubs, and black spruce are occasionally present. Moderately rich fens are dominated by graminoids (e.g., sedges) and brown mosses. Drier, rich fens support shrubs (birch, willow and tamarack), and trees (black spruce, tamarack) can be found on

moss hummocks up to 20cm above the water table (National Wetlands Working Group 1997).

Bogs are characterized by an accumulation of peat, with a surface that is raised or level with the surrounding terrain. Precipitation and snowmelt are primary water sources, resulting in acidic bog waters low in dissolved minerals, enhanced by the decomposition of acidic *Sphagnum* moss leaves. Vegetation largely consists of *Sphagnum*-dominated peat mosses, ericaceous shrubs (Labrador tea, leather leaf and bog cranberry) and where present, black spruce in sparse to closed stands (National Wetlands Working Group 1997).

The distribution of wetlands across the region (shown in Map 7 and Table 4.4.3), is based on digitized data from a study on wetland types and their distribution in Manitoba (Halsey et al. 1997). Here, wetlands are distinguished by wetland class (bog, fen, marsh, swamp, shallow water), the presence/absence of a tree canopy (open, wooded, forested), and a landform modifier (e.g., patterned, non-patterned). For the sake of mapping at this scale, in many cases wetland complexes, rather than individual wetlands were identified. In the wetland complex class, 30 to 70% of land is comprised of a mosaic of fen and bog habitats, (while upland habitat occupies the inversely remaining 30-70%) of a given polygon. This method results in a slight overestimation of wetland habitat area across the landscape, due to the inclusion of small mineral upland pockets within the wetland complex areas.

This roughly corresponds to the wetland cover classes of the Land Cover Classification (LCC) described earlier in Section 4.4.1, which are differentiated solely on the basis of vegetation structure (e.g., vegetation height). 'Treed wetlands' encompass treed bog and fen complexes; 'tall shrub wetlands' include shrubby bogs and fens; and 'herbaceous wetlands' include open fens (both patterned and non-patterned). Because both data sets were originally compiled differently and at different scales, the area calculations of classes are not necessarily directly comparable in this region.

Non-patterned open fens lack the presence of linear hummocky ridges and hollow depressions, and are characterized by the presence of a continuous sedge cover and sparse to no trees. Fens can be poor, or moderately to extremely rich in dissolved nutrients. Birch and willow shrubs may be present, the ground cover in wet poor fens is *Sphagnum* mosses. Non-patterned open fens can occur as collapse scars in association with peat plateaus, associated with bog islands, or as small isolated basins (Halsey et al. 1997).

Non-patterned treed fens have a variable range in tree cover (i.e., wooded >6 to 70% to forested >70%) in some combination of black spruce/ tamarack, with a common shrub understory of birch and willow, ground mosses are *Sphagnum* or brown mosses. These fens can be poor, or moderately to extremely rich in dissolved minerals.

The distribution of wetlands types in the P6 study area includes primarily bog and fen complexes, with occasional non-patterned fens classed as shrubby, or with an open (<10%), or treed (>10%) canopy, shown in Table 4.4.3. Patterned fens (as distinguished by the presence of linear hummocky ridges and hollow depressions), marshes, and treed bogs are present over the greater landscape, although not found within the P6 regional assessment area, see Map 7.

Table 4.4.3. Area (km²) and percent of wetland types among assessment areas.

Wetland Types	Project		Local		Regional	
	Area (km²)	%	Area (km²)	%	Area (km²)	%
Bog -Fen Complex, 30-70% wetland	15.6	55.3	156.0	54.9	646.4	45.2
Fen non-patterned, open-shrubby	1.0	3.7	1.6	0.6	12.3	0.9
Fen non-patterned, treed	-	-	11.4	4.0	45.0	3.1
Mineral soils, <30% wetland	11.6	41.0	115.1	40.5	726.9	50.8
Marsh	0.0	0.0	0.0	0.0	0.0	0.0
Patterned, open fen	0.0	0.0	0.0	0.0	0.0	0.0

Source: Halsey et al. 1997.

The percent cover for bog-fen complex are roughly comparable across all assessment area scales. The mosaic bog and fen wetland complexes account for 55.3%, 54.9% and 45.2% in the project, local and regional assessment areas, respectively.

The next dominant class, mineral soils, may have a wetland component present over no more than 30% of the area given. This dominantly upland class accounts for 41.0%, 40.5% and 50.8% of the project, local and regional assessment areas, respectively.

Fen habitats are minimally represented within the P6 assessment areas. Non-patterned treed fens occur in 3.1-4.0% of the local and regional scales (absent at the project scale), whereas open and shrubby non-patterned fens cover <1.0% of the local and regional scales, and 3.7% of the land base at the project scale.

4.5 Local Flora

4.5.1 Native Species

A list of potential plant species expected to occur within the P6 study area and throughout the region was compiled from available data sources including provincial data (MBCDC 2016), herbarium records from The Manitoba Museum and the University of Manitoba herbaria, regional flora (e.g., Cody 1989; Flora of North America 1993+; Scoggan 1957), and existing literature (e.g., Manitoba Hydro 2000a and 2000b; Terraform Environmental Consulting 1999a and 1999b). This preliminary flora list contains all species that have been previously collected or recorded in the P6 study area, including 241 vascular species from

60 families, which occur in terrestrial, wetland and aquatic habitats. A species list from the field component of this study (June 2016) is expected to include species identified in the preliminary species list, see Appendix II.

4.5.2 Introduced Species

A number of introduced (non-native) and invasive species are expected to occur across the greater P6 study area. Although not naturally found in undisturbed boreal forest habitats, many of these species are introduced along roads, rivers and streams, often following human activities. The boreal shield has a relatively high number of invasive plants, compared to other ecozones in Canada (CFIA 2008). Introduced species are those that grow outside of their region of origin, and generally thrive on disturbed sites, they are often prolific seed producers, and can tolerate poor or disturbed soils (Langor et al. 2014). Invasive species compete with native species, forming dense populations that may subsequently spread to other areas. Invasive species have been cited as risk factors for species of conservation concern (Canadian Food and Inspection Agency 2008). Where established, non-native and invasive plants can impact ecosystem diversity, structure, and function. The resulting displacement of native species changes the floristic composition of an ecosystem, and potentially endangers the survival of species of conservation concern. Non-native and invasive plants in boreal habitats are commonly perennial herbs and grasses, particularly from among the Asteraceae (composites), Fabaceae (legumes), and Poaceae (grasses) plant families, (Langor et al. 2014).

Of the 241 preliminary species expected to occur in the greater P6 study area, there are 13 introduced species, ranked SNA (conservation status rank is not applicable) by Manitoba Conservation Data Centre (2016), Table 4.5.2. The Invasive Species Council of Manitoba (ISCM) lists two of these species (*Arctium minus* and *Sonchus arvensis*) as invasive capable of further spread, with pathways for further spread present (ISCM 2016). Of the preliminary species previously recorded for this area, none are listed with the Global Invasive Species Database (GISD 2015).

Table 4.5.2. Potential introduced species found in the Hayes River Upland Ecoregion.			
Family	**Scientific Name**	**Common Name**	**S Rank**
Asteraceae	*Arctium minus*	Common Burdock	SNA*
Asteraceae	*Artemisia absinthimum*	Wormwood	SNA
Asteraceae	*Sonchus arvensis*	Field Sow-thistle	SNA*
Asteraceae	*Sonchus asper*	Spiny-leaved Sow-thistle	SNA
Asteraceae	*Taraxacum officinale*	Common Dandelion	SNA
Brassicaceae	*Erysimum cheiranthoides*	Wormseed Mustard	SNA
Caryophyllaceae	*Stellaria media*	Common Chickweed	SNA
Fabaceae	*Trifolium repens*	White Clover	SNA
Plantaginaceae	*Plantago major*	Common Plantain	SNA
Poaceae	*Agrostis stolonifera*	Creeping Bent	SNA
Poaceae	*Elymus repens*	Quackgrass	SNA
Polygonaceae	*Fagopyrum esculentum*	Buckwheat	SNA
Polygonaceae	*Fallopia convolvulus*	Black Bindweed	SNA

* Invasive species (ISCM 2016).

4.5.3 Species of Conservation Concern

There are currently no vascular species at risk listed in the Hayes River Upland Ecoregion, with either the Manitoba Endangered Species and Ecosystems Act (ESEA), the federal Species at Risk Act (SARA), or the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). No vascular species at risk are expected to occur within the Project 6 assessment area, as the Project is beyond known ranges for all vascular species at risk currently listed.

A single non-vascular species, the flooded jellyskin lichen (*Leptogium rivulare*) is federally listed through SARA (threatened), and with COSEWIC (special concern). Flooded jellyskin grows on periodically inundated surfaces, and is usually found on the bark of deciduous trees (e.g., ash, red maple, silver maple, American elm), along the banks of ponds and waterways, and in swampy forests that flood annually in the spring (Government of Canada 2016). According to the Environment Canada Recovery Strategy for the flooded jellyskin lichen, rocky shorelines of permanent lakes were identified as critical habitat for the eight extant populations in Manitoba. While 15 critical habitat locations within these populations have been identified in northwestern Manitoba (Environment Canada 2013), all are outside of the regional assessment area for the P6 All-Season Road Project. Although unlikely, any occurrences of the flooded jellyskin lichen during field studies (June 2016) will be noted.

There are an estimated 14 species of conservation concern that occur within the P6 regional assessment area and surroundings, based on records from the Manitoba Conservation Data Centre, georeferenced specimens housed in the Manitoba Museum and the University of Manitoba herbaria, as well as literature data available, Table 4.5.3.

Table 4.5.3. Species of conservation concern previously recorded in the God's Lake area and surrounding Hayes River Upland Ecoregion.				
Family	**Scientific Name**	**Common Name**	**S Rank**	**Record**
Balsaminaceae	*Impatiens noli-tangere*	Western Jewelweed	S1	-
Cyperaceae	*Carex loliacea*	Rye-grass Sedge	S2?	HRU
Cyperaceae	*Carex maritima*	Seaside Sedge	S2?	HRU
Cyperaceae	*Carex microglochin*	False Uncina Sedge	S2?	HRU
Dryopteridaceae	*Woodsia alpina*	Northern Woodsia	S2	GL/HRU
Fabaceae	*Astragalus bodinii*	Bodin's Milkvetch	S1	HRU
Fabaceae	*Oxytropis borealis*	Boreal Locoweed	S1S2	-
Lycopodiaceae	*Diphasiastrum sitchense*	Ground-fir	S1	HRU
Lycopodiaceae	*Huperzia selago*	Mountain Club-moss	S2S3	HRU
Ophioglossaceae	*Botrychium matricariifolium*	Daisy-leaf Moonwort	S1	HRU
Orchidaceae	*Platanthera hookeri*	Hooker's Orchid	S2S3	HRU
Poaceae	*Glyceria pulchella*	Graceful Manna Grass	S2S3	HRU
Potamogetonaceae	*Potamogeton robbinsii*	Robbin's Pondweed	S2S3	HRU
Potamogetonaceae	*Potamogeton strictifolius*	Straightleaf Pondweed	S2S3	HRU

Twelve species have been collected from the larger Hayes River Upland Ecoregion, while additional species of conservation concern have been collected from the God's Lake area or were observed in previous studies (e.g., Manitoba Hydro 2000a and 2000b).

4.6 Traditional Knowledge

Aboriginal people have been sustainably gathering and harvesting plants from the boreal forest in Canada for thousands of years, and in that time have accumulated a body of local, cultural and traditional knowledge. Aboriginal traditional knowledge can be considered a dynamic process of learning from elders and observing from nature, while adapting this knowledge to enhance the quality of life (Marles et al. 2000).

A great deal of aboriginal traditional knowledge is related to plant use as food, medicines, for handicrafts, and technology. Country foods and medicines increase dietary quality and generally consist of animals (e.g., moose, fish, deer, rabbit, birds), wild berries or nuts, and wild plants (Fieldhouse and Thompson 2012). The ability to harvest, share and consume traditional country foods is central to the food securities of aboriginal people.

Historically, many plants including trees, shrubs, flowers, mosses, lichens and fungi have been important as food and medicine sources (Davidson-Hunt et al. 2012). As an outcome of a study on indigenous plants, the Poplar River Anishinabek Plant Guide (Bruce et al. *Compilers* 2002, *In:* Asatiwisipe Aki Management Plan 2011) was produced to describe Aboriginal values and uses for local plants. The plant guide documents fifty different trees,

shrubs, herbs grasses, mosses and lichens that are used for sustenance and in traditional cultural practices.

Primarily preserved by oral traditions passed down through generations, the documentation of aboriginal traditional knowledge, particularly when led by individual Aboriginal communities, can help further preserve local knowledge and culture for generations to come. The repertory of traditional uses for plants may be widely known across communities or unique to a specific locale (Marles et al. 2000), and uses for a given species may vary from one community or region to another.

4.6.1 Plants of Cultural Importance

A traditional knowledge study was carried out in collaboration with local community members using workshops and one-on-one interviews by MESRA in 2016. Local elders, resource users and other knowledge holders were invited to take part in workshops and interviews. Topics included community knowledge of vegetation, wildlife and fish habitats; land use by community members; and areas that are particularly important or sensitive for cultural, historical, or other reasons. Each community was further involved during the study through regular and open communication with local leaders, and the use of local coordinators and translators, where required.

As a result of workshops and personal interviews, more than 17 plants, plus wood, lumber and firewood resources were identified by participants from the communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation, God's Lake First Nation, and God's Lake Northern Affairs Community (NAC) as important for sustenance and cultural practices. Common food plants include blueberry, raspberry, strawberry, cloudberry, cranberry, cherry and Saskatoon. Over six medicinal plants were identified, including black spruce, sweet flag and Labrador tea. Wood cutting, and firewood and willow stick collection was also valued, shown in Table 4.6.1a. Actual numbers of plants valued are considered minimums as several plants are represented in the region by more than one related species (e.g. multiple species of blueberries, gooseberries, and Labrador tea). In addition, general descriptions such as 'plants for tea', or 'medicine plants' may refer to multiple species. Exact spelling and plants names used by participants are preserved.

Results showed little shared land use between communities, as participants identified primarily the land adjacent to their own communities, see Maps 8a-d.

Table 4.6.1a. Plants of sustenance and cultural value identified by members of the Manto Sipi Cree Nation (MS), Bunibonibee Cree Nation (BB), God's Lake First Nation (GL), and God's Lake Northern Affairs Community (GLNAC), within the regional assessment area.		
Community	**Local Name**	**Scientific Name**
	Food Plants	
GL	*Weekes*	*Acorus americanus*
MS	Saskatoon	*Amelanchier alnifolia*
MS	Strawberries	*Fragaria virginiana*
MS	Cherry	*Prunus* spp.
GL	Swamp Gooseberries	*Ribes* spp.
BB	Cloudberries	*Rubus chamaemorus*
MS	Head berries (*Mistegonemina*)	*Rubus chamaemorus*
MS, BB, GL	Raspberries	*Rubus idaeus*
GL	Mossberries	*Vaccinium oxycoccus*
MS, GL	Blueberries	*Vaccinium* spp.
BB, GL	Cranberries	*Vaccinium vitis-idaea*
GL	Medicines	various, unspecified
BB	Historic berry picking area	various, unspecified
	Medicinal Plants	
MS, BB, GL , GLNAC	*Wihkes, Weekis*	*Acorus americanus*
GL	Water Calla	*Calla palustris*
GL	Juniper	*Juniperus* spp.
GL	Black Spruce Bark	*Picea mariana*
MS	Spruce	*Picea* spp.
MS, GL, GLNAC	Labrador Tea	*Rhododendron* spp.
MS, GL	Ginger Root	unknown
BB	Medicinal Plant Gathering Location	various, unspecified
BB	Plants for Tea	various, unspecified
GL	Berries	various, unspecified
GL	Muskeg Leaves	various, unspecified
GL	Medicinal Plants	various, unspecified
GLNAC	Poplar sap	*Populus* spp.
	Other Uses	
GL	Strawberries	*Fragaria virginiana*
GL	Labrador Tea	*Rhododendron* spp.
GL	Raspberries	*Rubus idaeus*
GL, GLNAC	Willow Sticks	*Salix* spp.
GL	Ginger Root	unknown
BB	Firewood Harvest	various
MS	Wood cutting	various
GLNAC	Birch	*Betula* spp.

The total mapped area (with no overlap) including harvested areas for plants of sustenance and cultural importance to all communities covered 31.6%, 31.9% and 25.7% of the project, local and regional assessment areas, respectively (Table 4.6.1b).

Table 4.6.1b. Total mapped area for plants of sustenance and cultural value identified by community members, by assessment area.

Community	Project		Local		Regional	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
God's Lake First Nation	6.0	21.3	58.5	20.6	235.5	16.5
Bunibonibee Cree Nation	0.2	0.7	4.5	1.6	27.6	1.9
Manto Sipi Cree Nation	2.7	9.7	27.3	9.6	100.8	7.0
God's Lake NAC	0.0	0.0	0.2	0.1	3.8	0.3
Total	8.9	31.6	90.5	31.9	367.6	25.7

Notably, participants from each community produced a unique list of valued plant species for edible berries, medicines and other plant uses. Although, there was common use of some edible berries, (i.e. blueberries, raspberries), as well as *wihkes* used for medicinal purposes. The plant species and their uses are discussed separately for each community.

The area for each plant or groups of plants was quantified by marking known locations of plant occurrences, by area (km^2) or along a linear feature (km). In few cases, a point provides location information only, with no measure of the area occupied by a plant or plant group, as shown in the following sections for each community.

4.6.2 Manto Sipi Cree Nation

As a result of workshops and personal interviews, participants from Manto Sipi, identified at least 10 plant species used for food, medicine and other uses. Food berries include blueberries, raspberries, strawberries, Saskatoons, cherries and cloudberries. Medicinal plants include plant parts (e.g. leaves, roots) of several plants including Labrador tea, spruce and *wihkes*. Areas of occupancy (km^2) for valued plant species are shown in Table 4.6.2. In addition, two point locations for blueberry harvest were identified within the regional assessment area, see Map 8a. The regional assessment area was important for all species, while medicinal plants and wood cutting were found at all scales of assessment.

Table 4.6.2. Manto Sipi Cree Nation Aboriginal Traditional Knowledge summaries: Areas (km²) for valued plants by assessment area.				
Plant Species Valued: Area (km²)	**Plant Use**	**Project**	**Local**	**Regional**
Blueberries	Food	-	0.05	4.20
Blueberries, Raspberries	Food	-	-	0.09
Blueberries, Strawberries	Food	-	-	8.75
Blueberry, Saskatoon, Cherry, Raspberry	Food	-	-	6.62
Head berries (*Mistegonemina*)	Food	-	0.03	0.03
Raspberries	Food	-	-	1.59
Raspberry, Blueberry	Food	-	-	1.71
Saskatoon, Blueberries, Strawberries	Food	-	-	0.54
Saskatoon, Raspberries, Strawberries	Food	-	-	5.18
Labrador Tea	Medicine	0.03	0.77	0.83
Labrador Tea, Ginger Root	Medicine	1.22	16.76	62.31
Spruce	Medicine	1.53	9.89	12.69
Wihkes	Medicine	0.07	0.28	0.28
Firewood	Other	-	-	<0.001
Wood cutting	Other	0.001	0.55	4.35

4.6.3 Bunibonibee Cree Nation

Community participants in workshops and personal interviews identified areas (km² or km) for more than five valued food and medicinal plants. Edible berries include cloudberries, cranberries, and raspberries. Medicinal plants include *wihkes*, and other unspecified plant species used for medicinal teas. Further areas of historical berry gathering, medicinal plant gathering, and firewood harvest were also identified, see table 4.6.3. and Map 8b. All plants were found within the regional area, while collection of raspberries, *wihkes*, and firewood harvest also occurred in the local and project areas.

Table 4.6.3. Bunibonibee Cree Nation Aboriginal Traditional Knowledge summaries: Areas (km² or km) for valued plants by assessment area.				
Plant Species Valued: Area (km²)	**Plant Use**	**Project**	**Local**	**Regional**
Cloudberries	Food	-	-	0.72
Cranberries	Food	-	-	4.99
Raspberries	Food	0.01	1.17	5.98
Historic berry picking area	Food	-	-	0.01
Plants for Tea	Medicine	-	-	4.20
Wihkes	Medicine	0.19	3.49	7.08
Medicinal Plant Gathering Location	Medicine	-	-	0.70
Firewood Harvest	Other	-	0.11	5.61
Plant Species Valued: Linear (km)	**Plant Use**	**Project**	**Local**	**Regional**
Firewood Harvest	Other	3.25	27.64	42.99

4.6.4 God's Lake First Nation

Community participants in workshops and personal interviews identified at least 14 valued plants. All plants were located at the regional level, with the occurrence of some medicinal plants also identified at the project and local levels. Six food plants, including berries and one root; the berries, bark, roots and leaves of at least eight plants used for medicine; and five plants used for other purposes, are shown with areas (km^2 or km) in Table 4.6.4a, and Map 8c. In addition, point locations were provided for certain plants within the regional assessment area. Three locations were identified as important areas for raspberry picking. Areas known for harvesting three medicinal plants were identified: Labrador tea (2 areas); Ginger root (2 areas) and Juniper (1 area), see Table 4.6.4b.

Table 4.6.4a. God's Lake First Nation Aboriginal Traditional Knowledge summaries: Areas (km^2 or km) for valued plants by assessment area.

Plant Species Valued: Area (km^2)	Plant Use	Project	Local	Regional
Blueberries	Food	-	-	3.83
Blueberries & Swamp Gooseberries	Food	-	-	0.12
Cranberries	Food	-	-	0.73
Medicines, *weekes*	Food	-	-	0.02
Berries	Medicine	-	-	0.02
Black Spruce Bark, Labrador Tea & Muskeg Leaves	Medicine	5.87	56.58	223.51
Labrador Tea	Medicine	5.57	53.35	205.74
Medicinal Plants	Medicine	-	-	0.56
Water Calla	Medicine	-	-	0.84
Ginger root and *wihkes*	Medicine	-	-	0.33
Wihkes	Medicine	-	0.004	0.88
Labrador Tea & Ginger Root	Other	0.65	8.65	33.79
Raspberries & Strawberries	Other	-	-	0.30
Plant Species Valued: Linear (km)	**Plant Use**	**Project**	**Local**	**Regional**
Mossberries	Food	0.59	12.29	29.10
Labrador Tea	Medicine	-	-	2.70
Willow Sticks	Other	-	-	2.67

Table 4.6.4b. God's Lake First Nation Aboriginal Traditional Knowledge: Number of locations for valued food and medicine plants, in the regional assessment area.

Plant Species	Plant Use	Point Locations
Raspberries	Food	3
Labrador Tea	Medicine	2
Ginger Root	Medicine	2
Juniper	Medicine	1

4.6.5 God's Lake Northern Affairs Community

In a workshop held in June 2016, participants from God's Lake Northern Affairs Community shared their knowledge of medicinal and cultural plants as well as harvesting locations. The workshop identified several valued plant species including Labrador tea which is used to treat sore throats, poplar tree sap for healing wounds, and *weekis* for treating all types of ailments. Other plant species harvested by community members include diamond willow and birch trees, used for crafts and other purposes. Only collection of Labrador tea is shown in the local assessment area (0.22 km^2), see Map 8d.

5.0 POTENTIAL EFFECTS ASSESSMENT

The identification of potential effects of the proposed P6 All-Season Road Project was carried out based on information provided by MESRA, information from the MBCDC, literature and internet searches. Environmental assessments conducted on other recent all-season road projects in Manitoba were also reviewed. Requirements of *The Environment Act* (Manitoba) and the *Canadian Environmental Assessment Act* (2012) and regulations and guidelines were considered in the preparation of the effects assessment for the Road Project. This assessment report conforms to Manitoba Conservation and Water Stewardship's guideline for preparing an Environment Act Proposal Report (Manitoba Conservation and Water Stewardship 2015).

The environmental effects of the proposed P6 All-Season Road Project were identified from review of environmental assessment reports conducted on other all-season road projects, east of Lake Winnipeg, an interaction matrix and linkage diagram (Appendix III) and by using professional judgement. Community concerns will be considered in the effects assessment, where information is available. For the purpose of this assessment environmental effects are defined as a predicted change in the environment caused by the project and mitigation as measures to avoid, prevent, and minimize adverse environmental effects. Additionally, residual effects are defined as environmental effects predicted to remain after the application of mitigation measures. Valued Components (VCs) refer to elements of an ecosystem that are identified as having scientific, social, cultural, historical, archaeological or aesthetic importance that may be impacted by a project.

The significance of the residual environmental effects for the proposed P6 All-Season Road Project was evaluated using criteria provided by the Manitoba East Side Road Authority (Table 5.0.).

Table 5.0. Description of significance criteria used for the residual effects assessment.

VEC/Other Vegetation Component	Direction of Change (type of effect)	Duration (period of time the effect occurs)	Magnitude (degree or intensity of the change)	Extent (spatial boundary)	Frequency (how often the effect occurs)	Reversibility (the degree of permanence)	Ecological and Social Context (whether a VC is particularly sensitive to disturbance and can adapt to change)
VEC - Species of Conservation Concern	**Neutral or Negligible:** No measurable change on the environment. **Negative:** Net loss (adverse or undesirable change) on the VC. **Positive:** Net benefit (or desirable change) on the VC.	**Short-Term (Level I):** The potential effect results from short-term events or activities such as the time required to complete a discrete component, seasonal or annual construction, maintenance or rehabilitation activities (i.e., a timeframe of several months). **Medium-Term (Level II):** The potential effect is likely to persist until the completion of construction and rehabilitation activities (i.e., a timeframe of 8 to 10 years). **Long-Term (Level III):** The potential effect is likely to persist beyond the completion of construction and rehabilitation activities into the operations and maintenance phase of the Project (i.e., a timeframe of greater than 10 years).	**Negligible or Low (Level I):** A change that is not likely to have a definable, detectable or measurable potential effect above baseline (i.e., potential effect is within a normal range of variation) or is below established thresholds of acceptable change (e.g., minimal risk of loss of species of conservation concern). **Moderate (Level II):** A change that will have a potential measurable effect that can be detected with a well-designed monitoring program; but is only marginally beyond standards/guidelines or established thresholds of acceptable change (e.g., loss of species of conservation concern but not predicted to change the state of the plant community or population). **High (Level III):** A change that will have potential effects that are easily observed, measured and described (i.e., readily detectable without a monitoring program) and are well beyond guidelines or established thresholds of acceptable change (e.g., loss of species of conservation concern and is predicted to change the state of the plant community or population).	**Project Footprint (Level I):** The physical space or directly affected area on which Project components or activities are located and/or immediately adjacent area which is within the defined limits of the P6 ASR ROW (i.e., 100 m) and permanent and temporary facilities (e.g., temporary access routes and quarries) within which potential effects are likely to be measurable. **Local Assessment Area (Level II):** Area within which potential project effects are measurable and extending beyond the Project Footprint to, but not beyond, the Local Assessment Area. **Regional Assessment Area (Level III):** Area beyond the Local Assessment Area within which most potential indirect and cumulative effects would occur.	**Infrequent (Level I):** The potential effect occurs once or seldom during the life of the Project (e.g., initial clearing of the ROW). **Sporadic/Intermittent (Level II):** The potential effect occurs only occasionally and without any predictable pattern during the life of the Project (e.g., blasting at quarries; site-specific construction equipment noise; potential wildlife-vehicle collisions). **Regular/Continuous (Level III):** The potential effect occurs at regular and frequent intervals during the Project phase in which they occur or over life of the Project (e.g., construction traffic; operations traffic).	**Reversible (short-term) (Level I):** Potential effect is readily reversible over a relatively short period of time (i.e., ≤ to the Project construction phase of approximately 8 years). **Reversible (long-term) (Level II):** Potential effect is potentially reversible but over a long period of time (i.e., many years into the Project operations phase). **Irreversible (Level III):** Project-specific potential effects are permanent.	**Low (Level I):** The VC is not rare or unique and is resilient to imposed change (e.g., has little to no unique attributes and is of minor importance to ecosystems functions or relationship). **Moderate (Level II):** The VC is moderately/seasonally fragile and has some capacity to adapt to imposed change (e.g., has some unique attributes and is somewhat important to ecosystem functions or relationship). **High (Level III):** The VC is a protected/designated species or fragile with low resistance to imposed change or part of a very fragile ecosystem (e.g., is considered to be unique and involves provincially or federally protected species).

Table 5.0. Description of significance criteria used for the residual effects assessment.							
VEC/Other Vegetation Component	**Direction of Change** (type of effect)	**Duration** (period of time the effect occurs)	**Magnitude** (degree or intensity of the change)	**Extent** (spatial boundary)	**Frequency** (how often the effect occurs)	**Reversibility** (the degree of permanence)	**Ecological and Social Context** (whether a VC is particularly sensitive to disturbance and can adapt to change)
VEC – Key Community Harvest Areas (Plant Species of Interest)	**Neutral or Negligible:** No measurable change on the environment. **Negative:** Net loss (adverse or undesirable change) on the VC. **Positive:** Net benefit (or desirable change) on the VC.	**Short-Term (Level I):** The potential effect results from short-term events or activities such as the time required to complete a discrete component, seasonal or annual construction, maintenance or rehabilitation activities (i.e., a timeframe of several months). **Medium-Term (Level II):** The potential effect is likely to persist until the completion of construction and rehabilitation activities (i.e., a timeframe of 8 to 10 years). **Long-Term (Level III):** The potential effect is likely to persist beyond the completion of construction and rehabilitation activities into the operations and maintenance phase of the Project (i.e., a timeframe of greater than 10 years).	**Negligible or Low (Level I):** A change that is not likely to have a definable, detectable or measurable potential effect above baseline (i.e., potential effect is within a normal range of variation) or is below established thresholds of acceptable change (e.g., no or minimal loss of key community harvest areas). **Moderate (Level II):** A change that will have a potential measurable effect that can be detected with a well-designed monitoring program; but is only marginally beyond standards/guidelines or established thresholds of acceptable change. (e.g., loss of key community harvest areas but not predicted to change the state of the plant community). **High (Level III):** A change that will have potential effects that are easily observed, measured and described (i.e., readily detectable without a monitoring program) and are well beyond guidelines or established thresholds of acceptable change. (e.g., loss of key community harvest areas and is predicted to change the state of the plant community).	**Project Footprint (Level I):** The physical space or directly affected area on which Project components or activities are located and/or immediately adjacent area which is within the defined limits of the P6 ASR ROW (i.e., 100 m) and permanent and temporary facilities (e.g., temporary access routes and quarries) within which potential effects are likely to be measurable. **Local Assessment Area (Level II):** Area within which potential project effects are measurable and extending beyond the Project Footprint to, but not beyond, the Local Assessment Area. **Regional Assessment Area (Level III):** Area beyond the Local Assessment Area within which most potential indirect and cumulative effects would occur.	**Infrequent (Level I):** The potential effect occurs once or seldom during the life of the Project (e.g., initial clearing of the ROW). **Sporadic/Intermittent (Level II):** The potential effect occurs only occasionally and without any predictable pattern during the life of the Project (e.g., blasting at quarries; site-specific construction equipment noise; potential wildlife-vehicle collisions). **Regular/Continuous (Level III):** The potential effect occurs at regular and frequent intervals during the Project phase in which they occur or over life of the Project (e.g., construction traffic; operations traffic).	**Reversible (short-term) (Level I):** Potential effect is readily reversible over a relatively short period of time (i.e., ≤ to the Project construction phase of approximately 8 years). **Reversible (long-term) (Level II):** Potential effect is potentially reversible but over a long period of time (i.e., many years into the Project operations phase). **Irreversible (Level III):** Project-specific potential effects are permanent.	**Low (Level I):** The VC is not rare or unique and is resilient to imposed change (e.g., has little to no unique attributes and is of minor importance to ecosystems functions or relationship). **Moderate (Level II):** The VC is moderately/seasonally fragile and has some capacity to adapt to imposed change (e.g., has some unique attributes and is somewhat important to ecosystem functions or relationship). **High (Level III):** The VC is a protected/designated species or fragile with low resistance to imposed change or part of a very fragile ecosystem (e.g., is considered to be unique and involves provincially or federally protected species).

Table 5.0. Description of significance criteria used for the residual effects assessment.							
VEC/Other Vegetation Component	**Direction of Change** (type of effect)	**Duration** (period of time the effect occurs)	**Magnitude** (degree or intensity of the change)	**Extent** (spatial boundary)	**Frequency** (how often the effect occurs)	**Reversibility** (the degree of permanence)	**Ecological and Social Context** (whether a VC is particularly sensitive to disturbance and can adapt to change)
Other Vegetation and Soil Components	**Neutral or Negligible:** No measurable change on the environment. **Negative:** Net loss (adverse or undesirable change) **Positive:** Net benefit (or desirable change)	**Short-Term (Level I):** The potential effect results from short-term events or activities such as the time required to complete a discrete component, seasonal or annual construction, maintenance or rehabilitation activities (i.e., a timeframe of several months). **Medium-Term (Level II):** The potential effect is likely to persist until the completion of construction and rehabilitation activities (i.e., a timeframe of 8 to 10 years). **Long-Term (Level III):** The potential effect is likely to persist beyond the completion of construction and rehabilitation activities into the operations and maintenance phase of the Project (i.e., a timeframe of greater than 10 years).	**Negligible or Low (Level I):** A change that is not likely to have a definable, detectable or measurable potential effect above baseline (i.e., potential effect is within a normal range of variation). **Moderate (Level II):** A change that will have a potential measurable effect that can be detected with a well-designed monitoring program; but is only marginally beyond standards/guidelines of acceptable change. **High (Level III):** A change that will have potential effects that are easily observed, measured and described (i.e., readily detectable without a monitoring program) and are well beyond guidelines of acceptable change.	**Project Footprint (Level I):** The physical space or directly affected area on which Project components or activities are located and/or immediately adjacent area which is within the defined limits of the P6 ASR ROW (i.e., 100 m) and permanent and temporary facilities (e.g., temporary access routes and quarries) within which potential effects are likely to be measurable. **Local Assessment Area (Level II):** Area within which potential project effects are measurable and extending beyond the Project Footprint to, but not beyond, the Local Assessment Area. **Regional Assessment Area (Level III):** Area beyond the Local Assessment Area within which most potential indirect and cumulative effects would occur.	**Infrequent (Level I):** The potential effect occurs once or seldom during the life of the Project (e.g., initial clearing of the ROW). **Sporadic/Intermittent (Level II):** The potential effect occurs only occasionally and without any predictable pattern during the life of the Project (e.g., blasting at quarries; site-specific construction equipment noise; potential wildlife-vehicle collisions). **Regular/Continuous (Level III):** The potential effect occurs at regular and frequent intervals during the Project phase in which they occur or over life of the Project (e.g., construction traffic; operations traffic).	**Reversible (short-term) (Level I):** Potential effect is readily reversible over a relatively short period of time (i.e., ≤ to the Project construction phase of approximately 8 years). **Reversible (long-term) (Level II):** Potential effect is potentially reversible but over a long period of time (i.e., many years into the Project operations phase). **Irreversible (Level III):** Project-specific potential effects are permanent.	**Low (Level I):** The component is not rare or unique and is resilient to imposed change (e.g., has little to no unique attributes and is of minor importance to ecosystems functions or relationship). **Moderate (Level II):** The component is moderately/seasonally fragile and has some capacity to adapt to imposed change (e.g., has some unique attributes and is somewhat important to ecosystem functions or relationship). **High (Level III):** The component is a protected/designated species or fragile with low resistance to imposed change or part of a very fragile ecosystem (e.g., is considered to be unique and involves provincially or federally protected species).

5.1 Environmental Issues

Regional issues of concern for the assessment of the proposed P6 All-Season Road Project were determined from literature and professional experience; any concerns identified through future traditional knowledge workshops will be considered. Regional issues of concern include the following:

Country Foods

In remote northern regions, country food is an important part of the Aboriginal people's traditional diet. Many Aboriginal people consume a diet of foods that are fished, hunted, trapped and gathered locally. Today, foods are expensive to import and many people still rely on country foods as a portion of their diet. Plants as country foods may include berries, herbs, nuts, wild rice, and locally grown garden vegetables.

Spread of Invasive Plant Species

Invasive plant species are plants that out-compete native species when introduced outside of their natural setting. Invasive species may establish and proliferate as a result of the Project. These species are problematic because they are capable of growing under a wide range of climatic and soil conditions, produce abundant seeds, and often have vigorous growth.

5.2 Valued Components

Valued Components (VCs) refer to elements of an ecosystem that are identified as having scientific, social, cultural, historical, archaeological or aesthetic importance that may be impacted by a project. The value of a component not only relates to its role in the ecosystem, but also to the value people place on it. The value of a component may be determined on the basis of scientific, social, cultural, economic, historical, archaeological, or aesthetic importance. Canadian Environmental Assessment Agency Guidelines (CEAA 2015) for the proposed Project were also reviewed for including potential VCs.

Information on importance, environmental indicators, measurable parameters, and rationale are provided on the VCs. Environmental indicators are aspects of VCs or the environment that are subject to change by a project activity, while measurable parameters are variables used to express changes in the environmental indicators. VCs that have the potential to be adversely affected by project activities after mitigation has been applied receive special consideration in the assessment of cumulative environmental effects. VCs identified for the proposed P6 All-Season Road Project assessment include the following (see also Table 5.2.):

Species of Conservation Concern

Species of conservation concern are valued because these are plants that exist in low numbers, play a role in helping to preserve species diversity, their distribution is often restricted, and some species are protected. These include species listed by the federal Species at Risk Act (SARA), under Schedule 1, The Endangered Species and Ecosystems Act – Manitoba (ESEA), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and those species listed by the Manitoba Conservation Data Centre (MBCDC) ranked very rare to rare.

Key Community Harvest Areas

Key community harvest areas (plant species of interest) are important to the community and valued for food, ceremonies, income or medicinal purposes. These plants and areas are often identified through traditional knowledge studies and other engagement activities. Key community harvest areas (plant species of interest) may include blueberries, cranberries, raspberries, strawberries, saskatoons, cloudberries and wild rice, and many other medicinal plants and herbs (Northern Lights Heritage Services 2000).

Table 5.2. Vegetation Valued Components.

VCs	Group	Importance	Environmental Indicator	Measurable Parameter	Rationale
Species of Conservation Concern	Various Plants	• Government • Other[1]	Species occurrence	Presence/ absence	• Regulatory importance (SARA under Schedule 1; COSEWIC; ESEA; MBCDC species listed very rare to rare) • Ecological and environmental importance
Key Community Harvest Areas (Plant Species of Interest)	Various Plants	• First Nation[2] • Government • Other[1]	Species occurrence; area of resource use	Presence/ absence; hectares	• Cultural importance • Regulatory importance • Ecological and environmental importance

[1]Other (e.g., science).

[2]First Nations (Gods Lake, Bunibonibee and Manto Sipi).

5.3 Effects Analysis

The following identifies the effects on vegetation and soils for the proposed P6 All-Season Road Project.

5.3.1 Vegetation

Effects of roads on vegetation and terrestrial ecosystems have been reported on by Angold (1997), Forman and Alexander (1998), Trombulak and Frissell (1999), Hui et al. (2003), Noss (2002), Watkins et al. (2003), Li et al. (2014) and others. Effects include habitat loss, altering interior forest conditions, destroying natural vegetation along sides of the road, reduction in biomass, introduction of non-native plant species, increased erosion potential, and increased abundance of grass species near roads. Road dust affects vegetation by covering plant surfaces, affecting photosynthesis, respiration and transpiration, resulting in decreased productivity (Farmer, 1993). Brown (2009) found that fugitive dust in forested roadsides influenced plant species with the greatest effect closest to the roadway.

Potential environmental effects of similar all-season road projects have been reported on to include the loss of vegetation and other culturally important species in the project assessment area during construction; increased risk of invasive species spread, impairment of vegetation during construction and maintenance activities, and increased risk of forest fire (e.g., MESRA 2016a; MESRA 2016b; Szwaluk Environmental Consulting et al. 2015; Manitoba Floodway and East Side Road Authority 2010 and 2011; Canadian Environmental Assessment Agency 2011).

Predicated effects from other linear development projects in Manitoba's boreal forest have been reported on by Calyx Consulting (2012) and Szwaluk Environmental Consulting et al. (2011) and include loss of native forest vegetation, introduction of invasive plant species, potential loss of habitat and plants used by Aboriginal people, disruption of riparian areas and wetlands, increased fragmentation, and increased risk of wildfire.

The proposed P6 All-Season Road Project may affect vegetation and botanical resources during construction, operation and maintenance stages. Potential environmental effects prior to mitigation include the following:

1. Loss of species of conservation concern in the project assessment area due to clearing during construction. These plants include species listed by SARA, ESEA, and COSEWIC, and plants listed by the MBCDC as very rare to rare, however protected vascular plant species listed by SARA and ESEA are not expected to occur as the study area is beyond the geographic range of the listed species. Flooded jellyskin (*Leptogium rivulare*) lichen listed by SARA and COSEWIC does not occur in the ecoregion and was not found during the 2016 field studies.

2. Disturbance to or removal of key community harvest areas of plant species of interest (medicinal and cultural) in the project assessment area due to clearing during construction. The local communities use a number of plants in the area, and the P6 All-Season Road Project will result in removal of approximately 8.9 km^2 of vegetation, from road construction, that is locally valued. A potential beneficial effect from the P6 All-Season Road Project will be increased access to new botanical resource areas by local community members.

3. Disturbance to or removal of native vegetation in the project assessment area due to clearing during construction. The P6 All-Season Road Project will result in the removal of approximately 27.3 km^2 of native vegetation (excluding exposed land and water) from road construction; additionally 1.9 km^2 will be removed from quarries and access roads.

4. Disturbance or loss to species composition and ecology of wetlands (bog and fen) in the project assessment area due to clearing during construction. The Project will result in the loss of approximately 3.5 km^2 of wetland (bog and fen) area from road construction; another 0.1 km^2 will be removed from quarries and access roads. Wetlands in the boreal forest are highly connected systems that transport water and nutrients across the landscape. Water balances that have been altered in wetlands may result in increased drainage (drier moisture regime) or flooding that could affect species abundance and composition (Ecological Land Surveys Ltd. 1999). Road development has the potential to impede water flow resulting in long-term vegetation changes (Ducks Unlimited Canada et al. 2014).

5. Fragmentation of the local and regional vegetation communities due to clearing during construction. The P6 All-Season Road, quarries and access roads will result in discontinuity in the spatial distribution of native vegetation, resulting in fragments and ecosystem patches. A consequence of fragmentation is the isolation of vegetation communities that may result in reduced pollen quantity and reproduction. The continued fragmentation of an area can cause long-term reduction in species diversity and suitable habitat (Public Service Commission of Wisconsin 2009).

6. Modification of vegetation composition and structure adjacent to the disturbance zone due to clearing during construction. The removal of native vegetation and the creation of new forest edges along a disturbance zone may result in changes to the vegetation. Increased solar radiation exposure and a change in microclimate along these edges may cause changes in structure and species composition (Ecological Land Surveys Ltd. 1999). Along newly created forest edges, windfall may result due to extreme weather events (e.g., high winds).

7. Introduction and spread of invasive and non-native species in the project assessment area during construction, operation and maintenance. Construction equipment and granular material used for construction can be a source of non-native and invasive plant species which can become problematic for the native plant species in the area. Where road development occurs, a change in plant composition adjacent to the road is generally a result non-native and invasive species introduction. A large number of invasive species have the potential to be introduced during project activities.

8. Loss/impairment of vegetation in the project assessment area from accidental releases of fuels or hazardous substances during road construction, and operation and maintenance. In a past study that examined the effects of oil spills and vegetation, non-vascular plants and most dicot plants showed no recovery after oil was spilled on selected plant communities (Walker et al. 1978).

9. Loss/impairment of desirable plant species in the project assessment area from herbicide application during road operation and maintenance. Unfortunately, herbicides not only inhibit the growth of undesirable species but can also negatively affect desirable species by causing stress and possible mortality of vegetation that may be considered important for wildlife, traditional uses, or botanical value.

10. Impairment of vegetation in the project assessment area from dust during road construction, operation and maintenance. Dust can have a potential negative effect on the environment causing stress to adjacent vegetation. A covering of dust on leaf surfaces increases solar heat absorption and decreases transpiration rates resulting in a reduction of carbon uptake (Succarieh 1992).

11. Increased risk of forest fire in the local and regional assessment area during construction, and operation and maintenance. Wildfire has the potential to develop from the accumulation of slash during clearing and construction activities, and from human related causes as a result of new access during road operation.

12. Increased access to botanical resources used by non-community members during road operation. The P6 All-Season Road Project will attract people and allow access to areas that were previously unreachable. This can result in the potential adverse effects on local botanical resources. The local aboriginal people have long established traditional uses related to botanical resources, including berry picking, medicine gathering and harvesting plants.

13. Reduced floristic diversity immediately adjacent to the road due to clearing and construction. The P6 All-Season Road will be centered on a 100 m ROW with a

typical clearing width of 60 m and additional clearing as required in horizontal curves to maintain sight distances; the roadway will be constructed with a road top width of 10 m (MESRA 2016c). As a result, the flora will be temporarily reduced along the All-Season Road in the cleared RoW. Any rehabilitation plantings usually consist of a limited mix of graminoids, forbs and shrubs.

Mitigation measures for vegetation effects have been reported by Forman and Alexander (1998), Daigle (2010), Ducks Unlimited Canada et al. (2014), Szwaluk Environmental Consulting et al. (2015), and MESRA (2016a and 2016b). Best practices and environmental protection measures identified to mitigate adverse environmental effects on vegetation as a result of the proposed P6 All-Season Road Project include: limit clearing to designated area within the ROW, undertake construction activities during winter months to the extent possible, grubbing activities to end 2 m from standing timber to avoid disturbing the root system of standing trees, identify plant species of conservation concern prior to clearing, adjust the road alignment, where possible, to avoid loss of important harvest areas as identified by communities; design road and construction practices to avoid adversely affecting the functionality of bogs and fens; implement design measures to maintain existing moisture conditions that support localized vegetative communities as per the Operational Guide to Forest Road Wetland Crossings (Ducks Unlimited Canada et al. 2014), clean construction equipment and vehicles (where possible) prior to bringing them into the construction area, adhere to permit terms and conditions for herbicide use, undertake burning of slash piles during the winter months to the extent possible, and restore ground cover vegetation using natural means augmented with planting and seeding as required.

The range of evaluation criteria for potential residual effects on vegetation were determined to be adverse in direction of change, low to high ecological and societal context, medium to long-term duration, low to moderate magnitude, extent ranging from the project footprint to the regional assessment area, frequency of infrequent to continuous, and long-term reversibility of effects.

Follow-up actions identified include inspections to ensure that mitigation is implemented and effective. The residual effects on VCs (i.e., species of conservation concern, key community harvest areas/plant species of interest) were determined to have minimal risk of loss/mortality in the project assessment area. The environmental effects analysis for vegetation is summarized in Table 5.3.1.

Table 5.3.1. Vegetation effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
Loss of species of conservation concern in the project assessment area due to clearing during construction	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term	• Identify/survey plant species of conservation concern prior to clearing • Adjust road alignment where possible to avoid loss of plant species of conservation concern • Prohibit equipment and vehicle use outside the designated cleared area	Minimal risk of loss of plant species of concern; no species of conservation concern were found during 2016 field studies	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – long-term
Loss of flooded jellyskin (*Leptogium rivulare*) lichen in the project assessment area due to clearing during construction	Direction – negative Ecological and societal context – high Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term	• Identify and flag plant species of locations prior to clearing • Adjust road alignment where possible to avoid loss of species locations • Prohibit equipment and vehicle use outside the designated cleared area • Limit clearing to designated areas within the project assessment area	Minimal risk of loss to flooded jellyskin lichen; **flooded jellyskin was not observed during 2016 field studies**	Direction – negative Ecological and societal context – high Duration – long-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – long-term
Disturbance to or removal of key community harvest areas of plant species of interest (medicinal, cultural) in the project assessment area due to clearing during construction	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term	• Identify areas of cultural importance prior to clearing • Identify important medicinal and cultural plants and harvesting areas • Adjust road where possible to avoid to the loss of important harvesting area • Limit clearing to designated area within the project assessment area • Prohibit use of equipment and	Minimal loss of vegetation and loss confined to project assessment area	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – long-term

Table 5.3.1. Vegetation effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
		vehicles outside the designated cleared area		
Disturbance to or removal of native vegetation in the project assessment area due to clearing during construction	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – high Extent – project footprint Frequency – infrequent Reversibility – long-term	• Limit clearing to designated areas within the project assessment area • Prohibit equipment and vehicle use outside the designated cleared area • Grubbing activities to end 2 m from standing timber to avoid disturbing the root system of standing trees • Restore ground cover vegetation along road shoulders using natural means augmented with planting and seeding of native species as required	Removal of native vegetation confined to the project assessment area	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term
Disturbance or loss to species composition and ecology of wetlands (bogs and fens) in the project assessment area due to clearing during construction	Direction – negative Ecological and societal context – moderate Duration – long-term Magnitude – high Extent – project footprint Frequency – infrequent Reversibility – long-term	• Design road and construction practices to avoid adversely affecting the functionality of bogs and fens (i.e., equalization culverts to maintain bog/fen hydraulics) • Undertake construction activities in bog/fens during winter months to extent possible • Implement design measures to maintain existing moisture conditions that support localized vegetative communities as per the Operational Guide to Forest Road Wetland Crossings (Ducks	Wetland (bog and fen) loss confined to the project assessment area	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term

Table 5.3.1. Vegetation effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
		Unlimited Canada et al. 2014)		
Fragmentation of the local and regional vegetation communities due to clearing during construction	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – high Extent – local and regional assessment area Frequency – infrequent Reversibility – long-term	• Undertake clearing activities during winter months to extent possible • Limit clearing to designated area within the project assessment area • Prohibit equipment and vehicle use outside the designated cleared area	Fragmentation confined to the project assessment area	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term
Modification of vegetation composition and structure adjacent to the disturbance zone due to clearing during construction	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – moderate Extent – local assessment area Frequency – infrequent Reversibility – long-term	• Undertake clearing activities during winter months to extent possible • Limit clearing to designated area within the project assessment area • Prohibit equipment and vehicle use outside the designated cleared area	Minimal modification of vegetation adjacent to disturbance zone	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – long-term
Introduction and spread of invasive and non-native species in the project assessment area during construction, operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – high Extent – project footprint Frequency – continuous Reversibility – long-term	• Clean construction equipment and vehicles prior to bringing them into the construction site (where possible) • Undertake construction activities during winter months to the extent possible	Minimal risk of invasive and non-native species introduction	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – continuous Reversibility – long-term
Loss/impairment of vegetation in the project assessment area from accidental releases of fuels or hazardous substances during road construction	Direction – negative Ecological and societal context – moderate Duration – long-term Magnitude – moderate Extent – project footprint Frequency – intermittent	• Construction sites to have an approved emergency response plan that includes fuel spills • Store fuel in approved containers provided with secondary containment	Minimal risk of vegetation mortality	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – low Extent – project footprint Frequency – intermittent

Table 5.3.1. Vegetation effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
and operation and maintenance	Reversibility – long-term	• Drip trays, blankets or pads to be used when transporting fuel		Reversibility – long-term
Loss/impairment of desirable plant species in the project assessment area from herbicide application during road operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – intermittent Reversibility – long-term	• Apply herbicides in accordance with manufacturers guidelines and adhere to permit terms and conditions • Limit herbicide application beyond road shoulder	Minimal risk of vegetation mortality	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – project footprint Frequency – intermittent Reversibility – long-term
Impairment of vegetation in the project assessment area from dust during road construction, operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – intermittent Reversibility – short-term	• Undertake construction activities during winter months to extent possible • Use water or approved dust suppression agents that will not negatively affect plants	Minimal risk of vegetation mortality	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – project footprint Frequency – intermittent Reversibility – short-term
Increased risk of forest fire in the local and regional assessment area during construction and operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – high Extent – regional assessment area Frequency – intermittent Reversibility – long-term	• Undertake construction and burning during the winter months to the extent possible • Prohibit burning of slash piles during high forest fire conditions	Minimal risk of forest fires	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – regional assessment area Frequency – intermittent Reversibility – long-term
Increased access to botanical resources used by non-community members during road operation	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – local assessment area Frequency – intermittent Reversibility – long-term	• Non-mitigable	Minimal loss of botanical resources	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – local assessment area Frequency – intermittent Reversibility – long-term
Reduced floristic diversity immediately adjacent to	Direction – negative Ecological and societal context – low	• Limit clearing to designated areas within the project assessment	Reduced floristic diversity confined to the project	Direction – negative Ecological and societal context – low

Table 5.3.1. Vegetation effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
the road due to clearing and construction	Duration – medium-term Magnitude – moderate Extent – local assessment area Frequency – infrequent Reversibility – long-term	area • Prohibit equipment and vehicle use outside the designated cleared area • Restore ground cover vegetation along road shoulders using natural means augmented with planting and seeding of native species as required	assessment area	Duration – medium-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term

5.3.2 Soils

A close relationship between soils and vegetation develop as soils begin to form. Vegetation helps break down solid materials and provides organic matter building soil. In return, soils are important to vegetation for several reasons including providing a medium for growth and the storing of nutrients. According to Hironaka et al. (1990), soils and vegetation are mutually associated with each other when reviewing basic concepts of development, both influenced by the same environmental variables. The relationship between soils and vegetation growth has been researched by several authors (e.g., Twardy and Corns 1980; Strong and La Roi 1983; Klinka et al. 1994; Szwaluk and Strong 2003).

Effects of road construction on the soil environment has been documented by a variety of authors (Bilby et al. 1989; Brown 2009; Daigle 2010; Noss 2002; Senes Consultants Ltd. 2005; Swift 1988; and Trombulak and Frissell 1999). Effects of road construction on soils include contamination from a variety of pollutants, loss of productivity, erosion, compaction, and loss of biomass. Brown (2009) found that soil chemistry was influenced from roadside dust in forested environments and dust from limestone roads had a greater effect on soils that led to an increase in roadside invasive species.

Potential environmental effects of similar all-season road projects have been reported on to include the loss of soils from construction activities, compaction, erosion, modification of the soil moisture regime, and impaired soil quality from accidental releases of hazardous materials (e.g., MESRA 2016a; MESRA 2016b; Szwaluk Environmental Consulting et al. 2015; Manitoba Floodway and East Side Road Authority 2010 and 2011; Canadian Environmental Assessment Agency 2011).

The proposed P6 All-Season Road Project may affect soils during construction, operation and maintenance stages. Potential environmental effects prior to mitigation include the following:

1. Loss of soil in the project assessment area due to clearing, stripping and construction.

2. Compaction of soil in the project assessment area due to heavy equipment use during construction.

3. Loss of soil in the project assessment area due to erosion of cleared sites during construction.

4. Loss of soil in the project assessment area due to erosion of soil stockpiles during construction.

5. Modification of soil moisture regime in the local assessment area during operation and maintenance.

6. Impaired soil quality in the project assessment area from accidental releases of fuels and hazardous substances during construction, operation and maintenance.

7. Impaired soil quality in the project assessment area from herbicide application during operation and maintenance.

Measures identified to mitigate adverse environmental effects on soils include stockpiling soils that are stripped for use in re-vegetation, minimize the amount of soil stripped in construction sites, minimize compaction of soils by heavy equipment in construction areas, provide erosion protection and sediment control, manage surface drainage at construction sites, minimize the loss of soil by covering stockpiles (i.e., impervious layer such as geotextile fabric); minimize the amount of soil stockpiled on site if possible; remove or spread excess material as soon as work is completed to minimize erosion, provide hydraulic equalization culverts to prevent ponding of water at upstream locations and drying at downstream locations, store fuels and other hydrocarbon containing substances in approved containers, use drip trays when fuelling construction equipment and vehicles, construction sites to have an approved emergency response plan that includes fuel spills, and adhere to herbicide permit terms and conditions.

The range of evaluation criteria for potential residual effects on soils were determined to be adverse in direction of change, low to moderate ecological and societal context, short to long-term duration, low to moderate magnitude, extent restricted to the project footprint and local assessment area, frequency of infrequent to intermittent, and short to long-term reversibility of effects. Follow-up actions identified include inspections to ensure that mitigation is implemented and effective. The environmental effects analysis for soils is summarized in Table 5.3.2.

Table 5.3.2. Soils effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
Loss of soil in the project assessment area due to clearing, stripping and construction	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term	• Stockpile soil stripped from the proposed road bed for re-vegetation purposes • Minimize amount of soil stripped in construction sites	Minimal loss of soils	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – long-term
Compaction of soil in the project assessment area due to heavy equipment use during construction	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – short-term	• Carry out construction during the winter months to the extent possible • Minimize compaction of soils by heavy equipment in construction areas	Minimal compaction of soils	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – short-term
Loss of soil in the project assessment area due to erosion of cleared sites during construction	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – short-term	• Provide erosion protection and sediment control as required • Manage surface drainage at construction sites	Minimal risk of soil erosion	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – short-term
Loss of soil in the project assessment area due to erosion of soil stockpiles during construction	Direction – negative Ecological and societal context – low Duration – short-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – short-term	• Minimize the loss of soil by covering stockpiles (i.e., impervious layer such as geotextile fabric) • Minimize the amount of soil stockpiled on site if possible • Remove or spread excess material as soon as work is completed to minimize erosion • Provide erosion protection	Minimal risk of soil erosion	Direction – negative Ecological and societal context – low Duration – short-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – short-term

Table 5.3.2. Soils effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
		and sediment control as required		
Modification of soil moisture regime in the local assessment area during operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – local assessment area Frequency – infrequent Reversibility – short-term	• Provide hydraulic equalization culverts to prevent ponding of water at upstream locations and drying at downstream locations	Minimal impairment to soil moisture regime	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – local assessment area Frequency – infrequent Reversibility – short-term
Impaired soil quality in the project assessment area from accidental releases of fuels and hazardous substances during construction, operation and maintenance	Direction – negative Ecological and societal context – moderate Duration – long-term Magnitude – moderate Extent – project footprint Frequency – intermittent Reversibility – long-term	• Store fuels and other hydrocarbon containing substances in approved containers • Use drip trays, pads or sheets when fuelling construction equipment and vehicles • Construction sites to have an approved emergency response plan that includes fuel spills	Minimal risk of impaired soil quality	Direction – negative Ecological and societal context – moderate Duration – long-term Magnitude – low Extent – project footprint Frequency – intermittent Reversibility – long-term
Impaired soil quality in the project assessment area from herbicide application during operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – intermittent Reversibility – long-term	• Apply herbicide in accordance with manufacturers guidelines • Adhere to herbicide permit terms and conditions	Minimal risk of impaired soil quality	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – project footprint Frequency – intermittent Reversibility – long-term

6.0 ENVIRONMENTAL PROTECTION

6.1 Environmental Protection Measures

Environmental protection measures identified in this assessment report include specific mitigation measures to avoid or minimize potential adverse effects on vegetation and soils arising from the Project. The environmental protection measures are based on best practices and guidance materials from other development projects, and are summarized from the Effects Assessment (Section 5.0).

Vegetation Mitigation Measures

- Limit clearing to designated areas within the project assessment area.
- Prohibit equipment and vehicle use outside the designated cleared area.
- Restore ground cover vegetation along road shoulders using natural means augmented with planting and seeding of native species as required.
- Grubbing activities to end 2 m from and standing timber to avoid disturbing the root system of standing trees.
- Design road and construction practices to avoid adversely affecting the functionality of bogs and fens. i.e., installation of equalization culverts
- Implement design measures to maintain existing moisture conditions that support localized vegetative communities as per the Operational Guide to Forest Road Wetland Crossings (Ducks Unlimited Canada et al. 2014).
- Undertake construction activities during winter months to extent possible.
- Identify areas of cultural importance prior to clearing.
- Identify important medicinal and cultural plants and harvesting areas.
- Identify species of conservation concern prior to clearing.
- Adjust road alignment where warranted to avoid loss of key community harvest areas.
- Wash construction equipment and vehicles prior to bringing them into the construction site.
- Construction sites to have an approved emergency response plan that includes fuel spills.
- Store fuel in approved containers provided with secondary containment.
- Use drip trays, blankets or pads when transporting fuel.
- Apply herbicides in accordance with manufacturer's guidelines and adhere to permit terms and conditions.
- Limit herbicide application beyond road shoulder.
- Use water or approved dust suppression agents that will not negatively affect plants.
- Undertake construction and burning during the winter months to the extent possible.

- Prohibit burning of slash piles during high forest fire conditions.

Soil Mitigation Measures

- Stockpile soil stripped from the proposed road bed for revegetation purposes.
- Minimize amount of soil stripped in construction sites.
- Minimize compaction of soils by heavy equipment in construction areas.
- Provide erosion protection and sediment control as required.
- Manage surface drainage at construction sites.
- Minimize the loss of soil by covering stockpiles (i.e., impervious layer such as geotextile fabric).
- Minimize the amount of soil stockpiled on site, if possible.
- Remove or spread excess material as soon as work is completed to minimize erosion.
- Provide hydraulic equalization culverts to prevent ponding of water at upstream locations and drying at downstream locations.
- Store fuels and other hydrocarbon containing substances in approved containers.
- Use drip trays, pads or sheets when fuelling construction equipment and vehicles.
- Construction sites to have an approved emergency response plan that includes fuel spills.
- Apply herbicides in accordance with manufacturer's guidelines and adhere to permit terms and conditions.
- Limit herbicide application beyond road shoulder.

6.2 Field Investigation

Vegetation and soil surveys were conducted within the proposed P6 road alignment in the spring/early summer of 2016. The field investigation gathered additional data for the Project assessment including vegetation types, forest resource information, species composition, and presence/absence of species of conservation concern and species of interest, such as those traditionally used for medicine, subsistence and cultural purposes. Surveys were also conducted to characterize and classify the associated soils. Detailed vegetation and soils field information collected in 2016 is provided in the P6 Project Field Report.

7.0 CUMULATIVE EFFECTS

Cumulative effects are the environmental effects that are likely to result from a project in combination with the environmental effects of other past, existing and future projects or activities. The environmental assessment process for cumulative environmental effects includes: scoping, analysis of effects, identification of mitigation, evaluation of significance, and follow-up.

7.1 Scoping

Regional Issues: Regional vegetation issues of concern for the assessment of cumulative effects for the P6 All-Season Road Project connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation were determined to include:

- Country foods, and
- Spread of invasive plant species

Regional issues are discussed in Section 5.1 of the vegetation report.

Regional Valued Components: Regional VCs relevant to the cumulative effects assessment for the P6 All-Season Road Project connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation were determined to be:

- Species of conservation concern, and
- Key community harvest areas (plant species of interest)

VCs are discussed in Section 5.2 of the vegetation report.

Spatial and Temporal Boundaries: Spatial and temporal boundaries for a cumulative effects assessment generally occur over a wide area and extend before and after the project boundaries. The spatial boundary identified for the cumulative effects assessment includes the regional assessment area, while the temporal boundary was determined to be long-term (beyond 10 years of operation).

Other Actions: Other actions that may affect the VCs were determined to include:

Past:

- Community Development
- Resource Use

Existing:

- Winter Roads

- Transmission Line Maintenance
- Resource Use
- Off-road Vehicles

Future:

- Transmission Line Maintenance
- Transmission Line Construction Projects
- Road Construction and Maintenance Projects
- Resource Use
- Off-road Vehicles
- Community Development
- Mining

Potential Effects: The potential environmental effects on VCs due to the proposed P6 All-Season Road Project and other projects and activities in the cumulative effects assessment area for the foreseeable future are shown as interactions in Table 7.1.

Table 7.1. Potential cumulative effects identification.

Projects and Activities	Valued Components		Regional Issues	
	Species of Conservation Concern	**Key Community Harvest Areas**	**Country Foods**	**Spread of Invasive Plant Species**
Proposed Project				
Project construction	X	X	X	X
Project operation	X	X	X	X
Past Projects and Activities				
Community development projects	X	X	X	X
Resource use	X	X	X	X
Existing Projects and Activities				
Winter roads	X	X	X	X
Transmission maintenance	X	X	X	X
Resource use	X	X	X	X
Off-road vehicles	X	X	X	X
Future Projects and Activities				
Transmission projects	X	X	X	X
Road projects	X	X	X	X
Mining projects	X	X	X	X
Community development projects	X	X	X	X

7.2 Effects Analysis

Eleven different cover types were recognized in the regional assessment area. Coniferous dense forest and coniferous open forest are the dominant cover types and account for 382.4 km^2 and 351.4 km^2, respectively. Other abundant types include open water (283.9 km^2), wetland shrub (193.5 km^2) and coniferous sparse forest (126.2 km^2). The remaining cover types are divided among broadleaf forest, mixedwood forest, wetland treed and herb, shrub lands, and exposed land.

In the regional assessment area, more than 17 plants, plus wood and firewood resources were identified by the communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation, God's Lake First Nation, and God's Lake Northern Affairs Community as important for sustenance and cultural practices. Mapped area of occupancy for plants of sustenance and cultural value identified by community members totaled 367.6 km^2.

Up to 14 species of conservation concern may occur, of which five are very rare (S1) and nine are rare (S2) or rare/uncommon (S2S3), as ranked by the MBCDC.

The potential cumulative effects of the proposed P6 All-Season Road Project in combination with the effects of other Projects and activities in the assessment area are summarized below:

Species of Conservation Concern and Key Community Harvest Areas (Plant Species of Interest): The effects of construction and operation of the proposed P6 All-Season Road Project may act cumulatively with the effects of the existing winter roads, transmission line maintenance, resource use, and off-road vehicles. Future activities such as transmission line construction projects, road construction and maintenance projects, mining projects, and community development may adversely affect the VCs identified. Past activities have included community development projects and resource use, but past effects on VC's are anticipated to be small.

The potential cumulative effects of the proposed P6 All-Season Road Project effects in combination with the effects of other projects and activities in the assessment area are evaluated in Table 7.2. The range of evaluation criteria (see Table 5.0.) for the potential cumulative effect categories include an adverse direction of change, moderate ecological and societal context, long-term duration, low magnitude, a project footprint extent or spatial boundary, frequency of infrequent to intermittent, and reversible over the long-term. Any potential cumulative environmental effects for the Project would be very small.

Table 7.2. Potential cumulative environmental effects analysis.							
Potential Cumulative Effect Categories	**Evaluation Criteria and Rating**						
	Direction of Change	**Ecological and Societal Context**	**Duration**	**Magnitude**	**Extent**	**Frequency**	**Reversibility**
Species of Conservation Concern	Negative	Moderate	Long-term	Low	Project	Infrequent	Long-term
Key Community Harvest Areas	Negative	Moderate	Long-term	Low	Project	Intermittent	Long-term

7.3 Identification of Mitigation

No additional mitigation measures are required for any potential cumulative environmental effects beyond those mitigation measures to be implemented as a part of the P6 project as described in sections 5.3.1 and 5.3.2, and tables 5.3.1 and 5.3.2.

7.4 Evaluation of Significance

No significant cumulative environmental effects were identified for the proposed P6 All-Season Road Project, connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation, in combination with the environmental effects of other projects and activities in the assessment area currently, or for the reasonably foreseeable future.

7.5 Follow-up

No additional follow-up is required for any potential cumulative environmental effects.

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APPENDIX I. Definitions of Selected Technical Terms[1].

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.

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.

Canopy – The more or less continuous cover of branches and foliage formed by the crowns of trees.

Canopy Closure – The degree of canopy cover relative to openings.

Classification – The systematic grouping and organization of objects, usually in a hierarchical manner.

Community-Type – A group of vegetation stands that share common characteristics, an abstract plant community.

Coniferous – A cone-bearing plant belonging to the taxonomic group Gymnospermae.

Cover – The area of ground covered with plants of one or more species, usually expressed as a percentage.

Deciduous – Refers to perennial plants from which the leaves abscise and fall off at the end of the growing season.

Ecoregion – An area characterized by a distinctive regional climate as expressed by vegetation.

Family – Taxonomic grouping of plants that are related at a particular hierarchical level.

Fen – Wetland with a peat substrate, nutrient-rich waters, and primarily vegetated by shrubs and graminoids.

Flora – A list of the plant species present in an area.

Forest – A relatively large assemblage of tree-dominated stands.

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.

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.

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.

Mixedwood – Forest stands composed of conifers and angiosperms each representing between 25 and 75% of the cover.

Riparian – Refers to terrain, vegetation or simply a position adjacent to or associated with a stream, flood plain, or standing body of water.

Shrub – A perennial plant usually with a woody stem, shorter than a tree, often with a multi-stemmed base.

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.

Stand – A collection of plants having a relatively uniform composition and structure, and age in the case of forests.

Terrestrial – Pertaining to land as opposed to water.

Understory – Vegetation growing beneath taller plants such as trees or tall shrubs.

Vascular – Having tissues that transport water, sap, nutrients; refers to plants that are not mosses, lichens and algae.

Vegetation – The general cover of plants growing on a landscape.

Vegetation Type – In phytosociology, the lowest possible level to be described.

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 activity that are adapted to wet environments.

[1]All references Cauboue et al. 1996, unless otherwise noted.

APPENDIX II. Preliminary Species List.

A preliminary list of flora expected to occur in the Project 6 All-Season Road study area, organized taxonomically by family. MBCDC provincial ranks are included, SNA species marked with an asterisk (*) indicate species invasive status (ISCM 2016).

Scientific Name	Common Name	Rank
Ferns and Allies		
DRYOPTERIDACEAE	**WOOD FERN FAMILY**	
Gymnocarpium dryopteris	Common Oak Fern	S4S5
Gymnocarpium jessoense	Northern Oak Fern	S3S4
Dryopteris carthusiana	Spinulose Wood Fern	S5
Woodsia alpina	Northern Woodsia	S2
EQUISETACEAE	**HORSETAIL FAMILY**	
Equisetum arvense	Field Horsetail	S5
Equisetum fluviatile	Swamp Horsetail	S5
Equisetum pratense	Meadow Horsetail	S4S5
Equisetum scirpoides	Dwarf Scouring-rush	S4S5
Equisetum sylvaticum	Woodland Horsetail	S5
LYCOPODIACEAE	**CLUB-MOSS FAMILY**	
Diphasiastrum sitchense	Ground-fir	S1
Diphasiastrum ×zeilleri	Zeiller's Ground Cedar	SNA
Huperzia selago	Mountain Club-moss	S2S3
Lycopodium annotinum	Stiff Club-moss	S5
Lycopodium lagopus	Running Pine	S3
OPHIOGLOSSACEAE	**ADDER'S TONGUE FAMILY**	
Botrychium matricariifolium	Daisy-leaf Moonwort	S1
Botrypus virginianus	Rattlesnake Fern	S4
SELAGINELLACEAE	**SPIKE-MOSS FAMILY**	
Selaginella rupestris	Rock Spike-moss	S4
Gymnosperms		
CUPRESSACEAE	**CYPRESS FAMILY**	
Juniperus communis	Common Juniper	S5
Juniperus horizontalis	Creeping 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		
ACORACEAE	**SWEET FLAG FAMILY**	
Acorus americanus	Sweet Flag	S4S5
ALISMATACEAE	**ARROWHEAD FAMILY**	
Sagittaria cuneata	Arum-leaved Arrowhead	S5
ARACEAE	**ARUM FAMILY**	
Calla palustris	Water-arum	S5
CYPERACEAE	**SEDGE FAMILY**	
Carex aquatilis	Water Sedge	S5
Carex atherodes	Awned Sedge	S5
Carex aurea	Golden Sedge	S5
Carex bebbii	Bebb's Sedge	S5
Carex brunnescens	Brownish Sedge	S5
Carex canescens	Hoary Sedge	S5
Carex capillaris	Hair-like Sedge	S5
Carex chordorrhiza	Prostrate Sedge	S4S5
Carex deflexa	Bent Sedge	S4S5
Carex diandra	Two-stamened Sedge	S4S5
Carex disperma	Two-seeded Sedge	S5
Carex gynocrates	Northern Bog Sedge	S5
Carex houghtoniana	Sand Sedge	S5
Carex leptalea	Bristle-stalked Sedge	S5
Carex limosa	Mud Sedge	S5
Carex loliacea	Rye-grass Sedge	S2?
Carex magellanica	Bog Sedge	S5
Carex maritima	Seaside Sedge	S2?
Carex media	Intermediate Sedge	S4S5
Carex microglochin	False Uncina Sedge	S2?
Carex pauciflora	Few-flowered Sedge	S3
Carex pellita	Woolly Sedge	S5
Carex retrorsa	Turned Sedge	S5
Carex siccata	Dry-spike Sedge	S4S5
Carex utriculata	Beaked Sedge	S5
Carex vaginata	Sheathed Sedge	S5
Eleocharis palustris	Creeping Spike-rush	S5
Eriophorum gracile	Slender Cotton-grass	S4S5
Eriophorum vaginatum	Tussock Cotton-grass	S5
Eriophorum viridicarinatum	Thin-leaved Cotton-grass	S4
Schoenoplectus tabernaemontani	Soft-stem Bulrush	S5

Trichophorum alpinum	Alpine Cotton-grass	S5
JUNCACEAE	**RUSH FAMILY**	
Juncus alpinoarticulatus	Alpine Rush	S5
Juncus bufonius	Toad Rush	S5
Luzula parviflora	Small-flowered Woodrush	S4S5
JUNCAGINACEAE	**ARROW-GRASS FAMILY**	
Scheuchzeria palustris	Pod-grass	S3S4
LILIACEAE	**LILY FAMILY**	
Allium schoenoprasum	Chives	S3S4
Maianthemum canadense	Two-leaved Solomon's-seal	S5
Maianthemum trifolium	Three-leaved Solomon's-seal	S5
ORCHIDACEAE	**ORCHID FAMILY**	
Calypso bulbosa	Calypso	S4
Corallorhiza trifida	Early Coral-root	S5
Galearis rotundifolia	Round-leaved Orchis	S5
Goodyera repens	Lesser Rattlesnake Plantain	S4S5
Platanthera dilatata	Bog Candle	S3S4
Platanthera hookeri	Hooker's Orchid	S2S3
Platanthera huronensis	Huron Fringed Orchid	S4S5
Platanthera obtusata	Small Northern Bog Orchid	S5
Platanthera orbiculata	Round-leaved Bog Orchid	S3S4
Spiranthes romanzoffiana	Hooded Ladies'-tresses	S5
POACEAE	**GRASS FAMILY**	
Agrostis scabra	Ticklegrass	S5
Agrostis stolonifera	Creeping Bent Grass	SNA
Alopecurus aequalis	Short-awned Foxtail	S5
Beckmannia syzigachne	Slough Grass	S5
Bromus ciliatus	Fringed Brome	S5
Calamagrostis canadensis	Marsh Reed Grass	S5
Calamagrostis stricta	Northern Reed Grass	S5
Elymus repens	Quack-grass	SNA
Glyceria borealis	Northern Manna Grass	S4S5
Glyceria grandis	Tall Manna Grass	S5
Glyceria pulchella	Graceful Manna Grass	S2S3
Hordeum jubatum	Wild Barley	S5
Oryzopsis asperifolia	White-grained Mountain Rice Grass	S5
Poa glauca	Glaucous Bluegrass	S4S5
Poa palustris	Fowl Bluegrass	S5

POTAMOGETONACEAE	**PONDWEED FAMILY**	
Potamogeton friesii	Fries Pondweed	S4
Potamogeton gramineus	Various-leaved Pondweed	S5
Potamogeton natans	Common Floating Pondweed	S5
Potamogeton richardsonii	Clasping-leaved Pondweed	S5
Potamogeton robbinsii	Robbin's Pondweed	S2S3
Potamogeton strictifolius	Straightleaf Pondweed	S2S3
SPARGANIACEAE	**BURR-REED FAMILY**	
Sparganium angustifolium	Narrow-leaved Bur-reed	S4S5
Angiosperms - Dicotyledons		
ACERACEAE	**MAPLE FAMILY**	
Acer spicatum	Mountain Maple	S5
APIACEAE	**CARROT FAMILY**	
Cicuta bulbifera	Bulb-bearing Water-hemlock	S5
Cicuta maculata	Spotted Water-hemlock	S4S5
Sium suave	Water-parsnip	S5
ARALIACEAE	**GINSENG FAMILY**	
Aralia nudicaulis	Wild Sarsaparilla	S5
ASTERACEAE	**ASTER FAMILY**	
Achillea alpina	Many-flowered Yarrow	S4S5
Achillea millefolium	Common Yarrow	S5
Anaphalis margaritacea	Pearly Everlasting	S3S4
Antennaria neglecta	Field Cat's-foot	S5
Arctium minus	Common Burdock	SNA*
Artemisia absinthium	Wormwood	SNA
Doellingeria umbellata	Flat-topped White Aster	S5
Erigeron hyssopifolius	Hyssop-leaved Fleabane	S4
Euthamia graminifolia	Flat-topped Goldenrod	S5
Hieracium umbellatum	Umbellate Hawkweed	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
Solidago hispida	Hairy Goldenrod	S5
Solidago missouriensis	Missouri Goldenrod	S5
Solidago multiradiata	Alpine Goldenrod	S4S5
Sonchus arvensis	Field Sow-thistle	SNA*
Sonchus asper	Spiny-leaved Sow-thistle	SNA
Symphyotrichum ciliolatum	Lindley's Aster	S5
Symphyotrichum lanceolatum	Panicled Aster	S4S5

Taraxacum officinale	Common Dandelion	SNA
BALSAMINACEAE	**TOUCH-ME-NOT FAMILY**	
Impatiens noli-tangere	Western Jewelweed	S1
BETULACEAE	**BIRCH FAMILY**	
Alnus incana ssp. *rugosa*	Speckled Alder	S5
Alnus viridis	Green Alder	S5
Betula papyrifera	White Birch	S5
Betula pumila	Dwarf Birch	S5
BORAGINACEAE	**BORAGE FAMILY**	
Hackelia deflexa ssp. *americana*	Beggar's Lice	S4S5
Mertensia paniculata	Tall Lungwort	S5
BRASSICACEAE	**MUSTARD FAMILY**	
Erysimum cheiranthoides	Wormseed Mustard	SNA
Rorippa palustris	Bog Yellowcress	S4S5
CAMPANULACEAE	**BELLFLOWER FAMILY**	
Campanula aparinoides	Marsh Bellflower	S5
CAPRIFOLIACEAE	**HONEYSUCKLE FAMILY**	
Diervilla lonicera	Bush-honeysuckle	S5
Linnaea borealis	Twinflower	S5
Lonicera dioica	Limber or Twining Honeysuckle	S5
Lonicera villosa	Mountain-Fly-Honeysuckle	S5
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
Stellaria media	Common Chickweed	SNA
CHENOPODIACEAE	**GOOSEFOOT FAMILY**	
Blitum capitatum	Strawberry Blite	S4S5
CLUSIACEAE	**MANGOSTEEN FAMILY**	
Triadenum fraseri	Marsh St. John's-wort	S3
CORNACEAE	**DOGWOOD FAMILY**	
Cornus canadensis	Bunchberry	S5
Cornus rugosa	Round-leaved Dogwood	S3
Cornus stolonifera	Red-osier Dogwood	S5
DROSERACEAE	**SUNDEW FAMILY**	
Drosera anglica	Oblong-leaved Sundew	S3S4
Drosera rotundifolia	Round-leaved Sundew	S4S5
ELAEAGNACEAE	**OLIVE FAMILY**	

Shepherdia canadensis	Canada Buffaloberry	S5
ERICACEAE	**HEATH FAMILY**	
Andromeda polifolia	Bog-rosemary	S5
Arctostaphylos uva-ursi	Common Bearberry	S5
Arctous alpina	Alpine Bearberry	S3S4
Chamaedaphne calyculata	Leatherleaf	S5
Gaultheria hispidula	Creeping Snowberry	S4S5
Kalmia polifolia	Bog Laurel	S5
Rhododendron groenlandicum	Labrador Tea	S5
Vaccinium caespitosum	Dwarf Bilberry	S3
Vaccinium myrtilloides	Velvet-leaf Blueberry	S5
Vaccinium oxycoccos	Small Cranberry	S5
Vaccinium uliginosum	Bog Whortleberry	S5
Vaccinium vitis-idaea	Bog Cranberry	S5
FABACEAE	**PEA FAMILY**	
Astragalus bodinii	Bodin's Milkvetch	S1
Astragalus canadensis	Canada Milkvetch	S5
Lathyrus ochroleucus	Pale Vetchling	S5
Oxytropis borealis	Boreal Locoweed	S1S2
Trifolium repens	White Clover	SNA
FUMARIACEAE	**FUMITORY FAMILY**	
Corydalis aurea	Golden Corydalis	S5
Capnoides sempervirens	Pink Corydalis	S5
GERANIACEAE	**GERANIUM FAMILY**	
Geranium bicknellii	Bicknell's Geranium	S5
GROSSULARIACEAE	**CURRANT FAMILY**	
Ribes glandulosum	Skunk Currant	S5
Ribes hudsonianum	Northern Wild Black Currant	S5
Ribes lacustre	Bristly Black Currant	S4
Ribes oxyacanthoides	Canada Wild Gooseberry	S5
HALORAGACEAE	**WATER-MILFOIL FAMILY**	
Myriophyllum sibiricum	Spiked Water-milfoil	S5
HIPPURIDACEAE	**MARE'S-TAIL FAMILY**	
Hippuris vulgaris	Common Mare's-tail	S5
LAMIACEAE	**MINT FAMILY**	
Dracocephalum parviflorum	American Dragon-head	S5
Lycopus asper	Western Water-horehound	S4
Lycopus uniflorus	Northern Bugleweed	S4S5
Scutellaria galericulata	Hooded Skullcap	S5
Stachys palustris	Marsh Hedge-nettle	S5

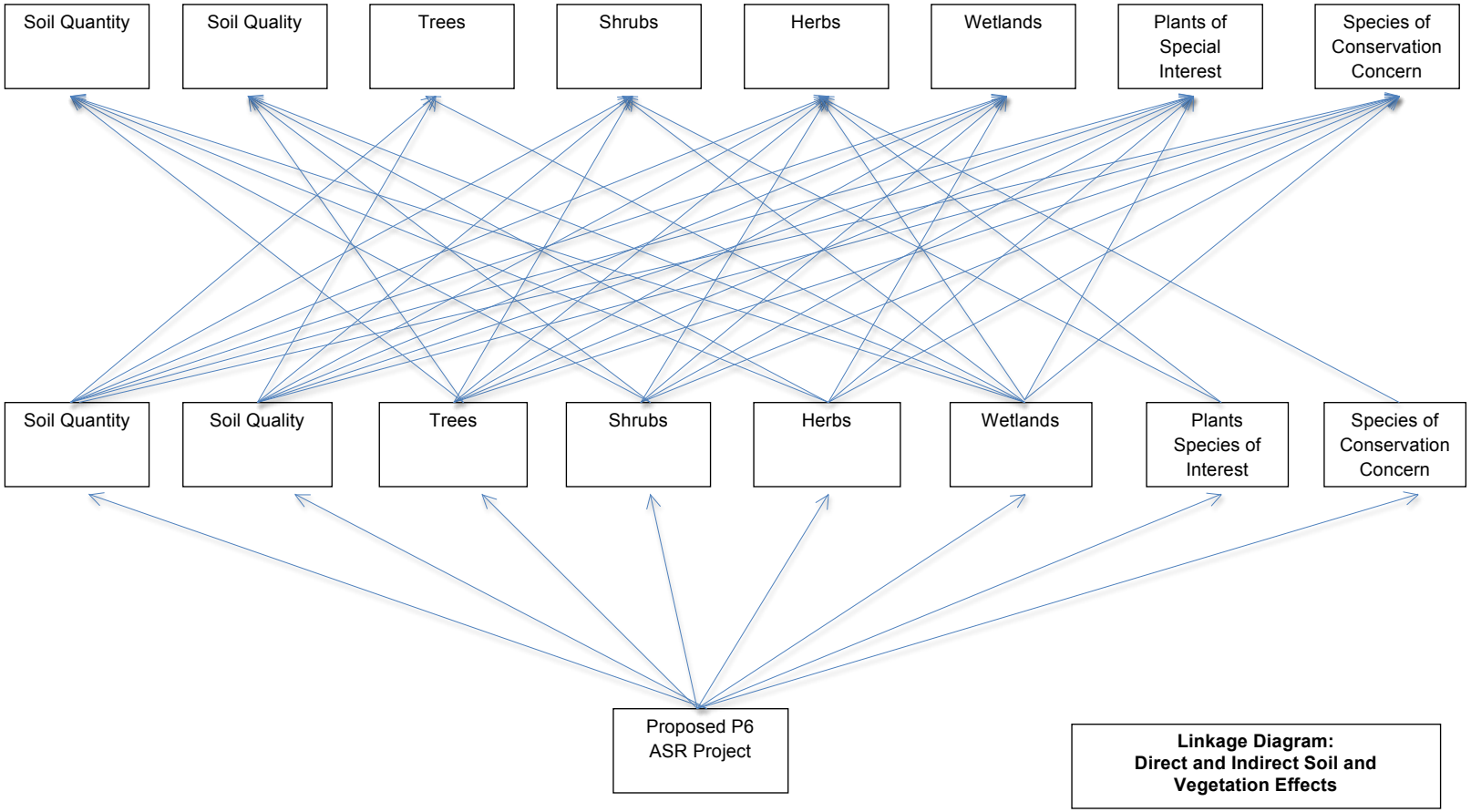
LENTIBULARIACEAE	**BLADDERWORT FAMILY**	
Utricularia cornuta	Horned Bladderwort	S3S4
MENYANTHACEAE	**BUCKBEAN FAMILY**	
Menyanthes trifoliata	Bog Bean	S5
MYRICACEAE	**WAX-MYRTLE FAMILY**	
Myrica gale	Sweet Gale	S5
NYMPHACEAE	**WATER-LILY FAMILY**	
Nuphar variegata	Yellow Pond-lily	S5
ONAGRACEAE	**EVENING PRIMROSE FAMILY**	
Epilobium ciliatum ssp. *glandulosum*	Willowherb	S5
Epilobium ciliatum ssp. *watsonii*	Willow-herb	SU
Epilobium leptophyllum	Linear-leaf Willowherb	S4S5
PLANTAGINACEAE	**PLANTAIN FAMILY**	
Plantago major	Common Plantain	SNA
POLYGONACEAE	**SMARTWEED FAMILY**	
Fagopyrum esculentum	Buckwheat	SNA
Fallopia convolvulus	Black Bindweed	SNA
Persicaria amphibia	Water Smartweed	S5
Persicaria lapathifolia	Pale Smartweed	S5
Rumex occidentalis	Western Dock	S4S5
PRIMULACEAE	**PRIMROSE FAMILY**	
Lysimachia thyrsiflora	Tufted Loosestrife	S5
PYROLACEAE	**WINTERGREEN FAMILY**	
Orthilia secunda	One-sided Wintergreen	S5
Pyrola asarifolia	Pink Pyrola	S5
RANUNCULACEAE	**CROWFOOT FAMILY**	
Anemone canadensis	Canada Anemone	S5
Anemone multifida	Cut-leaved Anemone	S5
Anemone parviflora	Small Wood Anemone	S4
Aquilegia brevistyla	Small-flowered Columbine	S4
Caltha palustris	Marsh Marigold	S5
Ranunculus aquatilis	White Water Crowfoot	S5
Ranunculus flammula	Creeping Spearwort	S4S5
Ranunculus pensylvanicus	Bristly Crowfoot	S5
Ranunculus sceleratus	Cursed Crowfoot	S5
RHAMNACEAE	**BUCKTHORN FAMILY**	
Rhamnus alnifolia	Alder-leaved Buckthorn	S5
ROSACEAE	**ROSE FAMILY**	

Amelanchier alnifolia	Saskatoon	S5
Comarum palustre	Marsh Cinquefoil	S5
Fragaria virginiana	Smooth Wild Strawberry	S5
Geum aleppicum	Yellow Avens	S5
Potentilla norvegica	Rough Cinquefoil	S5
Prunus pensylvanica	Pin Cherry	S5
Prunus virginiana	Chokecherry	S5
Rosa acicularis	Prickly Rose	S5
Rubus arcticus ssp. *acaulis*	Stemless Raspberry	S5
Rubus chamaemorus	Cloudberry	S5
Rubus idaeus	Wild Red Raspberry	S5
Rubus pubescens	Dewberry	S5
Sibbaldiopsis tridentata	Three-toothed Cinquefoil	S5
Sorbus decora	Mountain-ash	S4
RUBIACEAE	**MADDER FAMILY**	
Galium labradoricum	Ladie's Bedstraw	S4S5
Galium trifidum	Three-petal Bedstraw	S5
SALICAEAE	**WILLOW FAMILY**	
Populus balsamifera	Balsam Poplar	S5
Populus tremuloides	Trembling Aspen	S5
Salix bebbiana	Bebb's Willow	S5
Salix candida	Hoary Willow	S5
Salix exigua	Sandbar Willow	S5
Salix humilis	Gray Willow	S4
Salix maccalliana	Velvet-fruited Willow	S4
Salix pedicellaris	Bog Willow	S5
Salix pellita	Satin Willow	S3S4
Salix petiolaris	Basket Willow	S4S5
Salix planifolia	Plane-leaved Willow	S5
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
Saxifraga tricuspidata	Three-toothed Saxifrage	S4S5
SCROPHULARIACEAE	**FIGWORT FAMILY**	
Rhinanthus minor	Little Yellow Rattle	S4

APPENDIX III. Environmental Component Interaction Matrix and Linkage Diagram

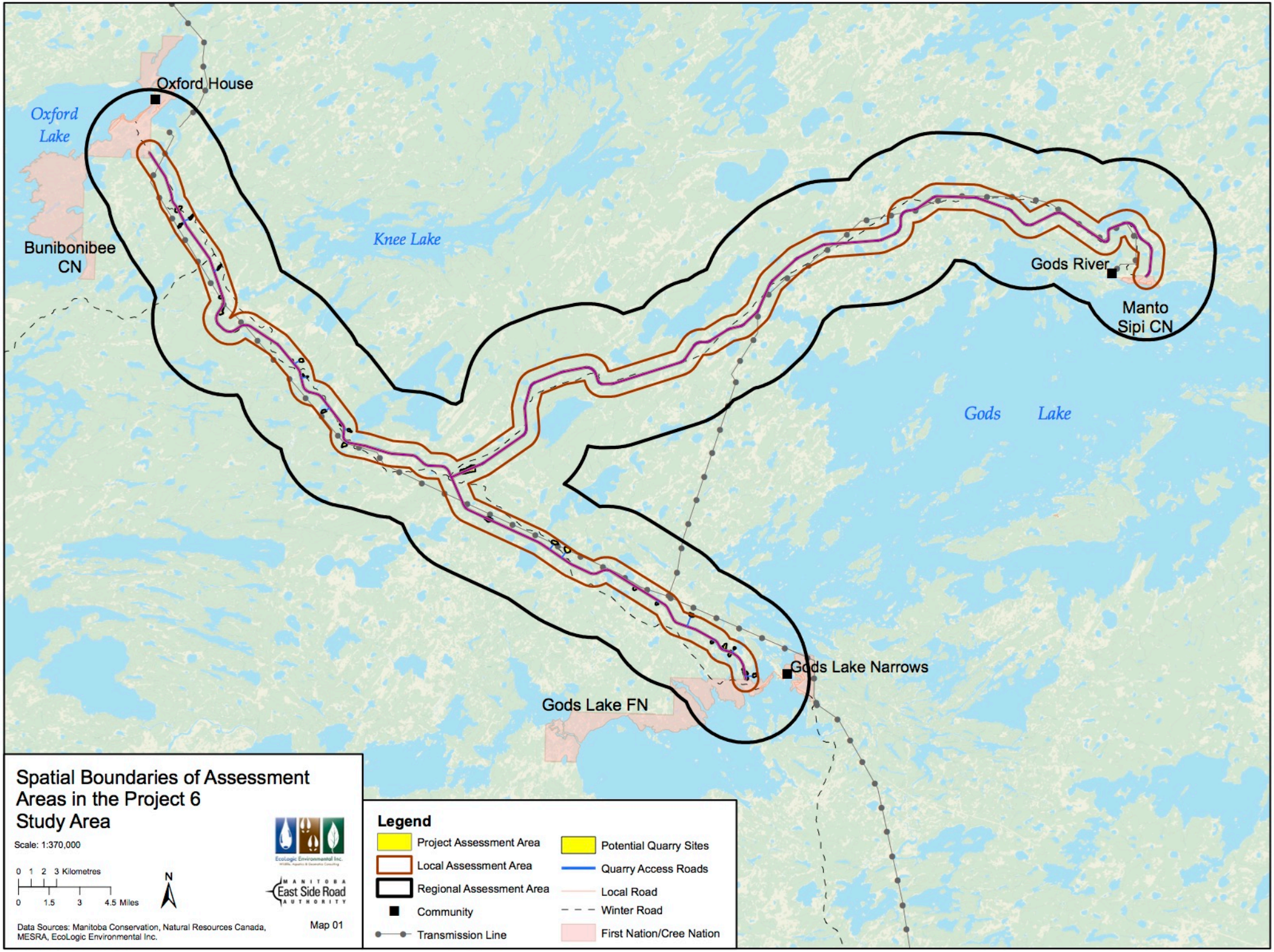
Project Activity - Environmental Component Interaction Matrix

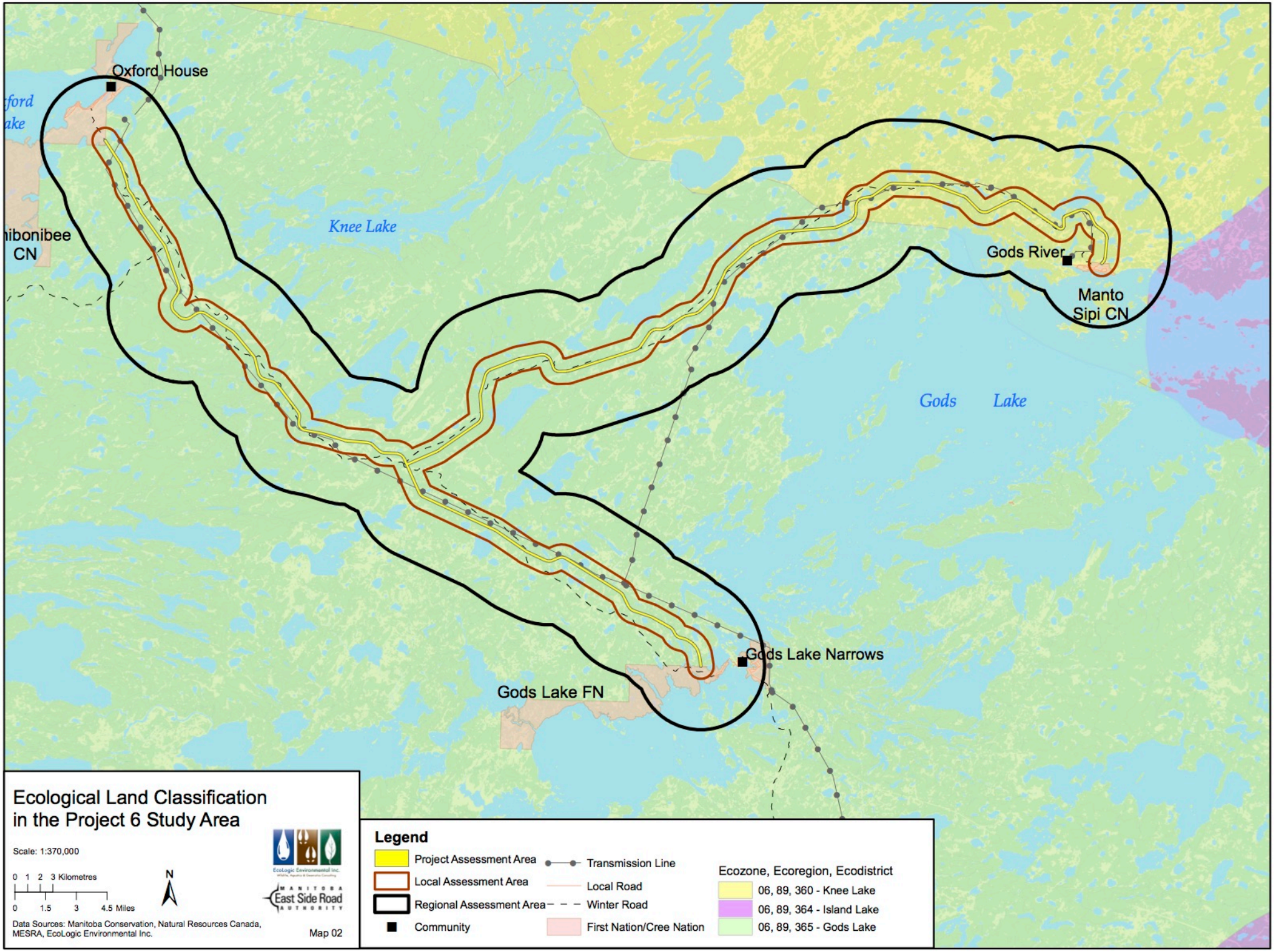
Project Activities / Environmental Components	Accessing	Surveying/Flagging	Clearing Vegetation	Removing Trees	Windrowing	Burning	Excavating	Crushing Rock	Sorting Aggregate	Filling	Stockpiling Materials	Grading/Contouring	Laying Aggregate	Compacting	Drilling	Using Explosives	Operating Equipment	Operating Vehicles/ATVs	Operating Generators	Establishing Camps	Housing Workers	Establishing Staging Areas	Erecting Fences	Transporting Equip. Suppl	Transporting Materials	Transporting Fuel	Storing Fuel	Dispensing Fuel	Crossing Streams	Cofferdamming	Controlling Erosion	Batching Concrete	Pouring Concrete	Demobilizing	Dismantling Facilities	Dismantling Bridge	Disposing Solid Waste	Disposing Haz. Waste	Disposing Liquid Waste	Restoring	Planting/Seeding	Controlling Dust	Erecting Signs	Plowing Snow	De-icing Culverts	Removing Beaver Dams	De-icing Road	Controlling Vegetation
Pre-Construction	X	X	X	X													X	X			X			X	X	X		X	X																	
Construction	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Operation/Maintenance																	X	X	X					X	X	X		X			X										X	X	X	X	X	X
Decommissioning									X		X	X				X	X	X	X	X	X			X	X	X	X	X	X		X			X	X	X	X	X	X	X	X					
Soil																																															
Soil Quantity							X						X									X										X															
Soil Quality	X		X	X		X	X	X			X	X	X	X			X	X		X		X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X
Vegetation																																														
Trees	X		X	X	X	X		X						X		X				X		X			X	X	X	X	X		X									X	X					X
Shrubs	X		X		X	X		X						X		X				X		X			X	X	X	X	X		X									X	X					X
Herbs	X		X		X	X		X						X		X				X		X			X	X	X	X	X		X									X	X			X	X	X
Wetlands			X					X						X											X	X	X	X																X		X
Plant Species of Interest			X	X	X	X		X						X											X	X	X	X																		X
Species of Conservation Concern			X		X	X		X						X		X				X		X			X	X	X	X																		X

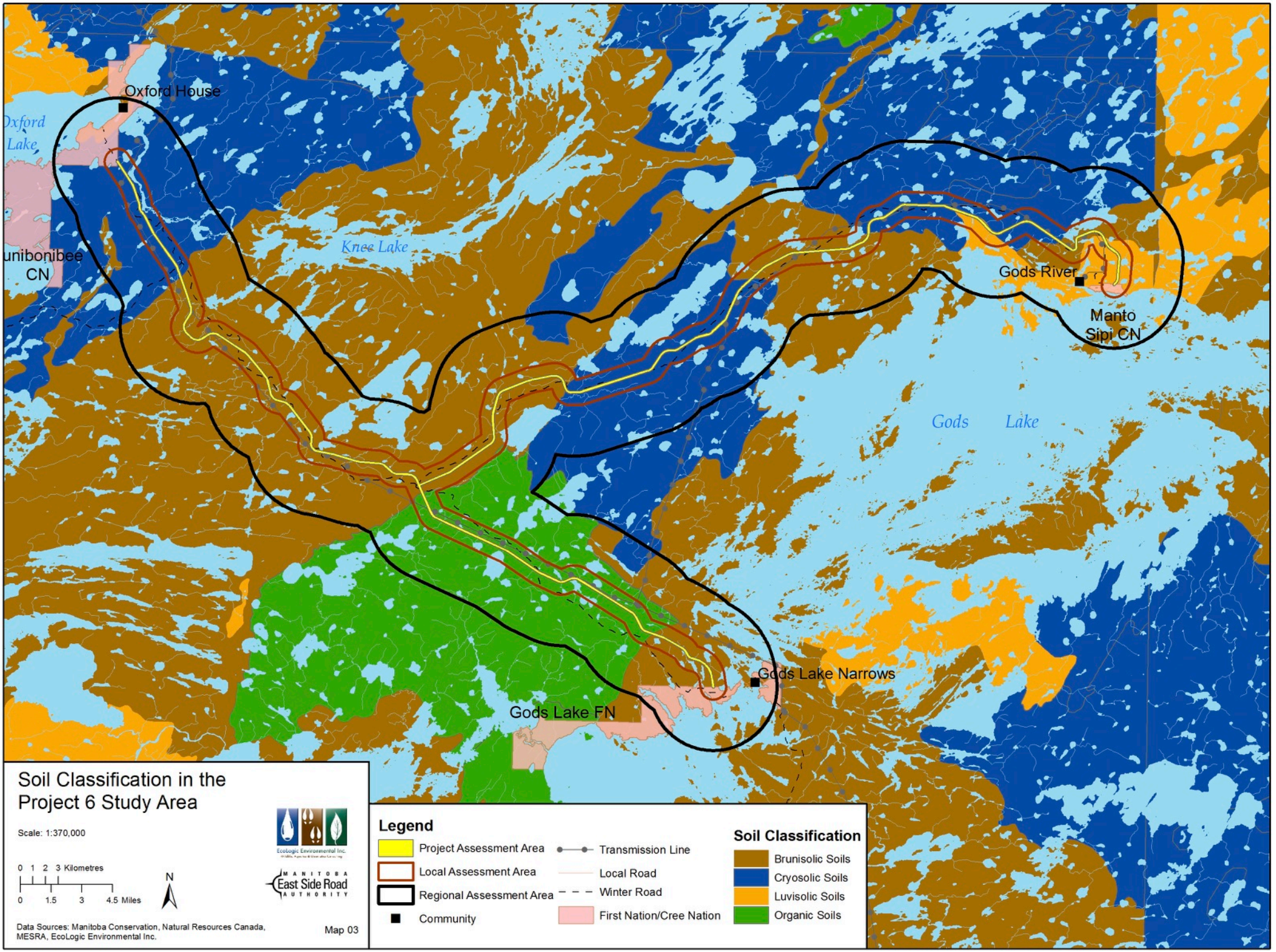


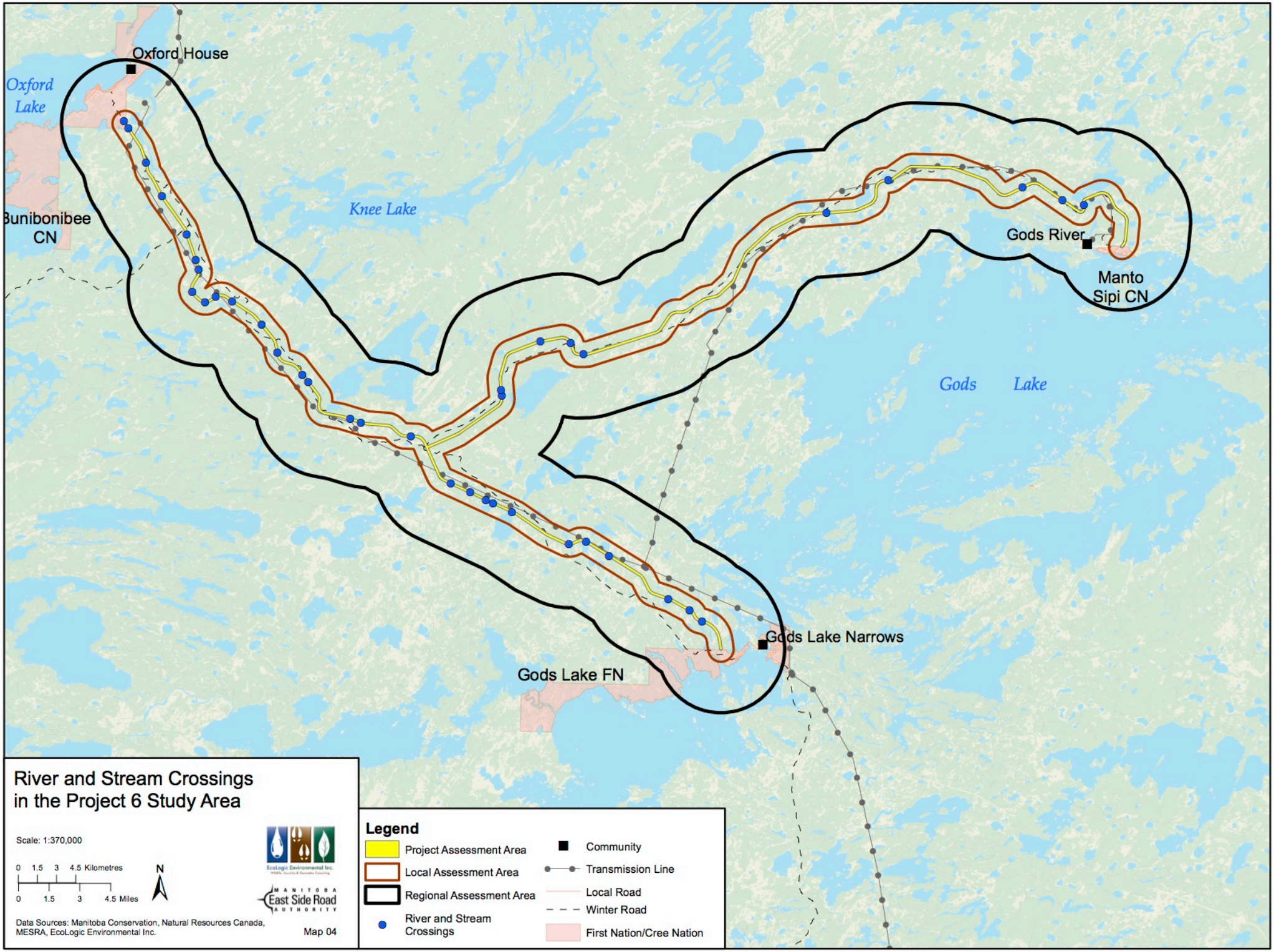
Linkage Diagram:
Direct and Indirect Soil and Vegetation Effects

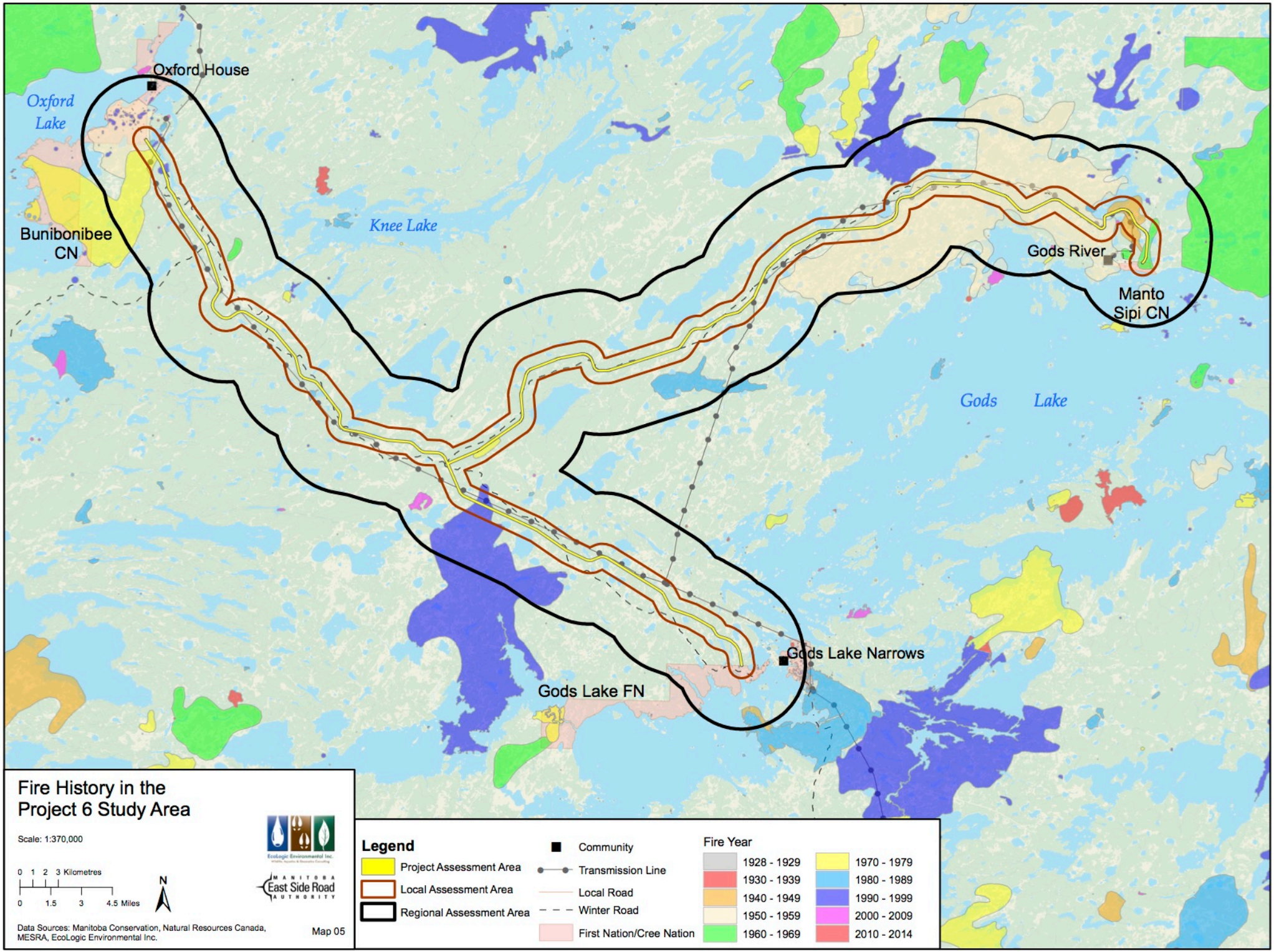
APPENDIX IV. Report Maps.

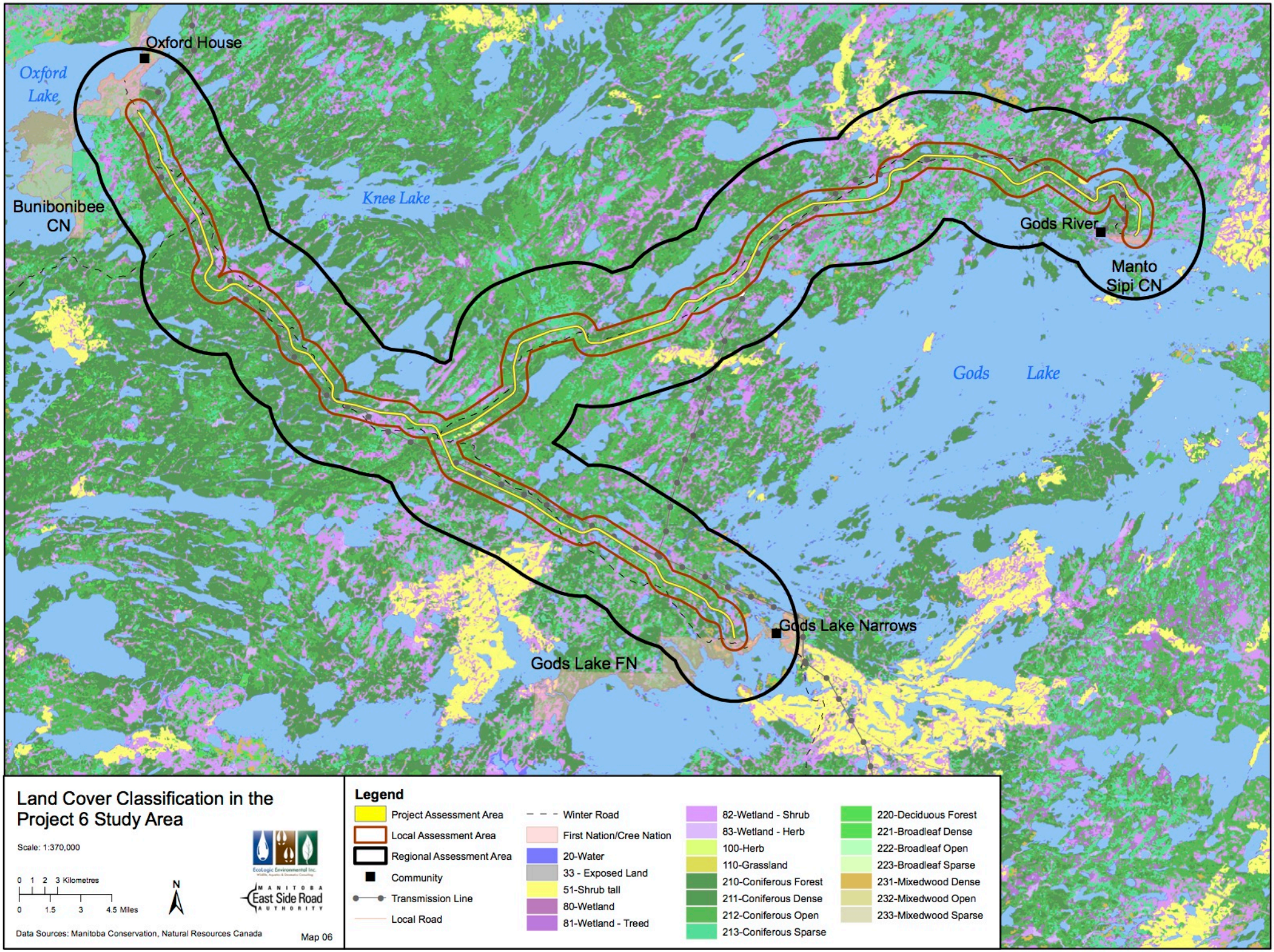

Oxford House
Oxford Lake
Bunibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Spatial Boundaries of Assessment Areas in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
EcoLogic Environmental Inc.
Manitoba East Side Road Authority
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 01
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Potential Quarry Sites
Quarry Access Roads
Local Road
Winter Road
First Nation/Cree Nation


Oxford House
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Ecological Land Classification in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 02
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation
Ecozone, Ecoregion, Ecodistrict
06, 89, 360 - Knee Lake
06, 89, 364 - Island Lake
06, 89, 365 - Gods Lake


Oxford House
Oxford Lake
unibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Soil Classification in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
Ecologic Environmental Inc.
Manitoba East Side Road Authority
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 03
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation
Soil Classification
Brunisolic Soils
Cryosolic Soils
Luvisolic Soils
Organic Soils


Oxford House
Oxford Lake
Bunibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
River and Stream Crossings in the Project 6 Study Area
Scale: 1:370,000
0 1.5 3 4.5 Kilometres
0 1.5 3 4.5 Miles
N
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 04
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
River and Stream Crossings
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation


Oxford House
Oxford Lake
Bunibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Fire History in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 05
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation
Fire Year
1928 - 1929
1930 - 1939
1940 - 1949
1950 - 1959
1960 - 1969
1970 - 1979
1980 - 1989
1990 - 1999
2000 - 2009
2010 - 2014



Land Cover Classification in the Project 6 Study Area

Scale: 1:370,000

0 1 2 3 Kilometres

0 1.5 3 4.5 Miles

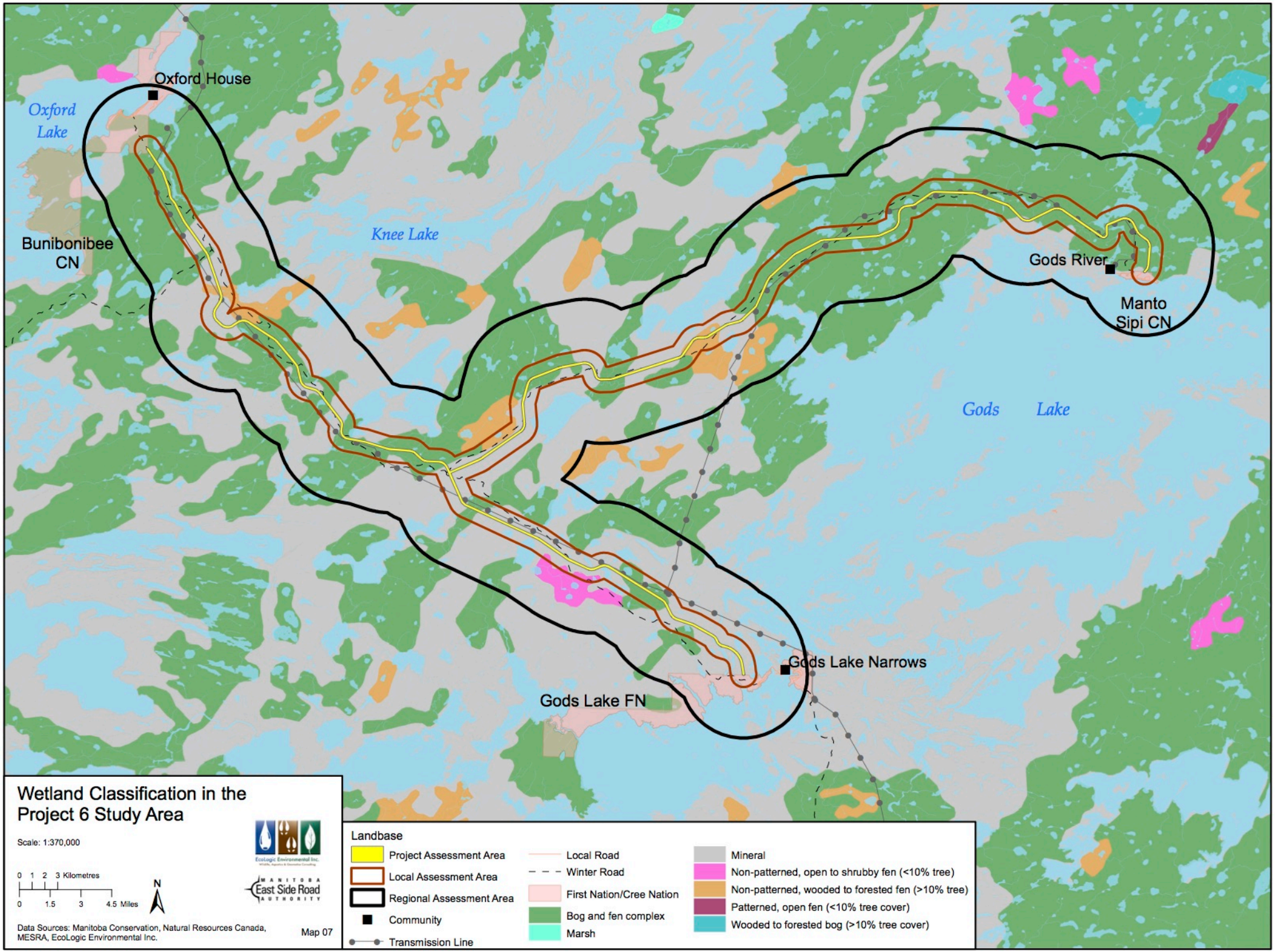
N

Data Sources: Manitoba Conservation, Natural Resources Canada

Map 06

Legend

- Project Assessment Area
- Local Assessment Area
- Regional Assessment Area
- Community
- Transmission Line
- Local Road
- Winter Road
- First Nation/Cree Nation
- 20-Water
- 33 - Exposed Land
- 51-Shrub tall
- 80-Wetland
- 81-Wetland - Treed
- 82-Wetland - Shrub
- 83-Wetland - Herb
- 100-Herb
- 110-Grassland
- 210-Coniferous Forest
- 211-Coniferous Dense
- 212-Coniferous Open
- 213-Coniferous Sparse
- 220-Deciduous Forest
- 221-Broadleaf Dense
- 222-Broadleaf Open
- 223-Broadleaf Sparse
- 231-Mixedwood Dense
- 232-Mixedwood Open
- 233-Mixedwood Sparse


Oxford House
Oxford Lake
Bunibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Wetland Classification in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 07
Landbase
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation
Bog and fen complex
Marsh
Mineral
Non-patterned, open to shrubby fen (<10% tree)
Non-patterned, wooded to forested fen (>10% tree)
Patterned, open fen (<10% tree cover)
Wooded to forested bog (>10% tree cover)

Maps 8a to 8d removed – Confidential Cover to be viewed only with written permission from respective community