# MANITOBA-MINNESOTA TRANSMISSION PROJECT

## Biophysical Technical Data Reports



# Manitoba-Minnesota Transmission Project – Soil and Terrain Technical Data Report

Final Report

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# Abbreviations

| | |
|---|---|
| ASI | Area of Special Interest |
| CLI | Canada Land Inventory |
| EIS | Environmental Impact Statement |
| ESS | Environmentally Sensitive Site |
| kV | Kilovolt |
| LAA | Local Assessment Area |
| masl | metres above sea level |
| MMTP | Manitoba-Minnesota Transmission Project |
| NEB | National Energy Board |
| PDA | Project Disturbance Area |
| PTH | Provincial Trunk Highway |
| RAA | Regional Assessment Area |
| RM | Rural Municipality |
| SLC | Soil Landscapes of Canada |
| SLTC | Southern Loop Transmission Corridor |
| SRI | Soil Resource Information |
| TDR | Technical Data Report |
| USLE | Universal Soil Loss Equation |
| VC | Valued Component |

# Glossary

| Term | Definition |
|---|---|
| Agricultural capability class | A rating that indicates the degree of limitation imposed by a soil in its use for mechanized agriculture. In the Canadian system, it is the grouping of lands with the same relative degree of limitation or hazard (nil in Class 1 and becomes progressively greater to Class 7). |
| Calcareous | Soil containing sufficient calcium carbonate, often with magnesium carbonate, to effervesce visibly when treated with cold 0.1 N hydrochloric acid. |
| Clay | As a particle-size term: a size fraction less than 0.002 mm in equivalent diameter.<br><br>As a soil term: a textural class. |
| Drainage | Pertaining to the frequency and duration of periods when the soil is free from saturation with water. |
| Eolian deposit | Sand or silt, or both, deposited by the wind. |
| Erosion | The detachment and movement of soil by water, wind, ice or gravity. |
| Fluvial deposit | All sediments, past and present, deposited by flowing water, including glaciofluvial deposits. Wave-worked deposits and deposits resulting from sheet erosion and mass wasting are not included. |
| Gleyed | A soil condition resulting from prolonged saturation with water and reducing conditions that manifest themselves in greenish or bluish colors throughout the soil mass or in mottles. |
| Gleysolic | An order of soils developed under wet conditions and permanent or periodic reduction. These soils have low chromas, or prominent mottling, or both, in some horizons. |
| Gravel | Rock fragments with diameters of 2 mm to 7.5 cm. |

| | |
|---|---|
| Kettled | Topography characterized by depressions in a glacial outwash drift created by the melting of a detached mass of glacial ice that become wholly or partly buried. |
| Lacustrine | Material deposited in lake water and later exposed either by lowering the water level or uplifting the land. |
| Mottling | Presence of spots or blotches of different colour or shades of colour interspersed with the dominant colour. |
| Parent material | The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of a soil has developed by pedogenic processes. |
| pH | The negative logarithm of the hydrogen ion activity (concentration) of a soil. The degree of acidity (or alkalinity) of a soil as determined by means of a glass or other suitable electrode or indicator at a specified moisture content or soil-to-water ratio, and expressed in terms of the pH scale. |
| Rutting | That which occurs when soil strength is not sufficient to support the applied load from vehicle traffic. |
| Sand | A soil particle between 0.05 and 2.0 mm in diameter.<br><br>Any one of five soil separates: very coarse sand, coarse sand, medium sand, fine sand or very fine sand.<br><br>A soil textural class. |
| Silt | A soil separate consisting of particles between diameters of 0.05 and 0.02 mm.<br><br>A soil textural class. |
| Slope | The degree of deviation of a surface from horizontal, measured in a numerical ratio, percent or degrees. |
| Soil map unit | A soil map unit is a collection of areas defined and named the same in terms of their soil components (*e.g.,* series) or miscellaneous areas or both. Soil map units are the basic unit of a soil map. |
| Soil series | A category in the in the Canadian System of Soil Classification. This is the basic unit of soil classification and consists of soils that |

| | |
|---|---|
| | are essentially alike in all major profile characteristics except the texture of the surface. |
| Structure | The combination or arrangement of primary soil particles into secondary particles, units, or peds which may be, but usually are not, arranged in the profile in such a manner as to give a distinctive characteristic pattern. The secondary units are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types, and grades, respectively. |
| Texture | The relative proportions of the various soil separates in a soil. |
| Till | Unstratified glacial drift deposited directly by the ice and consisting of clay, sand, gravel and boulders intermingled in any proportion. |
| Topography | The physical feature of a district or region, such as those represented on a map, taken collectively; especially, the relief and contours of the land. |

# 1.0 INTRODUCTION

Manitoba Hydro is proposing construction of the Manitoba-Minnesota Transmission Project (MMTP) which includes construction of a 500 kV AC transmission line in southeastern Manitoba. The proposed Project would originate at the Dorsey Converter Station northwest of Winnipeg, then travel south around Winnipeg within planned utility corridors including the Southern Loop Transmission Corridor (SLTC) and the Riel to Vivian Transmission Corridor (RVTC) to just east of PTH 12. The line then continues southward across the rural municipalities of Springfield, Tache, Ste. Anne, La Broquerie, Stuartburn and Piney to the Manitoba-Minnesota border crossing located south of the community of Piney. The project also includes the construction of terminal equipment at the Dorsey Converter Station, and electrical upgrades within the Dorsey and Riel converter stations, and modifications at the Glenboro South Station requiring re-alignment of transmission lines entering the station.

This Technical Data Report (TDR) for soil and terrain was developed to support of the overall Environmental Impact Statement (EIS). For this assessment, soil and terrain is considered a pathway to an effect on Valued Components (VCs) rather than a VC itself. The soil and terrain TDR also informs the Groundwater TDR. Changes to soil and terrain can be a mechanism of change in multiple VCs, including agriculture and fish and fish habitat.

## 1.1 BACKGROUND

### 1.1.1 Project Overview

For the purposes of this TDR, the Project is described in three general regions: the upgrade work to the three stations, the additional transmission line constructed in the existing planned transmission utility corridors extending from Dorsey Converter Station to just east of PTH 12, and the new transmission line extending south from the Anola area to the border by Piney, Manitoba.

### 1.1.2 Spatial Boundaries

The following spatial boundaries were used to collect and analyze data for the Project:

#### 1.1.2.1 Project Development Area (PDA)

The Project Development Area (PDA) is the area of physical disturbance from Project activities, within areas of construction activity for the Project, namely the Transmission Line ROW (80-100 m) and the three converter station improvement sites.

#### 1.1.2.2 Local Assessment Area (LAA)

The LAA for the transmission line and converter stations consists of a 1 km buffer extending from edges of the PDA. In relation to the specific VCs:

***Agriculture:*** The LAA consists of a 1 km buffer from the ROW centerline for the transmission line and 1 km buffer around all station footprints, and includes all components of the PDA. The LAA for each of the transmission line and station components covers an area which will generally encompass the basic field management unit most commonly used within the Project region – the quarter section, or an area of land 800 m x 800 m in dimension. The LAA represents the area where direct and indirect effects on agriculture are likely to be most pronounced or identifiable, and encompasses the locally-affected agricultural land uses or activities. Effects caused by the Project that are experienced across the entire field management unit (typically a quarter section) will, therefore, generally be considered within the boundary of the LAA. The 1 km buffer proposed for Soil and Terrain is sized to match the LAA adopted for the Agriculture VC.

***Fish and fish habitat:*** For large watercourses (i.e., Red River and Assiniboine River), the LAA extends 200 m upstream and 600 m downstream from the centerline of the transmission line crossing, and 30 m up bank from the high water mark (HWM). For smaller watercourses crossed by the Project, the LAA extends 100 m upstream and 300 m downstream beyond the centerline, and 30 m up bank from the HWM. The LAA represents the area where direct effects on fish and fish habitat are likely to be most pronounced or identifiable. The 1 km buffer proposed for Soil and Terrain will contain the area included within the large watercourse LAA.

#### 1.1.2.3 Regional Assessment Area (RAA)

The RAA includes the PDA and the boundaries of all Rural Municipalities traversed by the PDA. From north to south RMs considered include: Rosser, Headingley, Macdonald, Ritchot, Springfield, Tache, Ste. Anne, La Broquerie, Stuartburn, Piney and South Cypress (for the Glenboro South Station component only). The RAA is the area in which cumulative effects are assessed and it is anticipated other projects or activities occurring within the same RMs may have the potential to act cumulatively with the Project.

For the agriculture VC, this RAA was selected because it represents the region which encompasses all of the communities within which changes in socio-economic parameters attributable to Project effects on agriculture might occur. The Soil and Terrain RAA has been sized to match the RAA used for both the Agriculture VC.

Soil and terrain data were not compiled or analyzed for the fish and fish habitat VC RAA, as this data was deemed not relevant to completing the EIS and are therefore not presented for the RAA.

## 1.2 PURPOSE

The purpose of this TDR is to describe the existing conditions of soil and terrain the vicinity of the Project, including the methods used to collect, compile and interpret this information, to support various components of the environmental assessment. Changes to soil and terrain can be a mechanism of change in multiple VCs. This TDR is supportive of the agriculture and fish and fish habitat VCs, and informs the Groundwater TDR (see Table 1-1).

### Table 1-1: Relationship Between Soil and Terrain Pathway and Other Discipline Reports

| Pathway/Mechanism of Change | Report |
|---|---|
| Agricultural Capability | Agriculture VC |
| Soil Compaction | Agriculture VC |
| Risk of Wind Erosion | Agriculture VC |
| Risk of Water Erosion | Agriculture VC, Fish and Fish Habitat VC |
| Contaminated Soils | Groundwater TDR |

This TDR describes how desktop information was gathered and the information gaps and limitations that were identified. Soil and terrain information identified as important to the above VCs is reported to provide an overview of pertinent existing conditions. As available data met information needs, no additional field studies were completed for this report.

# 2.0 REVIEW OF EXISTING DATA SOURCES AND BASELINE DATA GAPS

## 2.1 SUMMARY OF EXISTING DATA SOURCES

The information described in this TDR comes from a synthesis of data for the Project area from a variety of literature sources, as well as provincial and federal databases. Analysis and interpretation was required for some data to support the environmental assessment.

### 2.1.1 Soil Resource Information

Existing soil resource information (SRI) was obtained from the Manitoba Agricultural Interpretation Database (SoilAID) (Manitoba Land Initiative [MLI] 2014), which is a digital repository for provincial soil survey data in Manitoba. The portion of the database used to provide SRI for the Project area is based on information contained in the following soil survey reports:

- Ellis, J.H., Shafer, W.M. 1948. Report of the Reconnaissance Soil Survey of South-Central Manitoba, Report 4. Manitoba Soil Survey. Scale – 1:126,720.
- Ehrlich, W.A., Poyser, E.A., Pratt, L.E. and Ellis, J.H. 1963. Report of Reconnaissance Soil Survey of Winnipeg and Morris Map Sheet Areas, Report 5. Canada-Manitoba Soil Survey. Scale – 1:126,720.
- Ehrlich, W.A., Poyser, E.A. and Pratt, L.E. 1957. Report of Reconnaissance Soil Survey of Carberry Map Sheet Area, Report 7. Canada-Manitoba Soil Survey. Scale – 1:126,720.
- Smith, R.E., Ehrlich, W.A., Jameson, J.S. and Cayford, J.H. 1964. Report of the Soil Survey of the South-Eastern Map Sheet Area, Report 14. Canada-Manitoba Soil Survey. Scale – 126,720.
- Smith, R.E., Ehrlich, W.A and Zoltai, S.C. 1967. Soils of the Lac du Bonnet Area, Report 15. Canada-Manitoba Soil Survey. Scale – 126,720.
- Michalyna, W., Gardiner, W. and Podolsky, G. 1975. Soils of the Winnipeg Region Study Area, Report D14. Canada-Manitoba Soil Survey. Scale – 1:20,000.
- Mills, G.F., Hopkins, L.A. and Smith, R.E. 1977. Organic Soils of the Roseau River Watershed in Manitoba, Report D17. Agriculture Canada. Scale – 1:63,360.
- Podolsky, G. 1979. Soils of the Brokenhead Area, Report D26. Canada-Manitoba Soil Survey. Scale – 1:20,000.

- Hopkins, L. 1985. Soils of the Rural Municipalities of Ste Anne and La Broquerie, and Part of the Local Government District of Stuartburn, Report D49. Canada-Manitoba Soil Survey. Scale – 1:50,000.

- Podolsky, G. 1989. Soils of the St. Eustache, Springstein, Brunkild, Southwest Perimeter and La Salle River Areas, Report D67. Canada-Manitoba Soil Survey. Scale – 1:20,000.

- Hopkins, L.A., St. Jacques, E. and Mills, G.F. 1993. Soils of the Rural Municipality of Hanover, Report D82. Soil Resource Section, Manitoba Agriculture. Scale – 1:50,000.

- Haluschak, P.W., St. Jacques, E., and Podolsky, I.G. 1994. Soils of the Rural Municipality of Argyle, Report D84. Soil Resource Section, Manitoba Agriculture. Scale – 1:50,000.

- Podolsky, G.P. 1999. Soils of the Rural Municipality of Strathcona, Report D86. Agricultural Resources Section, Manitoba Agriculture. Scale – 1:50,000.

The combined SRI provides an overview of soil and terrain resources. The soil surveys vary in scale from 1:20,000 to 1:126, 720 (see Map 2-1 and Map 2-2).

The Soil Landscapes of Canada v3.2 Soil Name File (Soil Landscapes of Canada Working Group 2010) was used to complete the soil database used for the Project, including provision of soil taxonomic information (*i.e.*, sub-group classification), mode of material deposition, parent material texture and drainage.

### 2.1.2 Terrain/Surficial Geology Information

Baseline terrain-related information is available from numerous maps and publications. The following is a series of 1:100,000 surficial geology maps for the project area that were reviewed:

- Matile, G.L.D., 2004. Surficial geology, Winnipeg, Manitoba; Geological Survey of Canada; Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, Geoscientific Map MAP2003-7, scale 1:100,000.

- Matile, G.L.D., 2004. Surficial geology, Steinbach, Manitoba; Geological Survey of Canada; Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, Geoscientific Map MAP2003-8, scale 1:100,000.

- Matile, G.L.D., 2004. Surficial geology, Manitoba –Ontario_Minnesota; Geological Survey of Canada; Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, Geoscientific Map MAP2003-12, scale 1:100,000.

### 2.1.3 Contaminated Soils

Four databases were reviewed to identify sites with potential for contaminated soils:

- Manitoba Hydro's internal Contaminated Sites Database (Zahariuk 2015, pers. comm.)
- Contaminated, Impacted and Other Sites database (Manitoba Conservation and Water Stewardship 2015)
- Federal Contaminated Sites Inventory (Treasury Board of Canada Secretariat 2015)
- NEB Interactive Incident Map (NEB 2015).

## 2.2 DATA GAPS AND LIMITATIONS

Identified data gaps and limitations of the existing soil and terrain data includes:

- The SoilAID (MLI 2014) database covers the area traversed by the Project. However, these data are available at different scales, ranging from detailed (large scale; typically 1:20,000; local land planning) to reconnaissance (small scale; typically 1:126,000; regional land planning) (Coen 1987). Further, the age of this information is variable, with SRI publication dates ranging from 1948 to 1999. These data are of sufficient scale and accuracy to support the environmental assessment.

# 3.0 METHODS

## 3.1 DESKTOP DATA COLLECTION METHODS

The approach taken to understand the current soil and terrain in the area of the Project involved the collection, review, analysis and interpretation of the available information.

## 3.2 ANALYTICAL METHODS

As noted previously, soil and terrain is defined as a pathway mechanism and not as a valued component. For this reason, the assessment areas for the soils and terrain report are defined based on the VCs that require the data for their assessment. The agriculture VC, fish and fish habitat VC require soil and terrain information for the assessment of potential effects.

Planning and implementation of the soil and terrain desktop studies occurred in 2014 and early 2015. Studies focused on the multiple refined alternate routes that were being considered along the Existing Transmission Corridor (Existing Corridor) and the New Right of Way (New ROW). Following the selection of the preferred transmission line route, data on soil and terrain were analyzed at three spatial scales: the PDA, LAA and RAA as described in Section 1.1.2.

### 3.2.1 Soil Resource Information

Information contained in the SoilAID (MLI 2014) was combined with data in the SLC v3.2 Soil Name File (Soil Landscapes of Canada Working Group 2010) to provide a complete soil database for the Project. This combined soil resource information provides an overview of soil and terrain resources, and was used to derive interpretative ratings, including agricultural capability, compaction risk, water erosion risk and wind erosion risk, as outlined in the following sections.

### 3.2.2 Agricultural Capability Class Ratings

An agricultural capability class rating for each soil map unit exists in SoilAID (MLI 2014) polygons. These ratings were determined according to the modified Canada Land Inventory (CLI) soil capability for agriculture rating system developed for Manitoba (Fraser *et al.* 2001). The CLI is a seven class system based on the degree of limitation of land for production of a specified crop.

The system rates climate, soil and landscape factors independently as each factor can control the suitability of land for dryland agricultural crop production. The CLI is intended as an interpretive classification for the productive capacity of soils for common field crops. The combination of a class and a subclass denotes the agricultural capability: the class rating provides the degree of limitation while the subclass provides the kind of limitation. The seven classes that reflect variations in agricultural capability are described in Table 3-1. Subclasses are assigned within the classes to denote the type of limitation for agricultural use. For the limitations associated with the agricultural capability subclasses, see Table 3-2.

**Table 3-1: Agricultural Capability Class Descriptions**

| Agricultural Capability Class | Class Description |
|---|---|
| 1 | Soils in this class have no significant limitations in use for crops |
| 2 | Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices |
| 3 | Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices |
| 4 | Soils in this class have severe limitations that restrict the range of crops or require special conservation practices or both |
| 5 | Soils in this class have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible |
| 6 | Soils in this class are capable only of producing perennial forage crops, and improvement practices are not feasible |
| 7 | Soils in this class have no capability for arable culture or permanent pasture |
| O | Organic soils, which are not rated for agricultural capability. |

**Table 3-2: Agricultural Capability Subclass Limitation Descriptions**

| Agricultural Capability Class | Type of Limitation |
|---|---|
| C – Climate | Significant adverse climate for crop production |
| D – Undesirable Soil Structure and or Low Permeability | Soils difficult to till, or which absorb water very slowly or in which the depth of rooting zone is restricted by conditions other than a high water table or consolidated bedrock. |
| E – Erosion | Soils where damage from erosion is a limitation to agricultural use. |
| F – Low Fertility | Soils having low fertility that either is correctable with careful management in the use of soil fertilizers and soil amendments or is difficult to correct in a feasible way. |
| I – Inundation | Soils subjected to inundation causing crop damage or restricting agricultural use. |
| M – Moisture Limitation | Soils where crops are adversely affected by droughtiness owing to inherent soil characteristics. |
| N – Salinity | Soils with enough soluble salts to adversely affect crop growth or restrict the range of crops that may be grown. |

**Table 3-2: Agricultural Capability Subclass Limitation Descriptions**

| Agricultural Capability Class | Type of Limitation |
|---|---|
| P – Stoniness | Soils sufficiently stony to significantly hinder tillage, planting and harvesting operations. |
| R – Consolidated Bedrock | Soils where the presence of bedrock near the surface restricts their agricultural use. |
| S – Adverse Soil Characteristics | Used in place of subclasses D, F, M and N either individually or collectively. |
| T – Topography | Soils where topography is a limitation. |
| W – Excess Water | Soils where excess water other than that brought about by inundation is a limitation to their use for agriculture. |
| X – Cumulative Minor Adverse Characteristics | Soils with a moderate limitation caused by the cumulative effect of two or more adverse characteristics which are singly not serious enough to affect the rating. |
| Source: Canada Land Inventory 1969 | |

### 3.2.3 Soil Compaction Risk

A generalized rating system for compaction risk was developed using professional judgment and review of two compaction systems that had been designed for forestry applications; specifically the Soil Compaction and Puddling Hazard Key (British Columbia Ministry of Forests 1999) and the table of Compaction and Rutting Hazard for Soils in Ontario (Archibald *et al.* 1997). The generalized rating system developed for compaction risk (see Table 3-3) takes into consideration soil texture and drainage regime within a given polygon and has been used in numerous technical reports (Stantec 2011, Stantec 2014, Manitoba Hydro 2014). Soil compaction can result in degradation of soil structure and loss of topsoil tilth.

Susceptibility to soil compaction is dependent on soil physical properties, the moisture content during the disturbance and the nature of the applied force (Cannon and Landsburg 1990). Generally, in mineral soils, compactibility increases with higher clay content, higher soil moisture content and lower organic matter content (Cannon and Landsburg 1990).

**Table 3-3: Compaction Risk Matrix**

| Drainage | Textural Class | | | | | |
|---|---|---|---|---|---|---|
| | **Very Coarse (S, LS, LFS)** | **Moderately Coarse (SL, FSL)** | **Medium (VFSL, L, SiL)** | **Moderately Fine (SCL, CL, SiCL, Si)** | **Fine/Very Fine (SC, SiC, C, HC)** | **Organic** |
| **Rapid** | Low | Low | - | - | - | - |
| **Well** | Low | Low | Low | Moderate | Moderate | |
| **Imperfect** | Low | Low | Moderate | High | High | |
| **Poor** | Moderate | Moderate | High | High | High | |
| **Very Poor** | - | | | | | High |

**NOTES:**
S=sand; LS = loamy sand; LFS = loamy fine sand; SL = sandy loamy
FSL = fine sandy loam; VFSL = very fine sandy loam; L = loam; SiL = silt loam
SCL = sandy clay loam; CL = clay loam; SiCL = silty clay loam; Si = silt
SC = sandy clay; SiC = silty clay; C = clay; HC = heavy clay

### 3.2.4 Water Erosion Risk

Water erosion risk classes are determined using the Universal Soil Loss Equation (USLE, Wischmeier and Smith et al, 1965) and are provided in the publically-available SoilAID (MLI 2014) database. The USLE was developed to predict average soil loss by water erosion, taking into account rainfall, soil and landscape characteristics and management practices. The following factors are considered in the method:

$$A = R * K * LS * C * P$$

Where:

A = Potential, long-term average annual soil loss (tonnes $ha^{-1}$ $yr^{-1}$)

R = Rainfall and Runoff Factor - a measure of the total annual erosive rainfall for a specific location, and the distribution of erosive rainfall throughout the year (MJ mm $ha^{-1}$ $h^{-1}$)

K = Erodibility Factor - a quantitative measure of the soil's inherent susceptibility to erosion and the soil's influence on runoff amount and rate (t h $MJ^{-1}$ $mm^{-1}$)

LS = Topographic Factor - accounts for the slope angle and length on erosion (dimensionless)

C = Crop/Vegetation and Management Factor - used to determine the effectiveness of soil and crop management systems in terms of preventing or reducing erosion (dimensionless)

P = Support Practice Factor - accounts for the erosion control effectiveness of support practices, and supports the C factor (dimensionless)

The USLE system has five classes of water erosion risk. Water erosion classes and categories, and associated potential soil losses are presented in Table 3-4.

**Table 3-4: Water Erosion Risk Classes**

| Water Erosion Class | Category | Potential Loss (t/ha/y) |
|---|---|---|
| 1 | Very Low | <6 |
| 2 | Low | 6–11 |
| 3 | Moderate | 11–22 |
| 4 | High | 22–33 |
| 5 | Severe | > 33 |

### 3.2.5 Wind Erosion Risk

Wind erosion risk classes were determined using the methods of Coote and Pettapiece (1989). The following algorithm is used to calculate the risk of wind erosion:

$$E = KC(V_*^2 - \gamma W^2)^{1.5}$$

Where:

*E* = maximum instantaneous soil movement by wind (dimensionless)

K = surface roughness and aggregation factor (dimensionless)

C = factor representing soil resistance to movement by wind (dimensionless)

$V_*$ = drag velocity of wind at the soil surface (cm $s^{-1}$)

$\gamma$ = soil moisture shear resistance (dimensionless)

W = available moisture of the surface soil ($m^3$water $m^{-3}$soil)

The K, C and $\gamma$ factors are provided in Coote and Pettapiece (1989). Wind speed data to calculate the $V_*$ factor were obtained from multiple weather stations (Environment Canada 2014). Wind speed data was interpolated for the project area using spatial statistics to account for the heterogeneous nature of wind speed. Available moisture at the surface (W) was estimated for each soil texture class based on data available in the soil layer table of the Canadian Soil Information Service (Soil Landscapes of Canada Working Group 2010). The rating system is based on a land surface that is bare and unprotected (no vegetation or litter cover) with a non-crusted surface. The classification of potential wind erosion risk consists of five classes (see Table 3-5).

**Table 3-5: Wind Erosion Risk Classes**

| Wind Erosion Class | Category | *E* (maximum instantaneous soil movement by wind, dimensionless) |
|---|---|---|
| N | Negligible | <100 |
| L | Low | 100-249.9 |
| M | Moderate | 250-399.9 |
| H | High | 400-699.9 |
| S | Severe | >700 |

### 3.2.6 Terrain Instability

Unstable slopes are those that are subject to mass movement processes; either slow (*e.g.,* soil creep) or fast (*e.g.,* slope failures and landslides). The potential for a slope to experience mass movement is determined by a series of factors including the nature and texture of the surficial material, slope angle, active geomorphological processes and local soil drainage conditions. Human activity such as the construction of homes and businesses or the construction of linear infrastructure such as roads, railways, pipelines, and to a lesser degree transmission lines, can trigger the potential for or trigger mass movement.

The identification of unstable or potentially unstable terrain within the study area is based on a review of existing literature relevant to slope stability, existing soil and terrain mapping data as well as a review of available imagery.

### 3.2.7 Contaminated Soils

The Manitoba Hydro Contaminated Sites Database (Zahariuk 2015, pers. comm.), the Contaminated, Impacted and Other Sites database (Manitoba Conservation and Water Stewardship 2015), the Federal Contaminated Sites Inventory (Treasury Board of Canada 2015) database and the NEB Interactive Incident Map (NEB 2015) were reviewed to determine the potential for the Project PDA to traverse contaminated soils. Where applicable, contaminant types were identified.

# 4.0 RESULTS

The following presents a summary of soil and terrain data identified as required to support the assessment of the pertinent VCs previously identified as well as key soil and terrain findings. Summaries of soil data are prescribed for the agriculture PDA, LAA and RAA unless specified otherwise.

## 4.1 GENERALIZED SURFICIAL GEOLOGY AND LANDFORMS

The terrain and surficial geology in the Project region is the result of the Pleistocene glaciation modified by post-glacial processes. The surficial materials are, for the most part, glaciolacustrine sands, silts and clays from Glacial Lake Agassiz overlying till. In the western portions of the Project region, the landform is dominantly a level to gently sloping lacustrine plain composed of clayey deposits from Glacial Lake Agassiz. Elevation in the Project region ranges from 221 masl (metres above sea level) in the Glacial Lake Agassiz basin to 396 masl at the Bedford Hills in the southeast.

The Existing Corridor, Dorsey Station and Riel Station are within a smooth, level to gently sloping landscape characterized by glaciolacustrine sediments deposited from Glacial Lake Agassiz. This glaciolacustrine parent material is comprised of varved deposits of clay and silts and exhibits slopes ranging from level to less than two percent (Hopkins 1985; Smith *et al.* 1998). The mean elevation is 236 masl.

The New ROW originates in the same glaciolacustrine plain as the Existing Corridor. However it transitions to an area of gently undulating water-worked moraines with thin and discontinuous veneers and blankets of sandy to clayey glaciolacustrine sediments (Smith *et al.* 1998). The moraines are composed of cobbly and gravelly-loam till. Sandy to gravelly beach materials and bouldery near-shore materials are also present. Slopes range from level to five percent. The mean elevation is 297 masl.

Moving south and southeastly along the New ROW into the RMs of La Broquerie, Stuartburn and Piney, a more complex surficial geology is apparent. The area consists of gently undulating ground moraine composed of medium-textured calcareous till; coarse-textured outwash and beach ridge deposits; undulating to hummocky terrain with some dunes composed of thin, coarse- to fine-textured lacustrine and deltaic deposits overlying till; and large, level to depressional areas of poorly drained organic deposits (Mills *et al.* 1977). Elevation ranges from 221 masl at the borders of Glacial Lake Agassiz to 396 masl at the Bedford Hills – Whitemouth Lake upland.

The Glenboro South Station is located within a level to hummocky pro-glacial lacustrine plain with slopes ranging between level and 15 percent. Surficial deposits and landforms in the area range from kettled to gently undulating loamy till, to level to gently undulating sandy glaciofluvial and glaciolacustrine deposits. The level to hummocky physiography is a major part of the Assiniboine Delta (Smith *et al.* 1998). The mean elevation is 366 masl.

## 4.2 GENERALIZED SOILS

The dominant soils in the Project region are of the Vertisolic, Chernozemic, Gleysolic, Organic, Luvisolic and Brunisolic orders (see Map Series 4-100 – Dominant Soil Orders). In general, the soils have developed on glaciolacustrine deposits from Glacial Lake Agassiz deposited over the till in moraines from the last glaciation (Smith *et al.* 1998).

The soils within the Existing Corridor, Dorsey Station and Riel Station are dominantly imperfectly drained Gleyed Humic Vertisols and Gleyed Vertic Black Chernozems, with areas of poorly drained Gleysolic Humic Vertisols and Humic Gleysols (Smith *et al.* 1998). These soils are formed in the clayey glaciolacustrine deposits of Glacial Lake Agassiz. Gleyed Rego Black Chernozems and other Gleysolic soils have also developed on calcareous loamy to silty sediments from the latter stages of lacustrine sedimentation from the glacial lake.

Soils within the central portion of the New ROW (RMs of Tache, Ste. Anne and La Broquerie) are dominated by well and imperfectly drained Dark Gray Chernozems developed on thin, discontinuous sandy to loamy glaciolacustrine veneers over till. Well drained Luvisolic soils occur on the exposed moraine ridges with imperfectly drained Luvisols and Brunisols occurring in the sandy deposits. Soils occupying the lowlands are dominantly poorly drained peaty Gleysols and very poorly drained Organic soils (see Map Series 4-100 – Dominant Soil Orders).

Soils within the south-central and southeast portions of the New ROW (RMs of La Broquerie, Stuartburn and Piney) Project region are complex and have developed on a variety of different materials and under a range of drainage conditions. Lowland areas are dominated by poorly drained peaty Gleysols and very poorly drained Mesisols developed on sedge peat. Dark Gray Chernozems, Eutric Brunisols and Gray Luvisols are common in the sandy to loamy veneers overlying till and moraine ridges, while Dystric Brunisols are found on the weakly to non-calcareous glaciofluvial, till and eolian deposits (see Map Series 4-100 – Dominant Soil Orders).

Soils within the Glenboro South Station belong to the Chernozemic and Gleysolic orders. Both Chernozems and Gleysols have developed on the strongly calcareous, fine loamy sediments that dominate the area. Surface texture within the station is dominantly fine loamy.

## 4.3 SOIL SERIES AND CLASSIFICATION

The extents of soils within the LAAs and PDAs were identified and are reported in Table A-1 (see Appendix A). Soil series and classification beyond the LAA were deemed not relevant to completing the EIS and are therefore not presented for the RAA. The dominant soils within the Existing Corridor LAA belong to the Osborne (45.9%) and Red River (22.2%) series, both of the Vertisolic order, with Urban Land representing 14.6% of the LAA (see Table A-1). The Existing Corridor PDA is dominantly comprised of the Osborne series, a Vertisolic soil. The soils occupying the largest areal proportions within the New ROW LAA belong to the Malonton (16.2%), Inwood (7.3%) and Pansy (7.2%) soil series. The Malonton series, a Gleysolic soil, occupies the largest proportion of the New ROW PDA. The distribution of the soil orders is reported in Table 4-1. The dominant soil order in the Existing Corridor is the Vertisolic soil order, which represents 70.7% of the LAA and 66.4% of the PDA; 18.9% of the LAA and 23.1% of the PDA are characterized as developed land. The dominant soil order in the New ROW LAA and PDA is the Gleysolic soil order (36.1% and 40.8%, respectively). Other extensive soil orders are the Organic and Chernozemic soil orders.

The dominant soil series in the Dorsey Station LAA are the Osborne (45.7%) and Red River (40.8%) soil series. The Dorsey Station PDA is comprised entirely of the Osborne series (see Table A-1 and Table 4-1). Both series are classified in the Vertisolic soil order.

The dominant soil series in the Riel Station LAA is the Red River (36.6%) series, a soil of the Vertisolic order; however the LAA is mostly described as developed land (38.9%). The PDA is dominantly comprised of the Red River (52.0%) series, and of Vertisolic soils (86.5%, see Table A-1 and Table 4-1).

The dominant soil series in the Glenboro South Station LAA are the Wellwood (41.0%) and Oberon (40.3%) soil series, both classified in the Chernozemic soil order. The dominant soil series in the Glenboro South Station PDA are the Oberon (50.0%) and Wellwood (40.0%) soil series (see Table A-1 and Table 4-1).

Dominant soil orders are presented in Map Series 4-100 – Dominant Soil Orders. The Glenboro South Station soil orders are presented in Map 4-1.

### Table 4-1: Soil Orders in the Agriculture PDA and LAA

| Soil Order | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Existing Corridor** | | | | |
| Vertisolic | 1321.6 | 66.4 | 14,853.7 | 70.7 |
| Chernozemic | 146.6 | 7.4 | 1,270.6 | 6.0 |
| Gleysolic | 49.9 | 2.5 | 781.7 | 3.7 |
| Regosolic | 10.3 | 0.5 | 100.6 | 0.5 |
| Organic | | | 8.4 | <0.1 |
| Developed Land[1] | 458.5 | 23.1 | 3,962.0 | 18.9 |
| Water | 2.2 | 0.1 | 29.6 | 0.1 |
| **Total[3]** | **1989.1** | **100.0** | **21,006.7** | **100.0** |

## Table 4-1: Soil Orders in the Agriculture PDA and LAA

| Soil Order | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **New Right-of-Way** | | | | |
| Gleysolic | 445.0 | 40.8 | 9,225.3 | 36.1 |
| Organic | 277.3 | 25.4 | 6,339.0 | 25.1 |
| Chernozemic | 168.5 | 15.5 | 4,940.1 | 19.3 |
| Brunisolic | 119.6 | 11.0 | 2,830.2 | 11.1 |
| Luvisolic | 67.5 | 6.2 | 1,496.8 | 5.9 |
| Regosolic | 10.0 | 0.9 | 268.9 | 1.1 |
| Vertisolic | | | 125.7 | 0.5 |
| Developed Land[1] | | | 217.0 | 0.8 |
| Water | 2.4 | 0.2 | 38.1 | 0.1 |
| **Total[3]** | **1090.4** | **100.0** | **25,541.1** | **100.0** |
| **Dorsey Station** | | | | |
| Vertisolic | 1.6 | 100 | 329.3 | 86.5 |
| Chernozemic | | | 51.3 | 13.5 |
| **Total[3]** | **1.6** | **100.0** | **380.6** | **100.0** |
| **Riel Station** | | | | |
| Vertisolic | 64.3 | 86.5 | 441.5 | 58.3 |
| Chernozemic | 10.0 | 13.5 | 21.7 | 2.9 |
| Developed Land[1] | | | 294.4 | 38.9 |
| **Total[3]** | **74.3** | **100.0** | **757.7** | **100** |
| **Glenboro South Station** | | | | |
| Chernozemic | 5.0 | 90.0 | 408.1 | 81.3 |
| Gleysolic | 0.6 | 10.0 | 45.9 | 9.1 |
| Solonetzic | | | 11.1 | 2.2 |
| Open Water[2] | | | 36.9 | 7.4 |
| **Total[3]** | **5.6** | **100.0** | **501.9** | **100.0** |
| Notes: | | | | |

**Table 4-1: Soil Orders in the Agriculture PDA and LAA**

| Soil Order | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |

[1] Developed land = disturbed, urban, etc.
[2] Open water = surface water features such as rivers and lakes.
[3] Values might not sum to totals shown because of rounding.

## 4.4 SOIL DRAINAGE

The distribution of the soil drainage is reported for the PDA and LAA in Table 4-2. Soil drainage beyond the LAA was deemed not relevant to completing the EIS and is therefore not presented for the RAA. The dominant soil drainage class in the Existing Corridor LAA is imperfect (73.1%), with extensive areas that are unclassified (18.9%) and correspond to developed land. Similar to the Existing Corridor LAA, the dominant soil drainage class in the Existing Corridor PDA is also imperfect (72.0%), with 23.4% of the PDA being unclassified.

The dominant soil drainage class in the New ROW LAA is very poor (39.6%), with extensive areas that are imperfectly (32.8%) and poorly (20.5%) drained. Similar to the LAA, the dominant soil drainage class in the PDA is also very poor (45.1%), with 30.2% of the PDA imperfectly drained and 20.1% of the PDA poorly drained (see Table 4-2).

Soil drainage for both the Dorsey Station LAA and PDA is imperfect (see Table 4-2).

The dominant soil drainage at the Riel Station LAA is imperfect, which represents 59.0% of the LAA; 38.9% of the LAA is unclassified. The PDA is dominantly imperfectly drained (84.6%), with the remainder poorly drained (15.4%, see Table 4-2).

The dominant soil drainage classes at the Glenboro South Station LAA are imperfect (42.5%) and well (41.0%) drained. The PDA shows a similar distribution, with 50% classed as imperfectly drained and 40% classed as well drained (see Table 4-2).

Dominant soil drainage is presented in Map Series 4-200 – Dominant Soil Drainage. The Glenboro South Station soil drainage is presented in Map 4-2.

## Table 4-2: Soil Drainage in the Agriculture PDA and LAA

| Soil Drainage | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Existing Corridor** | | | | |
| Rapid | | | 4.9 | <0.1 |
| Well | 36.7 | 1.8 | 495.8 | 2.4 |
| Imperfect | 1433.1 | 72.0 | 15,353.1 | 73.1 |
| Poor | 58.7 | 3.0 | 1,119.1 | 5.3 |
| Very Poor | | | 42.2 | 0.2 |
| Unclassified | 458.5 | 23.4 | 3,962.0 | 18.9 |
| Open water[2] | 2.2 | 0.1 | 29.6 | 0.1 |
| **Total[3]** | **1989.1** | **100.0** | **21,006.7** | **100.0** |
| **New Right-of-Way** | | | | |
| Rapid | 7.9 | 0.7 | 522.5 | 2.0 |
| Well | 39.7 | 3.6 | 1,019.3 | 4.0 |
| Imperfect | 329.4 | 30.2 | 8,373.5 | 32.8 |
| Poor | 219.3 | 20.1 | 5,246.9 | 20.5 |
| Very Poor | 491.6 | 45.1 | 10,123.8 | 39.6 |
| Unclassified[1] | | | 217.0 | 0.8 |
| Open water[2] | 2.4 | 0.2 | 38.1 | 0.1 |
| **Total[3]** | **1090.4** | **100.0** | **25,541.1** | **100.0** |
| **Dorsey Station** | | | | |
| Imperfect | 1.6 | 100.0 | 380.6 | 100.0 |
| **Total[3]** | **1.6** | **100.0** | **380.6** | **100.0** |
| **Riel Station** | | | | |
| Imperfect | 62.9 | 84.6 | 447.0 | 59.0 |
| Poor | 11.5 | 15.4 | 16.2 | 2.1 |
| Unclassified[1] | | | 294.4 | 38.9 |
| **Total[3]** | **74.3** | **100.0** | **757.7** | **100.0** |

**Table 4-2: Soil Drainage in the Agriculture PDA and LAA**

| Soil Drainage | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Glenboro South Station** | | | | |
| Well | 2.2 | 40.0 | 205.6 | 41.0 |
| Imperfect | 2.8 | 50.0 | 213.5 | 42.5 |
| Poor | 0.6 | 10.0 | 45.9 | 9.1 |
| Open water[2] | | | 36.9 | 7.4 |
| **Total[3]** | **5.6** | **100.0** | **501.9** | **100.0** |

Notes:

[1] Developed lands (disturbed, urban, etc.) are not assigned a soil drainage class.

[2] Open water = surface water features such as rivers and lakes

[3] Values might not sum to totals shown because of rounding.

## 4.5 SOIL TEXTURE

The distribution of the soil parent material texture is reported for the PDA and LAA in Table 4-3. Soil texture beyond the LAA was deemed not relevant to completing the EIS and is therefore not presented for the RAA. The dominant soil texture in the Existing Corridor LAA and PDA are very fine, or heavy clay (71.1% and 66.9%, respectively).

The dominant soil texture class in the New ROW LAA is coarse (36.6%), with extensive areas of organic (25.1%), medium (14.7%) and coarse skeletal (11.3%, very gravelly) textured soils. The dominant soil texture class in the New ROW PDA is coarse (39.8%), with extensive areas of organic (25.4%), and medium textured soils (15.8%).

The dominant soil texture in the Dorsey Station is very fine, which represents 86.5% of the LAA and 100% of the PDA (see Table 4-3).

The dominant soil texture in the Riel Station LAA is very fine, which represents 58.3% of the LAA and 86.5% of the PDA (see Table 4-3). The LAA has considerable area characterized as Unclassified (38.9%).

The dominant soil texture in the Glenboro South Station LAA is moderately fine, which represents 88.2% of the LAA (see Table 4-3). The PDA is comprised entirely of moderately fine soils.

Dominant soil texture is presented in Map Series 4-300 – Dominant Soil Texture. The Glenboro South Station soil texture is presented in Map 4-3.

**Table 4-3: Soil Texture in the Agriculture PDA and LAA**

| Soil Texture | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Existing Corridor** | | | | |
| Very Fine | 1,331.7 | 66.9 | 14,932.9 | 71.1 |
| Fine | 147.6 | 7.4 | 1,218.1 | 5.8 |
| Moderately Fine | 4.2 | 0.2 | 64.6 | 0.3 |
| Medium | 45.0 | 2.3 | 729.7 | 3.5 |
| Coarse | | | 11.4 | 0.1 |
| Coarse Skeletal | | | 49.9 | 0.2 |
| Organic | | | 8.4 | <0.1 |
| Unclassified[1] | 458.5 | 23.1 | 3,962.0 | 18.9 |
| Open water[2] | 2.2 | 0.1 | 29.6 | 0.1 |
| **Total[3]** | **1989.1** | **100.0** | **21,006.7** | **100.0** |
| **New Right-of-Way** | | | | |
| Very Fine | 0.3 | 0.0 | 242 | 0.9 |
| Fine | 47.9 | 4.4 | 1,173.9 | 4.6 |
| Moderately Fine | 28.2 | 2.6 | 699.7 | 2.7 |
| Medium | 171.8 | 15.8 | 3,742.1 | 14.7 |
| Moderately Coarse | 29.1 | 2.7 | 794.2 | 3.1 |
| Coarse | 434.2 | 39.8 | 9,342.4 | 36.6 |
| Coarse Skeletal | 99.1 | 9.1 | 2,893.1 | 11.3 |
| Organic | 277.3 | 25.4 | 6,399.0 | 25.1 |
| Unclassified[1] | | | 217.0 | 0.8 |
| Open water[2] | 2.4 | 0.2 | 38.1 | 0.1 |
| **Total[3]** | **1090.4** | **100.0** | **25,541.1** | **100.0** |

**Table 4-3: Soil Texture in the Agriculture PDA and LAA**

| Soil Texture | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Dorsey Station** | | | | |
| Very Fine | 1.6 | 100.0 | 329.3 | 86.5 |
| Fine | | | 51.3 | 13.5 |
| **Total[3]** | **1.6** | **100.0** | **380.6** | **100** |
| **Riel Station** | | | | |
| Very Fine | 64.3 | 86.5 | 441.5 | 58.3 |
| Fine | 10 | 13.5 | 21.7 | 2.9 |
| Unclassified[1] | | | 294.4 | 38.9 |
| **Total[3]** | **74.3** | **100.0** | **757.7** | **100.0** |
| **Glenboro South Station** | | | | |
| Fine | | | 22.1 | 4.4 |
| Moderately Fine | 5.6 | 100.0 | 442.9 | 88.2 |
| Open water[2] | | | 36.9 | 7.4 |
| **Total[3]** | **5.6** | **100.0** | **501.9** | **100.0** |

Notes:

1 Developed lands (disturbed, urban, etc.) are not assigned a soil texture.

2 Open water = surface water features such as rivers and lakes

3 Values might not sum to totals shown because of rounding.

## 4.6 AGRICULTURAL CAPABILITY CLASS

The dominant agricultural capability class for the PDAs and LAAs are shown in Table 4-4; the data for the RAAs are shown in Table 4-5. Limitations to agricultural capability are shown in Tables 4-6 and 4-7.

The dominant agricultural capability classes in the Existing Corridor, New ROW, Dorsey Station and Riel Station RAA are Class 3 (26.8%), Class 2 (21.4%) and Class 5 (18.3%, see Table 4-5). The main limitations to agricultural capability in the Existing Corridor, New ROW, Dorsey Station and Riel Station RAA are excess water (subclass W, 68.9%) and moisture limitation (subclass M, 20.5%, see Table 4-7). The dominant agricultural capability classes in the Glenboro South Station RAA are Class 6 (34.6%), Class 4 (16.6%), Class 5 (13.6%) and Class 2 (11.3%). The dominant limitations are moisture limitation (subclass M, 61.2%) and excess water (subclass W, 15.5%).

The dominant agricultural capability classes in the Existing Corridor LAA are Class 3 (48.5%) and Class 2 (28.1%, see Table 4-4). The main limitation to agricultural capability in the Existing Corridor LAA is excess water (subclass W, 76.3%, see Table 4-6). The predominant agricultural capability class in the New ROW LAA is Class O (25.1%), with 22.7% of the LAA being Class 5. The main limitation to agricultural capability in the New ROW LAA is excess water (subclass W, 63.3%). The dominant agricultural capability classes in the Dorsey Station LAA are Class 2 (54.3%) and Class 3 (45.7%). The dominant limitation to agricultural land capability in the Dorsey Station LAA is excess water (subclass W, 100%). The predominant agricultural capability class in the Riel Station LAA is Class 2 (39.4%); developed land occupies 38.9% of the Riel Station LAA and is not assigned a rating. The dominant limitation to agricultural land capability in the Riel LAA is excess water (subclass W, 61.1%). The Glenboro South Station LAA is co-dominantly rated as Class 1 (41.0%) and Class 2 (40.3%) with excess water (subclass W, 49.5%) being the dominant limitation.

The dominant agricultural capability classes in the Existing Corridor PDA is Class 3 (45.5%, see Table 4-4). The main limitation to agricultural capability in the Existing Corridor PDA is excess water (subclass W, 73.4%, see Table 4-6). The dominant agricultural capability class in the New Right-of-Way PDA is Class O (25.4%), with 20.7% of the PDA being Class 6 and 20.3% being Class 5. The main limitation to agricultural capability in the New ROW PDA is excess water (subclass W, 66.8%). The agricultural capability class in the Dorsey Station PDA is Class 3 (100%) and the limitation to agricultural land capability is excess water (subclass W, 100%). The dominant agricultural capability class in the Riel Station PDA is Class 2 (65.5%); the dominant limitation to agricultural land capability in the Riel Station PDA is excess water (subclass W, 100%). The Glenboro South Station PDA is co-dominantly rated as Class 2 (50.0%) and Class 1 (40.0%) with excess water (subclass W, 60.0%) being the dominant limitation.

Dominant agricultural capability classes are presented in Map Series 4-400 – Dominant Agricultural Capability Classification. The Glenboro South Station agricultural capability is presented in Map 4-4.

**Table 4-4: Agricultural Capability in the Agriculture PDA and LAA**

| Agricultural Capability[1] | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Existing Corridor** | | | | |
| 1 | 10.1 | 0.5 | 91.8 | 0.4 |
| 2 | 562.9 | 28.3 | 5,901.2 | 28.1 |

**Table 4-4: Agricultural Capability in the Agriculture PDA and LAA**

| Agricultural Capability[1] | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| 3 | 905.5 | 45.5 | 10,181.8 | 48.5 |
| 4 | | | 1.3 | <0.1 |
| 5 | 49.9 | 2.5 | 796.9 | 3.8 |
| 6 | | | 33.7 | 0.2 |
| Organic | | | 8.4 | <0.1 |
| Unclassified[1] | 458.5 | 23.1 | 3,692.0 | 18.9 |
| Open Water[2] | 2.2 | 0.1 | 29.6 | 0.1 |
| **Total[3]** | **1989.1** | **100.0** | **21,006.7** | **100.0** |
| **New Right-of-Way** | | | | |
| 2 | 11.6 | 1.1 | 880.8 | 3.4 |
| 3 | 171.0 | 15.7 | 4,220.6 | 16.5 |
| 4 | 181.6 | 16.7 | 4,420.6 | 17.3 |
| 5 | 221.3 | 20.3 | 5,787.8 | 22.7 |
| 6 | 225.2 | 20.7 | 3,577.2 | 14.0 |
| Organic | 277.3 | 25.4 | 6,399.0 | 25.1 |
| Unclassified[1] | | | 212.0 | 0.8 |
| Open Water[2] | 2.4 | 0.2 | 43.1 | 0.2 |
| **Total[3]** | **1090.4** | **100.0** | **25,541.1** | **100.0** |
| **Dorsey Station** | | | | |
| 2 | | | 206.6 | 54.3 |
| 3 | 1.6 | 100 | 174.1 | 45.7 |
| **Total[3]** | **1.6** | **100.0** | **380.6** | **100.0** |
| **Riel Station** | | | | |
| 2 | 48.7 | 65.5 | 298.9 | 39.4 |
| 3 | 25.6 | 34.5 | 164.4 | 21.7 |
| Unclassified[1] | | | 294.4 | 38.9 |

### Table 4-4: Agricultural Capability in the Agriculture PDA and LAA

| Agricultural Capability[1] | PDA Extent (ha) | PDA Proportional Extent (%) | LAA Extent (ha) | LAA Proportional Extent (%) |
|---|---|---|---|---|
| **Total[3]** | **74.3** | **100.0** | **757.7** | **100.0** |
| **Glenboro South Station** | | | | |
| 1 | 2.2 | 0.6 | 205.6 | 41.0 |
| 2 | 2.8 | 50.0 | 202.5 | 40.3 |
| 4 | | | 11.1 | 2.2 |
| 5 | 0.6 | 10.0 | 45.9 | 9.1 |
| Open Water[2] | | | 36.9 | 7.4 |
| **Total[3]** | **5.6** | **100.0** | **501.9** | **100.0** |

Notes:
1 Developed lands (disturbed, urban, etc.) are not assigned an agricultural capability class.
2 Open water = surface water features such as rivers and lakes.
3 Values might not sum to totals shown because of rounding.

### Table 4-5: Agricultural Capability in the Agriculture RAA

| Agricultural Capability[1] | Extent (ha) | Proportional Extent (%) |
|---|---|---|
| **Existing Corridor, New ROW, Dorsey Station and Riel Station RAA** | | |
| 1 | 2,096.9 | 0.2 |
| 2 | 181,087.2 | 21.4 |
| 3 | 227,054.8 | 26.8 |
| 4 | 82,527.0 | 9.7 |
| 5 | 154,841.3 | 18.3 |
| 6 | 53,019.2 | 6.3 |
| 7 | 118.1 | <0.1 |
| Organic | 133,449.4 | 15.8 |
| Unclassified[1] | 9,117.9 | 1.1 |
| Open Water[2] | 3,876.4 | 0.5 |
| **Total[3]** | **847,188.2** | **100.0** |

### Table 4-4: Agricultural Capability in the Agriculture PDA and LAA

<table>
<tr><th rowspan="2">Agricultural Capability[1]</th><th colspan="2">PDA</th><th colspan="2">LAA</th></tr>
<tr><th>Extent (ha)</th><th>Proportional Extent (%)</th><th>Extent (ha)</th><th>Proportional Extent (%)</th></tr>
<tr><td colspan="5">Glenboro South Station RAA</td></tr>
<tr><td>1</td><td colspan="2">8,720.1</td><td colspan="2">7.8</td></tr>
<tr><td>2</td><td colspan="2">12,574.9</td><td colspan="2">11.3</td></tr>
<tr><td>3</td><td colspan="2">8,224.8</td><td colspan="2">7.4</td></tr>
<tr><td>4</td><td colspan="2">18,473.0</td><td colspan="2">16.6</td></tr>
<tr><td>5</td><td colspan="2">15,066.9</td><td colspan="2">13.6</td></tr>
<tr><td>6</td><td colspan="2">38,453.3</td><td colspan="2">34.6</td></tr>
<tr><td>7</td><td colspan="2">4,457.8</td><td colspan="2">4.0</td></tr>
<tr><td>Organic</td><td colspan="2">3,510.4</td><td colspan="2">3.2</td></tr>
<tr><td>Open Water[2]</td><td colspan="2">1,653.0</td><td colspan="2">1.5</td></tr>
<tr><td>Total[3]</td><td colspan="2">111,134.2</td><td colspan="2">100.0</td></tr>
</table>

Notes:

1 Developed lands (disturbed, urban, etc.) are not assigned an agricultural capability class.

2 Open water = surface water features such as rivers and lakes.

3 Values might not sum to totals shown because of rounding.

### Table 4-6: Agricultural Capability Limitations in the Agriculture PDA and LAA

| Agricultural Capability Limitation | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Existing Corridor** | | | | |
| W – Excess Water | 1,460.8 | 73.4 | 16,025.5 | 76.3 |
| N - Salinity | 95.2 | 4.8 | 861.7 | 4.1 |
| D – Structure and/or Permeability | 47.3 | 2.4 | 744.4 | 3.5 |
| I - Inundation | 10.3 | 0.5 | 103.7 | 0.5 |
| M – Moisture Deficit | | | 60.4 | 0.3 |
| P – Stoniness | | | 1.3 | <0.1 |

### Table 4-4: Agricultural Capability in the Agriculture PDA and LAA

| Agricultural Capability[1] | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| T - Slope | | | 0.9 | <0.1 |
| **New Right-of-Way** | | | | |
| W – Excess Water | 728.5 | 66.8 | 16,158.1 | 63.3 |
| M – Moisture Deficit | 228.9 | 21.0 | 6,288.9 | 24.6 |

### Table 4-7: Agricultural Capability Limitations in the Agriculture PDA and LAA

| Agricultural Capability Limitation | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| D – Structure and/or Permeability | 121.9 | 11.2 | 2,681.3 | 10.5 |
| P – Stoniness | 56.2 | 5.2 | 1,041.2 | 4.1 |
| I - Inundation | 11.4 | 1.0 | 385.0 | 1.5 |
| F - Fertility | | | 42.7 | 0.2 |
| **Dorsey Station** | | | | |
| W – Excess Water | 1.6 | 100.0 | 380.6 | 100.0 |
| N - Salinity | 0.3 | 20.0 | 21.5 | 5.6 |
| **Riel Station** | | | | |
| W – Excess Water | 74.3 | 100.0 | 463.2 | 61.1 |
| **Glenboro South Station** | | | | |
| W – Excess Water | 3.3 | 60.0 | 248.3 | 49.5 |
| D – Structure and/or Permeability | | | 11.1 | 2.2 |

**Table 4-8: Agricultural Capability Limitations in the Agriculture RAA**

| Agricultural Capability[1] | Extent (ha) | Proportional Extent (%) |
|---|---|---|
| **Existing Corridor, New ROW, Dorsey Station and Riel Station RAA** | | |
| W – Excess Water | 583,646.4 | 68.9 |
| M – Moisture Deficit | 173,344.2 | 20.5 |
| D – Structure and/or Permeability | 65,783.8 | 7.8 |
| P – Stoniness | 55,758.4 | 6.6 |
| N - Salinity | 17,732.4 | 2.1 |
| I - Inundation | 8,265.9 | 1.0 |
| F - Fertility | 416.8 | <0.1 |
| T - Slope | 296.2 | <0.1 |
| X – Cumulative Minor Adverse Characteristics | 73.1 | <0.1 |
| R – Consolidated Bedrock | 8.8 | <0.1 |
| **Glenboro South Station RAA** | | |
| W – Excess Water | 17,240.2 | 15.5 |
| M – Moisture Deficit | 68,063.0 | 61.2 |
| D – Structure and/or Permeability | 12.2 | <0.1 |
| N - Salinity | 63.4 | 0.1 |
| I - Inundation | 9,618.0 | 8.7 |
| T - Slope | 8,464.1 | 7.6 |
| X – Cumulative Minor Adverse Characteristics | 761.1 | 0.7 |

## 4.7 COMPACTION RISK

Compaction risk ratings for the PDAs, LAAs and RAA are shown in Tables 4-8 and 4-9. The dominant compaction for all components is high. The high ratings are due to the combination of fine, very fine and organic soil textures with imperfectly to poorly drained soils.

Dominant compaction risk is presented in Map Series 4-500 – Dominant Compaction Risk. The Glenboro South Station dominant compaction risk is presented in Map 4-5.

## Table 4-9: Compaction Risk in the Agriculture PDA and LAA

| Compaction Risk | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Existing Corridor** | | | | |
| Low | 0.7 | <0.1 | 105.5 | 0.5 |
| Moderate | 56.6 | 2.8 | 784.5 | 3.7 |
| High | 1,471.1 | 74.0 | 16,125.2 | 76.8 |
| Unclassified[1] | 458.5 | 23.1 | 3,962.0 | 18.9 |
| Open water[2] | 2.2 | 0.1 | 29.6 | 0.1 |
| **Total[3]** | **1,989.1** | **100.0** | **21,006.7** | **100.0** |
| **New Right-of-Way** | | | | |
| Low | 274.3 | 25.2 | 7,179.7 | 28.1 |
| Moderate | 217.9 | 20.0 | 5,128.4 | 20.1 |
| High | 595.8 | 54.6 | 12,977.9 | 50.8 |
| Unclassified[1] | | | 212.0 | 0.8 |
| Open water[2] | 2.4 | 0.2 | 43.1 | 0.2 |
| **Total[3]** | **1090.4** | **100.0** | **25,541.1** | **100.0** |
| **Dorsey Station** | | | | |
| High | 1.6 | 100.0 | 380.6 | 100.0 |
| **Total[3]** | **1.6** | **100.0** | **380.6** | **100.0** |
| **Riel Station** | | | | |
| High | 74.3 | 100.0 | 463.2 | 61.1 |
| Unclassified[1] | | | 294.4 | 38.9 |
| **Total[3]** | **74.3** | **100.0** | **757.7** | **100.0** |
| **Glenboro South Station** | | | | |
| Moderate | 2.2 | 40.0 | 205.6 | 41.0 |
| High | 3.3 | 60.0 | 259.4 | 51.7 |
| Open water[2] | | | 36.9 | 7.4 |
| **Total[3]** | **5.6** | **100.0** | **501.9** | **100.0** |

### Table 4-9: Compaction Risk in the Agriculture PDA and LAA

| Compaction Risk | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |

Notes:
1 Developed lands (disturbed, urban, etc.) are not assigned a soil compaction risk.
2 Open water = surface water features such as rivers and lakes.
3 Values might not sum to totals shown because of rounding.

### Table 4-10: Compaction Risk in the Agriculture RAA

| Agricultural Capability[1] | Extent (ha) | Proportional Extent (%) |
|---|---|---|
| **Existing Corridor, New ROW, Dorsey Station and Riel Station** | | |
| Low | 196,803.3 | 23.2 |
| Moderate | 102,875.3 | 12.1 |
| High | 534,515.4 | 63.1 |
| Unclassified[1] | 9,117.9 | 1.1 |
| Open water[2] | 3,876.4 | 0.5 |
| **Total[3]** | **847,188.2** | **100.0** |
| **Glenboro South Station** | | |
| Low | 76,958.4 | 69.2 |
| Moderate | 16,287.1 | 14.7 |
| High | 16,235.7 | 14.6 |
| Open water[2] | 1653.0 | 1.5 |
| **Total[3]** | **111,134.2** | **100.0** |

Notes:
1 Developed lands (disturbed, urban, etc.) are not assigned a compaction risk rating.
2 Open water = surface water features such as rivers and lakes.
3 Values might not sum to totals shown because of rounding.

## 4.8 WATER EROSION RISK

The distribution of water erosion risk is reported in Table 4-10 for the agriculture spatial boundaries. The dominant water erosion risk in the Existing Corridor LAA and the New ROW LAA is negligible (51.8% and 93.5%, respectively). Similarly, the PDAs for these two components are also dominantly rated as negligible for risk of water erosion, with 47.5% of the Existing Corridor and 94.2% of the New ROW rated as negligible (See Table 4-10).

The dominant water erosion risk in the Dorsey Station LAA is low, which represents 54.3% of the LAA. The PDA is rated as negligible for risk of water erosion (see Table 4-10).

The dominant water erosion risk in the Riel Station LAA and PDA is low (36.6% and 52.0%. respectively); and additional 38.9% of the LAA is identified as unclassified (see Table 4-10).

The dominant water erosion risk in the Glenboro South Station LAA is moderate (64.6%). Similarly, the PDA is dominantly rated as moderate for risk of water erosion (90%) (see Table 4-10).

Dominant water erosion risk is presented in Map Series 4-600 – Dominant Water Erosion Risk. The Glenboro South Station dominant compaction risk is presented in Map 4-6.

**Table 4-11: Water Erosion Risk in the Agriculture PDA and LAA**

| Water Erosion Risk | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Existing Corridor** | | | | |
| Negligible | 944.5 | 47.5 | 10,876.4 | 51.8 |
| Low | 570.5 | 28.7 | 5,975.5 | 28.4 |
| Moderate | 13.4 | 0.7 | 154.1 | 0.7 |
| High | | | 9.2 | <0.1 |
| Unclassified[1] | 458.5 | 23.1 | 3,962.0 | 18.9 |
| Open water[2] | 2.2 | 0.1 | 29.6 | 0.1 |
| **Total[3]** | **1,989.1** | **100.0** | **21,006.7** | **100.0** |
| **New Right-of-Way** | | | | |
| Negligible | 1,026.9 | 94.2 | 23,872.2 | 93.5 |
| Low | 31.8 | 2.9 | 802.2 | 3.1 |
| Moderate | 29.3 | 2.7 | 610.8 | 2.4 |
| High | | | 5.9 | <0.1 |

### Table 4-11: Water Erosion Risk in the Agriculture PDA and LAA

| Water Erosion Risk | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| Unclassified[1] | | | 212.0 | 0.8 |
| Open water[2] | 2.4 | 0.2 | 38.1 | 0.1 |
| **Total[3]** | **1,090.4** | **100.0** | **25,541.1** | **100.0** |
| **Dorsey Station** | | | | |
| Negligible | 1.6 | 100.0 | 174.1 | 45.7 |
| Low | | | 206.6 | 54.3 |
| **Total[3]** | **1.6** | **100.0** | **380.6** | **100.0** |
| **Riel Station** | | | | |
| Negligible | 25.6 | 34.5 | 164.4 | 21.7 |
| Low | 38.6 | 52.0 | 277.2 | 36.6 |
| Moderate | 10.0 | 13.5 | 21.7 | 2.9 |
| Unclassified[1] | | | 294.4 | 38.9 |
| **Total[3]** | **74.3** | **100.0** | **757.7** | **100.0** |
| **Glenboro South Station** | | | | |
| Negligible | 0.6 | 10.0 | 45.9 | 9.1 |
| Low | | | 94.7 | 18.9 |
| Moderate | 5.0 | 90.0 | 324.4 | 64.6 |
| Open water[2] | | | 36.9 | 7.4 |
| **Total[3]** | **5.6** | **100.0** | **501.9** | **100.0** |

Notes:

1 Developed lands (disturbed, urban, etc.) are not assigned a water erosion risk rating.

2 Open water = surface water features such as rivers and lakes

3 Values might not sum to totals shown because of rounding.

Water erosion risk for the fish and fish habitat LAA is reported in Table 4-11. Water erosion risk is predominantly considered negligible to low within the fish and fish habitat LAA, based on existing soil resource information. Moderate risk was identified within the LAA at crossings 8 and 19 (Type A,B and C crossings). Low risk was identified within the LAA at crossing 1 (Type D crossings). No areas within the aquatic LAA were identified as high water erosion risk. This data provides the relative risk of water erosion within a regional context. Slope stability and riverbank erosion is discussed further in Section 4.11.

### Table 4-12: Water Erosion Risk in the Fish and Fish Habitat LAA

| Crossing No. | Negligible | | Low | | Moderate | | Unclassified[1] | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % |
| **Type A, B and C Crossings** | | | | | | | | | | |
| 1 | 4.4 | 92.9 | 0.3 | 7.1 | | | | | 4.7 | 100.0 |
| 2 | 1.8 | 24.6 | 5.6 | 75.4 | | | | | 7.4 | 100.0 |
| 3 | 1.6 | 26.0 | 4.6 | 74.0 | | | | | 6.2 | 100.0 |
| 4 | | | 20.8 | 68.7 | | | 9.5 | 31.3 | 30.3 | 100.0 |
| 5 | | | | | | | 6.0 | 100.0 | 6.0 | 100.0 |
| 6 | | | | | | | 40.3 | 100.0 | 40.3 | 100.0 |
| 7 | | | | | | | 33.3 | 100.0 | 33.3 | 100.0 |
| 8 | 1.9 | 37.3 | 0.5 | 9.1 | 0.5 | 9.1 | 2.2 | 44.5 | 5.0 | 100.0 |
| 9 | 6.5 | 100.0 | | | | | | | 6.5 | 100.0 |
| 10 | 4.5 | 95.1 | 0.2 | 4.9 | | | | | 4.7 | 100.0 |
| 11 | 4.8 | 100.0 | | | | | | | 4.8 | 100.0 |
| 12 | 6.1 | 93.2 | 0.4 | 6.8 | | | | | 6.6 | 100.0 |
| 13 | 2.7 | 100.0 | | | | | | | 2.7 | 100.0 |
| 15 | 3.0 | 100.0 | | | | | | | 3.0 | 100.0 |
| 16 | 3.3 | 100.0 | | | | | | | 3.3 | 100.0 |
| 17 | 3.6 | 100.0 | | | | | | | 3.6 | 100.0 |
| 18 | 3.3 | 100.0 | | | | | | | 3.3 | 100.0 |
| 19 | | | | | 4.1 | 100.0 | | | 4.1 | 100.0 |
| 20 | 3.8 | 100.0 | | | | | | | 3.8 | 100.0 |
| 21 | 3.6 | 100.0 | | | | | | | 3.6 | 100.0 |
| 22 | 3.3 | 100.0 | | | | | | | 3.3 | 100.0 |
| 23 | 2.7 | 100.0 | | | | | | | 2.7 | 100.0 |

### Table 4-12: Water Erosion Risk in the Fish and Fish Habitat LAA

| Crossing No. | Negligible | | Low | | Moderate | | Unclassified[1] | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % |
| **Type D Crossings** | | | | | | | | | | |
| 1 | 0.8 | 30.0 | 1.9 | 70.0 | | | | | 2.7 | 100.0 |
| 2 | 2.7 | 100.0 | | | | | | | 2.7 | 100.0 |
| 3 | 2.7 | 100.0 | | | | | | | 2.7 | 100.0 |
| 4 | 2.7 | 100.0 | | | | | | | 2.7 | 100.0 |
| 5 | 2.7 | 100.0 | | | | | | | 2.7 | 100.0 |
| 6 | 2.7 | 10.0 | | | | | | | 2.7 | 100.0 |
| 7 | 1.2 | 43.5 | | | | | 1.5 | 56.5 | 2.7 | 100.0 |
| 8 | 2.7 | 100.0 | | | | | | | 2.7 | 100.0 |

Notes:

[1] Unclassified includes developed land and/or open water which are not assigned a water erosion risk rating.

## 4.9 WIND EROSION RISK

The distribution of wind erosion risk is reported in Table 4-12. The dominant wind erosion risk in the Existing Corridor LAA and PDA is high (60.3% and 55.9%, respectively). The dominant wind erosion risk in the New ROW LAA and PDA is severe (50.0% and 50.5%, respectively).

The dominant wind erosion risk in the Dorsey Station LAA and PDA is severe, which represents 100% of the LAA and PDA (see Table 4-12).

The dominant wind erosion risk in the Riel Station LAA and PDA is high (61.1% and 100%, respectively, see Table 4-12).

The dominant wind erosion risk in the Glenboro South Station LAA low (88.2%). Similarly, the PDA is dominantly rated as low for risk of wind erosion (100%) (see Table 4-12).

Dominant wind erosion risk is presented in Map Series 4-700 – Dominant Wind Erosion Risk. The Glenboro South Station dominant wind erosion risk is presented in Map 4-7.

### Table 4-13: Wind Erosion Risk Potential in the Agriculture PDA and LAA

| Wind Erosion Risk | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Existing Corridor** | | | | |
| Moderate | 49.2 | 2.5 | 791.3 | 3.8 |
| High | 1,101.9 | 55.4 | 12,661.7 | 60.3 |
| Severe | 377.3 | 19.0 | 3,553.8 | 16.9 |
| Not Applicable[1] | 458.5 | 23.1 | 3,970.5 | 18.9 |
| Open water[2] | 2.2 | 0.1 | 29.6 | 0.1 |
| **Total[3]** | **1989.1** | **100.0** | **21,006.7** | **100.0** |
| **New Right-of-Way** | | | | |
| Low | 28.2 | 2.6 | 699.7 | 2.7 |
| Moderate | 174.5 | 16.0 | 4,007.8 | 15.7 |
| High | 57.0 | 5.2 | 1,403.5 | 5.5 |
| Severe | 551.0 | 50.5 | 12,775.9 | 50.0 |
| Not Applicable[1] | 277.3 | 25.4 | 6,611.0 | 25.9 |
| Open water[2] | 2.4 | 0.2 | 43.1 | 0.2 |
| **Total[3]** | **1090.4** | **100.0** | **25,541.1** | **100.0** |
| **Dorsey Station** | | | | |
| Severe | 1.6 | 100.0 | 380.6 | 100.0 |
| **Total[3]** | **1.6** | **100.0** | **380.6** | **100.0** |
| **Riel Station** | | | | |
| High | 74.3 | 100.0 | 463.2 | 61.1 |
| Unclassified[1] | | | 294.4 | 38.9 |
| **Total[3]** | **74.3** | **100.0** | **757.7** | **100.0** |
| **Glenboro South Station** | | | | |
| Low | 5.6 | 100.0 | 442.9 | 88.2 |
| Moderate | | | 22.1 | 4.4 |
| Open water[2] | | | 36.9 | 7.4 |
| **Total[3]** | **5.6** | **100.0** | **501.9** | **100.0** |

**Table 4-13: Wind Erosion Risk Potential in the Agriculture PDA and LAA**

| Wind Erosion Risk | PDA | | LAA | |
|---|---|---|---|---|
| | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |

Notes:

1 Developed lands (disturbed, urban, etc.) and organic soils are not assigned a wind erosion risk rating.

2 Open water = surface water features such as rivers and lakes

3 Values might not sum to totals shown because of rounding.

## 4.10 TERRAIN INSTABILITY

The level to very gently sloping topography found along the proposed alignment results in a low likelihood for mass movement processes. The destabilization of riverbank sections by fluvial erosion and slumping are considered to be the main sources of potential mass movement within the RAA. The erosion and slumping of unstable riverbank sections are the only active mass movement processes that were identified within the RAA through desktop review. Based on this desktop review, the occurrence of unstable slopes is very limited and no evidence of recently unstable slope segments was identified within the proposed PDA.

The topography along the Project is, for the most part, level with the exception of small areas with gently undulating terrain and short, steep riverbank slopes. The soils associated with slope stability problems in southern Manitoba consist mainly of brown and grey plastic clays deposited in former glacial Lake Agassiz (Teller 1976). Slope stability problems in glaciolacustrine deposits found in and around Winnipeg have been examined by several authors: Baracos (1960), Freeman and Sutherland (1974), Tseng (1975), Baracos and Graham (1981) and more recently by Tutkaluk (2000) and James (2009).

Slope instability problems are primarily associated with the banks of major water courses such as the Red River, the Assiniboine River, and their tributaries. The occurrence of mass movement and landslides is related to various factors including the presence of fine-grained soils, seasonal variation in groundwater pore pressure, seepage and riverbank erosion. A figure by Baracos and Graham (1981) show the locations of active and inactive landslide areas within the City of Winnipeg: two active slide areas (as of 1981) are located at proximity to the proposed transmission line but not within the PDA: along the bank of the Red River (approximately 2.5 km both north and south of the PDA) and along the bank of the La Salle River (approximately 4 km from its confluence with the Red River). As expected, these areas correspond to outside bends of river meanders, where generally faster current, wave action and ice scour contribute to lateral bank erosion, bank undercutting and/or bank slumping.

Recent studies by James (2009) indicate that "*Extremely slow to very slow, rotational to translational sliding of riverbanks is common along the Red River. Earth sliding is especially common along the outside bends of the river where the river is immediately adjacent to Lake*

*Agassiz sediments. However, riverbank failures are not limited to outside bends, and can occur on inside, straight and transition sections of the Red River*".

Observations on riverbank failure by authors cited above indicates that bank erosion and channel migration in the Winnipeg area are generally minimal. The extent of unstable riverbank sections can reach up to several hundred meters, however the lateral erosion and/or width of bank slumping is generally limited to a few meters from the edge of the streams. The increased frequency and magnitude of flooding along the Red and Assiniboine Rivers over the past decade appears to have influenced the number of slope failures, with slope movement commonly occurring in early spring before the freshet (*i.e.,* the spring thaw period) as well as late fall after the drawdown of the Red River (James 2009).

A review of slope data available from the Manitoba Agricultural Interpretation Database (SoilAID; MLI 2014) indicates that the average slope gradient found along both LAA and PDA range between 0 and 0.5% (Table 4-13). Slopes between 5 and 9% are found in areas characterized by gently undulating ground moraine located in the southeastern portion of the PDA.

Although the soil database does not indicate the presence of slopes over 9% (mainly due to the original mapping scale), several short, steep slope segments are found along the various rivers and streams crossed by the Project. Refer to Table 3-1 of the Aquatic Environment Technical Data Report for a complete list of crossings traversed by the Project.

A review of available satellite imagery suggests that other potentially unstable riverbank sections within the RAA are located at the Assiniboine River crossing just east of Beaudry Provincial Park (*i.e.,* just outside the LAA). In addition, from the review of imagery, there is potential for very minor lateral riverbank erosion and slumping along the meanders of the larger streams crossed by the PDA such as the Seine River, Rat River and Pine Creek in the southeastern portion of the RAA.

### Table 4-14: Slope Classes in the Agriculture PDA and LAA

| Slope Class | Slope Range | PDA Extent (ha) | PDA Proportional Extent (%) | LAA Extent (ha) | LAA Proportional Extent (%) |
|---|---|---|---|---|---|
| **Existing Corridor** | | | | | |
| A | 0 to 0.5% | 1,528.4 | 76.8 | 16,970.8 | 80.8 |
| C | 2 to 5% | | | 44.3 | 0.2 |
| Unclassified[1] | | 458.5 | 23.1 | 3,962.0 | 18.9 |
| Open water[2] | | 2.2 | 0.1 | 29.6 | 0.1 |
| **Total[3]** | | **1989.1** | **100.0** | **21,006.7** | **100.0** |
| **New Right-of-Way** | | | | | |
| A | 0 to 0.5% | 1,025.3 | 94.0 | 23,472.3 | 91.9 |
| B | 0.5 to 2% | 30.6 | 2.8 | 1,017.1 | 4.0 |
| C | 2 to 5% | 25.6 | 2.3 | 734.8 | 2.9 |
| D | 5 to 9% | 6.5 | 0.6 | 61.8 | 0.2 |
| Unclassified[1] | | | | 211.9 | 0.8 |
| Open water[2] | | 2.4 | 0.2 | 43.1 | 0.2 |
| **Total[3]** | | **1090.4** | **100.0** | | |
| **Dorsey Station** | | | | | |
| A | 0 to 0.5% | 1.6 | 100.0 | 380.6 | 100.0 |
| **Total[3]** | | **1.6** | **100.0** | **380.6** | **100.0** |
| **Riel Station** | | | | | |
| A | 0 to 0.5% | 74.3 | 100.0 | 463.2 | 61.1 |
| Unclassified[1] | | | | 294.4 | 38.9 |
| **Total[3]** | | **74.3** | **100.0** | **757.7** | **100.0** |
| **Glenboro South Station** | | | | | |
| A | 0 to 0.5% | 0.6 | 10.0 | 151.7 | 30.2 |
| B | 0.5 to 2% | 5.0 | 90.0 | 313.3 | 62.4 |
| Unclassified[1] | | | | 36.9 | 7.4 |
| **Total[3]** | | **5.6** | **100.0** | **501.2** | **100.0** |
| Notes:: | | | | | |

**Table 4-14: Slope Classes in the Agriculture PDA and LAA**

| Slope Class | Slope Range | PDA | | LAA | |
|---|---|---|---|---|---|
| | | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |

[1] Developed lands (disturbed, urban, etc.) are not assigned a slope class.
[2] Open water = surface water features such as rivers and lakes
[3] Values might not sum to totals shown because of rounding.

## 4.11 CONTAMINATED SOILS

Existing soil and groundwater contamination unrelated to the Project may be encountered during construction. Manitoba Hydro has developed a Project Environmental Protection Plan (EPP) that explains how contaminated sites that are unexpectedly encountered during construction will be managed.

The Manitoba Hydro Potentially Contaminated Sites Database was reviewed for known contaminated or impacted sites occurring within the Project PDA. One impacted site, the Manitoba Hydro Dorsey Station, was identified as occurring within the Project PDA. A review of the Manitoba Hydro Potentially Contaminated Sites Database indicated that the areas of Dorsey Station where impacts were previously identified are not within the planned construction area. Prior to Project construction at the Dorsey Station, soil and groundwater sampling will be collected within the proposed construction location and analyzed for contamination. If the analyses indicates that soil conditions exceed applicable contamination guidelines, that portion of the Dorsey Station will be managed in accordance with an approved Remediation Plan.

Two other Manitoba Hydro properties, the Hydro Glenboro Station and the Richer South Terminal #2756 are within the Project PDA. Active Manitoba Hydro Station properties are considered to be potentially impacted. Potential contaminants of concern associated with Manitoba Hydro Stations include petroleum hydrocarbons (PHC), polycyclic aromatic hydrocarbons (PAH), and polychlorinated biphenyls (PCB). Soil and/or groundwater sampling will be conducted in the planned project footprint of these properties prior to project construction. If soil conditions exceed applicable guidelines, the planned project footprint area of these sites will be remediated in accordance with an approved Remediation Plan.

The Manitoba Conservation and Water Stewardship Contaminated Sites List, Impacted Sites List, and List of All Sites were also reviewed. No other known contaminated or impacted sites were identified within the Project PDA.

Unexpected soil contamination that is encountered during construction will be managed in accordance with the EPP.

# 5.0 ENVIRONMENTALLY SENSITIVE SITES

Environmentally sensitive sites (ESS) are locations, features, areas, activities or facilities that are identified to be environmentally, socially or economically important or sensitive to disturbance and require protection and mitigation during Project construction and operation and maintenance. Sensitive sites traversed by the Project or in the immediate vicinity of Project components and subject to effects from the Project are included. These sites are assessed for potential environmental effects and appropriate mitigation measures are identified within the EIS. In order to provide protection during the construction and maintenance and operation phases of the Project, ESS will be included in the Environmental Protection Plan.

Sites of known contaminated soils have been identified as ESS for soil and terrain. These sites were discussed in Section 4.12. Locations of these ESS are summarized in Table 5-1, below.

**Table 5-1: Environmentally Sensitive Sites for Soil and Terrain**

| ESS Name | ESS Description | Rationale |
|---|---|---|
| Dorsey Station | Potential for encountering contaminated soils | Project activities including drilling and excavation for structure installation may result in disturbance of contaminated soils. |
| La Verendrye Station #1435 | | |
| Oakbluff Farm Tap (FT-509) | | |
| Richer South Terminal #2756 | | |
| Saltel Station #2429 | | |

# 6.0 SUMMARY

The foregoing presents existing environmental conditions for the soil and terrain environment to support agriculture and fish and fish habitat valued components for the MMTP environmental assessment and the groundwater TDR. The report is based on the review and interpretation of desktop data.

A summary of highlights includes:

- Soils are predominantly very fine to moderately fine in texture, with extensive areas of coarse and organic soils.
- Drainage is predominantly imperfect and very poor.
- Agricultural capability was found to be predominantly Class 3 for Existing Corridor and Classes 5, 6 and Organic for the New ROW.
- Water erosion risk was found to be predominantly negligible.
- Wind erosion was predominantly high due to the very fine to fine texture soils, and severe, largely due to coarse textured soils along the new ROW.
- Based on review of desktop information, satellite imagery and existing literature, there is no evidence that slope stability is concern in PDA.
- Five areas have been identified as environmentally sensitive sites where contaminated soil may potentially be encountered.

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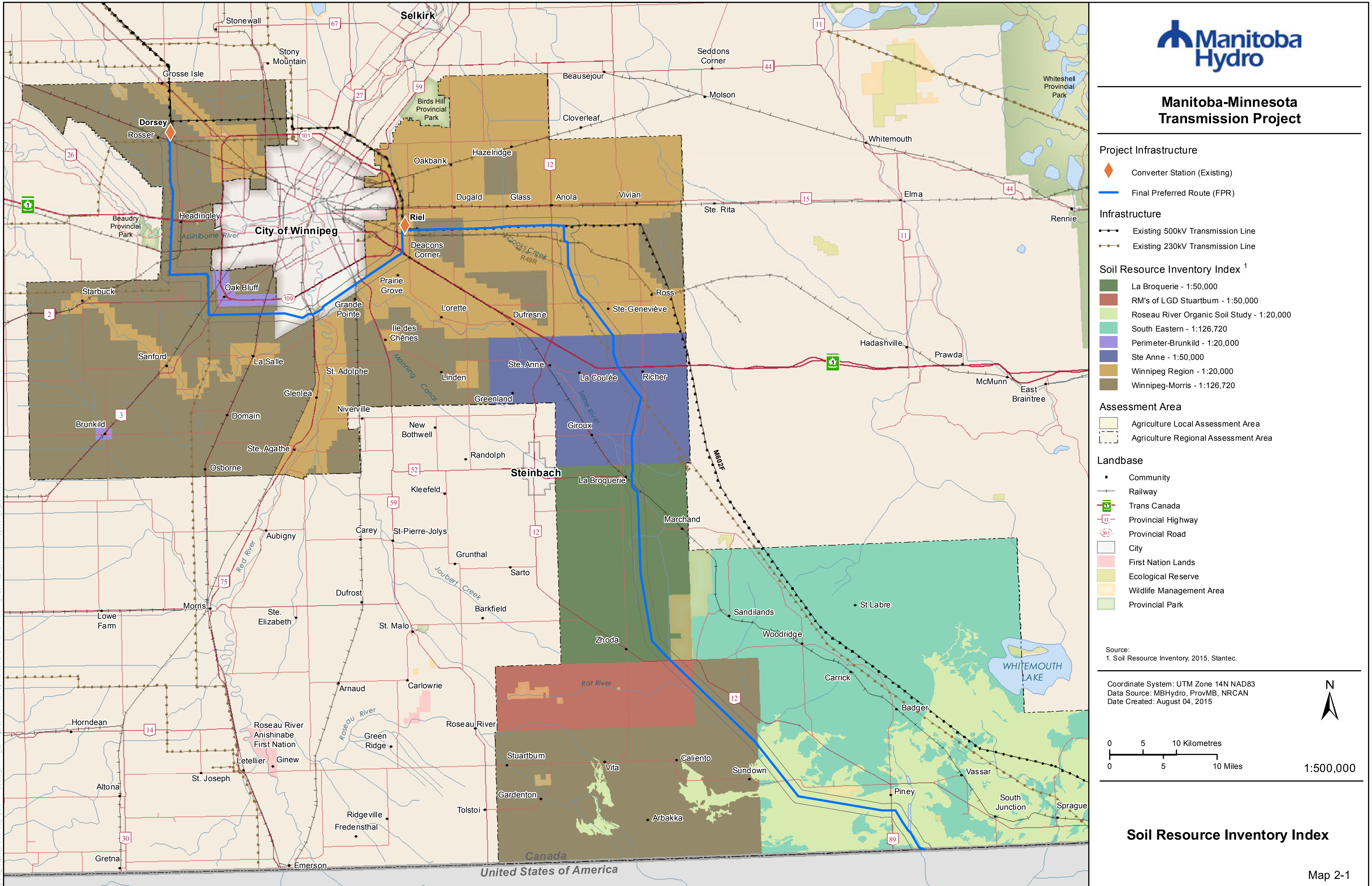
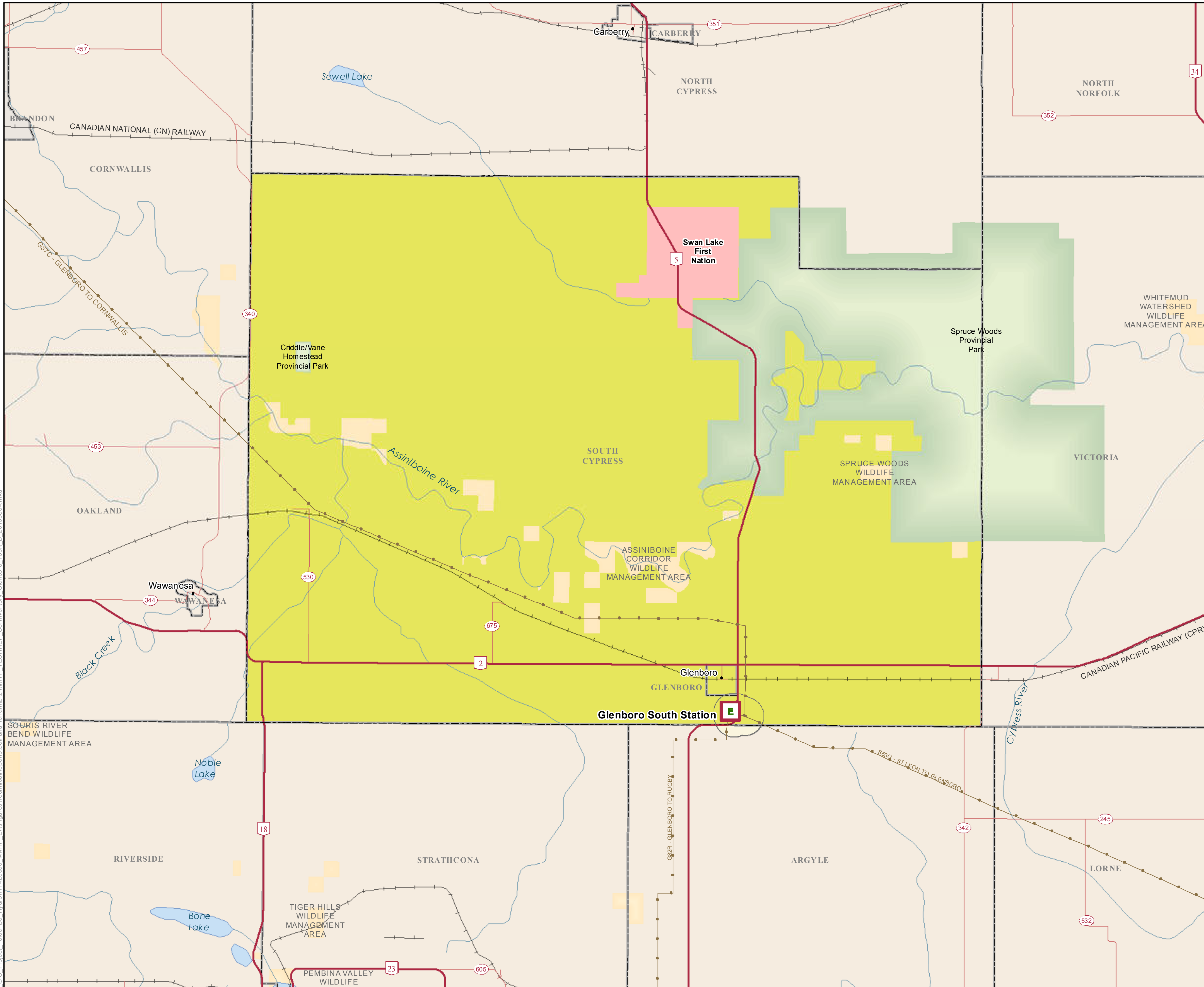

Manitoba Hydro
Manitoba-Minnesota Transmission Project
Project Infrastructure
Converter Station (Existing)
Final Preferred Route (FPR)
Infrastructure
Existing 500kV Transmission Line
Existing 230kV Transmission Line
Soil Resource Inventory Index 1
La Broquerie - 1:50,000
RM's of LGD Stuartburn - 1:50,000
Roseau River Organic Soil Study - 1:20,000
South Eastern - 1:126,720
Perimeter-Brunkild - 1:20,000
Ste Anne - 1:50,000
Winnipeg Region - 1:20,000
Winnipeg-Morris - 1:126,720
Assessment Area
Agriculture Local Assessment Area
Agriculture Regional Assessment Area
Landbase
Community
Railway
Trans Canada
Provincial Highway
Provincial Road
City
First Nation Lands
Ecological Reserve
Wildlife Management Area
Provincial Park
Source:
1. Soil Resource Inventory, 2015, Stantec.
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015
N
0 5 10 Kilometres
0 5 10 Miles
1:500,000
Soil Resource Inventory Index
Map 2-1
Selkirk
Stonewall
Stony Mountain
Grosse Isle
Dorsey
Rosser
Birds Hill Provincial Park
Beausejour
Seddons Corner
Molson
Cloverleaf
Whitemouth
Whiteshell Provincial Park
Oakbank
Hazelridge
Dugald
Glass
Anola
Vivian
Ste. Rita
Elma
Rennie
Beaudry Provincial Park
Headingley
Assiniboine River
City of Winnipeg
Riel
Deacons Corner
Cooks Creek
R49R
Oak Bluff
Starbuck
Prairie Grove
Grande Pointe
Lorette
Dufresne
Ross
Ste-Geneviève
Hadashville
Prawda
McMunn
East Braintree
Ile des Chênes
Sanford
La Salle
St. Adolphe
Linden
Ste. Anne
La Coulée
Richer
Glenlea
Manning Canal
Greenland
Niverville
Seine River
Giroux
Brunkild
Domain
New Bothwell
Randolph
Ste. Agathe
Osborne
Steinbach
La Broquerie
M602F
Kleefeld
Marchand
Carey
St-Pierre-Jolys
Aubigny
Red River
Grunthal
Sarto
Joubert Creek
Dufrost
St.Labre
Morris
Lowe Farm
Ste. Elizabeth
Barkfield
Sandilands
St. Malo
Woodridge
Zhoda
WHITEMOUTH LAKE
Arnaud
Carlowrie
Rat River
Carrick
Badger
Horndean
Roseau River Anishinabe First Nation
Roseau River
Green Ridge
Letellier
Ginew
St. Joseph
Stuartburn
Vita
Caliento
Sundown
Vassar
Altona
Gardenton
Piney
South Junction
Sprague
Ridgeville
Fredensthal
Tolstoi
Arbakka
Gretna
Emerson
Canada
United States of America




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**
- Electrical Station

**Infrastructure**
- Existing Transmission Line

**Soil Resource Inventory Index** [1]
- Carberry - 1:126,720

**Assessment Area**
- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**
- Community
- Provincial Highway
- Provincial Road
- Railway
- City / Town
- First Nation Lands
- Wildlife Management Area
- National/Provincial Park
- Rural Municipality

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

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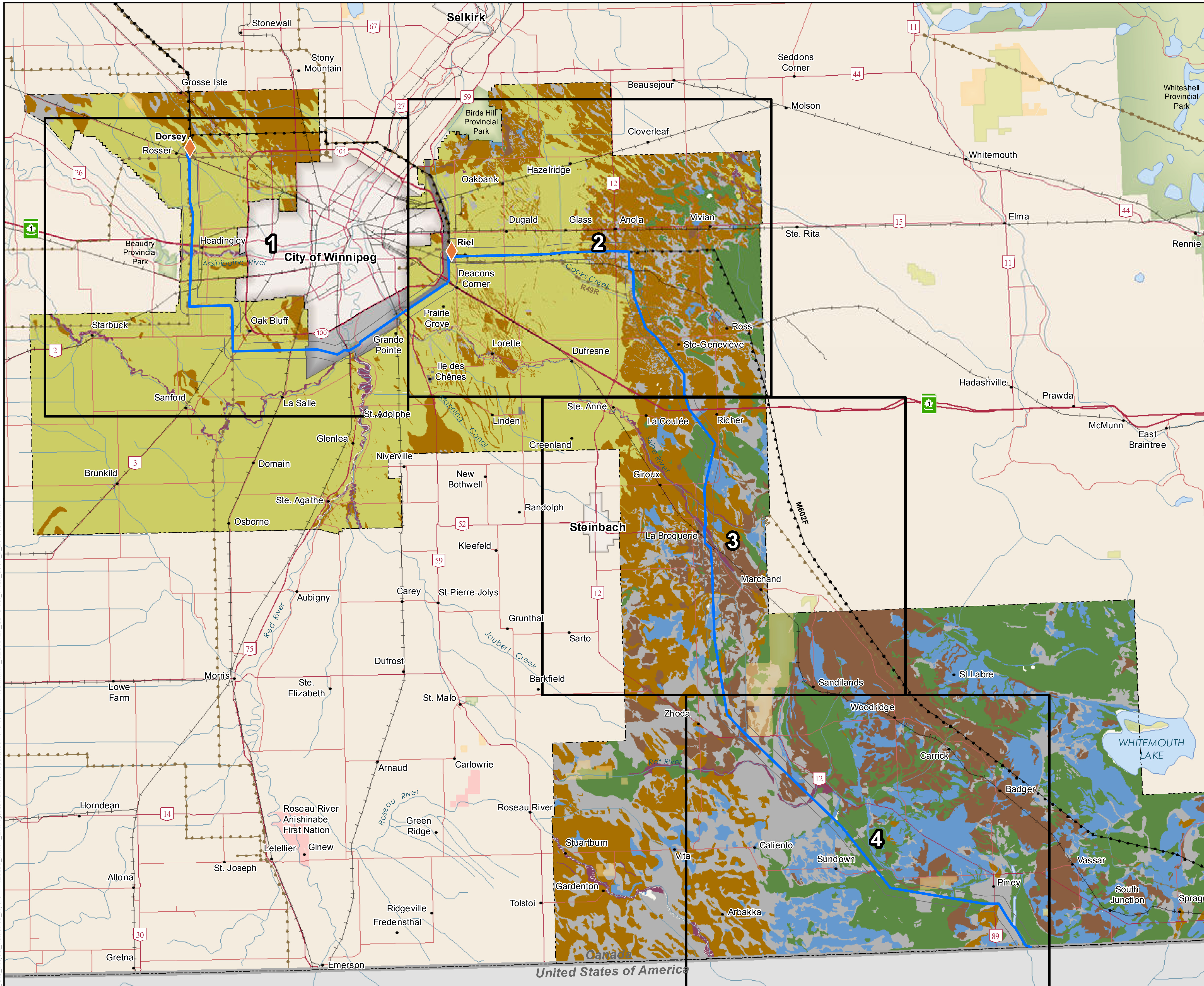
0 2.5 5 Miles
1:200,000

## Glenboro South Station Soil Resource Inventory Index

Map 2-2




## Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**

- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Map Tile Index - 1:150,000**

- Map Series Tile

**Soil Order** [1]

- BR - Brunisolic
- CH - Chernozemic
- GL - Gleysolic
- LU - Luvisolic
- OR - Organic
- RG - Regosolic
- SZ - Solonetzic
- VE - Vertisolic
- Unclassified

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City
- First Nation Lands

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

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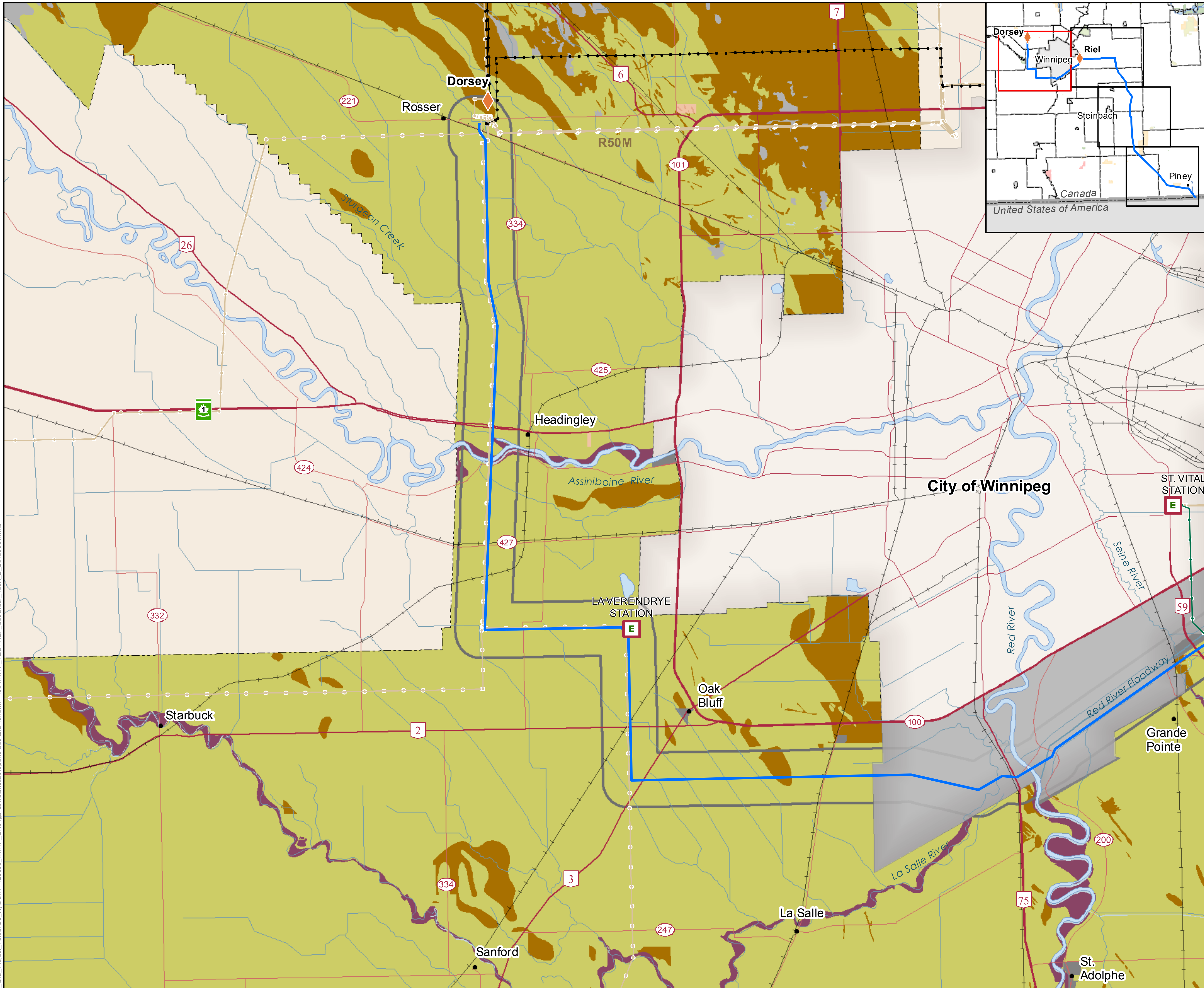
0 5 10 Miles

1:500,000

## Index of Map Series Dominant Soil Order

Map 4-100




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

### Project Infrastructure

- Converter Station (Existing)
- Final Preferred Route (FPR)

### Infrastructure

- Electrical Station
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

### Soil Order [1]

- BR - Brunisolic
- CH - Chernozemic
- GL - Gleysolic
- LU - Luvisolic
- OR - Organic
- RG - Regosolic
- SZ - Solonetzic
- VE - Vertisolic
- Unclassified

### Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

### Landbase

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

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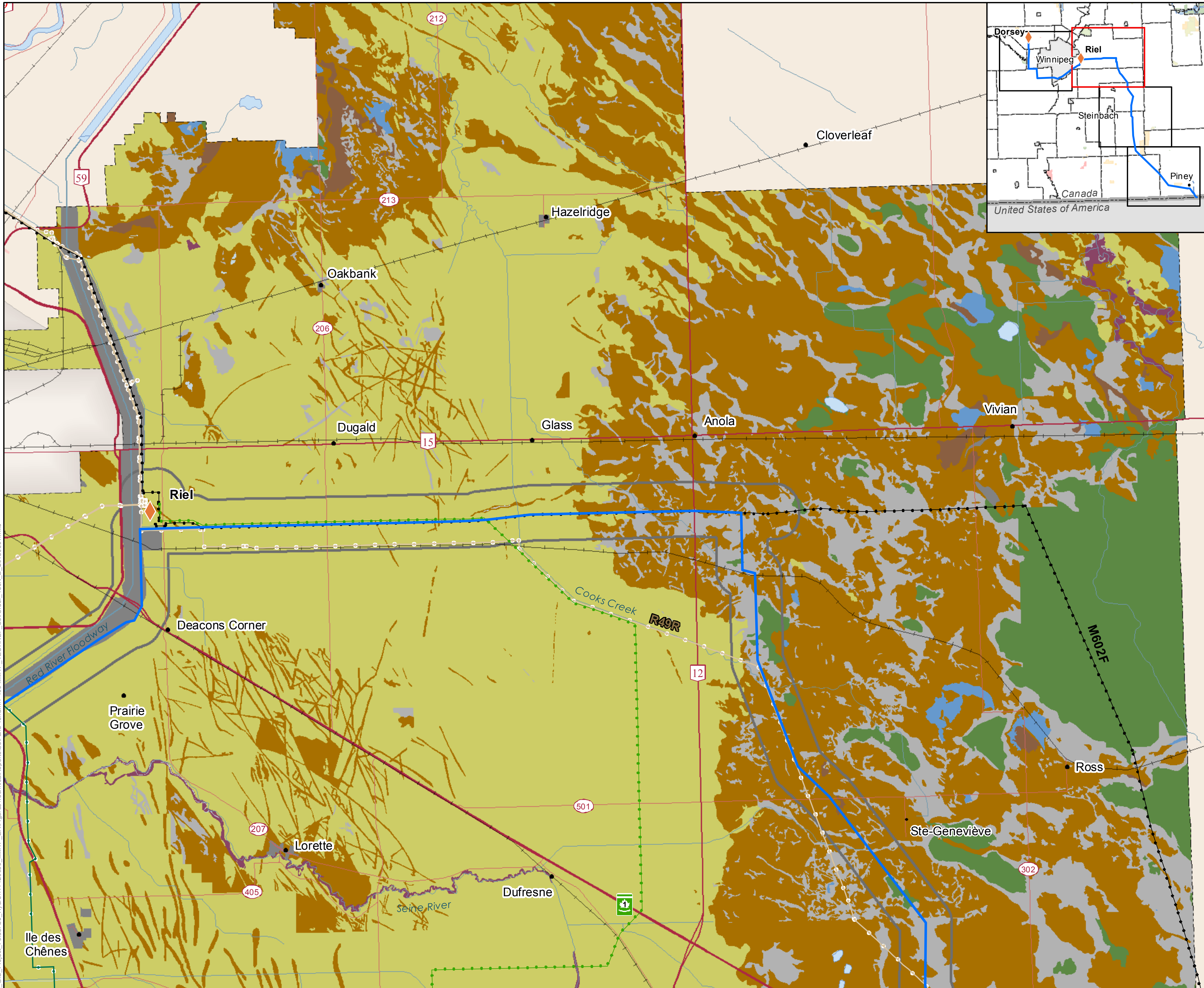
0 1.5 3 Miles

1:150,000

## Dominant Soil Order

Map 4-100-01




Manitoba Hydro

# Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**

- Electrical Station
- Bipole III Transmission Line (Approved)
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Soil Order**

- BR - Brunisolic
- CH - Chernozemic
- GL - Gleysolic
- LU - Luvisolic
- OR - Organic
- RG - Regosolic
- SZ - Solonetzic
- VE - Vertisolic
- Unclassified

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

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0 1.5 3 Miles

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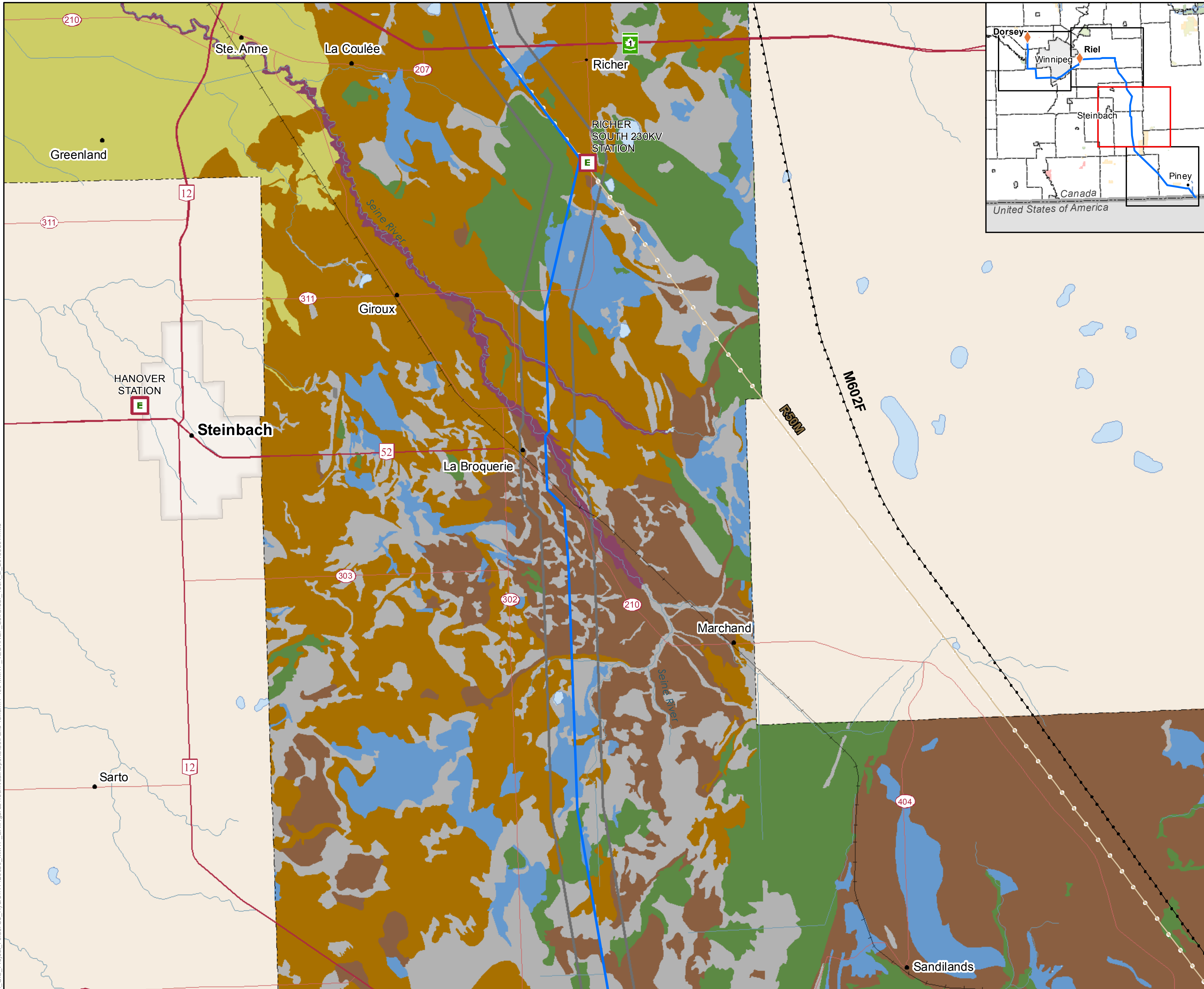
## Dominant Soil Order

Map 4-100-02




## Manitoba-Minnesota Transmission Project

**Project Infrastructure**
- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**
- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Soil Order** [1]
- BR - Brunisolic
- CH - Chernozemic
- GL - Gleysolic
- LU - Luvisolic
- OR - Organic
- RG - Regosolic
- SZ - Solonetzic
- VE - Vertisolic
- Unclassified

**Assessment Area**
- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**
- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

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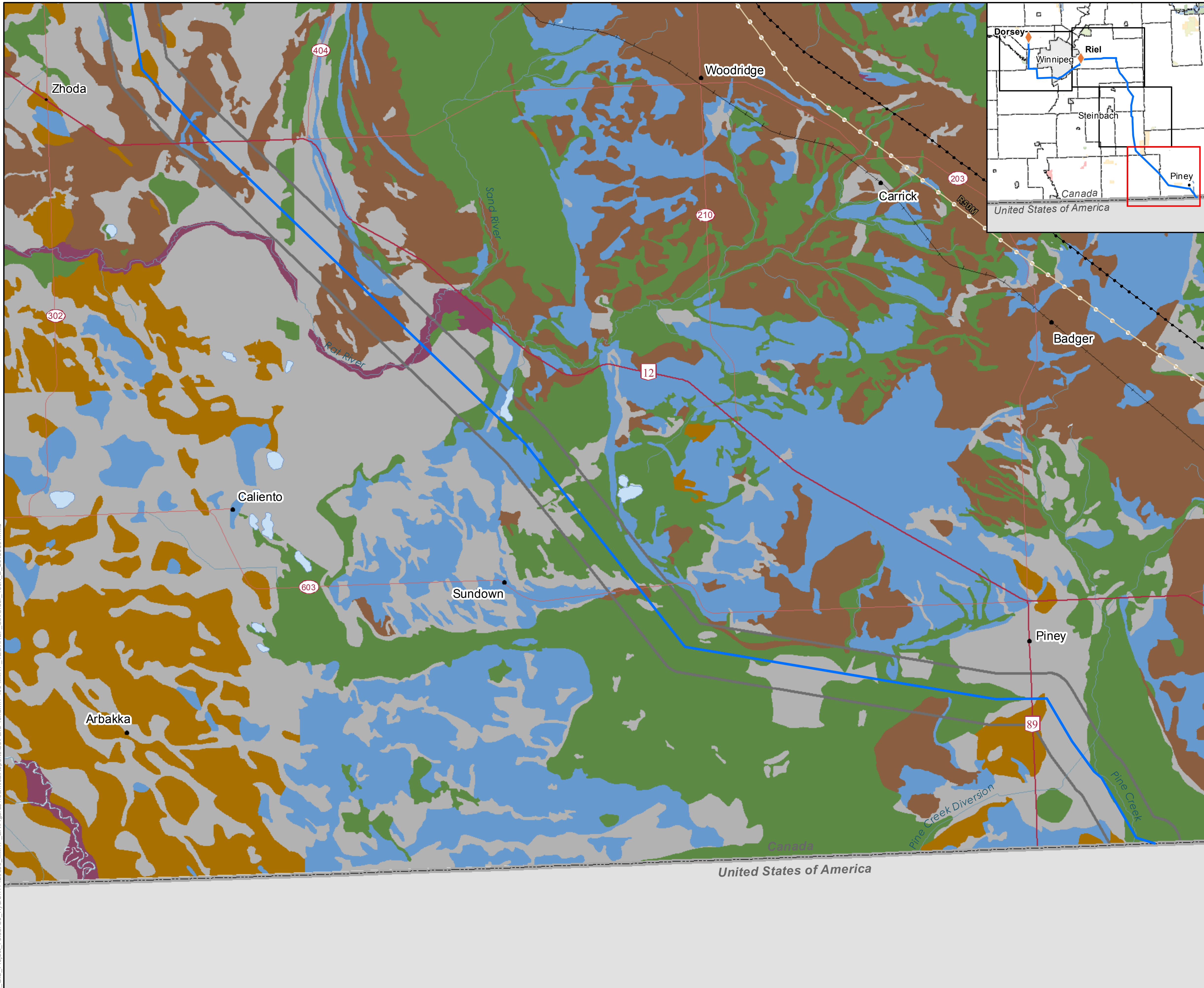
0 1.5 3 Miles

1:150,000

## Dominant Soil Order

Map 4-100-03

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## Manitoba-Minnesota Transmission Project

**Project Infrastructure**
- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**
- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Soil Order [1]**
- BR - Brunisolic
- CH - Chernozemic
- GL - Gleysolic
- LU - Luvisolic
- OR - Organic
- RG - Regosolic
- SZ - Solonetzic
- VE - Vertisolic
- Unclassified

**Assessment Area**
- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**
- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

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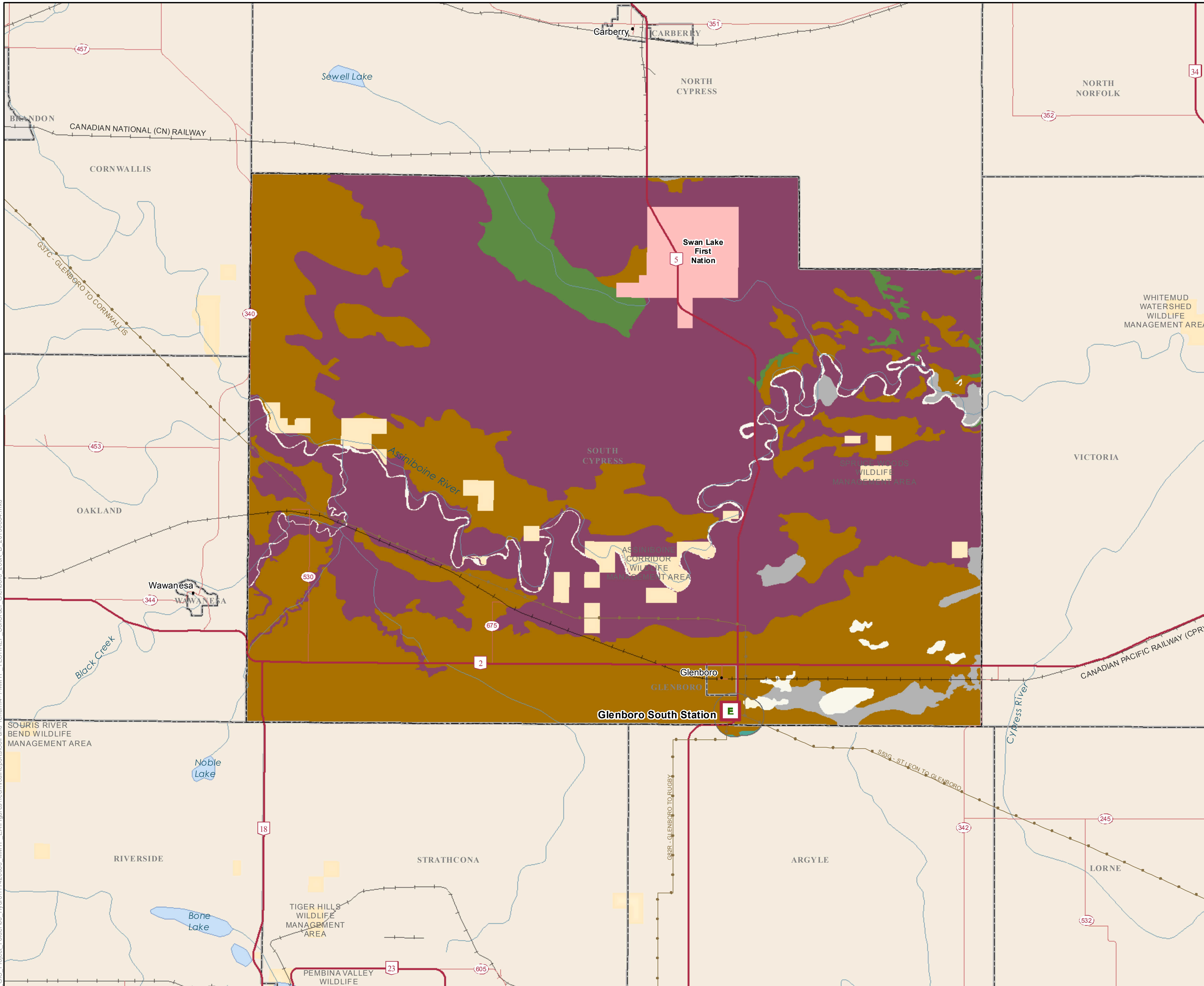
1:150,000

## Dominant Soil Order

Map 4-100-04




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- E Electrical Station

**Infrastructure**

- Existing Transmission Line

**Soil Order** [1]

- BR - Brunisolic
- CH - Chernozemic
- GL - Gleysolic
- LU - Luvisolic
- OR - Organic
- RG - Regosolic
- SZ - Solonetzic
- VE - Vertisolic
- Unclassified

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Provincial Highway
- Provincial Road
- Railway
- City / Town
- First Nation Lands
- Wildlife Management Area
- Rural Municipality

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

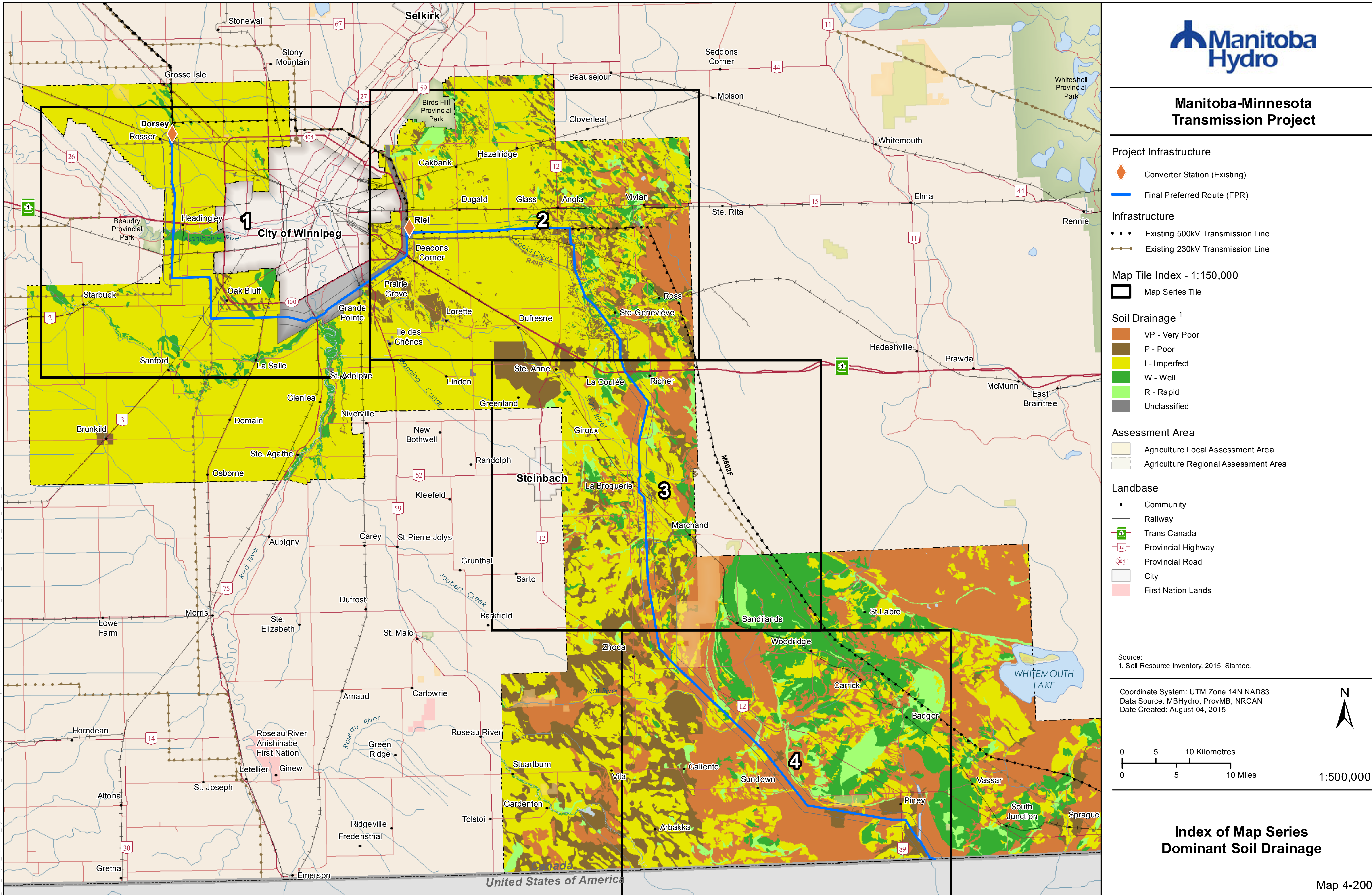
N

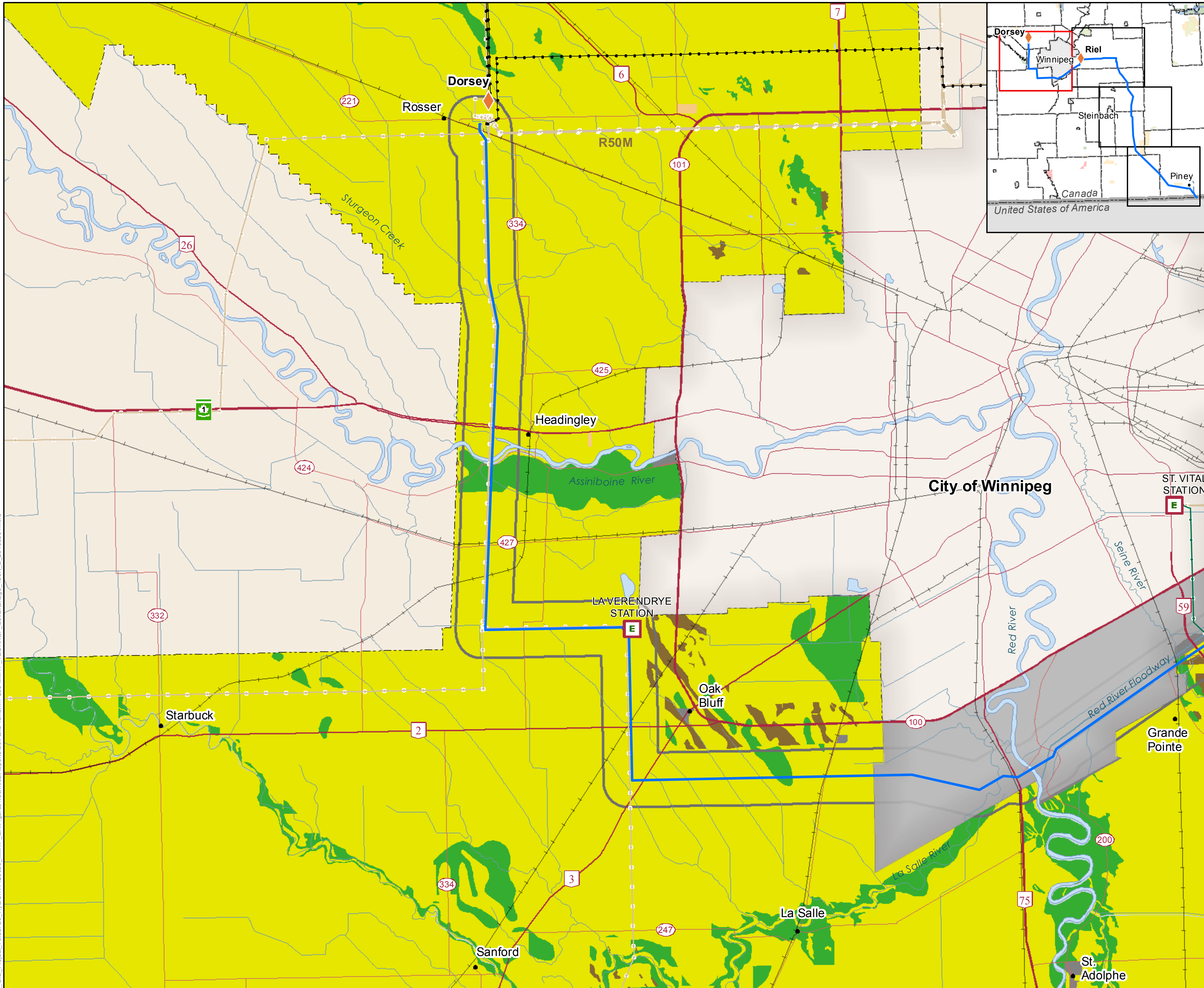
0 5 Kilometres
0 2.5 5 Miles

1:200,000

## Glenboro South Station Dominant Soil Order

Map 4-1


Manitoba Hydro
Manitoba-Minnesota Transmission Project
Project Infrastructure
Converter Station (Existing)
Final Preferred Route (FPR)
Infrastructure
Existing 500kV Transmission Line
Existing 230kV Transmission Line
Map Tile Index - 1:150,000
Map Series Tile
Soil Drainage 1
VP - Very Poor
P - Poor
I - Imperfect
W - Well
R - Rapid
Unclassified
Assessment Area
Agriculture Local Assessment Area
Agriculture Regional Assessment Area
Landbase
Community
Railway
Trans Canada
Provincial Highway
Provincial Road
City
First Nation Lands
Source:
1. Soil Resource Inventory, 2015, Stantec.
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015
N
0 5 10 Kilometres
0 5 10 Miles
1:500,000
Index of Map Series
Dominant Soil Drainage
Map 4-200
1
2
3
4
Selkirk
Stonewall
Stony Mountain
Grosse Isle
Dorsey
Rosser
City of Winnipeg
Headingley
Beaudry Provincial Park
Assiniboine River
Starbuck
Oak Bluff
Sanford
La Salle
St. Adolphe
Glenlea
Brunkild
Domain
Ste. Agathe
Osborne
Niverville
Riel
Deacons Corner
Prairie Grove
Grande Pointe
Lorette
Ile des Chênes
Dufresne
Birds Hill Provincial Park
Beausejour
Cloverleaf
Hazelridge
Oakbank
Dugald
Glass
Anola
Vivian
Cooks Creek
R49R
Ross
Ste-Geneviève
Ste. Anne
La Coulée
Richer
Linden
Greenland
Giroux
New Bothwell
Randolph
Steinbach
La Broquerie
Marchand
M602F
Kleefeld
Seddons Corner
Molson
Whitemouth
Whiteshell Provincial Park
Elma
Ste. Rita
Rennie
Hadashville
Prawda
McMunn
East Braintree
Aubigny
Carey
St-Pierre-Jolys
Grunthal
Sarto
Joubert Creek
Dufrost
Barkfield
Red River
Morris
Lowe Farm
Ste. Elizabeth
St. Malo
Sandilands
St Labre
Woodridge
Zhoda
Carrick
Badger
WHITEMOUTH LAKE
Arnaud
Carlowrie
Roseau River
Horndean
Roseau River Anishinabe First Nation
Letellier
Ginew
St. Joseph
Green Ridge
Stuartburn
Vita
Caliento
Sundown
Piney
Vassar
South Junction
Sprague
Gardenton
Arbakka
Altona
Tolstoi
Ridgeville
Fredensthal
Gretna
Emerson
Canada
United States of America




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**

- Electrical Station
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Soil Drainage** [1]

- VP - Very Poor
- P - Poor
- I - Imperfect
- W - Well
- R - Rapid
- Unclassified

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

N

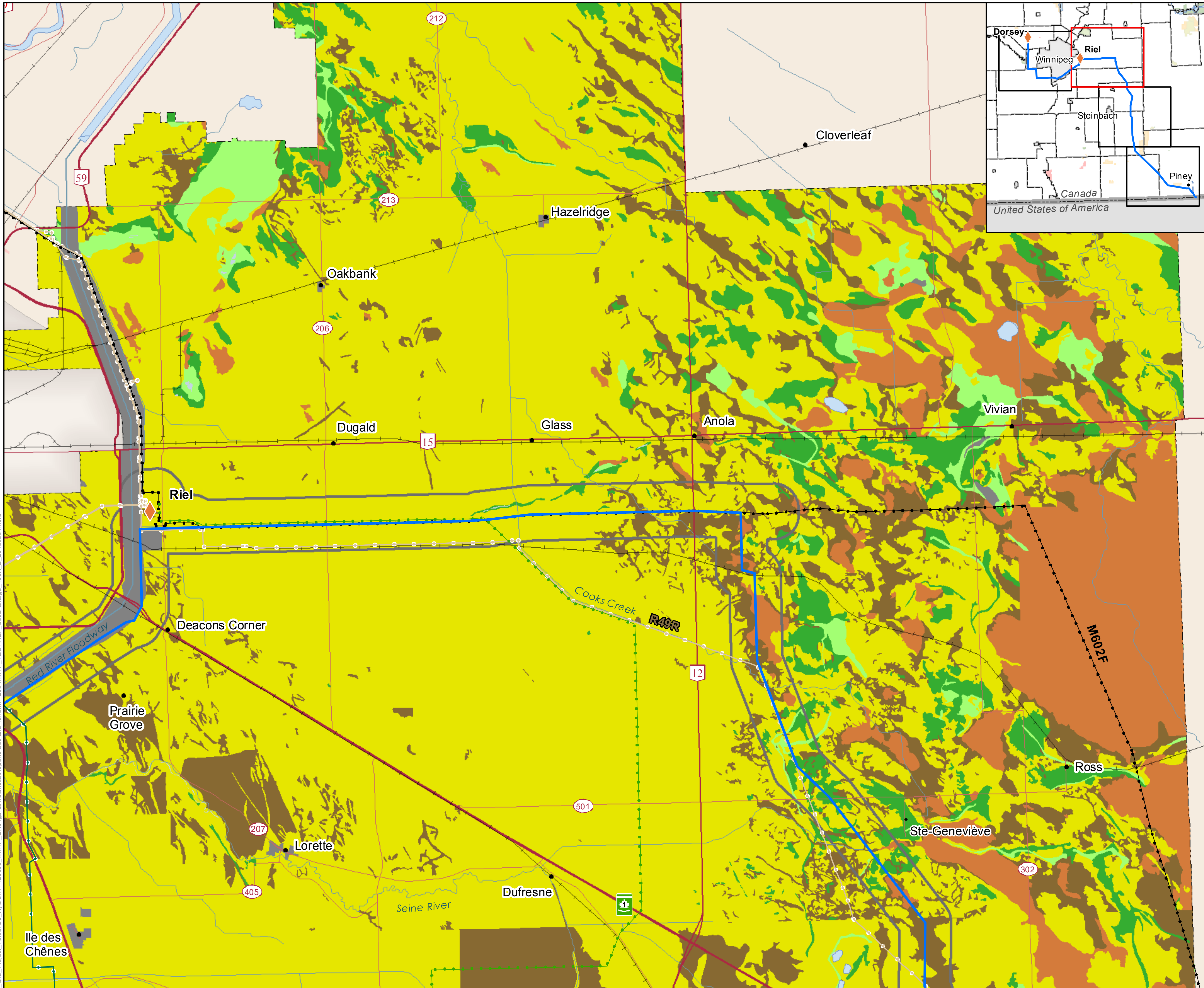
0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Soil Drainage

Map 4-200-01

G:_GIS_Project_Folder\00_Hydro\111420050_MMTP_EA\Figures\TechnicalReports\Soil and Terrain\4-200-MMTP_TECHREP_SoilDrainage_150K_B_20150804.mxd




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

### Project Infrastructure

- Converter Station (Existing)
- Final Preferred Route (FPR)

### Infrastructure

- Electrical Station
- Bipole III Transmission Line (Approved)
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

### Soil Drainage[1]

- VP - Very Poor
- P - Poor
- I - Imperfect
- W - Well
- R - Rapid
- Unclassified

### Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

### Landbase

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

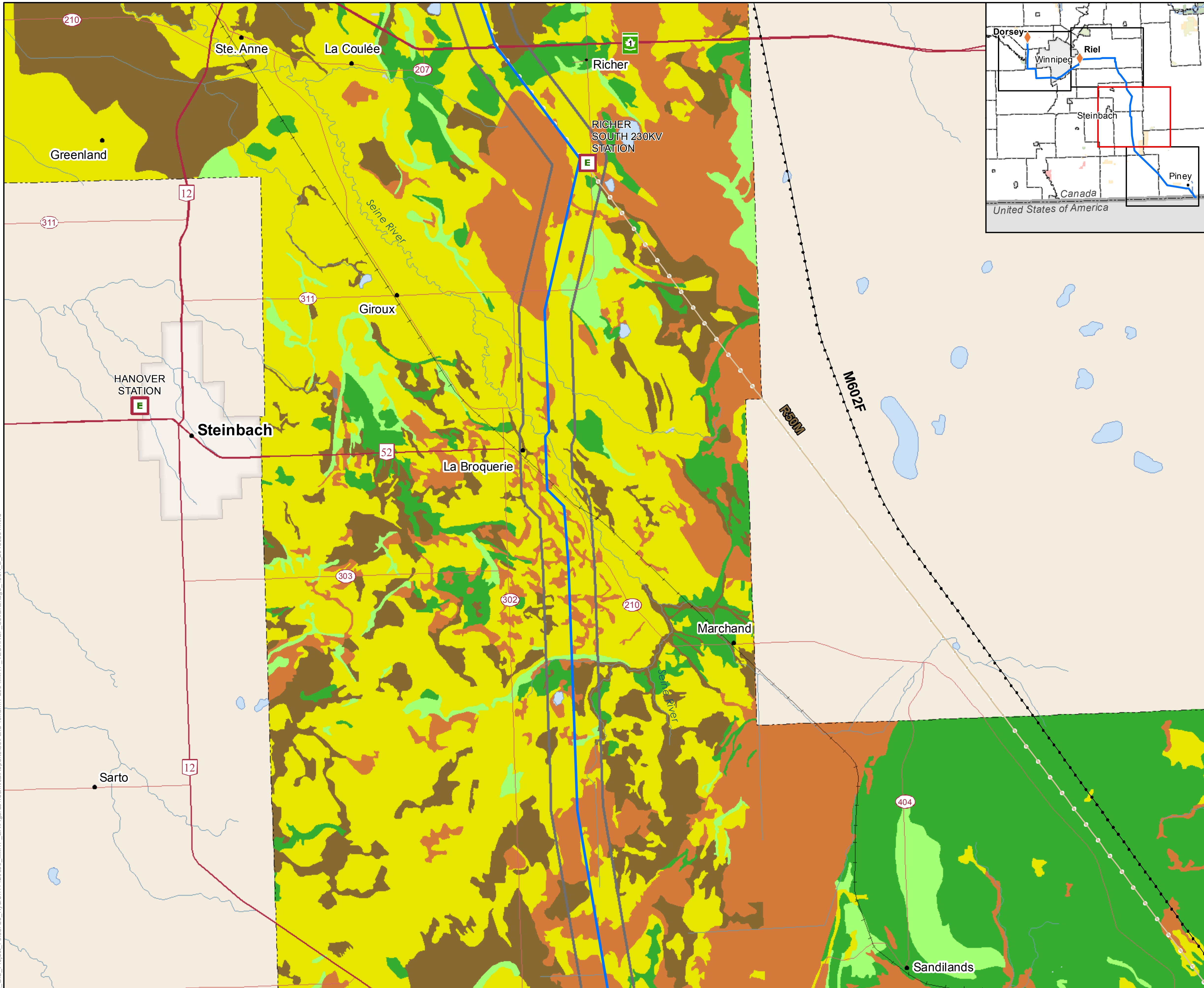
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Soil Drainage

Map 4-200-02




**Manitoba Hydro**

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**
- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**
- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Soil Drainage** [1]
- VP - Very Poor
- P - Poor
- I - Imperfect
- W - Well
- R - Rapid
- Unclassified

**Assessment Area**
- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**
- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

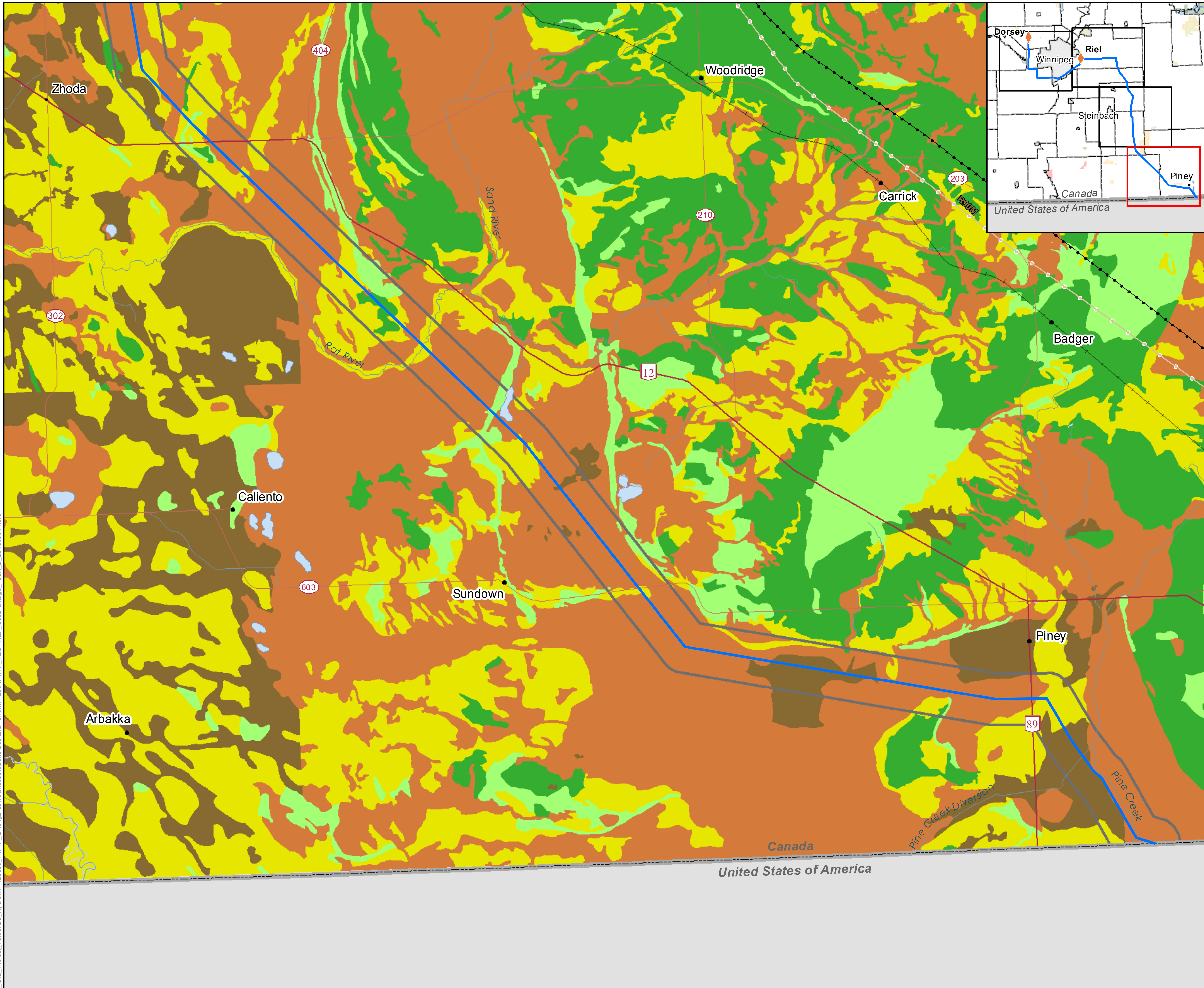
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Soil Drainage

Map 4-200-03




Manitoba Hydro

**Manitoba-Minnesota Transmission Project**

Project Infrastructure

- Converter Station (Existing)
- Final Preferred Route (FPR)

Infrastructure

- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Soil Drainage [1]

- VP - Very Poor
- P - Poor
- I - Imperfect
- W - Well
- R - Rapid
- Unclassified

Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

Landbase

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

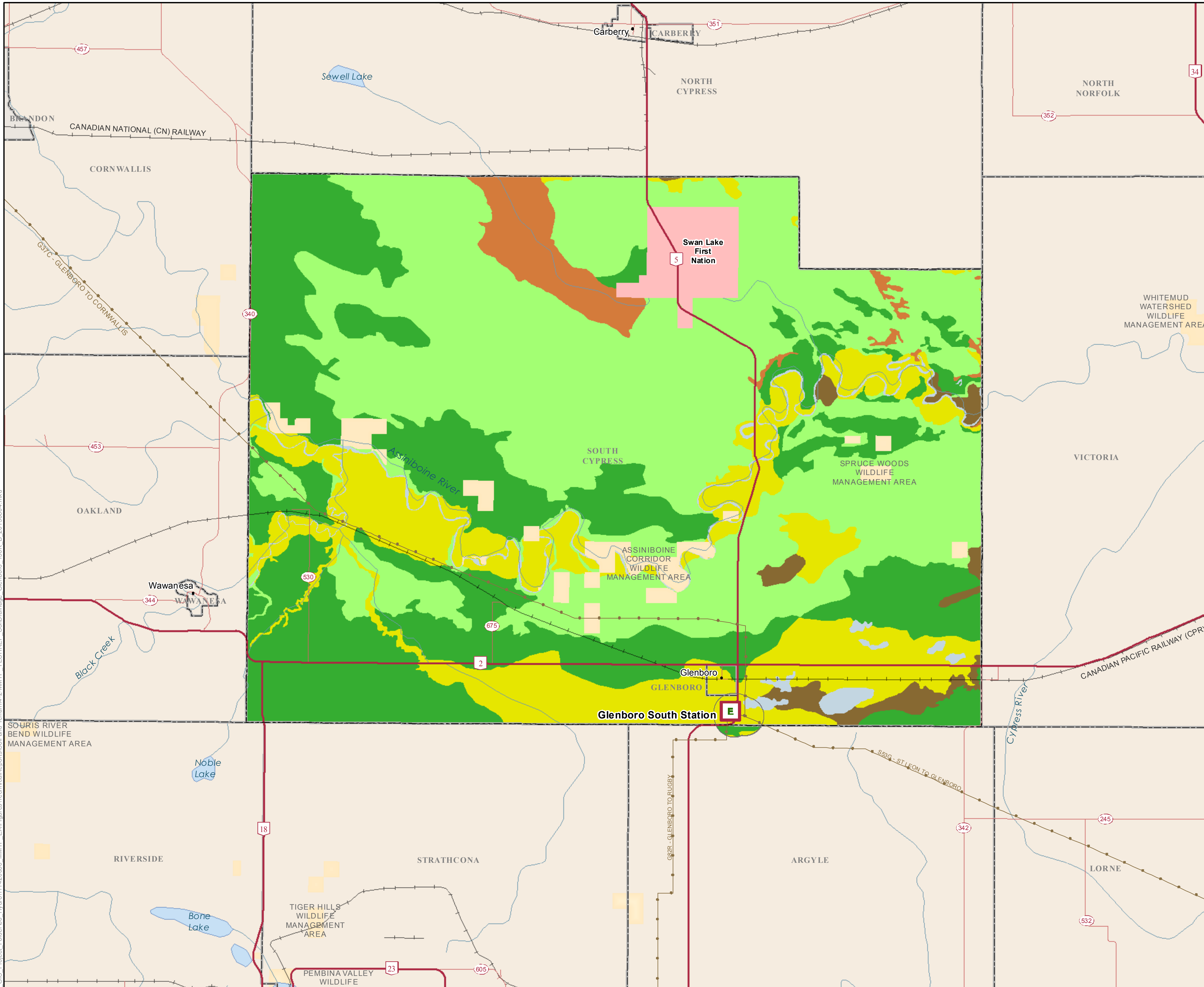
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

**Dominant Soil Drainage**

Map 4-200-04




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Electrical Station

**Infrastructure**

- Existing Transmission Line

**Soil Drainage** [1]

- VP - Very Poor
- P - Poor
- I - Imperfect
- W - Well
- R - Rapid
- Unclassified

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Provincial Highway
- Provincial Road
- Railway
- City / Town
- First Nation Lands
- Wildlife Management Area
- Rural Municipality

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

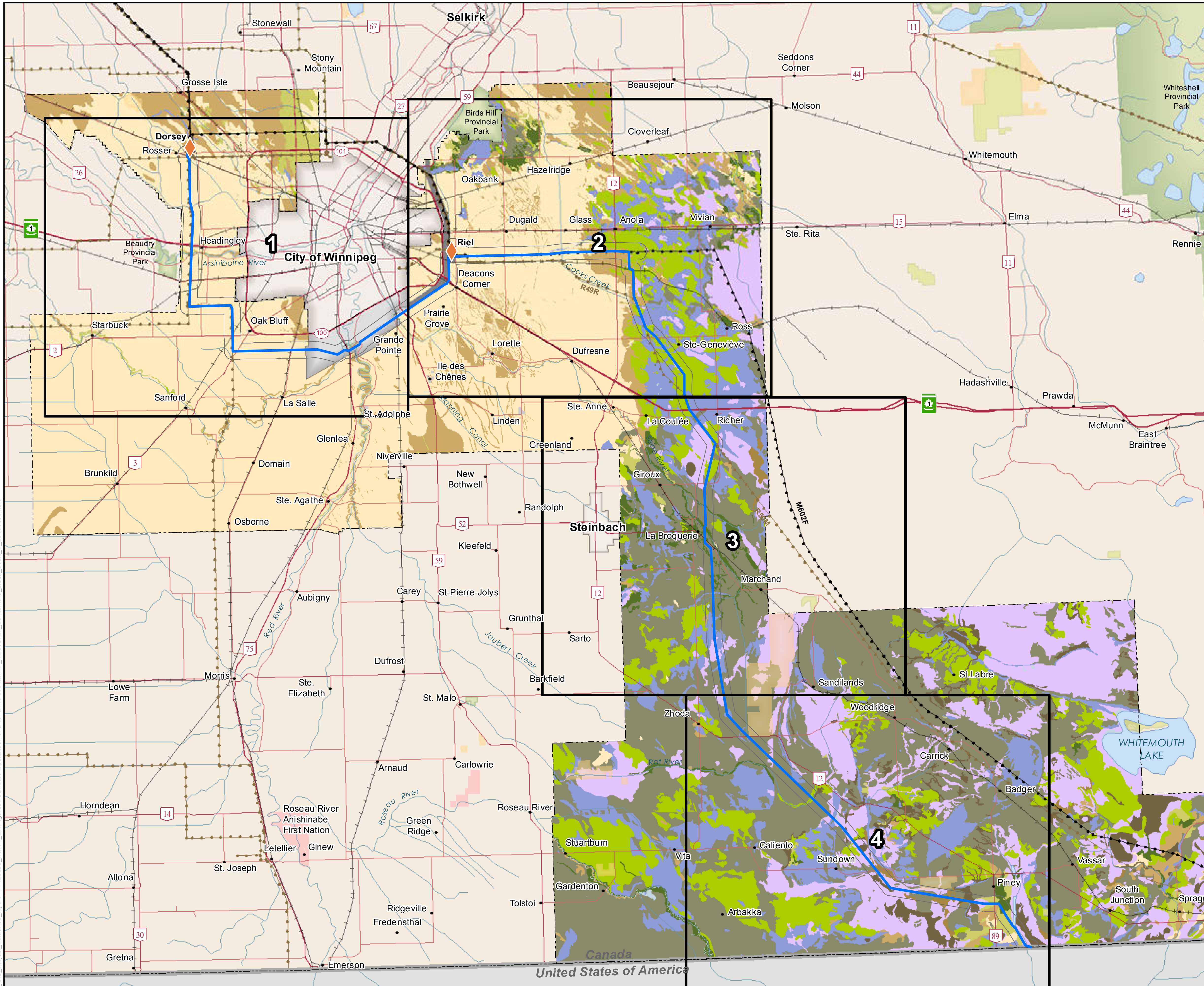
N

0 — 5 Kilometres
0 — 2.5 — 5 Miles

1:200,000

## Glenboro South Station Dominant Soil Drainage

Map 4-2




# Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**

- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Map Tile Index - 1:150,000**

- Map Series Tile

**Soil Texture [1]**

- C - Coarse
- CS - Coarse Skeletal
- MC - Moderately Coarse
- M - Medium
- MF - Moderately Fine
- F - Fine
- VF - Very Fine
- FI - Fibric
- HU - Humic
- ME - Mesic
- UD - Undifferentiated
- Disturbed
- Rock
- Unclassified
- Urban

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City
- First Nation Lands

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

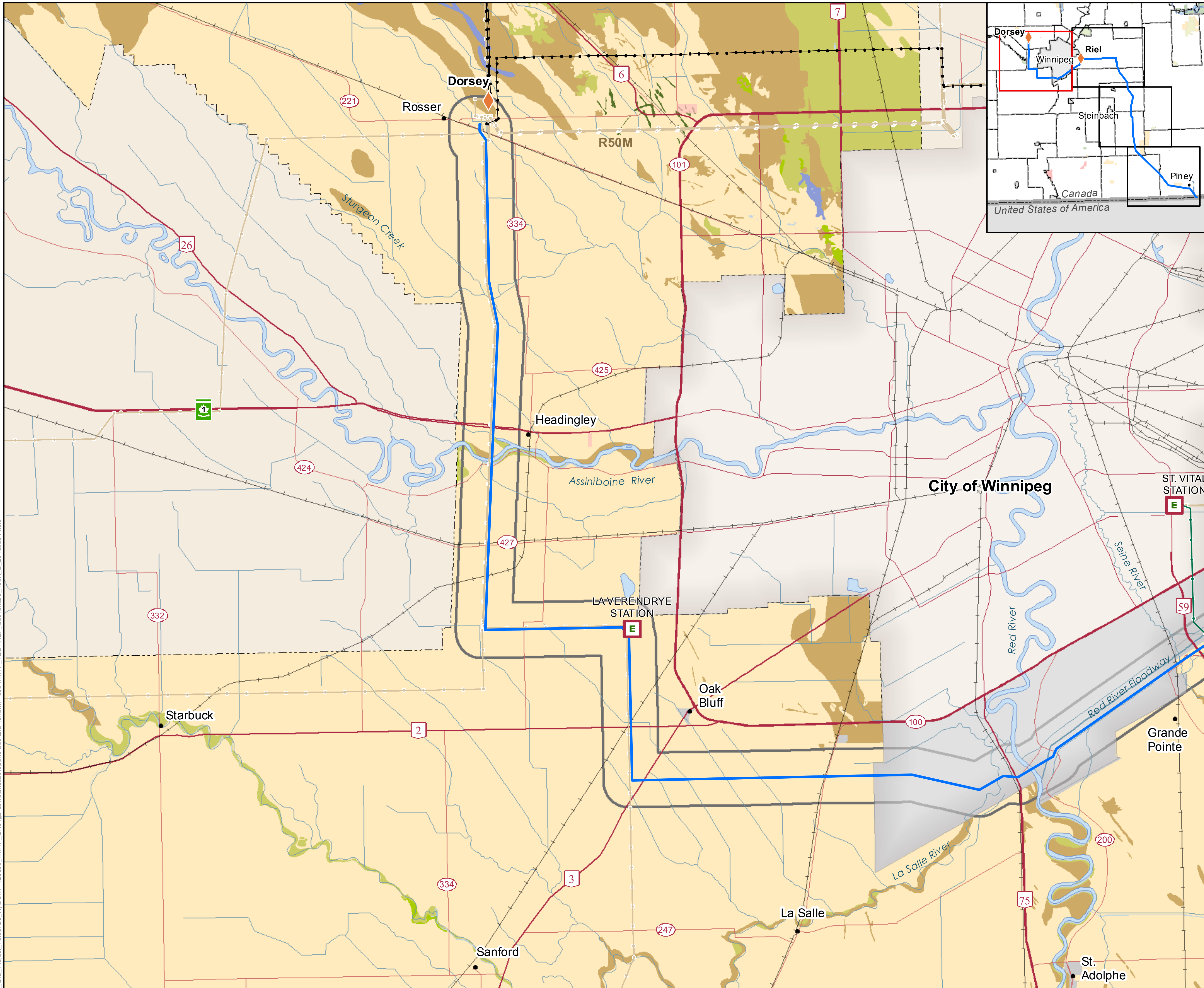
N

0 5 10 Kilometres
0 5 10 Miles

1:500,000

## Index of Map Series Dominant Soil Texture

Map 4-300




## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**

- Electrical Station
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Soil Texture [1]**

- C - Coarse
- CS - Coarse Skeletal
- MC - Moderately Coarse
- M - Medium
- MF - Moderately Fine
- F - Fine
- VF - Very Fine
- FI - Fibric
- HU - Humic
- ME - Mesic
- UD - Undifferentiated
- Disturbed
- Rock
- Unclassified
- Urban

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

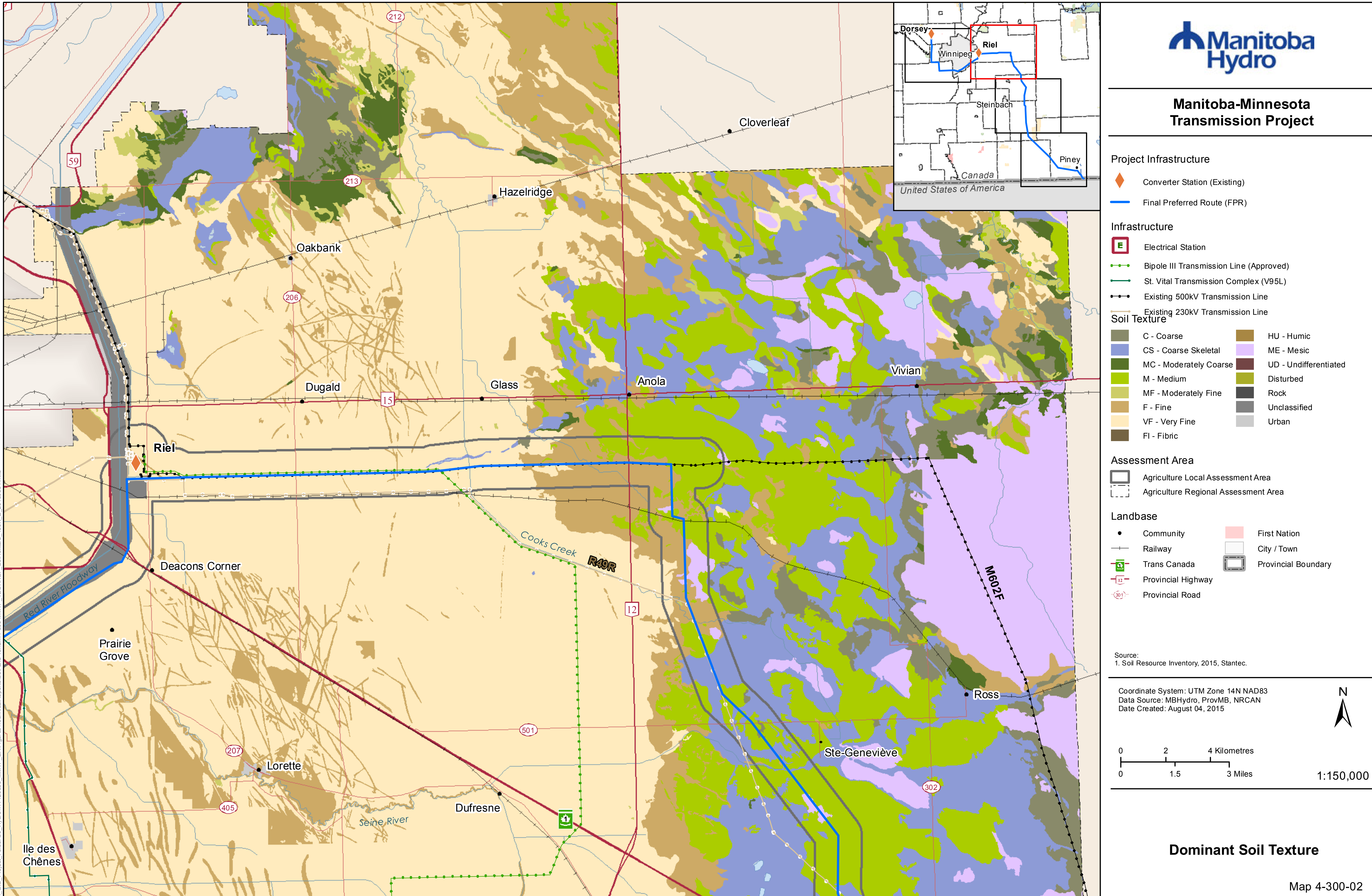
N

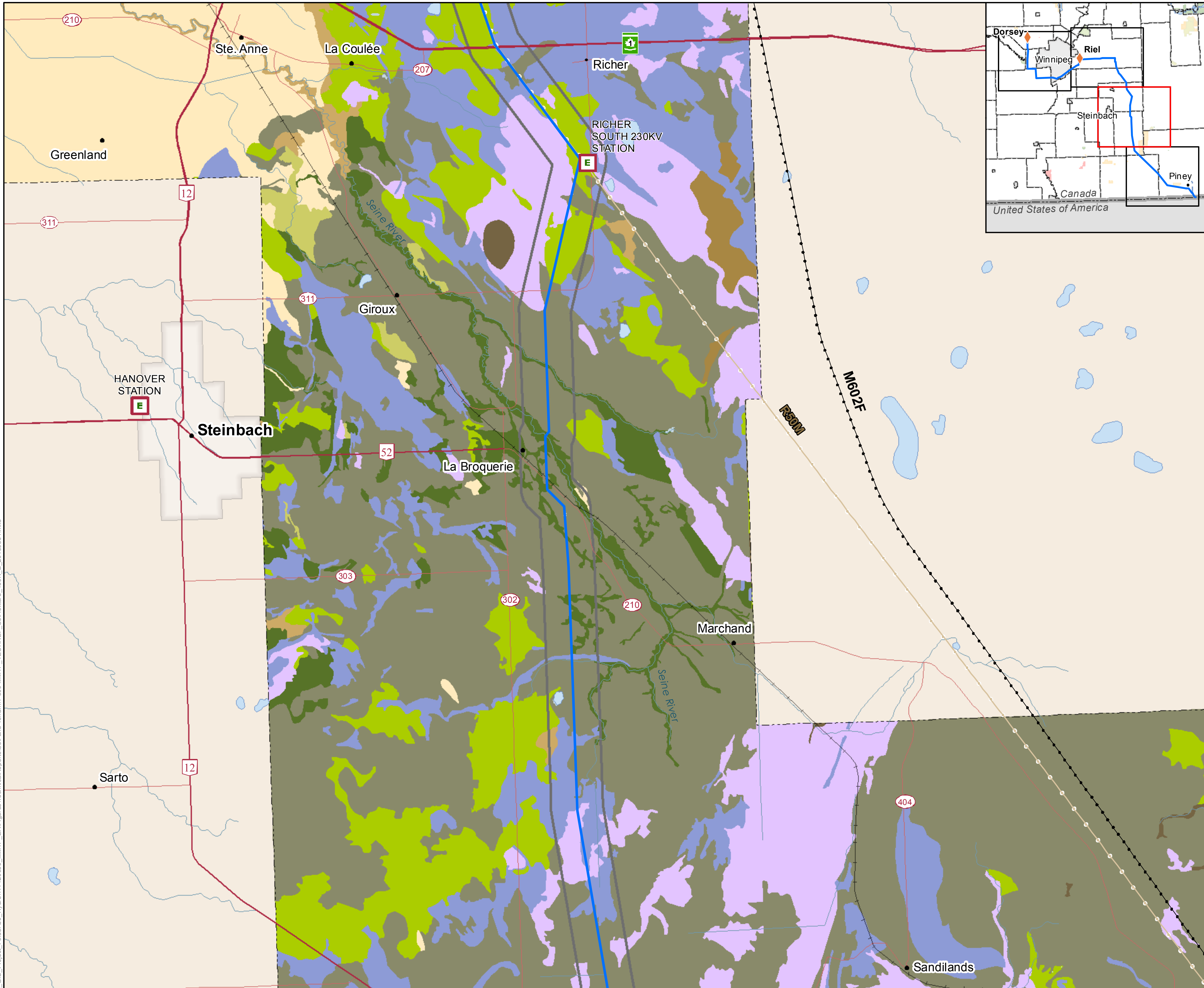
0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Soil Texture

Map 4-300-01


Manitoba Hydro
Manitoba-Minnesota Transmission Project
Project Infrastructure
Converter Station (Existing)
Final Preferred Route (FPR)
Infrastructure
Electrical Station
Bipole III Transmission Line (Approved)
St. Vital Transmission Complex (V95L)
Existing 500kV Transmission Line
Existing 230kV Transmission Line
Soil Texture
C - Coarse
CS - Coarse Skeletal
MC - Moderately Coarse
M - Medium
MF - Moderately Fine
F - Fine
VF - Very Fine
FI - Fibric
HU - Humic
ME - Mesic
UD - Undifferentiated
Disturbed
Rock
Unclassified
Urban
Assessment Area
Agriculture Local Assessment Area
Agriculture Regional Assessment Area
Landbase
Community
Railway
Trans Canada
Provincial Highway
Provincial Road
First Nation
City / Town
Provincial Boundary
Source:
1. Soil Resource Inventory, 2015, Stantec.
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015
N
0 2 4 Kilometres
0 1.5 3 Miles
1:150,000
Dominant Soil Texture
Map 4-300-02
Dorsey
Winnipeg
Riel
Steinbach
Piney
Canada
United States of America
Cloverleaf
Hazelridge
Oakbank
Dugald
Glass
Anola
Vivian
Riel
Deacons Corner
Cooks Creek
R49R
M602F
Red River Floodway
Prairie Grove
Lorette
Dufresne
Seine River
Ste-Geneviève
Ross
Ile des Chênes
212
213
59
206
15
12
501
207
405
302
1




# Manitoba Hydro

## Manitoba-Minnesota Transmission Project

### Project Infrastructure

- Converter Station (Existing)
- Final Preferred Route (FPR)

### Infrastructure

- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

### Soil Texture [1]

- C - Coarse
- CS - Coarse Skeletal
- MC - Moderately Coarse
- M - Medium
- MF - Moderately Fine
- F - Fine
- VF - Very Fine
- FI - Fibric
- HU - Humic
- ME - Mesic
- UD - Undifferentiated
- Disturbed
- Rock
- Unclassified
- Urban

### Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

### Landbase

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

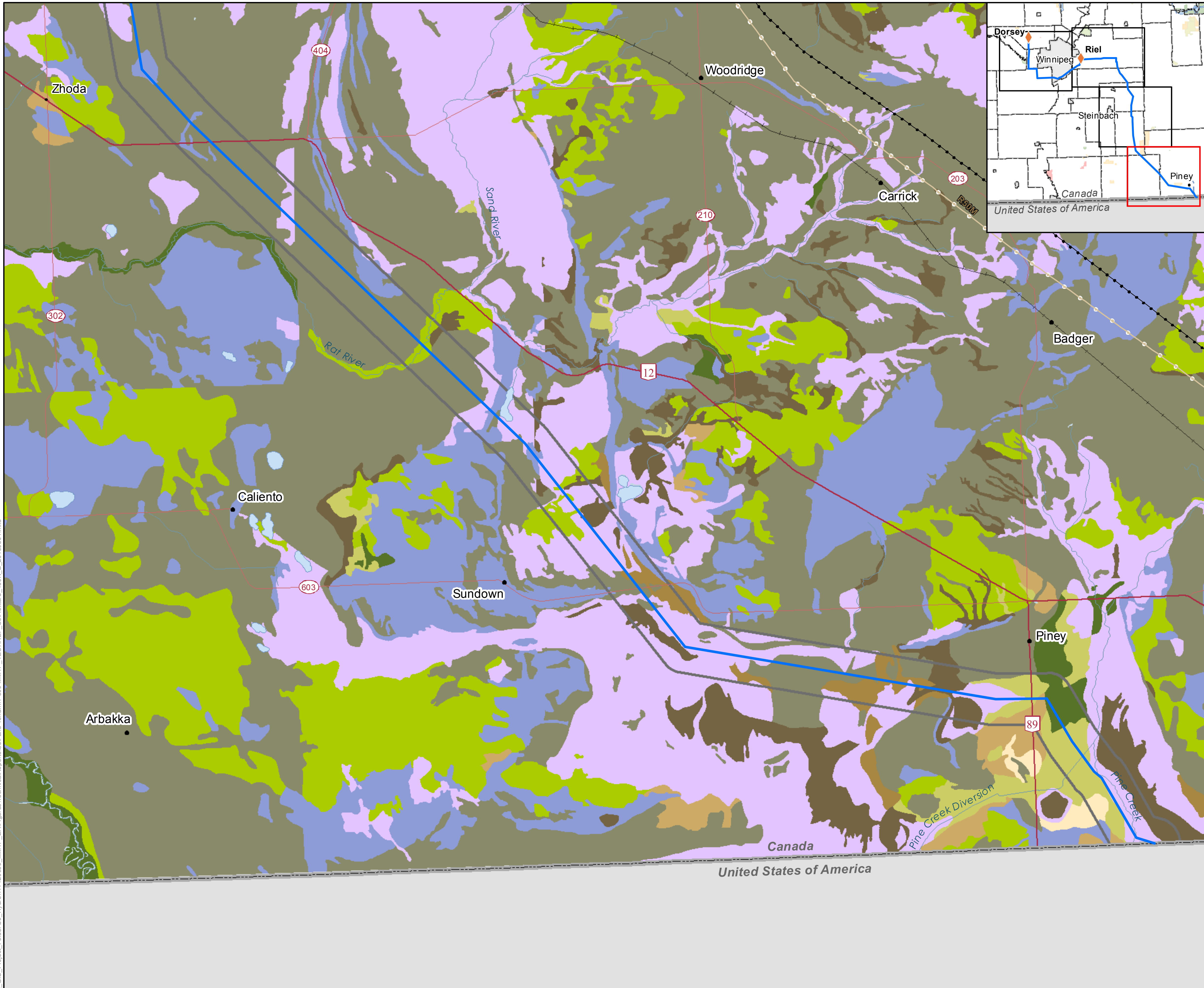
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Soil Texture

Map 4-300-03




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

### Project Infrastructure

- Converter Station (Existing)
- Final Preferred Route (FPR)

### Infrastructure

- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

### Soil Texture [1]

- C - Coarse
- CS - Coarse Skeletal
- MC - Moderately Coarse
- M - Medium
- MF - Moderately Fine
- F - Fine
- VF - Very Fine
- FI - Fibric
- HU - Humic
- ME - Mesic
- UD - Undifferentiated
- Disturbed
- Rock
- Unclassified
- Urban

### Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

### Landbase

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

N

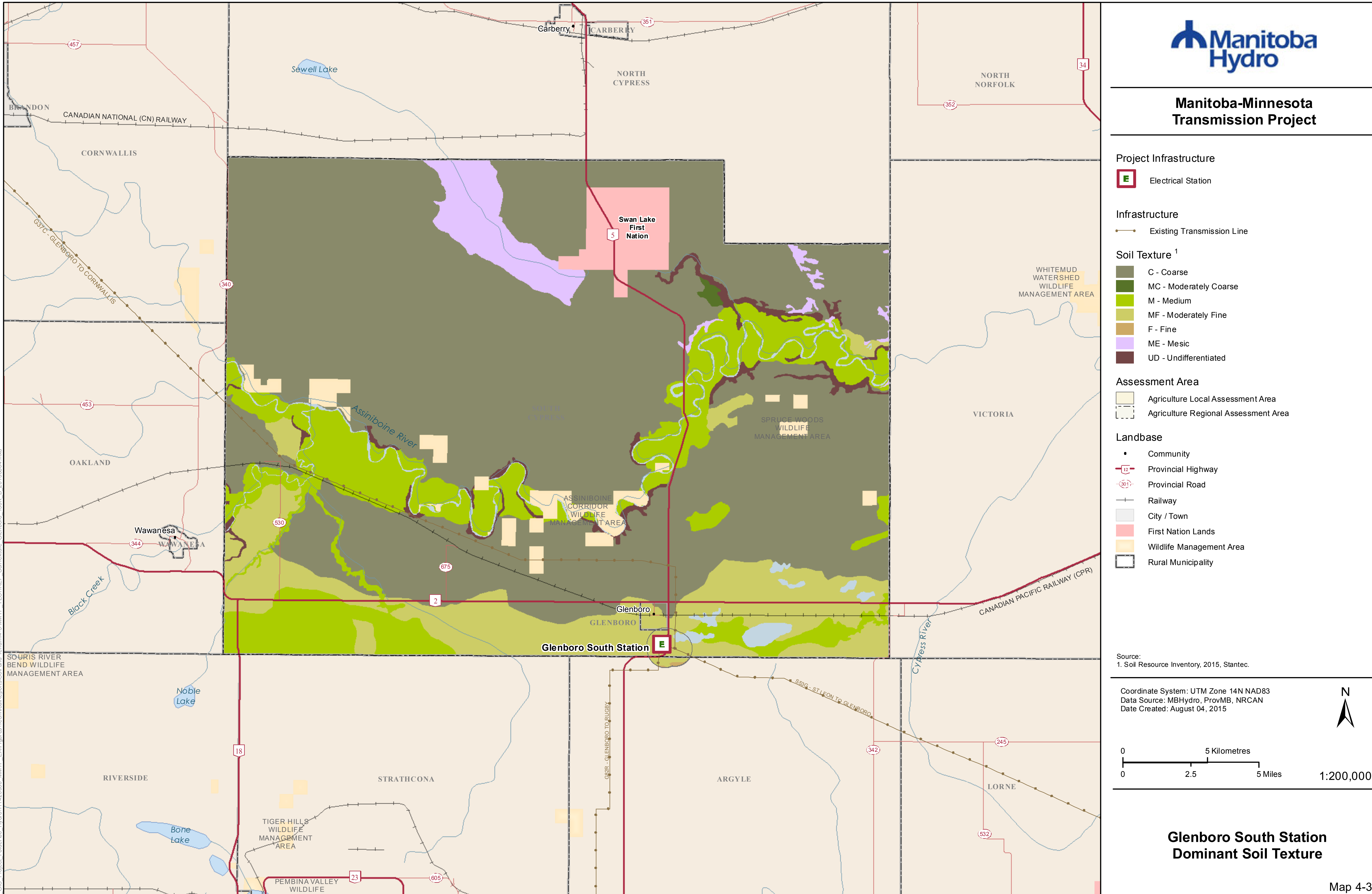
0 2 4 Kilometres
0 1.5 3 Miles

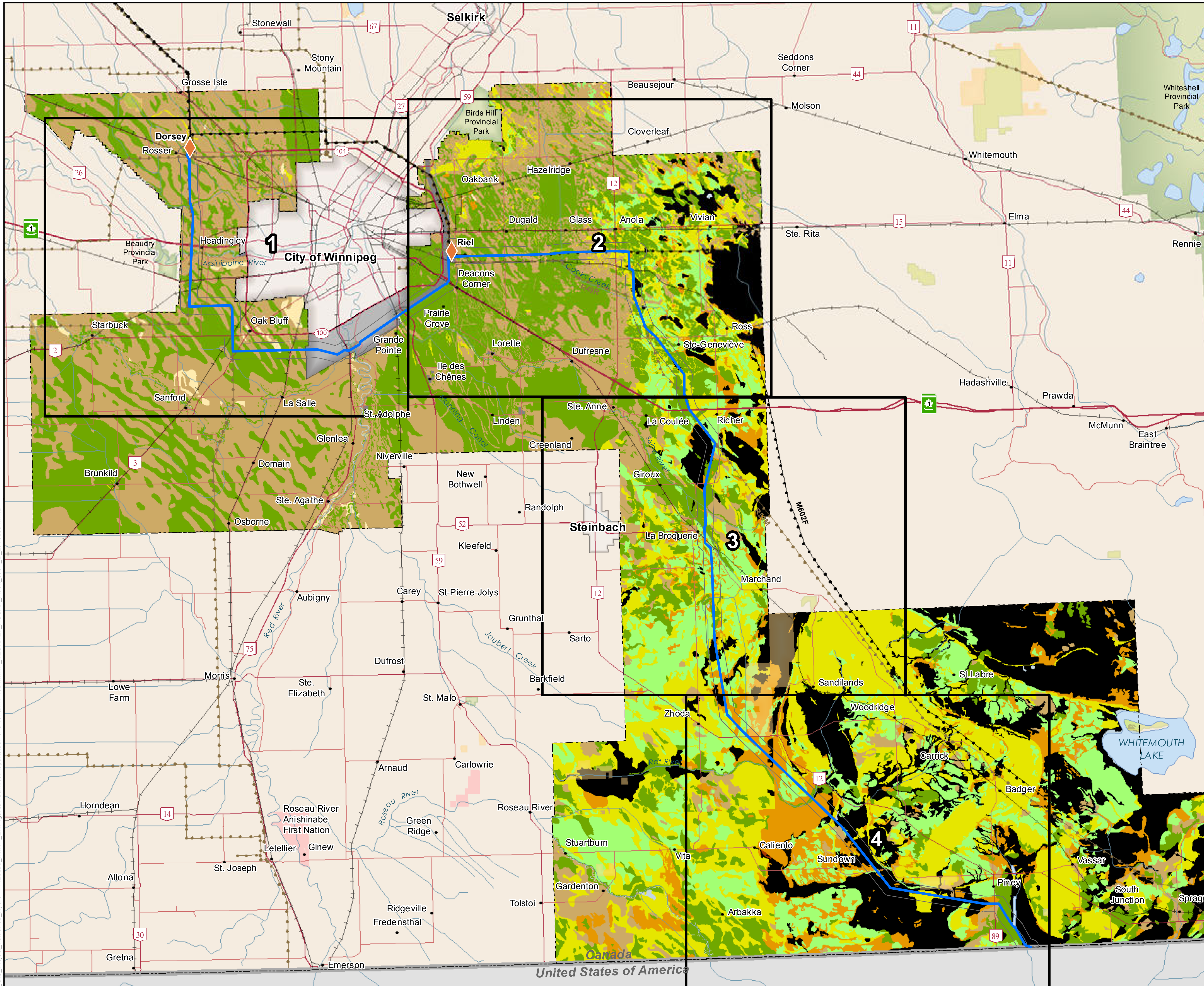
1:150,000

## Dominant Soil Texture

Map 4-300-04

G:_GIS_Project_Folder\00_Hydro\1114200050_MMTP_EA\Figures\TechnicalReports\Soil and Terrain\4-300-MMTP_TECHREP_SoilTexture_150K_B_20150804.mxd


Manitoba Hydro
Manitoba-Minnesota Transmission Project
Project Infrastructure
Electrical Station
Infrastructure
Existing Transmission Line
Soil Texture 1
C - Coarse
MC - Moderately Coarse
M - Medium
MF - Moderately Fine
F - Fine
ME - Mesic
UD - Undifferentiated
Assessment Area
Agriculture Local Assessment Area
Agriculture Regional Assessment Area
Landbase
Community
Provincial Highway
Provincial Road
Railway
City / Town
First Nation Lands
Wildlife Management Area
Rural Municipality
Source:
1. Soil Resource Inventory, 2015, Stantec.
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015
N
0
5 Kilometres
0
2.5
5 Miles
1:200,000
Glenboro South Station
Dominant Soil Texture
Map 4-3
Carberry
CARBERRY
NORTH CYPRESS
NORTH NORFOLK
Sewell Lake
BRANDON
CANADIAN NATIONAL (CN) RAILWAY
CORNWALLIS
G37C - GLENBORO TO CORNWALLIS
Swan Lake First Nation
WHITEMUD WATERSHED WILDLIFE MANAGEMENT AREA
Assiniboine River
SPRUCE WOODS WILDLIFE MANAGEMENT AREA
VICTORIA
OAKLAND
ASSINIBOINE CORRIDOR WILDLIFE MANAGEMENT AREA
Wawanesa
WAWANESA
Black Creek
Glenboro
GLENBORO
Glenboro South Station
CANADIAN PACIFIC RAILWAY (CPR)
Cypress River
SOURIS RIVER BEND WILDLIFE MANAGEMENT AREA
Noble Lake
S59G - ST LEON TO GLENBORO
G82R - GLENBORO TO RUGBY
RIVERSIDE
STRATHCONA
ARGYLE
LORNE
TIGER HILLS WILDLIFE MANAGEMENT AREA
Bone Lake
PEMBINA VALLEY WILDLIFE MANAGEMENT AREA
457
351
34
352
340
453
344
530
675
2
5
18
23
605
342
245
532




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**

- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Map Tile Index - 1:150,000**

- Map Series Tile

**Dominant Agricultural Capability [1]**

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 6
- Class 7
- Organic
- Unclassified

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City
- First Nation Lands

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

N

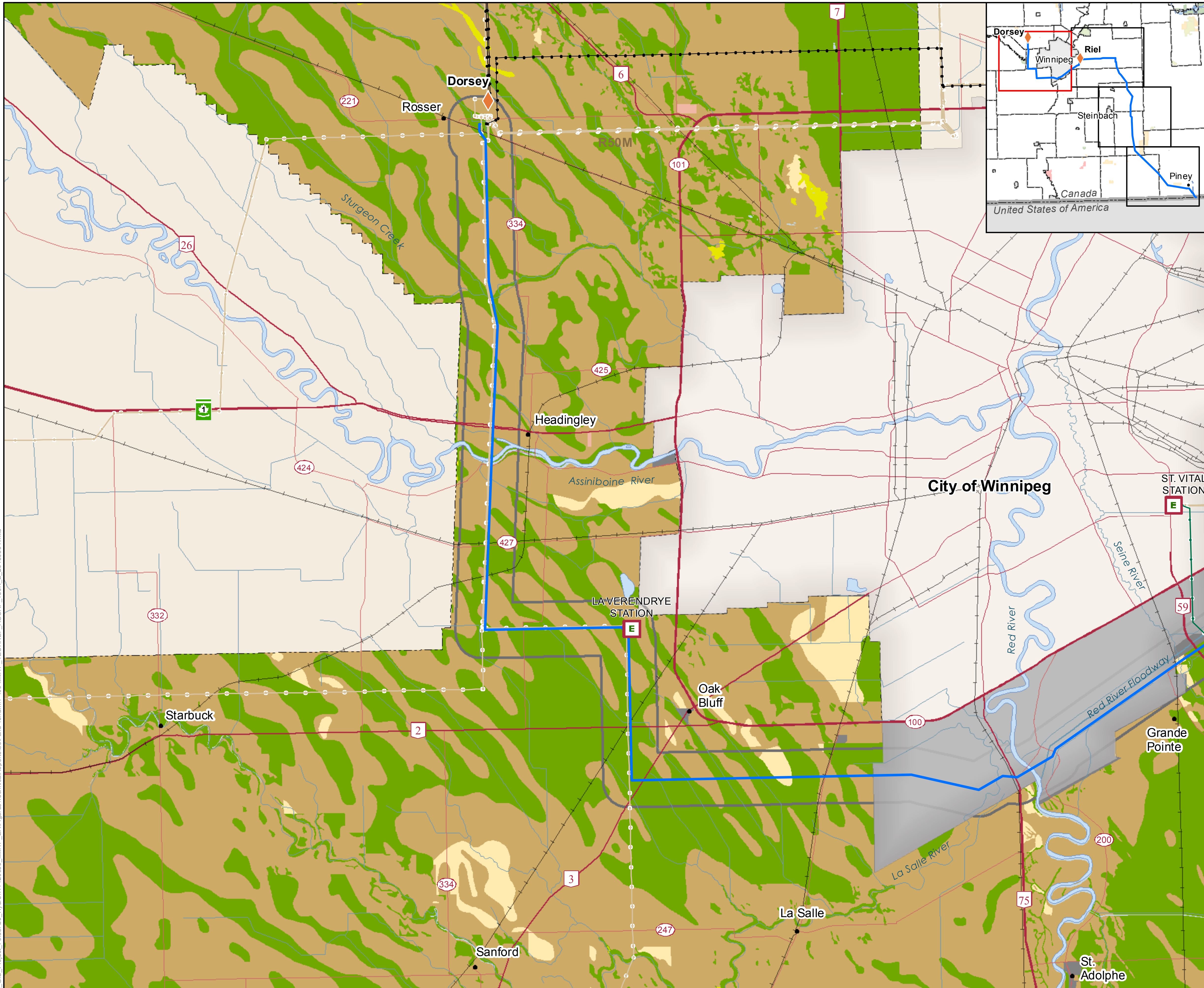
0 5 10 Kilometres
0 5 10 Miles

1:500,000

## Index of Map Series
## Dominant Agricultural Capability

Map 4-400

G:_GIS_Project_Folder\00_Hydro\1114220050_MMTP_EA\Figures\TechnicalReports\Soil and Terrain\4-400-MMTP_TECHREP_AGCAP_Index_500K_B_20150804.mxd




Manitoba Hydro

**Manitoba-Minnesota Transmission Project**

Project Infrastructure

- Converter Station (Existing)
- Final Preferred Route (FPR)

Infrastructure

- Electrical Station
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Dominant Agricultural Capability [1]

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 6
- Class 7
- Organic
- Unclassified

Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

Landbase

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

N

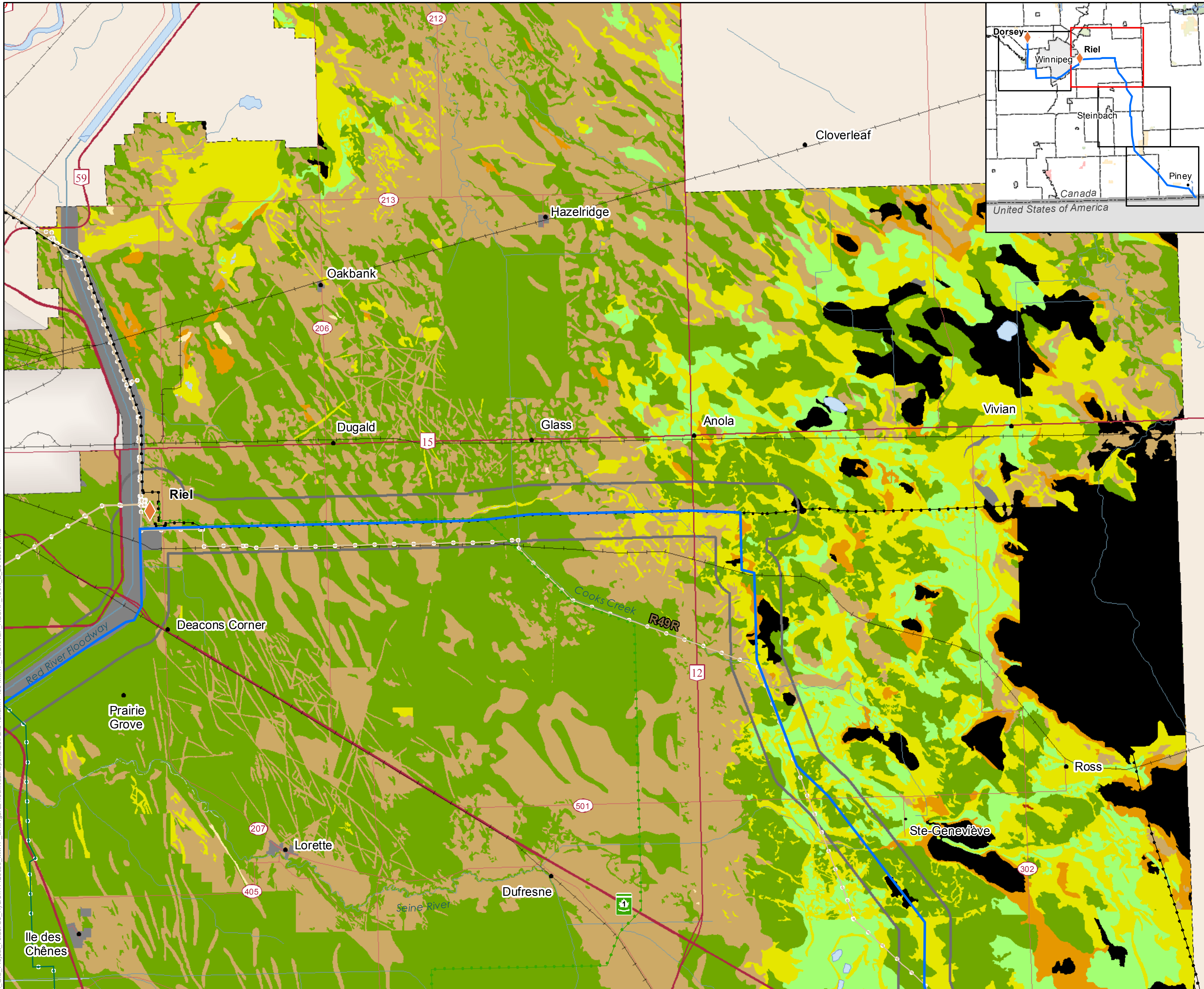
0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

**Dominant Agricultural Capability**

Map 4-400-01

G:_GIS_Project_Folder\00_Hydro\1114200500_MMTP_EA\Figures\TechnicalReports\Soil and Terrain\4-400-MMTP_TECHREP_AGCAP_150K_B_20150804.mxd




Manitoba Hydro

**Manitoba-Minnesota Transmission Project**

Project Infrastructure

- Converter Station (Existing)
- Final Preferred Route (FPR)

Infrastructure

- Electrical Station
- Bipole III Transmission Line (Approved)
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Dominant Agricultural Capability

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 6
- Class 7
- Organic
- Unclassified

Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

Landbase

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

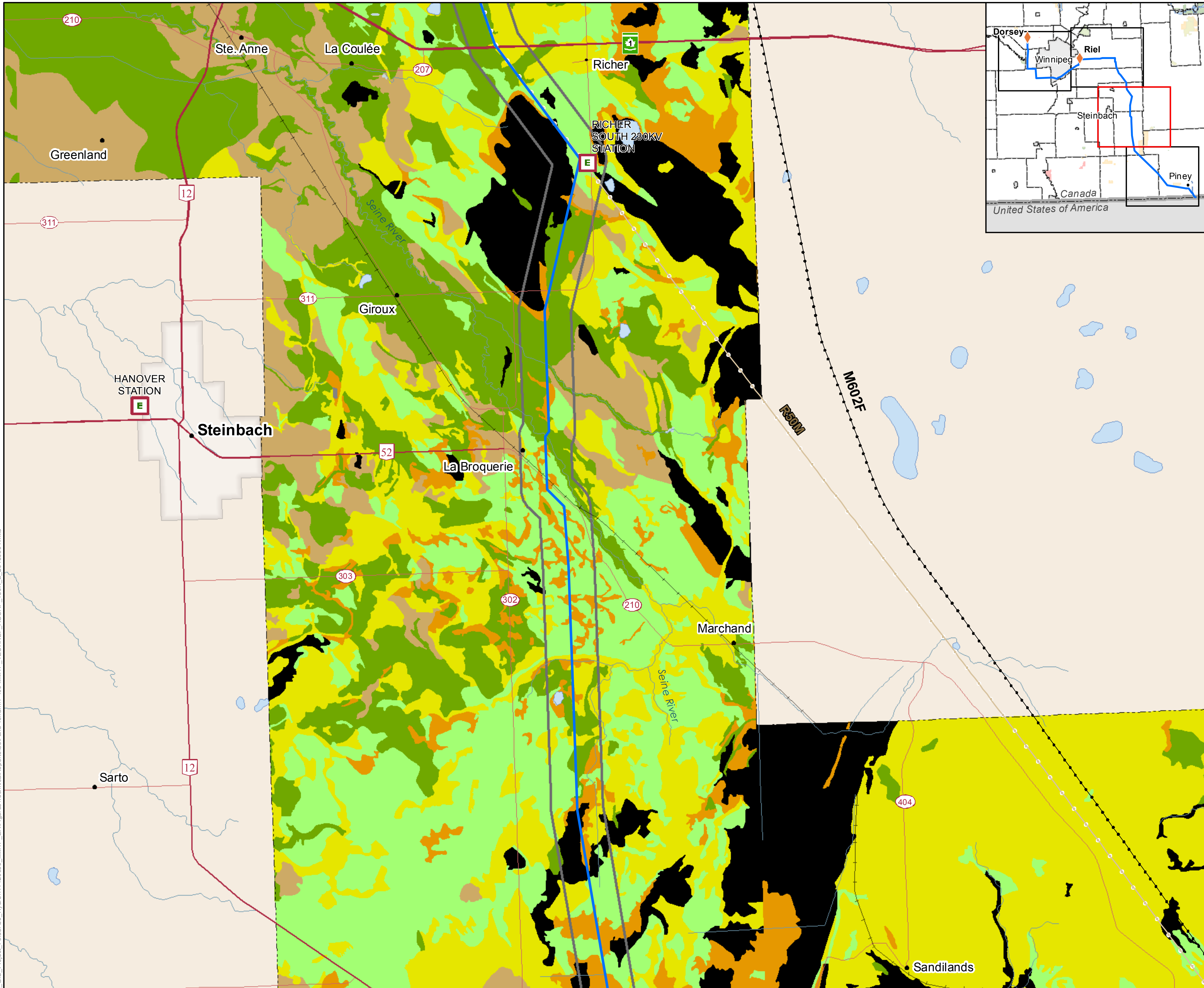
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

**Dominant Agricultural Capability**

Map 4-400-02




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**
- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**
- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Dominant Agricultural Capability** [1]
- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 6
- Class 7
- Organic
- Unclassified

**Assessment Area**
- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**
- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

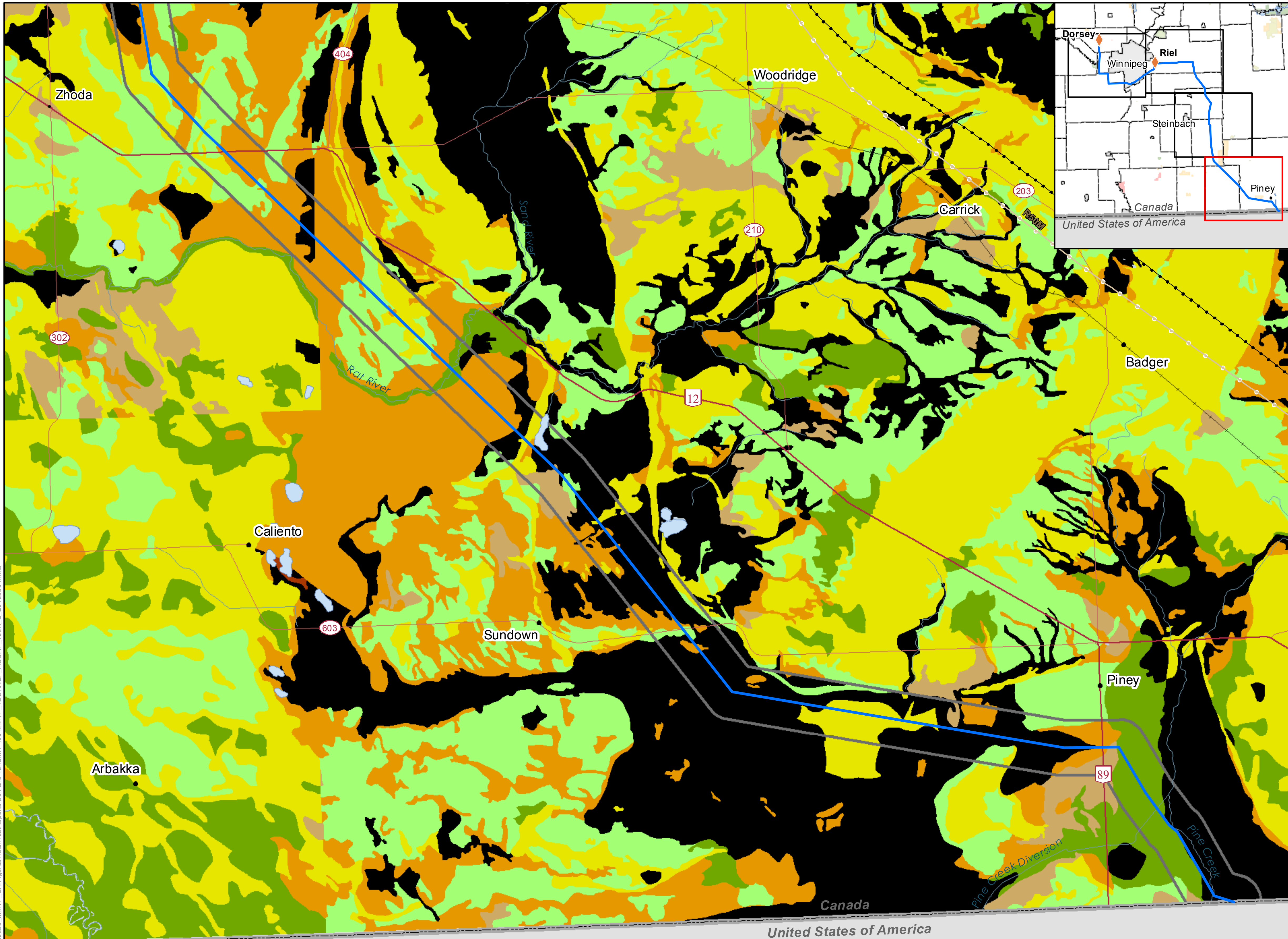
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Agricultural Capability

Map 4-400-03




# Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**

- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Dominant Agricultural Capability [1]**

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 6
- Class 7
- Organic
- Unclassified

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

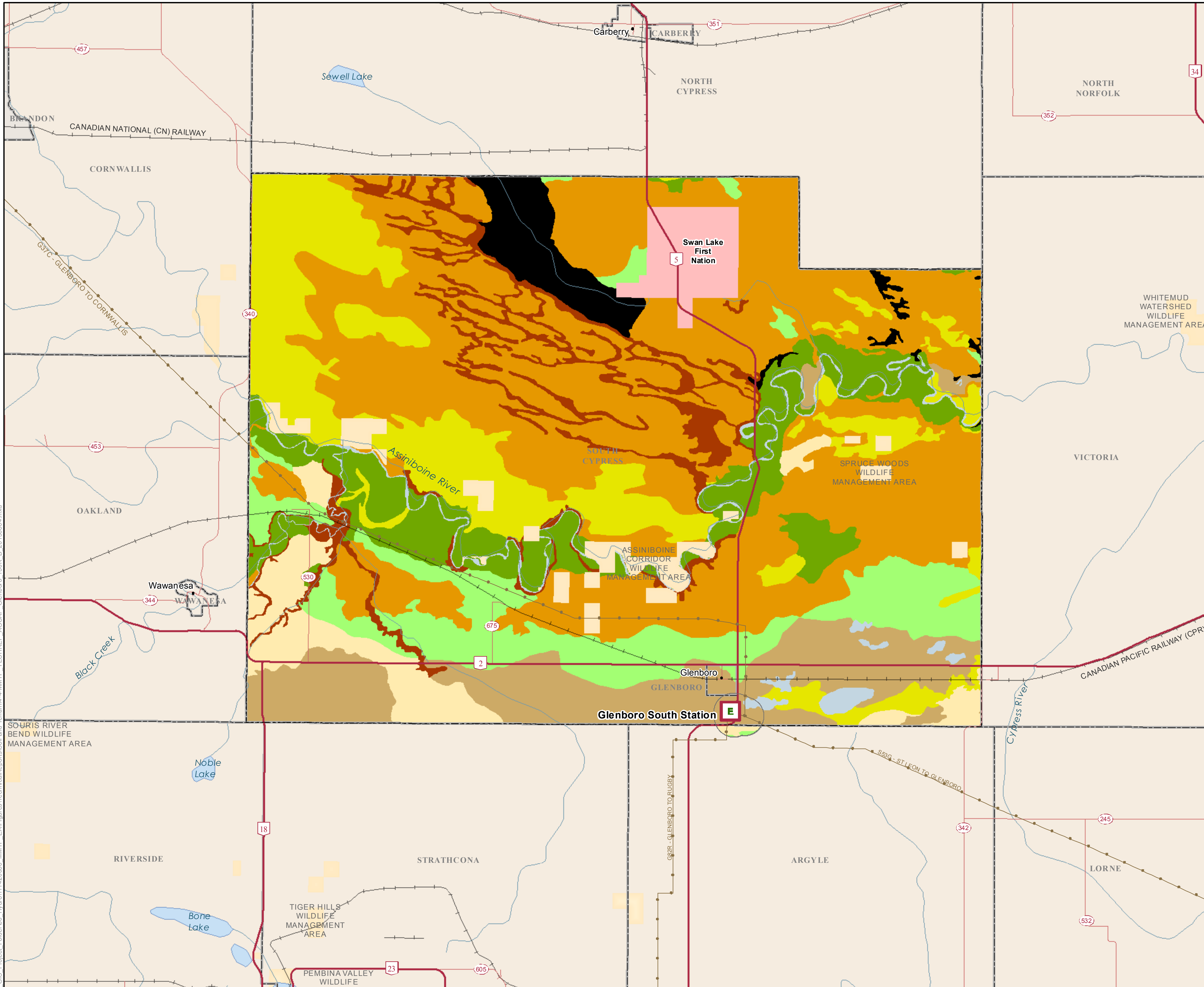
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Agricultural Capability

Map 4-400-04




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Electrical Station

**Infrastructure**

- Existing Transmission Line

**Dominant Agricultural Capability [1]**

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 6
- Class 7
- Organic
- Unclassified

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Provincial Highway
- Provincial Road
- Railway
- City / Town
- First Nation Lands
- Wildlife Management Area
- Rural Municipality

Source:
1. Soil Resource Inventory, 2015, Stantec.

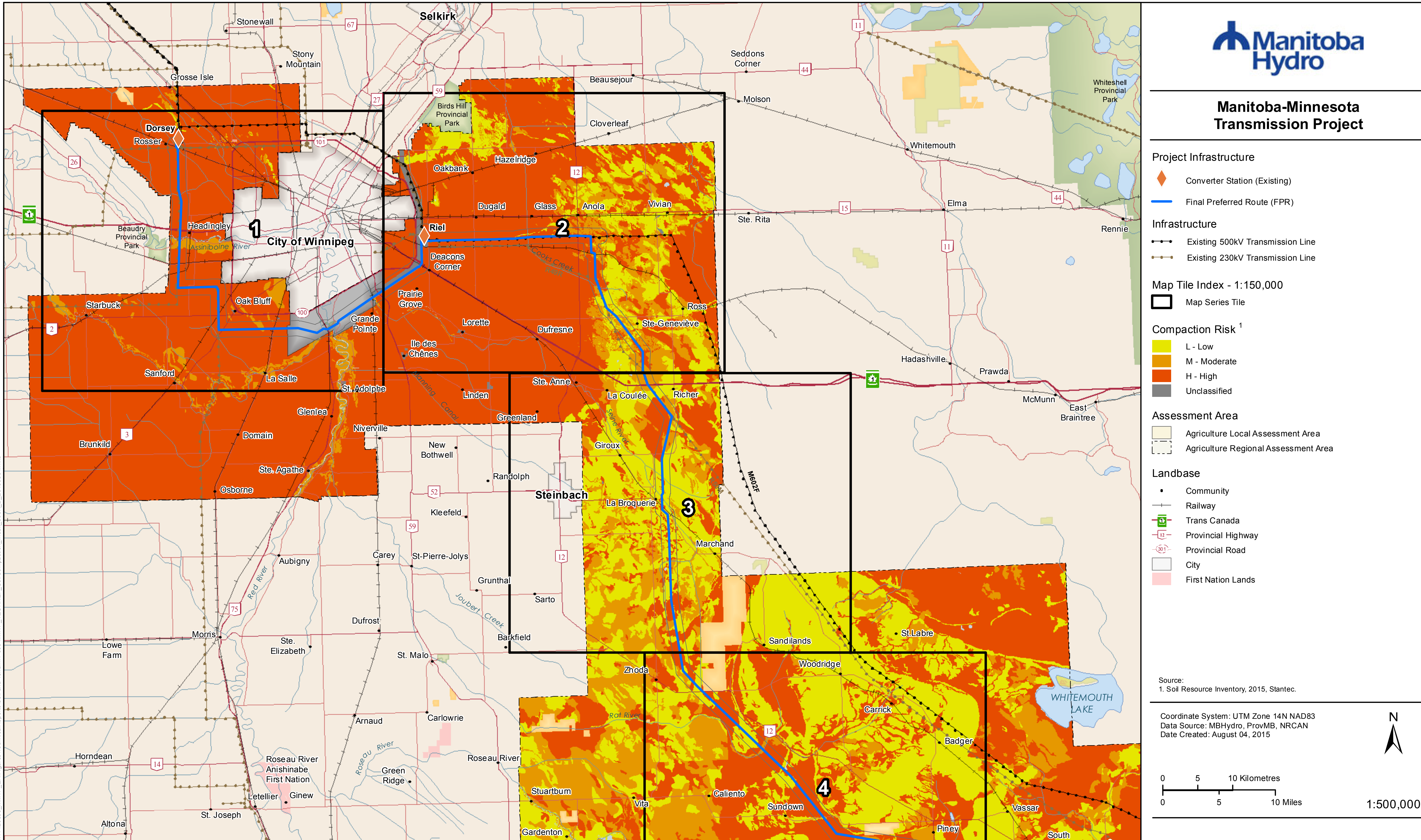
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

N

0 5 Kilometres
0 2.5 5 Miles
1:200,000

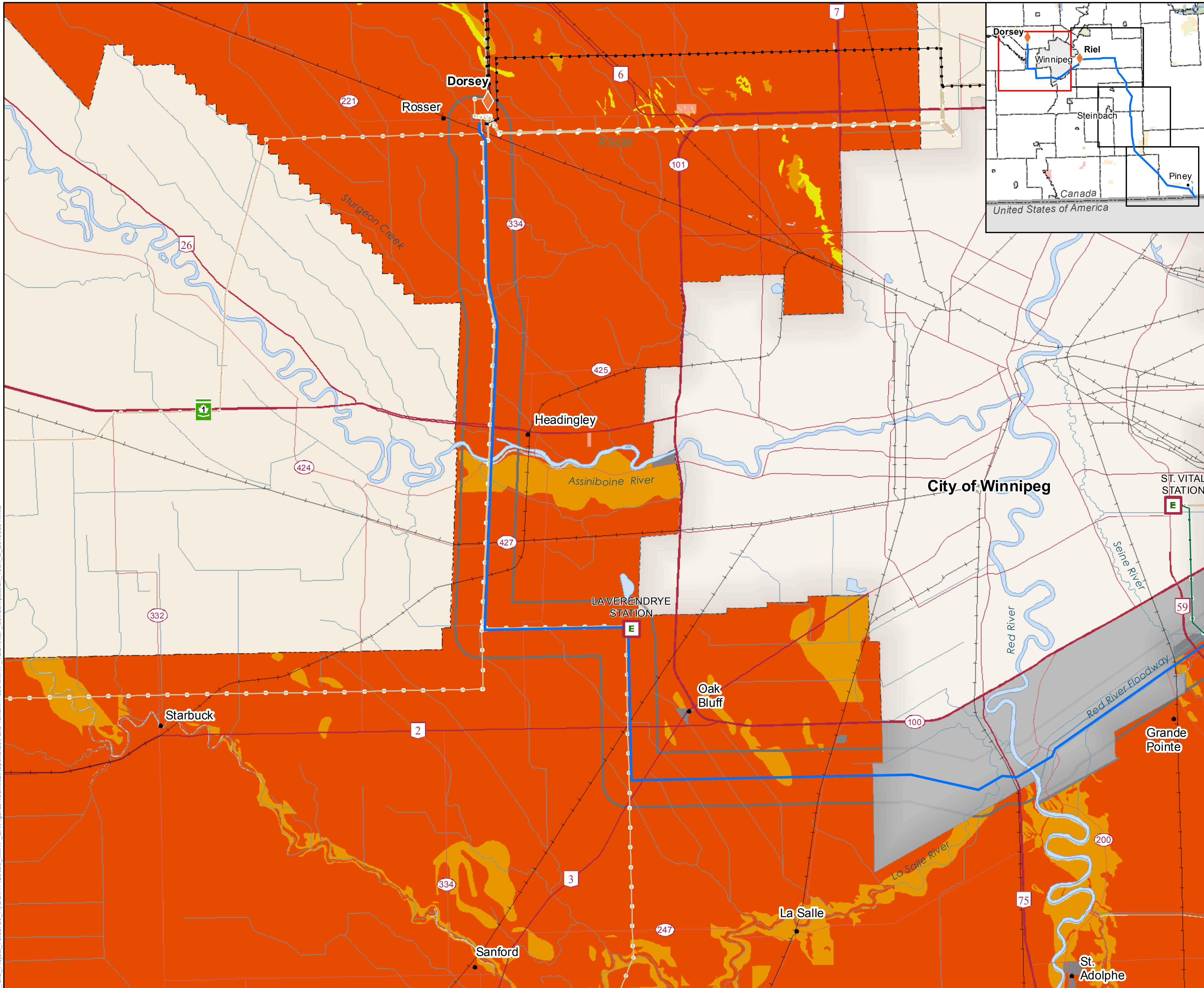
## Glenboro South Station Dominant Agricultural Capability

Map 4-4




# Index of Map Series
# Dominant Soil Compaction Risk

Map 4-500




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

### Project Infrastructure
- Converter Station (Existing)
- Final Preferred Route (FPR)

### Infrastructure
- Electrical Station
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

### Compaction Risk [1]
- L - Low
- M - Moderate
- H - High
- Unclassified

### Assessment Area
- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

### Landbase
- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

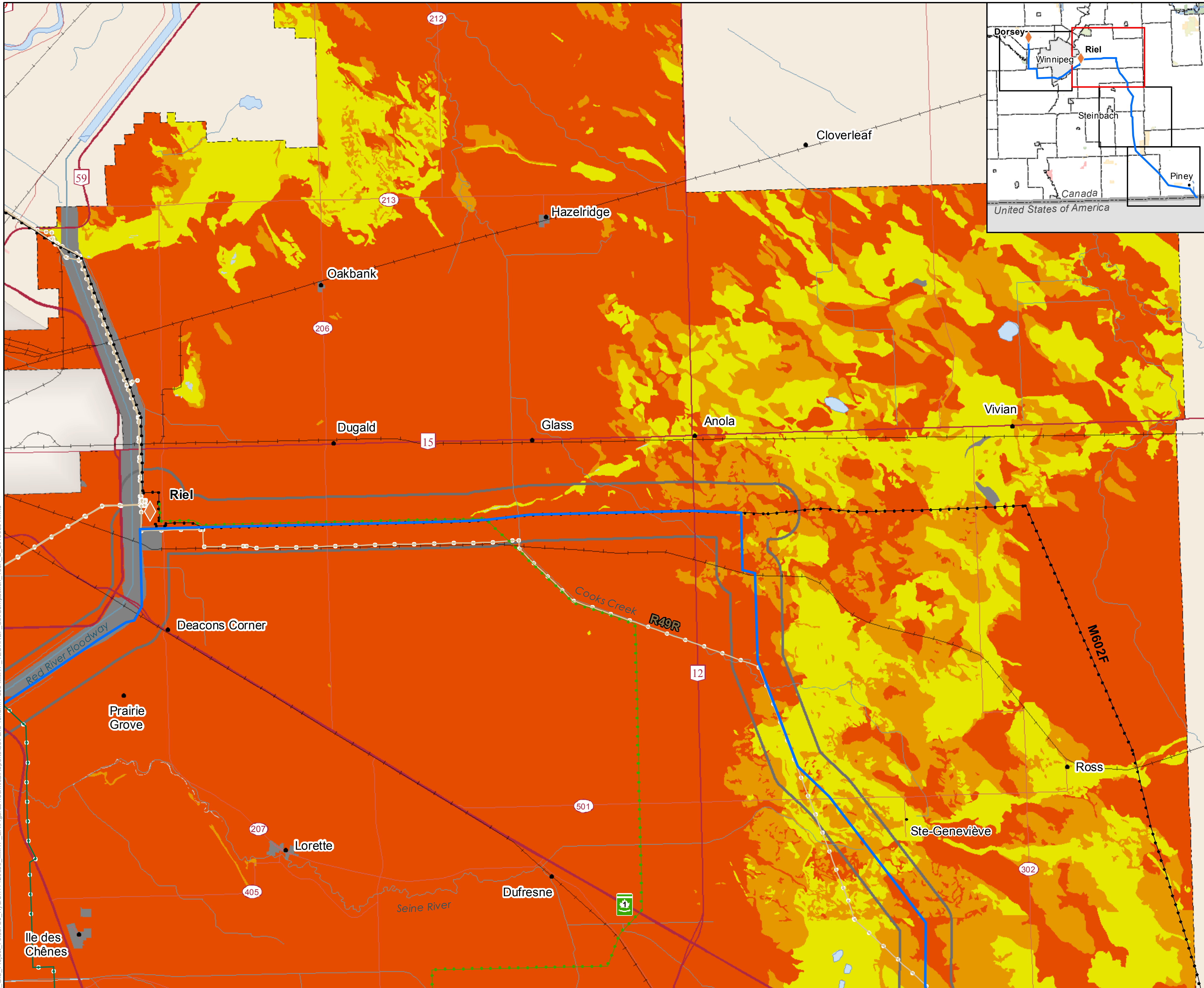
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Soil Compaction Risk

Map 4-500-01




Manitoba Hydro

**Manitoba-Minnesota Transmission Project**

Project Infrastructure
- Converter Station (Existing)
- Final Preferred Route (FPR)

Infrastructure
- Electrical Station
- Bipole III Transmission Line (Approved)
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Compaction Risk
- L - Low
- M - Moderate
- H - High
- Unclassified

Assessment Area
- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

Landbase
- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

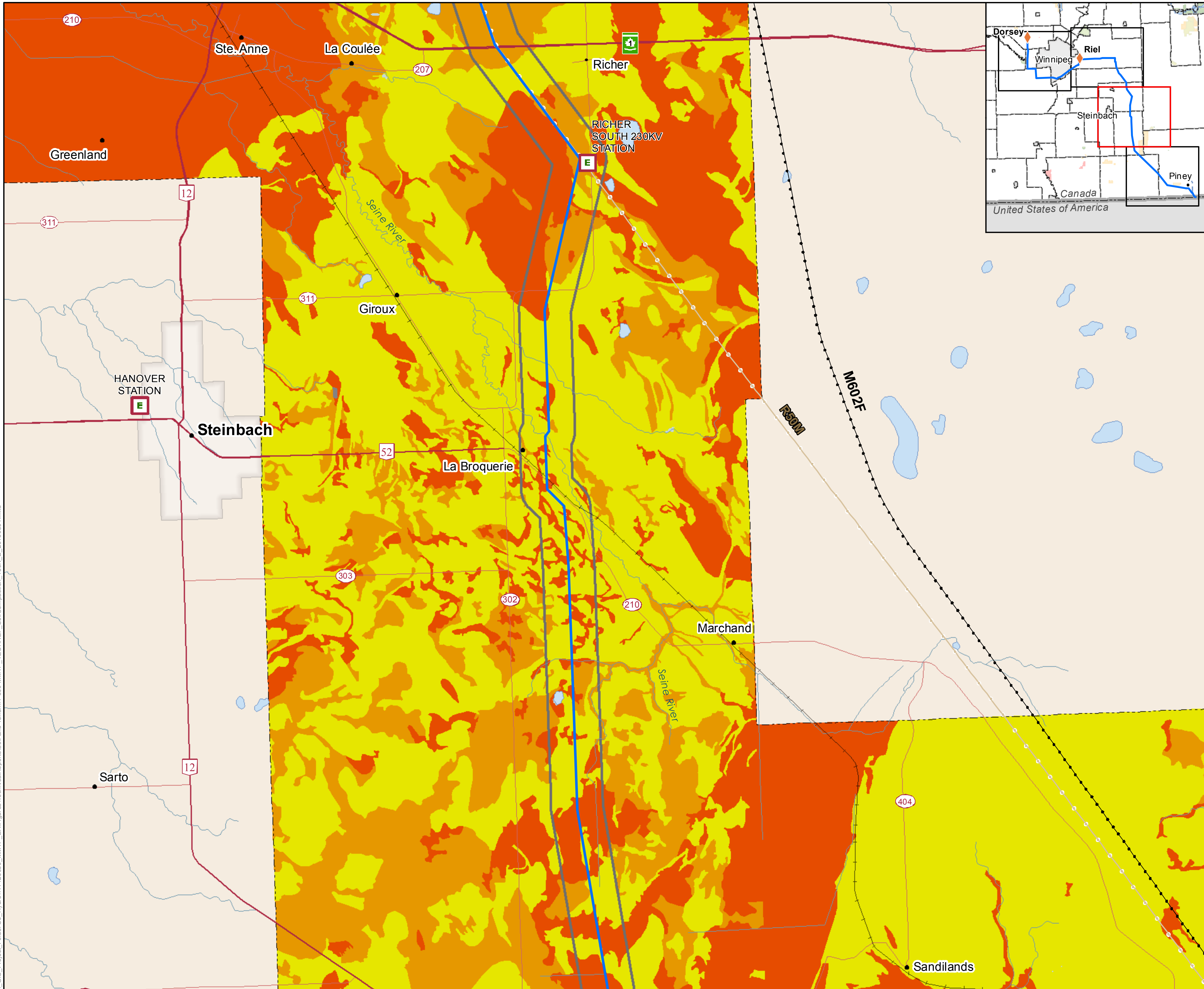
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

**Dominant Soil Compaction Risk**

Map 4-500-02




Manitoba Hydro

**Manitoba-Minnesota Transmission Project**

Project Infrastructure

- Converter Station (Existing)
- Final Preferred Route (FPR)

Infrastructure

- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Compaction Risk [1]

- L - Low
- M - Moderate
- H - High
- Unclassified

Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

Landbase

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

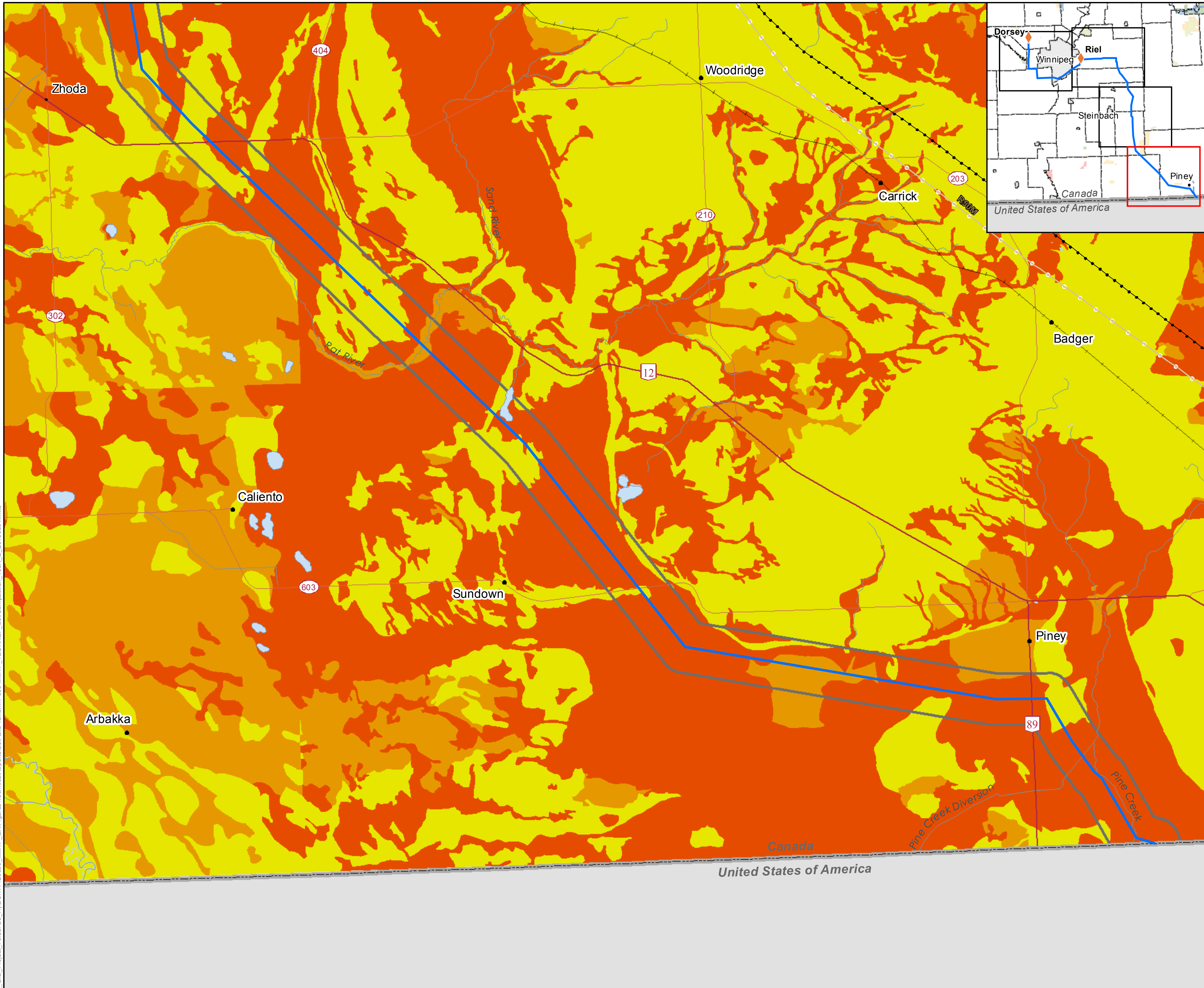
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

**Dominant Soil Compaction Risk**

Map 4-500-03




Manitoba Hydro

**Manitoba-Minnesota Transmission Project**

Project Infrastructure

- Converter Station (Existing)
- Final Preferred Route (FPR)

Infrastructure

- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Compaction Risk [1]

- L - Low
- M - Moderate
- H - High
- Unclassified

Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

Landbase

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

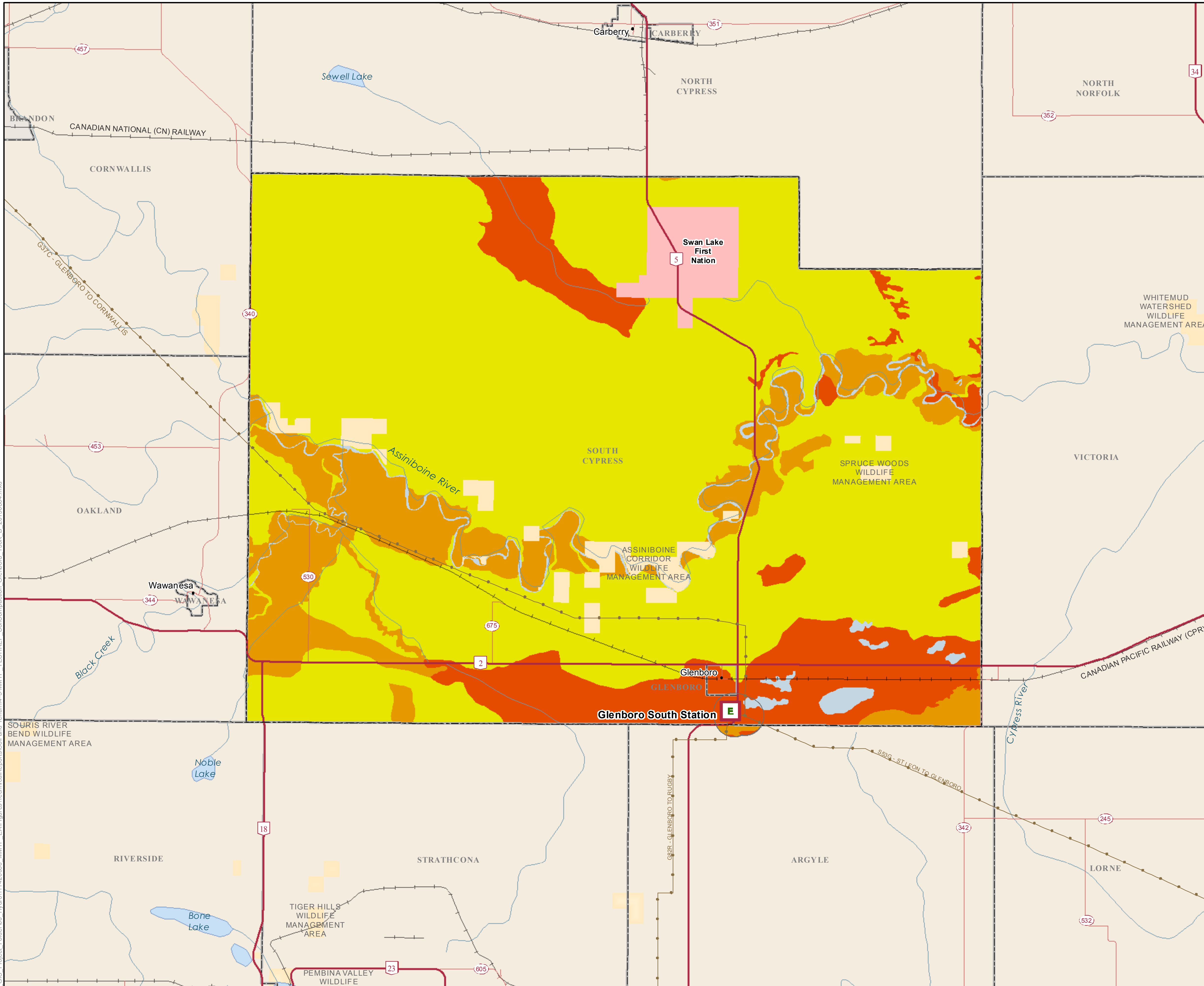
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

**Dominant Soil Compaction Risk**

Map 4-500-04




Manitoba Hydro

**Manitoba-Minnesota Transmission Project**

Project Infrastructure

- Electrical Station

Infrastructure

- Existing Transmission Line

Compaction Risk [1]

- L - Low
- M - Moderate
- H - High
- Unclassified

Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

Landbase

- Community
- Provincial Highway
- Provincial Road
- Railway
- City / Town
- First Nation Lands
- Wildlife Management Area
- Rural Municipality

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

N

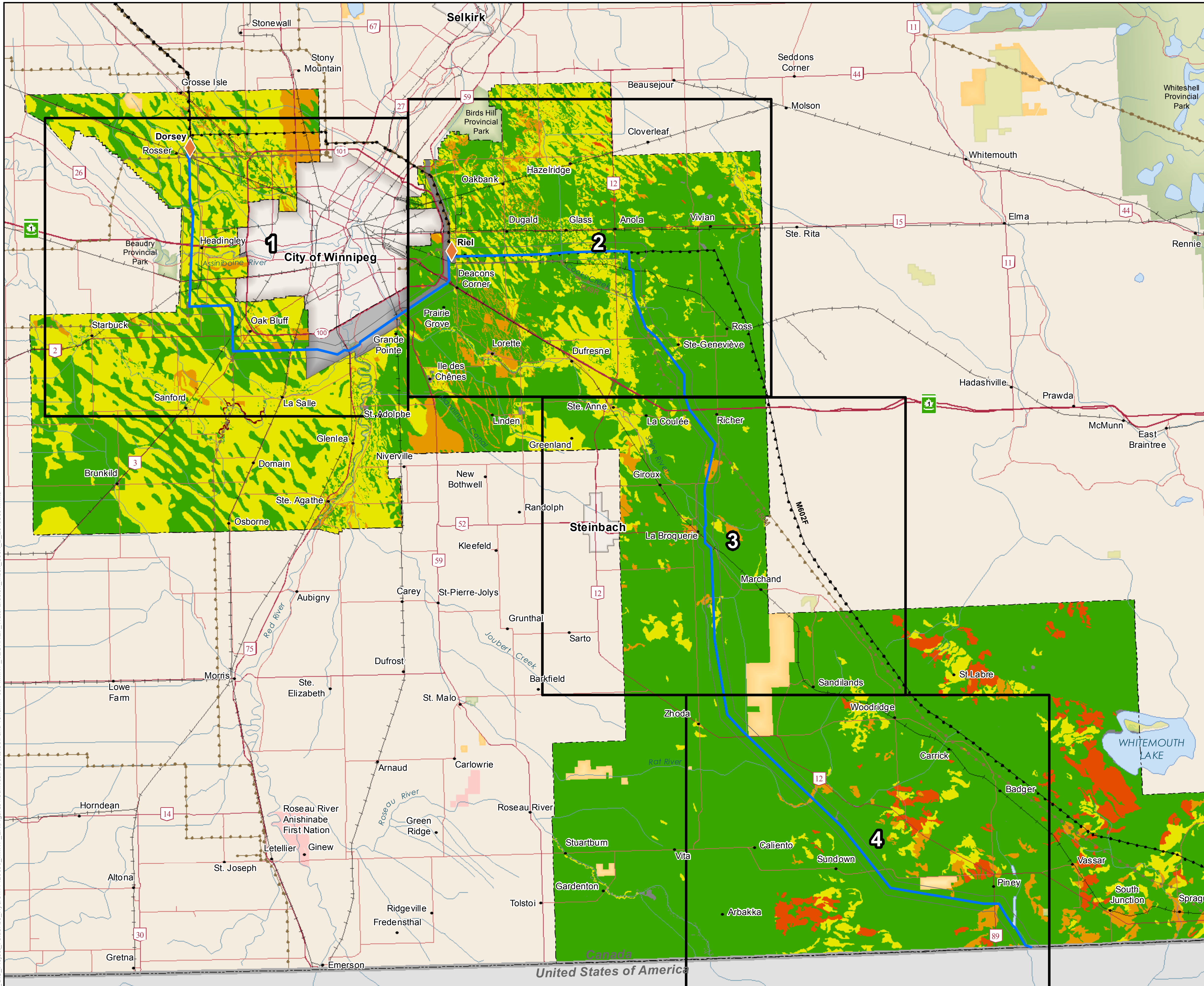
0 — 5 Kilometres
0 — 2.5 — 5 Miles

1:200,000

**Glenboro South Station**
**Dominant Soil Compaction Risk**

Map 4-5

G:_GIS_Project_Folder\00_Hydro\1114200\50_MMTP_EA\Figures\TechnicalReports\Soil and Terrain\4-5-MMTP_TECHREP_SoilCompaction_Glenboro_150K_B_20150804.mxd




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**
- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Map Tile Index - 1:150,000**
- Map Series Tile

**Water Erosion Risk** [1]
- N - Negligible
- L - Low
- M - Moderate
- H - High
- S - Severe
- Not Rated

**Assessment Area**
- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**
- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City
- First Nation Lands
- Ecological Reserve
- Wildlife Management Area
- Provincial Park

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

N

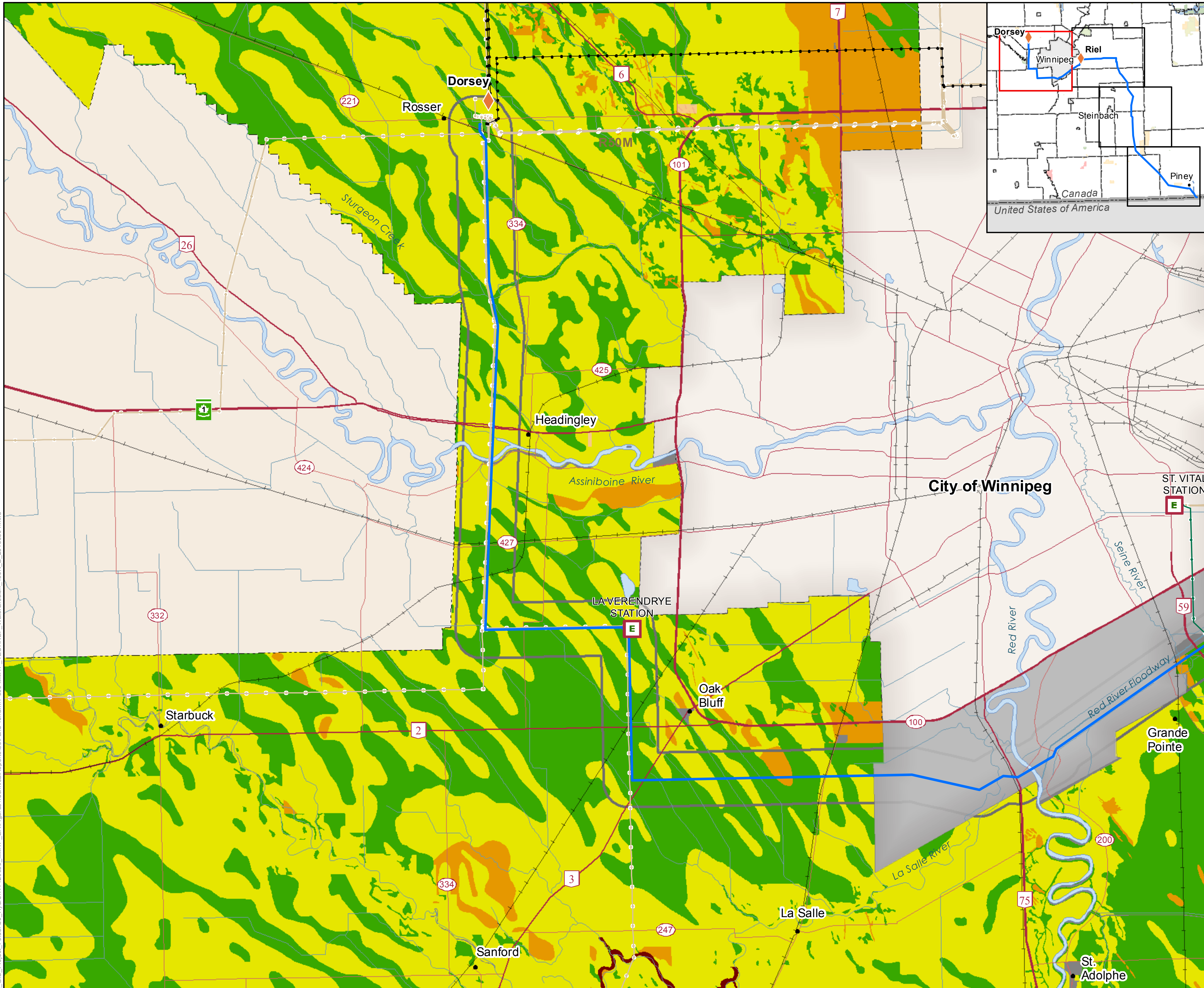
0 5 10 Kilometres
0 5 10 Miles

1:500,000

## Index of Map Series Dominant Water Erosion Risk

Map 4-600

G:_GIS_Project_Folder\00_Hydro\111420050_MMTP_EA\Figures\TechnicalReports\Soil and Terrain\4-600-MMTP_TECHREP_WaterErosion_Index_500K_B_20150804.mxd




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**

- Electrical Station
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Water Erosion Risk [1]**

- N - Negligible
- L - Low
- M - Moderate
- H - High
- S - Severe
- Not Rated

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

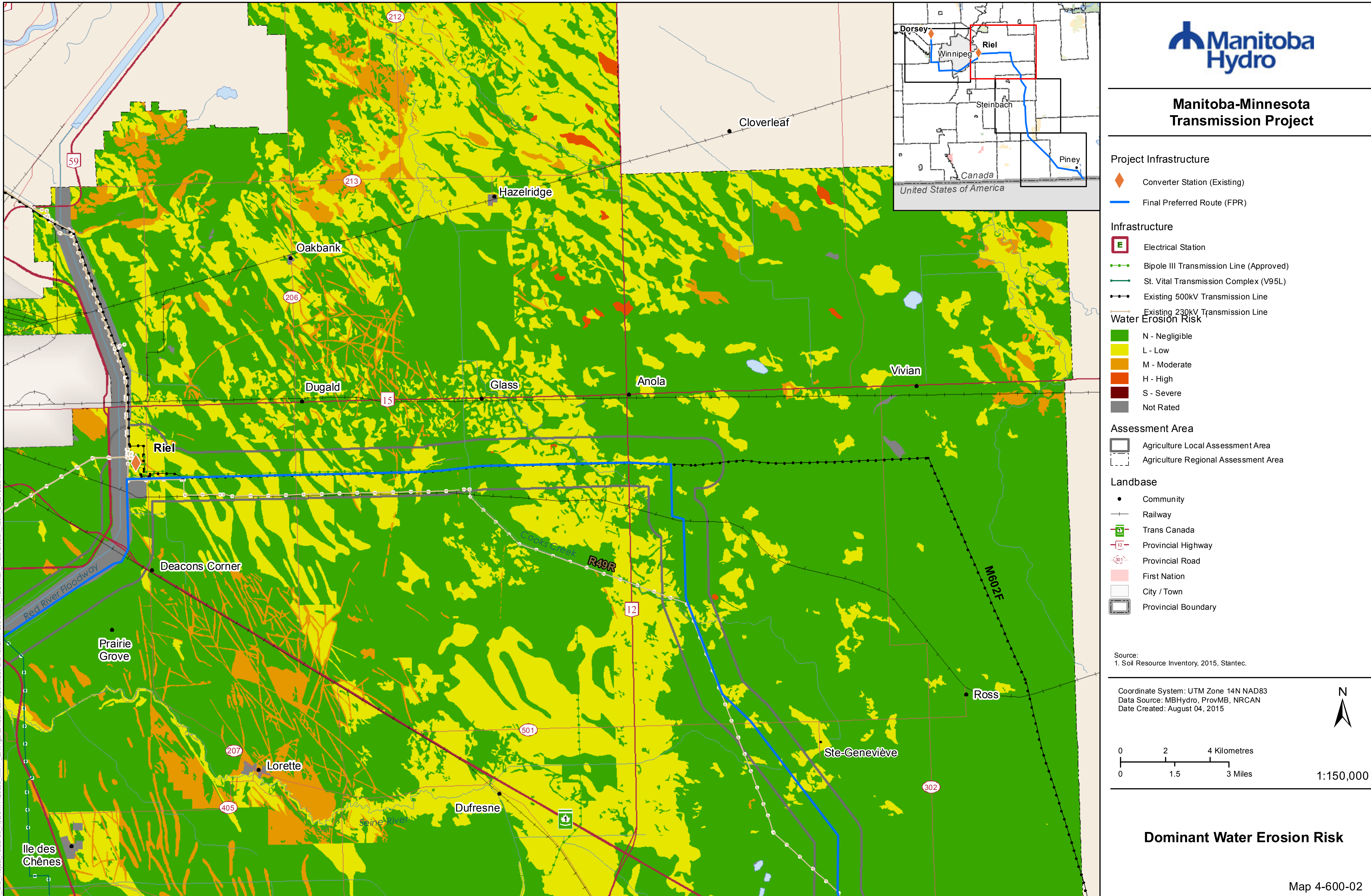
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

0 2 4 Kilometres
0 1.5 3 Miles

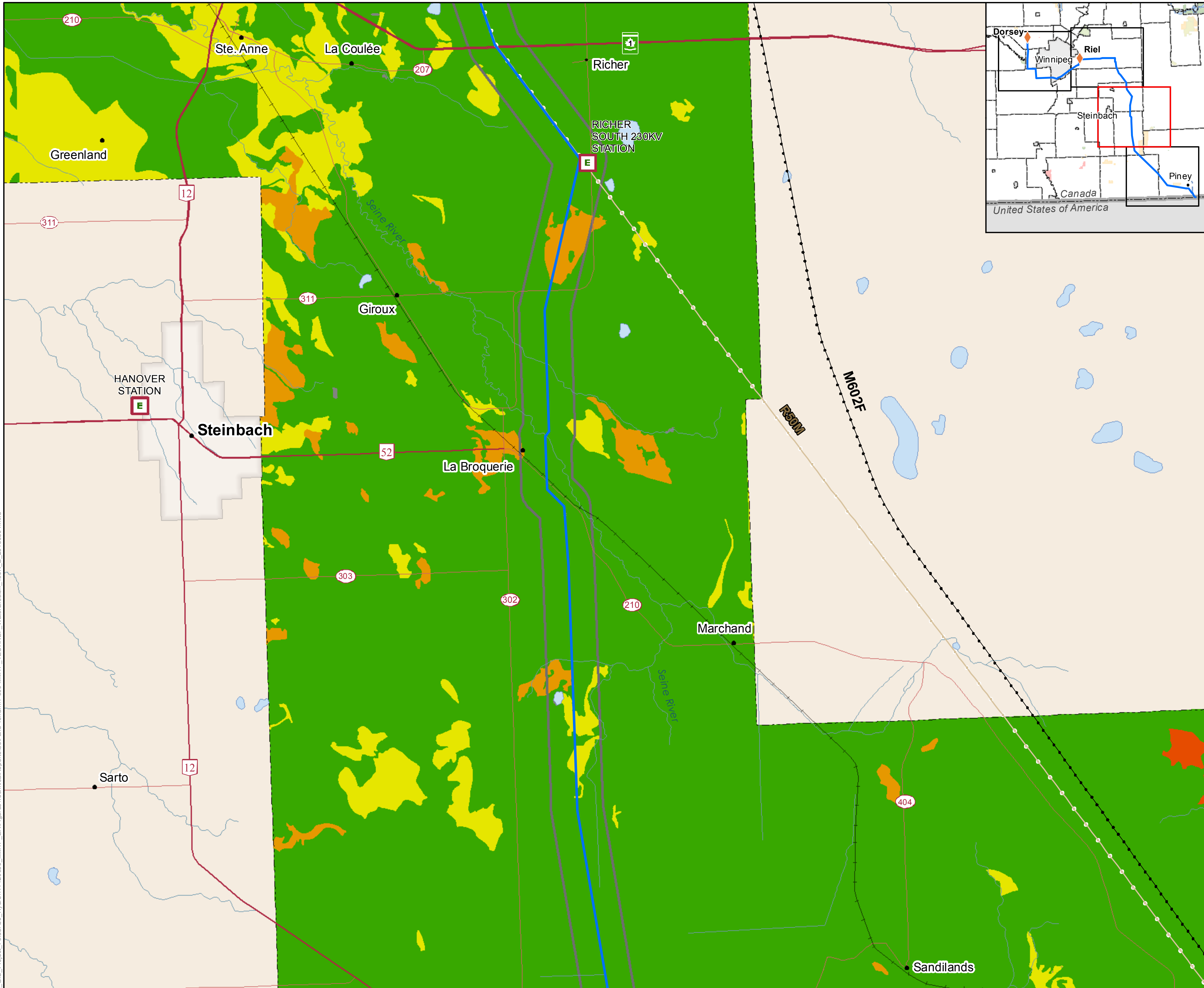
1:150,000

# Dominant Water Erosion Risk

Map 4-600-01



Manitoba Hydro
Manitoba-Minnesota Transmission Project
Project Infrastructure
Converter Station (Existing)
Final Preferred Route (FPR)
Infrastructure
Electrical Station
Bipole III Transmission Line (Approved)
St. Vital Transmission Complex (V95L)
Existing 500kV Transmission Line
Existing 230kV Transmission Line
Water Erosion Risk
N - Negligible
L - Low
M - Moderate
H - High
S - Severe
Not Rated
Assessment Area
Agriculture Local Assessment Area
Agriculture Regional Assessment Area
Landbase
Community
Railway
Trans Canada
Provincial Highway
Provincial Road
First Nation
City / Town
Provincial Boundary
Source:
1. Soil Resource Inventory, 2015, Stantec.
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015
N
0 2 4 Kilometres
0 1.5 3 Miles
1:150,000
Dominant Water Erosion Risk
Map 4-600-02
Dorsey
Winnipeg
Riel
Steinbach
Piney
Canada
United States of America
Cloverleaf
Hazelridge
Oakbank
Dugald
Glass
Anola
Vivian
Riel
Deacons Corner
Prairie Grove
Lorette
Dufresne
Ste-Geneviève
Ross
Ile des Chênes
Red River Floodway
Cooks Creek
Seine River
R49R
M602F
212
213
206
59
15
12
501
207
405
302
1




Manitoba Hydro

**Manitoba-Minnesota Transmission Project**

Project Infrastructure

- Converter Station (Existing)
- Final Preferred Route (FPR)

Infrastructure

- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Water Erosion Risk [1]

- N - Negligible
- L - Low
- M - Moderate
- H - High
- S - Severe
- Not Rated

Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

Landbase

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

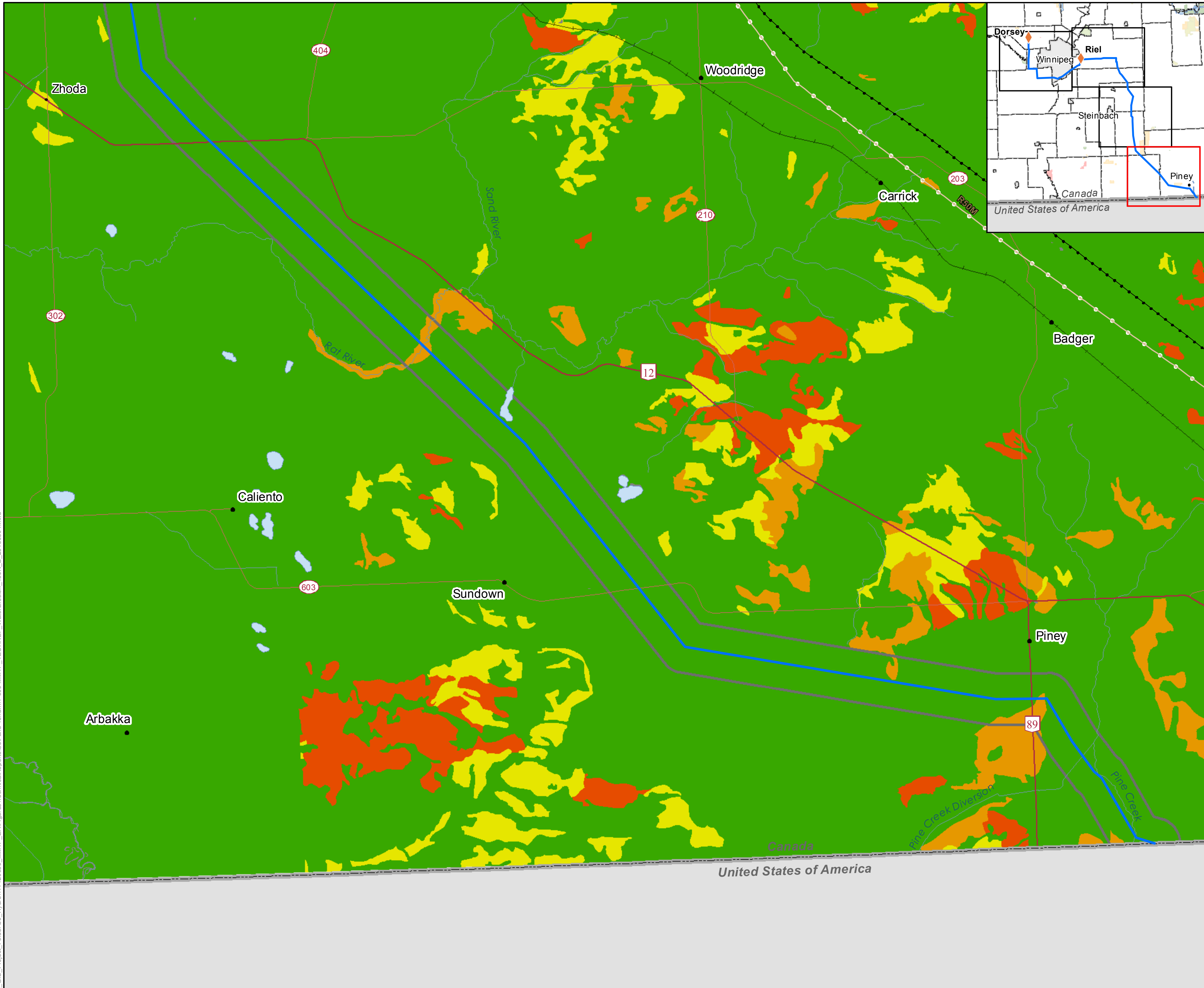
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

**Dominant Water Erosion Risk**

Map 4-600-03




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**

- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Water Erosion Risk** [1]

- N - Negligible
- L - Low
- M - Moderate
- H - High
- S - Severe
- Not Rated

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

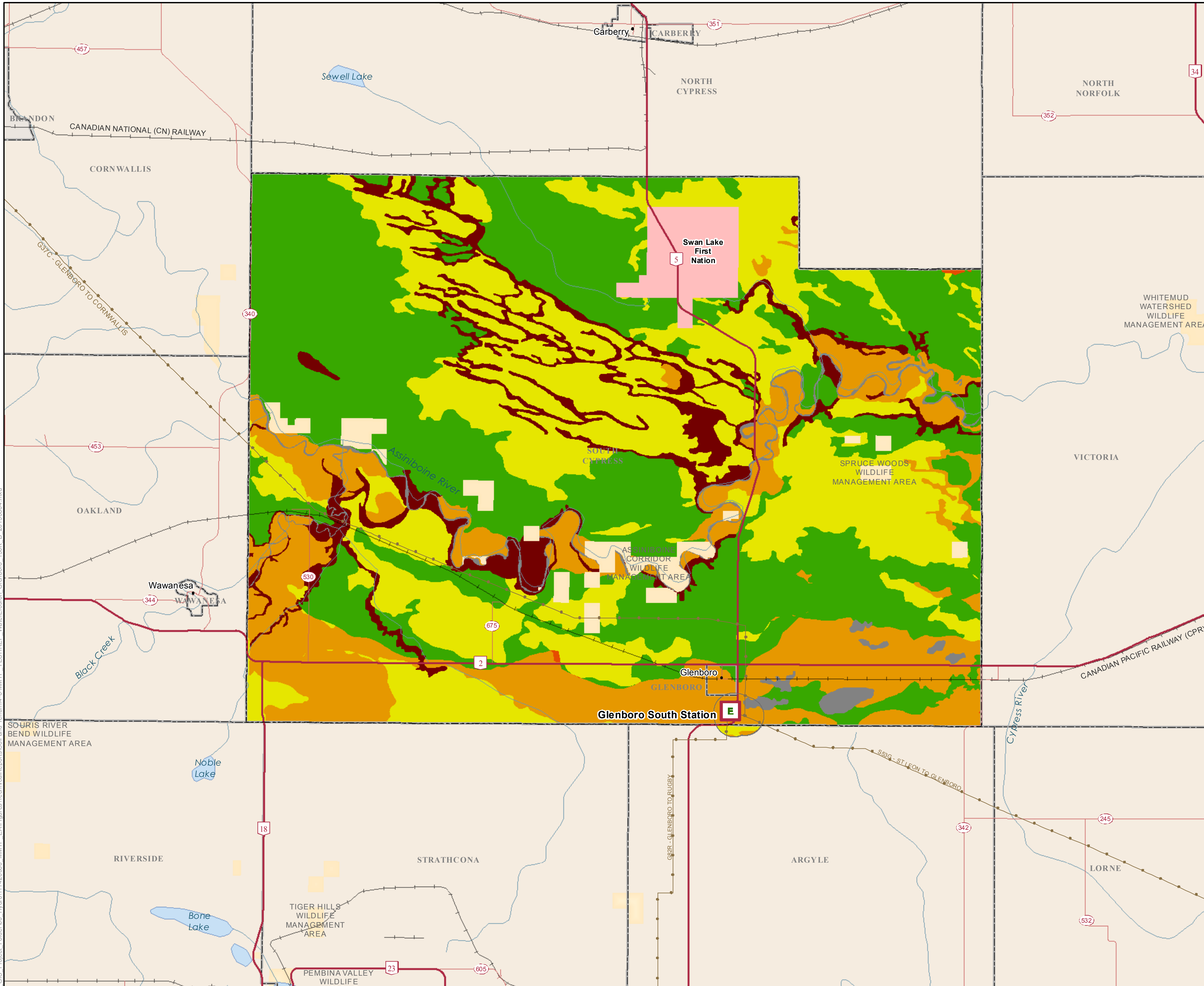
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Water Erosion Risk

Map 4-600-04




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

Electrical Station

**Infrastructure**

Existing Transmission Line

**Water Erosion Risk [1]**

N - Negligible
L - Low
M - Moderate
H - High
S - Severe
Not Rated

**Assessment Area**

Agriculture Local Assessment Area
Agriculture Regional Assessment Area

**Landbase**

Community
Provincial Highway
Provincial Road
Railway
City / Town
First Nation Lands
Wildlife Management Area
Rural Municipality

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

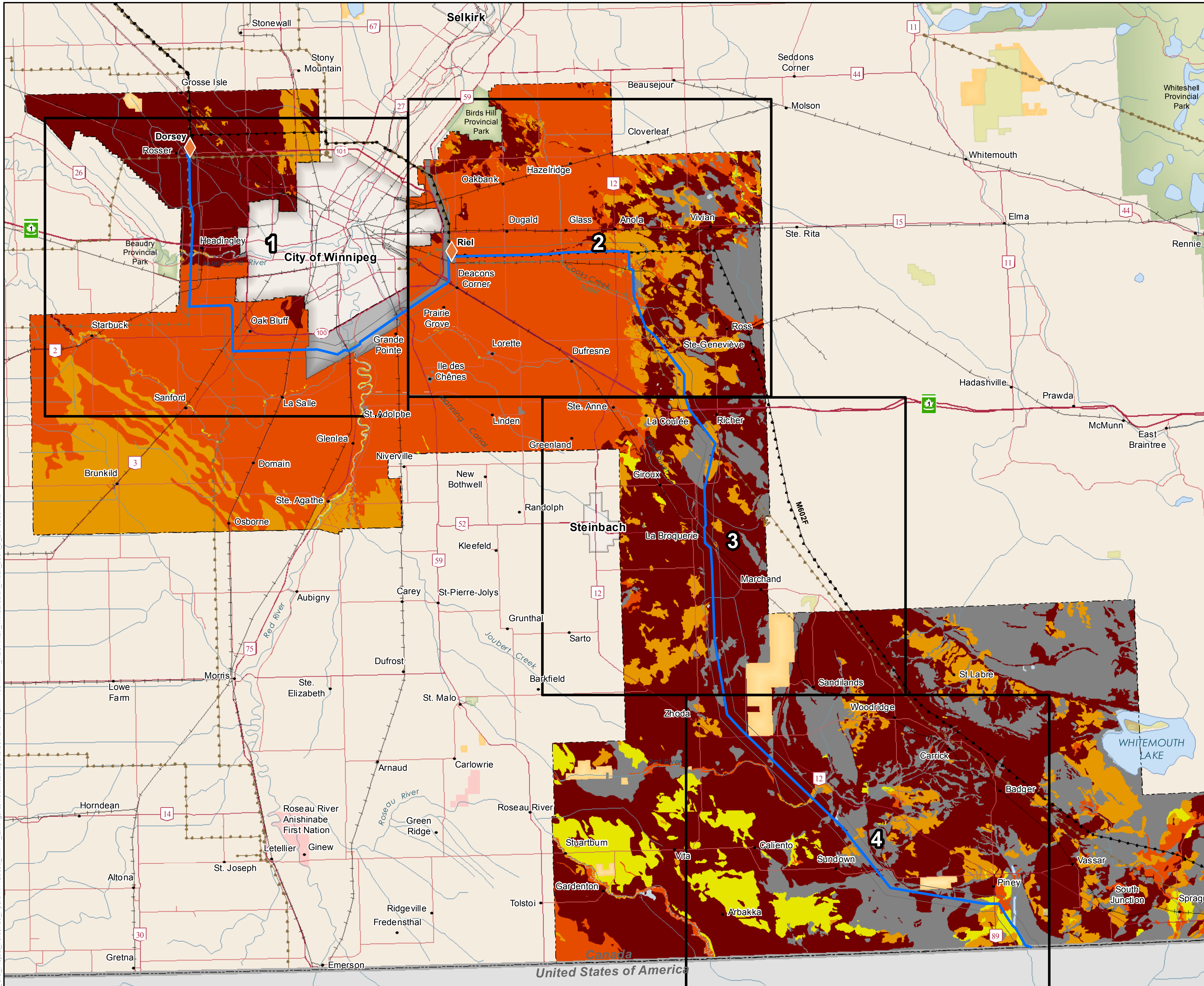
N

0 5 Kilometres
0 2.5 5 Miles

1:200,000

## Glenboro South Station Dominant Water Erosion Risk

Map 4-6




Manitoba Hydro

# Manitoba-Minnesota Transmission Project

Project Infrastructure

- Converter Station (Existing)
- Final Preferred Route (FPR)

Infrastructure

- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Map Tile Index - 1:150,000

- Map Series Tile

Wind Erosion Risk [1]

- N - Negligible
- L - Low
- M - Moderate
- H - High
- S - Severe
- Not Rated

Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

Landbase

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City
- First Nation Lands
- Ecological Reserve
- Wildlife Management Area
- Provincial Park

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

N

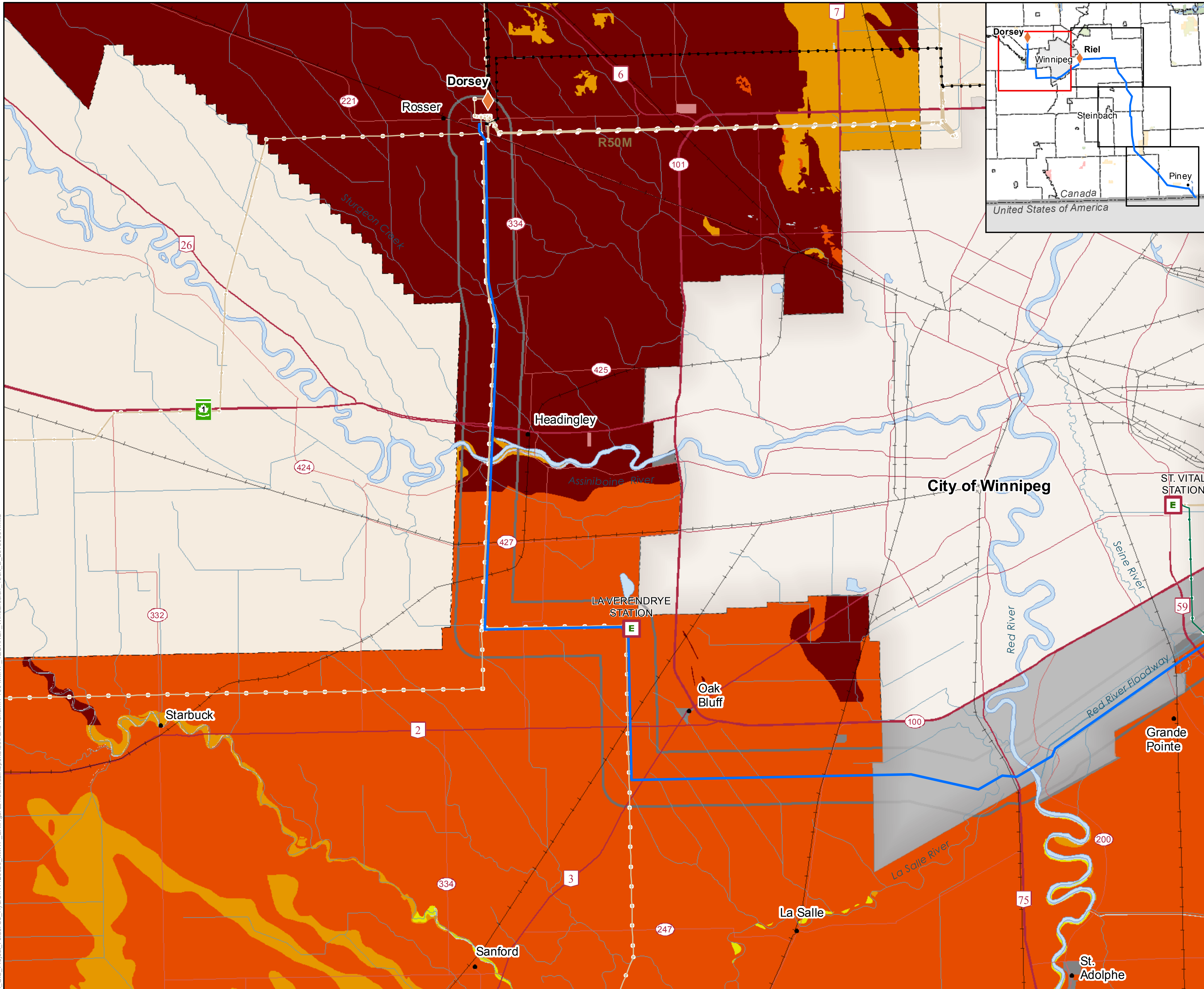
0 5 10 Kilometres
0 5 10 Miles

1:500,000

## Index of Map Series Dominant Wind Erosion Risk

Map 4-700

G:_GIS_Project_Folder\00_Hydro\1114-20050_MMTP_EA\Figures\TechnicalReports\Soil and Terrain\4-700-MMTP_TECHREP_WindErosion_Index_500K_B_20150804.mxd




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**
- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**
- Electrical Station
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Wind Erosion Risk [1]**
- N - Negligible
- L - Low
- M - Moderate
- H - High
- S - Severe
- Not Rated

**Assessment Area**
- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**
- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

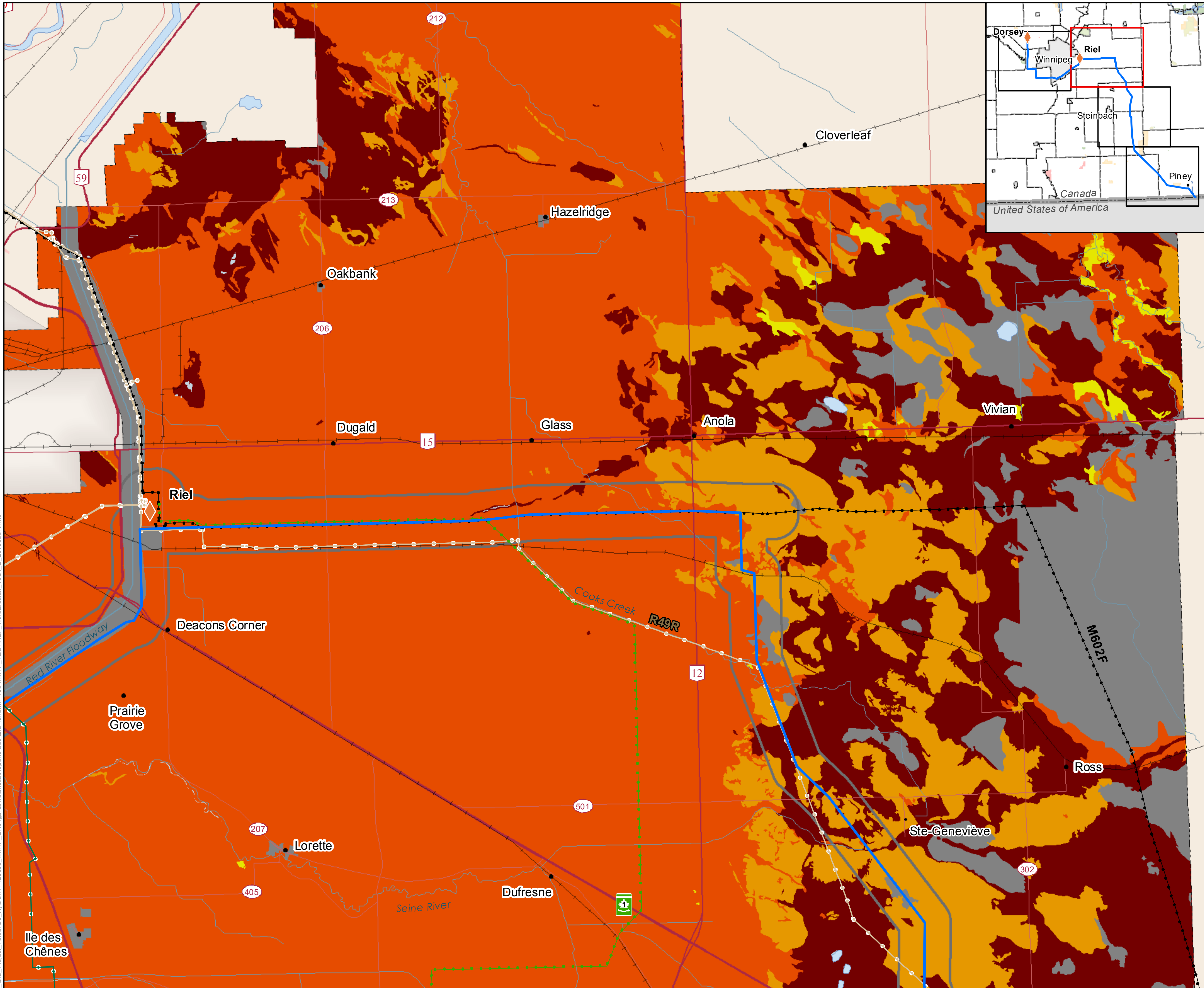
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Wind Erosion Risk

Map 4-700-01




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

Project Infrastructure
- Converter Station (Existing)
- Final Preferred Route (FPR)

Infrastructure
- Electrical Station
- Bipole III Transmission Line (Approved)
- St. Vital Transmission Complex (V95L)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Wind Erosion Risk
- N - Negligible
- L - Low
- M - Moderate
- H - High
- S - Severe
- Not Rated

Assessment Area
- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

Landbase
- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- First Nation
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

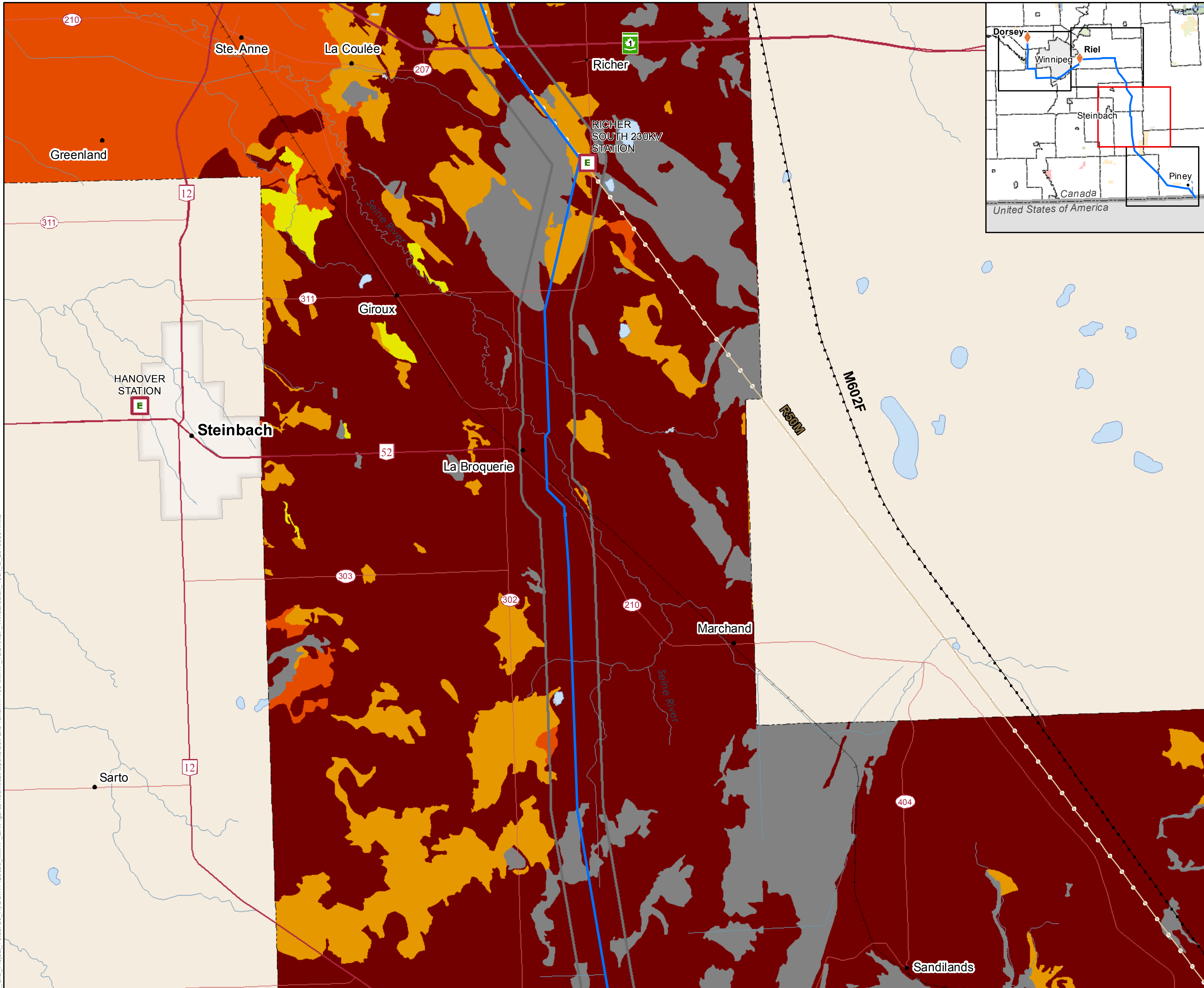
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Wind Erosion Risk

Map 4-700-02




# Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**

- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Wind Erosion Risk** [1]

- N - Negligible
- L - Low
- M - Moderate
- H - High
- S - Severe
- Not Rated

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- City / Town
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

N

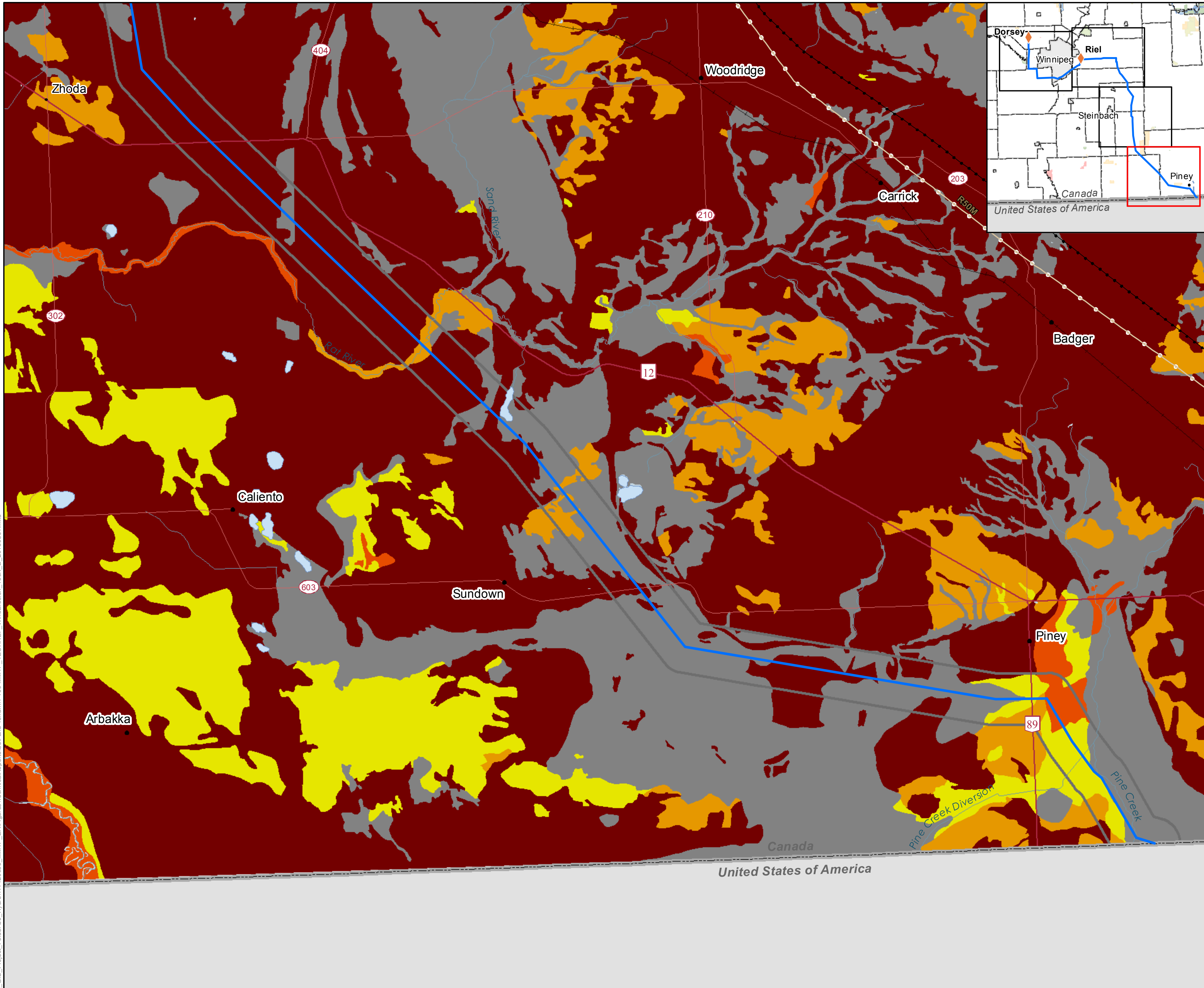
0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Wind Erosion Risk

Map 4-700-03

G:_GIS_Project_Folder\00_Hydro\111420050_MMTP_EA\Figures\TechnicalReports\Soil and Terrain\4-700-MMTP_TECHREP_WindErosion_150K_B_20150804.mxd




Manitoba Hydro

## Manitoba-Minnesota Transmission Project

**Project Infrastructure**

- Converter Station (Existing)
- Final Preferred Route (FPR)

**Infrastructure**

- Electrical Station
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

**Wind Erosion Risk** [1]

- N - Negligible
- L - Low
- M - Moderate
- H - High
- S - Severe
- Not Rated

**Assessment Area**

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

**Landbase**

- Community
- Railway
- Trans Canada
- Provincial Highway
- Provincial Road
- Provincial Boundary

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

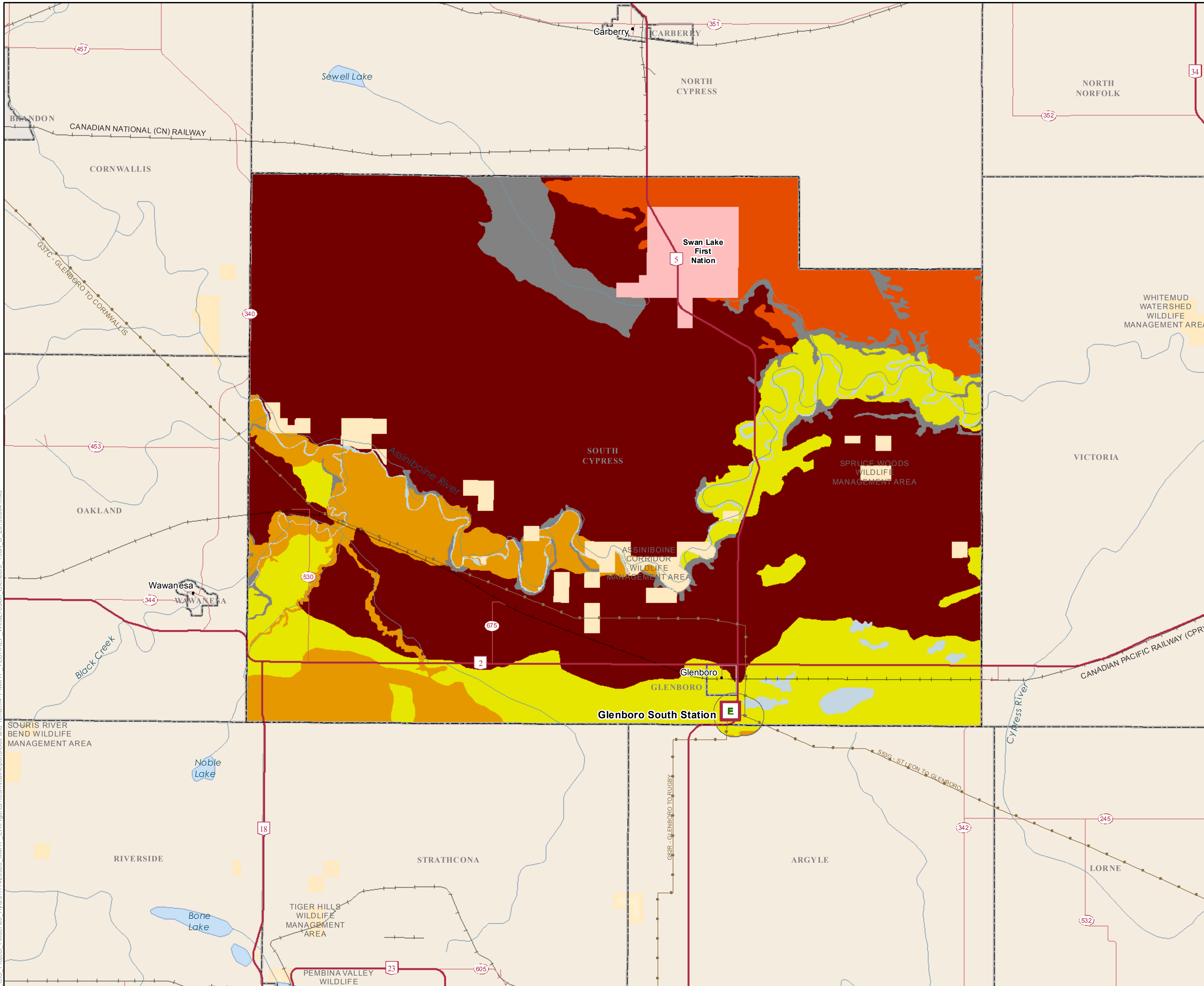
N

0 2 4 Kilometres
0 1.5 3 Miles

1:150,000

## Dominant Wind Erosion Risk

Map 4-700-04




Manitoba Hydro

# Manitoba-Minnesota Transmission Project

Project Infrastructure

- Electrical Station

Infrastructure

- Existing Transmission Line

Wind Erosion Risk [1]

- N - Negligible
- L - Low
- M - Moderate
- H - High
- S - Severe
- Not Rated

Assessment Area

- Agriculture Local Assessment Area
- Agriculture Regional Assessment Area

Landbase

- Community
- Provincial Highway
- Provincial Road
- Railway
- City / Town
- First Nation Lands
- Wildlife Management Area
- Rural Municipality

Source:
1. Soil Resource Inventory, 2015, Stantec.

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 04, 2015

N

0 5 Kilometres
0 2.5 5 Miles

1:200,000

## Glenboro South Station Dominant Wind Erosion Risk

Map 4-7

# Appendix A ADDITIONAL RESULTS

## A.1 EXTENT OF SOIL SERIES IN THE AGRICULTURE PDA AND LAA

### Table A-1: Soil Series Extent

| Soil Name | Soil Series Code | PDA | | LAA | |
|---|---|---|---|---|---|
| | | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Existing Corridor** | | | | | |
| Aneda | AND | 0.7 | 0.0 | 45.1 | 0.2 |
| Agassiz | ASZ | | | 35.2 | 0.2 |
| Berry Island | BYD | | | 1.0 | 0.0 |
| Dencross | DCS | 3.3 | 0.2 | 75.8 | 0.4 |
| Davidson | DVD | | | 11.4 | 0.1 |
| Fisher | FIH | 4.2 | 0.2 | 64.6 | 0.3 |
| Fort Garry | FTY | | | 13.5 | 0.1 |
| Grindstone | GDT | | | 8.4 | 0.0 |
| Glenmoor | GOO | 0.3 | 0.0 | 16.1 | 0.1 |
| Gunton | GUO | | | 8.9 | 0.0 |
| Inwood | IWO | 20.7 | 1.0 | 388.3 | 1.8 |
| Kline | KLI | 26.1 | 1.3 | 468.3 | 2.2 |
| Leary | LRY | | | 4.9 | 0.0 |
| Meleb | MEB | 23.6 | 1.2 | 293.2 | 1.4 |
| Marquette | MRQ | 111.9 | 5.6 | 601.9 | 2.9 |
| Myrtle | MYT | 10.1 | 0.5 | 79.1 | 0.4 |
| Osborne | OBO | 873.9 | 43.9 | 9,637.6 | 45.9 |
| Peguis | PGU | | | 6.5 | 0.0 |
| Red River | RIV | 407.8 | 20.5 | 4,673.7 | 22.2 |
| Rochelle | RLL | | | 3.1 | 0.0 |
| Scanterbury | SCY | 14.0 | 0.7 | 239.9 | 1.1 |
| St Norbert | SOR | 25.9 | 1.3 | 302.6 | 1.4 |

## Table A-1: Soil Series Extent

| Soil Name | Soil Series Code | PDA | | LAA | |
|---|---|---|---|---|---|
| | | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| Seine River | SRE | 6.0 | 0.3 | 36.0 | 0.2 |
| Unclassified land | $UL | 206.1 | 10.4 | 886.2 | 4.2 |
| Urban land | $UR | 252.4 | 12.7 | 3,075.8 | 14.6 |
| Open Water | $ZZ | 2.2 | 0.1 | 29.6 | 0.1 |
| **Total[2]** | | **1989.1** | **100.0** | **21,006.7** | **100.0** |
| **New Right-of-Way** | | | | | |
| Aneda | AND | 14.7 | 1.4 | 291.5 | 1.2 |
| Balmoral | BAM | 28.2 | 2.6 | 696.9 | 2.8 |
| Buffalo Bay | BFY | 34.3 | 3.1 | 786.7 | 3.1 |
| Berlo | BLO | 13.1 | 1.2 | 185.9 | 0.7 |
| Beaverdam Lake | BVR | 21.0 | 1.9 | 753.1 | 3.0 |
| Berry Island | BYD | 12.6 | 1.2 | 484.3 | 1.9 |
| Baynham | BYH | 28.4 | 2.6 | 433.7 | 1.7 |
| Cayer | CAY | 16.5 | 1.5 | 134.7 | 0.5 |
| Caliento | CIO | 2.5 | 0.2 | 199.4 | 0.8 |
| Crane | CRN | 16.2 | 1.5 | 206.2 | 0.8 |
| Cantyre | CYE | | | 14.3 | 0.1 |
| Davidson | DVD | 3.2 | 0.3 | 81.1 | 0.3 |
| Foley | FOY | 11.4 | 1.0 | 253.7 | 1.0 |
| Fyala | FYL | 0.3 | 0.0 | 115.9 | 0.5 |
| Grindstone | GDT | 1.1 | 0.1 | 50.4 | 0.2 |
| Giroux | GRX | 1.4 | 0.1 | 53.9 | 0.2 |
| Garson | GSO | | | 7.1 | 0.0 |
| Gunton | GUO | 7.5 | 0.7 | 280.3 | 1.1 |
| Haute | HAU | 13.8 | 1.3 | 309.4 | 1.2 |
| Halcrow | HCW | | | 20.7 | 0.1 |

## Table A-1: Soil Series Extent

| Soil Name | Soil Series Code | PDA | | LAA | |
|---|---|---|---|---|---|
| | | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| Howell | HWL | 3.0 | 0.3 | 66.4 | 0.3 |
| Inwood | IWO | 71.8 | 6.6 | 1,842.2 | 7.3 |
| Kircro | KIC | 36.0 | 3.3 | 1,061.0 | 4.2 |
| Kline | KLI | 41.7 | 3.8 | 734.4 | 2.9 |
| Katimik | KMK | 15.6 | 1.4 | 383.6 | 1.5 |
| Kergwenan | KRW | 17.7 | 1.6 | 250.0 | 1.0 |
| Kerry | KRY | 33.1 | 3.0 | 664.9 | 2.6 |
| La Broquerie | LAB | 3.3 | 0.3 | 164.5 | 0.6 |
| Lambert | LAM | 13.1 | 1.2 | 255.0 | 1.0 |
| Leary | LRY | 4.3 | 0.4 | 110.5 | 0.4 |
| Lonesand | LSD | 32.4 | 3.0 | 766.7 | 3.0 |
| Ladywood | LYW | | | 4.9 | 0.0 |
| Marchand | MAR | 1.4 | 0.1 | 116.1 | 0.5 |
| Medika | MDK | 6.7 | 0.6 | 104.4 | 0.4 |
| Meleb | MEB | 60.5 | 5.6 | 1,231.1 | 4.9 |
| Magnet | MGT | | | 2.9 | 0.0 |
| McKinley | MLI | | | 10.4 | 0.0 |
| Malonton | MNT | 229.5 | 21.1 | 4,100.5 | 16.2 |
| Marquette | MRQ | 3.9 | 0.4 | 258.2 | 1.0 |
| Mud Lake | MXB | | | 14.9 | 0.1 |
| Murray Hill | MYI | 40.2 | 3.7 | 540.8 | 2.1 |
| Osborne | OBO | | | 60.4 | 0.2 |
| Okno | OKO | 5.3 | 0.5 | 189.4 | 0.7 |
| Orok | OOK | 0.6 | 0.1 | 66.8 | 0.3 |
| Overflowing | OVO | | | 118.0 | 0.5 |
| Pansy | PAN | 78.6 | 7.2 | 1,818.5 | 7.2 |
| Partridge Creek | PGE | | | 31.5 | 0.1 |

## Table A-1: Soil Series Extent

| Soil Name | Soil Series Code | PDA | | LAA | |
|---|---|---|---|---|---|
| | | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| Peguis | PGU | 2.3 | 0.2 | 149.7 | 0.6 |
| Piney | PIY | 18.0 | 1.7 | 255.4 | 1.0 |
| Pelan | PLN | 6.1 | 0.6 | 402.7 | 1.6 |
| Poppleton | PPL | 14.5 | 1.3 | 461.9 | 1.8 |
| Prawda | PRA | 5.3 | 0.5 | 171.9 | 0.7 |
| Pine Ridge | PRG | 2.1 | 0.2 | 104.3 | 0.4 |
| Red River | RIV | | | 65.3 | 0.3 |
| Reed River | RRV | 4.2 | 0.4 | 242.2 | 1.0 |
| Rat River | RTV | 41.7 | 3.8 | 748.1 | 3.0 |
| Sandilands | SDI | 6.5 | 0.6 | 140.7 | 0.6 |
| Sirko | SIK | 24.5 | 2.3 | 267.1 | 1.1 |
| St Labre | SLB | 5.7 | 0.5 | 114.3 | 0.5 |
| Shelley | SLY | | | 103.0 | 0.4 |
| Summerberry | SMY | 1.6 | 0.1 | 45.3 | 0.2 |
| Sprague | SPG | | | 42.4 | 0.2 |
| Stead | STD | 18.7 | 1.7 | 600.2 | 2.4 |
| Santon | STO | | | 66.1 | 0.3 |
| Sundown | SUW | 7.9 | 0.7 | 313.5 | 1.2 |
| Vita | VIT | | | 22.2 | 0.1 |
| Whithorn | WHI | | | 28.3 | 0.1 |
| Waskwei | WKW | | | 168.8 | 0.7 |
| Wampum | WMP | | | 33.4 | 0.1 |
| Woodridge | WOG | 3.6 | 0.3 | 412.0 | 1.6 |
| Unclassified land | $UL | | | 212.0 | 0.8 |
| Open Water | $ZZ | 2.4 | 0.2 | 43.1 | 0.2 |
| **Total[2]** | | **1,090.4** | **100.0** | **25,541.1** | **100.0** |

## Table A-1: Soil Series Extent

| Soil Name | Soil Series Code | PDA | | LAA | |
|---|---|---|---|---|---|
| | | Extent (ha) | Proportional Extent (%) | Extent (ha) | Proportional Extent (%) |
| **Glenboro South Station** | | | | | |
| Landseer | LSR | | | 11.1 | 2.2 |
| Oberon | OBR | 2.8 | 50.0 | 202.5 | 40.3 |
| Oliver | OIV | | | 11.1 | 2.2 |
| Sutton | SXP | 0.6 | 10.0 | 34.8 | 6.9 |
| Wellwood | WWD | 2.2 | 40.0 | 205.6 | 41.0 |
| Open Water[1] | $ZZ | | | 36.9 | 7.4 |
| **Total[2]** | | **5.6** | **100.0** | **501.9** | **100.0** |
| **Dorsey Station** | | | | | |
| Marquette | MAR | | | 45.0 | 11.8 |
| Osborne | OSBd | 1.6 | 100.0 | 174.1 | 45.7 |
| Peguis | PGU | | | 6.3 | 1.6 |
| Red River | RIV | | | 155.3 | 40.8 |
| **Total[2]** | | **1.6** | **100.0** | **380.6** | **100.0** |
| **Riel Station** | | | | | |
| Dencross | DCS | 10.0 | 13.5 | 21.7 | 2.9 |
| Osborne | OSB | 25.6 | 34.5 | 164.4 | 21.7 |
| Red River | RIV | 38.6 | 52.0 | 277.2 | 36.6 |
| Unclassified Land | $UL | | | 294.4 | 38.9 |
| **Total[2]** | | **74.3** | **100.0** | **757.7** | **100.0** |

Notes:
1 Open water = surface water features such as rivers and lakes.
2 Values might not sum to totals shown because of rounding.