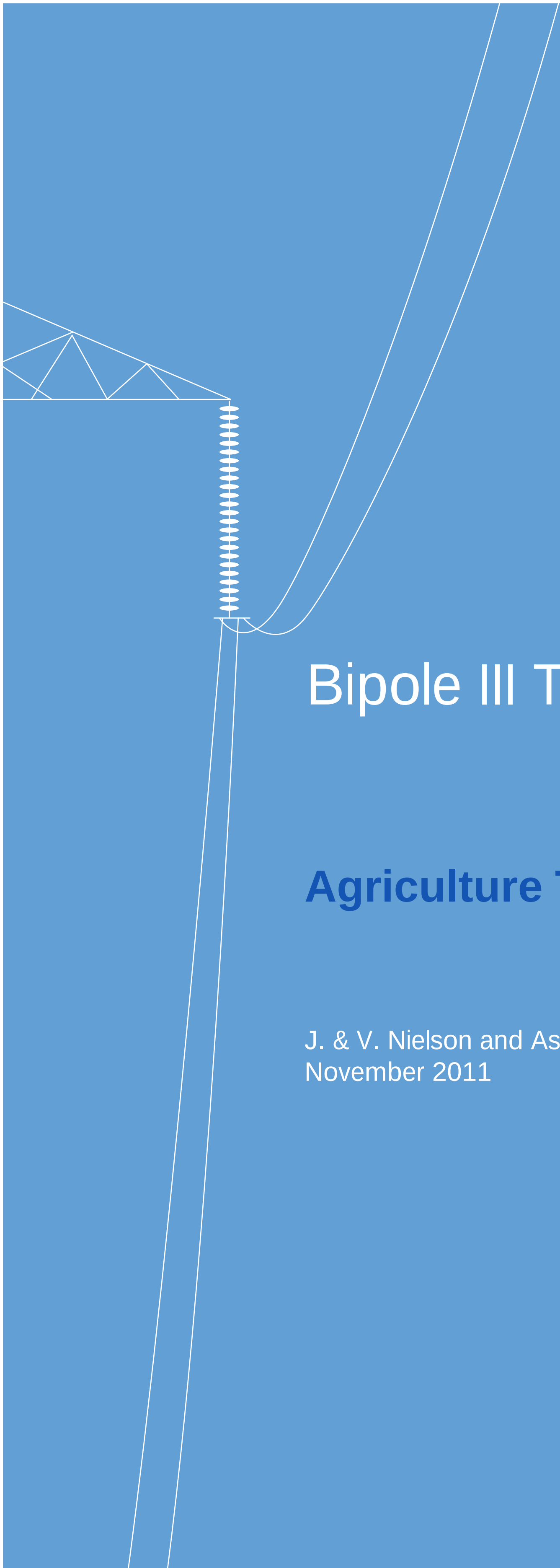

Bipole III Transmission Project

Agriculture Technical Report

J. & V. Nielson and Associates Ltd.
November 2011

BIPOLE III

AGRICULTURE TECHNICAL REPORT

Selection and Environmental Assessment (SSEA)

November 2011

Manitoba Hydro

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF MAPS

LIST OF APPENDICES

PREFACE

SITE SELECTION AND ENVIRONMENTAL ASSESSMENT PROCESS

Manitoba Hydro transmission projects utilize a Site Selection and Environmental Assessment (SSEA) process to better understand the potential issues and concerns associated with the routing and siting of the transmission line and components. The specific objectives of the SSEA process were to:

- Provide a description of the proposed transmission facilities to all stakeholders and the public;
- Select alternate routes and sites for transmission lines and associated facilities in a technically, economically and environmentally sound manner;
- Assess the potential impacts of the proposed transmission line and its associated facilities;
- Conduct the SSEA process with consideration of local input from potentially affected First Nations and other aboriginal communities, other communities and municipalities, land and resource users, interest groups, resource managers, and the public at large, in a responsive, documented and accountable fashion;
- Find practical ways to mitigate potential negative effects and enhance benefits; and
- Prepare an Environmental Impact Statement (EIS) that documents the results of the SSEA process.

Through the SSEA process, three alternative route corridors were identified. The alternative routes selected avoided significant sensitivities where possible, and sought to minimize potential effects where avoidance was not possible or practical. During the course of the route selection process, several adjustments were made to the original alternative route segments based on additional input provided by the Environmental Assessment study team and various stakeholders (e.g., mining and agricultural interests).

A route selection matrix was developed to facilitate the evaluation of alternative routes on a segment-by-segment basis. The alternate routes were separated into 13 sections and evaluated and compared, by segment, considering geographic features, potential opportunities, technical considerations and professional judgment.

A total of 28 factors were identified to evaluate the alternative routes. These factors included a full range of biophysical, socio-economic, land use, technical and stakeholder considerations. Evaluation criteria were identified for each factor that would facilitate three-tier (high, medium and low) ranking. Biophysical, socio-economic and land use rankings were based on the degree to which the factor is affected. Technical rankings were based on the degree to which the factor is a constraint while stakeholder rankings were based on the nature and degree of response.

The Aboriginal Traditional Knowledge (ATK) was considered separately for agricultural areas. Generally routing avoided First Nations lands and lands identified as to be purchased by the community.

The conclusion of the route evaluation and analysis process resulted in the selection of a Final Preferred Route (PPR) for the Bipole III transmission line. From an agricultural perspective the most favourable line routing was chosen.

1.0 INTRODUCTION

Manitoba Hydro is proposing to construct a 500 kV HVdc transmission line from Riel Converter Station located east of Winnipeg to the Keewatinoow Converter Station near the proposed Conawapa Generating Station located on the Nelson River. A Site Selection and Environmental Assessment (SSEA) study has been conducted for the Bipole III transmission line. The overall length of the line is about 1376 km located on a 66 m wide right-of-way.

Two basic tower types will be used for the straight line sections of the transmission line. In northern Manitoba and forested/pasture areas in the south, the line conductors will be suspended from guyed lattice steel towers. In the more densely developed areas of southern Manitoba, self-supporting lattice steel towers will be used to minimize potential effects on farming practice (i.e., to reduce the tower footprint) and to reduce the land acquisition requirement. Typical tower dimensions will be 45 m in height with a 7.8 m square base footprint for self-supporting towers. Towers will be spaced approximately 480 meters apart in most areas.

Prior to construction, the right-of-way and required easements will first be surveyed and flagged to establish the line alignment. Clearing and disposal of trees on the proposed right-of-way will be undertaken in advance to facilitate construction activities.

The new southern converter station will include the HVdc switchyard facilities necessary to terminate the new Bipole III transmission line, together with the converters and the ancillary facilities required to convert the dc power from the Bipole III transmission line to ac power at the 230 kV level necessary for injection into the southern receiving system. The southern converter station will be located at the existing Riel station site in the RM of Springfield, east of Winnipeg, which is now under construction for sectionalization purposes. Site development under the sectionalization project will include the portion required for the converter station site.

Construction activities for the converter station development will involve necessary civil works and installation of systems (e.g., foundations for building and equipment, grounding arrangements, water supply, oil spill containment, site services and buildings). Station apparatus and equipment installation will follow, including filling of equipment with insulating oil, construction clean-up and commissioning.

The ground electrode required for Riel converter station will be located approximately 20 km from the station site. On the assumption of a shallow land ring electrode (similar to the electrodes used at the existing Henday and Radisson converter stations), the electrode will be a buried iron ring approximately 500 m in diameter and will require a site area in the order of one mile square, together with an access road for construction and ongoing maintenance. There will also be a low voltage line connection between the ground electrode site and the converter station.

The agricultural study area is approximately 567 – 700 km in length and 33 – 217 km wide (Map 1). It is generally bounded by Winnipeg, Steinbach and Carman to the south, Portage La Prairie to Austin along Highway 1, and Westbourne, Neepawa, Minnedosa, Shoal Lake and Russell along PTH 16. To the north the study encompassed the area on the west side from the Saskatchewan border north past the Riding, Duck and Porcupine Mountains to the east side along the shores of Lake Manitoba and Lake Winnipegosis. The study area continued north along the Saskatchewan border to the west and on the east it followed the western shores of Lake Manitoba and Lake Winnipgosis north to Mafeking. North of Mafeking agricultural activities were nonexistent except in and around The Pas.

Agricultural land use in the study area between Riel and The Pas is diverse with intensive cropping in the south, east, and west from Riel Station to PTH 16. Mixed livestock production and grain farming occur along portions of the remaining route and are in association with large tracts of land that have little to no agricultural activity although some grazing and haying does occur. Many smaller farm and rural residential holdings are found in southern areas as result of an outflow of people from larger urban settlements such as Winnipeg, Carman and Portage la Prairie. From an agricultural perspective the transmission line routing process attempts to locate the transmission line in areas with the least intensive agricultural use and next to the road allowance where possible on the mile line where cropped land is to be crossed; however, half-mile line placement is a consideration in irrigation areas and to avoid farm yards. Structure placement along existing linear features (road allowances and drainage ditches) or land ownership boundaries (half mile lines) is expected to moderate the amount of land taken out of production, production costs, and general inconvenience to farming next to structures. Diagonal and in-field placement creating agricultural management unit splits are avoided as much as possible, as are irrigated lands and lands with irrigation potential.

The initial routing had the Bipole III line placed on the one half mile line where feasible. A decision was then made by Manitoba Hydro to place the transmission line on the road allowance. The line analysis was conducted with the line situated on the edge of the road allowance. Upon further review, Manitoba Hydro determined that placement of towers close to the road allowance had safety/reliability issues. The following outlines some of the concerns:

1. **Reliability Concerns**
   Towers may be subject to vehicle collisions if placed near the edge of a road allowance. Collisions can cause tower leg damages and can potentially cause tower collapse depending on the impact. Due to the importance that Bipole III will play in the system, to minimize the potential for these types of accidents it was determined that an in-field placement is desirable.

2. **Clearance Violations**
   If Bipole III towers are erected on the edge of a road allowance, one of the conductor bundles will overhang the road allowance. This could lead to safe clearance infractions since Manitoba Hydro would not have the right to restrict any developments within the road allowance. An example of such an infraction can be erection of signage or light standards.

As a result of the above, Manitoba Hydro decided that an in-field placement for the towers would be necessary. The decision was made prior to round four of the consultation process.

During the fourth round of the consultation process, Manitoba Hydro participants noted a general concern over the effects to agricultural lands due to tower placement, as well as the general nuisance they felt would be caused by the transmission line. Some members of the farming community noted the challenges of working around large towers that were situated near road allowances, especially with respect to weed management. They indicated that they would be unable to navigate between the tower and road allowance with their spraying equipment that is large and cumbersome with the proposed in-field placement. Some individuals expressed a desire to have towers located further in-field to be to able to navigate between the tower and the road allowance.

To address the concerns heard during round four, if the project is licensed, Manitoba Hydro decided that south of PTH 16 towers would be placed into the field from the edge of the road allowance to allow large sprayer equipment to manoeuvre around towers. North of PTH 16 the towers would be placed 33 m from the edge of the road allowance. The reason for the difference in tower locations between north and south of PTH 16 is that much of the land south of the highway is intensively cultivated and requires large spraying equipment that could not be accommodated if the towers were located 33m from the edge of the road allowance. North of the highway lands are not intensively cultivated for the most part (e.g., hay, bog, bush) and does not require such spraying equipment.

2.0 LITERATURE REVIEW

2.1 INTRODUCTION

The literature review has been developed based on agriculture topics relevant to the project. The first part covers the rationale behind transmission line placement, cost to work around the poles and towers and mitigation measures to be considered. The remainder of the discussion addresses the relationship between transmission lines and irrigation systems.

2.2 TRANSMISSION LINE LOCATION AND CONCERNS

Routing a 500 kV DC transmission line through agricultural Manitoba can create land owner and farm operator issues and concerns. The literature on this topic is quite comprehensive and reflects effects and impacts on agricultural producers.

The literature on this topic includes a number of comprehensive reports and books which summarize scientific papers. The Environment Council of Alberta commissioned a report on the impact of transmission lines on agriculture (Webb, 1982). The paper identified the loss and fragmentation of agricultural land as a general concern related to high voltage transmission lines crossing agricultural lands. It indicated that placing transmission towers on cultivated farm land increases the cost of farming primarily because of the additional time needed to farm around the towers and extra cost associated with weed control. This document recommended that transmission lines avoid cultivated and irrigated land and, where possible, be placed on less productive agricultural land. It also recommended that lines be routed on existing linear features such as road allowances, fence lines, quarter section lines, abandoned railway rights-of-way, etc., and avoid farm residences and livestock facilities, wherever feasible. Webb (1982) suggests it is preferable to locate transmission lines on the road allowance or immediate edge of the field rather than in the field; however, if the transmission line had to be located in a cultivated field, boundary lines were preferred to diagonal lines as towers situated parallel to the direction of travel of machinery result in less loss of production, time, and income than towers which cross a field diagonally. The document suggests that diagonal lines will likely be shorter than lines following field boundaries and may have less total impact on agriculture by comparison. In Saskatchewan a proposal to have a large transmission line cross the agricultural land fabric diagonally created concern within the farm community affected (Western Producer, September 28, 1995).

When transmission line structures are placed on agricultural land, there is a cost to the farmer for this imposition (Hanus, 1979). Although Bipole III will not be using double pole structures, the ensuing discussion provides context on the costs associated with transmission lines in an agricultural setting. Hanus (1979) found double pole structures placed in cultivated land removed 37.9 square meters of land per tower and a steel tower removed 86.1 square meters of land from production while yield reduction from extra cultivation, seed, fertilizer and chemicals on the overlapped area was 8.5% to 18.8%. In a farm survey where 148 farmers responded Hanus (1979) found weeds were a problem within 15 to 18 meters (50 to 60 feet) of the structures, decreasing yield by 10%. The study suggested loss of production from land removed from agricultural use was $13.06 (all figures adjusted for inflation at 2.84 times from 1979 to 2010 as per Bank of Canada Inflation Factor Adjustment) per double pole and $16.76 per steel tower, and that the cost of farming around the two structures was $75.54 and $89.46 per year, respectively (based on a crop value of $200.00 per acre). This included consideration for production loss, value of extra time to farm around structures and cost of weed control. Hanus (1979) reports farmers remembered damage on their farms during construction of the transmission lines including damage to existing crops, shelterbelts, fences, and drainage and/or irrigation ditches. Other effects identified by interview respondents (Hanus 1979):

- Transmission lines in fields resulted in decreased efficiency of field operations from reduced speeds and overlapped field operations, and extra time was required to work around the structure;
- Risk of colliding with structures was great as every second respondent in the farm survey had hit a structure at least once;
- Some aerial spray applicators did not want to spray fields with transmission lines in them;
- Some interviewees felt that pivot irrigation systems and transmission lines were not compatible;
- Care must be taken on sensitive grazing range to have construction occur when it does not damage the native forage range;
- All machinery could be safely operated under the lines as clearance was adequate;

- Farmers felt the negotiation process at the farm level was inadequate; and
- Farmers believed compensation should be paid annually (to be renegotiated every five years).

A list of typical mitigation measures suggested by Rumsey (1993) include:

- Minimization of or elimination of diagonal crossing of fields;
- Specification of tower spacing at 0.4 km (1/4 mile) intervals;
- Specification of a single pole tower design in agricultural areas;
- Timing of the construction of the transmission line prior to normal planting periods or after normal harvest periods; and
- Commitment to greater than required conductor to ground clearances [specifically to 12.5 m. (41 ft.)] in agricultural areas where aerial applicator applications are common.

Rumsey (1993) concluded there are residual effects after all the mitigation measures have been applied. Where possible they calculate residual impacts in monetary terms related to impact on agricultural production and agricultural operations. However, he concludes the last, and very real problem, is the comparison of the residual agricultural impacts with other resources similarly such as visual, archaeological, recreation and environmentally protected resources. Final routing decisions for transmission lines must ultimately consider the most economic routing but also the one least disruptive to the environment as a whole.

For the construction of a 345 kV electric transmission line through agricultural lands, the Northern States Power Company adopted the following mitigation measures (Minnesota, USA) (2009):

- Discussion with landowners regarding pole location;
- Removal of excess soil, rock, and construction debris;
- Soil restoration through fertilization, liming, ripping and/or chiseling; and
- Weed control.

The Illinois Department of Agriculture has published an Electric Transmission Line Construction Standards and Policies directive (Retrieved November 15, 2010). Where possible it notes that a transmission line will be placed parallel or adjacent to roads and/or railroad right-of-ways. The State of Wisconsin recommends placing transmission lines on road allowances, property lines or sections line. This routing minimizes the effect the line has on agriculture. In their Environmental Impacts of Transmission Lines publication (*Public Service Commission of Wisconsin, 2009*), Wisconsin recognizes the impacts of pole placement on agriculture. Pole placement can have the following effects according to the utility:

- Create problems for turning field machinery and maintaining efficient field work patterns;
- Create opportunities for weed encroachment;
- Compact soils and damage drain tiles;
- Result in safety hazards due to pole and guy wire placement;
- Hinder or prevent aerial activities by planes or helicopters;
- Interfere with moving irrigation equipment; and
- Hinder future consolidation of farm fields or subdividing land for residential development.

To mitigate the impact of pole placement on the lands, the following actions are recommended by the utility:

- Working with landowners on optimal pole location and height;
- Placing poles along fence lines and roads;
- Using larger structures with longer spans and less poles;
- Orientating pole to plowing pattern;
- Keeping guy wires outside crop or hay land and making the wire highly visible;
- Minimizing pole height in areas where aerial spraying is common;
- Constructing transmission lines during winter when soil compaction would be minimized; and
- Trimming wind breaks and/or planting lower-growing trees.

2.3 IRRIGATION

Irrigating crops around and near a large transmission line creates concerns related to the physical operation of quarter section pivot irrigation system. Concerns center around hitting the transmission line towers with the pivot and additionally from concerns over the water stream hitting the transmission wires. Operating irrigations systems safely is a major objective. There are many articles in the literature on these topics.

The interaction between transmission lines and irrigation systems is a concern *(Edy et al., 1981*). Physical contact between an irrigation system and power lines in installation, operation and maintenance must be avoided (*Edy et al., 1981*). Edy recommends that direct contact of the water stream on the transmission line should be avoided and that utility companies should develop plans to mitigate problems and educate farmers. The study suggests that the main factors that influence the safety of the irrigation system include grounding, water conductivity, line to a nozzle distance, nozzle diameter, the turbulence of the stream due to the type of nozzle and its mounting, the wind velocity, and the line voltage. Grounding was important and was considered difficult to accomplish in traveler irrigation systems.

Irrigation systems can work in close proximity to transmission lines *(Roy et al., 1981)*. This document describes how part of a centre pivot irrigation system passed underneath a 765 kV transmission line for four years as part of its normal circular path. It pointed out that the main part of the system, which sprayed down, was 3.8 meters above the ground and 9.9 meters below the line, while the end gun sprayed 10 meters above ground at the highest point making the spray a minimum of 3.7 meters below the line. Roy et al. (*1981*) concluded that properly installed large irrigation systems can be operated under larger transmission lines.

The greatest potential for induced current on the irrigation equipment comes when systems such as wheels, laterals or pivots are set in a stationary position near and parallel to transmission lines *(Ewy et al., 1981; Roy et al., 1981)*. These studies also suggest that even a small deviation from the parallel position of the system to the transmission line greatly reduces the risk of induced current occurring. The documents suggest that the problem of induced current was greatest when tires on the system were dry and the crop was not touching the machine.

Both Ontario Hydro and SaskPower have developed information brochures for farmers irrigating next to a transmission line. They stress the same points which have been made in the scientific literature. These are:

- Do not unload or handle irrigation pipes in a vertical position under a transmission line;
- Do not allow a solid stream of water to come in contact with the line. Using nozzles which break up the water stream is a way to prevent current flow. Even with water

broken up, a hazard may still exist if products such as fertilizer are added to the water because they increase water conductivity;

- Build systems perpendicular, not parallel to the lines. Plastic pipe placed intermittently in the metal system also minimizes induced voltages and current;
- Do not store movable wheel-type or other systems parallel to the line within 30 meters of the line;
- Ensure the irrigation system is grounded; and
- Vehicles should not exceed a certain height.

SaskPower places a high priority on avoiding irrigation systems with transmission lines *(B. Bolen, 1993, pers. comm.)*. If the system is in place, they go around it, or avoid it completely. Bonneville Power Authority also avoids irrigation if at all possible, or helps farmers to redesign their irrigation systems around the utility infrastructure.

Six utility companies surveyed in Canada and the United States (Alberta Power, SaskPower, Ontario Hydro, Bonneville Power Authority, United Power Association, Northern States Power [all pers. comm.]) reduced the impact of transmission lines on irrigation by taking one or more of the following steps:

- Use taller and fewer structures (long spans);
- Route transmission lines between sections of land;
- Follow existing rights-of-way, fence lines, corridors or naturally occurring land features;
- Avoid routing transmission lines diagonally;
- Help to redesign irrigation systems to go around the utility infrastructure;
- Negotiate compensation for impacts;
- Consult with individual landowners; and
- Provide written brochures on precautions to take when using irrigation systems near transmission lines.

The British Columbia Ministry of Agriculture and Food has published an Irrigation Factsheet (2003) that outlines how to design irrigation systems to prevent current transfer. The maximum stream height of the nozzle is measured and the distance that stream is from the transmission line. The clearance required between the irrigation jet and the transmission line is a function of the voltage of the conductor. The Irrigation Factsheet has specific formulas for calculating the height of the irrigation water and distance the nozzles must be from the transmission line to prevent current transfer.

Manitoba Hydro's view on irrigation systems is as follows (Personal communications 2011):

Irrigation systems operating in proximity of energized transmission lines pose a number of hazards to the personnel on the ground and their equipment as well as to Manitoba Hydro due to:

- Electric flashovers caused by water spray contacting energized conductors;
- Electric flashovers during installation or maintenance of the irrigation equipment and contacting energized conductors; and
- Line outages causing disturbance to Manitoba Hydro system.

Safe co-existence of both transmission lines and irrigation systems is possible providing the following safety measures are taken:

- Safe separation between irrigation pivot and energized conductors is maintained;
- Safe spray irrigation clearances to energized conductors are maintained; and
- Safe operating procedures are followed to install and maintain the irrigation system.

It is impossible to provide a one-stop-shop solution to all irrigation system issues. Each case will have to be dealt with individually to assess its physical size and operating mode and to determine if the location of the Bipole III corridor and its towers will interfere with safe irrigation. If conflict occurs the following mitigation measures should be considered:

- Relocate the Bipole III centre line and tower locations;
- Change irrigation operation scheme (i.e., adjustments of spray nozzles, change in overall geometry); and
- Relocate irrigation system.

3.0 METHODS AND PROCEDURES

The agricultural study area was characterized, numerous alternate routes were developed through agricultural Manitoba and the impacts of the alternative routes on agriculture were assessed. The production potential and usage of the soils in the project area were mapped and intensively utilized agricultural areas were identified. The major agricultural issues addressed in the assessment of alternative routes and to determine the potential impact of the proposed route were:

- Agricultural land use along the proposed routes (i.e., farm yards, livestock facilities, irrigation, row cropping, intensive crop production, tame and native hay and pasture land, and shelterbelts);
- Impact on agricultural operations;
- Impact on intensive field activities including irrigation; and
- Selection of alternative routes to lessen potential impacts of the transmission line.

The work began by characterizing the study area. Agricultural use was examined through the use of:

- The Canada Land Inventory (CLI) Soil Capability Maps for Agriculture for the Study Area;
- The Canada-Manitoba Soil Survey, Reconnaissance Soil Survey Maps for the Study Area;
- Aerial photography;
- Ground and air reconnaissance conducted throughout the study area; and
- R.G. Eiders and J.G. Nielsen. 2010 *A Description of Soils and Major Agricultural Activities in the Study Area.* Prepared for Manitoba Hydro, Winnipeg. (Appendix A).

Between Riel and Mafeking and around The Pas the primary land use is for agricultural purposes. Since the new 500 kV HVdc transmission line must cross some of these lands it is necessary to identify types of agricultural use and place a priority on these uses to assist in the selection of the best transmission line route. Beginning with the highest priority, agricultural activities to avoid with the 500 kV HVdc transmission line are as follows:

- Dwellings and farm yards;
- Intensive livestock operations;
- Lands under irrigation;
- Lands with irrigation potential;
- Row crop areas;
- Intensive annually cropped areas;
- Tame forage areas;
- Mixed farming areas with some cultivated land;
- Native pasture and hay lands; and
- Lands with limited/no agricultural use.

The following are the general guidelines for routing transmission lines through agricultural lands:

- Route on or adjacent to road allowance;
- Follow linear features where possible;
- Route along the half mile to avoid farm yards, livestock barns, irrigation pivots and other higher priority obstacles;
- Avoid in-field placement in cultivated lands under annual crop production; and
- Placement parallel to the road allowance is preferred to diagonal placement.

3.1 SCOPE

The scope of work assigned to J. & V. Nielsen and Associates Ltd. began with the development of numerous alternate transmission line routes throughout agricultural Manitoba beginning at Winnipeg and Riel Converter Station and traveling south, west of Steinbach, and west, north of Carman, past Brandon on the south and north sides, then west and north on the west side of the Roding and Duck Mountains. The route went north and west over the Assiniboine River along the Arden Ridge, past McGregor and Bagot and north to HWG 50 the north of Lakes' Manitoba and Winnipegosis, east of the Riding and Duck Mountains and the Saskatchewan border to the Porcupine Hills at Mafeking and in the agricultural area at The Pas. The various routes were presented to MMM and Manitoba Hydro and subsequently three alternative routes were selected. After a look at the routes various modifications were made prior to the selection of the Final Preferred Route. Diagonal lines were removed where practical. Where possible these routes avoided farm houses, rural residential houses and buildings, farm yards, better quality agricultural land, lands belonging or entitled to First Nations, protected area lands, and wildlife habitat lands (e.g., Ducks Unlimited Canada, Manitoba Habitat Heritage Corporation), irrigation pivots, barns, and large sheds .

4.0 THE STUDY AREA BOUNDARIES

The agricultural study area is approximately 567 – 700 km in length and 33 - 217 km wide. It is generally bounded by Winnipeg, Steinbach and Carman to the south, Portage La Prairie to Austin and Brandon along Highway 1, and Westbourne, Neepawa, Minnedosa, Shoal Lake and Russell along PTH 16. To the north the study encompassed the area on the west side from the Saskatchewan border north past the Riding, Duck and Porcupine Mountains to the east side along the shores of Lake Manitoba and Lake Winnipegosis. The study area continued north along the Saskatchewan border to the west and on the east it followed the western shores of Lake Manitoba and Lake Winnipgosis north to Mafeking. North of Mafeking agricultural activities were nonexistent except in and around The Pas.

4.1 AN AGRICULTURAL DESCRIPTION OF THE STUDY AREA

4.1.1 Agricultural Setting

The study area between Riel Station and Mafeking, north of Swan River, between the Saskatchewan border and Lakes Manitoba and Winnipegosis and in and around The Pas encompasses a very large portion of agricultural Manitoba. Agricultural land use across the land base is diverse with intensive cropping east, south and west of Winnipeg in the Red River Valley, north to PTH 16, along PTH 5 past McCreary and Laurier, south, east and west of Dauphin, and through the Swan River Valley. Active and potential irrigation areas were found from Carman to Elm Creek, St. Claude, Rathwell, across the Assiniboine River to Austin, MacGregor, Bagot and Portage la Prairie, and north to Beaver, Arden and Gladstone.

From Riel Station to the east side of the Red River the study area encompasses flood prone lacustrine clay soils where intensive crop production is prevalent. Wheat, oats, barley, canola, soybeans and alfalfa are the main crops produced. Between Highway # 1 east of Winnipeg and the Red River, there are many towns and villages, numerous farms with residences and other rural residences, and many intensive livestock production facilities. Irrigation potential for the area is low.

On the west side of the Red River the lacustrine clay soils continue on past Sperling and Brunkild, in the Rural Municipalities (R.M.'s) of Macdonald and Morris, to Carman and Elm

Creek, in the R.M.'s of Dufferin and Grey. In this area the soils are not as flood prone compared to the east side of the Red River. West of the Red River there are fewer towns and villages, farm yards, other rural residences, and large scale livestock operations. The irrigation potential is still low and intensive crop production is normal for the area with similar types of crops being produced.

The clay soils turn to sandy soils at Carman to Elm Creek. The sandy soils have irrigation potential and quarter-section irrigation pivots are common for the production of potatoes and some other crops. The sandy soil treed area contains numerous smaller farms and many rural residences. These are found from Carman to Elm Creek, St. Claude, Rathwell in the R.M. of Grey, and to the Assiniboine River. All types of crops are produced from potatoes, corn, wheat, oats, barley, canola, sunflowers, alfalfa, peas and other pulse crops. Mixed farming is common with the utilization of tame pasture and alfalfa hay as well as native grazing and haying in sandy dunned soil areas. Active pivot irrigations systems exist north of Carman and west of St. Claude.

The sands with irrigation potential continue across the Assiniboine River and north past Highway #1 to Gladstone in the R.M. of Westbourne. Active pivot irrigation systems are found on both sides of the Assiniboine River on the lower side of the Arden Ridge, as well as south and north of Bagot, MacGregor and Austin. Several new irrigation pivots are found south of the community of Beaver in the R.M. of North Norfolk. North of Beaver the soils are more clay based and therefore they have less potential for irrigation.

The study area east of Riding Mountain crosses PTH 16 and follows PTH's 5 and 50, and continues north past the Big Grass Marsh in the R.M. of Alonsa, including the communities of Neepawa, Plumas, McCreary, Langruth, Alonsa, Ste Rose du Lac and Eddystone (through the R.M.'s of Langford, Lawrence, Rosedale, Westbourne, Lakeview, Glenella, McCreary, Ste. Rose, and Alonsa). From Neepawa north along PTH 5 there is more intensive agricultural crop production which continues north past the town of Ste. Rose du Lac to Rorketon (east of Dauphin Lake) and northwest from the village of McCreary to the city of Dauphin, the village of Ethelbert and on to Cowan. Intensive cropping with some mixed farming is found on the east side of Riding Mountain to PTH 5 and a few miles east of PTH 5. Further east of PTH 5, soils have lower agricultural capability and are mainly used for hay and pasture with a few cultivated fields producing annual crops. These less intensively utilized soils continue north past Ste. Amelie to the east and to the north of Rorketon. Comparatively, the land use from Laurier, in the

R.M. of Ste. Rose past the city of Dauphin to the community of Cowan, in the R.M. of Mountain (South), varies significantly from areas of intensive crop production to areas of native hay and pasture.

The east side of the Westlake area (so described as it is on the west side of Lake Manitoba) has less productive agricultural soils and less intensive livestock farming activities. From Eddystone and Ste. Amelie to the north side of Rorketon agricultural use is limited to sporadic livestock production (i.e., haying and grazing with the odd cultivated field). Many soils along PTH 50 have lower agricultural capability and are mainly used for hay and pasture with a few cultivated fields producing annual crops. From Alonsa to Eddystone large tracts of land have little to no agricultural activity although some grazing and haying does occur. The same conditions exist from Eddystone to east of Rorketon in the R.M. of Lawrence. From Rorketon to Winnipegosis, in the R.M. of Mossey River, agricultural activities are somewhat more intense with more cultivated fields intermixed with native haying and grazing. The Winnipegosis area has more intensive agricultural use with more cultivated fields found nearer to the Village of Winnipegosis. A large bog area found west of the Village of Winnipegosis to Cowan and on to the community of Lenswood, in the R.M. of Mountain limits the extent where agricultural usage occurs except for small areas at the community of Pulp River and east of Cowan. From Lenswood to the northern edge of the Swan River Valley more cultivated lands are found. From the north side of the Swan River Valley to PTH 10 north of Mafeking most soils are in bogs with only a few cultivated areas.

From the Neepawa area west the study area extends south of Riding Mountain through the towns of Minnedosa, Shoal Lake and Russell along PTH 16 and north to PTH 45 through the western parkland region of Manitoba. The study area continues north past the communities of Inglis, Roblin, crossing PTH 5 north past Boggy Creek and through the Swan River Valley. The area south of Riding Mountain is characterized by many permanent potholes and small lakes. West of Riding Mountain the soils landscape is more rolling with numerous small lakes. From the community of Arden (the end point of the Arden Ridge), past Neepawa to Shoal Lake, north to Inglis and Boggy Creek, and up to the Swan River Valley, agricultural crop production is intensive with mixed farming and little to no irrigation potential. North of Cowan the whole agricultural area in the Swan River Valley is under intensive annual crop production with some mixed farming. Forest cover dominates two areas along the west side of the Duck Mountains and Porcupine Hills to the Saskatchewan border separated by the Swan River Valley where there is no agricultural production (i.e., north of the community of Boggy Creek to south of Benito and north of the community of Bowsman to the Barrows area along PTH 77 respectively). From the north side of the Swan River Valley to PTH 10 north of Mafeking most soils are in bogs with only a few areas cultivated.

At The Pas, in the R.M. of Kelsey, a limited portion of the alluvial soils of the Saskatchewan River delta west of The Pas are cultivated for cereal grains, oilseeds and hay crops in the agricultural area at The Pas. East of The Pas, a limited portion of the clayey soils are cultivated for cereal grains, alfalfa, and hay crop. Most of the land is Crown land and some of it has been leased for native hay and pasture. A limited extent of the soils on Ralls Island is cultivated for the production of cereal grains, oils seeds and hay crops. Most of the land in this area is Crown-owned and/or leased for native pasture and hay.

The Aboriginal Traditional Knowledge (ATK) interests expressed by the Long Plains First Nation states their Reserve has 12,000 acres and plans are to purchase 22,000 more acres. To date 4000 acres have been purchased. Since the 1960's agricultural lands have been rented out to local farmers and have not been farmed by the Band. 6,000 acres are leased to area farmers who grow a variety of crops (canola, beans, sunflower, corn and wheat) and local community ranchers for growing alfalfa hay and for pasture land for livestock. Few gardens are grown due to poorer soils after the wind eroded their topsoil. Important traditional areas are now under private ownership; none of the sites identified are crossed by the preferred route. Traditional use areas identified include the Assiniboine River and other areas with semi-permanent sloughs/creeks running through reserve lands.

Swan Lake First Nation indicated that there are 10 sites that are in the path of the Bipole III Route. No specific sites; however, were identified in the report.

The Manitoba Metis Federation (MMF) traditional use and knowledge report does not specifically mention agriculture. The MMF report shows some traditional use in and around the Bipole III study area for the period of 1950 to 2010, however. Traditional use activities include large and small animal harvesting, fishing, trapping and harvesting various plants/products.

Other First Nations including Camperville, Dakota Plains First Nation and Dakota Tipi First Nation include hunting, trapping, timber harvesting, gardening, fishing and traditional plant gathering as traditional activities.

4.2 DEVELOPMENT OF ROUTE ALTERNATIVES FROM NOVEMBER 2007 TO MARCH 2009

In November 2007, work commenced on developing alternate transmission line routes for the Bipole III 500 kV HVdc transmission line in agricultural Manitoba. Numerous potential routes were identified through agricultural Manitoba (Map Series 100). The task was completed using Google Earth™ images and older aerial photography.

When the routing process began in late 2007 and in early 2008 it was decided to do a comprehensive study of the routing area east of Riel to PTH 12, south to Steinbach, across to Carman and on to Holland and PTH 34. The west and north boundaries of the study area followed the floodway south and around to the west side of Winnipeg, along PTH 2 and then north to the south side of Portage la Prairie and on to the Assiniboine River following the river to PTH 34 north of Holland. The study identified and placed 34 categories (Appendix B) of routing constraints from occupied farm yards, grain farms, livestock farms, rural residential housing, colonies, pivot irrigation, abandoned yards, etc. [(Hanus, 1979), (Rumsey, 1993), Public Service Commission of Wisconsin, 2009), (Edy et al., 1981), and (Roy et al., 1981)]. These locations were pinpointed onto Etopo™ maps for accurate placement. The completion of this task allowed the development of various routes from Riel station east and south around Winnipeg and west to the Assiniboine River and Holland. Once selected, the alternative routes were ground-truthed.

Routes in the rest of agricultural Manitoba were developed using past knowledge of the areas, older aerial photography and Google Earth imagery. Preliminary routes were identified and placed onto Etopo maps; however, the clarity of the Google Earth imagery did not provide the opportunity to identify farms or other activities in many instances. In addition these maps were not accurate enough to do the final route identification. Therefore, aerial photography was utilized derived from 1998 to 2005 data bases. Alternative routes were placed onto these maps mostly using ¼ and ½ mile placement. Farms and housing sites were identified; however, routes selected were also ground-truthed.

A summary of the routes developed (Map Series 100) is as follows:

1. Riel east and south past or through the Seine River corridor (both sides of Lorette) – 5 routes.
2. Seine River to the Red River – 3 routes. A number of Red River Crossings were selected; however, new aerial photography greatly assisted in verifying areas where crossings could be made on both the Red and Seine Rivers.
3. Red River west – 3 main routes were identified across the Red River Valley including crossovers between lines.
4. Assiniboine River – Crossings were identified north and south of the Long Plains First Nations Reserve with 4 routes heading north to PTH 16 passing on either side of an irrigation area around Bagot and McGregor.
5. One route followed the Arden Ridge and proceeded north, east of Highway 5 and then split with one line proceeding north past Ste Amelie and one traveling west just north of Riding Mountain National Park to a line that takes the route north-north-west along the beach ridge along PTH 10. It enters the Swan River Valley at Cowan and skirts the east side of the Swan River agricultural area on the way north to Mafeking. The other lines proceeded north and northwest along PTH 50 and the central Westlake past Rorketon, south of Winnipegosis, to Cowan on two different routes through the bog and north past Camperville.
6. Two additional routes crossed PTH 16, one at PTH 50 and one at Gladstone. Both traveled north past PTH 68 and on to Winnipegosis to connect with the two routes traveling to Cowan on two different routes through the bog and north past Camperville.
7. From Mafeking on the north side of the Swan River Valley routes passed on the east side of the valley to Cowan and to the west on the south side of the Porcupine Mountains where they connect to two routes to the south. One route skirted the west sides of Duck Mountain Provincial Park and Riding Mountain National Park. The other route was located further west providing the shortest distance through Duck Mountain Provincial Forest and was further west from Riding Mountain National Park.

8. On the south side of Riding Mountain 4 routes were delineated. One route followed the abandoned railway line along PTH 45 and the other was routed just south of the National Park where it joined the PTH 45 route west of Erickson. From this point, the route proceeded as one line east to the routes identified along the Arden Ridge.
9. A second route proceeded southeast to Solsgirth where it split with one line angling southeast to south of Rapid City, and then straight east to the routes identified along the Arden Ridge. The other line angled southeast to Alexander and on to Wawanesa south of Brandon and below Spruce Woods Provincial Park to connect with the routes emanating from Carman and the Red River Valley. Routing between Brandon and Spruce Woods was difficult due to the rural residential population and intensive pivot irrigation practices.
10. In The Pas area the route passed through a small agricultural area east of the town before crossing the Saskatchewan River.

There were only two potential routes not identified on the map (Map Series 100). The first route was through the center of the Westlake area passing through a community pasture. It was understood that the line should not pass through Federal Lands therefore this route was not considered. The other potential route not discussed was one that followed a 230 kV transmission line along PTH 10 to Mafeking from The Pas that then crossed through the Swan River Valley and the Duck Mountains. This existing 230 kV transmission line represented a potential parallel routing opportunity; however, in the routing process it was determined that separation from 230 kV lines was necessary.

Some work was conducted on the ground electrode sites east of Riel. A general knowledge of the areas was developed, however, no specific transmission line route was developed due to the fact the site for the ground electrode had not been selected. The site work was completed in 2010 and the preferred site was identified.

5.0 SOIL CAPABILITY, PRESENT AGRICULTURAL USE AND ROUTING OPPORTUNITIES

An agricultural map of the study area was prepared on the basis of soil type, present and potential agricultural use, and the intensity of present agricultural use (Map Series 200). It was designed to assist in alternate route identification by displaying agricultural areas at an appropriate scale so the potential impact of transmission line routing on agriculture could be assessed. CLI and Canada-Manitoba Soil Survey information was also combined with aerial photography and field reconnaissance to enhance the designation of areas in agricultural Manitoba. The study area was divided into seven agricultural categories:

1. Limited Agricultural Use Areas;
2. Mixed Farming Areas;
3. Cropped Area – Cereal, Special Crop and Mixed Farming Areas;
4. Intensively Cropped Area – Cereal and Special Crop Areas;
5. Intensively Cropped Area – Cereal, Special and Row Crop Areas;
6. Intensively Cropped Area – Existing and Potential Area Irrigation; and
7. Intensive Livestock Production Area.

5.1 SOIL CAPABILITY AND AGRICULTURAL USE

The study area consists of seven major agricultural categories of use as determined on the basis of soil type, present and potential agricultural use, and the intensity of present agricultural use (Map 2). The categories are described below:

- **Category 1 – Limited Agricultural Use Areas** – Most of these lands are located in areas generally with trees, swamp and lakes where there is little or no agricultural activity. Where the land is being used for agriculture, the main activity is grazing and hay production with small amounts of land in cultivation. Many areas have ridge and swale topography with small amounts of developed crop land. Soils are mostly organic soils or glacial till soils that have thin surface soil horizons, are stony, and have limited agricultural potential. These soils are generally found north of PTH 16 from the east side to the center of the Westlake area, north past the north side of Rorketon, and then past Winnipegosis, Cowan, Lenswood, Mafeking and onto The Pas.

- **Category 2 – Mixed Farming Areas –** These lands are generally found intermixed with limited agricultural use lands in pockets between PTH 16, Plumas, Ste Amelie, Eddystone, Rorketon north, Winnipegosis, Cowan, Lenswood, the Swan River Valley, Mafeking and The Pas. These types of lands are also found northwest of Laurier, along PTH 10 from Dauphin to Cowan and around Boggy Creek. Some of the lands are in native grass and trees and the rest have been broken and are in tame forage, go-back native forage or cereal crops. Farmers in the area produce crops and livestock on cultivated and native, hay and pasture lands. Many of these areas are high lime glacial till plains in the eastern and central part of the study area. Soils have limited agricultural capability.

- **Category 3 – Cereal, Special Crop and Mixed Farming Areas –** These areas include lands where cereal and special crops are grown, with limited row crop production, and irrigation potential is low, and where there is a mixed farming presence. Areas with this production pattern include rolling and pothole lands south and west of Riding Mountain, west of the Duck Mountains and the east side of the Swan River Valley. Wheat, barley, canola, alfalfa for hay and seed, specialty crops such soybeans and peas are produced.

- **Category 4 – Cereal and Special Crop Areas –** These lands are intensively cropped areas with limited row crop production. There is less potential for row crop production or irrigation. The soils of these areas are the highly productive lacustrine clay soils found in the eastern Red River Valley, south and west of Dauphin, the central and western parts of the Swan River Valley, the smooth soils south of the Riding Mountain along PTH 16, and other smaller areas between McCreary and Neepawa. Wheat, barley, canola, alfalfa for hay and specialty crops such soybeans and peas are produced.

- **Category 5 – Cereal, Special and Row Crop Areas –** These lands consist of high value row crops, such as soybeans, sunflowers and corn, and include areas where there is more potential for expansion in the future. This includes higher elevation lands in the western Red River Valley where there are increasing efforts to produce row crops such as corn, soybeans and sunflowers. The lands along the Arden Ridge north of Austin also fall into this category. The soils of the Dauphin area south, east and west, the Swan River Valley and other smaller areas between McCreary and Neepawa are also trending towards more row cropping.

- **Category 6 – Existing and Potential Irrigation Areas –** These lands consisting of sandy soils from Carman to Elm Creek to St. Claude and Rathwell form the southern part of the area with active quarter section pivot irrigation that mainly produces potatoes. Pivot irrigation for potato production is also found on both sides of the Assiniboine River and at Highway #1 West from Carberry to Austin to Bagot and north to Beaver. The area has potential for additional irrigation activities. The existing irrigation area continues north of the Assiniboine River along the Arden Ridge to Arden, south of Neepawa, east past Gladstone and around Portage la Prairie. North and east of Beaver soils have more clay and therefore have less irrigation potential. Row crops of potatoes and some corn are produced. There is potential to grow more row crops in this area.

- **Category 7 – Intensive Livestock Production Area –** This area is found between Highway #1 East and the east side of the Red River. There are many intensive livestock operations, including livestock barns, and numerous farm yards. Hog and poultry production are very common in the area east of the Red River. This area also has the greatest concentration of people in the study area, including towns and villages, farm yards, and rural residential development. The soils fall into Category 4.

5.1.1 Summary

Routing, from an agricultural perspective, considered the following:

- Soil Category Areas 1 and 2 provide the best routing opportunities with Area 1 considered to be the better opportunity;
- Soil Category Areas 3, 4 and 5 provide routing opportunities on the road allowance, linear features and the half mile line; and
- Soil Category Areas 6 and 7 should be avoided, if possible.

6.0 ROUTING METHODOLOGY FROM THE JANUARY 19, 2010, BIPOLE III ROUTING OPPORTUNITIES THROUGH AGRICULTURAL MANITOBA REPORT; A DISCUSSION OF ALTERNATE ROUTE SEGMENTS

6.1 INTRODUCTION

The study area characterization identified various routing opportunities from both biophysical and socio-economic perspectives. Alternative routing that would minimize potential negative impacts and maximize opportunities, while recognizing technical and cost factors, were identified.

The initial routing had the Bipole III line placed on the one half mile line where feasible. A decision was then made by Manitoba Hydro to place the transmission line on the road allowance. The line analysis was conducted with the line situated on the edge of the road allowance. Upon further review, Manitoba Hydro determined that placement of towers close to the road allowance had safety/reliability issues. The following outlines some of the concerns:

1. Reliability Concerns

Towers may be subject to vehicle collisions if placed near the edge of a road allowance. Collisions can cause tower leg damages and can potentially cause tower collapse depending on the impact. Due to the importance that Bipole III will play in the system, to minimize the potential for these types of accidents it was determined that an in-field placement is desirable.

2. Clearance Violations

If Bipole III towers are erected on the edge of a road allowance, one of the conductor bundles will overhang the road allowance. This could lead to safe clearance infractions since Manitoba Hydro would not have the right to restrict any developments within the road allowance. An example of such an infraction can be erection of signage or light standards.

As a result of the above, Manitoba Hydro decided that an in-field placement for the towers would be necessary. The decision was made prior to round four of the consultation process.

During the fourth round of the consultation process, Manitoba Hydro participants noted a general concern over the effects to agricultural lands due to tower placement, as well as the general nuisance they felt would be caused by the transmission line. Some members of the farming community noted the challenges of working around large towers that were situated near road allowances, especially with respect to weed management. They indicated that they would be unable to navigate between the tower and road allowance with their spraying equipment that is large and cumbersome with the proposed in-field placement. Some individuals expressed a desire to have towers located further in-field to be to able to navigate between the tower and the road allowance.

To address the concerns heard during round four, if the project is licensed, Manitoba Hydro decided that south of PTH 16 towers would be placed into the field from the edge of the road allowance to allow large sprayer equipment to manoeuvre around towers. North of PTH 16 the towers would be placed 33 m from the edge of the road allowance. The reason for the difference in tower locations between north and south of PTH 16 is that much of the land south of the highway is intensively cultivated and requires large spraying equipment that could not be accommodated if the towers were located 33m from the edge of the road allowance. North of the highway lands are not intensively cultivated for the most part (e.g., hay, bog, bush) and does not require such spraying equipment.

The principal activity from 2007 to March 31, 2009 was to develop and evaluate multiple transmission line routes for Manitoba Hydro's Bipole III Project in agricultural Manitoba. The preliminary investigation identified numerous corridors from the Riel Station, south and west across the Seine, Red and Assiniboine Rivers past Highways #1 and #16 and north to Mafeking (east of the Porcupine Hills):

- Alternate route 1: Rorketon and Winnipegosis;
- Alternate route 2: Dauphin and east of the Duck Mountain and north to Mafeking on the east side of the Swan River Valley; and
- Alternate route 3: South and west of Riding Mountain National Park (Riding Mountain) and west of the Duck Mountain Provincial Park (Duck Mountain) and through the Swan River Valley and Porcupine Hills.

After completing an initial review of the routes in July 2009 (Appendix C), three alternative route corridors (Routes A, B, and C) were selected for comparison (Map Series 300). Additionally various crossover segments were developed to provide cross combinations of alternative routes. Detailed agricultural routing criteria and analysis methodology were developed so the various routes could be evaluated. This evaluation process was conducted on all routes and crossovers. Following the presentation of report findings Manitoba Hydro made the decision to limit the amount of diagonal line placement in cultivated areas. Diagonal lines were removed and more lines were placed onto the edge of the road allowance.

Route A followed the most easterly route across the Seine River, the most southerly route across the Red River, over the Assiniboine River, across an irrigation area south of Highway #1, around the south and then west side of Riding Mountain, north along the west side of Duck Mountain, through the Swan River Valley, and through the Porcupine Hills to segment AC2. This was the longest route that travelled through more productive agricultural lands. It was not selected as the preferred route.

Route B followed the most westerly route across the Seine River, the most northerly route across the Red River, over the Assiniboine River, north along the west side of PTH's 16 and 50 through the east side of the Westlake area, past Langruth, Eddystone, Winnipegosis, Cowan, and north on the east side of the Porcupine Hills to PTH10 north of Mafeking to segment AC2. This route has by far the least impact on productive agricultural lands. It was selected as the Final Preferred Route with some modifications through the Red River Valley. For the Final Preferred route the line was moved east of the densely populated Lorette/Seine River area and crossed the Red River on the most southern crossing. The line was routed north to Brunkild, passed south of St Claude, crossed the Assiniboine River and followed Route B northwards from the meeting point of all routes west of Long Plains.

Route C traveled between Routes A and B across the Seine and Red Rivers, over the Assiniboine River, across an irrigation area south of Highway #1, north past Austin and Glenella, north along the east side of Riding Mountain, south and west of Dauphin, past Ethelbert to Cowan, through the Swan River Valley, Minitonas, and north on the east side the Porcupine Hills to PTH10 north of Mafeking to segment AC2. This route had less impact on productive agricultural lands compared to Route A, however; it had more impact on productive agricultural lands than Route B.

6.2 ROUTING METHODOLOGY

The following section outlines how a proposed transmission line can affect agricultural activities in southern Manitoba [(Hanus, 1979), (Rumsey, 1993), Public Service Commission of Wisconsin, 2009), (Edy et al., 1981), and (Roy et al., 1981)]. It describes the transmission line impacts in a descending order of importance. These criteria were used to create the scoring system used to analyze the alternative route segments.

6.3 IDENTIFICATION OF COMPONENTS AND CONSTRAINTS

Various components and constraints were considered prior to the selection of Routes A, B, and C and the crossover routes. Where possible these routes avoided farm houses, rural residential houses and buildings, farm yards, better quality agricultural land, lands belonging or entitled to First Nations, protected area lands, and wildlife habitat lands (e.g., Ducks Unlimited Canada, Manitoba Habitat Heritage Corporation). In areas such as Spruce Woods Provincial Park and Forest or the Arden Ridge, a tendency existed to place alternative potential routes on land being utilized for agriculture.

Once routes were selected, the agricultural and tower placement impact of the segments within the route as well as their length were evaluated. To evaluate each segment, which considered the length of the line, two impacts were measured: (1) the agricultural productivity of the land; and (2) the placement of the tower on the land. A transmission line will have a greater impact when it crosses more productive agricultural land. Likewise a transmission line on the road allowance or drainage ditch through productive agricultural land will have less impact than a line placed in the field, especially a diagonal line. A rating system was developed where the lower numbers reflected the least impact on agriculture. Therefore this route would receive the highest agricultural priority as a routing opportunity. For example, the shortest line combined with the poorest agricultural land crossed provided the lowest number and therefore would be given the highest priority for transmission line routing from an agricultural perspective.

6.4 AGRICULTURAL IMPACT RATING CATEGORIES

Agricultural soils were divided into eight categories based on productivity, present use and potential impacts. These ratings are presented in the following table.

Table 1: Agricultural Impact Rating Categories

Rating	Rating Description
1	Limited to no agricultural use including wetlands.
2	Shallow glacial till soils utilized mainly for native hay and grazing; however some tame hay and annual crops may be produced.
3	Higher quality glacial till soils with numerous larger potholes used for cereal, special, pulse, tame forage production and mixed farming.
4	Soils used for cereal, special, pulse and tame forage production, however the soils have production limitations such as topography, light soil texture, potholes, and others.
5	Intensively cropped soils used for cereal, special, pulse and tame forage production.
6	Intensively cropped soils used for row cropping and cereal, special, pulse and tame forage production.
7	Soils with irrigation potential.
8	Areas with active irrigation systems.

6.5 TOWER PLACEMENT

The preliminary analysis of alternative route segments and relative scores of tower placement are based on the towers being positioned on the edge of the Road Allowance or the Drainage Ditch and not in the farmer's field.

The agricultural impact of the tower placement is dependent on the land use of the area as well as the location of the tower in the field. In areas of intensive cropping the impact of the tower is greater and therefore the rating of tower placement through areas with lands in categories 3-8 was higher. Where lines are placed through lower category land (categories 1-2) the impact of the tower was minimal.

6.5.1 Tower Placement (Categories 1 and 2)

Soils in categories 1 and 2 are normally used for native and tame hay and pasture with few fields in annual crops; therefore, the impact on the land use of towers placed in the field is minimal. The rating for tower placement is the same for all placement categories (Table 2).

Table 2: Agricultural Impact of Categories 1 and 2 Tower Placement

Rating	Rating Description
1	Tower placement on or on the edge of the road allowance.
1	Tower placement on the edge of a drainage ditch.
1	Tower placement on the half mile line (some management unit splits).
1	Tower placement on the quarter mile line, 50 m into the field, or various distances in field (each field will have a management unit split).
1	Tower placement on the diagonal (each field will have a management unit split).

6.5.2 Tower Placement (Category 3)

Lands in category 3 are used for cereal, special, pulse crops and tame forage production. Fields are normally broken up by numerous potholes of various sizes. Additionally forage crops are less affected by tower placement; therefore the rating for this category is lower than for soils in categories 4-7. Table 3 outlines the ratings given to the various tower placements. When transmission line cross cultivated lands in the field a Management Unit Split is created and the operator has to consider management activities on both sides of the transmission line.

Table 3: Agricultural Impact of Category 3 Tower Placement

Rating	Rating Description
1	Tower placement on or on the edge of the road allowance.
1	Tower placement on the edge of a drainage ditch.
3	Tower placement on the half mile line (some management unit splits).
3	Tower placement on the quarter mile line, 50 m into the field, or various distances in field (each field will have a management unit split).
3	Tower placement on the diagonal (each field will have a management unit split).

6.5.3 Tower Placement (Categories 4-7)

Soils in categories 4-7 are used for growing crops including row cropping. Intensive cropping generally requires the use of larger implements. A tower placed in the middle of the field impedes operation and creates a Management Unit Split. This changes the farmer’s ability to manage production activities including aerial spraying. The towers impact equipment movement throughout the field and increase the difficulty and the hazards related to operating the machines. Thus the land owner or operator may have to divide the field into smaller management units. Towers placed on the road allowance or on the edge of a drainage ditch have less impact on the land use. Most agricultural land is divided in half sections and therefore towers placed on the half section line interfere less with cropping compared to in field placement. Towers placed on the quarter mile or in the field have more impact. Towers placed on a diagonal line have the greatest impact on agricultural production activities. Towers placed in the field or on the diagonal have a major impact on aerial spraying. Table 4 outlines the ratings given to the various tower placements.

Table 4: Agricultural Impact of Categories 4-7 Tower Placement

Rating	Rating Description
1	Tower placement on or on the edge of the road allowance.
1	Tower placement on the edge of a drainage ditch.
3	Tower placement on the half mile line (some Management Unit Splits will be created).
4	Tower placement on the quarter mile line, 33-50 m into the field, or various distances in field (each field will create a Management Unit Split).
5	Tower placement on the diagonal (each field will create a Management Unit Split).

6.5.4 Tower Placement (Category 8)

Tower placement in soils with active irrigation, category 8, should be avoided to the extent possible. If the line must pass through an area with active pivot irrigation the towers will need to be strategically placed and the line should be on the road allowance, drainage ditch, or half mile line. The ratings in Table 5 reflect the importance of minimizing towers placed in these areas.

Table 5: Agricultural Impact of Category 8 Tower Placement*

Rating	Rating Description
10	Tower placement on or on the edge of the road allowance.
10	Tower placement on the edge of a drainage ditch.
10	Tower placement on the half mile line.

* Diagonal placement is not compatible with pivot irrigation.

6.6 FINAL ASSESSMENT

The length in kilometers of each segment is measured. The total route length and rating is determined by the sum of the segments chosen for that route.

Each segment has various angles. These angles were measured and divided into four categories, 1-22°, 23-45°, 46-89°, and 90°. The total angles in each category for each segment were calculated and presented along with the length, tower placement rating, and agricultural rating.

Each segment of the three alternative route corridors (A, B, and C) and the crossover segments were assessed. The length of the segment was measured, the tower placement and agricultural productivity ratings were calculated and summed, and the angles categorized and summed.

6.7 DISCUSSION OF ALTERNATE ROUTES

The complete route analysis map with crossovers is shown in Map Series 300. Green route B, purple route C, and magenta route A centre lines were highlighted within a 4.8 km buffer. Following a helicopter flight over the routes and field ground truthing minor changes were made to these original routes. The segments making up Routes A, B, and C are shown as are the crossover segments. **A summary of the analysis for Routes A, B, and C are presented in Table 6. Route B scores the lowest in all categories and has been selected as the Final Preferred Route for these reasons. Route B is the shortest line to segment AC2, it has the lowest tower and agricultural rating, and has the fewest angle towers.** Route C is longer than Route B and crosses more quality agricultural land. It also has more angle towers. There are 41 angle towers at 1-22˚ compared to 17 angle towers at 1-22˚ for Route B. Route A is the longest and crosses the greatest amount of quality agricultural land; therefore, the tower and agricultural ratings are higher. The total angle towers for Route A are comparable to Route C.

Table 6: Summary of Alternative Route Corridor Segments A, B, and C

Alternative Routes	Description	Route Length in Kilometers	Tower Placement Rating	Agricultural Rating	TOTAL Rating	Total Angles			
						1-22˚	23-45˚	46-89˚	90˚
B***	Route B – East Westlake, Winnipegosis, Cowan, AC2	566.7	746.7	1037.2	1783.9	17	16	7	0
C	Route C - West Westlake, Dauphin, Cowan AC2	634.8	1016.8	1520.8	2419.0	41	14	5	3
A	Route A - West Riding Mountain, Porcupine Hills, AC2	693.2	1852.7	2107.1	3959.8	40	20	3	3

***Selected as the preferred route

7.0 EVALUATION OF ALTERNATIVE ROUTES

7.1 COMPARISON OF SECTIONS OF THE ROUTES

In addition to alternative routing A, B, and C, various other alternative routes were available. Crossover routes and convergence of routes provide opportunities to cross between alternative routes A, B, and C. To evaluate the alternate routes, the study area was divided into sections and is compared through tables. Detailed description of each segment and its rating is presented in table format. The first summary table compares routes between Riel Station and a point west of Long Plains First Nation Reserve (Long Plains) where all three alternative routes converge. This alternative route includes an area from Elm Creek to and across the Assiniboine River with active and potential irrigation (Map Series 400). The second table compares the three alternative routes through the active and potential irrigation areas from Elm Creek to PTH 16. The third table compares the potential routes from Long Plains to Winnipegosis. Comparisons of possible routing through Winnipegosis, from Winnipegosis to Cowan, and Cowan to segment AC2 were then made. The final comparison made was from Long Plains to segment AC2 comparing possible alternative routes using alternative Routes A and C.

7.1.1 Riel Station to Long Plains Alternative Routes

From Riel Station to the Red River all three alternative routes pass through clay soils and all three have a similar impact from an agricultural perspective. This is a very heavily populated area so routes are based on passing through the area to avoid residences, barns and farming operations. Route B is closest to the city of Winnipeg, Route C is in the middle and Route A is the furthest east. Both Routes A and C pass through the heavily populated area around Lorette and the Seine River. These routes have mainly in-field tower placement to avoid farm and rural residential yards. Route B does not cross through as heavily populated area and therefore from a routing perspective is better.

From the Red River west to the treed area at Elm Creek the population density is less than east of the Red River. These are still clay soils with large expansive fields. All three alternative routes attempt to avoid diagonal and in field tower placement and follow the road allowance and drainage ditches where possible. From Elm Creek to west of Long Plains, the soils are sandier, have irrigation potential or active irrigation and the local population is much greater. Alternative

Routes remain on road allowances or the half mile line in irrigation areas. As well, alternative routes avoid farm and rural residential yards and barns.

Initial alternative route identification in 2009 placed routes on the lower side of the Arden Ridge where agricultural activities predominate. Routing on the upper edge of the Arden Ridge was avoided due to undulating topography and the extensive tree cover along this feature. However, field investigations found the lower side of the Arden Ridge had active and potential irrigation. The alternative route along the lower edge of the ridge would have been on a diagonal and from an agricultural perspective diagonal placement through active or potential irrigation areas is not recommended. Therefore routing through this irrigated area was moved away from the Arden Ridge to follow road allowances and half mile lines.

Table 7: Summary of Riel Station to Long Plains Alternative Routes

Alternative Routes	Description	Route Length in Kilometers	Tower Placement Rating	Agricultural Rating	TOTAL Rating	Total Angles			
						1-22˚	23-45˚	46-89˚	90˚
1	Route B	174.3	356.1	578.7	934.8	8	10	3	0
2	Route C	197	372.8	653.1	1025.9	18	6	1	1
3	Route A***	219	503.3	758.7	1262.0	11	8	1	2
4	Route B to BB6	166.7	344.9	535	879.9	9	11	3	0
5	Route C to BC4 and BB6	166.7	355.9	535.5	891.4	10	7	3	0
6	Route C crossing to Route B at the Red River to BB6	189	346.8	584.5	931.3	17	6	1	1
7	Route B crossing to Route A at the Red River to CA2, BC4, and BB6	177.2	393.0	567.0	960.0	8	9	3	0
8	Route B crossing to Route C at the Red River	174.8	370.9	603.6	974.5	10	10	3	0
9	Route C to AC4 to Route A to CA2 to Route C to BC4 to Route B	208.3	423.8	662.7	1086.5	16	3	3	1
10	Route B crossing to Route A at the Red River	184	451.9	654.7	1106.6	7	12	3	0
11	Route A to CA3 to Route C	206.5	413.4	698.6	1112.0	14	7	2	1
12	Route C to AC4 to Route A	207.3	471.5	706.7	1178.2	16	7	2	1
13	Route A to CA2 to Route C	220.3	459.4	739.1	1198.5	12	7	2	2

***** Selected as the Preferred Route**

- As discussed in Section 4.0, alternative route B is the shortest route, has the least impact on agriculture, and has least number of angle towers relative to alternative routes C and A (Alternative routes 2 and 3).
- Alternative route 4 uses alternative route B and then a diagonal crossover to north of Long Plains.
- Alternative route 5 uses alternative route C and then two diagonal crossovers to north of Long Plains.
- Alternative routes 4 and 5 are shorter and score lower than Route B; however, from an agricultural prospective they are less desirable. The diagonal tower placement through quality agricultural land presents difficulties for farmers and should be avoided, if possible.
- Alternative route 6 is route C crossing to Route B at the Red River then to a diagonal crossover segment to south of Long Plains.
- Alternative route 7 is route B crossing to Route A at the Red River then to diagonal crossover segments, CA2, BC4, and BB6.
- Alternative routes 6 and 7 rate similar to route B; however they are less desirable due to the diagonal crossover segments.
- Alternative route 8 is route B from Riel Station and crossing to route C at the Red River. Alternative route 8 rates between routes B and C and while slightly longer than alternative routes 4 and 5 does not use as many diagonal line placements.
- Alternative route 9 begins with route C and uses crossover segments AC4, CA2, and BC4. Its rating is higher than previous alternative routes because it is longer.
- Alternative route 10 is route B from Riel Station and crossing to route A at the Red River. It rates less than route A, but more than other alternative routes.
- Alternative route 11 using route A, crossover segment CA3 to route C also rates high.
- Alternative route 12 is route C to route A using crossover segment AC4. This is a longer alternative route (due to route A) and a higher total rating.
- Alternative route 13 using route A, crossover segment CA2 to route C and is the longest alternative route.

Table 7 outlines 13 different alternative routes; however, many more are possible. To better evaluate the alternative routes, Table 8 shows the length of line for alternative routes B, C, and A on road allowances (RA), drainage ditches (DD), ½ mile, ¼ mile (in-field), and diagonal alignments. RA and DD placement are the best through this agricultural area while diagonal and ¼ mile (in-field) are less desirable. Alternative route A has a large portion of ¼ mile and diagonal placement and the longest length and therefore it is not the best choice. Alternative routes B and C have comparable amounts of diagonal placement. Route B is the shorter route and has less ¼ mile placement. Although alternative route C has more RA and DD placement and less ½ mile placement, alternative route B is still the better choice due to its shorter length and less ¼ mile placement.

Table 8: Comparison of Segment Placement in Kilometers from Riel Station to Long Plains

Alternative Routes	Description	Road Allowance (RA)	Drainage Ditch (DD)	Total RA & DD	½ mile	¼ mile (in-field)	Diagonal	Total Length
B	Riel Station to Long Plains	47.7	-	47.7	21.2	10.6	44.2	113.1
C	Riel Station to Long Plains	34.2	17.9	52.1	13.9	23.9	42	131.9
A***	Riel Station to Long Plains	43.2	-	43.2	-	49.8	55.7	148.7

***Selected as **the Preferred Route**

In summary, Table 7 indicates that alternative routes 1, 2, and 8 present the best alternative routes between Riel Station and Long Plains. They are amongst the shortest alternative routes while having the least diagonal line placement. Alternative routes 1 and 8 use alternative route B from Riel Station to the Red River. Alternative route B between Riel Station and the Red River would have the least impact on people since it crosses through less populated areas. Following this analysis, routing over the Seine River was moved further east away from the heavily populated areas around Lorette and Dufresne to avoid these areas.

7.1.2 Active and Potential Irrigation Area Alternative Routes

Some alternative routes for Bipole III pass through active and potential irrigation areas from Elm Creek to Highway 16 (Table 9). All three routes pass through these areas. Alternative Route B provides the shortest route and a tower placement rating lower than the other alternative routes due to more placements on road allowances and half miles. It is the shortest route through the irrigation areas.

Table 9: Summary of Active and Potential Irrigation Area Alternative Routes

Alternative Routes	Description	Route Length in Kilometers	Tower Placement Rating	Agricultural Rating	TOTAL Rating	Total Angles			
						1-22˚	23-45˚	46-89˚	90˚
B	Route B	81.5	150.20	325.20	475.40	3	3	3	0
C	Route C	94.3	216.4	396.2	612.60	3	6	1	1
A	Route A	118.7	289.4	492.8	782.20	5	6	1	1

7.1.3 Long Plains to Winnipegosis Alternative Routes

From Long Plains to Winnipegosis the most direct route, with the lowest tower rating and the lowest agricultural rating is alternative route B (Table 10). This route follows along the east edge of the Westlake area. Alternative route 2 using crossover segment BC3 through Westlake west has the second lowest total rating. Alternative route 3 also uses crossover segment BC3 through Westlake west but uses alternative route A to crossover segments C22 and BC3. This alternative route is only slightly longer than alternative route 2; however, it has a higher tower and agricultural rating. Alternative routes 4 and 5 use crossover segment BA4 through Westlake central and have the highest rating due to more routing through agricultural land between Long Plains and Glenella north of Highway 16.

Table 10: Summary of Long Plains to Winnipegosis Alternative Routes

Alternative Routes	Description	Route Length in Kilometers	Tower Placement Rating	Agricultural Rating	TOTAL Rating	Total Angles			
						1-22˚	23-45˚	46-89˚	90˚
1	Route B***	245	287.5	322.5	610.0	6	5	3	0
2	Route C, to BC3 to Route B	258	337.4	442.9	780.3	16	6	1	1
3	Route A, to C22, to BC3 to Route B	258.5	361.7	462.2	823.9	18	5	2	1
4	Route C, to BA4 to Route B	266.5	365.4	516.1	881.5	12	9	1	1
5	Route A, to BA4 to Route B	267.8	362.6	520.1	882.7	14	8	1	1

*****Selected as the Preferred Route**

7.1.4 Alternative Routes through Winnipegosis

Various alternative routes through Winnipegosis are necessary in order to cross between alternative route B and the crossover segments BB3 and BC3 (Table 11). Route B (alternative route 1) does not need to use a crossover segment and therefore does not have any rating through Winnipegosis. To cross from segment BC3 to alternative route B, Alternative route 2 is used. Alternative route 3 crosses between alternative route B and crossover segment BB3 and alternative route 4 connects crossover segments BC3 and BB3.

Table 11: Summary of Alternative Routes through Winnipegosis

Alternative Routes	Description	Route Length in Kilometers	Tower Placement Rating	Agricultural Rating	TOTAL Rating	Total Angles			
						1-22˚	23-45˚	46-89˚	90˚
1	Route B***	0.0	0	0	0.0	0	0	0	0
2	Crossovers BC3 and B5 to Route B	1.3	0.8	0.8	1.6	0	0	0	0
3	Route B, to B4 and BB3	2.5	1.5	1.5	3.0	0	1	0	0
4	Crossovers BC3, 4.15 and BB3	3.5	2.2	2.2	4.4	0	1	0	0

***Selected as the Preferred Route

7.1.5 Winnipegosis to Cowan Alternative Routes

From Winnipegosis to Cowan, the diagonal route through the bog is shortest and has the fewest turns (Table 12). The difference in tower and agricultural impact is due to the length of the line. To avoid the bog, the route would require more turns and would be 3.5 miles longer.

Table 12: Summary of Winnipegosis to Cowan Alternative Routes

Alternative Routes	Description	Route Length in Kilometers	Tower Placement Rating	Agricultural Rating	TOTAL Rating	Total Angles			
						1-22˚	23-45˚	46-89˚	90˚
1	Crossover BB3*** - through the bog	47.8	28.7	28.7	57.4	1	0	0	0
2	Route B21 - drier land to the northeast	53.7	32.2	32.2	64.4	1	1	1	0

***Selected as the Preferred Route

7.1.6 Cowan to AC2 Alternative Routes

The alternative routes from Cowan north to the crossover segment AC2 include one alternative route that skirts the agricultural area (alternative route 1) and another alternative route that crosses cropped land (alternative route 2). Alternative route 1 provides the most direct route to the crossover segment AC2 with the least impact from towers and angles on agriculture. The agricultural segment rating is the greater difference between these two alternative routes. While alternative route 2 is only 7 miles longer, it has more than double the agricultural segment rating due to the impact of crossing through more productive cropped land (Table 13).

Table 13: Summary of Cowan to AC2 Alternative Routes

Alternative Routes	Description	Route Length in Kilometers	Tower Placement Rating	Agricultural Rating	TOTAL Rating	Total Angles			
						1-22˚	23-45˚	46-89˚	90˚
1	Route B18 - along edge of cropped land***	93.7	70.9	103.8	174.7	2	0	0	0
2	Route C19 - through cropped land	105.3	115	212.4	327.4	3	1	0	1

***Selected as the Preferred Route

7.1.7 Long Plains to AC2 (Route A and C)

In the previous tables very few comparisons were made with Route A. Table 14 compares alternative routes to AC2 using Routes A or C (Table 14). Alternative routes 1 and 2 illustrate the difference between Route A and C. The relative length and angles made by alternative routes A and C is comparable, with Route A being longer by only 22 miles with 8 more angles. However, the real difference between these two lines is in their tower placement and agricultural impact. The tower placement rating is double for Route A and the agriculture rating is also higher. The amount of cropped land that Route A crosses is greater. Alternative routes 3, 4, and 5 compare routes using crossover segments between Route A and C. Alternative routes 3 and 4 that use alternative route C for the majority of the route have a lower total rating.

Table 14: Summary of Long Plains to AC2 (Route A and C) Alternative Routes

Alternative Routes	Description	Route Length in Kilometers	Tower Placement Rating	Agricultural Rating	TOTAL Rating	Total Angles			
						1-22˚	23-45˚	46-89˚	90˚
1	Route A	474.2	1349.4	1348.4	2697.8	29	12	2	1
2	Route C	437.7	644	867.7	1511.7	23	7	4	2
3	Route C to 4.12 & 4.13 continuing on Route C	439	653.5	889	1542.5	23	7	7	2
4	Route A, to 4.13 to Route C	438.3	668.3	887	1555.3	24	8	4	2
5	Route C to 4.12 to Route A	474.8	1334.6	1350.4	2685.0	28	12	3	1

7.2 THE PAS

North of crossover segment AC2 an agricultural area around The Pas exists and one potential route was identified (Table 15). This route uses alternative routes B and C. Alternative route A does not pass through The Pas area.

Table 15: Summary of The Pas Alternate Route

Alternative Routes	Description	Route Length in Kilometers	Tower Placement Rating	Agricultural Rating	TOTAL Rating	Total Angles			
						1-22˚	23-45˚	46-89˚	90˚
1	The Pas	18.5	11.1	11.1	22.2	0	1	0	0

7.3 COMPARISON OF WHOLE ROUTES

In addition to alternative routes A, B, and C , seven more complete alternative routes were prepared using the data analyzed in Section 5.1. Table 16 is a summary of these routes. The selection of seven more whole routes (alternative routes 2, 5, 6, 7, 8, 9 and 10) was based on the shortest routing with the least agricultural impact.

Table 16: Summary of Ten Whole Route Alternative Routes

Alternative Routes	Description	Route Length in Kilometers	Tower Placement Rating	Agricultural Rating	TOTAL Rating	Total Angles			
						1-22˚	23-45˚	46-89˚	90˚
1	Alternative Route B - East Westlake, Winnipegosis, Cowan, AC2	566.7	746.7	1037.2	1783.9	17	18	7	0
2	Alternative Route B*** (Bog) - East Westlake, Winnipegosis, Cowan (through Bog), AC2	560.8	743.2	1033.7	1776.9	17	17	6	0
3	Alternative Route C - West Westlake, Dauphin, Cowan, AC2	634.8	1016.8	1520.8	2537.6	41	14	5	3
4	Alternative Route A - West Riding Mountain, Porcupine Hills, AC2	693.2	1852.7	2107.1	3959.8	40	20	3	3
5	Route C, Route B from Long Plains, BB3, Route B, AC2	586.2	761.4	1109.6	1871.0	27	14	4	1
6	Route B, Route C from Long Plains, BC3, BB3, Route B, AC2	577.3	795.3	1156.3	1951.6	27	19	4	1
7	Route B, Route C from the Red River, BC3, BB3, Route B, AC2	577.7	810.1	1181.2	1991.3	29	19	4	1
8	Route B, Route C from Long Plains, BA4,B, BB3, Route B, AC2	582.3	821.1	1227.3	2048.4	23	21	4	1
9	Route B, Route C from the Red River, BA4, B, BB3, Route B, AC2	582.7	835.9	1252.2	2088.1	25	21	4	1
10	Route C to Cowan, Route B to AC2	623	972.7	1412.2	2384.9	40	15	5	2

***selected as the Preferred Route

In Summary:

- Alternative routes 2, 3, and 4 are the Routes B (**<u>the Preferred Route</u>**), C, and A, respectively;
- Alternative route 2 is the entire Route B except where it uses the crossover segment BB3 through the bog between Winnipegosis and Cowan (Table 7: alternative route 1, Table 10: alternative route 1, Table 12: alternative route 1, Table 13: alternative route 1);
- Alternative route 5 uses Route C from Riel Station to Long Plains (Table 7: alternative route 2), then alternative route B north through Westlake east (Table 10: alternative route 1), through the bog between Winnipegosis and Cowan (Table 12: alternative route 1), and skirts the cropped land from Cowan to AC2 (Table 13: alternative route 1);
- Alternative route 6 uses alternative route B from Riel Station to Long Plains (Table 7: alternative route 1), crosses over to Route C, uses crossover BC3 north through Westlake west (Table 10: alternative route 2), through the bog between Winnipegosis and Cowan (Table 12: alternative route 1), and skirts the cropped land from Cowan to crossover AC2 (Table 13: alternative route 1);
- Alternative route 7 uses alternative route B from Riel Station, crosses to alternative route C at the Red River (Table 7: alternative route 8), follows alternative route C to the crossover segment BC3 north through Westlake west (Table 10: alternative route 2), through the bog between Winnipegosis and Cowan (Table 12: alternative route 1), and skirts the cropped land from Cowan to AC2 (Table 13: alternative route 1);
- Alternative route 8 uses alternative route B from Riel Station to Long Plains (Table 7: alternative route 1), crosses over to alternative route C, uses crossover segment BA4 north through Westlake central (Table 10: alternative route 4), through the bog between Winnipegosis and Cowan (Table 12: alternative route 1), and skirts the cropped land from Cowan to crossover AC2 (Table 13: alternative route 1);
- Alternative route 9 uses alternative route B from Riel Station, crosses to alternative route C at the Red River (Table 7: alternative route 8), follows alternative Route C to the crossover segment BA4 north through Westlake central (Table 10: alternative route 4), through the bog between Winnipegosis and Cowan (Table 12: alternative route 1), and skirts the cropped land from Cowan to AC2 (Table 13: alternative route 1); and

- Alternative route 10 is the entire alternative route C to Cowan that then follows alternative route B to AC2 through less productive agricultural lands.

Of the 10 alternative routes, 1, 2 and 5 using Westlake east are the shortest and lowest scoring alternative routes with alternative route 2 through the bog being the best. Alternative routes 6 and 7 using Westlake west are next lowest while alternative routes 8 and 9 using Westlake central are higher. Alternative routes 3 and 4, Alternative Routes C and A, respectively, and alternative routes 10 have the highest scores due to their longer length and total agricultural and tower ratings.

7.4 CONCLUSION

A rating system was developed to compare the various segments in the Bipole III Transmission Line Study Area in agricultural Manitoba. Various combinations of segments are evaluated using this system. ***The best route from an agricultural perspective should be one that is shortest in length, does not have a high agricultural and tower rating, and uses road allowances and drainage ditches through agricultural land. The B Preferred Route was chosen because it had the least impact of agriculture and was the shortest route. It was moved east of the Lorette/ Seine River area and followed the easterly and southern route A to south of Brunkild. It passed south of Elm Creek and St Claude and on to the Assiniboine River where it followed route B to The Pas.*** Following the analysis of the alternate routes the decision was made to remove diagonal line routing wherever intensive agriculture was practiced. The final preferred route B had 47.4 km of diagonal transmission lines removed from the intensively cropped areas and 14.15 km remain in these areas. On the routes not chosen as the final route 99 km of diagonal lines were removed along the Arden Ridge and 151.5 km were removed in the Red River Valley.

7.5 PREFERENTIAL SEGMENTS

Preferential route segments are as follows:

1. **<u>Riel Station to Long Plains</u>**: Alternative route B to the Red River and any combination of alternative routes B or C from the Red River to Long Plains are the most desirable routes from an agricultural perspective with alternative route B having a slight advantage over alternative route C.

2. **<u>The Irrigation Area from Elm Creek to PTH 16</u>**: Alternative route B is preferred to alternative routes A and C because the line passes through less kilometers of lands with irrigation potential. Alternative routes A and C have similar impacts on potential and active irrigation areas.

3. **<u>Long Plains to Winnipegosis</u>**: From Long Plains to Winnipegosis alternative Route B (**<u>the Preferred Route</u>**) is preferred because there are more kilometers of lower quality agricultural land with less impact from tower placement. Alternative route B is preferred with alternative route C to crossover segment BC3 to alternative route B being an alternative if the transmission line needs to be further west than Alternative route B. The middle route between the above two alternative routes following Alternative route C to crossover segment BA4 to alternative route B also has potential.

4. **<u>Winnipegosis to Cowan</u>**: No difference in agricultural potential or tower placement impact with alternative route B (the drier route) or alternative route BB3 (through the bog) exists (**<u>the Preferred Route</u>**). The route through the bog is the shortest and is therefore selected as the preferential route for this segment.

5. **<u>Cowan to AC2</u>**: Alternative route B (**<u>the Preferred Route</u>**) is preferred to alternative route C because it has less impact on higher quality agricultural land and has less impact from tower placement.

6. **<u>Long Plains to AC2 following Route C</u>**: This alternative route scores higher than the alternative route B (**<u>the Preferred Route</u>**) because it travels through higher quality agricultural land.

7. **<u>Long Plains to AC2 following Route A</u>**: This alternative routes scores much higher than Route A and especially higher than the Route B alternative routes; therefore it is the least preferred route. It passes through the largest amount of higher quality land and therefore has the greatest tower impact on agricultural activities.

7.6 PREFERENTIAL COMPLETE ROUTES FROM RIEL STATION TO AC2

Preferential complete route segments from Riel Station to segment AC2 are as follows:

1. Alternative route A from Riel Station through Long Plains and the follows Alternative route B north from Long Plains segment BB3 (Cowan bog) to segment AC2 - score 1776.9 (**<u>the Preferred Route</u>**);

2. Alternative route B from Riel Station to Long Plains then Route C to BC3 to B and to AC2 through the BB3 bog - score 1951.6;
3. Alternative route B from Riel Station to Long Plains then Route C to BA4 to B and to AC2 through the BB3 bog - score 2048.4;
4. Alternative route C from Riel Station to Cowan and Route B to AC2 – score 2384.9;
5. Alternative route C from Riel Station to AC2 – score 2537.6; and
6. Alternative route A from Riel Station to AC2 – score 3859.8.

8.0 THE PREFERRED ROUTE

The Final Preferred Route (Map Series 500) for the Riel to Conawapa 500 kV HVdc transmission line attempts to minimize the disruption to people and the natural environment within the context of technical and cost implications. The EIS outlines the evaluation and comparison of the alternative route segments, as described in Section 7.0, from biophysical, land use, socio-economic, technical and cost perspectives, to obtain overall alternative “A”, “B” and “C” routes [(Hanus, 1979), (Rumsey, 1993), Public Service Commission of Wisconsin, 2009), (Edy et al., 1981), (Soja, G. et al., 2003), and (Roy et al., 1981)]. The alternative “A”, “B” and “C” routes were then compared to one another to identify the preferred route for the Riel to Conawapa 500 kV HVdc transmission line. The impact management recommendations contained in this report are from an agricultural use perspective only. The final impact management recommendations for the preferred route are outlined in the EIS and are based on a balance of all impact management recommendations.

Each section of the preferred route is discussed. The proposed transmission line crosses approximately 586.5 km of land, of which two-thirds to three-quarters is currently in agricultural use. The first 16 km of the Bipole III line follows an existing 500 kV HVdc transmission line, D602, where the land under the line is cultivated and used for tame forage and annual crop production. The remainder of the route to PTH 16 involves new line placement. The route crossed lands cultivated and planted to cereals, oilseeds, pulse, row and tame forage. The remainder of the route is in improved or unimproved pasture or grass hay with variable amounts of tree cover and some cultivated fields.

The preferred line will require 3 to 4 towers per mile. The line will necessitate a new right-of-way to be developed, of which 231 km (Table 17) will be in field away from road allowances or field edges, 104 km will be on the ½ mile and 251 km will be on the diagonal (crossing lands with limited agricultural use or agricultural potential). There will be 244 km of field severance or approximately 42% of the line will cause a field severance. The agricultural portion of the transmission line is 586.5 km long. Baseline information about the line includes the percentage cultivated and tame hay lands at 48% or 282 km. The percentage pasture, native grass lands is 17% or 98.5 km and the percentage trees, water, marsh lands is 32.4% or 191 km. None of the route is on the road allowance or drainage ditch edge. The baseline data for the preferred route is as follows:

1. Length: 586.5 km
2. Line on road drainage ditch: 0 km
3. Line on road allowance: 0 km
4. Line on ½ mile: 104 km
5. Line infield: 231 km
6. Line diagonal: 251 km
7. Management severance: 244 km
8. Percentage active irrigated lands: 0%
9. Percentage row crop lands: 2.6%; 15.5 km
10. Percentage cultivated, tame hay lands: 48%; 282 km
11. Percentage pasture, native grass lands: 17%; 98.5 km
12. Percentage trees, water, marsh lands: 32.4%; 191 km
13. Distance the line passes over shelter belts: 55.6 km
14. Distance the line parallels 602F: 16.7 km
15. Line less than 270 m from houses at: 30 houses
16. Line less than 270 m from barns at: 27 barns
17. Line less than 270 m from large sheds at: 12 large sheds

Following additional route analysis in January 2010, the route was re-adjusted to address land use issues in various areas. The preferred route chosen was alternative route A past the Red River. Just southeast of Brunkild the route was moved north to alternative route C and it followed alternative route C to the junction of alternative routes B and C at northwest of St. Claude. From here the route followed alternative route B to, and through the bog area west of Winnipegosis and on to Mafeking. The major adjustments were:

1. Diagonal lines were removed in intensively cultivated agricultural Manitoba and were replaced by in field placement and right angle towers. This occurred in the Red River Valley, between Carman and Highway 1, between Highway #1 and PTH 16 and in the Swan River Valley;
2. Alternative route A was moved east of Dufresne out of the highly populated Lorette-Dufresne area;

3. Just west of the Red River the alternative route A was moved 1.5 miles north to the ½ mile line to avoid houses;
4. The line was moved further west of the Long Plains First Nation Reserve;
5. The line was moved to the road allowance and half mile line between Highway #1 and PTH 16;
6. The line was moved to the road allowance near Alonsa to assist in passing through the small lake areas to the northwest of Alonsa;
7. Northwest of Eddystone the line was moved to the east and north to avoid a wildlife management area;
8. North of Cowan the line was moved northeast to avoid the Briggs Spur tower; and
9. East of Lenswood the line was placed on the road allowance to avoid a community pasture.

Further ground truthing of preliminary preferred route placement over the summer of 2010 resulted in the preferred route being moved slightly in several other locations.

Table 17: Bipole III 500 kV HVdc Transmission Line Route Analysis

Line Segment	Legal Description	Length (kilometers)	On Road Allowance	On Drainage Ditch	½ Mile Line	Infield Line	Diagonal Line	Management Severance	Irrigation	Row crop	Cultivated Tame Hay	Pasture, Native Grass	Trees/Marsh/ Water	Field Shelter Belt/Trees
13		47.2	0	0	11.2	27.7	8.3	36.3	0	0	45.2	2.0	0	9.0
12		31.6	0	0	0.0	30.8	0.8	31.2	0	6.4	25.2	0.0	0	2.0
11		59.0	0	0	24.2	33.0	1.9	37.4	0	0.6	57.9	0.0	0.5	1.0
10		56.2	0	0	33.0	21.6	1.6	21.6	0	7.7	36.2	7.9	4.2	16.0
9		157.1	0	0	27.5	64.6	65.0	66.1	0	0.8	84.4	21.8	50.1	27.6
8		131.0	0	0	8.0	0.0	123.0	15.7	0	0	12.6	40.2	78.3	0
7		96.6	0	0	0	46.2	50.3	35.8	0	0	18.0	21.0	57.6	0
6	No Agriculture lands													
5	The Pas portion only	6.9	0	0	0	6.9	0	0	0	0	2.1	4.8	0	0
TOTAL		585.6	0	0	103.8	230.8	251.0	244.1	0	15.5	281.5	97.7	190.7	55.6

8.1 ISSUES WITH TRANSMISSION LINE ANALYSIS

The route analysis for the transmission line included identifying houses, barns, sheds and abandoned locations on or near the preferred route. This was an evolutionary process. It began with identifying houses and large barns within 200 m of the transmission line. Subsequently the distance was increased to 235 m and finally to 270 m. Therefore the number of houses, barns, sheds and abandoned locations inside the distance limit increased over time.

All initial route analysis was made under the assumption the line would be on the edge of the road allowance or drainage ditch. Manitoba Hydro then decided the final preferred route would be placed approximately 33 m into the field rather than on the road allowance north of highway 16 and south of highway 16 the center of the tower would be 42 m into the field from the edge of the road allowance. This totalled 230.8 km of in-field transmission line placement creating 244 km of field severance.

8.2 LINE SECTION ANALYSIS

Manitoba Hydro divided the preferred transmission line route from Riel Station located east of Winnipeg to the Keewatinoow Converter Station near the proposed Conawapa Generating Station into 13 sections. Segments 13 at Riel through 7 to Mafeking and segment 5 at The Pas have agricultural activities. An analysis was conducted on each agricultural segment and the data is presented in the following sections.

8.2.1 Section 13

The soils in S13, from Riel Station to the R.M. of Hanover north of Niverville, are predominantly lacustrine clay soils. Ninety-six percent of these soils are used for intensive cultivated agricultural crop production. The Bipole III transmission line in Segment 13 is 47.2 km long. The transmission line will cross 27.4 km in the field, 11.3 km on the half mile and 8.5 km is diagonal line. There will be 36.3 km of field severance by the line. Due to the proximity of this area to Winnipeg and being located east of the Red River, there are also numerous large livestock operations and numerous rural residences in S13. The following is a summary of the baseline data:

- The line through S13 is 47.2 kilometers in length;
- 96% or 45.3 km is cultivated cropland;
- 4% or 1.9 km is pasture and native grass;

- 58% or 27.4 km will be located in the field;
- 24% or 11.3 km will be located on the ½ mile;
- 18% or 8.5 km will be located on the diagonal;
- The line placement (especially the infield placement) will cause management severance on 77% or 36.3 km of the line;
- 9 shelter belts;
- 4 km of fence in the RoW; and
- 9 houses, 5 barns and 3 large sheds are within 270 m of the line (Table 18).

Table 18: Section 13 - Houses, Barns and Large Sheds within 270 m of the Transmission Line

Segment	Buffer (m)	Name* R-House B-Barn or shed	Legal Description	Distance from ROW (m)	Comments
13	270	R1	NE19-10-05E1	202	
13	270	R2	NE21-10-05E1	137	
13	270	R3	SW30-10-06E1	142	
13	270	Bb1	SE30-10-06E1	161	
13	270	R4a	SE30-10-06E1	181	
13	270	R4b	SE30-10-06E1	225	
13	270	Rr1	NE17-10-06E1	166	
13	270	R5	SW24-8-5E1	174	
13	270	R6	SW12-8-5E1	147	
13	270	Bb3	SW12-8-5E1	75	
13	270	Bb4	SW12-8-5E1	134	
13	270	Bb6	SW12-8-5E1	125	Large Shed
13	270	R7	NW1-8-5E1	120	
13	270	Bb7	NW1-8-5E1	115	Large Shed
13	270	Bb8	NW1-8-5E1	112	Large Shed
13	270	Bb9	NW1-8-5E1	161	
13	270	Bb10	NW1-8-5E1	132	

8.2.2 Section 12

The soils in S12, from RM of Hanover south of Niverville and almost to the Red River, are predominantly lacustrine clay soils. One hundred percent of these soils are used for intensive cultivated agricultural crop production including 20% row cropping. The Bipole III transmission line in Segment 12 is 31.6 km long. The transmission line will cross 30.7 km in the field and 0.9 km is a diagonal line. There will be 31.3 km of field severance by the line. Due to the proximity of this area to Winnipeg and being located east of the Red River, there are also numerous large livestock operations and numerous rural residences in S12. The following is a summary of the baseline data:

- The line through S12 is 31.6 km in length;
- 80% or 25.3 km is cultivated cropland;
- 20% or 6.3 km is row cropping;
- 97% or 30.7 km will be located in field;
- 3% or 0.9 km will be located on the diagonal;
- The line placement (especially the infield placement) will cause management severance on 99% of the line;
- 2 shelter belts; and
- 6 houses, 22 barns and 2 large sheds are within 270 m of the line (Table 19).

Table 19: Section 12 - Houses, Barns and Large Sheds within 270 m of the Transmission Line

Segment	Buffer (m)	Name R-House B-Barn or shed	Legal Description	Distance from Line (m)	Comments
12	270	Bb11	SW36-7-4E1	213	
12	270	Bb12	SW36-7-4E1	223	
12	270	Bb13	SW25-7-5E1	92	
12	270	R8	SW25-7-5E1	144	
12	270	B1	SW14-7-5E1	109	
12	270	B1	SW14-7-5E1	110	
12	270	B2	SW15-7-5E1	89	
12	270	B2	SW15-7-5E1	234	
12	270	B2	SW15-7-5E1	234	
12	270	B3	SE16-7-5E1	111	
12	270	B3	SE16-7-5E1	110	
12	270	B4	SW16-7-5E1	111	
12	270	B4	SW16-7-5E1	110	
12	270	Rr13	NE10-7-5E1	231	
12	270	B5	NW8-7-5E1	153	
12	270	B5	NW8-7-5E1	140	
12	270	B5	NW8-7-5E1	139	
12	270	Bb16	NE7-7-5E1	225	
12	270	R9	NW12-7-4E1	153	
12	270	Rr15	NE10-7-4E1	210	
12	270	Bb17	NE10-7-4E1	198	
12	270	B6	NW10-7-4E1	139	
12	270	B6	NW10-7-4E1	139	
12	270	B6	NW10-7-4E1	199	
12	270	B6	NW10-7-4E1	162	large shed

Segment	Buffer (m)	Name R-House B-Barn or shed	Legal Description	Distance from Line (m)	Comments
12	270	B6	NW10-7-4E1	134	large shed
12	270	R10	NW9-7-4E1	204	
12	270	R11	NE8-7-4E1	166	
12	270	R12	NE7-7-4E1	175	
12	270	B7	NE11-7-3E1	139	
12	270	B7	NE11-7-3E1	232	
12	270	Rr2	NE11-7-3E1	207	

8.2.3 Section 11

The soils in S11 from the Red River to Brunkild are predominantly lacustrine clay soils. One hundred percent of these soils are used for intensive cultivated agricultural crop production. The Bipole III transmission line in Segment 11 is 59 km long. The transmission line will cross 33 km in the field, 24.2 km on the ½ mile and 1.8 km is a diagonal line. There will be 37.2 km of field severance by the line. Compared to S13 and S12 there are less large livestock operations and rural residences in S11. The following is a summary of the baseline data:

- The line through S11 is 59 km in length;
- 100% cultivated cropland;
- 56% or 33 km will be located in field;
- 41% or 24.2 km located on the ½ mile;
- 3% or 1.8 km will be located on diagonal;
- The line placement (especially on the ½ mile or diagonal) will cause management severance on 63% or 37.2 km of the line;
- 1 shelter belt; and
- 7 houses, 1 barn and 5 large sheds are within 270 m of the line (Table 20).

Table 20: Section 11 Houses, Barns and Large Sheds within 270 m of the Transmission Line

Segment	Buffer (m)	Name R-House B-Barn or shed	Legal Description	Distance from Line (m)	Comments
11	270	R13	RL 542	155	
11	270	Bb21	RL 542	137	large shed
11	270	Bb24	RL 542	185	large shed
11	270	Bb25	RL 542	195	large shed
11	270	R14	RL 544	153	
11	270	Bb27	RL 544	184	large shed
11	270	Bb28	RL 544	198	large shed
11	270	R15	RL543 + RL547	181	line could be moved between the houses to avoid both houses - RL 543 – 2 houses
11	270	R16	SW10-7-1W1	203	
11	270	B8	SE4-8-2W1	224	

8.2.4 Section 10

The east half of S10 from Brunkild to Carman are lacustrine clay soils with less population and the west half from Carman to the Assiniboine River are sandier soils with irrigation or irrigation potential. The route avoids any irrigation pivots currently operational (Map 4). Seventy-eight percent of these soils are used for intensive cultivated agricultural crop production and row cropping. The Bipole III transmission line in Segment 10 is 56.2 km long. The transmission line will cross 21.4 km in the field, 33.2 km on the ½ mile and 1.7 km is a diagonal line. There will be 21.4 km of field severance by the line. The sandy soils areas to the west have many rural residences and smaller livestock operations. The following is a summary of the baseline data:

- The line through S10 is 56.2 km in length;
- 64% or 36 km is cultivated cropland;
- 14% or 7.9 km is pasture and native grass;
- 14% or 7.9 km is in row crop;
- 8% or 4.5 km is in trees and marsh;
- 59 % or 33.2 km is located on the ½ mile;
- 38% or 21.4 km is located in field;
- 3% or 1.7 km is located on the diagonal;
- The line placement (especially on the ½ mile or diagonal) will cause management severance on 38% or 21.4 km of the line;
- 16 shelter belts;
- 21.3 km of fence in the RoW; and
- 3 houses are within 270 m of the line (Table 21).

Table 21: Section 10 - Houses, Barns and Large Sheds within 270 m of the Transmission Line

Segment	Buffer (m)	Name R-House B-Barn or shed	Legal Description	Distance from Line (m)	Comments
10	270	Rr16	SE2-8-5E1	230	
10	270	Rr17	SW4-8-6W1	225	
10	270	Rr5	SW5-8-7W1	216	

8.2.5 Section 9

This segment has been broken into 3 sections depending on agricultural activity. The soils in S9.1, from Assiniboine River to PTH 16, are sandy textured lands with irrigation potential between the Assiniboine River and 2 miles north of Beaver. The sandy soils areas have numerous rural residences and smaller livestock operations. Between Beaver and PTH 16 the soils are heavier clay with less irrigation potential. Eighty-seven percent of these soils are used for intensive cultivated agricultural crop production and row cropping. The Bipole III transmission line in Segment 9.1 is 63.5 km long. The transmission line will cross 30.5 km in the field, 27.3 km on the ½ mile and 5.7 km is a diagonal line. There will be 41.3 km of field severance by the line. The sandy soils areas have many rural residences and smaller livestock operations. The following is a summary of the baseline data:

- The line through S9.1 is 63.5 km in length;
- 85% or 54 km of cultivated cropland;
- 13% or 8.3 km of pasture and native grass;
- 2% or 1.3 km of row crop production;
- 43% or 27.3 km is located on the ½ mile;
- 48% or 30.5 km is located in field;
- 9% or 5.7 km is located on the diagonal;
- The line placement will cause management severance on 65% or 41.3 km of the line;
- 13 shelter belts;
- 2.6 km of fence in the RoW; and
- 2 houses and 2 large sheds are within 270 m of the line (Table 22).

Table 22: Section 9.1 Houses, Barns and Large Sheds within 270 m of the Transmission Line

Segment	Buffer (m)	Name R-House B-Barn or shed	Legal Description	Distance from Line (m)	Comments
9.1	270	R17	SE35-9-9W	198	
9.1	270	Bb37	SE35-9-9W	196	Large shed
9.1	270	Bb38	SE35-9-9W	147	Large shed
9.1	270	R18	SE11-11-9W	159	

The sandy loam to loam soils in S9.2, from PTH 16 to Langruth, are shallow high lime boulder till soils with lower production potential suited mainly to livestock production. One hundred percent of these lands are used for livestock production mainly producing tame and native hay and pasture. The Bipole III transmission line in Segment 9.2 is 24 km long. The transmission line will cross 21.6 km in the field and 2.4 km is a diagonal line. There will be 11.8 km of field severance by the line. The following is a summary of the baseline data:

- The line through S9.2 is 24 km miles in length;
- 46% or 11 km of tame or native hay or cultivated crop production;
- 16% or 3.8 km of pasture and native grass;
- 38% or 9.1 km of trees and marsh;
- 90% or 21.6 km is located in field;
- 10% or 2.4 km is located on the diagonal;
- The line placement will cause management severance on 49% or 11.8 km of the line;
- 9.75 shelter belts;
- 15.2 km of fence in the RoW; and
- 1 house and 1 tower are within 270 m of the line (Table 23).

Table 23: Section 9.2 Houses, Barns and Large Sheds within 270 m of the Transmission Line

Segment	Buffer (m)	Name R-House B-Barn or Shed	Legal Description	Distance from Line (m)	Comments
9.2	270	R19	NE36-14-10W	106	house
9.2	270	T1	SE1-16-10W	73	Radar tower

The sandy loam to loam soils in S9.3, from Langruth to Eddystone, are shallow high lime boulder till soils with lower production potential suited mainly to livestock production. The soils are lands with intermittent agricultural use for hay land, cropland and/or pasture. There are areas of trees and large marshes throughout the transmission line route. The Bipole III transmission line in Segment 9.3 is 69.2 km long. The transmission line will cross 12.5 km in the field and 56.7 km is a diagonal line in lower capability agricultural land. There will be 13.1 km of field severance by the line. The following is a summary of the baseline data:

- The line through S9.3 is 69.2 km in length;
- 27% or 18.7 km is tame hay or cultivated cropland;
- 14% or 9.7 km is in pasture and native grass;
- 59% or 40.8 km is in trees and marsh;
- 18% or 12.5 km is located in field;
- 82 % or 56.7 km located on the diagonal in lower capability agricultural land;
- The line placement will cause management severance on 19% or 13.1 km of the line;
- 3 shelter belts;
- 5.6 km of fence in the RoW; and
- There are no houses or barns within 270 m of the line.

8.2.6 Section 8

This section has been broken into 3 sections depending on agricultural activity. The soils in S8.1 are mostly high lime boulder till soils between Eddystone to Rorketon. Most land use is non-agricultural in this area however more land is under agricultural use towards Rorketon. The Bipole III transmission line in Segment 8.1 is 50.7 km long. The transmission line will cross 12.5 km in the field and 42.6 km is a diagonal line in lower capability agricultural land. There will be 13.1 km of field severance by the line. The following is a summary of the baseline data:

- The line through S8.1 is 50.7 km in length;
- 30% or 15.2 km is in pasture and native grass;
- 70% or 35.5 km is in trees and marsh;
- 84% or 42.6 km is located on the diagonal;
- 16% or 8.1 km is located on the ½ mile;
- The line placement will cause management severance on 2% or 1 km of the line;
- There are no shelter belts;
- 16 km of fence in the RoW; and
- There are no houses or barns within 270 m of the line.

The soils in S8.2 are highly calcareous high lime glacial till. These lands are generally utilized for agricultural production from Rorketon to Winnipegosis. The soils are utilized for tame and native hay and pasture and around Winnipegosis with some soils producing annual crops. Sixtysix percent of the land is used for livestock production mainly producing tame and native hay and pasture with some crop land. The Bipole III transmission line in Segment 8.2 is 39.9 km long. The transmission line will cross 39.9 km as a diagonal line. There will be 11.8 km of field severance by the line. The following is a summary of the baseline data:

- The line through S8.2 is 39.9 km in length;
- 26% or 10.4 km of tame hay or cultivated crop land;
- 40% or 16 km of pasture and native grass;
- 34% or 13.6 km of trees and marsh;
- 100% or 39.9 km of the line is located on the diagonal;
- The line placement will cause management severance on 32% or 12.8 km of the line;
- There are no shelter belts;
- 19.92 km of fence in the RoW; and
- 1 house is within 270 m of the line (Table 24). This house will have a view of the line.

Table 24: Section 8.2 Houses, Barns and Large Sheds within 270 m of the Transmission Line

Segment	Buffer (m)	Name R-House B-Barn or shed	Legal Description	Distance from Line (m)	Comments
8.2	270	Rr7	NE22-30-18W	214	

The soils in S8.3 are mostly highly calcareous high lime glacial till and organic soils between Winnipegosis and Cowan. Use is mainly non-agricultural lands between Winnipegosis and Cowan, except for some cultivated lands and pasture around Cowan and Pulp River. Twenty-eight percent are lands used for livestock production mainly producing tame and native hay and pasture with some crop land. Twenty-nine percent of the area is in trees and marsh. The Bipole III transmission line in Segment 8.3 is 40.4 km long. The transmission line will cross all 40.4 km as a diagonal line. There will be 2 km of field severance by the line. The following is a summary of the baseline data:

- The line through S8.3 is 40.4 km in length;
- 6% or 2.4 km is in tame hay or cultivated crop land;
- 22% or 8.9 km is in pasture and native grass;
- 72% or 29.1 km is in trees and marsh;
- 100% or 40.4 km of the line is located on the diagonal;
- The line placement will cause management severance on 5% or 2 km of the line;
- There are no shelter belts;

- 8 km of fence in the RoW; and
- There are no houses or barns within 270 m of the line.

8.2.7 Section 7

The soils in S7 are a mixture of sandy loams to silty clay loams with varying productive potential from moderate to highly productive for annual cropping. There are cultivated and non-agricultural lands between Cowan and Mafeking. Fifty percent of the area is used for crop and livestock production producing annual crops, tame and native hay and pasture. The Bipole III transmission line in Segment 7 is 96.6 km long. The transmission line will cross 50.2 km on the diagonal line, with 46.4 km in the field. There will be 35.7 km of field severance. The following is a summary of the baseline data:

- The line through S7 is 96.6 km in length;
- 18% or 17.4 km of tame hay or cultivated crop land;
- 22% or 21.3 km of pasture and native grass lands;
- 60% or 58 km of trees and marsh with some agricultural use;
- 52% or 50.2 km is located on the diagonal;
- 48% or 46.4 km is located in field;
- The line placement will cause management severance on 37% or 35.7 km of the line;
- There are no shelter belts;
- 12 km of fence in the RoW; and
- 2 houses are within 270 m of the line (Table 25). One of these houses will have a view of the line.

Table 25: Section 5 - Houses, Barns and Large Sheds within 270 m of the Transmission Line

Segment	Buffer (m)	Name R-House B-Barn or shed	Legal Description	Distance from Line (m)	Comments
7	270	R20	SW16-39-24W1	55	
7	270	R21	NW28-39-24W1	196	

8.2.8 Section 6

There are no agricultural lands in S6.

8.2.9 Section 5

The soils in S5 are recent alluvium sandy loam soils used mostly for tame pasture and hay land with some cultivated fields at Rahls Island east of The Pas's main cropped area. The Bipole III transmission line in Segment 5 is 6.9 km long in the agricultural area. The transmission line will cross 6.9 km in the field. There will be no field severance by the line. The following is a summary of the baseline data:

- The line through S5 is 6.9 km in length;
- 30% or 2 km is cultivated cropland;
- 70% or 4.9 km is in pasture and native grass;
- 100% of the line is located in field;
- The line placement will cause no management severance;
- There are no shelter belts;
- There are no fences in the RoW; and
- 2 houses are within 270 m of the line (Table 26).

Table 26: Section 6 - Houses, Barns and Large Sheds within 270 m of the Transmission Line

Segment	Buffer (m)	Name R-House B-Barn or shed	Legal Description	Distance from Line (m)	Comments
5	270	Rr10	SW15-56-25W1	230	
5	270	Rr9	SW15-56-25W1	217	

9.0 ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

9.1 CONSTRUCTION PHASE

Manitoba Hydro has general Environmental Protection Practices which are designed to minimize the impact of construction activity on cultivated and uncultivated agricultural lands. Winter construction will limit effects on crops and measures are included to limit effects on soil (e.g., compaction, erosion). The majority of construction will take place in the winter. If transmission line construction occurs during the growing season the soils should be dry and some crop damage close to the structures will likely result. Compensation will be paid for any crop or other physical damage. Transmission line construction will have a greater impact during the growing season and some damage to the soil and to the crop is likely to occur unless it is a dry summer. Compensation will be paid for physical damages created during construction, (i.e., crop loss, ruts, admixing soils, etc.). Construction in pastures along the proposed route will require access by construction crews and vehicles through gates and may involve contact with livestock.

9.2 OPERATION AND MAINTENANCE PHASE

Environmental Protection Practices are used to minimize potential impacts (e.g., soil erosion) caused by Manitoba Hydro crews during maintenance or emergency procedures. However, should crop or soil damages occur, compensation should be paid.

9.3 STRUCTURE PLACEMENT

The 500 kV HVdc transmission line is proposed to be constructed using steel lattice towers in agricultural Manitoba and structures with guy wires in non-agricultural Manitoba. Guyed structures are also used in hay, pasture and treed lands in agricultural Manitoba. Eighteen percent of the preferred route is along the half-mile line. Locating structures next to the road allowance is favored for ease of agricultural machine operation (the farmer can swing the machine out and past the pole and the impact is eliminated in two or three machine passes; the same is true for half mile line placement where the line does not split a management unit). Where the transmission line will split management units, placing structures 42 m or more from the nearest impediment, where possible, will help to facilitate the movement of machinery, such as field sprayers, around structures.

9.4 CONSULTATION WITH LANDOWNERS

During the course of establishing easement agreements with individual landowners along the proposed route, an opportunity for landowners and Manitoba Hydro representatives exists to discuss any landowner’s preferences for structure placement particularly in areas with irrigation potential. The ability to accommodate requests will be limited by the flexibility of the transmission line design (e.g., span requirements between towers).

9.5 TRANSMISSION LINE RIGHTS-OF-WAY

Manitoba Hydro's objective is to minimize the number of transmission line rights-of-way needed by:

- Developing the "utility corridor" concept removing existing lines when new lines of increased capacity are constructed, whenever possible, and by
- Utilizing multiple circuit structures rather than single circuit structures, whenever possible (BOARD 481-78-8).

9.6 PROPERTY DEPARTMENT RESPONSIBILITIES

The Property Department is responsible for obtaining all rights pertaining to land, buildings and rights-of-way by purchase, lease or easement. Landowners affected by the installation of high voltage facilities can expect to be compensated for land compensation, construction damage compensation, structure impact compensation and ancillary damage compensation. Land compensation is based on the total area of the easement. Construction damage is based on crop or soil damage that occurs during construction. Structure impact damage is a lump sum payment for the agricultural land taken out of production, for reduced productivity, for time to farm around the structure, for the additional cost of double seeding, fertilizing, spraying, for extra weed control and area overlap, Ancillary damage impact is for specific issues such as special agricultural impact, special residential impact and others.

9.7 COMPENSATION AND OTHER CONSIDERATIONS

Mitigation cannot eliminate all of the effects of the presence of the transmission line on cultivated or uncultivated agricultural land. Therefore, easement agreements will include provisions to compensate landowners for the physical impacts associated with the transmission line. Manitoba Hydro compensates landowners by acquiring an easement for the right-of-way and by payment for structure placement on agricultural land.

For towers structures the right-of-way easement is 66.0 meters wide. Compensation for all of the lands within the easement is calculated at 75% of market value. Normally land under the transmission line continues to be farmed.

Payments are a onetime lump sum to compensate for all impacts of the structure for the lifetime of the line. With the assistance of Manitoba Agriculture, Manitoba Hydro establishes a payment rate per tower for the year it is placed on the farmer's land. The annual compensation rate is calculated and then capitalized into a onetime payment per tower. The main considerations are:

- Lost income from land taken out of production;
- Reduced yields around the structure;
- Additional time required to work around the structure;
- Extra cost of double application of seed, fertilizer and chemicals; and
- Weed control around the structure.

The following identifies effects of the project on agriculture. The sites are not specific locations, but the effects will be present throughout the location of the transmission line in agricultural areas. Effects include:

- Crop and Soil Damage during construction;
- Agricultural Operations and Resource:
  - Land removed from production;
  - Additional cost to farm around towers;
  - Additional weed control needed around towers;
  - Nuisance and inconvenience of farming around towers;
  - Impact on weed control for organic farms; and
  - Impact on exotic animal production.
- Positive impact on livestock production of clearing bush, scrub and marsh lands that are poorer quality agricultural land;
- Management Unit Splits due to the transmission line;
- The potential for towers to interfere with irrigation systems:
  - Diagonal tower placement is not feasible; and

- Tower placement to allow ¼ section pivot operation is required.

- Potential tower interference with aerial spraying:
  - Ground spraying will be required under the transmission line;
  - Corners where lines cross will result in larger areas needing to be ground sprayed; and
  - Wet soils particularly in the Red River Valley necessitate the use of aerial spraying and make ground spraying under the line difficult.

Table 27 provides details of impacts on agriculture that will need consideration when discussing line placement with landowners and the impacts that should be considered when compensation levels are determined and discussed.

Table 27: Bipole III Transmission Project General Mitigation Measures

Source ID	ESS Name	ESS Description	Environmental Effects	Mitigation Measures
Nielsen	Crop Damage	• During construction – whole route	• Loss of farm income due to damages	• Construct line in the winter, summer if soils are dry or late fall after harvest and if crops or soils are impacted pay for damages.
Nielsen	Soil damage	• During construction – whole route	• Soil admixing when heavy construction vehicles mix the A, B and C soil horizons in wet conditions.	• Construct the line when soils are frozen or dry; admixing has a detrimental effect on soil productivity.
			• Soil compaction from heavy construction vehicles.	• Construct the line when soils are frozen, dry or in late fall after harvest.
				• Strip topsoil from tower area
				• Para-till soils after construction to reduce the impact of compaction.
		• Tile drainage systems	• Care needs to be taken so tile drainage systems are not impacted during construction.	• Repair the tile system if it is impacted.
Nielsen	Agricultural Operations and Agricultural Resource	• Towers remove a small amount of agricultural land from production and increase the cost of farming around the towers. Effects are prevalent in Segments S13, S12, S11, S10, and S9 to Highway 16, S8 at Winnipegosis and Cowan, and S7 in the Swan River Valley where crops are produced.	• Land is removed from production.	• Provide compensation based on a one-time payment.

Source ID	ESS Name	ESS Description	Environmental Effects	Mitigation Measures
			• Cost to farm around the towers is higher than normal acres, yields will be reduced due to overlap, and there will be double or triple application of inputs.	• Provide compensation based on a one-time payment.
			• Weeds may be an issue around the tower and yields will be reduced.	• Provide compensation based on a one-time payment; Manitoba Hydro should work with producers to facilitate good weed control.
			• Compaction from additional passes with agricultural machinery may result in naturally salinizing the soils.	• Manitoba Hydro should work with producers to minimize salinity impact in ways such as recommending fall tillage around the towers to reduce this impact.
			• There is a nuisance and inconvenience from farming around the towers and an increased risk of hitting the towers with large agricultural machinery.	• Provide compensation based on a one-time payment.
		• Lower land value	• The presence of the transmission line will lower land value.	• Provide compensation based on a one-time payment.
		• Towers and transmission line split management units and create a field severance, especially with ¼, 1/3 and ½ mile line placement. Effects are prevalent in Segments S13, S12, S11, S10, and S9 to Highway 16, S8 at Winnipegosis and Cowan, and S7 in the Swan River Valley where crops are produced.	• Field severance will remain for the lifetime of the line.	• Avoid ¼, 1/3 and ½ mile line placement and diagonal line placement if possible in cropped lands.
		• Towers interfere with irrigation systems. Effects are prevalent in Segments S10 and S9 where soils have irrigation potential.	• Towers placed in the field diagonally will restrict irrigation system usage.	• Towers need to be placed in a fashion that they will not interfere with ¼ section pivot operation; Provide compensation based on a one-time payment.
				• Manitoba Hydro needs to work with producers so the irrigation system may work safely under the transmission line.

Source ID	ESS Name	ESS Description	Environmental Effects	Mitigation Measures
				• Manitoba Hydro works with producers with wheel move irrigation systems so the system may work safely next to the transmission line.
		• Towers interfere with aerial spraying. Effects are prevalent in Segments S13, S12, S11, S10, and S9 to Highway 16, S8 at Winnipegosis and Cowan, and S7 in the Swan River Valley where crops are produced.	• Towers in the field interfere with aerial spraying.	• Provide compensation based on a one-time payment.
		• Organic farming – no specific locations known	• Issues with weed control and lower crop yields around the towers.	• Provide compensation based on a one-time payment.
		• Production of buffalo and other exotic animals - no specific locations known	• Concern with HV line being close the livestock barn and its impact on production.	• Provide compensation based on a one-time payment.
		• Clearing poorer quality lands – positive impact in Segments S9, S8, S7 and S5	• Provides pasture where poorer land capability would not support the cost of clearing bush.	• None required
		• Clearing bush and scrub – positive impact in Segments S9, S8, S7 and S5	• Open up pasture and hay land for agricultural producers.	• None required
		• Clearing marsh lands – positive impact in Segments S9, S8, S7 and S5	• Provides access to more pasture and hay land.	• None required

9.8 EFFECTS OF THE PROJECT ON AGRICULTURE

This section presents a discussion of general agricultural effects that are likely to occur along the transmission line route. Effects of construction and operation and maintenance of the line are discussed. In agricultural Manitoba approximately 50% of the preferred route crosses cultivated land with the remaining 50% of the route crossing uncultivated pasture land, native hay land, bush and organic soils.

For both cultivated and non-cultivated fields routine maintenance and emergency access to fields is also required by Manitoba Hydro. Each of the general impacts is discussed, in turn, below as well as mitigation measures identified. In addition, this section illustrates the impact of transmission lines on field operations through a series of photographs of examples in or near the study area.

9.8.1 Removal of Agricultural Land from Production

Crops will be lost on lands permanently removed from production by transmission line structures placed in the field (Photo 6). The Manitoba Hydro Landowner Compensation Information brochure indicates a footprint of 49 m^2 with 100% crop loss when Steel Lattice structures are placed in the field 42m from the edge of the road allowance with four poles in the field. The base of the tower is 7m x 7m. In cultivated land these areas will be totally removed from agricultural production. In grazing areas this is not the case because cattle do graze under towers.

Because the total area removed from production is small compared to farm size, the corresponding effect of having transmission lines in fields is negligible. Field measurements on cropped lands show Steel Gulfport structures will remove about 50 m^2 per structure; with 6 to 7 structures per mile, this totals about 350 m^2 per section. This is similar to the findings of others *(Webb, 1982*). The larger towers have 3.5 towers per mile. At 100 m^2 crop loss the impacted area is the same, i.e., 350 m^2.

Overall, the 230 kV and 500 kV HVdc transmission structures viewed throughout Manitoba have farming activities right up to the immediate base of the towers. Farmers appear to do an excellent job of working close to the towers to maximize crop produced and to reduce the area taken out of production. Vegetation under many towers has reverted to grass making weed control easier.

9.8.2 Extra Cost to the Farmer for Working around the Tower and Cost of Crop Production Lost Within the Immediate Vicinity of the Tower

The physical presence of the tower has a greater negative impact on the farmer and on agricultural production than the actual land taken out of production by the tower (Photo 6, 12 and 17). Portions of the area around the tower will be double cultivated, seeded, fertilized and sprayed, thus increasing input costs. The effect of a tower is shown in Photo 1. In order to revert to straight lines to seed, spray and fertilize there will be a doubling or tripling effect on the application of these inputs. It takes a skilled operator to farm effectively right up to the edge of the towers. Machines are 45 to 130 feet in width so the doubling effect is relatively large.

Sometimes double spraying will have a material effect on the crop. Achieving good weed control is difficult and time consuming. Soil compaction may occur in the affected area as the tractor travels around the tower. Farmers must take care with large equipment [sprayers are 21-37 m (70-120 ft.)] to avoid the tower. Hand spraying around and under the tower may be necessary to control weeds. Double and triple rates of weed control chemicals may also contribute to the reduction of crop yields. In some cases, the effect may even carry over to the following season (*Hanus, 1979; Webb, 1982*). It also takes more time per acre to produce a crop around a tower as operators slow down as they approach the towers.

Yield reduction around towers may be experienced from the activities described in Section 8.2.2 (Photo 6, 10, and 11). A 1991 study (*Accutrak Systems Ltd., 1991*) concluded that it would cost $20.00 to farm around a small (or very small) obstacle, and no more than $42.00 to farm around a larger obstacle (all figures adjusted for inflation at 1.4 times from 1991 to 2010 as per Bank of Canada Inflation Factor Adjustment), such as a slough several acres in size. Manitoba Hydro's one time compensation for the impact of these structures is more than these values. The impact of having the 500 kV HVdc transmission line pass through an area under agricultural use is as follows:

1. Crop production is reduced within the immediate vicinity of the tower due to overlap around each structure;
2. There are increased costs associated the time it takes to farm around transmission towers;
3. Application of seed, fertilizer and chemicals in the area of overlap around each structure; and
4. Decreased weed control around the towers.

The main considerations from Manitoba Hydro's compensation policy are similar:

- Lost income from land taken out of production;
- Reduced yields around the structure;
- Additional time required to work around the structure;
- Extra cost of double application of seed, fertilizer and chemicals; and
- Weed control around the structure.

9.8.3 Crop Production Lost Within the Immediate Vicinity of the Towers and Lines as a Result of Restricting Aerial Application of Agricultural Pesticides

Transmission lines may impact the ability of an aerial sprayer to do a proper job of spraying pesticides. No literature was found on this topic and there are no photos of this effect. Inadequate coverage in intensively farmed areas may result in weed and insect escapes which may spread and cause more problems in the same or subsequent years. Aerial operators suggest crop under the 500HVdc transmission line will have to be sprayed by ground sprayers. Transmission lines on both sides of the road allowance increase the difficulty to obtain proper coverage because the pilot does not have the alternative routes to spray on either side of the line. With the transmission line 42 m into the field from the edge of the road allowance the transmission line will not interfere with aerial spraying on the opposite side of the municipal road. Pilots suggest large lines will affect desired results; in some instances up to 200-300 feet of crop next to the line may not receive adequate coverage. Similarly lines on the road allowance meeting perpendicularly create a corner problem where obtaining proper coverage is difficult (pilots suggest up to 10 acres or more for large lines may have to be ground sprayed as a result). The larger transmission lines such as those with steel lattice structures present a greater obstacle to proper application of agricultural chemicals. It is best if towers are placed in a straight line along the road allowance. Lines in the field create more constraints and multiple and diagonal lines create the most difficulty. Due to limited information on these topics, interviews were undertaken to gather perspective on the potential effects. Some of the comments raised during the discussion included:

1. It was difficult to impossible to spray around these large diagonal transmission lines. Where the lines were straight the fields could be sprayed more easily.
2. Some interviewees felt that the crop under the line would have to be sprayed with a ground sprayer. Some pilots indicated that they try to stay approximately 90 to 100 feet from the line. Most farmers have high clearance sprayers today or the sprayers are available to rent like the airplane.
3. If the line is 150 feet high the pilot states he needs to start lifting his fully loaded spray airplane quite a ways before the line as the transmission line. If the plane is not loaded less distance is required.

4. The line has an impact as the field will be sprayed parallel to the transmission line. They will stay 90-100 feet from the line running parallel to the line. A ground sprayer will have to be used under the line. The difficulty the pilot faces is cleaning up the headlands that run perpendicular to the transmission line because the person is flying into or away from the line. This area may also have to be sprayed from the ground.
5. Landowners who grow tall crops such as sunflowers and corn depend on aerial spraying because of crop height may be limited in their crop choice by the presence of the transmission line unless they decide to use high clearance ground sprayers.
6. Landowners who want to aerial spray fungicides 2-3 times a crop year may be limited in their ability to do so because of the transmission line, especially if the fields are wet.
7. Aerial spraying is quite common in the Red River Valley because of wet and flooded land. The operator stated he aerial sprays about 100,000 acres per year. Excess water is the main driving factor. They have high clearance ground sprayers as well as spray airplanes.
8. Where two large scale lines intersect there will be acres that cannot be aerial sprayed.

The concerns regarding aerial spray pilots are valid, particularly in the Red River Valley where soils are quite prone to being wet. Today larger airplanes are used for field spraying and these should not be taken too close to the transmission line. In drier years ground spraying of most crops under the transmission line is a practical option although the taller crops may be aerial sprayed. There would likely be an additional charge to bring the ground sprayer to do the limited amount of spraying needed under the transmission line. The residual effect on aerial spraying will continue for the lifetime of the transmission line; crop production may be reduced within the immediate vicinity of the towers and lines as a result of restricting proper aerial application of agricultural pesticides. There is no particular mitigation for this effect other than Manitoba Hydro working with sprayers to improve their ground spraying equipment for wet soil conditions, i.e., develop a track machine for spraying under the transmission line in wet conditions. Additionally ½ mile line placement should be on both quarters as the towers will affect aerial spraying and this is the only way for compensation to be made to both impacted landowners.

9.8.4 Nuisance

Having transmission lines in fields is a nuisance and an inconvenience to the farmer because of the extra time and effort to work around towers and the fact that there are risks involved with operating farm machinery around the structure and avoiding collisions with the structures (Hanus, 1979) (Photos 4, 5, 8, 13, and 15). Operators must be more attentive to avoid the transmission line structures. The presence of structures must be considered during planning and executing field operations and may restrict who can operate a machine in these fields.

9.8.5 Presence of Towers and Lines May Restrict or Complicate the Conduct and Development of Certain Agricultural Activities such as Irrigation or the Production of Taller Crops

Where lines pass through or by irrigation activities there can be potential risks of water hitting the wires, the pivot irrigation system hitting towers and the potential for electrical transfer to parallel systems. Manitoba Hydro should undertake the responsibility to work with the irrigation operators to minimize the risk of irrigating next to a high voltage transmission line. Specific costs are dependent on each individual situation. It is possible for large scale transmission lines operate in areas with active irrigation and a pivot can operate under the line provided the water stream does not come close to the line (*Edy et al., 1981*).

Manitoba Hydro need to have their engineers determine if a ¼ section pivot irrigation system can work when the towers are placed 42 m into the field from the edge of the road allowance. If it is not possible then towers will need to be placed on the edge of the road allowance or on the half mile line. Towers will need to be strategically placed (not at the ¼ and ¾ mile point) if this is to be possible and Manitoba Hydro will have to work closely with landowners in areas when active irrigation occurs and where there is potential for irrigation to commence.

9.8.6 Routine Maintenance and Emergency Access

Manitoba Hydro undertakes routine transmission line maintenance which requires periodic access to transmission lines on agricultural land. This type of activity is generally scheduled to occur when crops are off the field. Access to pastures along the route may occur when they are in use. Maintenance of fencing and insuring that gates are closed are important considerations.

From time to time, Manitoba Hydro may require emergency access at any time of the year. Compensation will be dependent on the specific activity and the impact of that activity.

9.8.7 Transmission Lines in Pastures

Cattle utilize forage and land under transmission lines so these lines cause less loss and inconvenience to farmers compared to lines routed through or on the edge of cultivated fields (Photo 2 of the Red River Floodway). Tame forage is only replanted every four to five years. Clearing poorer quality lands provides pasture where poorer land capability would not support the cost of clearing bush. Additionally clearing bush and scrub opens up pasture and hay land for agricultural producers. Clearing provides access to more pasture and hay land and marsh lands.

9.8.8 Effects of the Project on Agriculture

The following table shows the residual agricultural effects.

Table 28: Bipole III Transmission Line Project: Residual Agricultural Effect - Environmental Effects Expression

Residual Agricultural Effect – Environmental Effects Expression						
Agricultural Effect	Category	Environmental Indicator	Measurable Parameter/ Variable	Environmental Effect	Mitigation Measures	Residual Environmental Effect
Agricultural Operation and Agricultural Resource	Crop Damage	Yield	Bushels/ha	Lower production due to construction activities damaging crops	Construct line in the winter, when soils are dry or late fall after harvest; pay compensation if crops are destroyed	None
	Soil damage	Yield	Bushels/ha	Lower production over 1 to 3 years due to soil admixing and compaction	Construct the line when soils are frozen, dry or in Para-till soils after construction to lessen compaction late fall;	One to three year effect; compensate for crop loss and activities to re-constitute soils to original productive state
	Tile Drainage Systems	Yield	Bushels/ha	Lower Production for 1 to 2 years	Place towers in locations where the tile drainage system is not affected	
	Loss of Net Income	Yield	Bushels/ha	Towers remove a small amount of agricultural land from production	Compensation	Land is removed from production permanently
	Loss of Net Income	Yield	Bushels/ha	Cost to farm around the towers is higher than normal acres, yields will be reduced due to overlap, and there will be double or triple application of inputs	Compensation . Training related to farming more efficiently around the towers	Annual crop loss for as long as the line is in place
	Loss of Net Income	Yield	Bushels/ha	Weeds may be an issue around the tower and yields will be reduced	Compensation	Annual crop loss for as long as the line is in place

Residual Agricultural Effect – Environmental Effects Expression						
Agricultural Effect	Category	Environmental Indicator	Measurable Parameter/ Variable	Environmental Effect	Mitigation Measures	Residual Environmental Effect
	Loss of Net Income	Machinery damage	Cost to repair machinery and tower	There is a nuisance and inconvenience from farming around the towers and an increased risk of hitting the towers with large agricultural machinery	Compensation	Sporadic loss as towers are hit with damage to tower and machinery and Increased insurance costs as farmers are expected to pay these costs
	Loss of Net Income	Yield	Bushels/ha	Towers and transmission line split management units and create a field severance; field severance will remain for the lifetime of the line	Avoid diagonal line placement; place the line on the edge of the road allowance or on the ½ mile line in areas with ¼ section pivots; pay compensation	Annual crop loss for as long as the line is in place
	Loss of Net Income	Potential restricted irrigation system usage	Loss of income	Towers placed in the field may restrict irrigation system usage	Towers need to be strategically placed on the ½ mile line, in-field or the road allowance in active and potential irrigation areas. Towers need to be placed in a fashion that they will not interfere with ¼ section pivot operation	Improperly placed towers interfere with irrigation systems or make irrigation impossible
	Loss of Net Income	Restricted irrigation system usage	Loss of income	Towers placed diagonally will restrict irrigation system usage	Towers placed diagonally will restrict pivot operation in the future	Improperly placed towers interfere with irrigation systems or make irrigation impossible
	Loss of Net Income	Restricted irrigation system usage	Loss of income	Electricity may travel to the irrigation system if it is not properly set up	Manitoba Hydro works with producers with wheel move irrigation systems so the system may work safely next to the transmission line.	Danger surrounding irrigation system usage
		Yield	Bushels/ha	Towers in the field interfere with aerial spraying; Crop under the line will have to be ground sprayed	Compensation	Inconvenience and loss of yield. It may be too wet to ground spray

Residual Agricultural Effect – Environmental Effects Expression						
Agricultural Effect	Category	Environmental Indicator	Measurable Parameter/ Variable	Environmental Effect	Mitigation Measures	Residual Environmental Effect
		Yield	Bushels/ha	Towers in the field interfere with aerial spraying; Fungicide spraying 2-3 times in a year may be restricted if fields are too wet	Compensation	Inconvenience and loss of yield. It may be too wet to ground spray
		Yield	Bushels/ha	Towers in the field interfere with aerial spraying; Producers may be restricted in crop choice when it comes to selecting tall crops like sunflowers that need to be aerial sprayed for insects when the crop is tall	Compensation	Inconvenience and loss of yield. It may be too wet to ground spray
		Yield	Bushels/ha	Towers in the field interfere with aerial spraying; Aerial spraying is common in the Red River Valley is a result of field being too wet to ground spray	Compensation	Inconvenience and loss of yield. It may be too wet to ground spray
		Yield	Bushels/ha	Organic farming - issues with weed control and lower crop yields around the towers	Compensation	Farmers concerns about income loss
		Production	Increased Income	Clearing poorer quality lands provides pasture where poorer land capability would not support the cost of clearing bush	None – this activity increases farm productivity	Positive impact on livestock, pasture and hay production
		Production	Increased Income	Clearing bush and scrub opens up pasture and hay land for agricultural producers	None – this activity increases farm productivity	Positive impact on livestock, pasture and hay production
		Production	Increased Income	Clearing provides access to more pasture and hay land and marsh lands	None – this activity increases farm productivity	Positive impact on livestock, pasture and hay production

9.8.9 A Photo Analysis of the Impact of Transmission Lines on Field Operations

Photographs of existing transmission lines in Manitoba's agricultural areas are provided to portray the impact on various agricultural activities (Appendix C).

9.9.9.1 Large Transmission Lines on Road Allowances

Photograph 1 shows transmission lines CN8 and CN9 (115 HVdc double wooden pole) crossing the highly productive Portage la Prairie plains just south of Lake Manitoba. It appears that farmers are growing crops within the road allowance; therefore, the effect shown is slightly magnified.

Photograph 1 showed a swathing pattern where the impact of the structures continued across the swathed field. In this case, the farmer had not "swathed out" the structure effect immediately and eliminated the effect of the structure in the 2 to 3 swather (machine) rounds.

Photo 1. Effects on swathing of double pole CN8 and CN9 north of Portage la Prairie

9.9.9.2 Tame Hay Production

Photograph 2 shows transmission lines along the Red River Floodway where tame hay was being produced (comparable to any other part of Manitoba where transmission lines cross tame hay lands). The impact on harvesting is similar to having lines in cropped fields. However, in total, the impact is less as forage fields are only cultivated and replanted every 5 or more years.

Photo 2. Tame hay production on the Red River; floodway around the large towers; small impact on production.

9.9.9.3 The Impact of Transmission Towers within Fields

Photographs 3, Photo 4, Photo 5, Photo 6 and Photo 7 of large steel transmission towers demonstrate that farmers are capable of producing crops right to the edge of the tower. The photos also show that the effects of the tower are limited, by the farmer, to two swather widths (machine passes) from the tower (Photo 4 and Photo 5). Allowing the effect to continue for more rounds, as in Photo 1, is not necessary. These photographs also clearly demonstrate that there is no interrelationship between towers on a single, large tower high voltage transmission line (Photo 4, Photo 8 and Photo 9). Field severance will not be an issue if agricultural operations are conducted by ground machines. Splitting fields may be considered where 1/4, 1/3, or 1/2 mile placement makes operating the field in two pieces appropriate. Placing the transmission line 33 m or 42 m into the field will not result in the operator creating two fields.

Photo 3. Crop production right up to the base of the tower.

Photo 4. Impacts of tower are swathed out immediately. There is no interaction between towers.

Photo 5. Impacts of tower are swathed out immediately. There is no interaction between towers

Photo 6. Crop production to the base of the tower; some crop loss around the base of the tower.

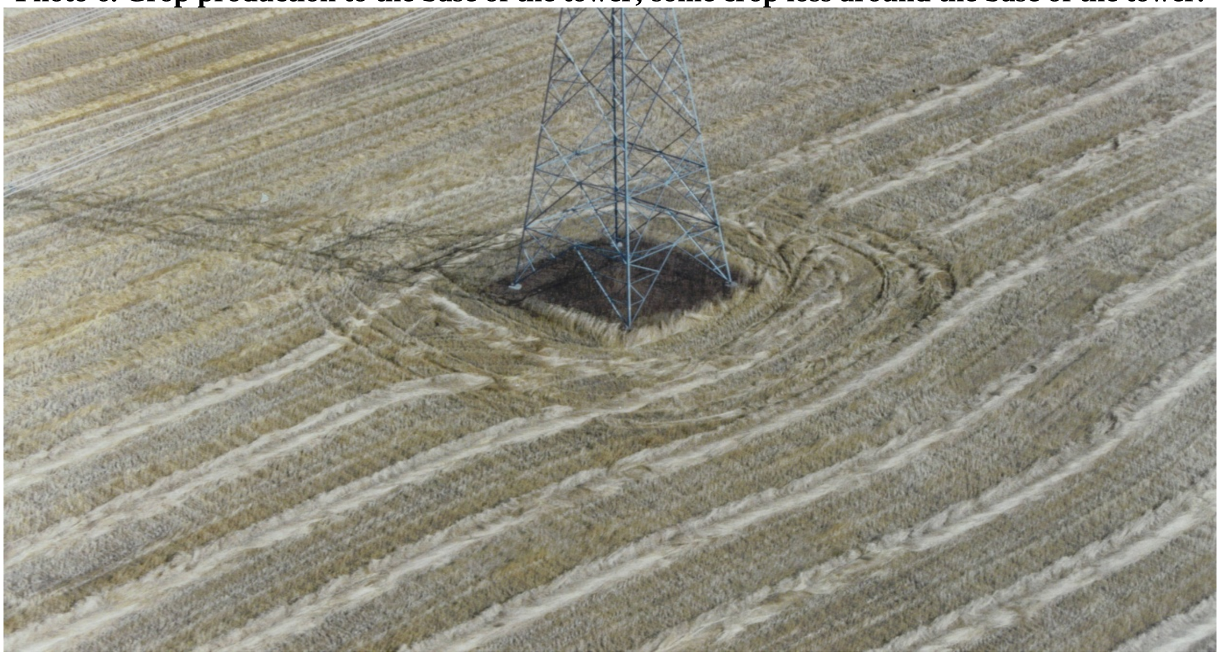
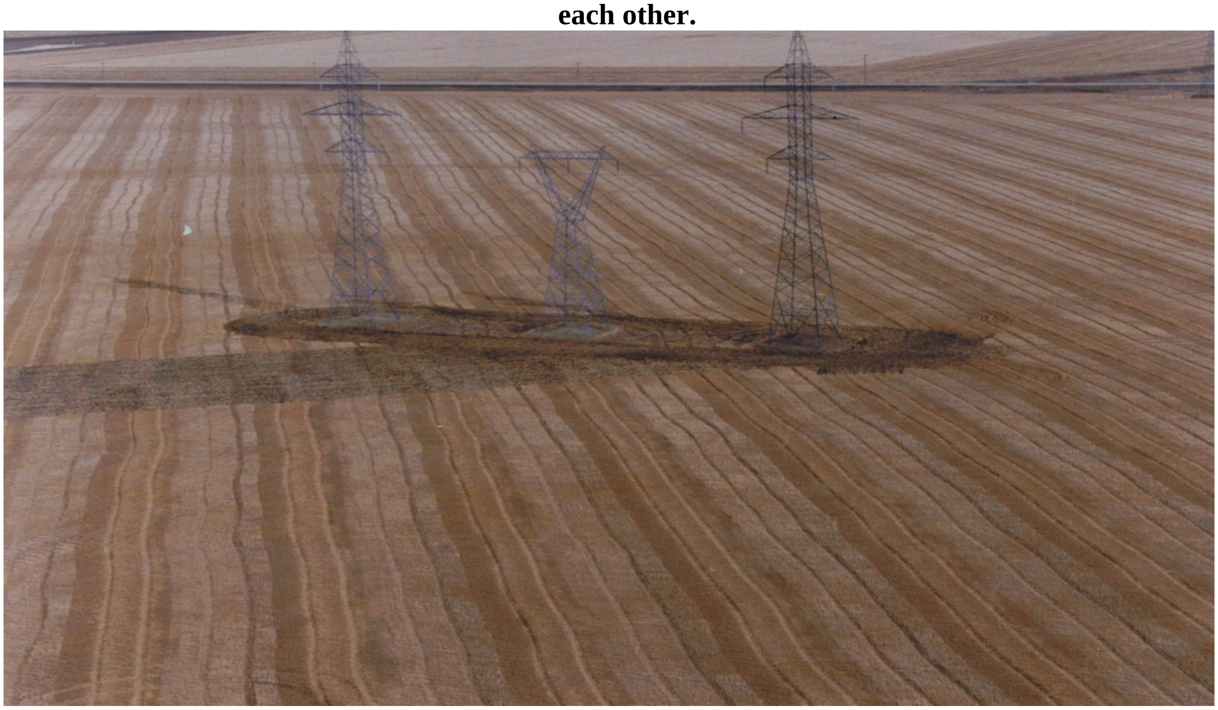


Photo 7. Crop production to the base of the tower; some crop loss around the base of the tower.

Photo 8. There is no cumulative effect between the large towers

Photo 9. There is no cumulative effect between the large towers other than those towers close to each other.



There is no effect between large towers. Tower placement in the corner of a field creates greater costs and inconvenience for the farmer (Photo 10). Crop growth patterns in photographs (Photo 11 and Photo 12) show equipment operation patterns created by having to work around the towers. Multiple lines result in a greater impact than a single line (Photo 13 and Photo 14). Photo 15 shows the effect of guyed towers on cropland from Bipole I and II. Photo 16 and Photo 17 show the additional effort needed to work around towers in the field.

Photo 10. Increased crop loss when towers are placed in the corner of the field.

Photo 11. Implement patterns are evident in crop around tower.

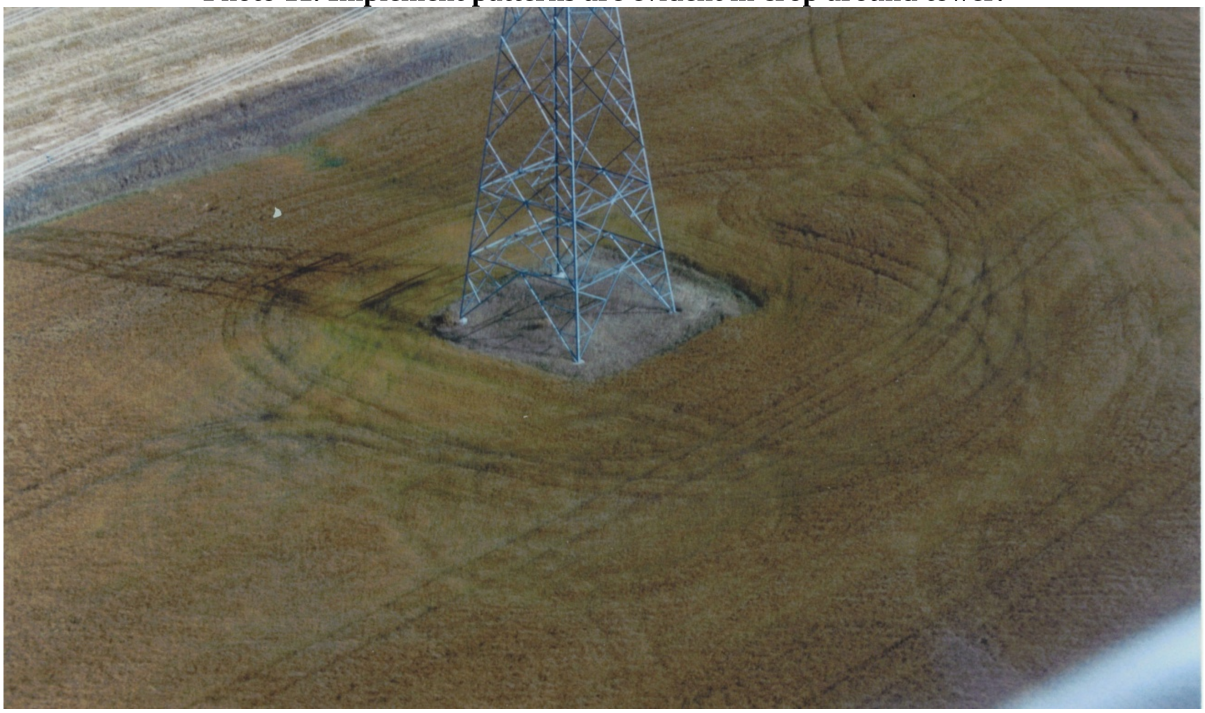


Photo 12. Implement patterns are evident in crop around tower.

Photo 13. Multiple lines result in a greater impact on operations.

Photo 14. Multiple lines result in a greater impact on operations.

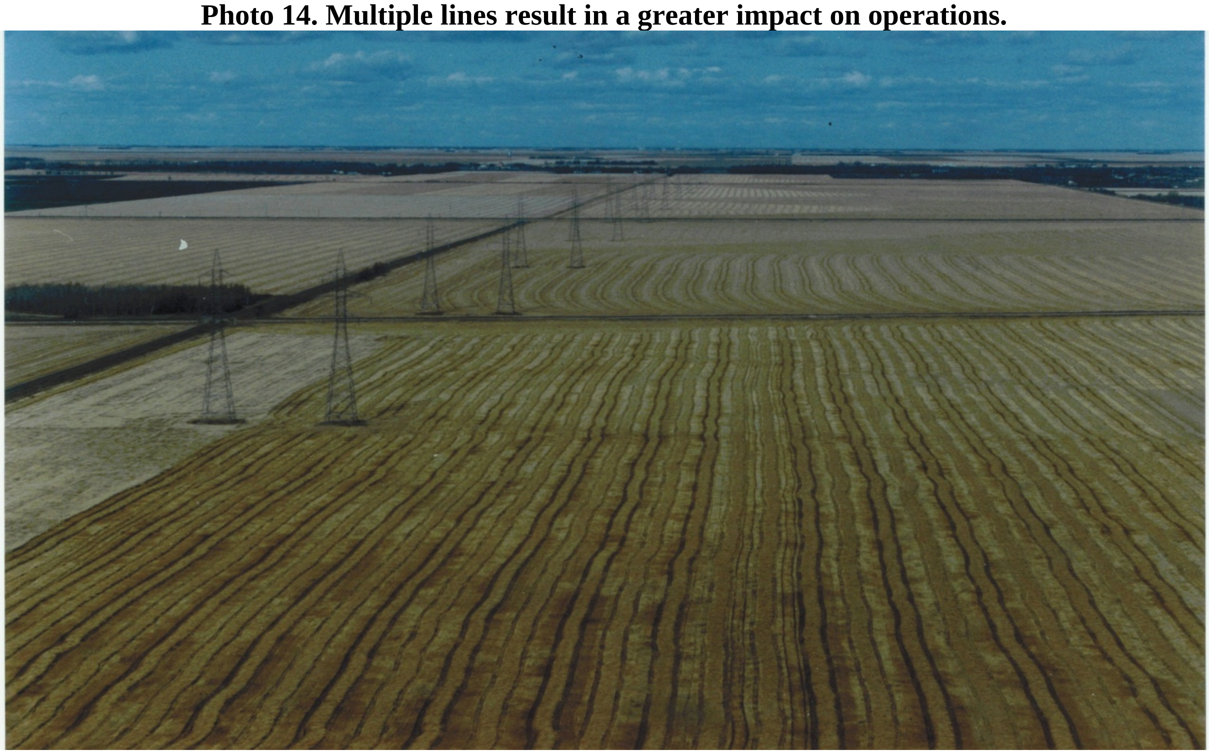
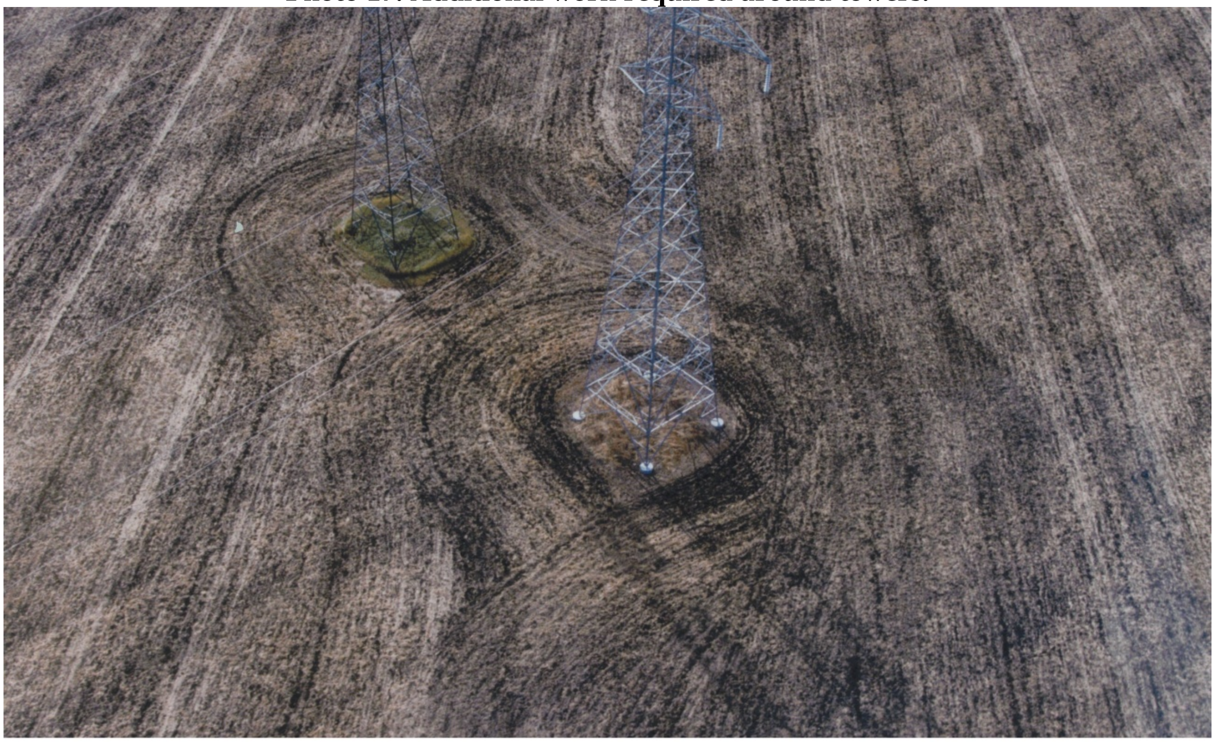


Photo 15. Bipole I and II – guyed towers in cropped fields cause major impact on cropping operations.

Photo 16. Additional work required around towers.

Photo 17. Additional work required around towers.



9.9.9.4 Diagonal Transmission Lines

Photographs of transmission line BN5 from Neepawa to Brandon (Photo18) demonstrate that diagonal poles have no interactive effect. In comparison to structures which run parallel to the property pattern, diagonal transmission lines appear to cause greater inconvenience to farming operations. The total impact of structures located on in-field alignments on field operations may not be worked out in the first few passes of a machine; rather the impact occurs intermittently during the time that the field is being worked. It is a matter of not "finishing with the nuisance" and then working the rest of the field normally (e.g., a farmer may have to make sure, repeatedly, that the combine auger is moved back to the side of the machine so it will not hit the tower and cause major damage to the tower and the machine).

Photo 18. No interactive effect of towers placed on the diagonal – Neepawa to Brandon 230 kV transmission line.

Diagonal lines may also conflict more with aerial spraying and irrigation. The total effect of diagonal lines may be somewhat greater than parallel lines on the individual farmer as it takes more towers to cross land diagonally. Comparatively, diagonal transmission lines are a benefit where the diagonal route is the shortest distance between two locations because the line will have the least overall impact on agriculture.

10.0 GROUND ELECTRODE

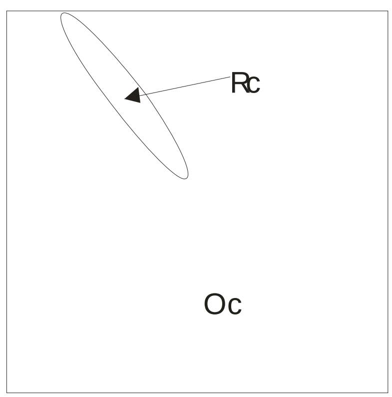
Eight Ground Electrode Sites were selected to be reviewed. Analyses of these sites were from an agricultural perspective and also included rural residential housing and other activities. The sites analyzed were as follows: 21-11-6E1; 22-11-6E1; N1/212-11-7E1; 13-11-7E1; 26-11-7E1; 20-11-8E1; 8-11-8E1; 24-10-7E1; and 9-10-7E1.

21-11-6E1 was chosen for the site to place the Ground Electrode.

10.1 21-11-6E1 AND 22-11-6E1

<u>21-11-6E1 – This section has been chosen as the section to place the Ground Electrode</u>

This section is all cropped. The soils are as follows:



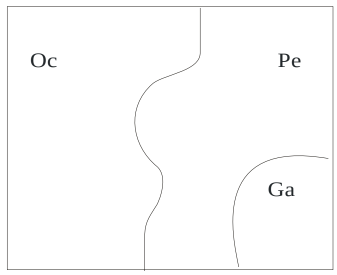
Oc – Osborne Clay – Black; poorly drained fine lacustrine clay.
Rc – Red River Clay - Black; intermediately drained fine lacustrine clay

<u>Analysis:</u>

21-11-6E1 – This section is all cropped. There is a farm in the northeast corner and on the road in the middle of the northwest quarter. In section 20 to the west there are 11 rural residences along the north-south municipal road. On the east side in section 22 there is a rural residence in the southwest corner and in the middle of the section on the west road. This is a good location from a farm and residential view point but it will remove the most agriculturally productive soils of all sites selected.

22-11-6E1

Most of this section is cropped except for the Garson complex soils in the southeast corner. The soils are as follows:



Oc – Osborne Clay – Black; poorly drained fine lacustrine clay.
Rc – Red River Clay - Black; intermediately drained fine lacustrine clay
Pe – Pegius Clay – Grey-Black – Fine textured lacustrine clay over till; well to intermediate internal drainage.
Ga – Garson complex – Grey wooded – sandy loam to clay loam stony calcarious till often with a thin sandy mantle and stony lens.

There were a total of 15 rural residential houses on section 22. There were 5 rural residential houses and 2 farm yards adjacent to section 22.

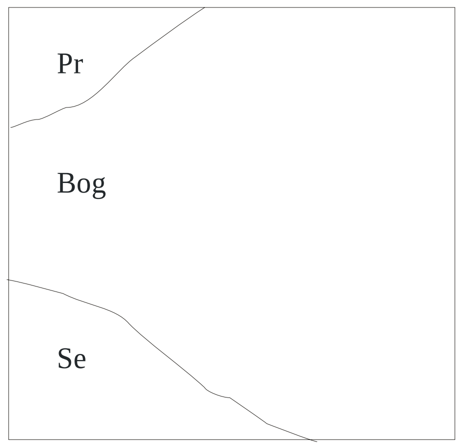
<u>Analysis:</u>

22-11-6E1 - This section is cropped except for the treed area on the Garson soils. There are many rural residential houses associated with the section. For these two reasons this section appears to be an unacceptable location for the ground electrode. If this is the type of soils needed for the ground electrode there are sections of land near this section that have few to no people living on or around the section.

10.2 12 AND 13-11-7E1

Most of this section is in bog except for the mineral soils in the southwest and northwest corners. The soils are as follows:

13-11-7E1



12-11-7E1

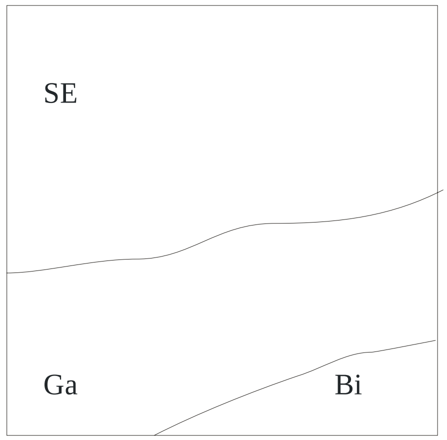
Se – Semple clay loam to clay – Grey - black; well to intermediate internal drainage; mantle of fine textures sediments (6-15 inches) over till.
Pr – Pine Ridge – well drained Grey Wooded – loamy sand to sandy loam outwash deposits over till.
B – Bog and half bog – peat deposits over 10 inches deep.

There is one active residence on the north side of the northwest quarter with a trailer, new garage, shed and horses. There is also an abandoned yard on the access road. The north half of section 12 was added to the list.

Analysis: Section 13 provides an opportunity for placement of the ground electrode from a rural residential and agricultural perspective in the south half portion of the section. The south half of section 13 and the north half of section 12 provide an opportunity for electrode placement in bog where there are only residences on the north side of section 13 and south side of section 12. From an agricultural perspective this is a good location as the lands are not presently used for agriculture.

10.3 26-11-7E1

This section is all mineral soils with stony Garson soils in the south and sandy Birds Hill soils in the southeast corner. The soils are as follows:



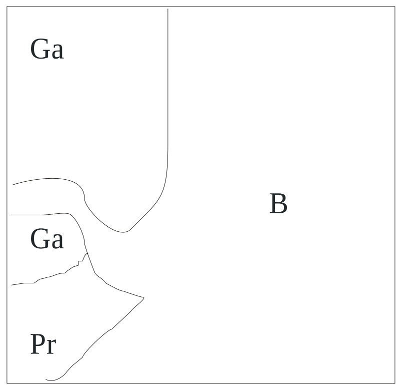
Se – Semple clay loam to clay – Grey - Black; well to intermediate internal drainage; this mantle of fine textures sediments (6-15 inches) over till.
Ga – Garson complex – Grey wooded – sandy loam to clay loam stony calcarious till often with a thin sandy mantle and stony lens
Bi – Birds Hill – Well drained loamy sand to sandy loam – gravelly beach and outwash plain deposit.

There is a municipal dump on the southeast corner of the southeast quarter and some farm fields on the northeast quarter. Additionally there are two houses on the northwest corner of the northwest quarter.

Analysis: This section provides an opportunity for placement of the ground electrode from a rural residential and agricultural perspective provided the ground electrode is placed in the treed area north of the garbage dump.

10.4 20-11-8E1

Most of this section is in bog except for the mineral soils in the southwest and northwest corners. The soils are as follows:



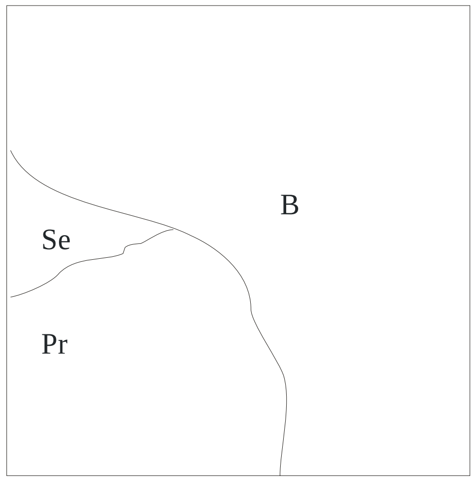
Pr – Pine Ridge – well drained Grey Wooded – Loamy sand to sandy loam outwash deposits over till.
B – Bog and Half Bog – Peat deposits over 10 inches deep
Ga – Garson complex – Grey wooded – sandy loam to clay loam stony calcareous till often with a thin sandy mantle and stony lens

There is no agricultural activity on the section.

Analysis: This section provides an opportunity for placement of the ground electrode from a rural residential and agricultural perspective.

10.5 8-11-8E1

Most of this section is in bog except for the mineral soils in the southwest corner. The soils are as follows:



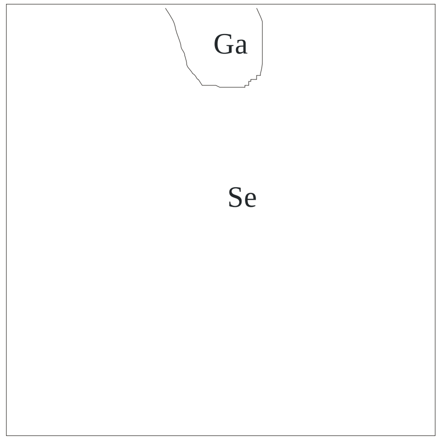
B – Bog and Half Bog – Peat deposits over 10 inches deep
Pr – Pine Ridge – well drained Grey Wooded – Loamy sand to sandy loam outwash deposits over till.
Se – Semple clay loam to clay – Grey - Black; well to intermediate internal drainage; this mantle of fine textures sediments (6-15 inches) over till.

There is no agricultural activity on the section.

Analysis: This section provides an opportunity for placement of the ground electrode from a rural residential and agricultural perspective.

10.6 24-10-7E1

Most of this section is in trees. The soils are as follows:



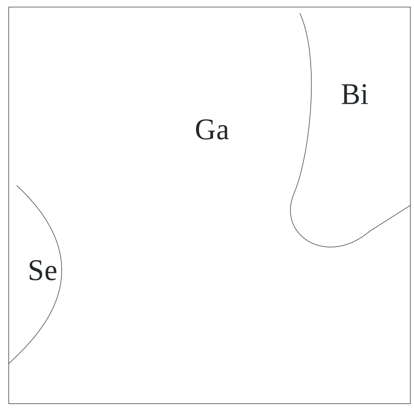
Se – Semple clay loam to clay – Grey - Black; well to intermediate internal drainage; this mantle of fine textures sediments (6-15 inches) over till.
Ga – Garson complex – Grey wooded – sandy loam to clay loam stony calcareous till often with a thin sandy mantle and stony lens

The section is fenced and grazed. There are no improvements on this section.

Analysis: This section provides an opportunity for placement of the ground electrode from a rural residential and agricultural perspective.

10.7 9-10-7E1

The west half of this section is in trees. There are some small fields on the northeast quarter. There is a rural residence and a small engine repair shop on the southeast quarter. The soils are as follows:



Se – Semple clay loam to clay – Grey - Black; well to intermediate internal drainage; this mantle of fine textures sediments (6-15 inches) over till.
Ga – Garson complex – Grey wooded – sandy loam to clay loam stony calcarious till often with a thin sandy mantle and stony lens

The section is fenced and grazed. There are no improvements on this section.

Analysis: This section provides an opportunity for placement of the ground electrode on the western half section.

11.0 MONITORING

It is recommended that some monitoring programs be implemented after the Bipole III transmission line is constructed. Monitoring needs are reflected in the following discussions:

- **IN FIELD LINE PLACEMENT**: Given the decision to place the transmission line 42 m into the field from the road allowance from Riel to PTH 16 and 33 m into the field from the road allowance north of PTH 16 there are now numerous kilometers of in field line placement. If the farmer uses aerial spraying as a common practice attention to crops below and beside the line may suffer to the point yields will be reduced. These implications should be monitored for 3-4 years following the construction of the line to assist in determining the true effect of placing the transmission line in field. It would be worthwhile to determine if ground spraying is possible and if any new machines need to be designed to address the need to spray under the transmission line.

- **MOVE THE TRANSMISSION LINE TO NEAR THE ROAD ALLOWANCE**: From Riel to the Red River a great percentage of the transmission line has been placed well into the field (1/4 to1/3 of a mile) because of numerous barns and houses from Lorette to the Red River. The impact of this line placement should be studied for the same 3-4 year period.

- **ACTIVE AND POTENTIAL IRRIGATION LANDS**: The Final Preferred Route should be monitored in 2011 to determine if any pivot irrigation systems are set up along the route. Additionally the Manitoba Hydro Engineering Department should determine where the line should be placed. Can the line be placed 42 m into the field and still have the irrigation pivot pass under the line? If there is 50 kilometers of lands with irrigation potential where would the towers be placed so a tower would not be constructed at the furthest point of the of the pivot irrigation system's circle, i.e., at the ¼ and 3/4 mile location? Will the towers need to be on the edge of the road allowance or can they be 42 m into the irrigated field? It appears as if numerous irrigation systems are being added to the potential irrigation areas every year.

- **IMPLICATION OF CROP PRODUCTION UNDER THE TRANSMISSION LINE**: The line should be monitored for 3-4 years to monitor determine if the line has any effects on cropping practices, crop production, crop selection, input use and land usage under the line. The study should be conducted on intensively cropped lands and on poorer agricultural lands.

- **HALF MILE LINE PLACEMENT**: The line should be placed on the half mile line boundary with the towers on both sides of the half mile line. This will involve working with two land owners, however, given the issues surrounding the transmission line it is appropriate that both landowners receive compensation as both will be affected by the transmission line. Additionally FIeld equipment will only have to swing out a few meters to miss the tower base on both sides of the half mile line. The implications of center one half mile line placement should be monitored for 3-4 years.

12.0 RESIDUAL EFFECTS

The following table (Table 29) entitled "Bipole III Residual Environmental Effect Assessment Summary Table" covers many of the items discussed in sections 12, 13, and 14. It completes the set of tables required by Manitoba Hydro. It utilizes the parameters set out for the table even though the definitions of the effects do not reflect agricultural land usage. Care was taken to reflect impacts as they apply to agriculture. Construction activities and damages should be back to normal in one to three years depending on the severity of the soil damage. The other negative implications or residual effects of the transmission line will be in place for the lifetime of the transmission line. Positive effects have the same long term duration as the increased productivity of hay and grazing lands will provide more livestock nutrition while vegetation under the transmission line is maintained by Manitoba Hydro.

Table 29: Bipole III Residual Environmental Effect Assessment Summary Table

1. Residual Environmental Effect	2. Direction	3. Ecological Importance	4. Societal Importance	5. Magnitude	6. Geographic Extent	7. Duration	8. Frequency	9. Reversibility	Comments
Crop Damage during construction	Negative	Moderate	Moderate	One time effect only	Medium – Crop loss measurable during construction	Short term - Construction phase only	Once	Back to normal in a year	Construction in the fall or winter in agricultural areas when crops are off the field
Soil Damage during construction admixing and compaction	Negative	Moderate	Moderate	One time effect with longer term consequences	Where soils are compacted and admixed due to heavy machines	Medium term - Construction phase and possibly a few years following	1 to 5 years	Back to normal in 1 to 5 years	Construct in the winter in agricultural areas when lands are frozen or when soils are dry
Agricultural Operations – interference with cultivation	Negative	Moderate	Moderate	Large – continuous effect	Regional Assessment Area -Hundreds of kilometers of infield line placement	Long Term -For the lifetime of the line	Continuous	Irreversible	Long term continuous impact as long as the line is in place
Agricultural Operations – management unit split by line – field severance	Negative	High	High	Large – continuous effect	Regional Assessment Area -Hundreds of kilometers of infield line placement	Long Term -For the lifetime of the line	Continuous	Irreversible	Long term continuous impact as long as the line is in place
Agricultural Operations – interference with irrigation	Negative	High	High	Large – continuous effect	Local Assessment Area - Many kilometers of infield and ½ mile line placement	For the lifetime of the line	Continuous	Irreversible – unless irrigation stops	Long term continuous impact as long as the line is in place
Agricultural Operations – interference with aerial spraying	Negative	High	High	Large – continuous effect	Regional Assessment Area -Hundreds of kilometers of infield line placement	Long Term -For the lifetime of the line	Continuous	Irreversible	Long term continuous impact as long as the line is in place

1. Residual Environmental Effect	2. Direction	3. Ecological Importance	4. Societal Importance	5. Magnitude	6. Geographic Extent	7. Duration	8. Frequency	9. Reversibility	Comments
Agricultural Resource – quality land taken out of production	Negative	Moderate	Moderate	Small	Regional Assessment Area -Hundreds of kilometers of infield line placement	Long Term -For the lifetime of the line	Continuous	Irreversible	Long term continuous impact as long as the line is in place
Agricultural Resource – organic farming	Negative	Moderate	Moderate	Small – few organic farms – continuous effect	Project Site –impact around towers	Long Term -For the lifetime of the line	Continuous	Irreversible - or as long as the enterprise operates	Long term continuous impact as long as the line is in place
Agricultural Resource – production of buffalo and other exotic animals	Negative	Low	Low	Small – few operations	Local Assessment Area – few specific producers	Long Term -For the lifetime of the line	Continuous	Irreversible - or as long as the enterprise operates	Long term continuous impact - or as long as the enterprise operates
Agricultural Resource – clearing bush pasture	Positive	Low	Low	Moderate - Positive long term effect	Medium – many kilometers of line	Local Assessment Area	Continuous	Irreversible – as long as line exists	Positive long term effect
Agricultural Resource – access to swamp lands	Positive	Low	Low	Moderate - Positive long term effect	Medium – many kilometers of line	Local Assessment Area	Continuous	Irreversible – as long as line exists	Positive long term effect
Agricultural Resource – clearing poorer quality lands	Positive	Low	Low	Moderate - Positive long term effect	Medium – many kilometers of line	Local Assessment Area	Continuous – as long as line exists	Irreversible – as long as line exists	Positive long term effect

13.0 CUMULATIVE EFFECTS

The following shows a progression of environmentally sensitive site concerns from an agricultural perspective. The sites are not specific locations but the impact will be significant through many kilometers of transmission line placement. Items assessed include:

- Crop and Soil Damage during construction – no cumulative effect;
- Agricultural Operations:
  - Land removed from production - no cumulative effect;
  - Additional cost to farm around towers – a cumulative effect may occur if the yields of crops grown around the towers continues to decline;
  - Additional weed control needed around towers – there will be a cumulative effect of poorer weed control as chemicals are double or triple sprayed so yields are reduced on the initial spraying year and there may be a residual effect from some chemicals that lower yields in subsequent years;
  - Nuisance and inconvenience of farming around towers – this is a continuing effect but not necessarily cumulative; and
  - Management Unit Splits due to the transmission line – there may be a cumulative effect until the field is split; once split the effect should be an annual effect and not necessarily cumulative.
- Towers interfere with irrigation systems – there should not be a cumulative effect if towers are placed so the pivot irrigation system can operate;
- Diagonal tower placement is not feasible where pivot or wheel move irrigation systems have to operate – no cumulative effect;
- Tower placement to allow ¼ section pivot operation is required;
- Towers interfere with aerial spraying – there will be a cumulative effect of not being able to spray weeds properly;
- Ground spraying will be required under the transmission line – this can be as effective as aerial spraying provided the soils are not too wet for ground sprayers to operate;
- Corners where lines cross will result in larger areas needing to be ground sprayed – there will be a cumulative effect;
- Wet soils particularly in the Red River Valley necessitate the use of aerial spraying and make ground spraying under the line difficult - there will be a cumulative effect;

- Impact on weed control for organic farms – there will be a limited cumulative effect as there are a limited number of these farms;
- Impact on exotic animal production – there will be a limited cumulative effect as there are a limited number of these farms; and
- There are numerous large scale, 230kV, transmission lines to cross between Riel and Mafeking. These crossings will have a cumulative effect in relation to crop production especially when it comes to aerial spraying in wet conditions.

14.0 HOUSES, BARNS AND LARGE SHEDS

Houses, Barns and Large Sheds within 270 m of the transmission line were identified (Appendix D). These are specific locations (Map Series 600) where concerns may be expressed by the owner of the facility. Manitoba Hydro should be prepared to address these persons' concerns by mitigating the effect by various methods such as buying out the facility, planting trees to replace the view of the transmission line, doing whatever is possible to alleviate noise concerns and discussing EMF issues with the owner. If common ground cannot be found an option would be to purchase or move the house, barn or large shed.

The following tables (Tables 30, 31, 32) shows the specific locations of houses, barns and large sheds within 270 m of the transmission line where owners may have a concern that needs to be mitigated in some fashion. All measurements are to the edge of the Right of Way.

14.1 HOUSES

Table 30: Houses Within 270 m

Buffer	Name	Legal Description	Concern	Photographs in Appendix D	Meters	Comments
270	R1	NE19-10-05E1	y		202	
270	R2	NE21-10-05E1	y	Attached	137	
270	R3	SW30-10-06E1	y		142	sheds in yard-OK
270	R4a	SE30-10-06E1	y		181	
270	R4b	SE30-10-06E1	y		225	
270	Rr1	NE17-10-06E1	y	Attached – 2 photos	166	
270	R5	SW24-8-5E1	y	Attached - 2	174	
270	R6	SW12-8-5E1	y	Attached	147	
270	R7	NW1-8-5E1	y	Attached	120	
270	R8	SW25-7-5E1	y	Attached	144	
270	Rr 13	NE10-7-5E1	y		231	
270	R9	NW12-7-4E1	y	Attached	153	
270	Rr15	NE10-7-4E1	y		210	
270	R10	NW9-7-4E1	y	Attached	171	
270	R11	NE8-7-4E1	y	Attached	166	

Buffer	Name	Legal Description	Concern	Photographs in Appendix D	Meters	Comments
270	R12	NE7-7-4E1	y	Attached	175	
270	Rr2	NE11-7-3E1	y	Attached	207	
270	R13	RL 542	y	Attached-2	155	Red River Crossing
270	R14	RL 544	y	Attached-2	153	Red River Crossing
270	R15	RL543 + RL546	y	Attached-2	181	line could be moved between the houses to avoid both houses - RL 543 and RL546
270	R16	SW10-7-1W1	y	Attached	203	
270	Rr16	SE2-8-5W1	y		230	
270	Rr17	SW4-8-6W1	y		225	
270	Rr5	SW5-8-7W1	y		216	
270	R17	SE35-9-9W1	y		198	
270	R18	SE11-11-9W1	y		159	
270	R19	NE36-14-10W1	y		106	
270	T1	SE1-16-10W1	y		73	radar tower
270	Rr7	NE22-30-18W1	y		214	
270	R20	SW16-39-24W1	y	Attached - 4	55	
270	R21	NW28-39-24W1	y		196	
270	Rr10	NE15-56-25W1	y	Attached	230	
270	Rr9	NE15-56-25W1	y	Attached	217	

14.2 LARGE BARNS

Table 31: Large Barns Within 270 m

Buffer	Name	Legal Description	Concern	Photographs in Appendix D	Meters	Comments
270	Bb1	SE30-10-06E1	y		161	
270	Bb3	SW12-8-5E1	y	Attached	75	
270	Bb4	SW12-8-5E1	y	Attached	134	
270	Bb9	NW1-8-5E1	y	Attached	161	
270	Bb10	NW1-8-5E1	y	Attached	132	
270	Bb13	SW25-7-5E1	y	Attached	92	
270	Bb16	NE7-7-5E1	y		225	
270	B1	SW14-7-5E1	y	Attached	109	
270	B1	SW14-7-5E1	y	Attached	110	
270	B2	SW15-7-5E1	y		89	
270	B2	SW15-7-5E1	y		234	
270	B2	SW15-7-5E1	y		234	
270	B3	SE16-7-5E1	y		111	

Buffer	Name	Legal Description	Concern	Photographs in Appendix D	Meters	Comments
270	B3	SE16-7-5E1	y		110	
270	B4	SW16-7-5E1	y		111	
270	B4	SW16-7-5E1	y		110	
270	B5	NW8-7-5E1	y		153	
270	B5	NW8-7-5E1	y		140	
270	B5	NW8-7-5E1	y		139	
270	Bb12	SW36-7-4E1	y		213	
270	Bb13	SW36-7-4E1	y		223	
270	B6	NW10-7-4E1	y	Attached	139	
270	B6	NW10-7-4E1	y		139	
270	B6	NW10-7-4E1	y		199	
270	B7	NE11-7-3E1	y	Attached	139	
270	B7	NE11-7-3E1	y		232	
270	B8	SE4-8-2W1	y		224	

14.3 LARGE SHEDS

Table 32: Large Sheds Within 270 m

Buffer	Name	Legal Description	Concern	Photographs in Appendix D	Meters	Comments
270	Bb6	SW12-8-5E1	y		125	Large shed
270	Bb7	NW1-8-5E1	y		115	Large shed
270	Bb8	NW1-8-5E1	y		112	Large shed
270	B6	NW10-7-4E1	y		162	Large shed
270	B6	NW10-7-4E1	y		134	Large shed
270	Bb21	RL 542	Y		137	Large shed
270	Bb24	RL 542	Y		185	Large shed
270	Bb25	RL 542	y		195	Large shed
270	Bb27	RL 544	y		184	Large shed
270	Bb28	RL 544	y		198	Large shed
270	Bb37	SE35-9-9W1	y		196	Large shed
270	Bb38	SE35-9-9W1	y		147	Large shed

15.0 SUMMARY AND CONCLUSIONS

- The Bipole III 500 kV HVdc transmission line will originate at the Keewatinoow converter station and terminate at the new southern converter station on the Riel site. The overall length of the line is about 1376 km located on a 66 m wide right-of-way. The agricultural study area is approximately 567 – 700 km in length and 33 – 217 km wide.
- The Final Preferred Route has been selected. It was the best route from an agricultural standpoint as it was the shortest, crosses the least amount of productive agricultural land and has the least number of angle towers. The Final Preferred Route selected crosses the least amount of intensively cropped lands possible as travels toward Mafeking and The Pas from Riel. The Final Preferred Route avoids the heavily populated area around Lorette and passes through the densely populated and intensive livestock area from Lorette to the Red River; in most cases the transmission line is routed on the 1/4, 1/3, or 1/2 mile line. The transmission line must pass through an active and potential irrigation area from Carman-Elm Creek to Beaver north of Highway #1.
- A study should be conducted to determine if the transmission line can be placed 42 m into the irrigated field while allowing a circular quarter section pivot to operate up to the edge of the road allowance.
- The scope of work assigned to J. & V. Nielsen and Associates Ltd. began with the development of numerous alternate transmission line routes throughout agricultural Manitoba beginning at Winnipeg and Riel Converter Station and traveling south, west of Steinbach, and west, north of Carman, then west and north west of Lake's Manitoba and Winnipegosis, and east of the Saskatchewan border. Western routes north and south of Brandon and proceeding north and west of the Riding and Duck Mountains were also developed. Once identified, three alternative routes were selected to be presented to the public. Finally a preferred route was identified. Care was taken to avoid rural residential and farm houses, barns, large sheds, irrigation pivots, and specialty farming where identified. The task was completed using Google Earth™ images and older aerial photography. Aerial photography was utilized derived from 1998 to 2005 data bases. Alternative routes were placed onto these maps mostly using ¼ and ½ mile placement.
- When the routing process began in late 2007 and in early 2008 it was decided to do a comprehensive study of the routing area east of Riel to Highway 12, south to Steinbach, across to Carman and on to Holland and Highway 34. The study

identified and placed 34 categories of routing constraints from occupied farm yards, grain farms, livestock farms, rural residential housing, colonies, pivot irrigation, abandoned yards, etc. The completion of this task allowed for the development of various routes from Riel station east and south around Winnipeg and west to the Assiniboine River and Holland.

- The major agricultural issues addressed in the assessment of alternative routes and to determine the potential impact of the proposed route were:
  - Agricultural land use along the proposed routes (i.e., farm yards, livestock facilities, irrigation, row cropping, intensive crop production, tame and native hay and pasture land, and shelterbelts);
  - Impact on agricultural operations; and
  - Impact on intensive field activities including irrigation and row cropping.
- Between Riel and Mafeking and around The Pas the primary land use is for agricultural purposes. Since the new 500 kV HVdc transmission line must cross some of these lands it is necessary to identify types of agricultural use and place a priority on these uses to assist is selecting the best transmission line route. Beginning with the highest priority, agricultural activities to avoid with the 500 kV HVdc transmission line are as follows:
  - Dwellings and farm yards;
  - Intensive livestock operations;
  - Lands under irrigation;
  - Lands with irrigation potential;
  - Row crop areas;
  - Intensive annually cropped areas;
  - Tame forage areas;
  - Mixed farming areas with some cultivated land;
  - Native pasture and hay lands; and
  - Lands with limited/no agricultural use.
- The following general guidelines have been adopted for routing tower transmission lines through agricultural lands:
  - Route on or adjacent to the road allowance;
  - Route along the half mile to avoid farm yards, livestock barns, irrigation pivots and other higher priority obstacles;
  - Avoid in-field placement in cultivated lands under annual crop production; and
  - Placement parallel to the road allowance is preferred to diagonal placement.

- North of PTH 16 the transmission line crosses lands suited for livestock production in most cases thus limiting its impact on agricultural production or even facilitating agricultural production; some crop lands are found in these areas.

- Most diagonal lines have been removed in intensively cropped lands.

- Diagonal line placement remains in areas with limited annual cropping and where no, limited, or agricultural use for hay and pasture prevail as line placement does not impact these farming operations to any great extent.

- The final preferred route had 47.4 km of diagonal transmission lines removed from the intensively cropped areas and 14.15 km remain in these areas; on the routes not chosen as the final route 99 km of diagonal lines were removed along the Arden Ridge and 151.5 km were removed in the Red River Valley.

- The best route from an agricultural perspective should be one that is shortest in length and does not have a high agricultural and tower rating. The Final Preferred Route meets all of these categories and therefore has the least effect on agriculture. Following the analysis of the alternate routes the decision was made to remove diagonal line routing wherever intensive agriculture was practiced. The final preferred route had 47.4 km of diagonal transmission lines removed from the intensively cropped areas and 14.15 km remain in these areas.

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