MANITOBA – MINNESOTA TRANSMISSION PROJECT
Environmental Impact Statement

ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS ON HUMAN HEALTH RISK

CHAPTER 18
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ABBREVIATIONS AND ACRONYMS

AC	alternating current
BR	basic restriction
CO	carbon monoxide
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
CSA	Canada Standards Association
dBA	A-weighted decibel
dBµV/m	decibels relative to 1 microvolt per metre
DC	direct current
ELF EMF	extremely low frequency electric and magnetic field
EMF	electric and magnetic field
ER	exposure ratio
G	gauss
HA	Highly Annoyed
Hz	hertz
ICES	International Committee on Electromagnetic Safety
ICNIRP	International Commission for Non-Ionizing Radiation Protection
kV	kilovolt
kV/m	kilovolt per metre
LAA	local assessment area
L_{dn}	day-night equivalent sound level
mG	milligauss
MMTP	Manitoba-Minnesota Transmission Project (the Project)
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institute of Health
NO_2	nitrogen dioxide
PDA	project development area

PM	particulate matter
PMRA	Pesticides Management Regulatory Agency
PTH	provincial trunk highway
RAA	regional assessment area
ROW	right-of-way
RVTC	Riel-Vivian Transmission Complex
SLTC	Southern Loop Transmission Corridor
SO_2	sulphur dioxide
TDR	technical data report
US EPA	United States Environmental Protection Agency
VC	valued component
V/m	volt per metre
WHO	World Health Organization

GLOSSARY OF TECHNICAL TERMS

Chemical of potential concern	Chemicals anticipated to be used or emitted by the Project that may be hazardous to human health
Country foods	Foods that may be produced in an agricultural or backyard setting, or that are harvested through hunting, gathering, or fishing activities, but that are not for commercial sale
Electric and magnetic fields	Zone around surrounding objects that generate, transmit, or use electricity, such as electronic devices, tools and appliances, electrical wiring, and transmission lines that is capable of exerting force on stationary (electric) or moving (magnetic) charges
Exposure pathway	The course a potential stressor (*e.g.,* chemical, noise, electromagnetic field) takes from its source to the person(s) being contacted
Human Health Risk Assessment	A process that evaluates the potential human health risks associated with predicted exposures to chemicals and non-chemical stressors (*e.g.,* noise, electromagnetic fields) in the environment

18 Assessment of Potential Environmental Effects on Human Health Risk

18.1 Introduction

Manitoba Hydro is proposing construction of the Manitoba–Minnesota Transmission Project (MMTP, or the Project), which involves the construction of a 500 kilovolt (kV) AC transmission line in southeastern Manitoba. The transmission line would originate at the Dorsey Converter Station (Dorsey) northwest of Winnipeg, continue south around Winnipeg and within the Existing Transmission Corridor (Existing Corridor), the Southern Loop Transmission Corridor (SLTC) and the Riel–Vivian Transmission Corridor (RVTC), to just east of Provincial Trunk Highway (PTH) 12. The transmission line then continues southward on a New Right-of-Way (New ROW) across the rural municipalities of Springfield, Tache, Ste. Anne, La Broquerie, Stuartburn and Piney to the Manitoba–Minnesota border crossing south of the community of Piney. The Project also includes the construction of terminal equipment at the Dorsey Converter Station, electrical upgrades within the Dorsey and Riel converter stations, and modifications at the Glenboro South Station (Glenboro South) requiring realignment of transmission lines entering the station.

Based on the above description, the assessment of the Project is divided into three components:

- transmission line construction in Existing Corridor, extending from Dorsey to just east of PTH 12;
- transmission line construction in a New ROW, extending south from the Anola area to the border by Piney; and
- station upgrades—at Glenboro South, Dorsey and Riel Converter Station (Riel)—and transmission line realignment work at Glenboro South.

This chapter assesses potential human health risks for people who live, work, or engage in traditional or recreational activities along the transmission line. The assessment method is based on Health Canada's risk assessment framework (Health Canada 2012a), which evaluates the potential effects of the Project that may influence health risk relative to the current scientific understanding of these effects. Specifically, this assessment evaluates the potential Project influence on human health risk from:

- change in air quality related to dust and emissions from construction and maintenance activities;
- change in the quality of country foods (*e.g.*, wild meat, fish, berries and traditional use vegetation) from vegetation management activities, which include application of herbicides along the Final Preferred Route;

- increase in noise levels from construction activities and operation of power lines; and
- electric and magnetic fields (EMF) generated by the transmission line.

Human health risk is a valued component (VC) because there is a potential for the Project to change the environmental conditions that influence the health risk of people. Project construction activities, such as ROW clearing and tower construction, will result in air emissions (*i.e.*, vehicle emissions and dust) and noise to which people may be exposed.

During operation, maintenance vehicles will produce air emissions and noise, and the transmission line will produce noise and EMF. Electric and magnetic fields are invisible lines of force surrounding objects that generate, transmit, or use electricity, such as electronic devices, tools and appliances, electrical wiring, and transmission lines.

A number of vegetation management methods, including herbicide application, will be used to control vegetation regrowth from interfering with transmission line operations. Herbicide uptake by plants and wildlife may affect the quality of country foods that people harvest and consume. Potential exposure to Project-related chemical emissions, noise, or EMF may affect real or perceived health risks, or cause concern for people who live, work, or engage in traditional or recreational activities in the area.

The transmission line passes several wildlife management areas, proposed ecological reserves and protected areas, and crosses a variety of land types including some Crown land. Some of these areas are used for hunting, fishing, and gathering traditional use vegetation (berries, roots, and leaves) (see Chapter 11).

Routing of the transmission line considered input from the Public Engagement Process and First Nation and Metis Engagement Process, as well as the proximity to potential human receptors such as houses. Routing also considered other potential human receptor locations, such as schools, daycares, recreational centers, churches or other worship sites, campgrounds and picnic areas.

The human health risk VC is closely associated with the community health and well-being VC, which considers change in stress, anxiety, and includes perceived health effects (see Chapter 19). The human health risk VC evaluates quantifiable health risks based on the current understanding of potential health effects as established in the scientific literature and applicable regulatory guidelines and objectives. It is not designed to evaluate perceived health effects, which are qualitative and variable among individuals. The community health and well-being chapter provides a qualitative discussion of perceived health risks.

The human health risk VC is also closely linked to traditional land and resource use (see Chapter 11). During the First Nation and Metis Engagement Process, Manitoba Hydro received health concerns about harvesting traditional foods (vegetation, fish and wild meat). The concerns were related to the potential effects of the Project on quality of traditional foods and the potential effect on human health.

Occupational health and safety for workers is addressed independently through compliance with the applicable provincial or municipal occupational health and safety standards and regulations because they apply different health standards than those applicable to the public. As such, worker health is not assessed in this EIS.

18.1.1 Regulatory and Policy Setting

A list of the various regulatory requirements that were considered in developing this EIS can be found in Section 2.3 (Regulatory Approvals) of Chapter 2 (Project Description). Particular consideration was given to the following federal and provincial legislation and guidelines in the preparation of this environmental assessment:

- The Project Final Scoping Document, issued on June 24, 2015, by Manitoba Conservation and Water Stewardship's Environmental Approvals Branch, which represents the Guidelines for this EIS;
- The relevant filing requirements under the *National Energy Board Act* (R.S.C., 1985, c. N-7), and guidance for environmental and socio-economic elements contained in the National Energy Board (NEB) Electricity Filing Manual, Chapter 6; and
- The *Canadian Environmental Assessment Act, 2012* (S.C. 2012, c. 19, s. 52) and its applicable regulations and guidelines.

18.1.1.1 Additional Federal Guidance

Assessment of the potential effects of the Project on human health considered the federal *Pest Control Products Act* (Health Canada 2006). Herbicide registration, premarket approval and regulations governing herbicide application follow the *Act*, which is reviewed by Health Canada to confirm that human health is adequately protected.

While neither Health Canada, nor Manitoba Health, Healthy Living and Seniors, maintain guidelines or standards for extremely low frequency electric and magnetic fields (ELF EMF), Health Canada recognizes the international exposure guidelines established by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), a group recognized by the World Health Organization (WHO) as the international independent advisory body for non-ionizing radiation protection. Government and international medical agencies, including Health Canada, the US National Institute of Health (NIH), and the National Institute of Environmental Health Sciences (NIEHS) have thoroughly reviewed the available scientific information about EMF, but have not recommended regulatory standards.

Health Canada does not have noise guidelines or enforceable noise thresholds or standards and encourages consultation with provincial and municipal authorities to determine appropriate local standards or regulations for projects. Health Canada does, however, consider the following noise-induced endpoints as health effects: noise-induced hearing loss, sleep disturbance, interference with speech comprehension, complaints, and change in the percentage of the population at a

specific receptor location who become highly annoyed, and advises different assessment approaches depending on project phase, duration of noise-producing activities, and range of noise levels (Health Canada 2010c; Health Canada 2011). The % Highly Annoyed (HA) metric is calculated based on measured or predicted daytime and night-time noise levels and is considered for construction noise at receptors with durations of more than one year, for operational noise, and where noise levels are in the range of 45-75 dB. Mitigation measures are recommended if the change in % HA at a specific location is greater than 6.5% from baseline, or when project-related noise is in excess of 75 dB. Health Canada advises that calculating the % HA be undertaken only for receptors that are exposed to long-term (*i.e.,* greater than one year) project noise (Health Canada 2011).

18.1.1.2 Additional Provincial Guidance

Regulatory requirements are in place for assessing potential Project-related change to air quality, effects of which provide input to the assessment of human health risk. Air quality is regulated by Manitoba Conservation and Water Stewardship based on the Manitoba Ambient Air Quality Guidelines and Objectives. Manitoba has adopted the National Ambient Air Quality objectives for chemicals that are relevant to the Project, including sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), and particulate matter (PM) (Manitoba Conservation 2008).

Project-related use of herbicides relates to a potential change in country foods quality, an effect that provides input to the assessment of human health risk. Herbicide registration and pre-market approval is controlled by the federal *Pest Control Products Act*, while the sale and use of herbicides, including applicator licensing, follows *The Pesticides and Fertilizers Control Act* (Province of Manitoba 2012).

Manitoba's Guidelines for Sound Pollution specify outdoor environmental sound level objectives for residential, commercial, and industrial areas and include maximum acceptable noise levels for the protection of human health (Province of Manitoba 1992). These guidelines are applied in the assessment of human health to determine whether predicted levels of noise are above the acceptable thresholds, and to determine whether additional mitigation measures may be needed to reduce or control noise levels. Manitoba Conservation and Water Stewardship does not enforce specific noise limits for regulation of ambient daytime and nighttime noise levels, but instead will review nuisance noise if five complaints have been reported by residents, and may provide requirements for proponents to seek methods to reduce noise (Eshetu Beshada 2015, pers. comm.).

18.1.1.3 Additional Municipal Guidance

No municipal policies or bylaws related to acquiring permits are applicable in the assessment of environmental effects on human health risk.

18.1.1.4 Manitoba Hydro

Manitoba Hydro has adopted a sustainable development policy and 13 guiding principles that influence corporate decisions, actions, and day-to-day operations to achieve environmentally sound and sustainable economic development (Manitoba Hydro 1993) (see Chapter 23). Stewardship of the economy and the environment is the first guiding principle of this policy. Under this principle, Manitoba Hydro commits to safeguarding human health.

18.1.2 Engagement and Key Issues

Manitoba Hydro has processes in place for Public and First Nation and Metis Engagement regarding the Project. This section summarizes the key issues related to health concerns raised during the engagement processes.

18.1.2.1 Public Engagement Process

A Public Engagement Process consisting of multiple rounds of engagement informed the public on the environmental assessment process and provided opportunities for the public to identify issues and concerns with the Project (see Chapter 3).

Key issues associated with the human health risk VC that were identified during the public engagement process include (see Chapter 3):

- potential air quality effects due to construction vehicles and dust;
- potential effects on drinking water, fish, and wildlife (country foods) associated with herbicide use;
- noise (from construction and operation of the transmission lines); and
- potential health risks associated with EMF.

These key issues were included as potential effects in the assessment of human health risk.

18.1.2.2 First Nations and Metis Engagement Process

Manitoba Hydro has an extensive First Nations and Metis Engagement Process (see Chapter 4). Eleven First Nations, the Manitoba Metis Federation, and four Aboriginal organizations were invited to participate in the process. The opportunity for input to project planning was available in multiple rounds of engagement.

The key health concerns identified during the engagement processes included the use of herbicides and their potential effects on water quality, plants, and hunting areas, and concerns regarding potential health risks associated with EMF. To address these concerns, a potential change in country food quality associated with herbicide application and an evaluation of EMF was included in the assessment of human health risk. Concerns about potential effects of spills

on water quality, vegetation, and wildlife are addressed in Chapter 21 (Accidents, Malfunctions and Unplanned Events).

18.2 Scope of Assessment

The scope of this assessment includes the evaluation of human health risk from physiological effects that may result from Project influences to air quality, country food quality, noise, and EMF along the Existing Corridor and New ROW.

The Project may affect the air quality that people breathe in the immediate vicinity of the transmission line by generating dust and vehicle emissions during construction and maintenance activities.

The quality of country foods may be influenced by vegetation management activities through the application of chemical herbicides during the operation and maintenance phase of the Project. The potential effects that herbicide use could have on country food quality is considered in this chapter. Potential effects of the Project on country food quantity are discussed in Chapter 19.

Increases in daytime noise from construction activities and transmission line noise during operation may affect annoyance rates of residents living in close proximity to the ROW. Stress and annoyance associated with noise are also discussed in the Community Health and Well-Being chapter (see Chapter 19).

The EMF produced during the operation of the transmission line is perceived by the public and First Nations to influence the health risk of nearby residents. A summary of the current scientific understanding of EMF and health risk is included in this assessment.

The following section describes the boundaries (spatial, temporal, administrative and technical) defining the extent of the scope of this assessment.

18.2.1 Spatial Boundaries

Spatial boundaries define the areas included in the assessment of human health risk (Map 18-1 – Human Health Risk Assessment Area). The spatial boundaries include:

- **Project Development Area (PDA):** The PDA encompasses the project footprint, including the stations and ROW, and is the anticipated area of physical disturbance associated with the construction and operation of the Project.
- **Local Assessment Area (LAA):** The LAA consists of a 1 km buffer extending from the edges of the PDA. The LAA represents the area where project influences to human health risk are most probable. For the noise assessment, a 1 km buffer was used based on the anticipated extent to which noise levels associated with the Project can be heard by the human ear (see the Noise TDR). For the air quality assessment, a 1 km buffer was used

based on the anticipated extent to which air contaminants may be generated and released to the atmosphere during construction and operations activities (see the Air Quality TDR).

- **Regional Assessment Area (RAA):** The RAA extends to the boundaries of the rural municipalities traversed by the PDA. The RAA is the area in which other projects or activities occurring within the same rural municipalities may have the potential to act cumulatively with the Project. The RAA is consistent with the RAA used for the air quality assessment.

18.2.2 Temporal Boundaries

Temporal boundaries define the time periods assessed for the human health risk VC. The project-specific temporal boundary includes the following Project phases:

- construction: Q2 2017 to Q4 2019
- operation and maintenance: 2020 onward

The potential health risks associated with Project construction are related to change in noise levels and air quality. There is no health risk from change to the quality of country foods during the construction phase, as there will be no application of chemical herbicides during construction. There are no potential health risks from EMF during the construction phase because the transmission line will not be energized.

For Project operation, the potential health risks associated with change to noise levels, EMF, and the quality of country foods are addressed. Noise and EMF will be generated along the ROW when the transmission line is carrying an electrical load. Vegetation management may include the application of chemical herbicides in some areas.

18.2.3 Learnings from Past Assessments

Past experience and recommendations from regulators regarding the evaluation of potential human health effects for other similar projects were incorporated into this assessment, where applicable. This allowed for a more accurate scope of assessment.

Results of the engagement processes for past projects show that potential effects of project-related change in air quality, country food quality, and noise are of concern. For transmission line projects, concerns related to potential health effects associated with EMF and herbicide use along ROWs were also identified. Previous human health assessments for transmission line projects in British Columbia (*e.g.*, the Northwest Transmission Line Project and Interior to Lower Mainland Transmission Project), as well as associated recommendations from regulators, were reviewed. The scope of the human health assessment for the Project incorporates change in air quality, country food quality (related to herbicide use), noise, and EMF as potential Project-related effects that could affect human health risk. This is consistent with the scope of assessment for other transmission line projects.

18.3 Methods

18.3.1 Existing Conditions Methods

This section describes the methods and sources of information used to characterize the existing air quality, country food quality, noise level, and EMF conditions related to human health risk issues associated with the Project.

18.3.1.1 Sources of Information

Baseline information for the assessment of human health risk was obtained through:

- a desktop review of general literature and project-specific technical reports (*e.g.*, previous projects, Traditional Land and Resource Use VC chapter, Air Quality TDR (Stantec 2015a), Noise TDR (Stantec 2015b), Exponent 2015a,b);
- review of input from the Public Engagement Process; and
- review of input from f the First Nation and Metis Engagement Process.

18.3.1.2 Desktop Analysis

The qualitative assessment of human health risk is based on a desktop study using the results and findings of other VC chapters, information from similar linear projects, research literature, and professional judgment by human health risk specialist on the Project team.

18.3.1.3 Addressing Uncertainty

Data gaps for existing conditions include a lack of Project-specific measurements. However, representative literature values or regional data were used to approximate existing conditions in the PDA, leading to conservatism (erring on the side of overstating, rather than understating risk). This was considered appropriate for this assessment, given the scope of expected Project-related change to human health risk.

Data gaps in the assessment are:

- The Pesticides Management Regulatory Agency (PMRA) and Health Canada do not allow the proprietary and unpublished information and data from the premarket assessment of herbicides to be used publically and therefore these data were not used in this assessment. Instead, literature on herbicides from publically available literature was used.
- Noise estimates do not include sound attenuation by natural features, human-made structures, and do not account for varying topographies. Attenuation would decrease estimated noise levels and therefore calculated values are a conservative estimate of the effects associated with noise exposure.

- Noise data from literature sources was used to assess and describe the existing and predicted noise environment, as Project-specific baseline data were not collected. Project-specific baseline monitoring was not conducted due to the availability of existing baseline data and robust characterization of expected noise outputs.
- The air quality evaluation is based upon literature values for the existing environment. Project-specific baseline air quality data were not collected due to the availability of existing data, the scale of the Project, and the availability of emissions estimates for construction and operation equipment required for the Project.

18.3.2 Assessment Methods

This assessment evaluates the potential health risk to people from exposure to chemicals of potential concern and non-chemical factors such as noise levels and EMF. The specific techniques used to assess the potential human health risk from exposure to change in air quality, country food quality, noise, and EMF follow standard risk assessment methods accepted by federal and provincial governments (Health Canada 2010a, 2010b, 2010c, 2012a).

When evaluating human health risk, three components must interact for there to be a potential for health risk. These three components are shown in Figure 18-1, and include:

- presence of a human receptor (*e.g.*, residents, country food harvesters);
- presence of a hazard (*e.g.*, chemical of potential concern, noise); and
- presence of an exposure pathway whereby humans may be exposed to the hazard.

If any of these components are missing, there is no potential health risk. For example, potential hazards, such as herbicides and EMF occur only during the operation and maintenance phase, so there is no potential risk from these hazards during Project construction. In some rural areas along the ROW, there are no nearby human receptors. Because noise attenuates with distance, human receptors will not be exposed to construction noise in these areas, and there will be no potential for health risks.

This assessment is based on a desktop study using the results and findings of other VC chapters and TDRs data from similar linear projects, research literature, and professional judgement of the Project team. When professional judgement is applied, the assumptions and rationale for the assessment findings are provided. Provincial and federal health standards are also applied to assess human health risk, when applicable. Relevant standards and guidelines are noted in the sections below.

Figure 18-1 Risk Components

18.3.2.1 Assessment Approach

The assessment of human health risk is based on scientifically accepted methods and guidance provided by Health Canada (Health Canada 2010a, 2010b, 2010c, 2012a). This guidance was applied when evaluating biophysical interactions with human health. Biophysical components associated with the Project that interact with human health are:

- air quality;
- country foods (fish, wild meat, garden produce, traditional use vegetation and berries);
- noise; and
- EMF.

This section describes the analytical techniques applied to assess the potential change in human health risk. These techniques are used when all three components of health risk (*i.e.*, the presence of a receptor, hazard and exposure) are present, representing a viable pathway for Project effects on human health risk.

18.3.2.1.1 Air Quality

The assessment of human health risk from the inhalation of chemicals of potential concern is based on the change in exposure experienced by an individual, that is predicted to occur between baseline (existing) and Project conditions. Chemicals of potential concern for the Project are associated with vehicle and machinery emissions, mainly during the construction phase. Relevant chemicals include SO_2, NO_2, CO, and PM, which are described further in Section 18.5.2.

Human health risks associated with air quality under both existing and future project-related conditions are typically estimated by comparing measured or calculated chemical concentrations in air to regulatory benchmarks for the protection of human health.

18.3.2.1.2 Country Food Quality

Country foods are defined as those that may be produced in an agricultural or backyard setting (not for commercial sale), or that are harvested through hunting, gathering, or fishing activities (Health Canada 2010b). Country foods are particularly important to First Nations and Metis for nutritional, medicinal, cultural, and spiritual purposes.

The application of herbicides for vegetation management and weed control during Project operation and maintenance may leave chemical residues on plants and soil, which have the potential to enter the food chain when consumed by wild animals or people.

Human health risks associated with country food quality are typically estimated by comparing measured or calculated chemical concentrations in country foods to regulatory guidelines or standards for the protection of human health, if available (*i.e.*, calculating an exposure ratio). The product information supplied to Health Canada to aid them in making their decisions is proprietary, and as a result, these data are not available publicly. Without these data, Project-specific exposure estimates and exposure ratios cannot be calculated to assess human health risk. However, all pesticides approved for used by Health Canada, including the herbicides proposed for use in the Project, have already undergone human health risk assessments by Health Canada and are considered safe for use, provided that all guidelines for herbicide application are followed.

18.3.2.1.3 Noise

The assessment of human health effects from noise uses predicted A-weighted noise levels measured in decibels (dBA), as per Health Canada (Health Canada 2010c). A-weighted noise levels approximate the sensitivity of human hearing at levels typical of rural backgrounds in mid frequencies.

Noises from multiple sources are not directly additive on the A-weighted scale. For example, two sources of noise at 50 dBA do not result in 100 dBA. On the A-weighted decibel scale, the following relationships occur with regards to increases in noise level (US EPA 1974):

- A change in 1 dBA cannot be perceived by humans;
- A change in 3 dBA is considered to be just-perceivable by humans;
- A 5 dBA change is required before any noticeable change in response is expected; and
- A 10 dBA change is subjectively heard as approximately a doubling in volume.

Table 18-1 presents a reference of typical suburban and urban noise levels.

Table 18-1 Commonly Encountered Sources of Noise and Audible Noise Levels

Source	A-weighted Decibels (dBA)
Pain Threshold[1]	130
Jackhammer	100
Diesel truck 50 km/hr at 20 m	90
Passenger car 60 km/hr at 20 m	70
Normal conversation at 1 to 2 m	60
Manitoba Provincial Guideline[2]	45-55
Quiet room	40
Quiet rural setting	30
Whispering	20
Hearing threshold	0

NOTES:
[1] Noise threshold causing pain (US EPA 1974)
[2] Maximum desirable 1-hour equivalent noise levels for residential and commercial areas (nighttime-daytime) (Province of Manitoba 1992)

Manitoba's provincial guidelines for maximum desirable1-hour equivalent noise levels for residential and commercial areas are 45 dBA for nighttime and 55 dBA for daytime. These guidelines represent acceptable levels to prevent public annoyance and to protect public health and welfare with an adequate margin of safety, and were used to assess predicted noise levels associated with Project activities.

There are two general sources of noise associated with the Project:

- noise generated by construction and maintenance activities (*e.g.*, vehicles, machinery); and
- noise generated by transmission lines and stations.

Methods to assess potential health risk associated with Project-related noise are provided below.

VEHICLES AND MACHINERY

The assessment of human health effects from noise generated by construction activities and vehicle and machinery use during operation is based on literature-based reviews of noise burdens associated with similar Manitoba Hydro projects, and literature values for noise defined for construction activity and equipment intended for use in construction and operations (see Noise TDR).

Health Canada does not have noise guidelines or enforceable noise thresholds or standards and recommends the use of standards or regulations specified for Project-specific jurisdictions. Health Canada provides recommendations for the evaluation of projects where construction noise at a given receptor location lasts for more than one year, for operational noise, and where noise levels are in the range of 45-75 dB (Health Canada 2010c; Health Canada 2011). As the Project is not anticipated to produce noise levels above baseline conditions over the long-term, and provincial noise regulations are available, Health Canada guidance was not used in this assessment. Manitoba's Provincial Guidelines for outdoor ambient daytime and nighttime noise levels were used to assess potential human health risk from audible noise associated with construction activities and vehicle and machinery use during operation.

TRANSMISSION LINE AND STATIONS

Audible noise associated with transmission lines is the "hissing" or "crackling" sound associated with corona discharge. Corona discharge occurs when the conductor surface electric field strength exceeds the electric field strength needed to start a flow of electrical current in the surrounding air. The associated rapid expansion of air produces noise. Transmission lines are designed, constructed, and operated to minimize corona discharges in fair weather. During foul weather (*e.g.,* rain or fog), however, droplets of precipitation on the conductor surfaces can increase corona generation and audible noise.

Noise levels were modelled for each of eight transmission line sections (see Figure 18-2) under fair- and foul-weather conditions at the maximum altitude along the transmission line (340 m above mean sea level) (see Exponent 2015b). Eight ROW sections were assessed to differentiate between portions of the ROW that the Project transmission line shares with different combinations of other existing lines. These sections are described in detail in Exponent 2015b. The maximum altitude along the Project route was used for modelling purposes, as audible noise increases with altitude.

The nighttime limit of 45 dBA was used to assess potential human annoyance from audible noise associated with Project transmission lines. A detailed description of the methods used to predict audible noise associated with transmission lines is provided in Exponent 2015b.

In addition to a new 500 kV transmission line, equipment needs to be installed at three stations (Dorsey, Riel, Glenboro South) to accommodate the new line. Very conservative estimates likely to yield high AN values were made of the estimated AN levels at the residences nearest each of these stations (Dorsey; Riel; and Glenboro South).

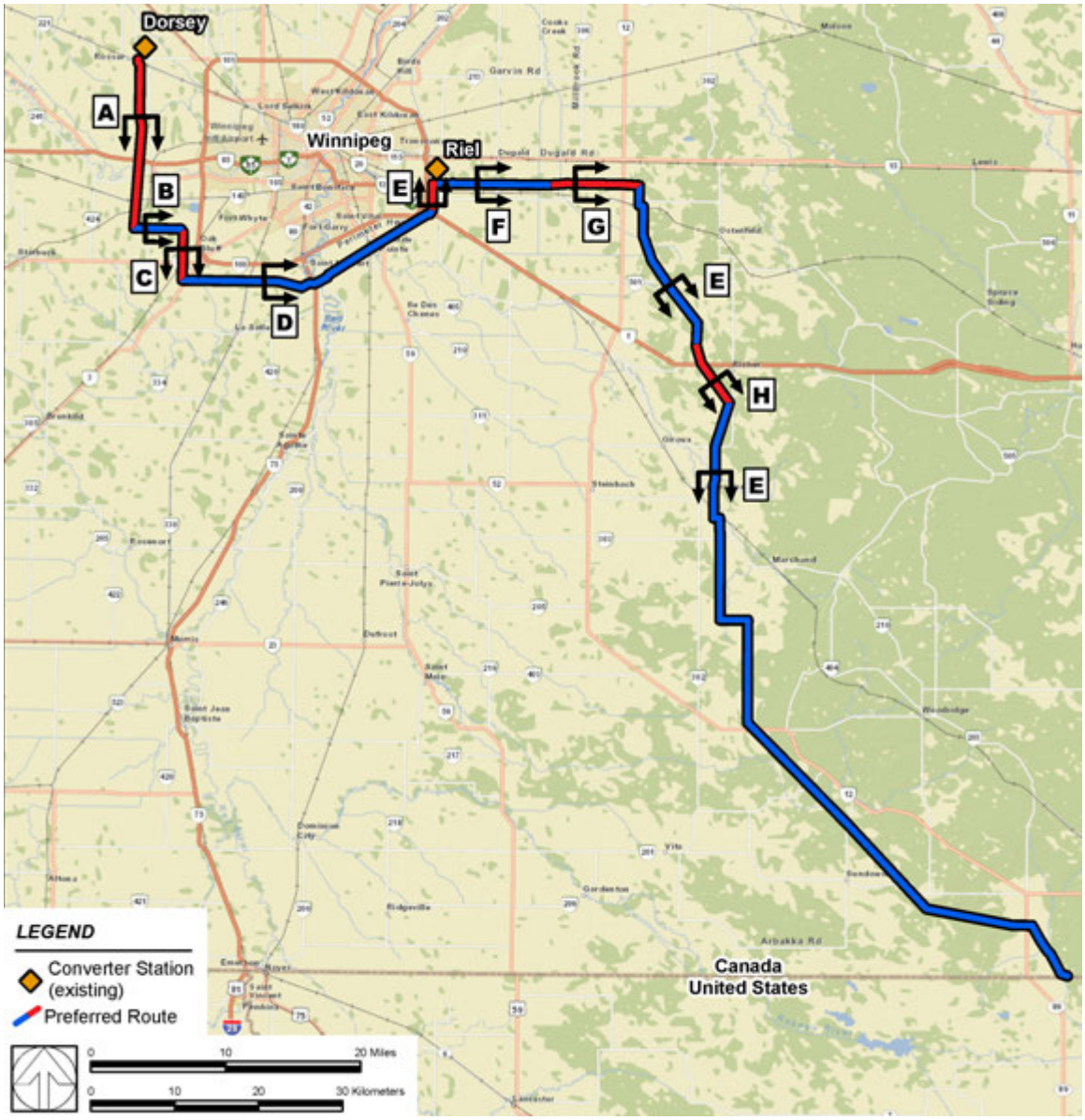

Figure 18-2 Preferred Route Showing Assessment Sections A-H

18.3.2.1.4 Electric and Magnetic Field Effects

Human exposure to EMF is determined by distance from the source (EMF decrease with distance from the source) and by the orientation of the EMF (*e.g.*, height of the source from the ground). Electric fields are a result of voltages applied to electrical conductors and equipment, expressed as volts per metre (V/m) or kilovolts per metre (kV/m), and are easily blocked by most objects (*e.g.*, fences, vegetation, buildings). Magnetic fields are produced by the flow of electric current, expressed as magnetic flux density in units of gauss (G) or milligauss (mG), and are not blocked by most materials (Exponent 2015a). Man-made sources of EMF including the generation and transmission of electricity, are at extremely low frequencies (ELF), defined as having frequencies between 0 and 300 Hz (WHO 2005) and so exposure to EMF in the ELF range is considered in this assessment.

Health effects can be categorized as long-term or short-term effects. For the purpose of this discussion, long-term effects, if any, would occur over a long period of time following exposure (*e.g.*, cancers, neurological diseases, reproductive effects), and short-term effects would occur over a short period of time following exposure. Acute (short-term) exposure to extremely low-frequency electric fields can cause biological responses ranging from perception to annoyance through surface electric-charge effects. The only well-established effects on people exposed to short-term ELF magnetic fields are the stimulation of central and peripheral nervous tissues and a perception of faint flickering light in the periphery of the visual field (IARC 2002) at very high exposure levels. No causal relationship between long-term exposure to ELF EMF and health effects has been established (Health Canada 2012b).

As there are no confirmed long-term health effects from exposure to ELF EMF, no standards or guidelines for protection of long-term health have been established (World Health Organization 2015). However, guidelines for short-term exposure to high levels of ELF EMF have been published. These guidelines are based on the avoidance of immediate short-term health effects, such as perception, annoyance, and the stimulation of nerves and muscles (Table 18-2). It is important to note that the levels at which these short-term effects occur are not encountered in typical environments accessible to the public, including areas near electric transmission and distribution facilities (Exponent 2015a).

Health Canada (2012b) states: "*Health Canada does not consider that any precautionary measures are needed regarding daily exposures to EMFs at ELFs. There is no conclusive evidence of any harm caused by exposures at levels found in Canadian homes and schools, including those located just outside the boundaries of power line corridors"*.

Table 18-2 Reference Levels and Basic Restrictions for Whole Body Exposure to 60-Hz Fields (General Public)

Agency	Magnetic Fields (mG)		Electric Fields (kV/m)	
	Reference Level	BR[1]	Reference Level	BR[1]
ICNIRP	2,000	12,420	4.2	36.4
ICES	9,040	9,150	5.0, 10.0[2]	26.8

NOTES:
[1] Calculated value (see Exponent 2015b)
[2] ICES (2002) specifies a transmission-specific reference level of 10 kV/m

The assessment of potential ELF EMF effects on human health is based on a comparison of predicted Project-related EMF levels at the edge of the ROW to the reference levels available from the ICNIRP and International Committee for Electromagnetic Safety (ICES) for protection of the general public (ICNIRP 2010; ICES 2002). These reference levels are dependent upon the frequency of the electric or magnetic field in question. In North America, 60 Hz frequency alternating current (AC) power is used, which means that the electricity changes direction and intensity 60 times per second.

Table 18-2 provides reference levels established by ICNIRP, as well as maximum permissible exposure levels published by ICES for 60 Hz fields. ICES reference levels are set well above ICNIRP guidelines. ICNIRP and ICES also specify basic restrictions (BR) for exposures of the general public. BRs are based on the internal electric field strength, which is what affects nerve cells and other electrically sensitive cells. Because levels of electric fields induced in tissues are difficult to measure, the reference levels are provided as screening values to ensure that BRs are not exceeded. Whenever a reference level is exceeded, it is necessary to test compliance with the relevant BR and to determine whether additional protective measures are necessary (Exponent 2015b; ICNIRP 2010).

EMF levels for the Project were calculated using inputs of voltage, current, phasing, and conductor configurations for each transmission line on the ROW. A detailed description of methods used to calculate EMF levels is provided in Exponent 2015b.

18.3.2.2 Potential Environmental Effects, Effect Pathways and Measurable Parameters

The selection of potential environmental effects on change in human health risk are based on the Project's potential health risks to people within the assessment area. The existence of an exposure pathway does not necessarily mean that there is a human health risk. If the probability of exposure is low, or the level of exposure is low, human health risk is unlikely. When both baseline and predicted data are available to assess Project-related change to the biophysical environment (*e.g.*, air, water, soil), measurable parameters are used to quantify this change. The predicted change in exposure are then compared to significance thresholds to determine whether a potential change in human health risk would be considered significant.

Table 18-3 presents the potential environmental effects and associated measurable parameters that are applicable to human health. Potential pathways of effect are identified in Table 18-3 and illustrated in Figure 18-3.

Table 18-3 Potential Environmental Effects, Effect Pathways and Measurable Parameters for Human Health Risk

Potential Environmental Effect	Effect Subcomponent	Effect Pathway	Measurable Parameter(s) and Units of Measurement	Notes or Rationale for Selection of the Measureable Parameter
Change in human health risk	Change to air quality	Emissions of dust and vehicle and equipment exhaust during construction pose a potential human health risk via inhalation of criterial air contaminants.	Exposure Ratios (ERs)	Exposure ratios provide a quantitative evaluation of whether exposure to criteria air contaminants represent potential human health risks.
	Change to country food quality	The application of herbicides along the ROW during operation pose a human health risk via uptake from country foods that are consumed.	Exposure Ratios (ERs)	Exposure ratios provide a quantitative evaluation of whether exposure to chemicals and herbicides represent potential human health risks.

Potential Environmental Effect	Effect Subcomponent	Effect Pathway	Measurable Parameter(s) and Units of Measurement	Notes or Rationale for Selection of the Measureable Parameter
	Change to noise levels	Construction noise and noise from vehicles and machinery during operation and maintenance pose a potential health risk for humans near the ROW and stations.	Manitoba Provincial Noise Guidelines (dBA)	The Manitoba government has provincial guidelines for audible noise to prevent public annoyance and protect public health and welfare (Province of Manitoba 1992).
		Transmission line and station noise during operation poses a potential health risk for humans near the ROW.	Manitoba Provincial Noise Guidelines (dBA)	The Manitoba government has provincial guidelines for audible noise to prevent public annoyance and protect public health and welfare (Province of Manitoba 1992).
	Change to electric and magnetic fields	Humans are exposed to EMF near the ROW during operation .	Electric and magnetic field reference levels and basic restriction values (BRs) (Kv/m and mG)	The International Commission on Non-Ionizing Radiation Protection has reference levels for electric and magnetic fields intended to protect the health of the general public.

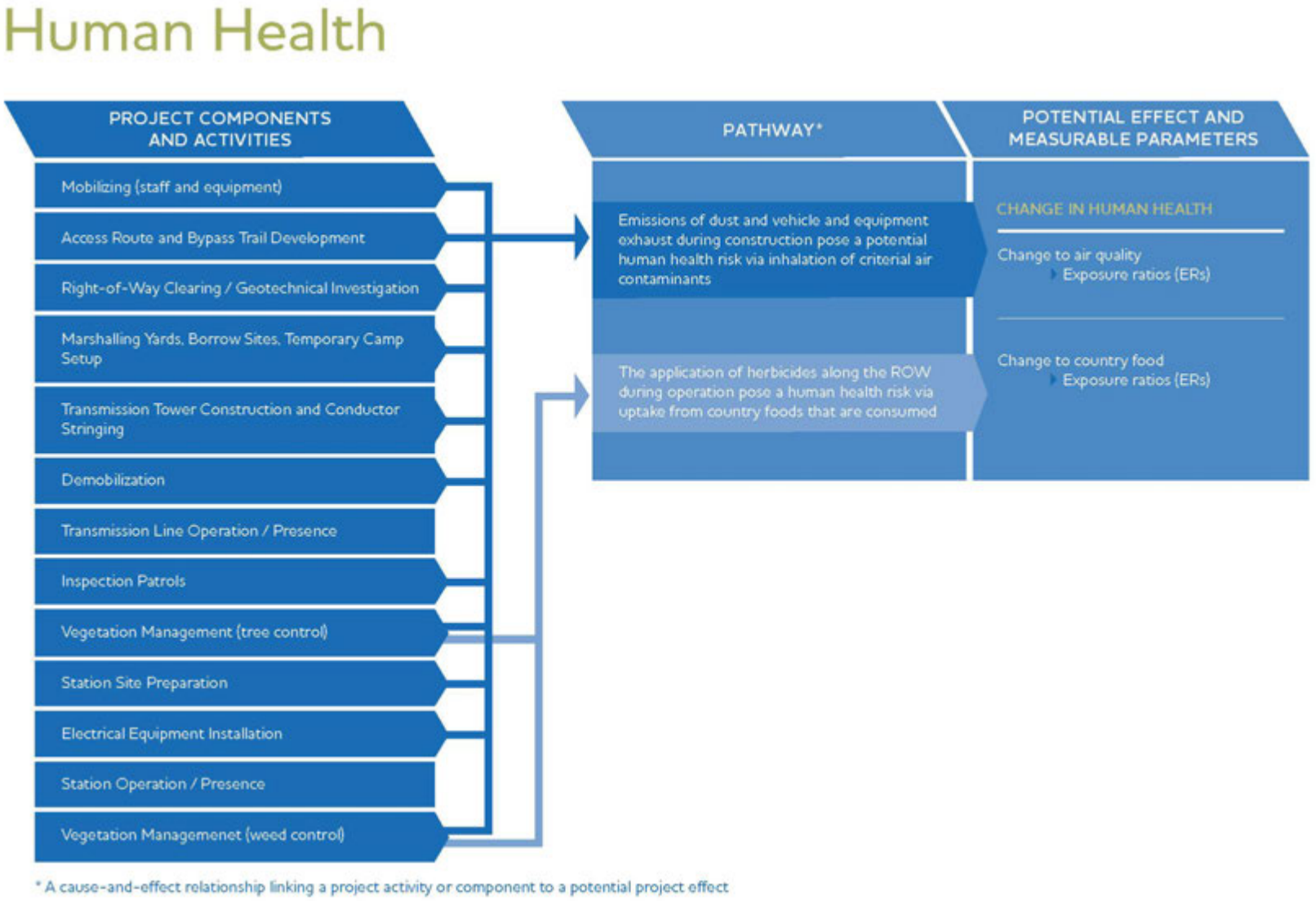

Figure 18-3 Pathway Diagram

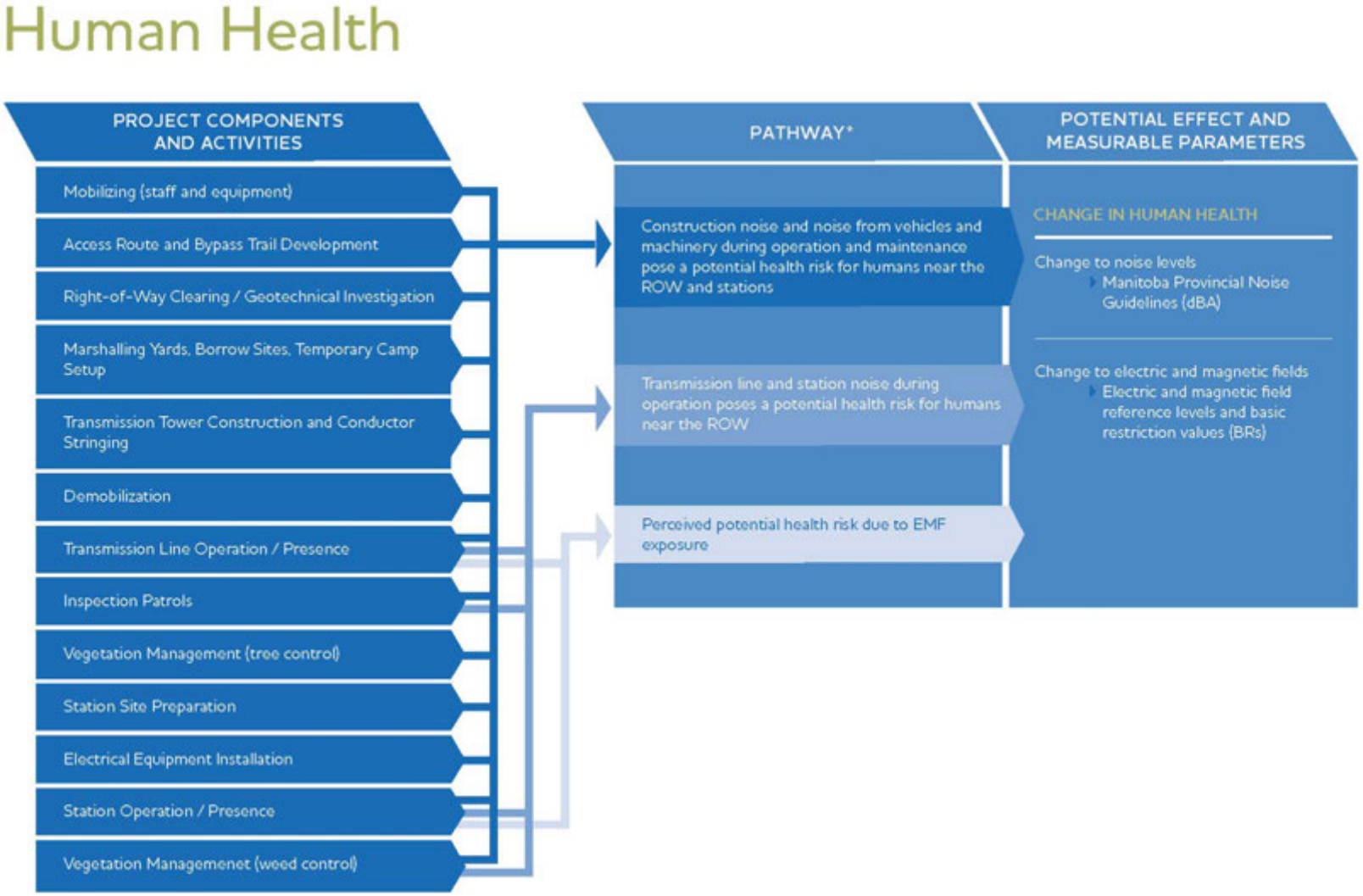

Figure 18-3 Pathway Diagram (continued)

18.3.2.3 Residual Environmental Effects Description Criteria

The residual environmental effects descriptions in Table 18-4 provide additional information to characterize the potential residual effects on human health risk.

Table 18-4 Characterization of Residual Environmental Effects on Human Health Risk

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The trend of the residual effect	**Adverse**—an increase in human health risk associated with exposures to Project emissions (noise, EMF, air contaminants, and herbicides) **Neutral**—no change in human health risk associated with exposures to Project emissions (noise, EMF, air contaminants, and herbicides)
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible**— non-discernable change to human health risk (no increase in health risk) **Low**— a discernable change in human health risk (increase in health risk, but health risk is below regulatory risk benchmarks) **High**— a measurable change in human health risk (increase in health risk above regulatory benchmarks)
Geographic Extent	The geographic area in which an environmental effect occurs	**PDA**—residual effects are restricted to the PDA **LAA**—residual effects extend into the LAA **RAA**-–residual effects interact with those of other projects in the RAA
Frequency	How often during the Project or in a specific phase	**Single event**—residual effect occurs once **Multiple irregular event (no set schedule)**—residual effect occurs multiple times at irregular intervals **Multiple regular event**—residual effect occurs multiple times at regular intervals **Continuous**—residual effect occurs continuously
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—residual effect restricted to construction phase **Medium-term**—residual effect extends more than the construction phase but less than project lifetime **Permanent**—residual effect extends for the lifetime of the Project or more

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible**—the effect is likely to be reversed after activity completion. **Irreversible**—the effect is unlikely to be reversed
Socio-economic context	Existing condition and trends in the area where environmental effects occur	**Undisturbed**—area is relatively undisturbed or not adversely affected by human activity (*i.e.,* more remote, undeveloped locations) (potential human health risk is not expected under existing conditions) **Disturbed**—area has been substantially previously disturbed by human development or human development is still present (potential human health risk under existing conditions is possible)

18.3.2.4 Significance Thresholds for Residual Environmental Effects

Significance thresholds are benchmark values used to assess the potential change to human health risk. The significance thresholds are based on Health Canada's guidance for conducting human health risk assessments for chemicals, Manitoba Provincial guidance for noise, and ICNIRP or ICES reference levels for ELF EMF.

If the measurable parameter is below the significance threshold, there is no significant change to human health risk for that subcomponent. If the measurable parameter is above the significance threshold, mitigation measures would be implemented or improved upon to reduce the potential risk to below threshold levels. Additionally, monitoring may be recommended to ground-truth the predicted risk levels.

The significance thresholds for potential change to human health are presented in Table 18-5. For the assessment of potential change in human health risk related to consumption of chemicals in country foods, or inhalation of chemicals in air, the levels of risk associated with baseline (existing) conditions are taken into account.

Table 18-5 Significance Thresholds for Human Health Risk

Potential Environmental Effect	Effect Subcomponent	Significance Thresholds
Change in human health risk	Change to air quality	The Project contributes to an increase in air quality parameter concentrations to levels that are above ambient air quality guidelines OR If the baseline ER is less than 1.0, the significance threshold is reached when: • predicted future case (baseline plus Project) ER is greater than 1.0[1] If the baseline ER is greater than 1.0, the significance threshold is reached when: • predicted Project-alone ER is greater than 0.2[1]
	Change to country food quality	Project increases chemical concentrations in traditionally harvested foods, such that the consumption of these foods would result in exposure that exceed the allowable daily intakes set by regulatory agencies OR If the baseline ER is less than 1.0, the significance threshold is reached when: • predicted future case (baseline plus Project) ER is greater than 1.0[1] If the baseline ER is greater than 1.0, the significance threshold is reached when: • predicted Project-alone ER is greater than 0.2[1]
	Change to noise levels	The significance threshold is reached when estimated audible noise exceeds the Manitoba Provincial guidelines for residential and commercial areas for both daytime and nighttime conditions. Manitoba Conservation and Water Stewardship does not enforce specific noise limits for regulation of ambient daytime and nighttime noise levels, but instead will review nuisance noise if five complaints have been reported by residents.
	Change to electric and magnetic fields	The significance threshold is reached when the estimated exposure of electric or magnetic field in human tissue exceeds the ICNIRP or ICES reference levels.

NOTES:

[1] Health Canada 2010a

The application of a Project-alone ER of 0.2 is consistent with Health Canada guidance for determining the acceptability of exposure to chemicals on federal contaminated sites.

A health risk is considered significant if either there is a likely exceedance of an allowable level of exposure to a chemical (qualitative based assessment), or in a quantitative-based assessment, there is a change in the exposure ratio (ER) between baseline and predicted conditions as follows:

- If the baseline case ER is less than 1.0, the significance threshold is reached when the future case (baseline plus Project) ER is greater than 1.0 (Health Canada 2010a). An exposure ratio of 1.0 indicates that the predicted exposure to a chemical of potential concern is equal to the applicable health-based objective, standard or criteria. These health-based objectives, standards or criteria are set by regulatory agencies such as Health Canada and can be viewed as the amount of a chemical a person would be safe consuming on a daily basis and are often referred to as allowable daily intakes.
- If the baseline case ER is greater than 1.0, the significance threshold is reached when the Project-alone case ER is greater than 0.2. This indicates that the chemical exposure influenced by a single project should not contribute more than 20% of the applicable health-based objective, standard, or criteria. The application of a Project-alone ER of 0.2 is consistent with Health Canada guidance for determining the acceptability of exposure to chemicals on federal contaminated sites (Health Canada 2010a).

18.4 Existing Conditions for Human Health Risk

18.4.1 Overview

Baseline conditions for human health risk are based on multiple information sources including baseline technical data reports, publicly available literature and databases, and Aboriginal traditional knowledge. This section presents information about existing conditions and relevant past conditions, as well as identified data gaps, for each of the human health risk subcomponents (air quality, country food quality, noise, EMF).

18.4.1.1 Air Quality

The Project ROW is located in urban, suburban and rural areas with few large sources of industrial air pollution. Baseline sources of air emissions include windblown dust from traffic and agricultural operations and vehicle emissions along roads and highways entering the City of Winnipeg.

Ambient air quality data are not available in the vicinity of the ROW, because air quality monitoring is infrequent in rural areas. However, the Project is located in the southeastern part of Manitoba which generally experiences excellent air quality (Manitoba Conservation and Water Stewardship 2012). Air emissions in the region are generated by industrial and agricultural

activities, vehicles, energy generation, waste and industrial combustion sources, and infrequent events such as wildfires (Manitoba Conservation and Water Stewardship 2009).

When applying the Canadian Annual Index of Air Quality, the air quality in the downtown and residential areas of Winnipeg is generally rated as “good” (highest rating) for greater than 91% of the year, based on data from 2003 to 2005 (Manitoba Conservation 2008). The air quality in the rural areas along the ROW is assumed to be similar to, or better than, air quality in Winnipeg.

18.4.1.2 Country Food Quality

Concerns during the First Nation and Metis Engagement Process include the use of herbicides for vegetation management and potential effects of herbicides on country food quality.

Information about existing levels of herbicides or other chemicals in country foods from the assessment area is not currently available. Existing conditions for country foods in terms of species harvested and traditional food consumption in the assessment area are available from other studies, described below.

Traditional land use studies have been conducted, or are currently in progress, to gather information regarding present use of lands and resources for traditional purposes by First Nations near to the Project (see Chapter 11). Three Aboriginal Traditional Knowledge (ATK) studies completed to date indicate the following related to country foods (see Chapter 11, Section 11.1.3 for details):

- Plant Harvesting: First Nations harvest plants for nutritional, medicinal, cultural, and spiritual purposes. Key plant types harvested include berries, cedar, sage, sweetgrass, and Seneca root and weke.
- Fishing: First Nations fish in the lakes, rivers, and streams throughout the region. Species harvested include trout, bass, pike, sturgeon, walleye, whitefish, and perch.
- Hunting: Hunting of large mammals (*e.g.*, deer, elk, moose), small mammals, birds, and waterfowls occurs throughout the region.
- Trapping: Trapping continues to be an important traditional activity practiced by First Nations for both economic and cultural purposes. Animals trapped include lynx, coyote, wolf, deer, beaver, mink, muskrat, and fox.

Data on traditional food consumption by First Nations communities potentially affected by the Project were obtained through the First Nations Food, Nutrition and Environment Study (Chan *et al.* 2012) and are reported in Chapter 19 (Community Health and Well-Being). Data from this study highlight the importance of subsistence foods as part of the diet of the First Nations that participated as part of the First Nation and Metis Engagement Process.

18.4.1.3 Noise Levels

The ambient acoustic environment throughout the PDA is characterized by rural noise types, with noise typical of suburban areas closest to Winnipeg. These types of noise include a combination of wildlife, weather effects (*e.g.*, wind, rain, thunder), agricultural activities, aircraft flyovers, rail traffic, road traffic, highway traffic, and existing transmission line and station electrical noise.

Land for the existing Dorsey and Riel converter stations and the Glenboro South Station are zoned according to applicable municipal zoning by-laws.

- The Dorsey Converter Station site is located on existing Manitoba Hydro owned property and is zoned a combination of “AL – Limited Agriculture” and “A80 – Agriculture Zone”. Under the applicable zoning by-law, “Public Utilities, Services and Works” are considered as a “Conditional Use” in both “AL” and “A80” zones. Where an existing use was listed as conditional use prior to Zoning By-law No. 4-85 (under the former Zoning By-law 1169) such uses are considered as legal existing conditional uses.
- The Riel Converter Station site is located on existing Manitoba Hydro owned property and is zoned as “AG – Agriculture General Zoning District”. Under the applicable zoning by-law, a “Public Utility Service” is a “Permitted Use” in the “AG” zone.
- The Glenboro South Station is located on existing Manitoba Hydro owned property and is zoned “AML – Agricultural (Moderately Limited) District”. Under the applicable zoning by-law, “Public Utilities and Buildings” are a “Permitted Use” in the “AML” zone.

Further, Manitoba Hydro purchased 17 properties adjacent to, or in the immediate vicinity of, the Riel Converter Station through negotiated agreements as part of the Riel Reliability Improvement Initiative Project. An offered to purchase was made for a further 3 properties (Manitoba Hydro 2009).

18.4.1.4 Electric and Magnetic Fields

Electric and magnetic fields are produced by both natural and anthropogenic sources. Natural sources of EMF include the Earth’s magnetic field, visible light and lightning. Anthropogenic sources include magnets, electrical appliances (*e.g.*, stoves, refrigerators, microwaves), electronic devices (*e.g.*, cellular phones, computers), vehicles, power lines and high-voltage transmission lines.

In a typical home away from appliances, background levels of magnetic fields range from 1 to 2 mG, whereas background levels of electric fields range from 0.01 to 0.02 kV/m (Exponent 2015a). However, in proximity to appliances, magnetic fields can be hundreds of times higher and electric field fields tens of times higher. The ubiquitous nature of EMF and variability in average background exposure levels make it difficult to quantify EMF levels (Exponent 2015a). However, the typical background levels are below ICNIRP and ICES reference levels and so short-term effects such as perception, annoyance, and the stimulation of nerves and muscles are would not

be present. As discussed previously, Health Canada states that there are no established links between exposure to EMF and long-term health effects.

18.5 Assessment of Project Environmental Effects on Human Health Risk

This section describes project interactions with human health risk during the construction, operation and maintenance phases. For each project interaction with human health risk (*i.e.*, air quality, country food quality, noise, and EMF), an assessment of the potential effects is provided, including an evaluation of the significance of the effect.

18.5.1 Project Interactions with Human Health

Project activities have the potential to influence short and long-term changes in human health effects. Table 18-6 identifies physical activities and components that might interact with human health for each potential effect.

During the construction phase, the use of heavy equipment has the potential to increase noise levels near these activities. Engine emissions from construction equipment, dust from physical works, and the burning of slash have the potential to alter ambient air quality near construction activities while these activities are occurring. These changes in air quality and noise have the potential to alter human health risk.

During the operation and maintenance phase, engine emissions from vehicles used for maintenance and inspection activities have the potential to alter air quality near these activities. In addition, herbicides used for maintenance of vegetation clearance during operation have the potential to enter the food chain and thereby alter the quality of country foods. Vehicle operation during maintenance and vegetation management activities have the potential to increase noise levels near these activities. Operation of the transmission line will generate electric and magnetic fields and noise. These changes in air quality, country foods, noise and EMF have the potential to alter human health risks.

During construction, interactions between the Project and country food quality or EMF are not expected, as herbicides will not be used for vegetation clearing, and the Project will not be emitting EMF during this phase. During transmission line and station operation, interactions between the Project and air quality are only expected as a result of vehicle operation during inspection patrols, and interactions between the Project and country food quality are only expected during vegetation management activities.

Table 18-6 Potential Project-Environment Interactions and Effects on Human Health Risk

Project Components and Physical Activities	Potential Environmental Effects			
	Change to Air Quality	Change to Country Food Quality	Change to Noise Levels	Change to Electric and Magnetic Fields
Transmission Line Construction Activities				
Mobilizing (staff and equipment)	✓	-	✓	-
Site Route and Bypass Trail Development	✓	-	✓	-
Right-of-way Clearing/Geotechnical Investigation	✓	-	✓	-
Marshalling Yards, Borrow Sites, Temporary Camp Setup	✓	-	✓	-
Transmission Tower Construction and Conductor Stringing	✓	-	✓	-
Demobilization	✓	-	✓	-
Transmission Line Operations/Maintenance				
Transmission Line Operation/Presence	-	-	✓	✓
Inspection Patrols	✓	-	✓	-
Vegetation Management (tree control)	✓	✓	✓	-
Station Construction				
Station Site Preparation	✓	-	✓	-
Electrical Equipment Installation	✓	-	✓	-
Station Operations/Maintenance				
Station Operation/Presence	-	-	✓	✓
Vegetation Management (weed control)	✓	✓	✓	-

NOTES:
"✓" = Potential interactions that might cause an effect.
"–" = Interactions between the project and the VC are not expected.

18.5.2 Assessment of Change to Air Quality

The Project has the potential to result in a change to air quality due to emissions from vehicles and machinery, the burning of slash, and dust generation, particularly during clearing and construction. The pathways, mitigation measures, and characterization of effects of change in air quality on human health risk are described below.

18.5.2.1 Pathways for Change to Air Quality

Air quality is determined by the levels of gases and particulate matter in the air. Gases include nitrogen dioxide, sulphur dioxide, and carbon monoxide, all of which can have health effects above certain concentrations. Particulate matter is classified according to particle size, with fine particulate matter defined as PM_{10} (less than 10 µm diameter) and $PM_{2.5}$ (less than 2.5 µm diameter). Smaller particles pose a greater health risk, as they can travel deeper into the respiratory system when inhaled. A brief summary of potential health effects associated with air pollutants relevant to the Project is provided in Table 18-7.

Table 18-7 Project-Related Air Emissions and Potential Human Health Effects

Chemical	Primary Sources	Exposure Pathway	Human Health Effects
SO_2	Fossil fuel combustion	Inhalation	Adverse effects on respiratory system (*e.g.*, constriction of the airways)[1]
NO_2	Fossil fuel combustion	Inhalation	Adverse effects on respiratory system (*e.g.*, inflammation, swelling of respiratory tract)[2]
CO	Incomplete combustion of fossil fuels	Inhalation	Decreased oxygen availability to critical organs[3]
PM (2.5 and 10)	Fires, dust, fuel combustion	Inhalation	Adverse effects on respiratory and cardiovascular systems[4]

NOTES:
[1] ATSDR 1999
[2] ATSDR 2002
[3] ATSDR 2009
[4] US EPA 2003

Project clearing, construction, operation, and maintenance activities due to vehicle and equipment exhaust, burning of slash, and dust emissions may cause a change in local air quality. Project-related change to air quality poses a potential human health risk if levels of gases and particulates exceed health-based air quality objectives. Change in air quality is of particular importance to sensitive individuals, including children, the elderly, and people with existing cardio-respiratory health problems such as asthma and chronic obstructive pulmonary disease.

18.5.2.1.1 Construction

Clearing activities along the ROW will involve cutting, piling, and burning of slash. During the construction phase, heavy equipment and vehicles will emit combustion products (*e.g.*, NO_2, SO_2, CO and particulate matter). Particulate matter is generally the focus of human health concerns associated with diesel emissions from construction equipment. Fugitive dust (dust from disturbed soils becoming airborne) from the operation of heavy machinery, vehicles and vegetation removal will also be emitted.

The estimation of emissions generated by Project construction focused on the following activities (see Air Quality TDR):

- construction of access roads;
- transportation of materials, equipment, support vehicles;
- clearing;
- construction of foundation;
- assembling and erecting of towers; and
- conductor stringing.

18.5.2.1.2 Operation and Maintenance

During the operation and maintenance phase, routine maintenance and inspection of transmission lines, emergency repairs, access to the stations and management of vegetation will require vehicles to travel along existing access roads. These activities will emit minimal amounts of particulate matter and fugitive dust. The estimation of emissions generated by Project operations and maintenance focused on annual maintenance patrols and vegetation maintenance (see Air Quality TDR).

18.5.2.2 Mitigation for Change to Air Quality

Mitigation measures to reduce Project-related combustion and dust emissions during the construction, operation and maintenance phases include:

- Mud, dust and vehicle emissions will be managed in a manner that allows for safe and continuous public activities near construction sites where applicable.
- Carrying out burning during winter season only, under supervision, and away from permanent human receptor locations, to confine fire to the cleared Project area and limit effects of off-site drift of smoke.

18.5.2.3 Characterization of Residual Environmental Effect for Change to Air Quality

Total emissions estimates for construction and operations and maintenance were generated based on construction vehicle fleet listings developed by Manitoba Hydro. Estimates were then compared to emission loadings for currently acceptable vehicle fleet emissions (Winnipeg Transit's diesel bus fleet) (see Air Quality TDR).

18.5.2.3.1 Construction

Results of the air quality assessment indicate that Project air emissions during the construction phase are expected to be minor, resulting in temporary, short-term reductions in local air quality in areas close to construction sites, but are unlikely to result in exceedances of Manitoba's Ambient Air Quality Guidelines (see Air Quality TDR).

Residual human health risk effects associated with change in air quality during the construction phase are adverse. Vehicles and heavy machinery, and burning of slash, will generate fugitive dust, particulate matter, and combustion products, but the magnitude of change in health risk from air quality will be negligible. Change to human health risk associated with air quality will be largely confined to the PDA, including the transmission line, stations, and immediately adjacent areas. This change will be an irregular event, as construction activities are carried out at different locations along the transmission line and at the stations. Change in human health risk during the construction phase will be short-term and reversible because air emissions will stop once construction is complete. The PDA and adjacent areas where air emissions will increase is categorized as disturbed, as the transmission line and stations will be located in predominantly agricultural, and suburban areas, where use of vehicles and machinery already occurs. More remote, undeveloped locations would be categorized as undisturbed.

18.5.2.3.2 Operation and Maintenance

Project-related activities that generate and release air contaminants to the atmosphere are expected to be temporary, primarily distributed along highways and transmission line ROWs, and intermittent in nature (see Air Quality TDR). Estimates for Project emission loadings were developed for each Project phase based upon equipment deployment estimates specific to each phase of the Project. Manitoba Hydro provided listings of anticipated equipment intended for use in each phase of the Project, each vehicle's power rating in horsepower, number of vehicles intended for deployment in each Project phase and the expected duration of use (see Air Quality TDR). Emission loadings were estimated and compared with known vehicle movements considered commonly acceptable by citizens and regulators within the City of Winnipeg – the emissions resulting from the operation of Winnipeg Transit's entire diesel bus fleet (>500 buses) on an annual and monthly basis (see Air Quality TDR).

Comparison of the total MMTP Project emissions with the annual and monthly Winnipeg Transit Diesel Bus Fleet, emissions indicate that the relative effects on air quality in response to the Project are expected to be minor, resulting in temporary, short-term reduction in local air quality in areas in close proximity to the construction sites, and unlikely to result in exceedance of Manitoba's Ambient Air Quality Guidelines (MCWS 2005) (see Air Quality TDR).

Residual human health risk effects associated with change in air quality during the operation and maintenance phase are adverse. However, particulate matter and dust generated during routine activities will be minor because of limited vehicle and equipment use during operations, and transient change in air quality will be limited to the PDA and immediately adjacent areas.

The magnitude of change in human health risk from air quality is negligible and the geographic extent is limited to the PDA. Change in air quality is described as an irregular event and short-term because maintenance activities will be infrequent and temporary. The effects of the operation and maintenance activities on air quality are reversible, as vehicle emissions and dust will not be generated upon completion of the work, and these emissions will dissipate or settle quickly. The area where change in air quality will occur is considered disturbed as the transmission line will be located in predominantly agricultural and suburban areas, where use of vehicles and machinery already occurs.

18.5.2.4 Summary

Total estimated emissions generated by the Project (construction and operation) over the lifetime of the Project are provided in Table 18-8 (from Air Quality TDR). Total Project emissions related to NO_x, CO, SO_2, and PM_{10} are estimated to be substantially less than annual emissions from the Winnipeg Transit Diesel bus fleet, based on reported fuel consumption for the buses in 2010.

Table 18-8 Emissions Estimates for the Project Relative to Winnipeg Transit Bus Fleet Emissions

Air Contaminant	Total Construction and Operation and Maintenance Phase Emissions (tonne)	Total Annual Winnipeg Transit Bus Fleet Diesel Emissions (tonne/yr)	Total Project Emissions as a Percentage of Annual Bus Emissions
NOx	40.81	1,150	3.55
CO	73.17	248	29.5
SO_2	0.26	76	0.34
PM_{10}	1.56	81	1.93

Sources of air emissions for the Project are mobile within the construction and ROW areas along the transmission line, stationary for short periods of time, and will be intermittent, as not all machinery and vehicles will be in service simultaneously. At the stations, equipment will be stationary for the duration of the expansion or upgrade, but air emissions will be variable over the course of the construction phase, depending on the types of vehicles and equipment being used, and relatively short-term. Residual human health risk effects are anticipated to be adverse but negligible in magnitude, limited to the PDA, irregular, short-term, and reversible.

18.5.3 Assessment of Change to Country Food Quality

18.5.3.1 Pathways for Change to Country Food Quality

The assessment of human health risk considers potential effects of the Project on country food quality. Real or perceived effects of project activities on the quantity of country foods are considered in Chapter 19.

18.5.3.1.1 Construction

As herbicides will not be used during the construction phase of the Project, there is no pathway for change to country food quality as a result of construction phase activities.

Dust generated during construction activities is expected to be minimal, localized and short-term in nature, and while dust may have a temporary physical effect on vegetation close to the construction area (via smothering), dust is not considered relevant to change in country food quality.

18.5.3.1.2 Operation and Maintenance

Herbicides applied to vegetation along the transmission line as part of an integrated vegetation management plan may be taken up by other organisms from the soil or foliage and passed on through the food chain. If chemicals contained in herbicides are taken up by species of vegetation or wildlife harvested as traditional country foods, there is the potential for human exposure to these chemicals via ingestion of the vegetation or wildlife.

Health Canada's Pest Management Regulatory Agency (PMRA) is responsible for the regulation of pest control products in Canada (*i.e.*, pesticides, including herbicides). If the PMRA deems there is reasonable certainty that no harm to human health, future generations, or the environment will result from exposure to, or use of, a pesticide, then a herbicide may be registered for use in Canada (PMRA 2015). In other words, PMRA's role is to determine whether pesticides can be used safely when label directions are followed and will be effective for their intended use (PMRA 2015).

The two major pesticides currently expected to be used for the Project on ROWs are Garlon XRT (Registration number 28945, registered in 1989) and Aspect Herbicide (Registration number 31641, registered in 2014). These herbicides are used to control unwanted vegetation:

- Garlon is used for the control of undesirable woody plants and annual and perennial broadleaved weeds on pastures and rangelands, in non-crop areas such as rights-of-way, military bases and industrial sites, and in forest and woodland management areas (Dow AgroSciences 2013); and
- Aspect Herbicide is for use on rights-of-way only to control unwanted brush and broadleaf weeds (Dow AgroSciences 2014).

The active ingredient (*i.e.*, the compound with the herbicidal property) in Garlon XRT is triclopyr and the active ingredients in Aspect Herbicide are 2,4-dichlorophenoxyacetic acid (2,4-D) and picloram.

For weed control at the Riel Converter Station, Glenboro South Station, and Dorsey Converter Station, these herbicides have been used:

- Esplanade SC Herbicide (Registration number 31333, registered in 2014);
- Overdrive Herbicide (Registration number 30065, registered in 2011); and
- Vantage (various registration numbers).

The active ingredient in Esplanade SC Herbicide is indaziflam; the active ingredients in Overdrive herbicide are diflufenzopyr and dicambal; and the active ingredient in the registered Vantage products is glyphosate.

Based on PMRA's scientific evaluation of these products, they can be used safely when label directions are followed. For example, in 2008 Health Canada completed an in depth re-evaluation of all uses of 2,4-D. The re-evaluation was based on all available information and included an extensive proprietary database, published scientific information including epidemiology and toxicity studies, foreign reviews, and use pattern information. Health Canada's conclusion was that 2,4-D meets Canada's strict health and safety standards, and as such, can be sold and used in Canada (Health Canada 2009). Moreover, Health Canada also consulted an independent Science Advisory Panel composed of government and university experts/researchers in toxicology, epidemiology and biology. The Panel agreed with PMRA's assessment that 2,4-D can be used safely when used according to label directions.

18.5.3.2 Mitigation for Country Food Quality

Health Canada assesses all registered herbicides for health and safety considerations, dependent on their proposed use, and herbicide operators must be licensed under *The Pesticides and Fertilizer Control Act* (Manitoba). Manitoba Hydro will develop an integrated vegetation management plan for the control of woody and non-woody vegetation along the transmission line ROW and at other Project sites. Manitoba Hydro is required to adhere to all laws and regulations

regarding herbicide use, which will mitigate the potential for harm. Label restrictions will be adhered to during application.

Herbicides used by Manitoba Hydro on ROWs are formulated to target woody vegetation and broad-leafed plants while leaving grasses largely unaffected.

In addition to the planned limited and infrequent use of herbicides, Manitoba Hydro has established several other herbicide use and application practices that will limit the potential for herbicides to enter the food chain and alter the quality of country foods. These include:

- Sensitive areas will not be treated with herbicides, such as those used for gathering berries and harvesting other types of traditional plant and animal country foods, that have been identified through ATK.

In addition to the restrictions and mitigation measures outlined on the product labels, Manitoba Hydro's detailed vegetation management plan limits the use of herbicides. In areas where agricultural activities do not occur on the ROW, Manitoba Hydro's vegetation management goal is the establishment of a self-sustaining, low-growing plant community along the ROW. This would consist of a well-established plant community of bushes and shrubs that would out-compete tree seedlings for available light, nutrients and water and hinder the growth of trees that could threaten the security and operation of the transmission line. The use of mechanical equipment or manual clearing for vegetation control is generally non-selective and removes the beneficial low-growing plants in addition to trees. Manitoba Hydro considers that selective herbicide application is a more effective means of controlling aspens and other fast-growing trees while encouraging the establishment of bushes and shrubs, than the use of mechanical equipment or manual clearing (Manitoba CEC 2013). Over time, developing healthy communities of bushes and shrubs on the ROW, coupled with the selective use of herbicides, will decrease the number of tall fast growing trees within the ROW. This, in turn, will decrease the need for regular application of herbicide and could increase the time between required herbicide treatments to periods of 15 years or more (Manitoba CEC 2013).

18.5.3.3 Characterization of Residual Environmental Effect for Change to Country Food Quality

Herbicides are designed to target specific vegetation without damaging the environment or posing a risk to human health (US EPA 1995, 1998, 2005). Health Canada and the United States Environmental Protection Agency (US EPA) work together on herbicide registration decisions. They publish information about herbicides in registration eligibility documents, which explain how the respective agency determines the appropriate types of uses for herbicides, and the limits on uses of those herbicides. As mentioned previously, the product information supplied to Health Canada and the US EPA to aid them in making their decisions is proprietary. As a result, neither Health Canada nor the US EPA can provide the numerical calculations used to determine the application rates recommended to protect human health. Without these data, Project-specific exposure estimates and exposure ratios cannot be calculated to assess human health risk, and

only a qualitative assessment of the human health risk associated with the application of herbicides to the Project ROW is possible. Due to numerous outstanding variables such as total area requiring treatment, feedback related to sensitive sites form FNMEP and landowner feedback, and knowledge of the final clearing method for specific sites, the amount of herbicide required for subsequent vegetation management efforts cannot be determined at this time. An objective of the Vegetation Management Plan is to reduce herbicide use through the establishment of a compatible vegetation community within the ROW. However, given that Health Canada has already conducted quantitative human health risk assessments for pesticides approved for use in Canada (*i.e.*, the products anticipated for use on the Project), and has determined these herbicides are safe for use, a qualitative assessment is appropriate to assess human health risk for the Project.

18.5.3.3.1 Operation and Maintenance

The residual effects associated with change to country food quality are neutral because as long as herbicides are applied according to Health Canada regulations, human health effects are not anticipated. The magnitude of the change in the quality of country foods is expected to be negligible as Manitoba Hydro will follow herbicide label requirements for ROW application, and will not use herbicides in clearly identified sensitive sites that contain plants of importance to country food harvesters, or that include crops.

The geographic extent of potential change to country food quality is the PDA, since Manitoba Hydro will spray herbicides on the ROW and around stations only, and herbicide label requirements for application will be followed. Herbicides are applied from a tank through a hose with a pressurized nozzle. Spray drift will be controlled by using appropriate nozzle pressure and by limiting application to low-wind conditions.

The frequency of the activities that could change country food quality occur as regular events, but will not exceed one application per year at a location. In addition, Manitoba Hydro's vegetation management goal for the ROW is to encourage low-growing shrubs that could increase the time between herbicide applications to periods of 15 years or more. Herbicides will be applied in accordance with the identified usage requirements as needed to control vegetation growth around some transmission line towers that are more difficult to clear with physical removal methods. The duration of effect is long-term, as herbicides will be sprayed on the ROW for the lifetime of the Project, to keep plants from growing underneath the power lines. However, effects are reversible, as potential change to human health risk will subside once herbicide treatment ceases. The areas where change in country food quality could occur are predominantly disturbed, as the transmission line will be located in predominantly agricultural and suburban areas. An exception is the southeast corner of the Project, which is relatively undisturbed. Herbicide application will not occur in agricultural areas.

18.5.3.4 Summary

Residual human health risk effects associated with country food quality in areas of herbicide application are neutral and negligible in magnitude, limited to the PDA, irregular, long-term, and reversible.

18.5.4 Assessment of Change to Noise Levels

18.5.4.1 Pathways for Change to Noise Levels

There are two general sources of noise associated with the Project, which have the potential to affect human receptors close to the ROW:

- noise generated by construction and maintenance activities (*e.g.*, equipment, vehicles); and
- noise generated by transmission lines and stations during operation.

18.5.4.1.1 Construction

VEHICLES AND MACHINERY

During the construction phase, various activities will have the potential to increase noise levels and disturb people. Construction activities that would create noise include ROW clearing, access road construction and improvement, station pad grading, installation of tower footings, assembling and lifting towers into place, helicopter assistance during tower installation, and splicing of conductors. Construction activities will involve the use of heavy machinery such as bulldozers, excavators or cranes. In rocky areas, where a conventional tower footing would be impractical, blasting could be required and would produce a short noise that could be audible for several kilometers.

Noise associated with construction will be intermittent and temporary and, with the exception of implosions and potentially, helicopters, is expected to be contained within and immediately adjacent to the PDA. The maximum combined noise level generated during construction is anticipated to be 89 dBA at 15 m from the noise source, excluding implosive sleeves used during conductor stringing which involve a split second detonation similar to a shotgun blast (about 110 dBA). The maximum combined noise level is based on one of each of the following: grader, bulldozer, heavy truck, backhoe, pneumatic tools, concrete pump, and crane (see Noise TDR). Noise that travels beyond the PDA during construction activities will dissipate substantially by natural and manmade attenuation features, and is anticipated to generate 59 dBA at a distance of 480 m from the noise source within the PDA (a noise level similar to an indoor conversation). This level of noise exceeds Manitoba guidelines for daytime activities (55 dBA); however, this level is typical of construction activities which routinely occur near residences throughout the province. Occupied residences located within the LAA will likely, on occasion, experience noise generated by construction activities along the transmission line, with more continuous noise during station

construction; however, this noise will be minimal and relatively short-term in duration (see Noise TDR). It also needs to be noted that Manitoba Conservation and Water Stewardship does not enforce specific noise limits for regulation of ambient daytime and nighttime noise levels, but instead will review nuisance noise if five complaints have been reported by residents, and may provide requirements for proponents to seek methods to reduce noise.

18.5.4.1.2 Operation and Maintenance

VEHICLES AND MACHINERY

The magnitude of the noise generated during operation and maintenance is expected to be less than that during the construction phase, as the main sources of Project noise will be related to the use of large construction vehicles and equipment, blasting, and conductor splicing (implosions).

Sources of noise during the operation and maintenance phase include activities for routine inspection (use of field vehicles and helicopters), maintenance of hardware, and vegetation management along the ROW. To control vegetation growth along the line, the use of chainsaws, roller choppers and brush hogs may be required. Equipment and vehicle-related noise associated with maintenance activities will be intermittent and temporary and is expected to be contained mostly within the PDA (see Noise TDR).

TRANSMISSION LINE AND STATIONS

The predicted fair-weather audible noise from Project transmission lines at the edge of the ROW represents an inaudible increase in noise (less than 1 dB) from 22 dBA for existing configurations to 23 dBA (Table 18-9) (Exponent 2015b). Therefore, noise from the Project transmission lines would have a negligible effect on ambient noise levels, and total sound levels would remain below guidelines for residential and commercial areas. During foul weather, the calculated levels of AN are higher, but the wind and rain that typically occur are themselves likely to generate ~41-63 dBA of AN and would likely mask the noise from the transmission lines during these conditions (Exponent 2015b).

AN levels due to equipment added at each station are calculated to be as high as 52 dBA at the residence nearest to Dorsey Converter Station, 44 dBA at the residence nearest to Riel Converter Station, and 55 dBA at the residence nearest to Glenboro South Station. These do not exceed the 55 dBA daytime guideline for maximum desirable 1-hour equivalent noise levels for residential and commercial areas as specified by the Manitoba Provincial Guidelines, but several do exceed the 45 dBA nighttime guideline (Exponent 2015b). As noted before, Manitoba Conservation and Water Stewardship do not enforce specific noise limits but rather complaints of nuisance due to noise. If five or more complaints are received requirements for proponents to seek methods to reduce noise may be requested.

Table 18-9 Fair Weather Audible Noise Predictions for the Transmission Line at the Edge of the ROW

Transmission Line Section[1]	Noise (dBA)	Limit (dBA)[2]
A	20	45-55
B	21	
C	18	
D	17	
E	20	
F	23	
G	23	
H	22	

NOTES:
[1] See Figure 18-2
[2] Maximum desirable 1-hour equivalent noise levels for residential and commercial areas (nighttime-daytime) (Province of Manitoba 1992)
SOURCE: Exponent 2015b

18.5.4.2 Mitigation for Change to Noise Levels

Transmission line routing considered proximity to residences and residential development, including areas designated for future urban and rural landscape development, to the extent practicable. The selected route avoids built-up areas around Oak Bluff, Ste. Anne and Ste. Genevieve, but will still intersect with rural residential areas occurring to the south and east of Winnipeg. Potential nuisance effects on sensitive receptors were a consideration in route planning and selection.

Predicted AN exceeds the 45 dBA nighttime guideline in a few cases (Exponent 2015b). Over 10 dB of noise reduction is readily achievable via passive techniques such as the construction of barriers, or active techniques such as noise cancellation. AN levels associated with the equipment to be added at the Glenboro South Station and the Dorsey Converter Station may warrant further investigation with more precise calculations and measurements, but the highest AN level estimates are already below the recommended daytime guidelines, and it is expected that appropriate mitigation procedures would be able to lower the AN levels below the recommended nighttime guidelines in the event that AN is found to become a nuisance.

Mitigation measures for noise emissions during the construction, operation and maintenance phases include:

- Conducting construction activities as per applicable noise bylaws; and
- Use of passive or active techniques to minimize noise such as construction of barriers or noise cancellation to the extent feasible.

18.5.4.3 Characterization of Residual Environmental Effect for Change to Noise Levels

18.5.4.3.1 Construction

VEHICLES AND MACHINERY

During the construction phase, residual effects for human health risk associated with noise levels are adverse. However, with the exception of isolated activities such as splicing conductors, the magnitude of change in noise level will be low and similar to ambient noise levels. This change will largely be restricted to the LAA. Change in noise levels is described as a multiple irregular event along the ROW because construction is carried out at different locations along the transmission line. Noise associated with construction at the stations will be regular for the duration of the construction phase. Human receptors located near the ROW will be exposed to noise from the construction of only one or two transmission line towers (typically constructed between 200 m and 500 m apart, depending on the terrain), as noise generated from construction farther down the line will attenuate with distance. Change in noise levels associated with construction activities are short-term, and the effects of change in noise levels are reversible, as noise emissions will stop after activity completion. Although some relatively undeveloped areas occur along the Project route, the socio-economic context for change in noise levels is categorized as disturbed, as most of the construction will occur in areas where suburban and/or agricultural activities are present. A notable exception to this is the southeast corner of the Project which is relatively undeveloped and, therefore, categorized as undisturbed.

18.5.4.3.2 Operation and Maintenance

VEHICLES AND MACHINERY

Residual effects for human health risk associated with noise levels during operation and maintenance are adverse. However, noise generated by vehicles and equipment during routine maintenance activities will be negligible and not expected to differ appreciably from noise levels associated the ambient environment. In areas where human activities are limited, noise generated during routine maintenance may be noticeable but of short duration. Change in noise levels associated with maintenance activities are short-term, and the effects of change in noise levels are reversible, as noise emissions will stop after activity completion. Although some relatively undeveloped areas occur along the Project route (*e.g.*, southeast corner of Project), the

socio-economic context for change in noise levels is categorized as disturbed, as most activities will occur in areas where suburban and/or agricultural activities are present.

TRANSMISSION LINE AND STATIONS

Residual effects associated with transmission line noise are adverse; however, the magnitude of change in noise levels is negligible under fair-weather conditions and negligible during foul weather when rain and wind noise are present. Indeed, during foul weather, wind and rain that typically occur are themselves likely to generate ~41-63 dBA of AN and would likely mask the noise from the transmission lines during these conditions. AN levels due to equipment added at each station are calculated to be as high as 52 dBA at the residence nearest to Dorsey Converter Station, 44 dBA at the residence nearest to Riel Converter Station, and 55 dBA at the residence nearest to Glenboro South Station. These do not exceed the 55 dBA daytime guideline for maximum desirable 1-hour equivalent noise levels for residential and commercial areas as specified by the Manitoba Provincial Guidelines, but several do exceed the 45 dBA nighttime guideline (Exponent 2015b). However, Manitoba Conservation and Water Stewardship do not enforce specific noise limits. Rather, they respond to complaints of nuisance due to noise. If five or more complaints are received requirements for proponents to seek methods to reduce noise may be requested. The geographic extent is limited to the Existing Corridor and New ROW and vicinity because noise emitted from the transmission line and stations will dissipate quickly with distance.

There are existing transmission lines 100 m from the Project that run parallel southward for 33 km from Dorsey, and eastward for 24 km from Riel. Noise levels in these two regions will be similar to existing levels. The increase in noise levels will be continuous and long-term. The effects of Project operation on noise levels are reversible because noise emissions will cease at the end of the Project lifetime. The socio-economic context for change in noise levels is categorized as disturbed because the transmission line will traverse predominantly suburban and agricultural areas, but it needs to be acknowledged that the existing Dorsey and Riel converter stations and the Glenboro South Station are zoned according to applicable municipal zoning by-laws.

18.5.4.4 Summary

Residual human health risk effects associated with change in Project-related noise are adverse but negligible in magnitude, limited to the LAA, regular, long-term, and reversible.

18.5.5 Assessment of Change to Electric and Magnetic Fields

18.5.5.1 Pathways for Change to Electric and Magnetic Fields

Project-related electric and magnetic fields (EMF) are only associated with the operation and maintenance phase; therefore, the construction phase is not assessed. The voltage and current carried by the transmission line will generate EMF. The EMF diminishes rapidly with distance from the transmission line, and physical buffers such as trees and buildings will reduce the intensity of electric fields but not magnetic fields. The effect of EMF on human receptors depends on the EMF frequency. Extremely low frequency (ELF) EMF, generated by transmission lines with a frequency of 60 Hertz, have the capacity to induce electric fields in a human body but the levels are extremely small (World Health Organization 2015). For example, the intensity of the induced electric field in human tissue by exposure to ELF electric fields from our power system is about 1 million times lower than the intensity of an external field.

Numerous reviews of research literature on exposure to ELF EMF and possible adverse health effects have been conducted by international and national scientific and governmental agencies, including Health Canada and the World Health Organization. None of these agencies has concluded that exposure to ELF EMF is a demonstrated cause of any long-term adverse health effect. The only direct adverse biological or health effects are those produced by very high field levels, which can stimulate nerves. However, EMF at intensities required to produce this stimulation are not encountered in environments accessible to the public. Study results are detailed in the EMF health research update report (Exponent 2015a).

18.5.5.1.1 Operation and Maintenance

Negligible changes between existing and proposed scenarios are expected for EMF. Where an existing 500 kV line is present in Sections F and G (see Figure 18-2) where the highest levels are predicted, the addition of the Project 500 kV line will have only a small effect on the highest existing levels of EMF as well as the existing levels at the edge of the ROW and beyond. In other sections where the Project transmission line will be the only line above 230 kV, there will be relatively larger increases in EMF above existing levels but EMF will still be below the acceptable levels set by international organizations to evaluate compliance with limits on electric fields within the body (Exponent 2015b).

ELECTRIC FIELD

Calculated electric field levels at the edge of the ROW and on the ROW for all sections of the transmission line are summarized in Table 18-10. The highest calculated electric-field at the edge of the ROW (refer to Exponent 2015b for ROW widths and distances from line) for any section of the route is 0.8 kV/m (Exponent 2015b; Table 18-10). This level is well below recommended

reference levels for public exposure (4.2 kV/m and 5.0 kV/m) (ICNIRP 2010; ICES 2002) (Exponent 2015b). The highest calculated electric field level on the ROW (more directly beneath the line) is 10 kV/m (Exponent 2015b; Table 18-10; Figure 18-4 and Figure 18-5), and is where the general public can be expected to spend a limited amount of time. ICES (2002) provides separate guidelines for electric-field levels on a ROW, recommending that they do not exceed 10 kV/m. Canadian Standards Association (CSA; 2015) also refers to this 10 kV/m recommendation and further notes that it is based on comfort, stating that electric-field levels may exceed 10 kV/m for voltage classes 200 kV and greater. ICNIRP does not discuss separate guidelines for within a ROW, but notes that in cases where reference levels are exceeded, further analyses and computations are needed to demonstrate compliance with the Basic Restriction (BR; Exponent 2015b). The peak electric field on the ROW is roughly 3 times lower than the BR (Exponent 2015b). In addition, the difference between calculated electric-fields for the proposed line and existing line are negligible (Table 18-10).

Table 18-10 Electric-field Levels (kV/m) for Existing and Proposed Configurations

Section	Existing/ Proposed	Location				
		30 m beyond −ROW edge	−ROW edge	Max on ROW	+ROW edge	30 m beyond +ROW edge
A	Existing	0.1	0.1	3.0	0.0	0.0
	Proposed	0.1	0.2	5.8	0.5	0.1
B	Existing	0.1	0.1	2.9	0.1	0.0
	Proposed	0.1	0.2	5.8	0.5	0.2
C	Existing	0.0	0.2	1.1	0.1	0.0
	Proposed	0.1	0.2	5.8	0.1	0.1
D	Existing	0.0	0.1	0.8	0.0	0.0
	Proposed	0.1	0.1	5.8	0.1	0.1
E1	Existing	n/a	n/a	n/a	n/a	n/a
	Proposed	0.2	0.7	5.7	0.7	0.2
E2	Existing	n/a	n/a	n/a	n/a	n/a
	Proposed	0.2	0.8	5.9	0.8	0.2
F	Existing	0.0	0.0	9.9	0.6	0.2
	Proposed	0.0	0.0	10.0	0.7	0.2
G	Existing	0.0	0.0	9.9	0.6	0.2
	Proposed	0.0	0.1	10.0	0.7	0.2
H	Existing	0.0	0.0	1.0	0.7	0.1
	Proposed	0.1	0.4	5.8	0.7	0.1

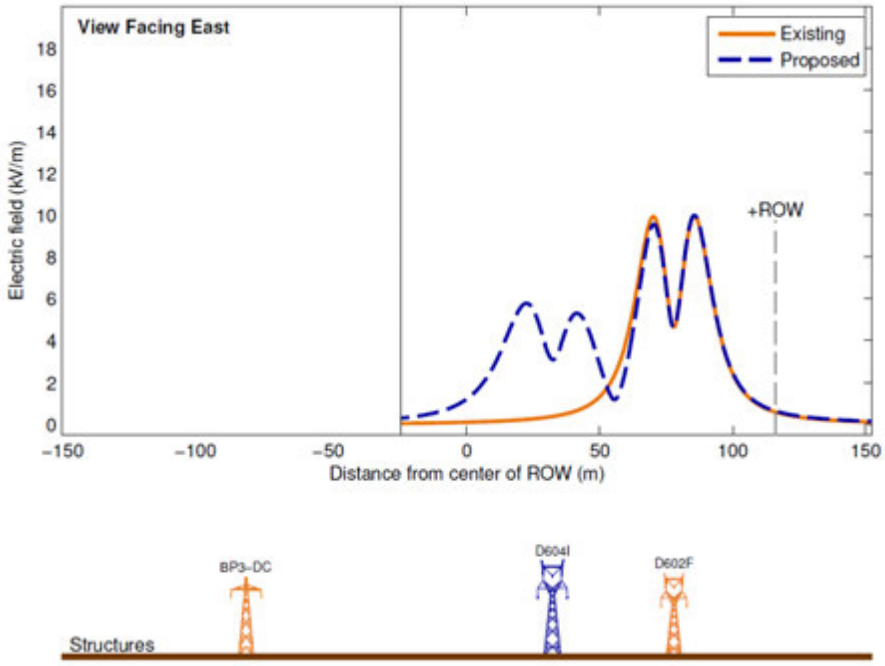

Figure 18-4 Electric-Field Profile along XS-F - Looking East from Riel

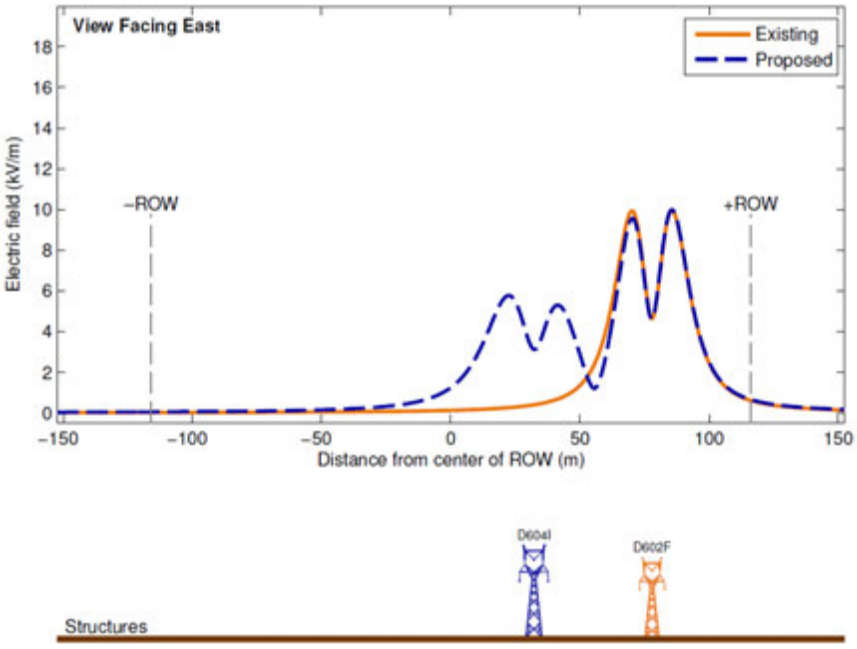

Figure 18-5 Electric-Field Profile along XS-G - Looking East From Riel

MAGNETIC FIELD

Calculated magnetic field levels at the edge of the ROW and on the ROW for all sections of the transmission line are summarized in Table 18-11 (average loading) and Table 18-12 (peak loading).The highest calculated magnetic field levels are 25 mG at the ROW edge (Section F) and 181 mG on the ROW (Section F and G) for average loading, and 32 mG at the ROW edge (Section F and G) and 225 mG on the ROW (Section F and G) for peak loading (Exponent 2015b). These values are well below the reference levels for public exposure of 2,000 mG (ICNIRP 2010) and 9,040 mG (ICES 2002). Moreover, proposed magnetic field levels are at times lower than existing levels (Table 18-11 and Table 18-12) (Exponent 2015b).

Table 18-11 Magnetic-field Levels (mG) at Average Loading for Existing and Proposed Configurations

Section	Existing/ Proposed	Location				
		30 m beyond −ROW edge	−ROW edge	Max on ROW	+ROW edge	30 m beyond +ROW edge
A	Existing	3.4	7.0	55	1.6	1.1
	Proposed	3.3	6.8	117	15	5.9
B	Existing	3.3	9.2	61	2.6	1.5
	Proposed	3.4	11	125	14	5.1
C	Existing	1.7	3.1	30	1.2	0.6
	Proposed	2.8	5.1	117	4.9	2.7
D	Existing	0.5	1.0	9.8	0.2	0.2
	Proposed	2.6	4.5	117	5.0	2.8
E1	Existing	n/a	n/a	n/a	n/a	n/a
	Proposed	6.9	20	118	20	6.9
E2	Existing	n/a	n/a	n/a	n/a	n/a
	Proposed	7.4	21	122	21	7.4
F	Existing	0.7	0.9	217	22	7.4
	Proposed	1.9	2.6	181	25	9.6
G	Existing	0.7	0.9	217	22	7.4
	Proposed	1.9	2.6	181	25	9.6
H	Existing	0.3	0.4	24	11	2.3
	Proposed	5.2	13	119	9.4	1.7

Table 18-12 Magnetic-field Levels (mG) at Peak Loading for Existing and Proposed Configurations

Section	Existing/ Proposed	Location				
		30 m beyond −ROW edge	−ROW edge	Max on ROW	+ROW edge	30 m beyond +ROW edge
A	Existing	4.9	10	83	2.4	1.6
	Proposed	4.8	9.9	133	17	6.7
B	Existing	5.0	14	91	3.9	2.2
	Proposed	4.8	15	144	15	5.5
C	Existing	2.0	2.8	34	1.8	0.9
	Proposed	3.1	4.5	132	5.8	3.2
D	Existing	0.7	1.6	15	0.4	0.2
	Proposed	3.0	5.4	132	5.8	3.2
E1	Existing	n/a	n/a	n/a	n/a	n/a
	Proposed	7.9	22	134	22	7.9
E2	Existing	n/a	n/a	n/a	n/a	n/a
	Proposed	8.4	24	139	24	8.4
F	Existing	1.2	1.6	384	40	13
	Proposed	2.9	4.1	225	32	13
G	Existing	1.2	1.6	384	40	13
	Proposed	2.9	4.1	225	32	13
H	Existing	0.3	0.5	29	13	2.9
	Proposed	5.9	14	135	12	2.0

18.5.5.2 Mitigation for Change to Electric and Magnetic Fields

Mitigation measures are not required for this Project as EMF levels within and outside the Project ROW are anticipated to be below limits recommended by national and international agencies.

18.5.5.3 Characterization of Residual Environmental Effect for Change to Electric and Magnetic Fields

18.5.5.3.1 Operation and Maintenance

Residual effects during the operation and maintenance phase with respect to EMF are neutral, as current scientific evidence indicates that ELF EMF from transmission lines are not harmful to human health. EMF generated during operation will be below the levels set by international organizations and the change from existing maximum levels will be of negligible magnitude. Increased EMF levels above existing levels will be long-term, continuous, and reversible, as EMF will be produced for as long as the transmission line is in operation. The socio-economic context for change in EMF levels is categorized as disturbed because the transmission line will be built in predominantly suburban and agricultural areas. One exception is the southeast corner of the Project, which is categorized as undisturbed.

18.5.5.4 Summary

Residual human health risk effects associated with EMF are neutral in direction, negligible in magnitude, limited to the LAA, continuous, permanent (will last over the life of the project), and reversible (effects will cease at the end of the Project life). There are no residual human health risks associated with EMF at the levels associated with the Project.

18.5.6 Summary of Environmental Effects on Human Health Risk

A summary of the environmental effects assessment and predictions of residual environmental effects resulting from the interactions of the Project and human health risk is provided in Table 18-13.

Table 18-13 Summary of Residual Environmental Effects on Human Health Risk

Project Phase	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Socio-economic Context
Change to Air Quality							
Construction	A	N	PDA	ST	IR	R	D
Operation and Maintenance	A	N	PDA	ST	IR	R	D
Change to Country Food Quality							
Construction	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Operation and Maintenance	N	N	PDA	P	IR	R	D
Change to Noise Levels							
Construction	A	N	LAA	ST	IR	R	D
Operation and Maintenance	A	L	PDA	P	C	R	D
Change to Electric and Magnetic Fields							
Construction	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Operation and Maintenance	N	N	LAA	P	C	R	D

KEY

See Table 18-4 for detailed definitions

Direction: *A: Adverse; N: Neutral; P: Positive*

Magnitude: *N: Negligible; L: Low; H: High*

Geographic Extent: *PDA:ROW/Site; LAA: Local; RAA: Regional*

Duration: *ST: Short-term; MT: Medium-term; P: Permanent*

Frequency: *S: Single event; IR: Irregular event; R: Regular event; C: Continuous*

Reversibility: *R: Reversible: I: Irreversible*

Socio-Economic Context: *U:Undisturbed, D:Disturbed*

N/A Not applicable

18.6 Assessment of Cumulative Environmental Effects on Human Health Risk

The Project residual effects described in Section 18.5.6 that are likely to interact cumulatively with residual environmental effects of other physical activities are identified in this section, and the resulting cumulative environmental effects are assessed. This is followed by an analysis of the project contribution to residual cumulative effects. The assessment of cumulative effects considers residual effects from the construction and operation and maintenance phases of the Project.

18.6.1 Identification of Project Residual Effects Likely to Interact Cumulatively

See Chapter 7, Table 7-4 for the project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. When residual environmental effects from the Project act cumulatively with those from other projects and physical activities, a cumulative effects assessment is conducted to determine their significance. These interactions are identified in Table 18-14.

The assessment of the cumulative environmental effects that are likely to result from the Project in combination with other projects and physical activities follows. Environmental effects identified in Table 18-14 as unlikely to interact cumulatively with residual effects of other projects and physical activities (no check mark) are not discussed further. Potential residual effects associated with these projects or activities are not anticipated to overlap with the Project spatially or to occur at the same time.

Table 18-14 Potential Cumulative Environmental Effects on Human Health Risk

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects			
	Change to Air Quality	Change to Country Food Quality	Change to Noise Levels	Change to EMF
Past and Present Physical Activities and Resource Use				
Agriculture (Conversion, Livestock Operations, Cropping and Land Drainage)	✓	✓	✓	–
Residential Developments	✓	–	✓	–
Existing Linear Developments	–	–	✓	✓
Other Resource Activities (Forestry, Mining, Hunting, Trapping, Fishing)	✓	–	✓	–
Recreational Activities	–	–	✓	–
Project-Related Physical Activities	✓	–	✓	✓
Future Physical Activities				
Bipole III Transmission Project	✓	–	✓	✓
St. Vital Transmission Complex	✓	–	✓	✓
Dorsey to Portage South Transmission Project	✓	–	✓	✓
Northwest Winnipeg Natural Gas Pipeline Project	✓	–	✓	–
Richer South Station to Spruce Station Transmission Project	✓	–	✓	–
Energy East Pipeline Project	✓	–	✓	–
Southend Water Pollution Control Centre Upgrade Project	–	–	–	–
St. Norbert Bypass	–	–	–	–
Headingley Bypass	–	–	–	–
Oakbank Corridor	–	–	–	–
Residential Development	✓	–	✓	–
Natural Gas Upgrade Projects	✓	–	✓	–
MIT Capital Projects (Highway Renewal)	✓	–	✓	–
Piney-Pinecreek Border Airport Expansion	–	–	–	–

NOTES:

"✓" = Other projects and physical activities whose residual effects are likely to interact cumulatively with project residual environmental effects.

"–" = Interactions between the residual effects of other projects and those of the Project residual effects are not expected.

18.6.2 Cumulative Effects Assessment for Change to Air Quality

18.6.2.1 Cumulative Effect Pathways for Change to Air Quality

Future projects and activities identified in Table 18-14 have the potential to interact cumulatively with air emissions from the Project and could increase the overall exposure to change in air quality experienced by people living and working in the RAA.

Given that air emissions associated with the Project will occur primarily during the construction phase, reasonably foreseeable projects and physical activities are only anticipated to interact cumulatively with the Project to cause change to air quality if construction activities occur concurrently.

18.6.2.2 Mitigation for Cumulative Effects for Change to Air Quality

Implementation of the mitigation measures described in Section 18.5.2.2 will reduce the effects of the Project on change to air quality. Other proponents may adopt mitigation measures to mitigate their own project effects. Manitoba Hydro will work with other proponents and government agencies where appropriate to address cumulative effects.

18.6.2.3 Residual Cumulative Effects

The projects listed in Table 18-14 are likely to contribute to change in air quality and related human health risk. These effects will be experienced primarily close to construction areas, and they will be short-term and continuous until the end of construction. Landowners and residents living near to both the Project and the other projects and activities identified above are most likely to experience cumulative health risk from project-related change in air quality. However, with mitigation measures, effects will be negligible in magnitude, irregular, short-term, and reversible.

18.6.3 Cumulative Effects Assessment for Country Food Quality

18.6.3.1 Cumulative Effect Pathways for Change to Country Food Quality

Project effects on country food quality are limited to the use of herbicides for vegetation control during the operation and maintenance phase of the Project. Herbicides will be applied according to Health Canada regulations protective of human health and will be limited to ground-based applications, which will limit the extent of herbicide release to the PDA. Other transmission line projects that share parts of the Final Preferred Route may also use herbicides for vegetation

management and weed control; however, their use of herbicides must also follow Health Canada regulations. Given that Health Canada has assessed the safety of herbicide application with respect to human health, Project activities related to the application of herbicides do not have the potential to interact cumulatively with future projects and activities to alter the quality of country foods. Therefore, there is no cumulative effects pathway for country food quality and an assessment of potential cumulative effects is not necessary.

18.6.4 Cumulative Effects Assessment for Change to Noise Levels

18.6.4.1 Cumulative Effect Pathways for Change in Noise Levels

Noise generated by future projects and activities in the RAA have the potential to interact cumulatively with the Project and could increase the overall exposure to noise experienced by people living and working in the RAA.

Reasonably foreseeable projects and physical activities listed in Table 18-14 have the potential to interact cumulatively with the Project to cause change to noise (for example, agriculture activities, residential developments, existing linear developments and resource and recreational activities [e.g., forestry, mining, hunting, trapping, fishing]). However, effects will only be additive if noise-generating activities occur concurrently and within close proximity to one another. Similarly, should other projects and activities be developed in close proximity to the Dorsey Converter Station and the Glenboro South Station, noise levels near those locations may increase.

Section F (see Figure 18-2) encompasses another known future transmission line project (Exponent 2015b). If the noise contribution of the Bipole III line is included in Section F, the calculated fair-weather audible noise at the southern edge of the ROW would rise by about 4 dB, which is still well below regulatory guidelines. In foul weather, the added contribution from Bipole III at the southern edge of the ROW would be less than 0.1 dB (Exponent 2015b).

18.6.4.2 Mitigation for Cumulative Effects for Change to Noise Levels

Implementation of the mitigation measures described in Section 18.5.4.2 will reduce the effects of the Project on change to noise levels. Other proponents may adopt mitigation measures to mitigate their own project effects. Manitoba Hydro will work with other proponents and government agencies where appropriate to address cumulative effects.

18.6.4.3 Residual Cumulative Effects

The projects listed in Table 18-14 are likely to contribute to noise and related human health risk (stress or annoyance). These effects will be experienced primarily close to construction areas; they will be short-term and continuous until the end of construction and will only be cumulative if noise-generating activities occur concurrently and in close proximity to each another. Landowners and residents living near to both the Project and the other projects and activities identified above are most likely to experience cumulative health risk from project-related noise. No mitigation measures are required.

It is noted in Section 18.5.4.1.2 that there will be exceedances of the night time noise limits at the Dorsey Converter Station and the Glenboro South Station. Should other projects or activities be developed in close proximity to these stations, the noise levels may increase. Manitoba Conservation and Water Stewardship do not enforce specific noise limits. Rather, they respond to complaints of nuisance due to noise. If five or more complaints are received requirements for proponents to seek methods to reduce noise may be requested. The geographic extent is limited to the near vicinity of the stations because noise emitted from the stations will dissipate quickly with distance.

In summary, potential cumulative effects due to noise will be negligible to moderate in magnitude, continuous, long-term, and reversible.

18.6.5 Cumulative Effects Assessment for Change to Electric and Magnetic Fields

18.6.5.1 Cumulative Effect Pathways for Change to Electric and Magnetic Fields

Future projects and activities that generate EMF will increase the overall EMF exposure for people living and working near the Project. Section F (see Figure 18-2) extends east from Riel and encompasses an existing ROW as well as the future 500-kV Bipole III transmission line. The Bipole III line will be located 115 m north of the Project line. Section F is the only assessment section of the ROW that encompasses another known future transmission line project (Exponent 2015b).

Bipole III is a direct current (DC) transmission line, while the Project uses alternating current (AC). DC transmission lines also produce electric and magnetic fields; however, the EMF are static (*i.e.*, they do not change at a rate of 60 Hz as do AC EMF), so the fields from adjacent AC and DC lines are considered separately with regard to health assessments (Exponent 2015b). As a result, the electrical environment of the proposed Bipole III DC transmission line was not included in the Project EMF assessment (Exponent 2015b). In general, both ICNIRP (2010) and ICES (2002) recommend that upon simultaneous exposure to multiple frequency EMF, the exposures should be considered additive in their effects and the sum of all frequency components should be

considered. In this case, however, the AC and DC EMF do not have significant additive effects on the internal electric field in tissue, which is the limiting factor for exposure (Exponent 2015b).

18.6.5.2 Mitigation for Cumulative Effects for Change to Electric and Magnetic Fields

Implementation of the mitigation measures described in Section 18.5.5.2 will reduce the effects of the Project on change to EMF. Manitoba Hydro will work with other proponents and government agencies where appropriate to address cumulative effects.

18.6.5.3 Residual Cumulative Effects

The projects listed in Table 18-14 are likely to contribute to EMF in the RAA. Landowners and residents living near to both the Project and the other projects identified above are most likely to experience potential cumulative exposure rom project-related EMF and common background sources. However, current scientific evidence indicates that ELF EMF from transmission lines and other sources do not pose a risk to human health (Exponent 2015a).

18.6.6 Summary of Cumulative Effects

Table 18-15 summarizes cumulative environmental effects on human health risk.

Table 18-15 Summary of Cumulative Environmental Effects on Human Health Risk

Cumulative Effect	Residual Cumulative Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological Context
Cumulative Effects on Change in Air Quality							
Cumulative environmental effect with the Project	A	N	ROW	ST	IR	R	D
Contribution from the Project to the overall cumulative environmental effect	The Project's contribution to overall air quality will occur in close proximity to active construction activities. The effects will be localized, short-term, irregular in occurrence, negligible in magnitude, and reversible once construction activities cease in a given location.						

Cumulative Effect	Residual Cumulative Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological Context
Cumulative Effects on Change in Noise Levels							
Cumulative environmental effect with the Project	A	L	ROW	P	C	R	D
Contribution from the Project to the cumulative environmental effect	During construction, the Project's contribution to overall noise levels will occur in close proximity to active construction activities. The Project will only contribute to cumulative increases in noise if Project construction activities occur concurrently with, and in proximity to, similar activities on other projects. The effects associated with construction activities will be short-term, irregular in occurrence, negligible in magnitude, and reversible once construction activities cease. During operations, the Project's contribution to overall noise levels will occur in close proximity to the ROW, and near the stations. The Project will contribute to cumulative increases in noise in areas where the ROW runs parallel to other noise-generating project/activities, and in the near vicinity of the stations. In these cases, increase in noise levels will be long-term (persisting for the operational life of the project) and negligible to moderate in magnitude, and reversible once operations cease.						
Cumulative Effects on Change in Electric and Magnetic Fields							
Cumulative environmental effect with the Project	N	N	ROW	P	C	R	D
Contribution from the Project to the cumulative environmental effect	The Project can only contribute to cumulative EMF in areas where the Project ROW runs in close parallel proximity to another AC high voltage transmission line. Bipole III is the only high voltage line to run in close proximity to the Project (150 m), However the Bipole III line is a DC line and thus, there are no cumulative effects on EMF between the Project and the Bipole III lines. Therefore, the project will not contribute to a cumulative increase in EMF.						

KEY

See Table 18-4 for detailed definitions.

Direction: *A: Adverse; N:Neutral; P: Positive*

Magnitude: *N: Negligible; L: Low; M: Moderate; H:High*

Geographic Extent: *PDA: ROW/Site; LAA: Local; RAA: Regional*

Duration: ST: Short-term; MT: Medium-term; P: Permanent

Frequency: S: Single event; IR: Irregular event; R: Regular event; C: Continuous

Reversibility: R: Reversible; I: Irreversible

Socio-Economic Context: U:Undisturbed, D:Disturbed

N/A Not applicable

18.7 Determinations of Significance

18.7.1 Significance of Environmental Effects for the Project

With the application of mitigation measures, the residual environmental effects of the Project on human health risk, associated with air quality, country food quality, noise, and EMF, are predicted to be not significant.

Change in air quality resulting from construction and maintenance activities will be short-term in duration, limited to the ROW, and is not be expected to produce emissions that differ greatly from current physical activities in developed (*i.e.*, agricultural, suburban) areas along the ROW. The Project is not expected to produce emissions that will result in an increase in air quality parameter concentrations that are above Manitoba's Ambient Air Quality Guidelines (MCWS 2005). As a result, residual environmental effects do not pose a human health risk.

Herbicide application will follow strict regulatory requirements, and that herbicides will be applied as part of an integrated vegetation management plan, which at full implementation aims to limit herbicide application to intervals of 15 years or more. Therefore, the application of such herbicides is not expected to result in concentrations in traditionally harvested such that the consumption of these foods would result in exposures that would exceed allowable daily intakes. Therefore, a measureable increase in human health risk associated with country food quality is not anticipated.

Change in ambient noise levels during construction, operation and maintenance is not anticipated to exceed typical ambient noise levels, with the exception of noise generated by construction activities (*e.g.*, implosions), which are temporary and of relatively short duration. Therefore, effects on human health risk are not anticipated.

Electric and magnetic fields originating from the transmission lines will be of low magnitude and are calculated to meet the regulatory requirements governing EMF limits for transmission lines. In addition, more than 30 years of extensive scientific evidence indicates that ELF EMF from transmission lines do not pose a risk to human health (Exponent 2015a). Perceived health risks are addressed in Chapter 19.

18.7.2 Significance of Cumulative Environmental Effects

With the application of mitigation measures, the residual cumulative effects of the Project on human health risk, associated with air quality, country food quality, noise, and EMF, are predicted to be not significant.

18.7.3 Project Contribution to Cumulative Environmental Effects

The Project's contribution to cumulative change in air quality and noise would only occur where Project-related activities occur in close proximity to similar concurrent activities on other projects. Should these events occur, they would be of short-duration, negligible in magnitude and would be reversible when concurrent activities ceased. The Project will not contribute to cumulative change in country foods quality. Therefore, the Project's overall contribution to cumulative environmental effects is negligible in magnitude.

18.7.4 Sensitivity of Prediction to Future Climate Change

According to the climate change scenarios presented in the Manitoba – Minnesota Transmission Project Historic and Future Climate Study growing season (May to September) temperature and precipitation are projected to increase into the future. Monthly mean temperatures for the growing season are projected to increase by 1.3°C, 2.5°C, and 3.5°C in the 2020s, 2050s and 2080s, respectively. Total growing season precipitation amounts are projected to increase by 2.5%, 1.5%, and 2.8% in the 2020s, 2050s and 2080s, respectively. However, precipitation amounts are projected to be lower in the month of July based on the 2050s and 2080s scenarios, and lower in the month of August based on all three scenarios.

Projected changes in the growing season may result in a change in species composition of the vegetation along the Final Preferred Route, potentially affecting vegetation management activities, including the use of herbicides. However, as previously discussed, herbicide use is not anticipated to affect human health risk. Projected climate change scenarios for the Project are not anticipated to have an effect on air quality, noise, EMF, or country foods that would lead to a change in human health risk; therefore, significance determinations for human health risk would not change.

18.8 Prediction Confidence

Prediction confidence is based on the information compiled during desktop-based data compilation and an understanding of Project activities, location and schedule. There is a high degree of confidence in the assessment predictions. While some of the available desktop data are limited (*e.g.*, information of country food use patterns within the LAA), the environmental effects mechanisms are well understood. Furthermore, there is a high degree of prediction confidence based on Manitoba Hydro's experience and demonstrated due-diligence on transmission projects in agricultural and urban areas.

18.9 Follow-up and Monitoring

There is no follow-up monitoring required specific to the assessment of potential human health risk. In terms of health concerns related to EMF, Manitoba Hydro will continue to monitor studies and make information available to the public.

18.10 Summary

Human health risk is a VC because there is a potential for the Project to change the environmental conditions that influence the health risk of people along transmission line.

A number of key issues and concerns were identified during the Project Public Engagement Process and First Nations and Metis Engagement Process and were carried forward in this assessment. These include concerns related to changes in air quality, country food quality, noise, and EMF; concerns that have also been identified as key issues for human health in previous transmission line projects.

Residual environmental effects of the Project on human health risk, associated with air quality, country food quality, noise, and EMF, are predicted to be not significant. Similarly, residual cumulative environmental effects on human health risk are predicted to be not significant. The Project will contribute to change in air quality, noise, and EMF; however, contributions are anticipated to be of negligible magnitude.

18.11 References

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18.11.2 Personal Communication

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Manitoba-Minnesota Transmission Project

Project Infrastructure

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

Infrastructure

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

Assessment Area

- Human Health Risk Assessment Area
- Human Health Risk Assessment Area

Landbase

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

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: July 22, 2015

N

0 10 Kilometres
0 5 10 Miles

1:600,000

Human Health Risk Assessment Area

Map 18-1

Glenboro South Station

1:650,000

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