J ELECTROMAGNETIC INTERFERENCE STUDY

WISOKOLAMSON ENERGY LP

ELECTROMAGNETIC INTERFERENCE STUDY

WISOKOLAMSON ENERGY PROJECT

ELECTROMAGNETIC INTERFERENCE STUDY

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SIGNATURES

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1 EXECUTIVE SUMMARY

The Wisokolamson Energy Project is located approximately 12 kilometres southwest of the town of Riverside-Albert, New Brunswick. The goal of this EMI study is to provide information on possible electromagnetic frequency interference that may be caused by the installation of wind turbines at the wind farm. The scope of the EMI analysis was to investigate radio frequencies registered within a study area extending 120 kilometres (km) from the project's center and identify consultation zones in accordance with the Radio Advisory Board of Canada (RABC) and the Canadian Wind Energy Association (CanWEA) guidelines[1]. Location information and frequency details were obtained from the Spectrum Management System Data[2] (SMS Data) that is administered by Industry Canada.

A total of 3,307 licenses were found in the SMS data with stations located inside a search area extending 120 km outwards from the center of the project lands[3]. Of these licenses, 1 licenses at 1 distinct location[4], was found to have consultation zones that intersect with a turbine location lands. These are the stations that this report focuses on and are summarized in Table 1, below.

The licensees of all possibly conflicting communication systems and broadcasters should be notified to assess interferences and mitigate concerns if required. As the coordinates for the stations in the SMS Data may be inaccurate by several hundred meters all relevant tower locations should be verified by high resolution air photos where possible or a site visit.

Television reception from local broadcasters may be affected by the wind farm. The RABC/CanWEA guidelines recommend that all residences within a TV service area and within 15 km of a wind turbine (for an analog service area) or 10 km (for a digital TV service area) be notified of this potential interference. All residents within the broadcasting consultation zone should be considered stakeholders and included in a public consultation. A method to record complaints from broadcasting receptors and a plan for mitigating problems should be established. Depending on the concerns of stakeholders, an impact study might include a field validation of reception before and after turbine installation. In the case of diminished reception due to turbine installation, the most cost-effective mitigation techniques for broadcasting reception include relocation of reception towers, purchase of a taller reception tower/antenna structures for TV/radio, or the purchase of cable/satellite TV/radio for affected receptors. Finally, mitigation methods can be applied in both

[1] Radio Advisory Board of Canada (RABC) and Canadian Wind Energy Association (CanWEA). Technical Information and Coordination Process Between Wind Turbines and Radio communication and Radar Systems. March 4, 2010.
[2] Industry Canada Spectrum Management System, https://sms-sgs.ic.gc.ca/eic/site/sms-sgs-prod.nsf/eng/home
[3] A 8 km square area was assumed for the project lands as the exact project lands were not provided.
[4] End-points for microwave links that cross project lands have been included in this count.

the planning stages of the wind power facility and after the installation of the wind turbines.

The Industry Canada SMS Data does not list non-disclosed (protected) frequency assignments for public safety systems. These include the Federal DND, RCMP, Environment Canada, NAV CANADA, Canadian Coast Guard, provincial and municipal police services, fire departments, and ambulance services. These entities, and Industry Canada, should be notified to address any potential radiocommunication interference issues.

Table 1: Summary of Priority EMI Consultation Zones

System	Comments
Microwave Links	No line-of-sight microwave links pass through the project lands. One non-line-of-sight microwave link (frequency below 890 MHz) passes through the project lands[5].
Base Stations and Land Mobile Systems	There are no licensees operating fixed or base stations that have consultation zones that intersect project lands or have end points for point-to-point links that pass through the project lands. None of the proposed turbine locations[6] are within the consultation zones of the base station and land mobile systems.
Satellite System	The project lands do not intersect with the consultation zone of any meteorological satellite earth station. Licensees should be notified and interference concerns mitigated.
Broadcasting Stations	No TV, FM, or AM broadcasting stations were found near the project lands.
Broadcast TV Reception	The project lands are within a broadcasting reception zones. Receptors (home owners) in an around the project lands should be notified of potential interference.
RCMP	The RCMP has been contacted by Wisokolamson Energy LP to determine if there are any interference concerns.
Environment Canada Radar	The project lands do not intersect with the consultation zone of any Environment Canada weather radar station.
Civilian Radar and Navigation (NAV CANADA)	The project lands intersect with the consultation zones of one radar system and one radionav station of NAV CANADA. Wisokolamson Energy LP has contacted NAV CANADA and no interference concerns have been identified.
Civilian Aerodromes	The project lands do not intersect with the consultation zones of any aerodromes.
Military (DND) Radar, Radiocommunications and Aerodromes	DND has been consulted (as part of NAV CANADA's review of the project) and have no interference concerns.

[5] The RABC/CanWEA guidelines do not include a recommendation to consult with the licensees of low frequency links (<890 MHz) radiocommunications as wind turbines generally do not cause interference with these links. They are; however, included in the report to document their existence.
[6] WSP, Wartenbe_TurbinePositions_Opt1_20171213_V4.shp

System	Comments
Canadian Coast Guard	The Canadian Coast Guard should be contacted directly to address any interference concerns.

WSP does not anticipate significant interference with any communication systems.

2 INTRODUCTION

Wind turbines are large enough to potentially interfere with radio waves emitted from telecommunication, navigation, and radar systems. In response to the potential for interference, the Radio Advisory Board of Canada (RABC) and the Canadian Wind Energy Association (CanWEA) has issued a set of guidelines which describe the methodology for assessing electromagnetic interference caused by wind turbines[7]. This guideline specifies areas, or consultation zones, surrounding communication transmission systems based on system type and function. If a potential turbine location is within a consultation zone, the owner of the radio communication system should be contacted to assess how the potential interference will impact both parties.

The location of radiocommunication stations was determined from a search of the data from the *Spectrum Management System*[8] (SMS Data) which is administered by Industry Canada. Appropriate consultation zones were assigned to the stations, as per the RABC/CanWEA guidelines, and an analysis was performed to identify the potentially impacted stations. Licensee information for stations of interest was retrieved from the SMS Data.

The procedure to complete an Electromagnetic Interference Study can be found in the *Recommended Process* section of the RABC/CanWEA guideline and is listed below.

1. The wind project proponent develops a map showing the location of the proposed wind farm. The proponent obtains and provides preliminary information for the proposed project, including project area, representative turbine characteristics and proposed number of wind turbines.
2. The proponent sends notices of consultation with the proposed wind farm location and preliminary project information to all mandatory contacts operating non-disclosed systems.
3. The proponent determines whether any of the consultation zones for disclosed systems overlaps/intersects the proposed project area as described by these Guidelines (the RABC/CanWEA guidelines).
4. In the event that the guidelines or mandatory consultation contacts indicate that a given installation is located within a consultation zone, the proponent contacts the applicable authority/owner of the disclosed or non-disclosed systems to determine if, in fact, further investigation is warranted.
5. The proponent and applicable authority/owner of the disclosed or non-disclosed systems undertake the necessary studies and identify mitigation measures to resolve the issue to the satisfaction of both parties. The wind

[7] Radio Advisory Board of Canada (RABC) and Canadian Wind Energy Association (CanWEA). Technical Information and Coordination Process Between Wind Turbines and Radio communication and Radar Systems. March 4, 2010.
[8] Industry Canada Spectrum Management System, https://sms-sgs.ic.gc.ca/eic/site/sms-sgs-prod.nsf/eng/home

project proponent develops a map showing the location of the proposed wind farm and all the wind turbines within.

This report provides general information regarding the different types of radio communications, possible mechanisms of interference and identifies sources of potential radio communication conflict. Maps have been created which show all disclosed radiocommunication station locations and areas of potential interference between the proposed wind facility and radio signals. This includes microwave communication links that may be impacted by the potential wind facility. The radiocommunication licensees must be contacted to determine whether further interference investigation is required, particularly in cases where proposed turbine locations fall within a consultation zone. Communication tower locations, specifications, and consultation zones have been presented in this report, as well as licensee contact information for each required consultation zone based on registered frequencies.

This analysis identifies consultation zones which should be incorporated into layout design. The reader is cautioned that the coordinates listed in the SMS Data can be inaccurate by up to 200m; therefore, the locations of all on-site communication towers should be verified with a GPS and adjusted for each registered frequency. The SMS Data may also contain obsolete and prospective registered communication frequencies, so all potential conflicts should be verified.

3 BACKGROUND

The electromagnetic interference created by a wind turbine can be classified in two broad categories. The first type of interference, known as obstruction, occurs when a wind turbine is placed between a receiver and a transmitter, creating a shadowed area where the signal is weakened or blocked. The second type of interference, known as reflection, is caused by the distortion between the raw signal and a reflection of the signal from an object. Interaction between the de-synchronised counterparts can degrade the signal. Scatter is a sub-category of reflection caused by the rotor blade movement. An example of scatter occurs when a wind turbine is identified as a moving object by radar systems due to the Doppler shift from the reflection of the moving rotor blades. Additionally, the orientation of the turbine nacelle changes with wind direction and the blades pitch according to wind speed, which may cause complex interference patterns.

The specific characteristics of a wind turbine will influence the type and magnitude of the interference. Other factors that influence interference include blade dimension and design, tower height, diameter of the supporting tower, as well as the material used for blade and tower construction. Furthermore, wind turbines affect different types of signals in various ways as some telecommunication signals are more susceptible to interference than others. AM radio, for example, is affected more by the presence of wind turbines than is FM radio[9]. The guideline establishes a list of systems that should be investigated early in the wind farm development process including, but not limited to, the following:

— Point-to-Point Systems (Microwave Hops, STLs, TTLs)
— Point-to-Multipoint Systems
— Over-the-Air Reception (Master Antenna TV (MATV), Cable TV (CATV) Head Ends, MMDS Systems, VHF TV, UHF TV, DTV)
— Cellular Type Networks
— Satellite Systems (DTH, Satellite Ground Stations)
— Land Mobile Networks
— Air Defence Radars, Vessel Traffic Radars and Air Traffic Control Radars
— Weather Radars

[9] Guidelines for a Technical Engineering Report on the Environmental Impacts of Wind Turbines on Radiocommunication Services, CBC, 1400 Rene-Levesque Blvd. East, Montreal, Quebec H2L 2M2.

4 SUMMARY OF REGISTERED FREQUENCIES

The SMS data contained 3,307 license records at 3,866 distinct station-locations[10] for radiocommunication stations contained in the study area (an area extending out 120 kilometres from the project's center). Table 2 summarizes the number of station locations with consultation zones that intersect the project lands. Broadcast receptor conflicts is addressed in Section 6.4.

WSP has provided an interpretation of the Potential for Interference for the purpose of ranking the severity of the potential impact of turbine placement within any required consultation zone of each ITU class. According to the RABC/CanWEA guidelines, all communications with potential for interference should be consulted by contacting the licensee of the communication source.

[10] Unique call-sign and location combinations.

Table 2: Summary of Licensees near Project Lands

ITU Class[11]	No. of Licensee Stations in Search Area	No. of Licensee Stations Requiring Consultations	Station Type	Frequency Category	Potential for Interference [12]	Consultation Zone
AL	20	1	Aeronautical radio navigation land station		Low	1000m; up to 15 km (VOR)
AX	0	0	Aeronautical fixed station		N/A	
BC	4	0	Broadcasting station, sound	AM - TX < 3 MHz	N/A	5 km; up to 15 km
BC	56	0	Broadcasting station, sound	FM - TX > 80 MHz	N/A	2000 m
BT	8	0	Broadcasting station, television	Television	N/A	
EX	0	0	Experimental		N/A	
FA	33	0	Aeronautical station		N/A	1000 m
FB	201	0	Base station	Other - TX < 890 MHz	N/A	1000 m
FB	44	0	Base station	Cellular/Paging - TX > 890 MHz	N/A	1000 m
FC	27	0	Coast station		N/A	
FL	0	0	Land station		N/A	
FX	1,239	0	Fixed station	Land mobile network or low capacity station < 890 MHz	N/A[13]	1000 m
FX	583	0	Fixed station	Microwave TX > 890 MHz	N/A	1000 m + link
LR	13	0	Radiolocation land station		N/A	
ML	1,616	0	Land mobile station		N/A	
MO	0	0	Mobile station		N/A	
MS	5	0	Ship station		N/A	
NL	1	0	Maritime radio navigation land station		N/A	
RC	0	0	Non-directional radio beacon		N/A	
SM	0	0	Meteorological aids station	Radar	N/A	
TC	11	0	Earth station in the fixed satellite service	Satellite	N/A	
TE	0	0	Earth station in the satellite service– search and rescue	Satellite	N/A	
TM	3	0	Earth station in the meteorological-satellite service	Satellite	N/A	500 m + link

[11] Industry Canada. ITU Class of Station Decoded Fields, Spectrum Direct. https://spectrumdirect.ic.gc.ca/engdoc/decode/itu_cls.txt
[12] WSP has provided an interpretation of the Potential for Interference for the purpose of ranking the severity of the potential impact of turbine placement within any required consultation zone of each ITU class. According to the RABC/CanWEA guidelines, all communications with potential for interference should be consulted by contacting the licensee of the communication source.
[13] The RABC/CanWEA guidelines do not include a recommendation to consult with the licensees of low frequency links (<890 MHz) radiocommunications as wind turbines generally do not cause interference with these links.

5 NETWORKS

5.1 FIXED LINK SYSTEMS

Fixed link systems can be classified as either point-to-point or point-to-multipoint. Point-to-point telecommunication systems are used to transfer data from one location to another. High capacity microwave systems use radio signals in the range of 890 MHz to 40 GHz to transmit data between two specific nodes in the communication network. These systems are line-of-sight and objects within the 3 times the maximum first Fresnel zone clearance may result in interference. Low capacity links use frequencies below 890 MHz and do not depend on a clear line-of-sight for signal propagation. Point-to-point systems may function to transport a television or radio signal prior to broadcast, telephone, or other high-volume data transfer. Television and radio networks use point-to-point systems (Studio-to-Transmitter link (STL) or Transmitter-to-Transmitter link (TTL)) to send their signals over long distances prior to broadcast. Telephone and cellular phone networks also use point-to-point systems as the signal can be delivered over large distances with minimal reception loss.

Point-to-multipoint telecommunications refer to systems that provide multiple paths from a single location to multiple locations. Point-to-multipoint systems are typically used to offer cable TV (MMDS) and internet access to multiple users in sparsely populated areas, as well as data transfer from multiple sites such as oilfield or irrigation SCADA systems. This system can be treated as multiple point-to-point systems.

The rotating blades of wind turbines near point-to-point beam paths can either obstruct or cause a pulsed scatter of the signal. The result of either type of interference is signal degradation or signal interruption.

A wind power developer can avoid interference with microwave point-to-point systems by placing turbines outside of corridors linking the transmitter and receiver. The RABC/CanWEA guideline recommendations for point-to-point systems distinguish between two types of consultation zones:

1. To avoid problems due to close proximity of the tower, a 1 km consultation zone should be applied around all towers (microwave and low capacity links) and stations (receiver or transmitter).
2. In order to avoid obstructing or scattering microwave links, line of sight consultation zones are calculated between the transmitter and the receiver for all systems above 890 MHz. This is represented by a cylinder with a width based upon three times the first Fresnel zone. The width of the Fresnel zone is proportional to the signal frequency and total link length as described in the RABC/CanWEA guidelines and is designed to avoid interference with the radio reception. A turbine blade diameter of 126 m was used to calculate the link path consultation zone.

The RABC/CanWEA guidelines do not include a recommendation to consult with the licensees of low frequency links (<890 MHz) radiocommunications as wind turbines generally do not cause interference with these links. They are; however, included in the report to document their existence.

A map of the microwave links passing through the project lands and their associated consultation zones is shown in *Appendix B: Wisokolamson Energy Project Site Maps*

5.2 BASE STATIONS: LAND MOBILE NETWORKS AND CELLULAR TYPE NETWORKS

Land Mobile Networks and other Base Stations are used by police services, fire departments, farmers, emergency services, military and other private companies to communicate with moving units or mobile users located in an area. Cellular type networks refer to mobile telephone systems that use frequency or phase modulation similar to FM radio between 800 and 1900 MHz.

The RABC/CanWEA guidelines recommend a 1 km consultation zone around such transmission sources. This is a conservative guideline for consultation and turbines will often be able to operate much closer to these stations.

Land mobile networks operated by police services and military are not listed in the spectrum data. The RCMP and DND should be contacted directly to determine if any radiocommunication interference concerns exist.

5.3 SATELLITE SYSTEMS

Satellite systems can be found in three basic forms: large commercial satellite systems used for data transfer between ground stations and orbiting repeater stations; satellite systems used for space exploration; and ground receptor satellite dishes used for private television reception or Internet. The RABC/CanWEA guidelines describe the method for calculating a satellite system consultation zone using the transmitting frequency, antenna height, and the satellite's orientation. One satellite base station was found with a consultation zone that intersects project lands.

Direct-to-Home (DTH) satellite broadcasting uses geostationary satellites to provide radio and television service. Users of such services are not listed in the spectrum data. However, existing regulations for setbacks from homes (for issues such as sound levels) should ensure adequate distances between DTH users and wind turbine locations.

6 BROADCASTING

Broadcasting signals are used to deliver television and radio service to the general population. These signals are typically transmitted over a general area reaching up to 80 km. This category of radio transmission can be split into three basic groups: AM (Amplitude Modulation) radio, FM (Frequency Modulation) radio, and television (analog and digital).

Multichannel Multipoint Distribution Services (MMDS), operating at microwave frequencies, are also used for radio and television broadcasting, internet, and IP telephone service. Any stations of this type will be assigned a consultation zone similar to a television broadcasting station

6.1 AM SIGNALS

The mechanism behind AM data transfer is modulation of the amplitude of a set frequency. This type of broadcasting system has relatively low capacity for data content. AM signals used for radio broadcasting typically operate in the frequency range of 0.525 MHz to 1.705 MHz[14]. Tall structures made of electrically conductive materials, such as wind turbines, can modify the radiation patterns of AM stations and may cause reception problems and interference with other stations.

6.2 FM SIGNALS

FM signals are typically used for audio broadcasting and operate in the frequency range of 87.5 to 108 MHz[15]. This technology incorporates frequency modulation of a signal to broad areas of reception. FM radio is less susceptible to interference than AM radio.

6.3 TELEVISION

Analogue and digital television signals are located in several bands of frequencies including the range of 54-72 MHz for channels 2-4, 76-88 MHz for channels 5-6, 174-216 MHz for channels 7-13, 470-608 MHz for channels 14-36 and 614-698 MHz for channels 38 51[16]. Examples of interference in television reception could include picture shadow caused by reflection from an obstacle, or picture flicker caused by the rotating blades of a turbine.

[14] < https://en.wikipedia.org/wiki/Broadcast_band >, Wikipedia, The Free Encyclopedia, Accessed December 2017.
[15] < https://en.wikipedia.org/wiki/Broadcast_band >, Wikipedia, The Free Encyclopedia, Accessed December 2017.
[16] <http://en.wikipedia.org/wiki/North_American_broadcast_television_frequencies>, Wikipedia, The Free Encyclopedia, Accessed December 2017.

6.4 MITIGATION FOR BROADCASTING STATIONS

According to the Canadian Broadcasting Corporation guidelines[17], a 2 km buffer is recommended around all television stations, a 2 km buffer for FM radio broadcasting transmitters, a 5 km buffer for omnidirectional AM radio broadcasting transmitters, and 15 km around directional AM radio broadcasting transmitters.

Based on the RABC/CanWEA guidelines, a public consultation should be organised for all broadcasting receptors in the vicinity of the wind power project. The consultation zone for broadcasting receptors is based upon a 10 km buffer around each turbine for digital TV and 15 km for analog TV.

The service areas[18] of TV broadcasters are retrieved as part of this analysis. The TV broadcast service areas and consultation zones are shown in *Appendix B: Wisokolamson Energy Project Site Maps*. Broadcaster information is provided in *Appendix A: Industry Canada Spectrum Management System Data*. A 10 km consultation buffer was applied to the proposed location of each turbine since all stations are broadcasting a digital signal.

Residents with a potential for interference should be notified about the potential reception interference risk in a public stakeholder meeting. This notification should provide details for a process of recording complaints of reception interference. In the case of a complaint, a third party communications engineer can be contracted to determine the protected service contour for each station, and measure the broadcasting signal to confirm affected dwellings. Mitigation methods might include the purchase of a taller reception tower for the affected residents, or providing a subscription for cable or satellite TV.

[17] Guidelines for a Technical Engineering Report on the Environmental Impacts of Wind Turbines on Radiocommunication Services, CBC, 1400 Rene-Levesque Blvd. East, Montreal, Quebec H2L 2M2.
[18] Industry Canada. Broadcast Contours. https://sms-sgs.ic.gc.ca/eic/site/sms-sgs-prod.nsf/eng/h_00015.html

7 RADAR

The potential impacts of wind turbines on radar (radio detection and ranging) systems are difficult to assess and usually require a case-by-case analysis. Interference is heavily dependent on topography, land cover, existing obstacles and other terrain features. The RABC/CanWEA guidelines[1] have established large consultation areas around radar facilities. Improper placement of turbines may render a radar station inoperable or severely compromised. In order to avoid such situations, a proper investigation must be performed in the planning process of a wind energy project. Under certain circumstances, even if a project is within the consultation zone of a radar station, it is possible for the interference effects to be mitigated.

Most radar systems operate within the 1 GHz to 10 GHz frequency band[19]. These systems are used mainly for aeronautical and maritime navigation, as well as for meteorological forecasting. Radar systems involve the transmission of radio waves in a sweeping or burst pattern and an antenna that collects waves reflected (scattered) by objects in the vicinity. By filtering the scattered electromagnetic waves, the radar operator is capable of identifying the range and size of fixed objects and the direction, altitude, size, range, and speed of moving objects. Conductive objects are more likely to reflect the electromagnetic waves.

Although most radar systems are capable of filtering unwanted echoes (clutter) from fixed obstacles, the rotating blades of wind turbines can generate dynamic interference which is difficult to filter. The problem is amplified because the turbine nacelle may rotate 360° based upon wind direction at hard to predict intervals.

The following section discusses three types of radar systems identified by the RABC/CanWEA guidelines which may have potential conflict with wind turbines.

7.1 WEATHER RADARS

Environment Canada (EC) operates the Canadian Weather Radar Network, which consists of 31 Doppler radar stations installed throughout the country. These radars are used for the purpose of meteorological forecasting, and also serve as a public safety tool by detecting severe weather events in advance. Environment Canada uses weather radar stations in order to locate and identify types of precipitation and forecast changes in position and intensity of meteorological activity. In addition, weather radar services such as hail monitoring programs are provided by private companies throughout Canada.

[19] Canadian Table of Frequency Allocations 9 kHz to 275 GHz (2005 Edition), Spectrum Management and Telecommunications, Industry Canada. Last amended February 2007

Turbines may cause interference by either obstruction or by creating Doppler shift of the signal via reflection from their rotating blades. In addition, wake induced turbulence may be detected by these radar systems.

Weather radars use various techniques that differ from aeronautical radar systems. They typically are located in regions with a clear line-of-sight far into the horizon. Weather radar systems are often located on high topographical features, allowing far-reaching radar detection at low altitudes (negative depression angle). In contrast, aeronautical radar stations are typically focused towards flying objects above the horizon. The target detection zone of weather radar systems results in a particular sensitivity to wind power projects, especially if there is clear line of sight between the radar and the turbines.

The RABC/CanWEA guidelines have recommended that a 50 kilometre radius consultation zone be applied around weather radar systems. Environment Canada has provided positions of their weather radars. Table 3 shows the location and the name of the closest weather radar to the wind power project, as well as the approximate distance that separates it from the study area.

Table 3: Environment Canada Radar Stations near the Project

Radar ID	Latitude	Longitude	Distance to Project (km)
Chipman, NB (XNC)	46.2221	-65.6994	84

7.2 AIR TRAFFIC CONTROL RADARS AND CIVILIAN AIRFIELDS

Most air traffic control radars are located in the vicinity of major airports. In addition, they can be located along major aerial traffic routes distant from populated regions. Air traffic control radars can be affected by the presence of wind turbines obstructing their line of sight. Although they typically sweep high altitude areas, large obstacles such as wind turbines may be difficult to differentiate from a flying object, especially if they are placed on ridges or in clusters. In addition, the signal from a plane may be lost when passing behind a cluster of wind turbines. A commercial wind turbine is equipped with blades that are comparable in length with a medium range airliner (a Boeing 737-400 is 36.4 m long).

NAV CANADA, a private company that provides civil air navigation services for Canada, operates all of the civilian air traffic control radars. The RABC/CanWEA guidelines have recommended that an 80 km radius consultation zone be applied around NAV CANADA Primary Surveillance Radars (PSR) and a 10 km consultation zone around Secondary Surveillance Radars (SSR). The RABC/CanWEA guidelines have also recommended that a minimal 10 km radius consultation zone be applied around any major civilian airfield to avoid the possibility of a collision between

planes and wind turbines. A consultation zone of 15 km should be applied to all VOR beacons. There are no major civilian airfields within 10 km of the Wisokolamson Energy Project.

NAV CANADA has supplied WSP with the location of all of their radar stations in Canada. The project lands are within the consultation zone of the Caledonia Mountain NAV CANADA radar station. Wisokolamson Energy LP has contacted NAV CANADA and no interference concerns have been identified.

NAV CANADA also maintains a database of all Canadian Aerodromes and Water Aerodromes. This database can be accessed using the Canadian Flight Supplement or Canadian Water Aerodrome Supplement. Based on the information contained in these documents, there are no Aerodromes with a consultation zone that intersects project lands.

7.3 MILITARY RADARS AND AIRPORTS

The Department of National Defence operates Air Defence Radars which provide the capability for the detection of foreign aircraft. This network is comprised of radars located throughout the country. This radar network represents a portion of Canada's contribution to NORAD and is considered more sensitive than civilian airfield infrastructure. The RABC/CanWEA guidelines have recommended that a 100 km radius consultation zone be applied around DND Air Defence Radars, 80 km around Primary Surveillance Radars (PSR) and 40 km for DND Precision Approach Radars (PAR). The RABC/CanWEA guidelines have also recommended that a minimal 10 km radius consultation zone be applied around any major military airfield.

DND has been notified of the Wisokolamson Energy Project as part of the NAV CANADA consultation conducted by Wisokolamson Energy LP and no interference concerns have been identified.

8 CONCLUSION

The results of the investigation into potential electromagnetic interferences at the Wisokolamson Energy Project have been compiled and presented in Table 2. There are no high capacity microwave links passing through the project areas studied in this report. The project lands are within the consultation zone of the Caledonia Mountain NAV CANADA radar station.

The consultation zones indicated on the maps found in *Appendix B: Wisokolamson Energy Project Site Maps* should be investigated during the turbine layout design. Licensee contact information can be cross referenced between the maps in *Appendix B: Wisokolamson Energy Project Site Maps* and tables in *Appendix A: Industry Canada Spectrum Management System Data*.

Wisokolamson Energy LP has been in contact with NAV CANADA, DND, Environment Canada, the RCMP, and the Canadian Coast Guard regarding the Wisokolamson Energy Project. No interference concerns have been raised.

Television reception from local broadcasters may be affected by the wind farm. The RABC/CanWEA guidelines recommend that all residents within the broadcasting consultation zone should be considered stakeholders and included in a public consultation. A method to record complaints from broadcasting receptors and a plan for mitigating problems should be established. Depending on the concerns of stakeholders, an impact study might include a field validation of reception before and after turbine installation. In the case of diminished reception due to turbine installation, the most cost-effective mitigation techniques for broadcasting reception include relocation of reception towers, purchase of a taller reception tower/antenna structures for TV/radio, or the purchase of cable/satellite TV/radio for affected receptors. Finally, mitigation methods can be applied in both the planning stages of wind power facility and after the installation of the wind turbines.

APPENDIX

A INDUSTRY CANADA SPECTRUM MANAGEMENT SYSTEM DATA

Table 4: Low Capacity Microwave Fixed Links with Consultation Zones Passing Through Project Lands

Origin Station Call Sign	Origin Station Location NAD 83 Zone 10N		Frequency (GHz)	Licensee	Address	License #	Link Station Call Sign	Link Station Location NAD 83 Zone 10N	
	Easting	Northing						Easting	Northing
VEF607	344501	5050675	0.466	VILLAGE OF ALMA	8 SCHOOL STREET,ALMA,NB,E4H 1L2	010412119-001	VEF605	364115	5074301
VEF605	364115	5074301	0.461	VILLAGE OF ALMA	8 SCHOOL STREET,ALMA,NB,E4H 1L2	010412119-001	VEF607	344501	5050675

Table 5: Licensees of Fixed and Base Stations with Consultation Zones Intersecting Project Lands[20]

Licensee	Address	NAD 83 Zone 10N		Licensee	Call Sign	TX (MHz)	RX (MHz)
		Easting	Northing				
NAV CANADA CNS ENGINEERING	1601 TOM ROBERTS, PO BOX 9824 STN T, OTTAWA, ON, K1G 6R2	360884	5079499	010651893-001	XLI738	1336 1335 132.5 1311 1310	1336 1335 132.5 1311 1310

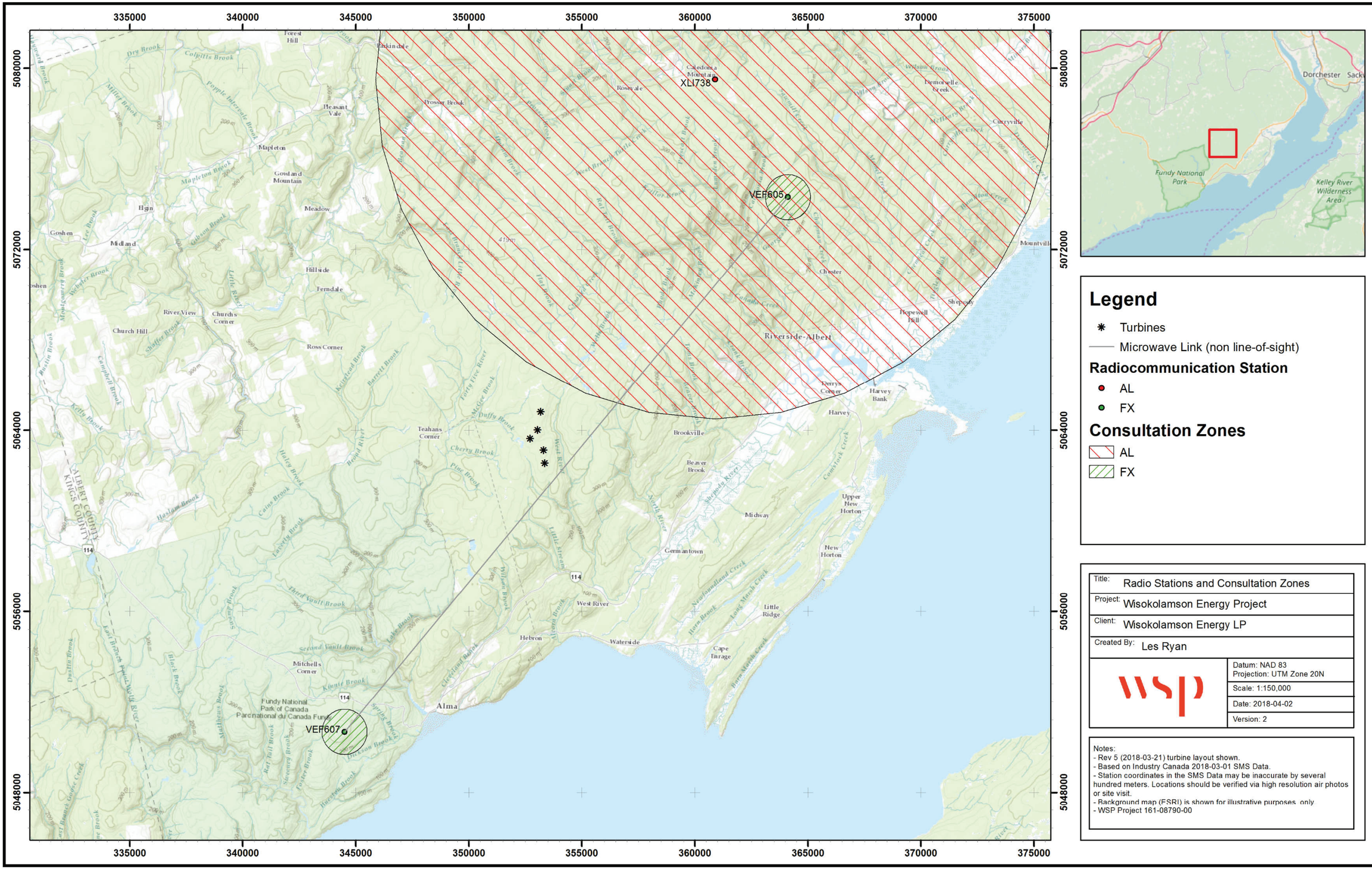
[20] May also include the end-points of high capacity (greater than 890 MHz) point-to-point links that intersect with the project lands.

Table 6: TV Broadcasters with Reception Areas in the Vicinity of Project Lands

Call Sign	NAD 83 Zone 10N		Type	Station Location	Licensee	Address
	Easting	Northing				
CKCW-DT	359281	5079195	Digital	Moncton	Bell Media Inc.	299 Queen Street West,Toronto,ON,M5V2Z5
CIHF-DT-3	364115	5074332	Digital	Moncton	Corus Television Limited Partnership	25 Dockside Drive,Toronto,ON,M5A 0B5
CIHF-DT-5	393265	4988750	Digital	Wolfville	Corus Television Limited Partnership	25 Dockside Drive,Toronto,ON,M5A 0B5
CBAFT-DT	353090	5111794	Digital	Moncton	CBC/ Radio-Canada	1400, boul René-Lévesque E,Montréal,QC,H2L 2M2

APPENDIX

B WISOKOLAMSON ENERGY PROJECT SITE MAPS



335000 340000 345000 350000 355000 360000

5080000

5072000

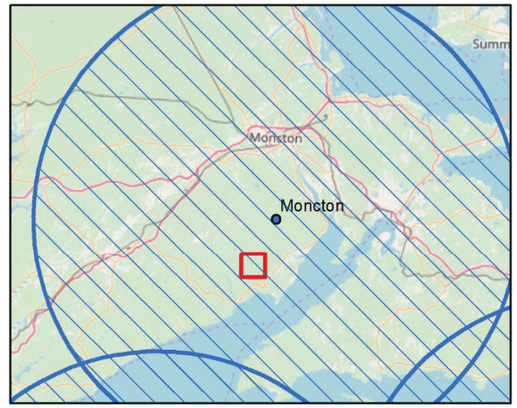
5064000

NAV CANADA CNS ENGINEERING: Call Sign XLI738 (1335 MHz)

NAV CANADA CNS ENGINEERING: Call Sign XLI738 (1311 MHz)

NAV CANADA CNS ENGINEERING: Call Sign XLI738 (1090 MHz)

NAV CANADA CNS ENGINEERING: Call Sign XLI738 (132.5 MHz)

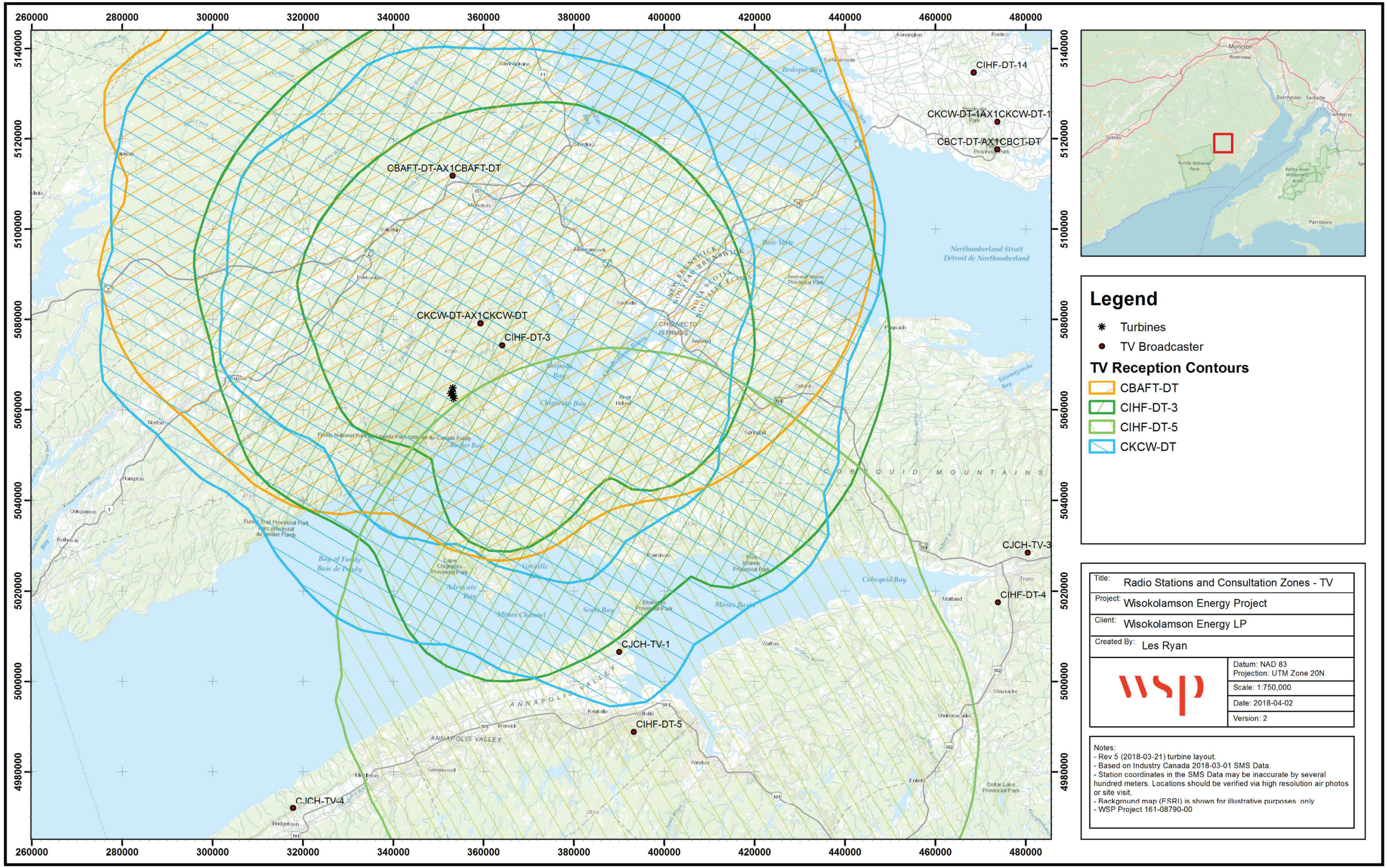


Legend

- Turbines
- Aeronautical Radionav Land Station
- NAV CANADA Radar Buffer
- Aeronautical Radionav Consultation Zone

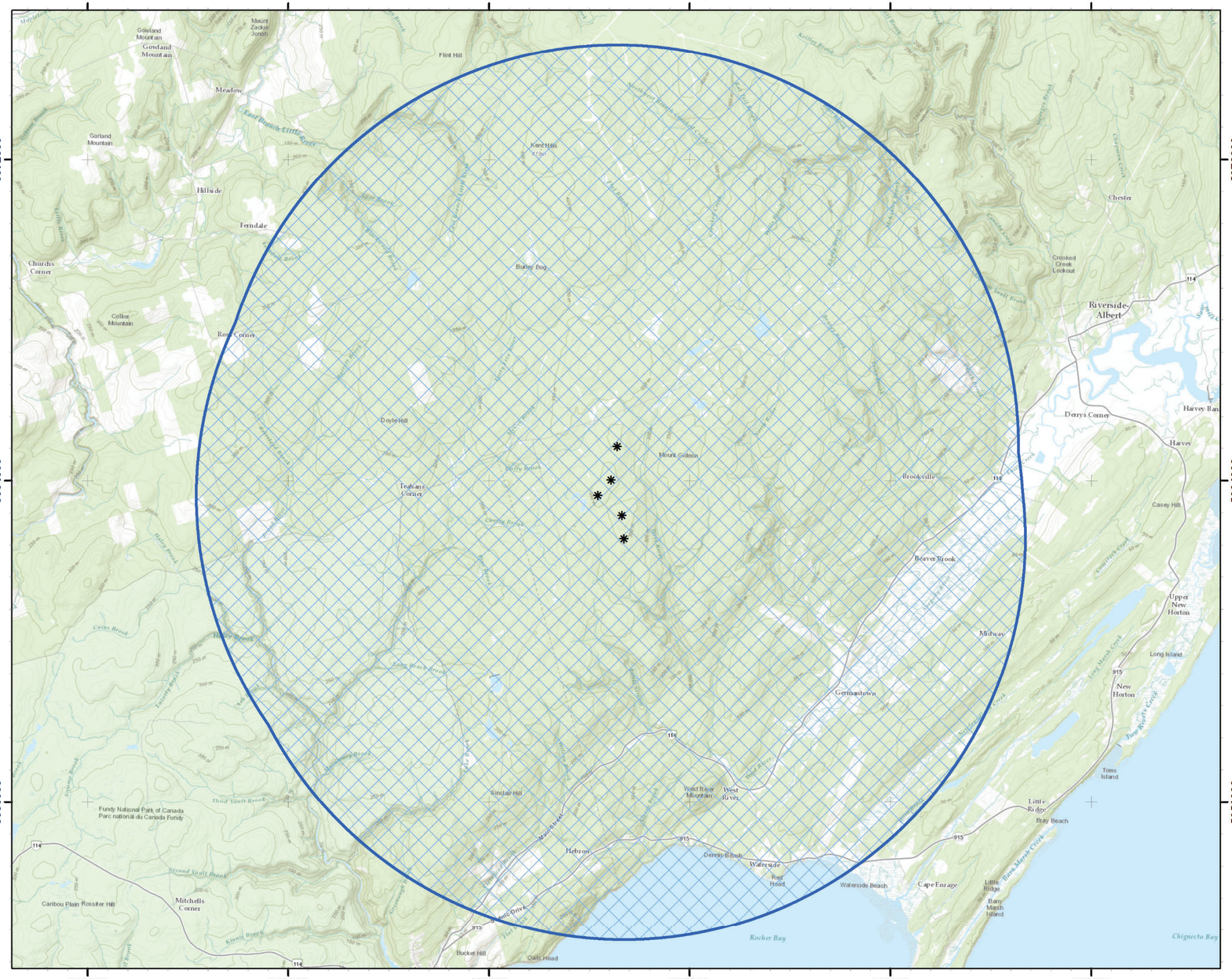
Title:	Radio Stations and Consultation Zones - Nav
Project:	Wisokolamson Energy Project
Client:	Wisokolamson Energy LP
Created By:	Les Ryan
	Datum: NAD 83 Projection: UTM Zone 20N
	Scale: 1:100,000
	Date: 2018-04-02
	Version: 2

Notes:
- Rev 5 (2018-03-21) turbine layout.
- Based on Industry Canada 2018-03-01 SMS Data.
- Station coordinates in the SMS Data may be inaccurate by several hundred meters. Locations should be verified via high resolution air photos or site visit.
- Background map (ESRI) is shown for illustrative purposes only.
- WSP Project 161-08790-00



Title:	Radio Stations and Consultation Zones - TV
Project:	Wisokolamson Energy Project
Client:	Wisokolamson Energy LP
Created By:	Les Ryan
	Datum: NAD 83 Projection: UTM Zone 20N
	Scale: 1:750,000
	Date: 2018-04-02
	Version: 2

Notes:
- Rev 5 (2018-03-21) turbine layout.
- Based on Industry Canada 2018-03-01 SMS Data.
- Station coordinates in the SMS Data may be inaccurate by several hundred meters. Locations should be verified via high resolution air photos or site visit.
- Background map (ESRI) is shown for illustrative purposes only.
- WSP Project 161-08790-00



Legend

- ✱ Turbines
- Digital TV Reception Consultation Zone

Title:	TV Reception Consultation Zones
Project:	Wisokolamson Energy Project
Client:	Wisokolamson Energy LP
Created By:	Les Ryan
	Datum: NAD 83 Projection: UTM Zone 20N
	Scale: 1:100,000
	Date: 2018-04-02
	Version: 2

Notes:
- Rev 5 (2018-03-21) turbine layout.
- Based on Industry Canada 2018-03-01 SMS Data.
- Station coordinates in the SMS Data may be inaccurate by several hundred meters. Locations should be verified via high resolution air photos or site visit.
- Background map (ESRI) is shown for illustrative purposes only.
- WSP Project 161-08790-00