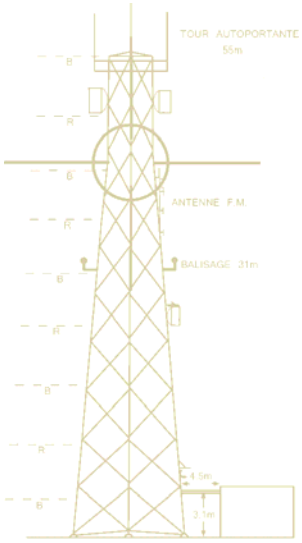

GRAND BEND WIND FARM
Grand Bend Wind Limited Partnership c/o Northland Power Inc.

In the region of
HURON COUNTY, ONTARIO

DRAFT IMPACT STUDY

IDENTIFICATION OF TELECOMMUNICATION SYSTEMS

Prepared for

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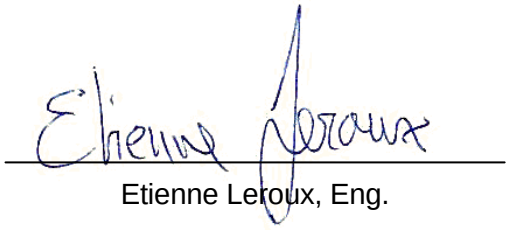
GRAND BEND WIND FARM
Grand Bend Wind Limited Partnership c/o Northland Power Inc.

In the region of
HURON COUNTY, ONTARIO

PRELIMINARY IMPACT STUDY
IDENTIFICATION OF TELECOMMUNICATION SYSTEMS

Team members in charge of the preparation of this document



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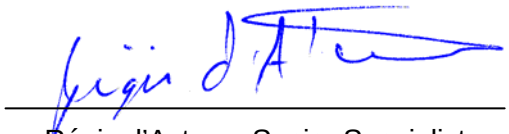

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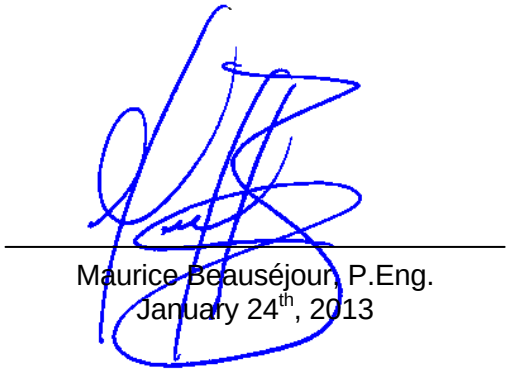


Maurice Beauséjour, P.Eng.
January 24th, 2013

Note: This document is written according to a mandate given to Yves R. Hamel et Associés Inc. by Neegan Burnside Ltd. This document is based on data obtained mainly from the database of Industry Canada and third parties, for which no field validation was made by YRH. Consequently, the information and conclusions presented in this document are strictly informative. Yves R. Hamel et Associés Inc. as well as the people acting on their account cannot be held responsible for any direct or indirect damage connected to the contents of this document.

TABLE OF CONTENT

1 Introduction

Yves R. Hamel et Associés Inc., broadcast and telecommunication consultants have been mandated by Neegan Burnside Ltd. to verify the impact of the deployment of the Grand Bend wind farm project on the telecommunication systems operating in the region of Huron County, Ontario.

This report presents the results of the first phase of the study, identifying the telecommunication systems in the wind farm area that might be affected by the deployment of the Grand Bend wind farm project. This study aims, among other things, to identify point-to-point microwave telecommunication links that intersect the proposed wind farm project and to define the consultation zones associated with these links and with the mobile base station located in the region. The study also aims to identify radar and navigation systems with the potential to be affected by wind turbines and to assess the potential for impact on radio and television broadcast signals in the region.

All consultation zones are in accordance with the proposed consultation distances of the RABC/CANWEA guidelines and are shown on the map in Annex 1. Most of these consultation zones are not designated areas where the placement of wind turbines is forbidden, as it is the case for an exclusion zone like the corridor linking two microwave stations. The placement of wind turbines within most of these consultation zones is possible. However, each case may require further detailed analysis before proceeding.

The results of this study will determine the extent of the detailed study, which could be required and would aim to evaluate the magnitude of the potential interference to specific systems, particularly TV signal reception, and to recommend alternative solutions where required.

2 Discussion

Previous studies from different sources indicate that almost every telecommunication systems could be affected by the operation of a wind turbine in cases of extreme proximity. In more representative cases, interference is unlikely when a spacing of only a few rotor diameters exists between the telecommunication system and the wind turbine.

Generally speaking, the potential for interference issues from wind turbines come from two different sources; the *obstruction* of the radio wave caused by the wind turbine and the *reflections* of the radio wave from the wind turbine's surfaces. Both types of interference will degrade the received signal and affect the performance and reliability of the communications system.

Many different parameters, related to the wind turbine itself, influence the magnitude of the potential interfering signals. The type of wind turbine, the rotor diameter, the number and shape of the blades, the material in the blades, the shape and size of the supporting tower and the shape and size of the nacelle, all have an impact on the potential obstruction or reflection of the signal. Similarly, the parameters of the telecommunication system such as the type of modulation, the frequency and the signal polarisation, the relative position of the transmitter, wind turbine and receiver as well as terrain topography, antenna radiation pattern and propagation conditions, also have an impact on the potential for interference with radio telecommunication systems.

The main factor to consider in evaluating the potential for wind turbine interference is the conductive nature of the material used for the turbine blades. The rotation plane of the blades and the support tower appear as a significant conductive surface causing potential obstruction or reflection of a signal. Fiberglass-epoxy blades offer some improvement but do not solve the potential problem entirely as the presence of wires connecting lightning receptors at the tips of the blades to the grounding system is often sufficient to make the blades appear as a significant metallic element.

The following system categories are considered to be potentially impacted by wind turbine interference under certain conditions and will be discussed in more details in the following section.

- Broadcast systems, TV, FM radio and AM radio;
- Navigational aids systems, VOR;
- Mobile systems, VHF and UHF mobile, cellular and PCS;
- Point to Point radio systems, UHF, microwave and satellite links;
- Point to Multipoint systems, FWA, MMDS, LMCS;
- Navigational and meteorological radar systems.
- Canadian National Seismograph Network

The following table 1 presents the locations of the Siemens SWT2.3-113 wind turbines as per the proposed PIA019991 layout, dated January 9th 2013, which was analyzed.

Table 1- Coordinates of the proposed PIA019991 Grand Bend wind farm layout

Turbine Number	Easting UTM NAD83 Zone 17	Northing UTM NAD83 Zone 17	Turbine Number	Easting UTM NAD83 Zone 17	Northing UTM NAD83 Zone 17
T-01	444036.1	4811877.7	T-25	443997	4804036.4
T-02	444375.9	4811760	T-26	443339.3	4803814
T-03	445882.2	4810066.6	T-27	443637.8	4803680.9
T-04	443801.9	4810147.5	T-28	443409.3	4803439.1
T-05	444206.4	4809868.6	T-29	443154	4802383
T-06	444035.3	4809533.4	T-30	443011.1	4802013.8
T-07	443954.1	4809147.5	T-31	443540	4801110
T-08	443717.5	4808841.1	T-32	442447.6	4800448.1
T-09	444323.1	4808855	T-33	442837.7	4800464.7
T-10	444002	4808745.4	T-34	442243	4800119.4
T-11	444329.7	4808460.6	T-35	442756.7	4800013.2
T-12	444001.1	4808314.9	T-36	442446.9	4799829.6
T-13	444228.1	4808040.7	T-37	442062	4799669
T-14	443801.7	4807901.6	T-38	442409.4	4799492.4
T-15	444499.7	4807773	T-39	441744	4799389
T-16	443896	4807611	T-40	441526.6	4798741.6
T-17	443376.5	4805355	T-41	441764.1	4798145.4
T-18	443716.7	4805336.7	T-42	441606.9	4797850.5
T-19	446261.4	4804829.2	T-43	442249.4	4797830.2
T-20	446912.9	4804824.7	T-44	441123.1	4797225.4
T-21	443654	4804591.7	T-45	440153.6	4796957.7
T-22	443974.2	4804634.8	T-46	440550.4	4796891.6
T-23	443320	4804183.5	T-47	440850.4	4796687.4
T-24	443623.2	4804056.9	T-48	440528.8	4796554.1

3 Systems Identification

3.1 Broadcast Systems

3.1.1 Television Broadcast Station

Historically, analog television signal reception has been very sensitive to signal reflection from wind turbines. Analog television signal impairments from wind turbines generally occurs as video distortion taking the form of a flicker of the picture synchronized with the blade's passage frequency. The impact on the audio channel is generally not perceptible as it is a frequency modulated (FM) sub-channel. As most of the analog TV stations have now been dismantled or converted to modern digital technology, television signal reception impairment by wind farm becomes less of an issue. However, exceptional cases of conflicting situation are theoretically still possible.

There is no simple rule to determine the minimum separation between wind turbines and a digital TV transmitter or receiver to ensure impairment-free operation. The topographic information and the relative positions of the sites are important parameters. With digital television technology, cases of reception impairment have been reported in the USA at proximity of wind turbines, in areas where the TV station's coverage was already marginal before wind farm implementation. While with analog TV technology, unacceptable impairment has been experienced at distances as far as 10 km from the wind farms, with digital TV, the geographical extent of quality degradation should be limited to the proximity of the wind turbines, mainly in areas located on the fringe of the TV station coverage. Under extreme conditions, image and sound quality impairments have been noticed within proximity of wind turbines, however a typical 550 m setback distance from residences minimize the risk of impact. Each case needs to be evaluated separately to consider the actual field conditions.

The operation of television transmitters is regulated and each television station has an associated protected service contour, within which interference from other stations affecting the quality of signal reception should be kept to a minimum. The deployment of wind turbines in close proximity to a television transmitter could be problematic as it may degrade a significant portion of the service contour area of the station and special care should be taken as the distance between the wind turbine and the transmitter decreases within the prescribed 2 km consultation radius. The deployment of wind turbines at the limit of the service contour

of a digital TV station may have an impact on the quality of reception in the vicinity of the wind farm and the risk of degradation may need to be evaluated.

With the ATSC (Advanced Television Systems Committee) digital TV technology (DTV), the issue associated with the static ghosting is solved, since the digital TV receivers have the ability to deal with the different signals reflected by fixed obstacles and arriving simultaneously at the receivers. As mentioned previously, when the wind turbines are in operation, the rapidly changing signal level reflected or blocked by the wind turbines could exceed the ability of the receivers to compensate for such variation, especially in locations where reception was already marginal.

The old analog NTSC TV technology may still be used for a few years in some region of Canada, however with the recent CRTC decisions 2012-384, 2012-413 and 2012-414 authorizing the CBC and TVO to shut-down their remaining analog re-transmitter as of July 31st 2012, the number of analog stations still in operation in Canada has been reduced to very few, which are planned to be shut-down or converted very shortly.

In the case of the Grand Bend wind farm project, there is only one analog TV station remaining and covering partially or entirely the wind farm project study area. It should be noted that CKNX-TV is a re-transmitter of CFPL-DT since 2009.

Table 2- List of analog TV station whose service contour overlap the wind farm study area.

STATION	NETWORK	TRANSMITTER LOCATION
CKNX-TV	CTV	Wingham

Most TV broadcast operators already converted their old analog NTSC TV stations to the new ATSC North American digital standard, providing a much higher quality picture and a better resilience to the changes in the environment. According to the Industry Canada database, there are six DTV stations covering at least partially the wind farm study area and they are listed in Table 3.

Table 3- List of DTV stations whose service contours overlap the wind farm study area.

STATION	NETWORK	TRANSMITTER LOCATION
CHCH-DT-2	Independent - English	London
CKCO-DT	CTV	Kitchener
CFPL-DT	CTV	London
CIII-DT	GTN	Paris
CICO-DT-18	TVO	London
CFMT-DT-1	Independent - English	London

It should be noted from the previous table that none of the remaining CBC stations cover the region of the Grand Bend wind farm.

The performance of an ATSC receiver has not yet been tested in detail in presence of wind turbines. Consequently, it is not possible to positively state that no impact will ever occur. However, it is clear that the potentially impacted area near a wind turbine will be significantly reduced with ATSC reception compared to the impact zone affecting the obsolete NTSC system reception, which would reduce the risk of degradation in reception quality for the neighboring residences by a similar ratio.

For the proposed wind farm project, the study area is located in a mainly rural region. According to the 2011 census data, there are approximately 373 permanent residences and a total population of about 946 peoples living within the study area. However, there are approximately 3 604 permanent residences and a total population of about 8 109 peoples living within the 10 km extended study area which represents the TV signal reception study area as stated by the RABC-CANWEA guidelines.

3.1.2 FM Broadcast Station

Previous studies and simulations in laboratories have shown that FM broadcast reception is generally not affected by the wind turbine operation, as long as a minimum distance of a few hundred meters from the wind turbine is maintained. Potential FM reception degradation would be perceived as a background “hissing noise” synchronised with the rotation of the blades. Potential degradation would typically only happen on the fringe of the coverage area of a station, as the signal to noise ratio is already marginal (<12dB) and at close proximity to

the wind turbine. These conditions occur mainly outside the protected service contours of the stations.

There is no FM broadcast transmitter station located within or at proximity of the proposed wind farm project area.

3.1.3 AM Broadcast Station

Just like television signals, AM broadcast signals are amplitude modulated and as such could experience interference from wind turbine operation. However, the AM broadcast systems operate at very low frequency with wavelengths much longer than TV signals and thus are not reflected by wind turbine components. The reception of AM broadcast signals will not be affected, unless the receiver is very close to the wind turbine itself (less than a few meters). One should note that the construction of any metallic vertical structure near an AM antenna system could modify the radiation pattern of the antenna system, as the new structure will react as a secondary radiator. In some instances, particularly with stations having a directional radiation pattern, the cumulative impact of a large number of wind turbines could be an issue, even at relatively large distance.

There is no AM broadcast transmitter station located within or at proximity of the proposed wind farm project area.

3.2 Navigational Aid Systems

3.2.1 VOR /Localizer Systems

The VOR (VHF Omnidirectional Range) use frequencies in the 108-118 MHz band and a combination of amplitude and frequency modulation to facilitate aircraft short-range navigation. The VOR ground stations are generally located within the boundaries of airports but are sometimes located along main navigation corridors for en route navigation. A clear area of approximately five hundred meters around ground stations should be maintained for proper operation and precision of the airborne receiver. Depending on the local condition and topography, tall buildings or structures should be avoided at much larger distance from the station to avoid distortion of the variable azimuth signal. Nav Canada, who is in charge of the operation of the VOR stations, would like to be notified as soon as possible of any proposed wind farm project within 15 km of these stations. Their initial analysis could help to provide

assistance to wind farm promoters during the process of turbines positioning, in order to minimize the impact on the operation of the station.

There is no VOR station located within 15 km of the project area. However, a consultation with Nav Canada through the mandatory Land Use Proposal process should be initiated as soon as the final layout is known.

3.3 Mobile Systems

All mobile systems operating in the VHF and UHF bands as well as the Cellular or PCS systems in the 800, 1900 MHz and AWS bands use some form of frequency or phase modulation which, similarly to the FM broadcast systems, are not considered susceptible to wind turbine interference. These systems are designed to operate with mobile units moving at vehicular speeds up to a few hundred kilometers per hour, which produce much stronger multipath and faster and deeper fades than what could be produced by reflections from wind turbines. Even if interference is theoretically possible at very close distances from the wind turbine under weak signal conditions, there is no reference in the literature describing any encountered real case. We do not expect any significant interference with that type of systems.

There are two mobile telecommunication system sites identified in the proposed wind farm project study area. A 1 km radius consultation zone is showed around each site on the map in Annex 1. One of these mobile sites is co-located with a microwave site.

The RCMP and DND were contacted by Neegan Burnside Ltd to identify any communication systems they may have in the area. The DND as well as the RCMP confirmed they have no objection with the Grand Bend wind farm project.

3.4 Point-to-Point Systems

The point-to-point telecommunication systems are used to link broadcast stations to their associated studio as well as for a multitude of applications associated with different utilities. The telephony and data networks use microwave point-to-point links and especially with the expansion of the cellular systems, microwave links are used to link every base station to their associated switching centre. At UHF and microwave frequencies, point-to-point links require

clear line of sight between communicating stations. The presence of structures on each side along the path may cause signal reflection partially cancelling the direct signal to the point where the communication may be disrupted.

The installation of wind turbines at close proximity to a point-to-point path can result in stronger impact than a static structure, considering the amplitude modulation effect and the Doppler Effect introduced by the rotation of the blades. Many references in the literature have evaluated the required clearance between the path optical line of sight and any wind turbine along the path and most conclude that the minimum distance to be maintained to ensure an interference free operation is 3 times the first Fresnel zone radius. The first Fresnel zone radius depends on the frequency of operation of the link, the path length and the position along the path.

An additional lateral distance equivalent to the wind turbine rotor radius is also included to ensure that the rotor blades clear entirely the path exclusion corridor.

In the case of the Grand Bend wind farm project, five point-to-point links crossing or terminating in the study area have been identified. The precise coordinates of the seven sites involved have been measured in the field, as part of a survey executed by Neegan Burnside Ltd. The associated exclusion corridors appear on the map included in annex 1. It should be noted that these corridors were computed based on a blade tip clearance of 3 times the first Fresnel zone radius, using a 3 m allowance for coordinate inaccuracies and using a 56.5 m rotor radius. The following Table 4 lists the point-to-point sites with the coordinates used for computation.

Table 4 - List of point-to-point sites with surveyed coordinates.

Location	Latitude NAD83	Longitude NAD83
ST JOSEPH (34961 SARARAS RD) ON	43.392825 N	81.703234 W
CORBETT (69413 GRAND BEND LINE) ON	43.252721 N	81.725248 W
HWY 21 / Homestead Rd	43.482424 N	81.694924 W
DRYSDALE (BLUEWATER HWY/KIPPEN)	43.450395 N	81.693568 W
ST JOSEPH (72385 ONTARION 21)	43.393301 N	81.703313 W
GRAND BEND (ON ST N/INDIAN RD)	43.316366 N	81.755737 W
DASHWOOD (MACDONALD/BABYLON)	43.364849 N	81.586502 W

Some of the wind turbines (T-1, T-2, T-4, T-17, T-18, T-21, T-22, T-23, T-24 and T-26) are located within the 1 km radius consultation zone of the St-Joseph and Drysdale microwave sites. These wind turbines are not expected to have any impact on the microwave links operation. However, wind turbine T-4, along with T-32, T-36, T-38 and T-43 are located within the microwave link consultation zones. As shown in Annex 2, the microwave beam passing close to the wind turbine T-4, and its associated consultation zone is completely below and outside of the wind turbine rotor swept area. Consequently, no significant interference is expected from wind turbine T-4 to this microwave link operation.

A similar situation occurs for T-32, as also shown in Annex 2. In this case, the consultation zone volume doesn't clear completely the rotor swept area, but only the tip of the blade is slightly penetrating the consultation volume, hence we do not expect significant impact from the wind turbine T-32.

The annex 2 also presents the elevation views of the microwave links at T-36, T-38 and T-43. These turbines would definitely have a significant impact on the new Bell Mobility Corbett – St-Joseph microwave link. This microwave link was built in the summer of 2012 and the frequencies authorized by Industry Canada in September 2012, well after the Grand Bend wind farm project and wind turbine layout was made public, hence Bell Mobility should have considered the future implementation of these wind turbines. Bell Mobility has been notified of the possible impact on their microwave link, for them to take corrective action before the wind farm construction. It should also be noted that wind turbine T-21 has been relocated from its previous location, in order to clear the exclusion corridor of an Xplornet microwave link between their St-Joseph site and the Dashwood site.

The same clearance criteria also apply to the satellite communication earth stations operating in the microwave bands between 4 GHz and 14 GHz. Once the azimuth and elevation angle of an earth station pointing at a specific satellite are known, the minimum distance to the closest wind turbine in a given direction can be evaluated. There is no licensed earth station identified within or near the proposed wind farm project area.

The Direct to Home (DTH) satellite TV services are very popular in these rural areas where cable networks are often non-existent. A validation of potential satellite line of sight blockage may have to be done as part of a detailed study, once the final wind farm layout is known. In

a relatively flat land region like in this case, a normal setback of 500 m from residences is largely sufficient to get a clear line of sight to the satellites used by the Canadian service providers.

3.5 Point-to-Multipoint Systems

Point-to-Multipoint systems are gaining in popularity in rural areas to offer services such as telephony, internet access and wireless cable TV networks. These systems operate in different frequency bands from 1.5 GHz up to 40 GHz with many different types of modulations. In the case of the point-to-multipoint systems oriented toward general public, as for the Xplornet Broadband Internet service, the location of the users are unknown and the protection of these systems can be limited only to the base stations of these systems which are co-located with the microwave sites. A consultation zone of 1.0 km radius is also associated with these stations as in the case of the mobile systems and the installation of wind turbines could typically be carried out as close as the limit of the physical protection of the radio station.

As indicated previously, some wind turbines are located within the 1 km consultation radius of the St-Joseph and the Drysdale sites operated by Xplornet Broadband for Internet access services. Consultation with them has been initiated, wind turbine locations have been provided to them and we don't expect any significant impact on these Internet access systems.

However, in the case of the point-to-multipoint systems whose stations require a licence from Industry Canada, they are treated as multiple point-to-point systems in our analysis and are therefore included in the previous section of this study. No such point-to-multipoint systems have been identified within or at proximity of the wind farm project study area.

3.6 Radar Systems

Radar systems generally operate in the microwave frequencies from 1 GHz to 10 GHz or more, and use the radio wave reflection to locate and identify any eventual target. Military and civil usage of radar systems is mainly related to air traffic control and meteorology to name a few applications. Any fixed structure in the radar station line of sight will reflect a part of the signal transmitted by the radar back to the radar receiver which will process it. The

echo from the structure will be similar to the echo from an aircraft, but will show different particularities designated as its radar signature and processing can differentiate between a structure signature and an aircraft signature, even between two different types of aircraft.

When the structure is fixed, filtration and processing can generally eliminate the structure signature from the radar display, reducing the impact for the radar operator. The navigational radar, especially the long range radar, typically have a slight positive antenna elevation angle, such that structures far enough from the radar station are not visible from the radar station position and generally do not cause any significant radar response. Moving structures like wind turbine cause important disturbance to radar operation, since the signature is continuously changing according to rotor speed and wind direction. Especially when many wind turbines are clustered in relatively large wind farms, the filtration and processing of these radar echoes become virtually impossible. Attempts to develop filtration and complex processing to cancel the responses from moving structures like wind turbine have been made with disappointing results. New processing algorithms are currently being tested to mitigate the impact on navigational radar. The results of these tests should be available relatively soon and possible mitigation solutions could be proposed if validation tests are conclusive.

The meteorological radars operate in a similar way and attempt to measure the cloud density and precipitation as close as possible to the earth surface as well as the air movement. In order to achieve a larger coverage area, they are usually installed on higher platforms and their antenna elevation angles are generally close to the horizon and sometime negative, depending on local topography. The presence of fix structures can be dealt with in the same way as for the navigational radar, however since the radar beam is grazing the earth surface, echo from structure even over the horizon are often seen.

Based on the latest discussions within the RABC/CANWEA Joint Working Group, a consultation zone of 60 km radius is required around Coast Guard radar station, while a 50 km radius consultation zone is required around the meteorological radar stations and an 80 km radius zone is required around the Air Traffic Control (ATC) radar stations. Similarly, the Department of National Defence requires a 100 km consultation zone around the so called defence radar stations.

There is no Canadian Coast Guard maritime traffic radar station within consultation distance. The closest station is located in Pointe Edwards, more than 65 km away.

However the Exeter meteorological radar station, operated by Environment Canada, is located approximately 22.4 km east of the closest wind turbine and between 25 and 30 km of most wind turbines. The sub-section 3.6.1 describes the situation with regard to this Exeter meteorological radar station.

There is also an ATC radar system at the London airport, operated by Nav Canada, located approximately 57 km southeast of the proposed wind farm area. Nav Canada has been contacted through the mandatory Land Use Proposal process and a formal letter to proponent has been received and is presented in Annex 3. It states that they have no objection to the project as proposed.

Neegan Burnside also transmitted a request to the air navigation department of the Department of National Defence (DND) to identify their communication systems, navigational aids, radar or others systems that could be in the area of the wind farm project. The DND has confirmed that they have no objection with the submitted Grand Bend wind farm area. If the project is to be modified, a new request should be submitted to the DND. This project is referenced as **WTA-2038** in the DND records and this number should be used as reference in any future communication with the DND regarding this Grand Bend wind farm project.

3.6.1 Exeter meteorological radar station

Considering the relative proximity of the Exeter radar station, the Grand Bend wind farm project and of many other wind farm projects in the area of Lake Huron, some of which are even closer to the Exeter radar station, Environment Canada (EC) issued a negative response to the consultation initiated by all wind farm projects in the area. The weather forecasting group of EC is responsible for weather forecasting in Canada and for the issuance of severe weather warnings and alerts. This region of Canada is considered as one of the Canadian region having the highest risk of severe weather occurrence and EC raised serious concerns regarding their ability to maintain the capacity of issuing such warnings and alerts in a timely manner with operational wind farms in the area.

A wind turbine visibility study was conducted and it concluded that all rotors of the wind turbines will be fully visible from the radar platform, causing significant Doppler data contamination under certain conditions of wind. Wind turbine operation also induces false cumulative precipitations data in the area of the wind farm and causes signal blockage in the area behind the wind farm.

Different mitigation approaches have been explored by different sources in the domain of navigational radar to mitigate the impact of wind farms on radar operation, but most of them are not applicable to meteorological radar, considering the different usage done of the radar technology in these two application fields.

For navigational radar, manufacturers like Lockheed Martin and Thales are proposing sophisticated 3D radar which is described as an efficient solution. Raytheon have been mandated by the British Ministry of Defence (MOD) and others, to develop new processing algorithms in order to discriminate between airborne targets and operational wind turbines, while using the existing radar. The results of extensive testing performed in UK and Netherlands were sufficiently convincing to initiate an upgrade process of the national radar networks in these countries. Other mitigation approaches have been proposed, like 3D holographic fill-in radar and stealth wind turbine blades, but have not yet been demonstrated as economically feasible on a large scale and especially for the stealth blades, it could potentially be applicable at certain frequencies, but not necessarily in the frequency of interest for the Canadian weather radar network.

Since many wind farm projects are planned in the same area near Lake Huron and after preliminary discussions with Environment Canada radar specialists with regard to the potential of the different mitigation options proposed worldwide, it appears that the most promising option to mitigate the impact on the Exeter radar station would be to implement a fill-in radar station at a location to be determined along the Huron lakeshore. However the planning, procurement and integration of such a fill-in radar station into the network can't be done overnight and may take 2 to 3 years in the best scenario or even longer if an agreement between the wind farm developers and Environment Canada is not reached quickly or if difficulties occur in the integration of the new station into the network.

In order to minimize the delay for the beginning of commercial operation of the wind farms, Environment Canada is evaluating the possibility to use a curtailment strategy while the fill-in radar is being implemented. The contemplated strategy would require the wind farm operators to stop the wind turbines on request from Environment Canada weather forecasters, typically when severe weather warnings or alerts are issued and will be authorized to restart the wind turbines once the alerts are lifted. This curtailment strategy would be used until the fill-in station is operational.

Discussions with Environment Canada regarding the Exeter radar station issue are ongoing and a regional mitigation strategy resolving the issue for multiple wind farms is contemplated. Grand Bend Wind Limited Partnership is attempting to regroup with the other wind farm projects in the area to develop a common solution. Grand Bend Wind Limited Partnership, along with other wind farm project developers in the area, are planning to hire a weather radar specialist, with deep knowledge of the Environment Canada radar network, to support the EC National radar program team effort to develop the fill-in station system requirements definition and its integration into the network, facilitating the procurement process and its implementation.

In order to potentially reduce the impact on the Exeter radar station Grand Bend Wind Limited Partnership is also exploring the possibility of using a more efficient model of wind turbine which could produce the same total energy using a lower number of wind turbines of the same dimensions. They are also exploring the potential of stealth blades as a possible way of reducing the signal returned from the wind turbines, but as indicated earlier, these approaches are not foreseen as very promising solutions.

4 CONCLUSION

An inventory and preliminary analysis was completed for every telecommunication system listed in the Industry Canada database and located within 100 km of the wind farm project study area. This permitted the identification of the systems which could suffer interference from the planned Grand Bend wind farm project. Overall, the Grand Bend wind farm layout has been adapted in order to eliminate the risk of significant impact on any existing telecommunication system at the time of final layout planning, with the exception of the Exeter weather radar station, for which solutions are under evaluation.

Based on the Industry Canada database, there are six digital TV stations and three analog TV stations identified as covering the wind farm area. However, following CRTC decision 2102-384, as of July 31st 2012 the CBC closed 607 analog stations throughout Canada, such that only one analog station remains in the Grand Bend wind farm area. The CBC does not currently cover this area, either in digital TV or analog TV.

There is no FM or AM broadcast transmitter station located within or near the wind farm project study area itself.

There is no VOR station located within a radius of 15 km of the proposed project area.

There is one cellular base stations located within the wind farm project study area and operated by Bell Mobility. No significant impact is expected on this station.

There are five identified point-to-point links crossing or terminating within the project study area. Following a field survey executed by Neegan Burnside Ltd, in order to get precise microwave site coordinates, it was found that three wind turbines, T-36, T-38 and T-43 would have a significant impact on a new microwave link operated by Bell Mobility. As Bell Mobility built that link after the wind farm project and its related information was made public, they are expected to take action to find a new traffic routing.

There is no maritime radar system within a 60 km radius. However, the Environment Canada Exeter weather radar station and the London ATC primary surveillance radar (PSR) station are located within their respective consultation radius. The DND confirmed having no objection with the submitted Grand Bend wind farm area. They requested to be

informed of any modification to the wind farm project area and the submission of a new request as necessary. The new submission, if required, should refer to the WTA-2038 wind farm project file.

Nav Canada response to the Land Use Proposal process confirm that there is no issue with the London airport PSR or any other system they may operate in the area.

Environment Canada (EC) expressed serious concerns with regard to the performance of the Exeter radar station located approximately 25 km East of the wind farm and their ability to maintain reliable severe weather forecasting capabilities. Consultation with EC is ongoing in order to implement the most appropriate mitigation solution, which at this point, is identified as the implementation of a fill-in radar station. Appropriate curtailment measures could be temporarily applied until the new fill-in radar station is commissioned.

It is necessary to add that all these evaluations, the resulting consultation and exclusion zones and the conclusions of this report are primarily based on the information published in the database of Industry Canada as of September 17th, 2012 or other sources for which no field validation has been executed. The microwave link identification process is mainly based on the Industry Canada database, which is the only public reference available. We have noticed that microwave links are occasionally built and operated before they appear in the database and would appear only a few months later. It is impossible for us to identify these links prior to their inclusions in the database, neither the links using unlicensed spectrum, which are not listed anywhere publicly. It should be noted that these unlicensed links do not beneficiate of any protection against interference from any sources.

References

Dipak L. Sengupta, Thomas B. A. Senior, “Electromagnetic Interference from Wind Turbines” in Wind Turbine Technology : Chapter 9, , David A, Spera (Ed), ASME Press, 1994.

David F. Bacon, “Fixed-link Wind-Turbine exclusion zone method”, D.F. Bacon, 2002.

M. M. Butler, D. A. Johnson, “Effect of wind farm on primary radar”, DTI PUB URN No. 03/976, 2003.

RABC/CANWEA “Coordination Process Between Wind Turbines and Radiocommunication and Radar Systems” December 2010.

Canadian Radio-television and Telecommunications Commission, Broadcasting Public Notice CRTC 2007-53, Ottawa, 17 May 2007.

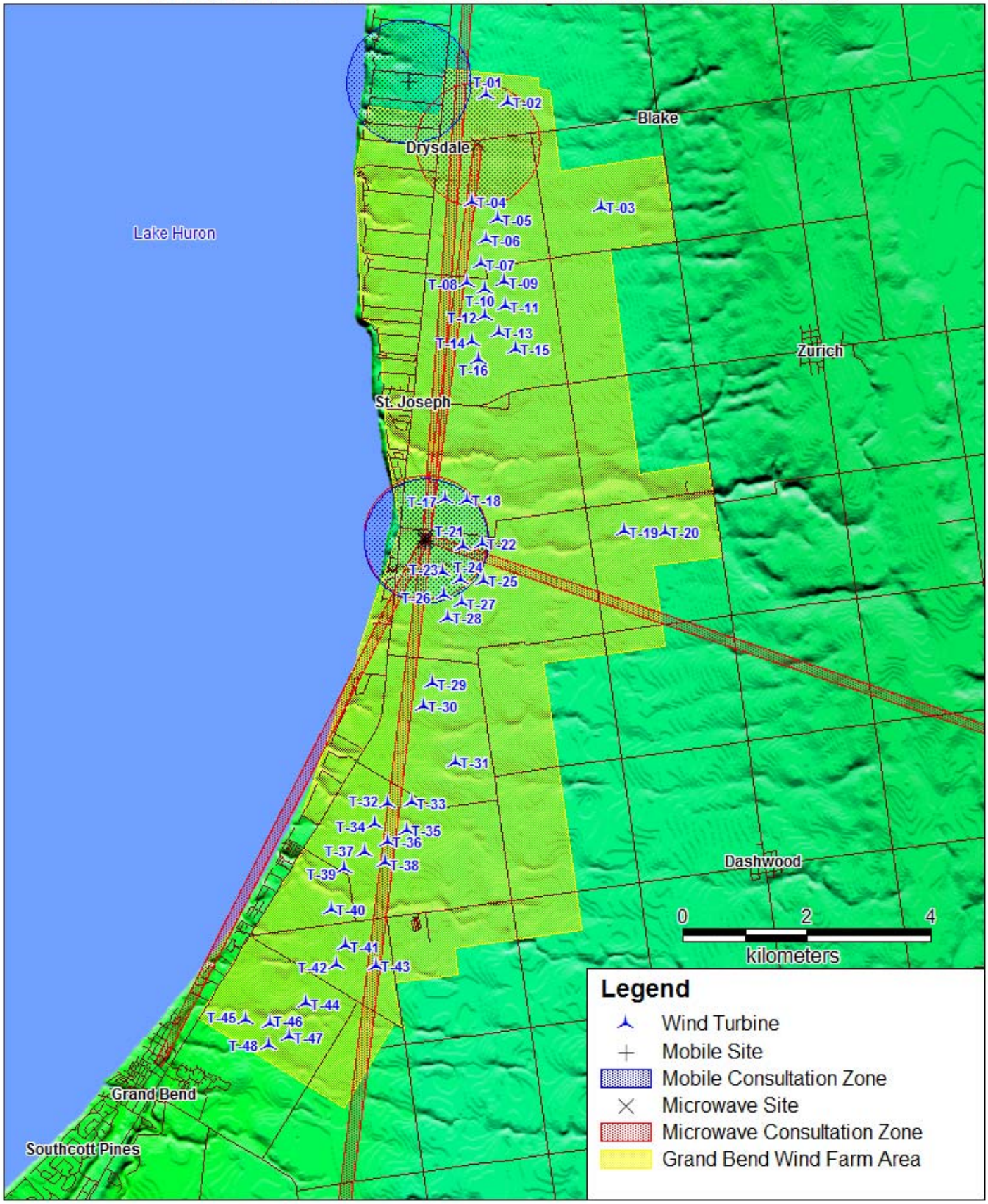
Canadian Radio-television and Telecommunications Commission, Broadcasting Public Notice CRTC 2012-384, Ottawa, 17 July 2012.

ATSC Standard, ‘’ ATSC Recommended Practice: Receiver Performance Guidelines’’, Document A/74, June 2004 with corrigendum July 2007.

Annex 1

Overview of the
Grand Bend wind farm project

OVERVIEW OFTHE GRAND BEND WIND FARM PROJECT AREA
TELECOMMUNICATION SYSTEMS CONSULTATION ZONES



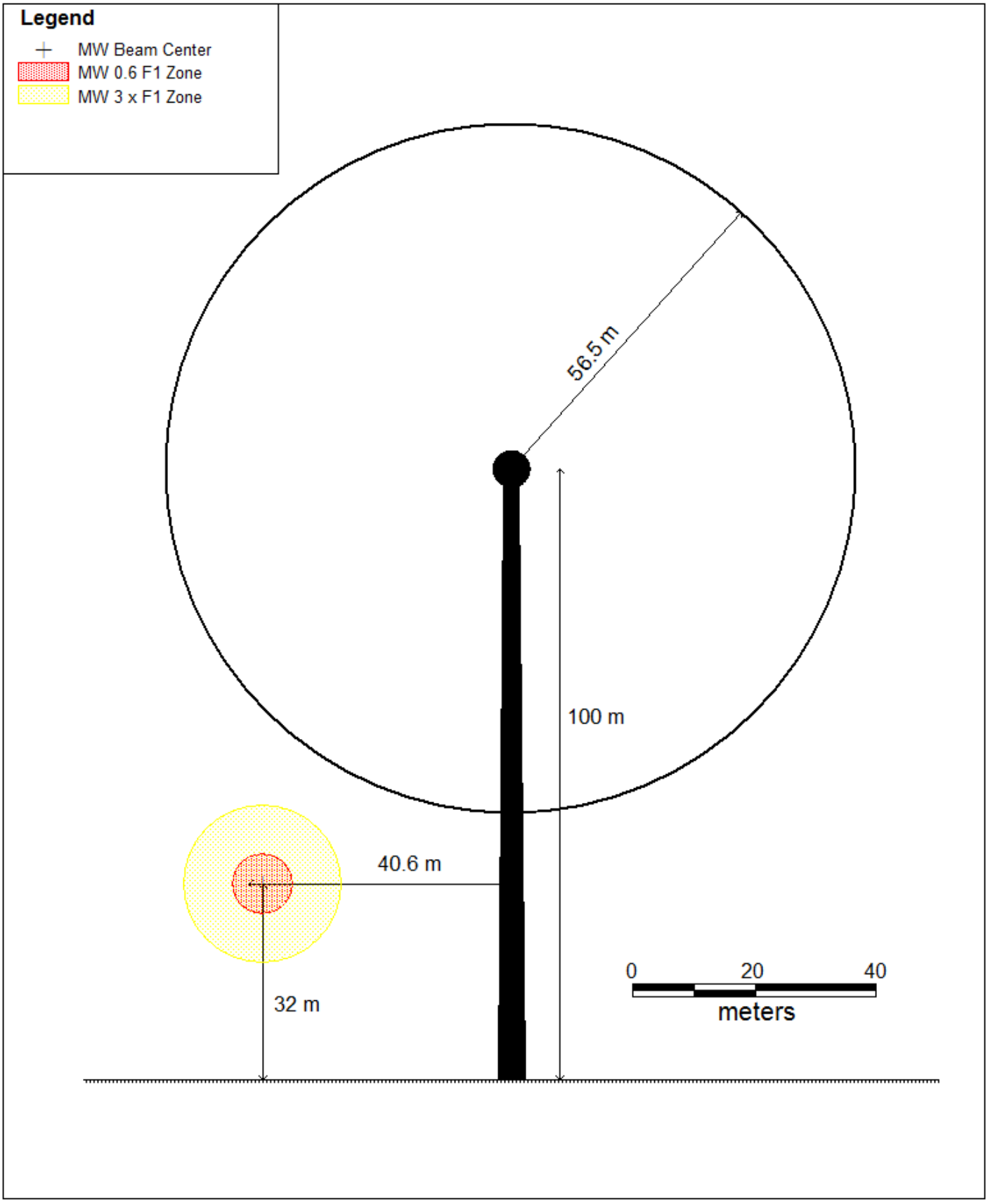
Annex 2

Elevation views

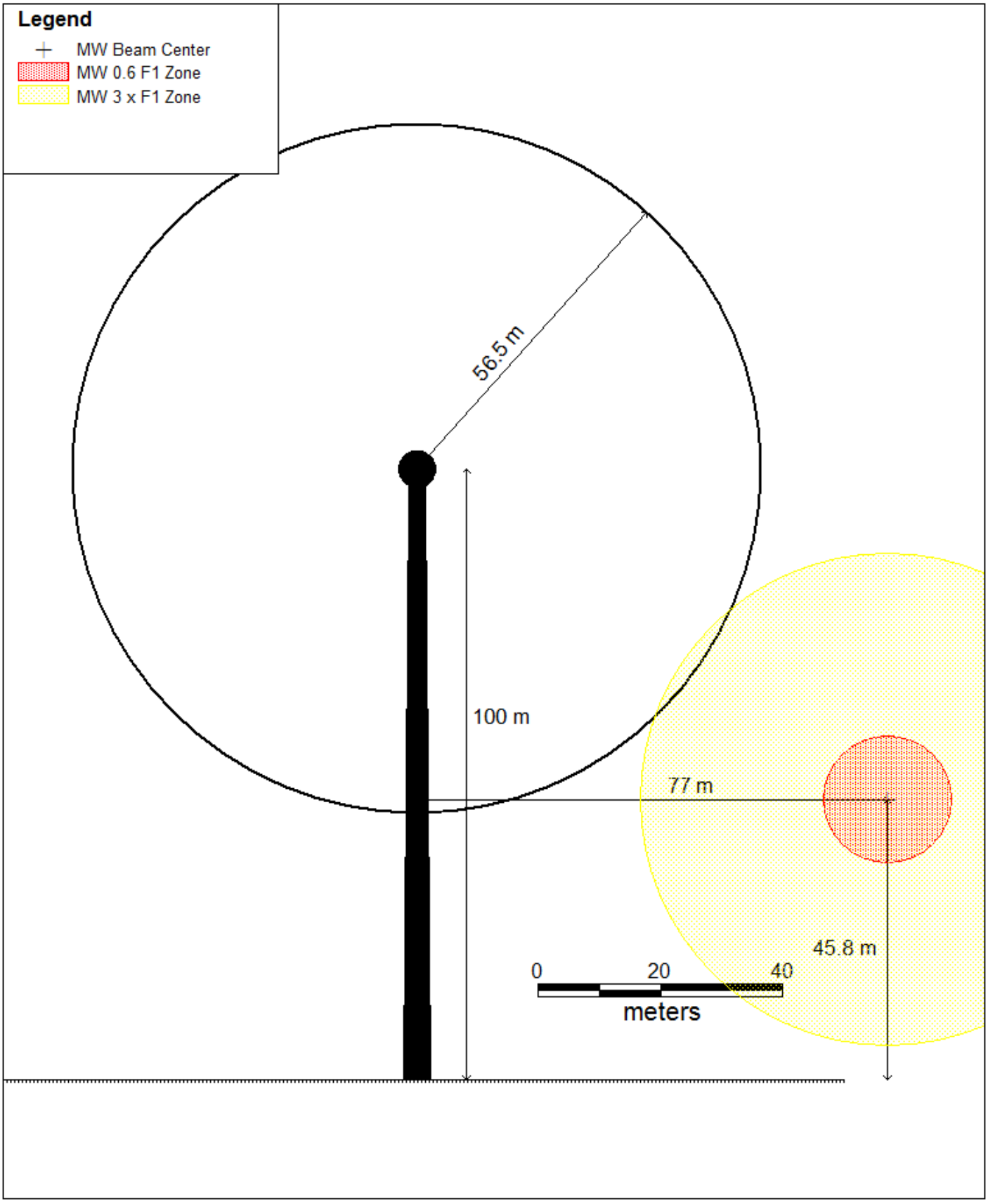
of wind turbines located along

microwave links

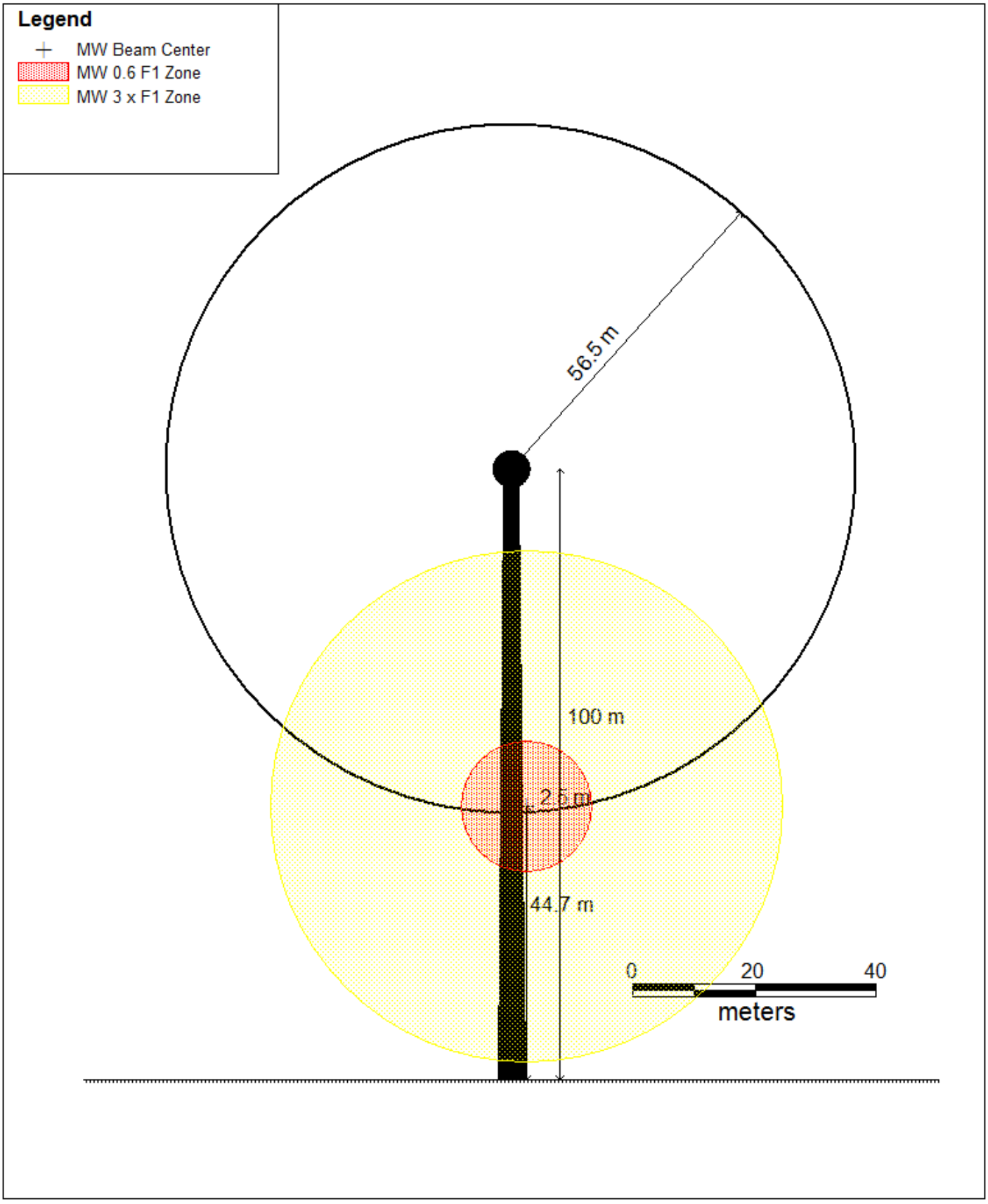
Elevation view at T-04



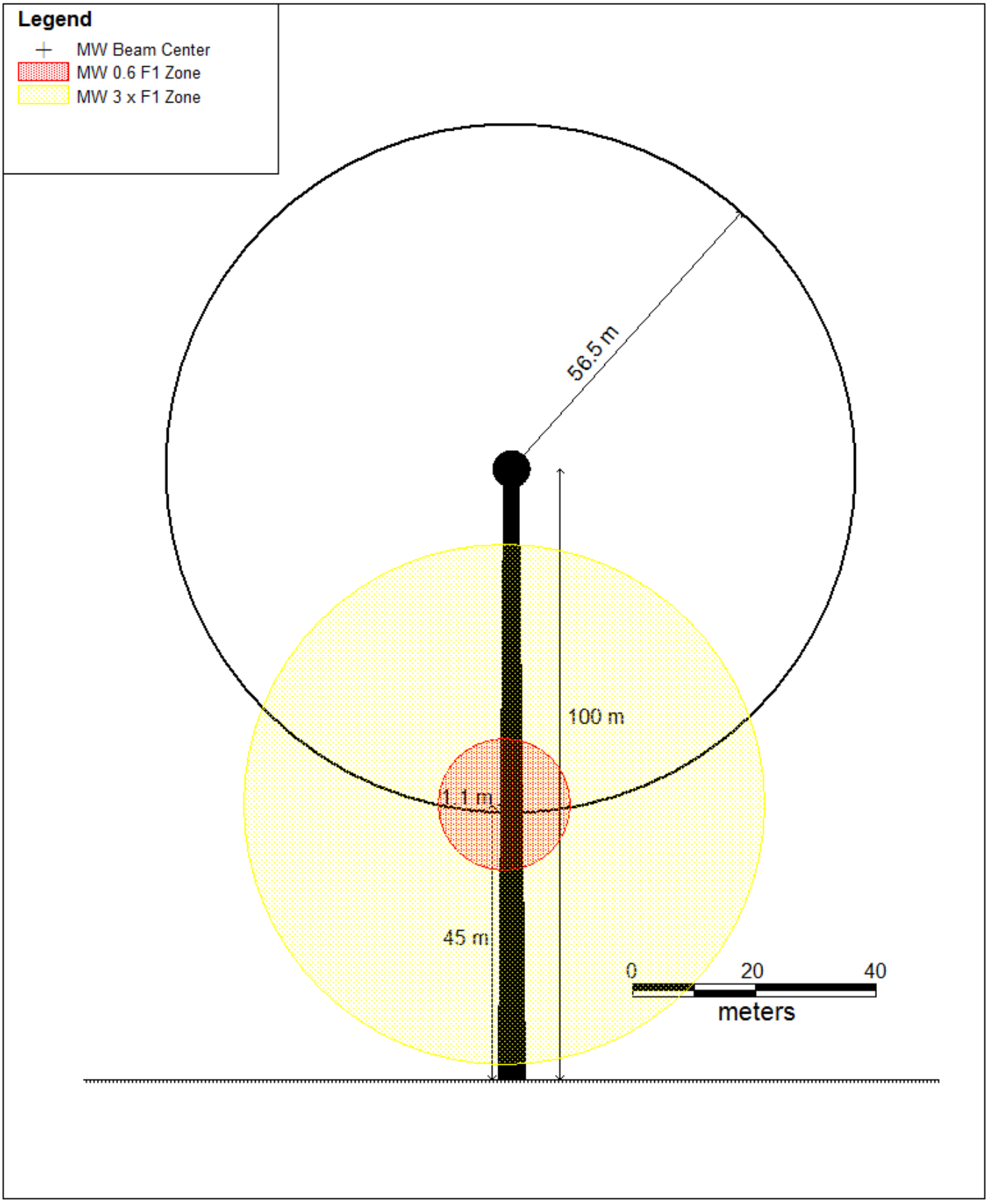
Elevation view at T-32



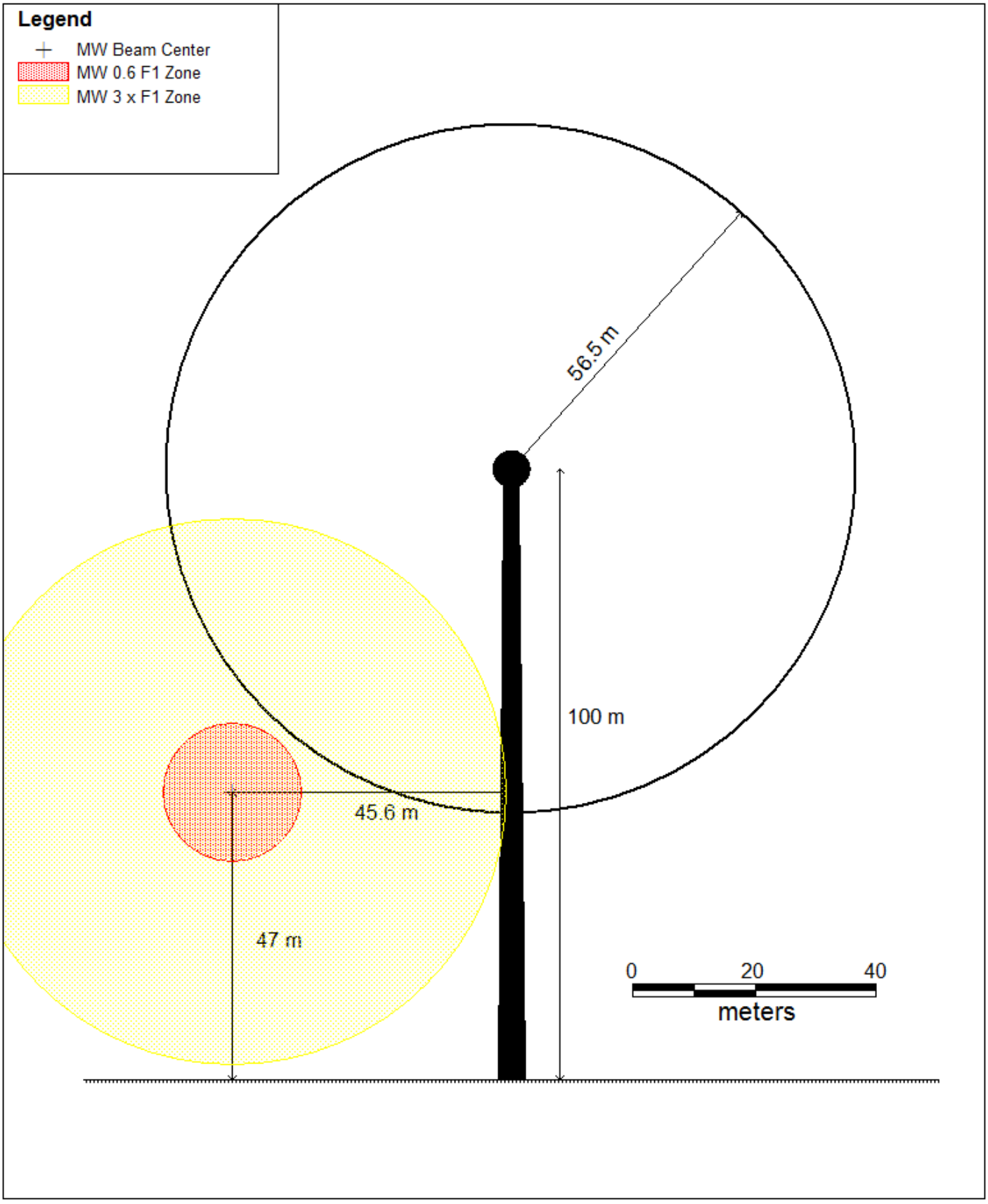
Elevation view at T-36



Elevation view at T-38



Elevation view at T-43



Annex 3

Responses from

the contacted agencies

to identify their
telecommunications systems

From: <ADIN.SWITZER@forces.gc.ca>
To: <paul.stubbert@rjburnside.com>,
Cc: <kristy.ramkissoon@rjburnside.com>
Date: 04/12/2012 02:23 PM
Subject: Detailed Analysis - No Interference - Grand Bend Wind Farm, Grand Bend, Ont - WTA-2038

Paul,

We have completed the detailed analysis of your proposed site, Grand Bend Wind Farm, located near Grand Bend, Ont (WTA-2038). The results of our detailed analysis have shown that there is likely to be no interference with DND radar and flight operations.
Therefore, as a result of these findings we have no objections with your project as submitted (attached).
If however, the layout were to change/move, please re-submit that proposal for another assessment using the assigned WTA number listed above. The concurrence for this site is valid for 24 months from date of this email. If the project should be cancelled or delayed during this timeframe please advise this office accordingly.
It should be noted that our office looks at each submission on a case by case basis and as such, concurrence on this submission in no way constitutes a concurrence for similar projects in the same area, nor does it indicate that similar concurrence might be offered in another region.
Finally, the concurrence offered in this email extends only to the subject projects and current proponent. Should the project or any part of it be altered, or be sold to another developer, this office must be notified and we reserve the right to reassess the project.
Thank you for your patience on this matter and for considering DND radar and airport facilities in your project development process.

If you have any questions feel free to contact me.
Thank you.

<<PIA019991_Grand_Bend_Windfarm_DND_Case_Number_WTA-2038.xls>>

Adin Switzer
Capt
AEC Liaison Officer
CCISF/ESICC
ATESS/ESTTMA
Défense nationale | National Defence
8 Wing Trenton, Astra, ON K0K 3W0
TEL: 613 392-2811 Ext4834 (CSN: 827-4834)
FAX: 613 965-3200
Gouvernement du Canada | Government of Canada
ü Please consider the environment before printing this email | S'il vous plaît pensez à l'environnement a

[attachment "PIA019991_Grand_Bend_Windfarm_DND_Case_Number_WTA-2038.xls" deleted by Paul Stubbert/RJB]

----- Forwarded by Kristy Ramkissoon/RJB on 07/05/2012 08:54 AM -----

From: <MARIO.LAVOIE2@forces.gc.ca>
To: <kristy.ramkissoon@rjburnside.com>,
Cc: <+WindTurbines@forces.gc.ca>
Date: 07/05/2012 08:08 AM
Subject: FW: Grand Bend Wind Farm, Grand Bend, Ont - WTA-2038

I have reviewed your proposal in respect to DND's radio communication systems, and I have no objections or concerns.
Thank you for coordinating with DND.
Have a good Day.
Mr. Mario Lavoie
Spectrum Engineering Technician
National Defence | Défense nationale
Ottawa, Canada K1A 0K2
mario.lavoie2@forces.gc.ca
Telephone | Téléphone 613-992-3479
Facsimile | Télécopieur 613-991-3961
Government of Canada | Gouvernement du Canada

From: Francine Boucher [mailto:FRANCINE.BOUCHER@rcmp-grc.gc.ca]
Sent: July-09-12 1:40 PM
To: Etienne Leroux
Cc: Regis Dastous
Subject: RE: P-2012203 Grand Bend wind farm

Good afternoon,

The proposed Gran Ben wind project does not create a problem for the RCMP as our closest site is located 10 km away.

Please do not hesitate to call me should there be further questions.

Thank you,

Francine Boucher

RCMP - Radio Spectrum Mgt

613-998-7338

francine.boucher@rcmp-grc.gc.ca

From: XNCR, Windfarm Coordinator [mailto:Windfarm.Coordinator@DFO-MPO.GC.CA]
Sent: July-06-12 1:28 PM
To: Etienne Leroux
Subject: RE: P-2012203 DFO-MPO Grand Bend wind farm

Hello,
The proposed Grand Bend Wind Farm is located 65 km from the nearest CCG radar site (Sarnia Point Edward).

Therefore, we do not anticipate any interference problems.

Regards,

Martin Grégoire, P. Eng
Canadian Coast Guard

From: Fox, Mark (MGS) [mailto:Mark.Fox@ontario.ca]
Sent: July-09-12 12:07 PM
To: Etienne Leroux
Cc: Regis Dastous; Guido, Sandra (ENE)
Subject: FW: P-2012147 GMCO : Grand Bend Wind Farm project

Hi Etienne;

Based upon the study area provided in the attached proposed Grand Bend Wind Energy Project, this project has been determine unlikely to affect the operations of Ontario's public safety mobile radio network. Please be advised that this network is only utilized by provincial ministries (ie OPP, MOHLTC, MTO, etc) and not utilized by federal, regional or local public safety organizations.

Should the proposed Grand Bend Wind Energy Project study area change, a reassessment will be required.

I have included Sandra Guido from the Ministry of the Environment in my response to ensure awareness of our analysis results.

If you have any questions, you can contact me at 416-327-0383 or by email at mark.fox@ontario.ca.

Regards,

Mark Fox, P. Eng.
Network Radio Engineer

Government Mobile Communications Branch
Infrastructure Technology Services
Ministry of Government Services
155 University Ave, 14th Floor, Toronto, ON M5H 3B7

Email: mark.fox@ontario.ca
Phone: 416-327-0383
Blackberry: 416-524-654

July 25, 2012

Your file
Grand Bend Wind Farm (Bluewater and South Huron)
Our file
12-1305

Mr. Gordon Potts
Northland Power Inc.
30 St. Clair Avenue West, 17th Floor
Toronto, ON
M4A 3A1

RE: Wind Farm: Preliminary Study Area - Grand Bend, ON
(See attached spreadsheet for turbine location)

Mr. Potts,

We have evaluated the captioned proposal and NAV CANADA has no objection to the project as submitted.

While this proposed wind structure is acceptable, it does not constitute NAV CANADA's approval for any other structure at this location such as a wind turbine. The nature and magnitude of electronic interference to NAV CANADA ground-based navigation aids, including RADAR, due to wind turbines depends on the location, configuration, number, and size of turbines; all turbines must be considered together for analysis. The interference of wind turbines to certain navigation aids is cumulative and while initial turbines may be approved, continued development may not always be possible.

In the interest of aviation safety, it is incumbent on NAV CANADA to maintain up-to-date aeronautical publications and issue NOTAM as required. To assist us in that end, we ask that you notify us at least 10 business days prior to the start of construction. This notification requirement can be satisfactorily met by returning a completed, signed copy of the attached form by e-mail at landuse@navcanada.ca or fax at 613-248-4094. In the event that you should decide not to proceed with this project or if the structure is dismantled, please advise us accordingly so that we may formally close the file.

If you have any questions, contact the Land Use Department by telephone at 1-866-577-0247 or e-mail at landuse@navcanada.ca.

NAV CANADA's land use evaluation is valid for a period of 12 months. Our assessment is limited to the impact of the proposed physical structure on the air navigation system and installations; it neither constitutes nor replaces any approvals or permits required by Transport Canada, Industry Canada, other Federal Government departments, Provincial or Municipal land use authorities or any other agency from which approval is required. Industry Canada addresses any spectrum management issues that may arise from your proposal and consults with NAV CANADA engineering as deemed necessary.

Yours truly,

Paul Pinard
for
David Legault
Manager, Data Collection
Aeronautical Information Services

cc ONTR - Ontario Region, Transport Canada

1601 Tom Roberts, P.O. Box 9824 Stn T, Ottawa, ON, K1G 6R2
Telephone: +1 (866) 577-0247, Fax: +1 (613) 248-4094

1601 Tom Roberts, C.P.9824 Succursale T, Ottawa, Ontario, K1G 6R2
Téléphone: +1 (866) 577-0247, Télécopieur: +1 (613) 248-4094
Z-LDU-102 Version 1.0

RE: Grand Bend Wind Farm
Weather Radars Contact,National Radar Program [Ontario]
to:
Kristy Ramkissoon, Weather Radars Contact,National Radar Program [Ontario]
05/14/2012 03:07 PM
Cc:
"Fiona Christiansen", "Chris Shilton"
Hide Details
From: "Weather Radars Contact,National Radar Program [Ontario]" <weatherradars@ec.gc.ca>
To: "Kristy Ramkissoon" <Kristy.Ramkissoon@rjburnside.com>, "Weather Radars Contact,National Radar Program [Ontario]" <weatherradars@ec.gc.ca>,
Cc: "Fiona Christiansen" <Fiona.Christiansen@rjburnside.com>, "Chris Shilton" <Chris.Shilton@rjburnside.com>

Dear Ms. Fiona Christiansen,

Thank you for contacting the Meteorological Service of Canada, a branch of Environment Canada, regarding your wind energy intentions.

Our assessment of the information provided to us via e-mail on May 3, 2012 indicates that interference created by the Grand Bend wind farm will adversely impact our Exeter weather radar, causing the following problem(s):

1. Significant Doppler interference
2. Multi-path scattering reflections

Upon consulting with Environment Canada's severe weather forecasting group and the radar science group, we believe that interference from the wind farm **cannot** be filtered out by our existing processing system. This interference would reduce the radar's monitoring capabilities with respect to severe weather warnings and ultimately, the public's safety and security.

Our opinion is that the Grand Bend wind farm cannot effectively co-exist with the Exeter weather radar as currently proposed.

We look forward to any potential mitigation discussions.

Please contact us at: weatherradars@ec.gc.ca

Best Regards,

Carolyn J. Rennie
National Radar Program
Meteorological Service of Canada
Environment Canada
4905 Dufferin Street
Toronto, Ontario M3H 5T4
Office : 3N-WS12
Carolyn.Rennie@ec.gc.ca
Phone : 416-739-4931
Cell : 289-221-1084
