

ELECTROMAGNETIC FIELD AND STRAY CURRENT STUDY

Pertaining to:

EMF MANAGEMENT PLAN & TTC TECHNICAL REVIEW

**685 WARDEN AVENUE
SCARBOROUGH, ONTARIO**

Prepared for:

CHOICE PROPERTIES LIMITED PARTNERSHIP

APRIL 29TH, 2021

April 29th, 2021

Choice Properties Limited Partnership
700-22 St. Clair Avenue East
Toronto, Ontario
M4T 2S5

Attention: Jennifer Michi: Coordinator, Development
RE: 685 Warden Avenue – EMF Management Plan, TTC Electrolysis and Stray Current Study

R-160772-01 R1

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1.0 Introduction

C-INTECH was contracted to perform an A.C. and D.C. electromagnetic field survey, as well as ground potential measurements, at the location of 685 Warden Avenue, located in Scarborough, ON. The purpose of the measurements was to determine the extent of possible negative impacts of the TTC operations as well as the existing hydro corridor on the new proposed development, caused by stray currents or EMI interference.

The site's A.C. and D.C. electromagnetic field measurements & ground potential measurements were performed on April 22nd, 2021 between the hours of 9:00a.m. and 11:00a.m.

2.0 Testing methodology

- 2.1** The testing instrument for the A.C. magnetic field survey was EMF/ELF Meter Model TM-192D manufactured by TENMARS, in Taiwan. This instrument is a handheld triaxial magnetic field meter with frequency response from 30Hz to 2000Hz. It is calibrated to match the power frequency.

The testing instrument used for D.C. magnetic field readings was D.C. Milligauss Meter Model TFM1186-PC manufactured by Metrolab Technology SA, in Switzerland.

The testing instrument used for ground potential and resistivity measurements was Model DET4TCR2 manufactured by MEGGER.

- 2.2** The electromagnetic field in both D.C. and A.C. frequency spectra were measured in accordance with IEEE standard 644-94 using a three-axial instrument. The measurements were carried out at 3ft height above ground.

The D.C. readings were observed over a time period corresponding to several subway train passes and the maximum value was recorded on the site plan at the location of the measurement together with the time fluctuations.

The ground potential and resistivity measurements were conducted as per IEEE Std 81-2012: IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System. The soil conductivity and soil potential measurements were carried out on an empty grass area along the West side of the property. 12" long electrodes were utilized for these measurements.

3.0 Sources of A.C. & D.C. Magnetic Field

- 3.1** The main source of A.C. magnetic field at the time of this survey evidently was the Hydro One transmission line running approximately 400ft North of the property: H11SL & H7SL 41. Readings taken within the direct vicinity of the Hydro One transmission lines H11SL & H7SL 41, were as high as 21.0mG. This would be consistent with electrical load approximately 20% of maximum.

- 3.2 Toronto Hydro distribution lines running alongside Warden Avenue were also a source of elevated electromagnetic field onto the property, but to a lesser degree. Electromagnetic field from the Toronto Hydro distribution lines decay with distance more rapidly than single phase current generated fields (with square of the distance) and thus affects a smaller area.
- 3.3 The extent of their combined electromagnetic field, at actual load during the time of the survey at 3ft height, is displayed in Drawing S-160772-01.

4.0 Findings

- 4.1 As displayed in Drawing S-105188-01, the A.C. electromagnetic field readings varied throughout the property with a notable increase within proximity to the Hydro One transmission line to the North, & the Toronto Hydro distribution lines to the West. The A.C. magnetic field measurements taken at 3ft height were found to range between 0.3mG and 5.9mG, with no significant time variations observed.

The A.C. magnetic field measurements are generally within normal levels. Higher values were found at close proximity to the Toronto Hydro distribution lines located alongside Warden Avenue, bordering the West side of the property. See Photos #1 & #2.

The Hydro One transmission line, located approximately 400ft North of the property, were also a source of elevated electromagnetic field. The Hydro One transmission lines were evidently lightly loaded during the time of this survey, approximately 20%. See Photos #3 & #4. As a result, when loading increases, the A.C. magnetic field readings will increase as well. There was a moderate variation of the readings at the same distance from the line, alongside the line length. This was evidently a result of the variation to the line height (conductor sag) and the conductor spacing.

The elevated A.C magnetic field readings evidently were not TTC related.

- 4.2 D.C. magnetic field was found to be between 710 – 716mG range, with some time variance in correlation with passing of the subway cars. See Photos #7 & #8. The absolute value of the unperturbed D.C. field typical for geomagnetic field at Toronto latitude is approx. 550mG. The time variance was found to be generally within +/- 1.5mG range.
- 4.3 The soil conductivity and soil potential measurements were carried out on the North West side of the property, on an empty grass area. The measurements were performed using the Four Point Wenner method. See Photo #5 & #6. Soil resistivity was found to be 1.76Ωm. No anomalies were revealed during the readings.
- 4.4 The ground potential was measured on the external electrodes, 36mV D.C. potential between external electrodes (40ft) was found with minor time variance over the time of measurement.

The data collected does not indicate any potential problems associated with stray currents and electrochemical corrosion at this time.

5.0 Exposure Guidelines

5.1 A.C. Magnetic Field

- 5.1.1 Presently, there is no Canadian standard governing human exposure to extremely low frequency fields. Health and Welfare Canada has adopted guidelines provided by the American Conference of Governmental Industrial Hygienists (ACGIH) and World Health Organization (WHO) of 1000mG for continuous exposure.
- 5.1.2 The City of Toronto's "Prudent Avoidance Policy" is based upon an international review of childhood leukemia studies by the World Health Organization, which found a possible increased risk for long term average exposures above 3-4mG. The City has adopted a policy which encourages limiting exposures to magnetic field with a particular focus on children under 12. This is to satisfy health concerns based on epidemiological studies indicating possible negative health effects about this level.
- 5.1.3 A.C. magnetic field over 20mG can cause interference with data and computer equipment. Sensitive equipment such as MRI's, electron microscopes, and others, can be affected with significantly lower levels, (0.1-0.3mG).

5.2 D.C. Magnetic Field

- 5.2.1 D.C. magnetic field and its swings do not pose any danger of negative health effects. However, it can effect sensitive electronic and communication equipment. To our knowledge, no D.C. magnetic field sensitive equipment will be present at this location. However, the D.C. field swings and its rate of rise, should be considered during space utilization allocation.

5.3 Stray Currents

- 5.3.1 D.C. stray currents can arise when insulation on the D.C. traction is compromised and a portion of the return current is carried through the bulk of the ground. Should such stray current enter a metallic object in the ground, it can cause electrochemical corrosion which, in serious cases, may affect mechanical integrity of such structure.

5.4 Industry Practice

- 5.4.1 Typically, it has been our experience that in situations where EMF exposure has been a concern, facilities have established a threshold of acceptance ranging from 2-10mG. It has been our experience that for a general office environment 5mG has been established as acceptable.
- 5.4.2 A.C. magnetic field (should it exceed acceptable levels) is controlled by means of architectural shielding at strategic locations, at, or around the sources of the field.

- 5.4.3 D.C. magnetic field, (and its swings) are usually controlled in accordance with the requirements of the sensitive equipment manufacturer. The typical approach would include a combination of passive and active shielding around the equipment itself.
- 5.4.4 Stray currents and their negative effects are usually controlled by minimizing the possibility of the current uptake into the structural metallic members. Extra bituminous insulation on the foundation caissons is frequently sufficient. In severe cases, insulated rebars and/or cathodic protection might be required.

6.0 Conclusion and Recommendations:

Based on the findings made during our field measurements, it can be concluded that the A.C. and D.C. magnetic fields are within acceptable limits. The time variance of the D.C. field was also found to be within acceptable limits.

Based on the findings, we do not expect any EMI interference problems associated with magnetic field radiation from the TTC subway line or the Hydro Corridor under normal operating conditions.

Localized elevated readings of the A.C. magnetic field are unrelated to the TTC operations.

The ground potential was found to be within acceptable limits as well. We recommend to re-measure the ground potential at the bottom of the excavation pit to confirm the findings and assess the extent of mitigation measures, if any.

Based on the survey findings, we do not anticipate any need for external magnetic field mitigation action at present.

We trust this fulfills our assignment. Should you have any questions please do not hesitate to contact our office.

Yours truly,



Amanda Jeffs

Reviewed by: Jan Morava, M.A.Sc., P.Eng.

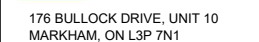


Encl: DWG S-160772-01

DWG S-160772-02

Graphs: POINT A: X, Y, Z DIRECTIONS (1 page)
POINT B: X, Y, Z DIRECTIONS (1 page)

Photographs: 4 pages



NOTES:

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NOTE:

ALL MEASUREMENTS IN mG @ 3 FT

PROJECT TITLE:

685 WARDEN AVENUE
EMI STUDY

DRAWING TITLE:

DC MAGNETIC FIELD MEASUREMENTS

DRAWN:

F. TS

SCALE:

DATE: 2021-04-23

PROJECT NO.

160772

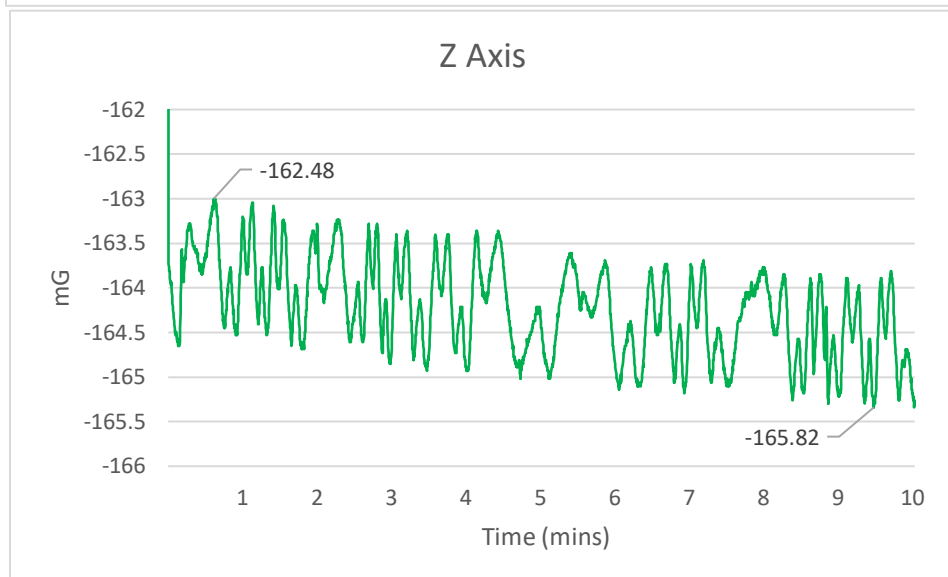
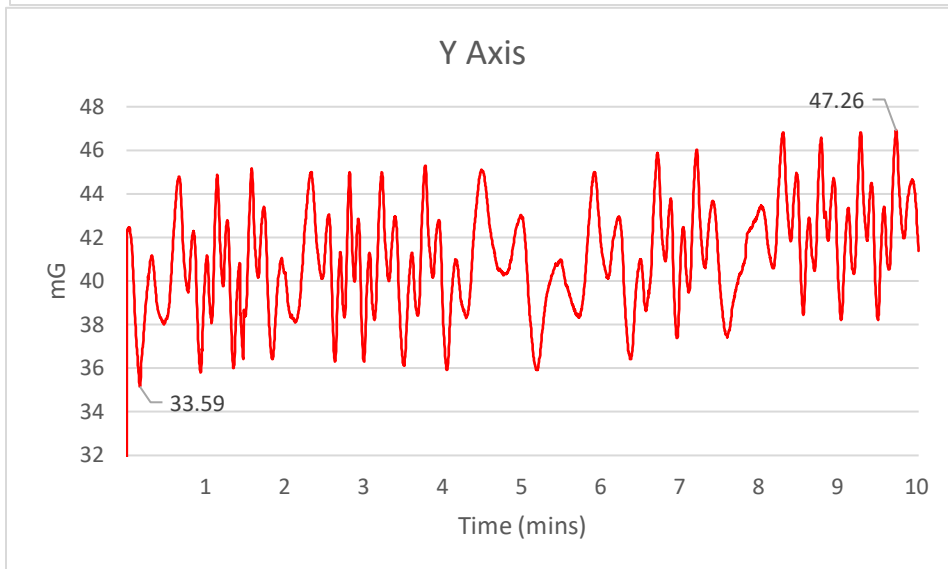
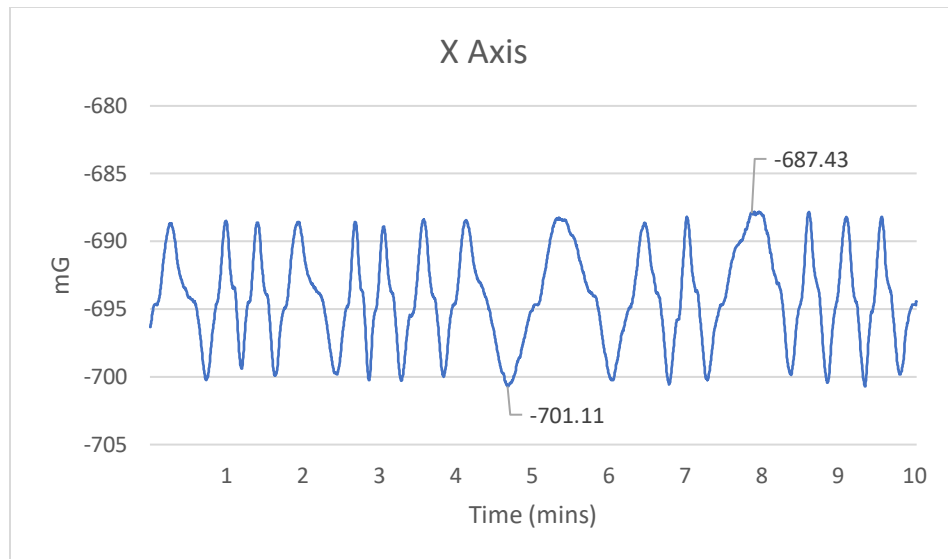
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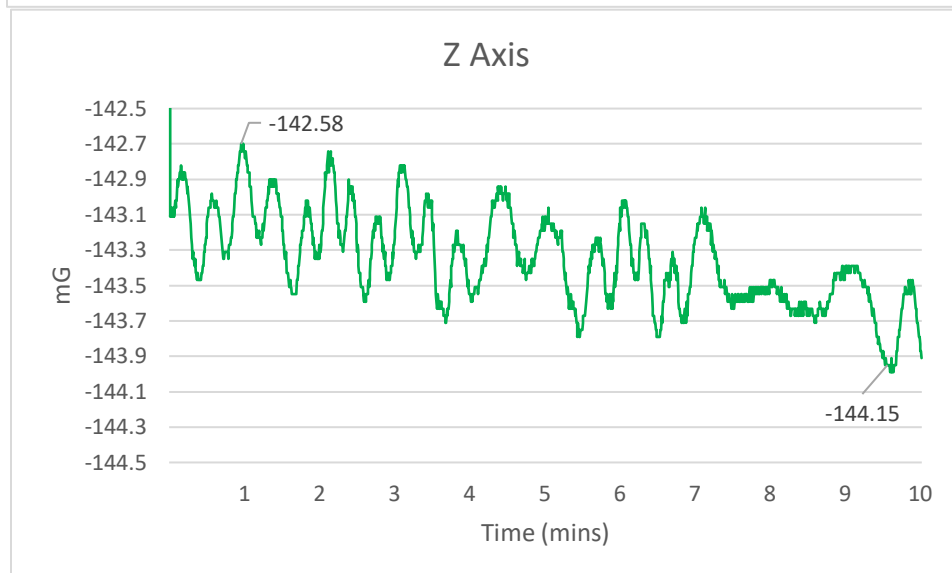
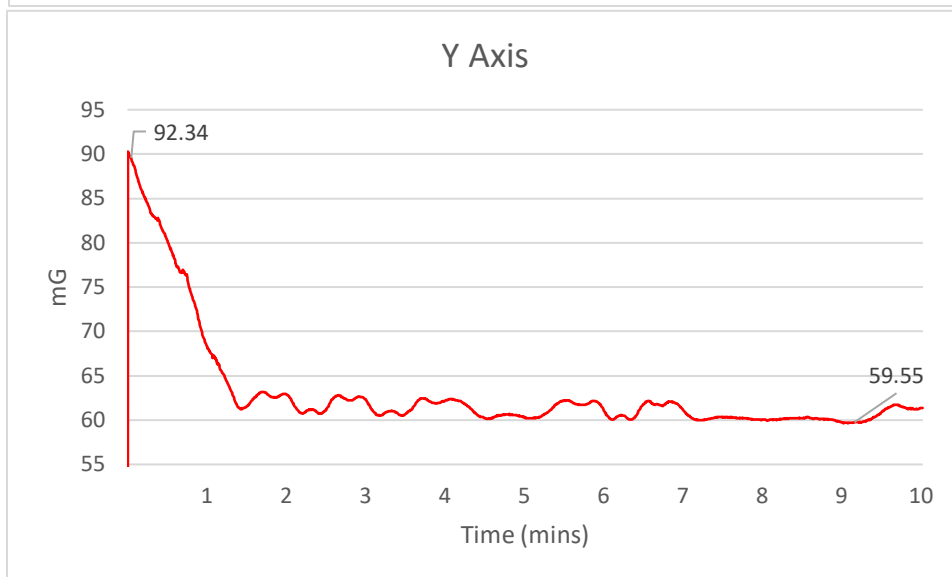
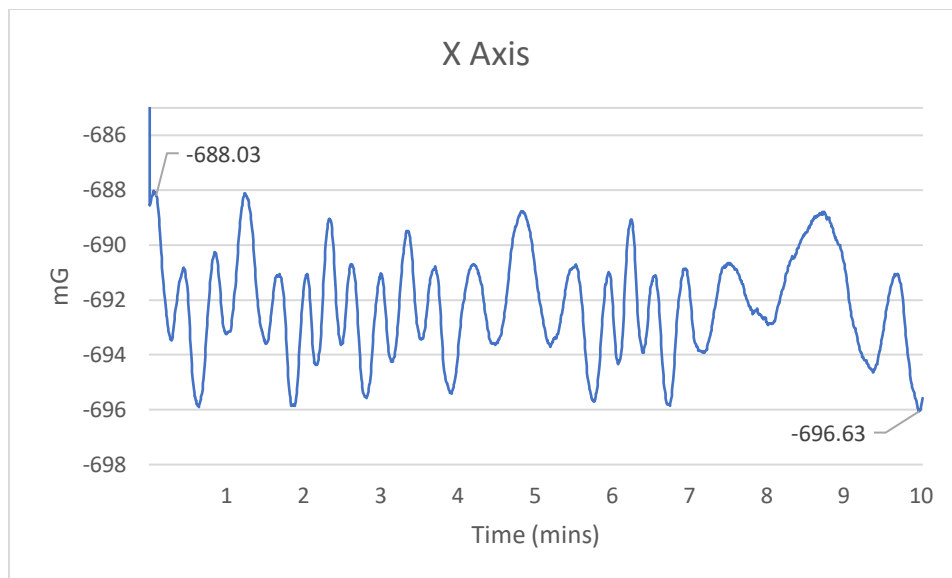
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685 WARDEN AVENUE: POINT A



685 WARDEN AVENUE: POINT B



685 WARDEN AVENUE: PHOTO DOCUMENTATION

Photo #1



Above & Below: A.C. Magnetic Field readings taken along the distribution lines on Warden Avenue

Photo #2



685 WARDEN AVENUE: PHOTO DOCUMENTATION

Photo #1



Above: A.C. Magnetic Field readings taken directly below the Hydro Corridor lines H11SL & H7SL 41

Below: Elevated A.C Magnetic Field readings located at the North side of the property. A combination of Hydro Corridor & Toronto Hydro distribution lines.

Photo #2



685 WARDEN AVENUE: PHOTO DOCUMENTATION

Photo #5



Above & Below: Soil conductivity and soil potential measurements were carried out in the centre of the property.

Photo #6



685 WARDEN AVENUE: PHOTO DOCUMENTATION

Photo #7



Above: D.C magnetic field readings taken at Point A.

Below: D.C magnetic field readings taken at Point B.

Photo #8

