Appendix E

Electric and Magnetic Field Report

This page intentionally left blank

Electric- and Magnetic-Field Assessment: Milvon to West River Railroad Transmission Line 115-kV Rebuild Project

Prepared for

The United Illuminating Company
100 Marsh Hill Rd.
Orange, CT 06477

Prepared by

Exponent
17000 Science Drive
Suite 200
Bowie, MD 20715

January 18, 2022

2004472.000 - 2140

Contents

List of Figures

Notice

At the request of The United Illuminating Company (UI), Exponent, Inc. (Exponent) modeled the electric and magnetic fields associated with the rebuild of transmission lines that connect the Milvon Substation in Milford, Connecticut, and the West River Substation in New Haven, Connecticut (the Project). This report summarizes work performed to date and presents the findings resulting from that work. In the analysis, we have relied on geometry, material data, usage conditions, specifications, and various other types of information provided by UI. We cannot verify the correctness of this input data, and rely on the client for the data's accuracy. UI has confirmed to Exponent that the summary of data provided to Exponent contained herein is not subject to Critical Energy Infrastructure Information restrictions. Although Exponent has exercised usual and customary care in the conduct of this analysis, the responsibility for the design and operation of the Project remains fully with the client.

The findings presented herein are made to a reasonable degree of engineering and scientific certainty. Exponent reserves the right to supplement this report and to expand or modify opinions based on review of additional material as it becomes available, through any additional work, or review of additional work performed by others.

The scope of services performed during this investigation may not adequately address the needs of other users of this report, and any re-use of this report or its findings, conclusions, or recommendations presented herein other than for permitting of this Project are at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. No guarantee or warranty as to future life or performance of any reviewed condition is expressed or implied.

Executive Summary

To maintain the reliability of the bulk transmission grid in the region, the United Illuminating Company (UI) proposes to rebuild the 115-kilovolt (kV) transmission lines that connect the Milvon Substation in Milford to the West River Substation in New Haven (the Project). En route, these 115-kV lines connect to the Woodmont Substation in Milford, the Allings Crossing Substation in West Haven, and the Elmwest Substation in West Haven.

At the request of UI, Exponent, Inc. (Exponent) *measured* the 60-Hertz electric- and magnetic-fields (EMF) levels associated with the existing 115-kV lines on Connecticut Department of Transportation [CT DOT] Railroad catenary structures between UI's Milvon and West River Substations. Exponent also *calculated* the EMF levels associated with operation of both the existing and rebuilt 115-kV lines (double-circuit monopoles located along the north side of the railroad tracks, principally within the existing CT DOT-owned corridor).

As part of the Project, UI proposes to remove two 115-kV transmission lines currently supported on the north and south side of existing railroad catenary structures, and relocate these circuits to new steel monopole structures, north of the existing catenary structures. This offset from the catenary structures to the new monopoles will vary based on location, but on average will be 25 feet. Where necessary, UI also will acquire additional easement beyond the existing CT DOT corridor boundary. This will provide a minimum horizontal distance of 25 feet from the transmission line conductors to the easement boundary in residential areas but not at all areas adjacent to commercial or industrial structures where additional easement is not available.

The results of this analysis demonstrate that before or after the Project, the EMF levels are far below internationally-recognized safety standards. The relocation of both transmission lines to double-circuit monopoles north of the existing catenary structures will both reduce overall EMF levels, and also shift the EMF profile to the northern side of the CT DOT corridor.

As a result, magnetic-field levels on the northern side of the CT DOT corridor will increase compared to existing levels. Although magnetic-field levels will increase as a result of the Project, magnetic-field levels decrease to levels similar to pre-project conditions within

approximately 100 feet of the existing CT DOT corridor boundary. Additionally, it is useful to note that the proposed magnetic-field levels at edge of the new UI easement will be similar to or lower than the existing levels at the edge of the existing CT DOT corridor. On the southern side of the CT DOT corridor, EMF from the proposed UI transmission lines will decrease substantially below existing levels along the entire Project route, because of the removal of the existing 115-kV transmission line on the southern catenary structures and its repositioning to the new monopole structures north of the railroad tracks.

Electric fields also shift northward as a result of the Project, but at the edge of the easement (either the existing CT DOT boundary or the proposed UI easement edge) electric-field levels were calculated to be low (0.6 kilovolts per meter or less) before and after the Project.

The calculated EMF levels associated with the Project are far below international safety and health-based standards for EMF. The engineering design and other activities initiated by UI demonstrate compliance with the Connecticut Siting Council's EMF Best Management Practices regarding EMF.

Note that this Executive Summary does not contain all of Exponent's technical evaluations, analyses, conclusions, and recommendations. Hence, the main body of this report is always the controlling document.

Introduction

The existing transmission lines between the Milvon and West River Substations are 60-years old. The lines were built atop railroad catenary structures that extend southwest-northeast within the Connecticut Department of Transportation (CT DOT) – Metro-North Railroad (MNR) Railroad corridor (the CT DOT corridor). Recent engineering analyses of the existing 115-kilovolt (kV) lines along the CT DOT corridor between the Milvon and West River Substations commissioned by The United Illuminating Company (UI) determined that the portions of the infrastructure that support the transmission lines exhibit age-related physical limitations, and that to maintain the reliability of the bulk transmission grid, the 115-kV transmission lines must be rebuilt to meet current National Electrical Safety Codes (NESC) and UI standards, which include the ability to withstand extreme weather conditions (e.g., hurricane category 3 events).

UI proposes to rebuild the 115-kV transmission lines on new double-circuit monopole structures from the Milvon Substation in Milford, to the West River Substation in New Haven (the Project), located parallel to and along the north side of the CT DOT corridor, on property mostly owned by the CT DOT. These 115-kV lines also connect to the Woodmont Substation in Milford, the Allings Crossing Substation in West Haven, and the Elmwest Substation in West Haven.

At the request of UI, Exponent, Inc. (Exponent) measured the 60-Hertz (Hz) electric- and magnetic-fields (EMF) levels associated with the existing 115-kV lines on CT DOT railroad catenary structures between UI's Milvon and West River Substations. Exponent also calculated the EMF levels associated with operation of both the existing and rebuilt 115-kV lines (double-circuit monopoles located along the north side of the railroad tracks, principally within the existing CT DOT-owned corridor).

The length of the transmission line segments between substations that were evaluated are:

- Milvon to Woodmont: 4.1 miles.
- Woodmont Road to Allings Crossing: 2.9 miles.

- Allings Crossing to Elmwest: 1.3 miles.
- Elmwest to West River: 1.2 miles.

The monopoles will be offset by varying distances from the catenary structures based on the CT DOT corridor width, clearance requirements specified by CT DOT / MNR, and electrical clearance standards. This offset will vary based on location, but on average will be 25 feet. Although only 13 of the 158 new double-circuit monopoles will be located outside of the CT DOT property, in many other locations, the new structures will be placed close to the edge of the CT DOT corridor. In these cases, UI will have to acquire new permanent easements from the owners of properties that abut the northern CT DOT corridor boundary. The new easements (typically 25 feet horizontally from transmission line conductors) will be required to adhere to mandated clearance distances for 115-kV conductors and for UI's operation, maintenance, and repair of the utility infrastructure. No new permanent easements will be required south of the CT DOT corridor except at limited locations (e.g., near UI's Elmwest and West Haven Substations). The configurations of the existing and proposed transmission lines are shown in Figure 1.

This report provides a summary of the modeling configurations, technical background, assessment criteria, calculation methods, and results. Attachment A provides a summary of the modeling configurations and loading. Attachments B and C provide tabular and graphical summaries of calculated results, respectively. Attachment D provides measurements of pre-construction EMF levels. A calibration certificate for the meter used to measure electric and magnetic fields is provided in Attachment E.

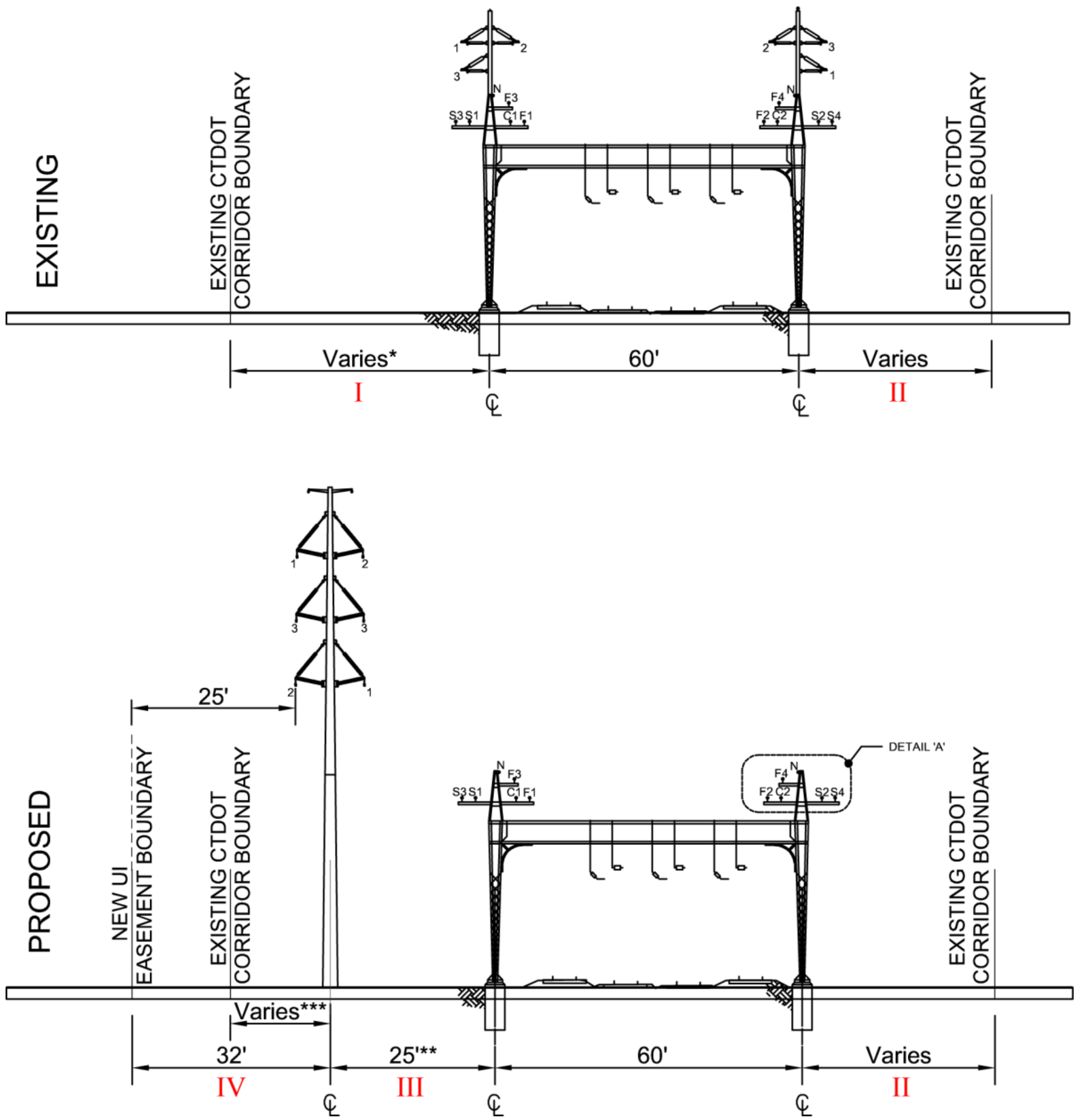

Figure 1. Existing and proposed configurations of the Project-related transmission lines and nearby CT DOT catenary structure (view facing northeast).

Distances I, II, III, and IV vary throughout the route. A summary of the range of these distances is summarized in Appendix A, Table A-1.

Model Configurations

The phasing of existing transmission lines is not uniform along the length of the Project because of changes at various points along the route due to maintenance over decades. For this reason, segments of the Project route with common phasing were combined into three groups for the EMF analyses. The configurations of these groups are described in three different models as shown in cross sections XS-A, XS-B, and XS-C. The configurations of the lines in these models are similar to those shown in Figure 1, except for variations in the phasing of the existing transmission lines and width of the existing CT DOT corridor. The proposed configuration of the structures on which the transmission circuits will be rebuilt is the same in all models, differing only in the spacing between the proposed transmission line structures and existing CT DOT catenary structures.

As noted, along different portions of the route, the spacing between the proposed double-circuit structures and the existing catenary structures varies, as does the width of the existing CT DOT corridor. Numerous models would be required to evaluate each unique combination of transmission line phasing and spacings. Conservative assumptions, however, were used in modeling to ensure that the reported EMF levels conservatively overestimate EMF levels along the Project. To achieve this conservative evaluation for the entirety of the Project in a concise and conservative manner, each model (XS-A, XS-B, and XS-C) was constructed using the following assumptions (with reference to Dimensions I, II, III, and IV in Figure 1).

- Dimension I: Minimum distance from the existing catenary structure to the existing CT DOT corridor boundary (north/west side).
- Dimension II: Minimum distance from the existing catenary structure to the existing CT DOT corridor boundary (south/east side).
- Dimension III: Minimum distance from the new monopole centerline to the existing catenary structure.
- Dimension IV: Distance between the new UI structure centerline and the edge of the new UI easement boundary.

The new UI monopole structures are proposed to be located on the north/west side of the existing CT DOT catenary structures, and because the width of the CT DOT corridor varies along the railway, where necessary, UI will acquire additional easement beyond the existing CT DOT corridor boundary. This will provide a minimum horizontal distance of 25 feet from the transmission line conductors to the easement boundary in the vicinity of residential areas. However, the CT DOT corridor is bordered by well-developed urban areas and in some route segments the proposed easement overlaps boundaries of existing commercial and industrial structures.

Attachment A provides a summary of the configurations of the three models (XS-A, XS-B, and XS-C) used to represent the various route segments, as well as a detailed description of the minimum and maximum values for Dimensions I through IV for each of the modeling cross sections.[1] A map showing the locations of these different modeled route segments is shown in Figure 2.[2]

---

[1] As described above, the transmission lines connect to multiple substations along the route and hence the electrical current flowing on the transmission lines also will vary along the route. The maximum loading appropriate to each modeling cross section was applied to conservatively overestimate magnetic-field levels in these models (Attachment A). .

[2] Figure 2 shows route segments that were not modeled as gaps. The majority of the unmodeled portions are transition spans (e.g., XS-A to XS-B) that are not well modeled by the two-dimensional modeling methods typically employed for transmission lines. EMF levels at transition spans, however, are generally lower than the modeled configurations due to additional cancellation of changing phases. Additionally, the conservatively-selected modeling parameters of minimum distances and maximum loads will generally overestimate EMF levels. Spans adjacent to substations may differ somewhat from spans further from the substation, but would require detailed three-dimensional modeling to evaluate. Additional unmodeled route segments include locations where the lines cross above roads and hence have much higher conductor clearances that result in lower EMF levels than calculated for other locations.

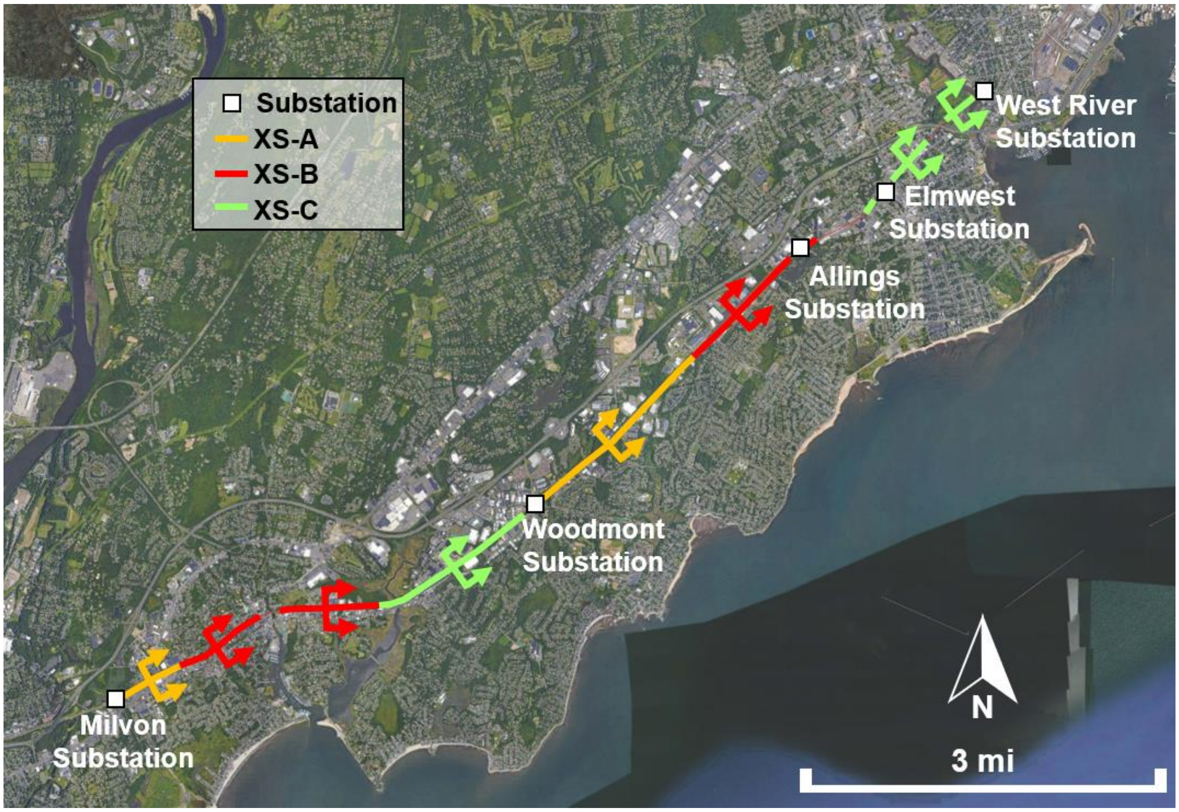

Figure 2. Overview of the route segments containing modeled cross-sections along the Project route.

The direction of arrows shows the view of modeled cross sections.

Technical Background

Magnetic Fields. The currents flowing in the conductors of transmission line and substation buswork generate magnetic fields near the conductors. The strength of Project-related magnetic fields in this report are expressed as magnetic flux density in units of milligauss (mG), where 1 Gauss = 1,000 mG. These currents (and thus magnetic fields) vary in direction and magnitude with a 60-Hz cycle. The load currents—expressed in units of amperes (A)—vary with the demand for electricity from customers, so generate magnetic fields around the conductors that vary proportionately to the load. Therefore, measurements or calculations of the magnetic field present a snapshot at only one moment in time. On a given day, throughout a week, or over the course of months and years, the magnetic-field level can change depending upon the patterns of power demand on the bulk transmission system.

Electric Fields. The voltage on the conductors of transmission lines generates an electric field in the space between the conductors and the ground. Many objects are conductive—including fences, shrubbery, and buildings—and thus shield electric fields. In this report, electric-field levels calculated for the transmission lines are expressed in units of kilovolts per meter (kV/m)—1 kV/m is equal to 1,000 volts per meter.

Electricity is an integral part of our infrastructure (e.g., transportation systems) and our homes and businesses, and people living in modern communities are therefore surrounded by sources of EMF. Figure 3 depicts typical EMF levels measured in residential and occupational environments and EMF levels measured on or at the edge of distribution line and transmission line rights-of-way.

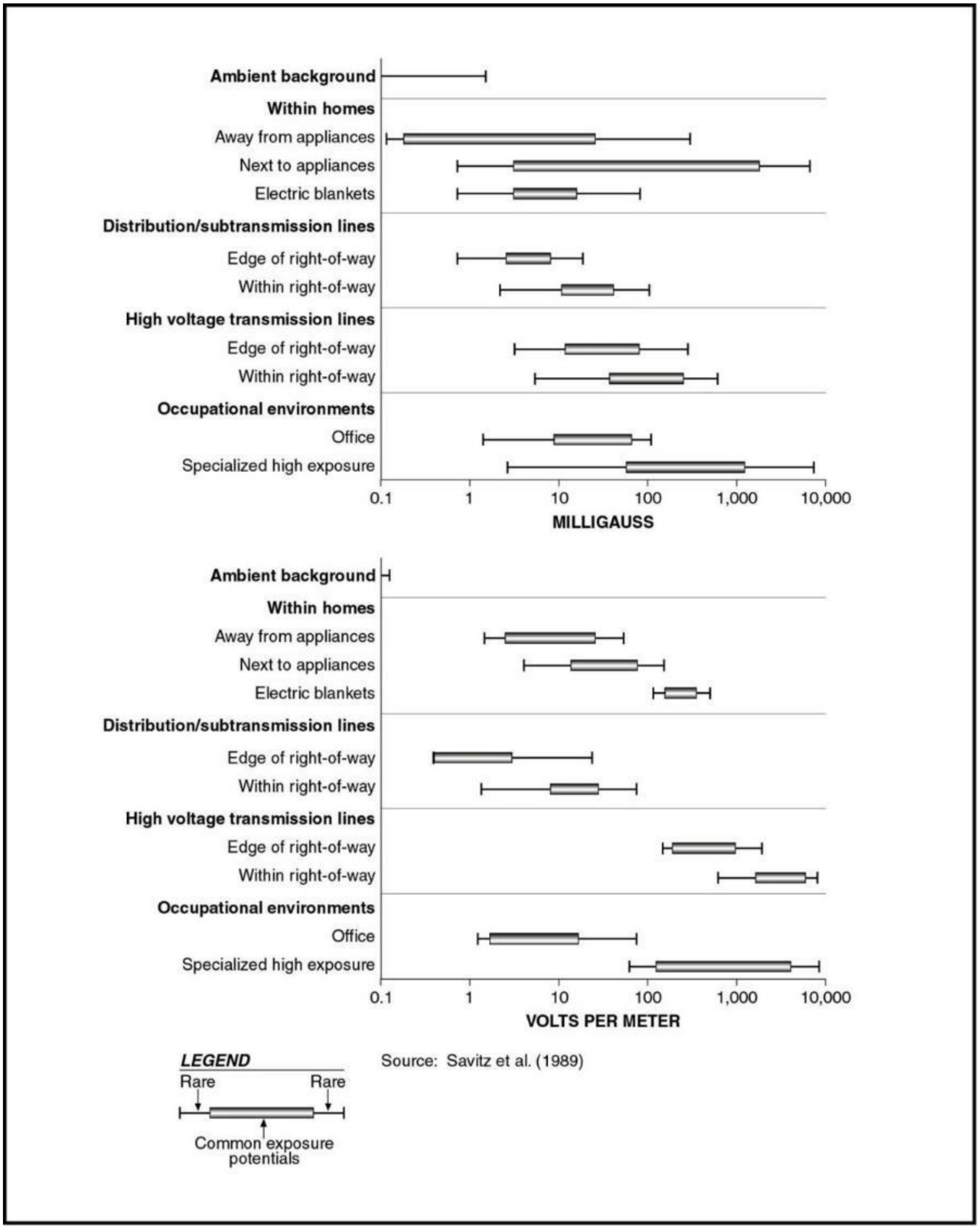

Figure 3. Electric- and magnetic-field levels in the environment.

Assessment Criteria

Neither the federal government nor the State of Connecticut has enacted standards for magnetic fields or electric fields from power lines or other sources at power frequencies, although the Connecticut Siting Council (CSC) has developed guidelines for the siting of new transmission lines as discussed in a subsequent section of this report.

Relevant health-based EMF assessment criteria include exposure limits recommended by scientific organizations. These exposure limits are included in guidelines developed to protect health and safety and are based upon reviews and evaluations of relevant health research. These guidelines include exposure limits for the general public recommended by the International Committee on Electromagnetic Safety (ICES) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) to address health and safety issues.[3]

In a June 2007 Factsheet, the World Health Organization (WHO) included recommendations that policy makers should adopt international exposure limit guidelines, such as those from ICNIRP or ICES (Table 1), for public and occupational exposure to EMF.[4]

Table 1. ICNIRP and ICES guidelines for EMF exposure at 60-Hz

	Exposure (60 Hz)	
	Electric Field	Magnetic Field
ICNIRP		
Occupational	8.3 kV/m	10 G (10,000 mG)
General Public	4.2 kV/m	2 G (2,000 mG)
ICES		
Occupational	20 kV/m	27.1 G (27,100 mG)
General Public	5 kV/m*	9.040 G (9,040 mG)

*Within power line rights of way, the guideline is 10 kV/m under normal load conditions.

[3] International Committee on Electromagnetic Safety (ICES). IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields 0 to 3 kHz. Piscataway, NJ: IEEE Std C95.1™-2019. IEEE Std C95.1™-2019/Cor2-2020; International Commission on Non-ionizing Radiation Protection (ICNIRP). Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz to 100 kHz). Health Phys 99: 818-836, 2010.

[4] World Health Organization (WHO). Fact Sheet No. 322: Electromagnetic Fields and Public Health – Exposure to Extremely Low Frequency Fields. Geneva, Switzerland: World Health Organization, 2007.

Connecticut Siting Council Best Management Practices

The CSC adopted "EMF Best Management Practices for the Construction of Electric Transmission Lines in Connecticut" (BMP) based upon a consensus of health and scientific agencies that the scientific evidence "*reflects the lack of credible scientific evidence for a causal relationship between MF [magnetic field] exposure and adverse health effects*" (CSC, 2014, p. 3). Nevertheless, the CSC concluded that precautionary measures for the siting of new transmission lines in the state of Connecticut are appropriate and advocates "*the use of effective no-cost and low-cost technologies and management techniques on a project-specific basis to reduce MF exposure to the public while allowing for the development of efficient and cost-effective electrical transmission projects*" (CSC, 2014, p. 4).

The CSC's EMF BMP guidance (CSC, 2014) expresses the CSC's interest in "*evidence of any new developments in scientific research addressing MF and public health effects or changes in scientific consensus group positions regarding MF*" (p. 5). Although the CSC's 2014 BMPs serve as the primary reference to new developments in EMF scientific research for this Project, Exponent notes that the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) of the European Union issued its opinion report in 2015 in which the Committee concluded that research published up to 2014 did not confirm any adverse health effects from EMF exposure. The SCENIHR review was the most comprehensive review completed since the WHO review in 2007 (WHO, 2007). The conclusions of the 2015 SCENIHR review are consistent with the conclusions expressed in the WHO report and the BMPs published in 2014.

The Project does not involve the development of new transmission lines, but rather the relocation of existing 115-kV transmission lines within the CT DOT corridor and new UI easements. Exponent considers the Project consistent with the CSC's EMF BMP for "no cost/low-cost" design based on the following:

1. **Distance**: The Project proposes to remove the existing transmission lines on both the north and south sides of the CT DOT catenary structures. Both 115-kV lines will be rebuilt on double-circuit monopoles north of the railroad tracks and thus much farther from the southern CT DOT boundary. Although the new double-circuit structures CT DOT will be closer to (and in the case of 13 structures, outside of) the northern CT DOT corridor

boundary, UI proposes to acquire new permanent easements, where necessary, adjacent to the CT DOT property. The new permanent easement is required to maintain a minimum horizontal distance of 25 feet between the new conductors and any future development, as required by federal and UI standards for conductor clearance. UI's acquisition of the proposed permanent easement will assure that no future development, inconsistent with overhead transmission line use, will occur within 25 feet of the conductor. Along the Project route, no existing homes are located within the proposed new easement area. CT DOT

2. **Height of Support Structures**: The taller monopole structures will raise the heights of the conductors of all the rebuilt 115-kV transmission lines compared to both existing catenary structures (which are about 60 feet with the UI facilities on top of the bonnets) and will be higher than minimum clearances required by the NESC.

3. **Line Consolidation and Conductor Configuration**: The proposed transmission line structures are dual-circuit vertical structures, with conductors arranged vertically, which greatly reduces the distance between lines compared to the existing configuration (where the two transmission lines are on bonnets on opposite sides of the CT DOT catenary structures). The proposed line configuration will result in substantial mutual-cancellation of EMF from the two transmission lines, resulting in lower overall EMF levels.

4. **Optimum Phasing**: Related to the consolidation of the lines and their configuration and separation, UI has selected the phasing of the dual-circuit vertical structures to be optimal, minimizing EMF levels at the edge of the CT DOT corridor boundary / new UI easement.

Methods

EMF Measurements

EMF measurements of the existing UI transmission lines along the CT DOT corridor were performed on June 28 and July 7, 2021. The purpose of these measurements was to characterize existing EMF levels along the CT DOT corridor and adjacent areas. The measurements were taken at a height of approximately 3.28 feet (1 meter) above ground in general accordance with the standard methods for measuring near power lines (IEEE Std. 644-2019).[5] Both electric fields and magnetic fields were expressed as the total field computed as the resultant of field vectors measured along vertical, transverse, and longitudinal axes.[6] The fields were measured with meters calibrated using methods like those described in IEEE 644-2019.

Exponent collected electric-field and magnetic-field measurements along the existing CT DOT corridor and along the Woodmont Road overpass in Milford, where it transects the transmission centerlines. Results of these measurements are summarized in the Results section below with additional details provided in Attachment D.

EMF Modeling

Exponent used computer algorithms developed by the Bonneville Power Administration (BPA), a division of the US Department of Energy, to calculate electric field and magnetic fields for the Project transmission lines.[7] UI provided the data regarding voltage, current flow, phasing, and conductor configuration. When used as inputs to the BPA algorithms, these parameters have been confirmed to accurately predict EMF levels measured near operating transmission lines

[5] Institute of Electrical and Electronics Engineers (IEEE). IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines (ANSI/IEEE Std. 644-2019). New York: IEEE, 2019.

[6] Measurements along the vertical, transverse, and longitudinal axes were recorded as root-mean-square magnitudes. Root mean square refers to the common mathematical method of defining the effective voltage, current, or field of an alternating current system.

[7] Data on the loading and configuration of the MNR conductors was not available and so these conductors were not included in the models. EMF from the existing configurations (including from MNR conductors) were captured in existing measurements performed June 28 and July 7, 2021, as summarized in Attachment D.

(Chartier and Dickson, 1990; Perrin et al., 1991). The calculation models assume that each conductor is infinite in length, above an infinite flat earth, with no nearby conductive objects. In addition, they assume that the conductors are all parallel to each other at a fixed height above ground.

Exponent calculated EMF levels at a height of 3.28 feet (1 meter) above ground, and reported as the root mean square value of the field in accordance with Institute of Electrical and Electronics Engineers (IEEE) Standards (C95.3.1-2010 and 644-2019).

Loading

The flow of electrical current on conductors is commonly referred to as the load or loading. A summary of the loading for each model is provided in Attachment A, along with a summary of the process undertaken by UI to determine these loading levels based upon reports from the Independent System Operator of New England (ISO-NE). The current flows used for modeling are also summarized in a table available from Exponent upon request, consistent with Critical Energy Infrastructure Information restrictions.

Results and Discussion

Measured EMF Levels

EMF measurements were obtained within the CT DOT corridor (as close to the edges of the corridor as could be safely measured) and at or near the boundaries of the adjacent properties listed in Attachment D. Measured magnetic-field levels within the CT DOT corridor averaged between 20 and 23 mG.[8] Measured electric-field levels within the CT DOT corridor varied between approximately 0.2 and 0.3 kV/m with a maximum measured level of 0.5 kV/m. EMF measurements in other areas within 300 feet of the CT DOT corridor were generally lower, consistent with the rapid decrease in EMF levels with distance. The average measured magnetic field in these areas (outside the CT DOT corridor) varied from approximately 0.2 mG to 8.7 mG, and all electric-field levels were generally less than 0.1 kV/m.

Attachment D provides both annotated aerial photographs of measurement locations and measured EMF values collected while walking within the existing CT DOT corridor and adjacent to residential properties. Attachment D also provides measured EMF values along the Woodmont Road overpass that transects the transmission lines. Table D-2 of Attachment D provides summary statistics for all obtained measurements.

Calculated EMF Levels

The calculated EMF levels from the Project are very far below accepted levels of exposure to the general public in ICNIRP or ICES standards. Figure 4 shows the graphical representations of the calculated EMF levels on the same scale as the ICNIRP reference levels (2,000 mG and 4.2 kV/m). The scale of the graph on the right is changed to magnify the small differences between the calculated existing and proposed EMF levels. The highest EMF levels are in route segments with the transmission lines in configuration XS-C; these result from the higher

[8] Isolated magnetic-field levels reached up to 197 mG, corresponding to locations while walking across the railway from one side of the CT DOT corridor to the other. This observation is consistent with potential current flow related to railroad operation, though the source was not conclusively identified through measurements. Regardless, these maximum levels occurred near the center of the CT DOT corridor, far from the edge of the corridor or adjacent properties.

electrical loading on the transmission lines. Here, even directly beneath the transmission lines where EMF levels are highest, EMF levels are more than 30-fold below the lowest limit. Farther from the transmission lines, at the CT DOT corridor boundary and beyond, EMF levels are still lower. In other proposed Project configurations (e.g., XS-A and XS-B), the EMF levels are even lower, and therefore very far below the lowest limit for exposure of the general public.

The calculated EMF levels for existing and proposed configurations of the modeled cross-sections are discussed below. Attachment B contains a tabular summary of magnetic-field levels at average and peak loading (Table B-1 and Table B-2, respectively) and electric-field levels (Table B-3). Attachment C provides graphical profiles of magnetic-field levels (Figure C-1 to C-3) and electric-field levels (Figures C-4 to C-6) illustrating the EMF level along transects perpendicular to each segment of the Project route for existing and proposed conditions. These graphical profiles provide a visual summary of the calculated results along with representations of the existing and proposed structures for illustrative purposes. These results also show that the new UI easement extends farther north from the existing CT DOT corridor boundary.

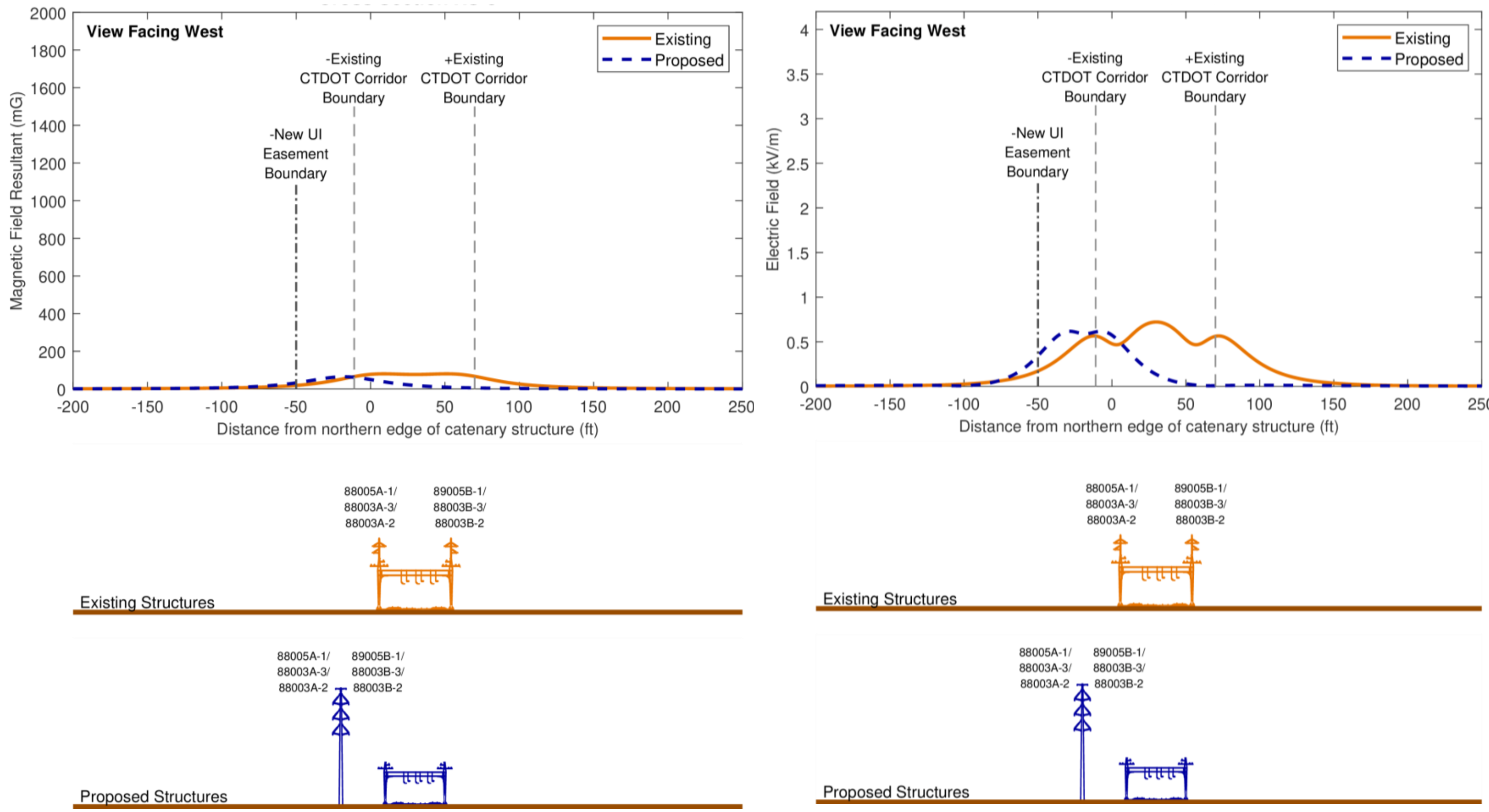

Figure 4. Magnetic-field levels in XS-C compared to the ICNIRP limit of 2,000 mG (left) and electric-field levels in XS-C compared to the ICNIRP limit of 4.2 kV/m (right). ICES limits for magnetic and electric fields within a transmission line right of way are 9,040 mG and 10 kV/m, respectively. These limits are represented by the upper bounds of the graphs. Note change in scale of figure at right to magnify the small differences in existing and proposed calculated field levels.

Magnetic Fields

The relocation of the transmission lines to double-circuit monopoles north of the existing catenary structures has two main effects on EMF levels.

First, the overall EMF levels are reduced due to co-location of the transmission lines on new monopole structures in a vertical configuration (with optimal phasing). This design also reduces the maximum magnetic field under the lines.

Second, the existing EMF profile is roughly centered on the CT DOT corridor, but the proposed profile shifts to the northern side of the CT DOT corridor. As a result, magnetic-field levels at the northern edge of the CT DOT corridor will increase compared to existing levels. At average loading, the highest magnetic-field level underneath the existing lines was calculated to be 80 mG in XS-C, decreasing to 65 mG for the rebuilt lines (see Attachment B, Table B-1). The existing magnetic-field levels at the northern CT DOT corridor boundary range from 21 mG to 65 mG. At the same CT DOT corridor boundary, the magnetic-field levels for the proposed configurations vary between 40 mG and 62 mG. As shown in Appendix B, Table B-1 and B-2, field levels decrease rapidly with distance to within 1 mG of pre-project levels within approximately 100 feet of the existing CT DOT corridor boundary and are 4.7 mG or less for either existing or proposed configurations.

At the southern CT DOT corridor boundary, a decrease in the magnetic-field level was evident because of the removal of the transmission line from the southern catenary structures. The magnetic-field level at the existing southern CT DOT corridor boundary ranges between 63 mG and 67 mG and decreases to 5.4 mG or less after the Project.

The magnetic-field levels were calculated to be similar for peak and average loading, as summarized in Attachment B, Table B-2.

Electric Fields

The calculated profiles of electric fields also shift northward as a result of the Project, but remain low both before and after the Project. The maximum electric-field levels under the existing lines are generally low (a maximum of 0.7 kV/m) and the maximum electric-field was not calculated to change significantly as a result of the Project (0.6 kV/m). At the edge of the easement (either the existing CT DOT boundary or the proposed UI easement edge), electric-field levels also were calculated to be low (0.6 kV/m or less) before and after the Project.

Conclusions

This report summarizes measurements and calculations of the EMF levels associated with the pre-Project configuration and post-Project configurations of the UI Milvon to West River 115-kV transmission lines. Elements of the Project design reduce magnetic field levels, a goal consistent with the CSC's EMF BMPs design goals (e.g., taller structures, line consolidation onto a single structure, and optimal phasing). Additionally, all measured and calculated EMF levels associated with the Project were a small fraction of limits recommended for the general public by international health-based standards (i.e., ICES and ICNIRP).

Pre-construction EMF measurements along the Project route were generally consistent with EMF levels calculated for the existing configurations of the transmission lines. Measured EMF levels outside the CT DOT corridor were generally lower than those measured inside the corridor, consistent with the rapid decrease in EMF levels with distance.

The relocation of both transmission lines to double-circuit monopoles north of the existing catenary structures will both reduce overall EMF levels and also shift the EMF profile closer to the northern side of the CT DOT corridor. As a result, magnetic-field levels on the northern side of the CT DOT corridor will increase compared to existing levels, but will diminish to within 1 mG of pre-project levels within approximately 100 feet of the existing CT DOT corridor boundary.

On the southern side of the CT DOT corridor, EMF from the proposed UI transmission lines will decrease substantially below existing levels along the entire Project route because of the removal of the transmission line on the southern catenary structures and its repositioning to new monopole structures.

Electric-field levels at the edges of the CT DOT boundary were calculated to be low (0.6 kV/m or less) before and after the Project.

Attachment A

Transmission Line Configurations and Loadings

Transmission Line Configurations

As a part of the Project, all existing transmission lines will be removed and replaced by transmission lines located on steel monopole structures north of the existing catenary structures, with a greater minimum height from the ground. The physical configurations of the transmission lines are similar throughout the route, with some small differences in the existing phasing of the transmission lines and with varying distances between the proposed transmission lines, the existing infrastructure, and the boundaries of the new UI easement. Three models were developed to conservatively evaluate EMF levels for all these variations: XS-A, XS-B, and XS-C (as shown in Figure 2).

The primary differences among the modeled cross sections were: 1) the phasing of the existing transmission lines; 2) the separation distance between the new proposed structures and the existing catenary railroad structures; and 3) the width of the existing CT DOT corridor (and new UI easement). These dimensions are shown graphically in Figure 1 and a summary of the range of distances is summarized in Table A-1. During modeling, Exponent conservatively used the minimum distances between the catenary structures and the existing CT DOT boundaries on both the north and south sides to represent the highest EMF levels at these boundaries. The EMF calculations were performed for three models of route segments that describe more than 90% of the route, excluding only transition structures, structures outside substations and some road/highway crossings.

XS-A represents portions of the Project route between the Milvon and Allings Crossing Substations, specifically, the portions bounded by structures P888N to P898N and P959N to P990N. The existing line is constructed on top of railroad catenary structures, supported by metal bonnets.

XS-B represents portions of the Project route between the Milvon and Elmwest Substations, specifically the portions bounded by structures P898N to P910N, P914N to P929N, P990N to P1007N, and P1009N to P1017N. The existing line is constructed on top of railroad catenary structures, supported by metal bonnets.

XS-C represents portions of the Project route between the Milvon and Woodmont and between Allings and West River Substations, specifically the portions bounded by structures P929N to P956N, P1024N to P1028N, P1030N to P1038N, and P1043N to P1049N. The existing line is constructed on top of railroad catenary structures, supported by metal bonnets.

Loading

The flow of electrical current on conductors is commonly referred to as the load or loading. UI Transmission Planning provided the pre- and post-Project loadings for the Project-related 115-kV transmission lines, based on reports from ISO-NE as described below.

UI is required by the CSC's BMP to provide calculations of EMF for "pre and post project conditions, under: 1) peak load conditions at the time of application filing, and 2) projected seasonal maximum 24-hour average current load on the line anticipated within five years" of the operational in service date.[9] The loading along the route varies as the transmission lines enter and exit various substations and hence magnetic-field levels also will vary along the route. The loading selected to calculate the magnetic fields from each model (XS-A to XS-C) was the highest loading of any segment within the respective group.

Line loadings for existing and proposed conditions were provided by UI. The maximum average and peak loading values of transmission lines in each cross section were used in modelling, regardless of the other route segments.

[9] Connecticut Siting Council (CSC). Electric and Magnetic Fields Best Management Practices for the Construction of Transmission Lines in Connecticut (Revised February 20, 2014). New Britain, CT: Connecticut Siting Council, 2014, p. 6.

Table A-1. Modeled transmission line segments, distances from old to new structures and corridor and easement boundaries

Route Section	Structure Numbers	Dimension I: Distance from catenary structure to existing CT DOT corridor north boundary (feet)	Dimension II: Distance from catenary structure to existing CT DOT corridor south boundary (feet)	Dimension III: New pole distance from existing catenary structure (feet)	Dimension IV: New pole distance to new UI easement north boundary (feet)
Milvon to Woodmont	P888N to P898N	45 - 71	7 - 71	24 – 36	32
Woodmont to Allings Crossing	P959N to P990N	43 - 143	15 - 116	22 – 42	32
Cross section XS-A modeling parameters		43	7	22	32
Milvon to Woodmont	P898N to P910N, P914N to P929N	21 - 91	10 - 80	20 – 33	32
Woodmont to Allings Crossing	P990N to P1007N	36 -76	10 - 43	24 – 31	32
Allings Crossing to Elmwest	P1009N to P1017N	31 - 58	21 - 33	20 – 51	32
Cross section XS-B modeling parameters		21	10	20	32
Milvon to Woodmont	P929N to P956N	26 - 97	10 - 103	18 – 69	32
Woodmont to Allings Crossing	P1024N to P1028N	34 - 46	25 - 55	21 – 51	32
Elmwest to West River	P1030N to P1038N, P1043N to P1049N	11 - 106	10 - 85	21 – 51	32
Cross section XS-C modeling parameters		11	10	18	32

Loading levels were provided to Exponent by UI. Excerpts from the power flow analysis supporting these load levels are quoted below.

> Forecast values in the 2020 ISO-NE [Independent System Operator of New England] Capacity, Energy, Loads, and Transmission (CELT) Report were used to determine specific load levels … The ISO-NE CELT report forecasts load data for ten years (e.g. 2020-2029); consequently, load forecasts for the full five years after the final transmission line segment goes into service are not available … therefore the 2029 forecast provided in the CELT Report was the final year considered for this analysis.[10]

The analysis steps performed by UI for determining the Peak Daily Average Load (2025-2029) include:

- UI first "[c]ollect[ed] actual hourly NE Load levels by using the ISO-NE SMD hourly data from the year prior to the CELT publication year … The 2020 CELT report is based on 2019 data and so this data was used to maintain consistency. The hourly data can be found here: http://www.iso-ne.com/isoexpress/web/reports/pricing/-/tree/zone-info."
- Next, UI "[d]etermine[d] the peak daily average load by finding the average load for each day of the year and then determining the single day with the highest value …"
- Finally, "[t]o estimate the value within 5 years of the project in-service date, [UI] scale[d] the actual maximum daily average load by the New England load growth rate from the data year until the projected load year. This can be deduced from the CELT report … Growth rate = (Projected system peak load)/(Data year peak load)."

The specific loading values used in the calculations of magnetic fields are classified as Critical Energy/Electric Infrastructure Information (CEII) and available to the CSC upon request.

[10] Milvon – West River 115 kV Transmission Line Rebuild Flow Study: Power Flow Analysis Report (5/4/2021).

Attachment B

Calculated EMF Levels

Table B-1. Magnetic-field levels (mG) at average loading

		Location					
Cross section	Configuration	–100 feet from Existing (Northern) CT DOT Corridor Boundary	–New UI (Northern) Easement Boundary	–Existing CT DOT (Northern) Corridor Boundary	Maximum	+Existing CT DOT (Southern) Corridor Boundary	+100 feet from Existing (Southern) CT DOT Corridor Boundary
XS-A	Existing	2.1	15	21	71	63	3.9
	Proposed	2.1	28	40	57	4.6	0.6
XS-B	Existing	3.0	16	45	73	60	3.7
	Proposed	3.5	29	58	58	4.6	0.6
XS-C	Existing	4.0	19	65	80	67	4.1
	Proposed	4.7	32	62	65	5.4	0.7

Table B-2. Magnetic-field levels (mG) at peak loading

		Location					
Cross section	Configuration	–100 feet from Existing (Northern) CT DOT Corridor Boundary	–New UI (Northern) Easement Boundary	–Existing CT DOT (Northern) Corridor Boundary	Maximum	+Existing CT DOT (Southern) Corridor Boundary	+100 feet from Existing (Southern) CT DOT Corridor Boundary
XS-A	Existing	1.9	14	19	66	58	3.6
	Proposed	2.0	26	38	53	4.3	0.6
XS-B	Existing	3.1	16	46	75	62	3.8
	Proposed	3.5	30	60	60	4.8	0.7
XS-C	Existing	4.3	20	70	86	72	4.4
	Proposed	5.1	35	66	69	5.8	0.8

Table B-3. Electric field levels (kV/m)

Cross section	Configuration	Location					
		–100 feet from Existing (Northern) CT DOT Corridor Boundary	–New UI (Northern) Easement Boundary	–Existing CT DOT (Northern) Corridor Boundary	Maximum	+Existing CT DOT (Southern) Corridor Boundary	+100 feet from Existing (Southern) CT DOT Corridor Boundary
XS-A	Existing	<0.1	0.1	0.2	0.7	0.5	< 0.1
	Proposed	<0.1	0.3	0.5	0.6	< 0.1	< 0.1
XS-B	Existing	<0.1	0.2	0.5	0.7	0.6	< 0.1
	Proposed	<0.1	0.3	0.6	0.6	< 0.1	< 0.1
XS-C	Existing	<0.1	0.2	0.6	0.7	0.6	< 0.1
	Proposed	<0.1	0.3	0.6	0.6	< 0.1	< 0.1

Attachment C

Graphical Profiles of Calculated EMF

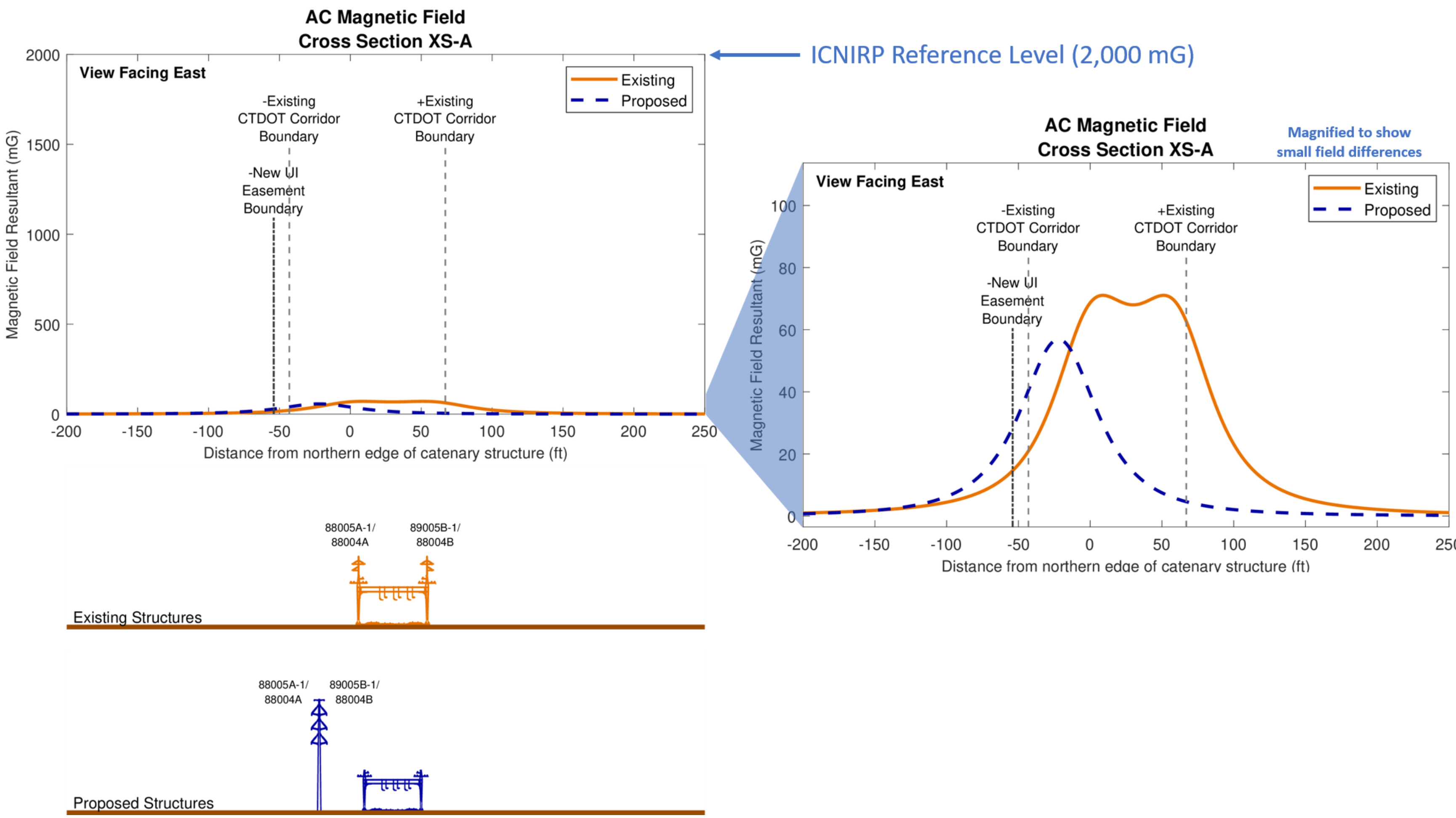

Figure C-1. Magnetic-field profile across XS-A at average loading.

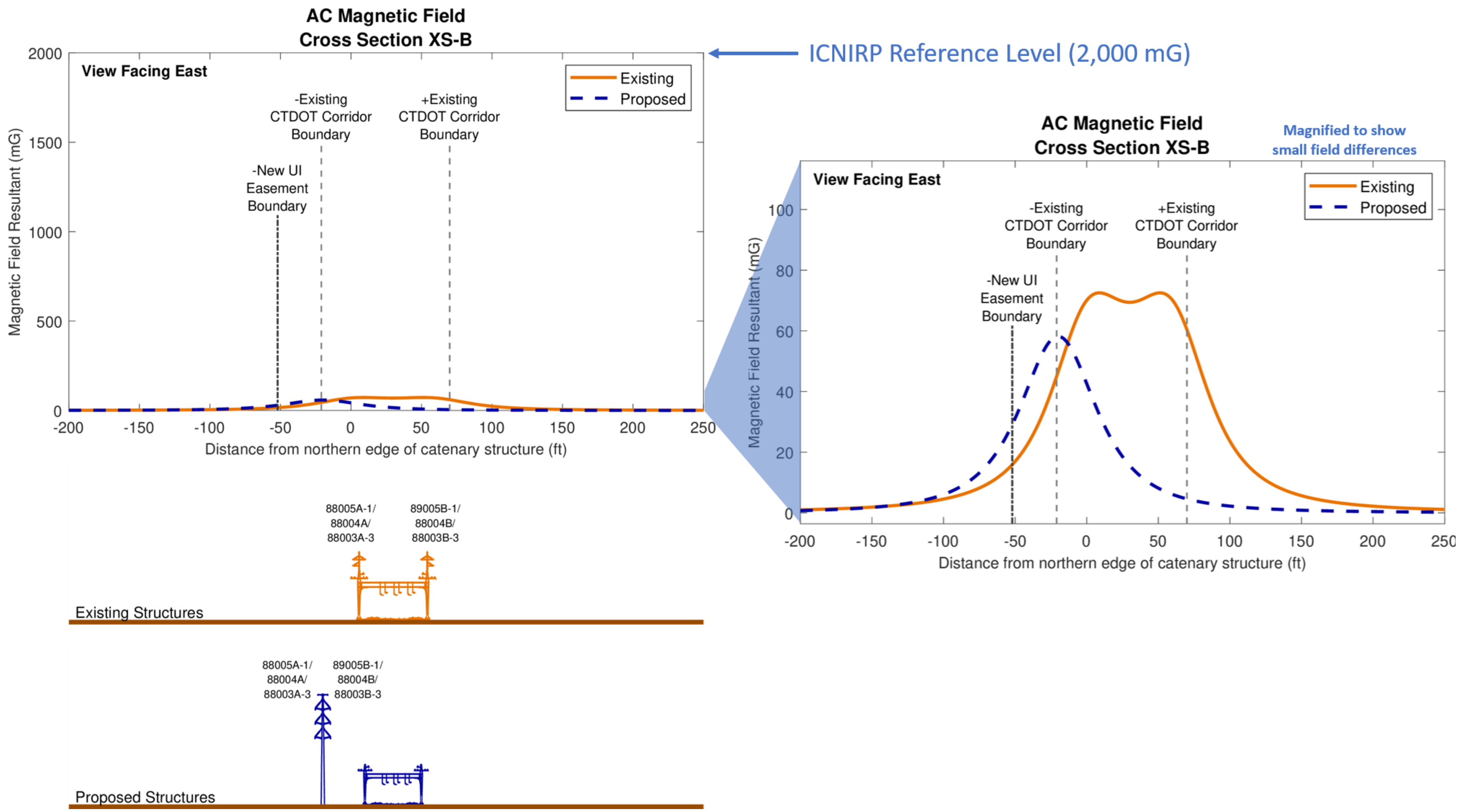

Figure C-2. Magnetic-field profile across XS-B at average loading.

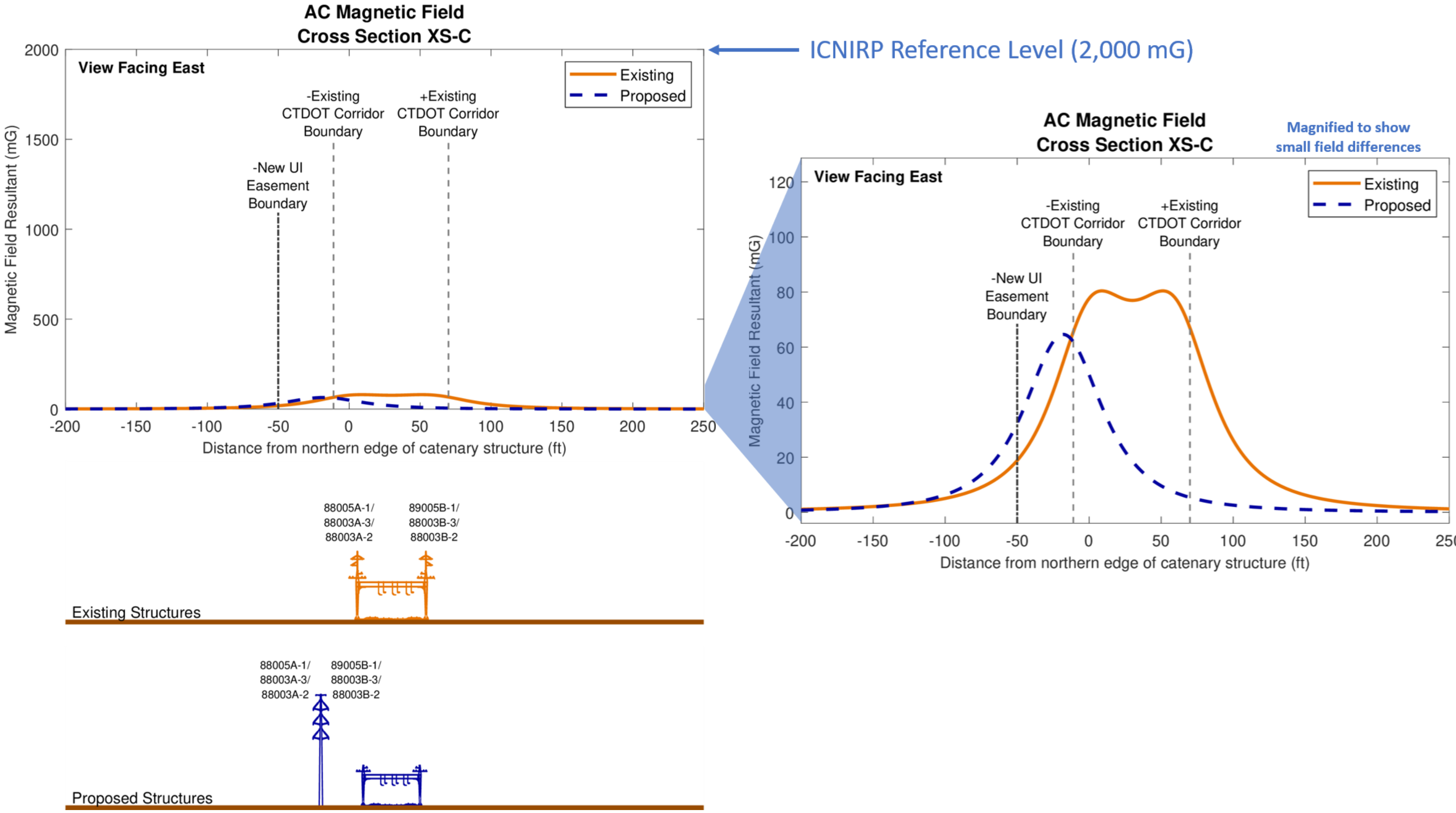

Figure C-3. Magnetic-field profile across XS-C at average loading.

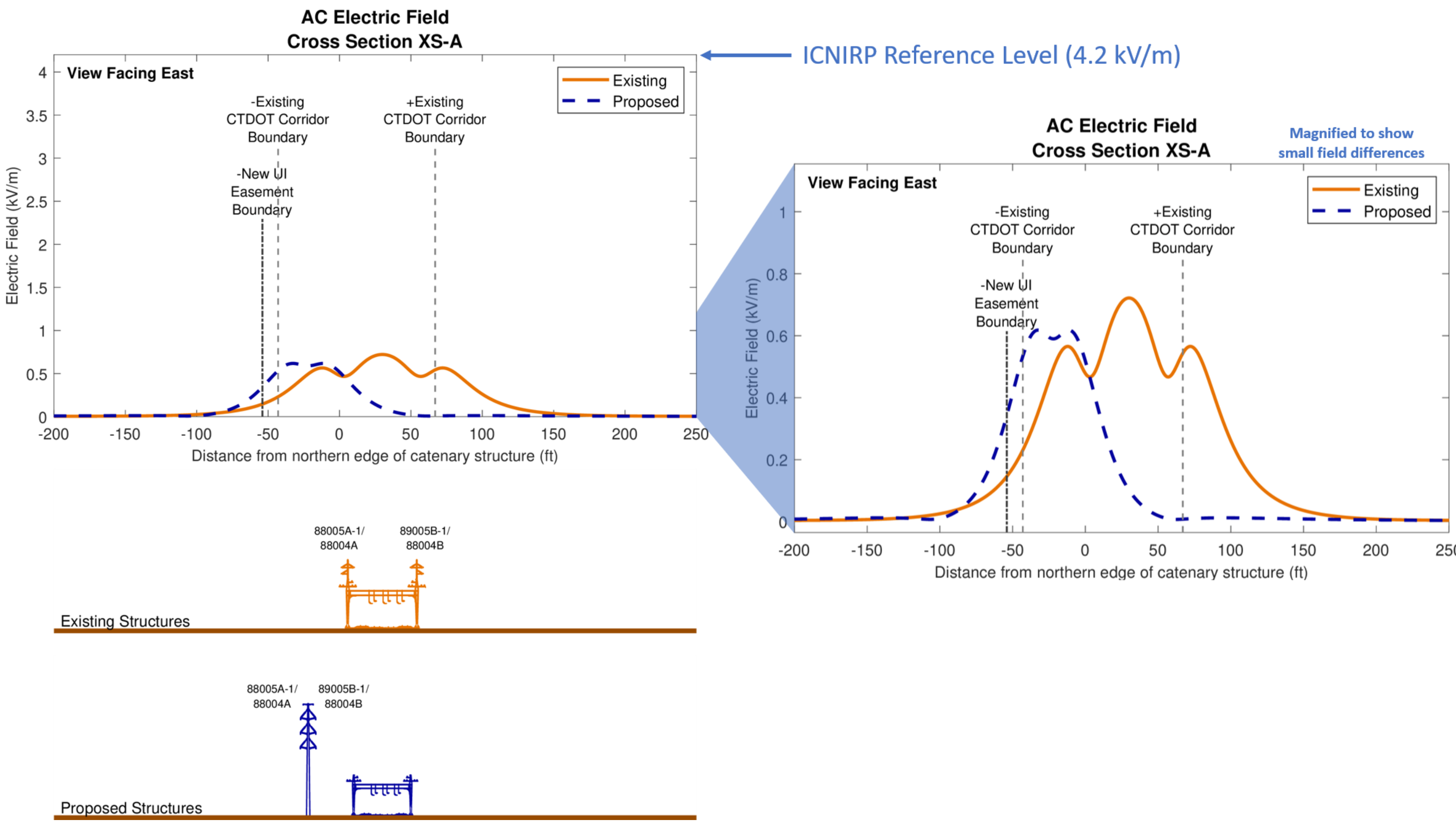

Figure C-4. Electric-field profile across XS-A at average loading.

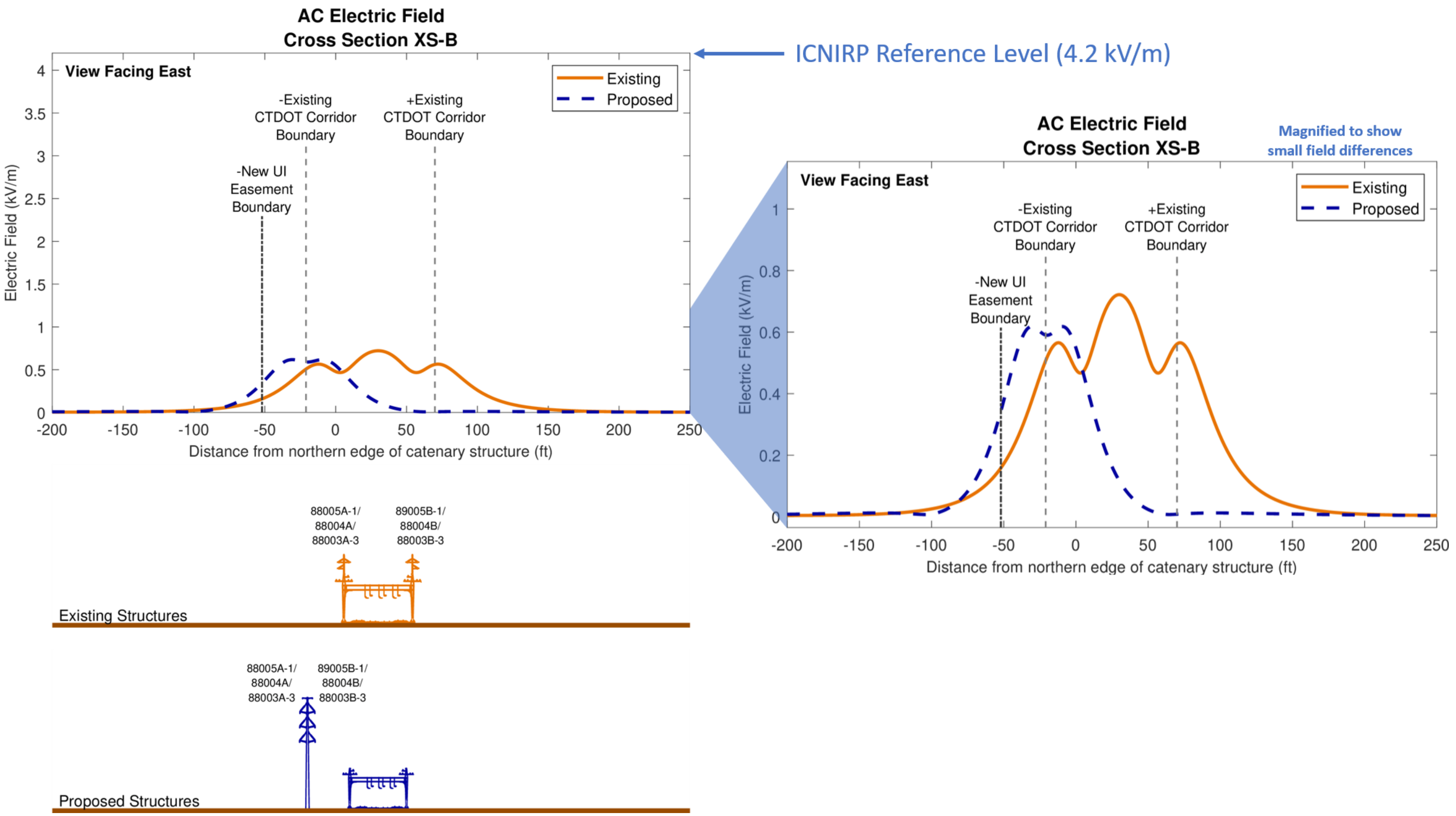

Figure C-5. Electric -field profile across XS-B at average loading.

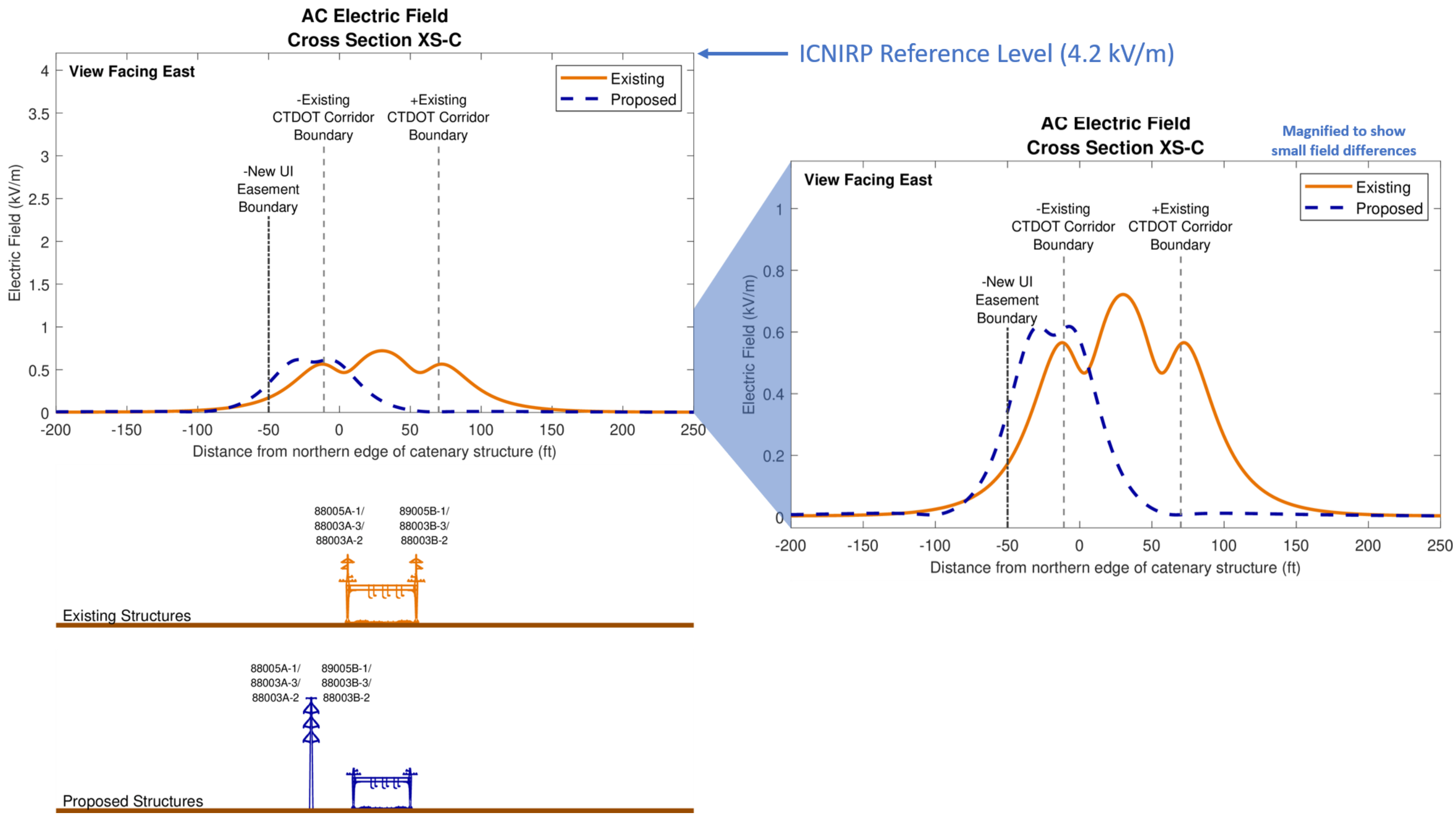

Figure C-6. Electric -field profile across XS-C at average loading.

Attachment D

Pre-Construction EMF Measurements

Pre-Construction EMF Measurements

In accordance with CSC guidance (CSC, 2016), measurements of EMF were taken at or near the edges of property boundaries, which included "adjacent schools, daycare facilities, playgrounds, and hospitals (and any other facilities described in Conn. Gen. Stat. § 16-50l)." Existing EMF levels were measured on June 28 and July 7, 2021. The measurements were taken at a height of approximately 1 meter (3.28 feet) above ground in general accordance with the standard methods for measuring EMF near power lines (IEEE Std. 644-2019). Both electric fields and magnetic fields were expressed as the total field computed as the resultant of field vectors measured along vertical, transverse, and longitudinal axes.[11] The magnetic field was measured in units of mG by orthogonally-mounted sensing coils whose outputs were logged by a digital recording meter (EMDEX II) manufactured by Enertech Consultants. The electric field was measured in units of kV/m with a single-axis field sensor attachment for the same EMDEX II meter. These instruments meet the IEEE instrumentation standard for obtaining accurate field measurements at power line frequencies. The meters were calibrated by the EMDEX LLC by methods like those described in IEEE Std. 644-2019. A calibration certificate is provided in Attachment E.

The locations identified by UI for measurements are summarized in Table D-1, and were grouped together for ease of measurements (non-residential areas are highlighted in blue). Areas with residences within 100 feet of the new structure are indicated with highlighted text. Figure D-1 depicts the CT DOT corridor and measurement locations overlayed on Google Earth satellite imagery. Along this route, Exponent collected electric-field and magnetic-field measurements along the existing CT DOT corridor where safely accessible. Close-up depictions of these route sections are provided in Figure D-2 and Figure D-3. In Figure D-2, the GPS-tracked measurement path walked along the northern-end of the proposed route is overlayed in green. Figure D-3 depicts the GPS-tracked measurement paths for separately accessed sections (green, blue, and red traces) of the southern-end of the CT DOT corridor.

[11] Measurements along the vertical, transverse, and longitudinal axes were recorded as root-mean-square magnitudes. Root mean square refers to the common mathematical method of defining the effective voltage, current, or field of an AC system.

Table D-1. Locations identified for measurements by UI

Location Name	Category	Location Address	Measurement Area (Table D-2)	Model XS Number	Distance from New Line (ft)
Duck Pond Day Care Preschool	Day Care	132 New Haven Ave. Milford, CT	Adjacent Area 6	XS-B	South Side 245
Gingerbread House of Milford	Day Care	61 River St. Milford, CT	Adjacent Area 7	XS-B	North Side 175
Day Care	Day Care	37 George St. West Haven, CT	Adjacent Area 20	XS-C	South Side 315
Great Beginnings Preschool	Day Care	100 Washington St. Milford, CT	Adjacent Area 16	XS-A	North Side 90 to 380
Beaver Brook Trails	Parks & Recreation	631 West Ave. Milford, CT	Beyond Area 15	XS-A	North Side ~630
Playground	Playground	1-11 Hill St. Milford, CT	Beyond Area 9	XS-B	North Side 165 to 525
Harborside Middle School	School	175 High St. Milford, CT	Beyond Area 8	Transition Spans	North Side 380
Milford Center for the Arts	Youth Camp	40 Railroad Ave. Milford, CT	Pin 9	Transition Spans	South Side 65
Residential Area 1	Residential	West Ave. Milford, CT	Area 15	XS-A	North Side 60 to 385
Residential Area 2	Residential	Washington St. Milford, CT	Area 16	XS-A	North Side 75 to 260
Residential Area 3	Residential	Dorsey Ln. Milford, CT	Area 14	XS-A	South Side 215 to 400
Residential Area 4	Residential	Pearl Hill St. Milford, CT	Area 10	XS-B	North Side 60 to 255
Residential Area 5	Residential	Golden Hill St. Milford, CT	Area 11	XS-B	South Side 100 to 330
Residential Area 6	Residential	North of Railroad Ave. Milford, CT	Area 9	XS-B	North Side 50 to 445
Residential Area 7	Residential	Broad St. Milford, CT	Area 12	XS-B	South Side 245 to 265
Residential Area 8	Residential	Broad St. Milford, CT	Area 13	XS-B	South Side 240 to 280
Future Potential Mixed Use Area 1	Residential	Broad St. Milford, CT	Area 13	XS-B	South Side 130 to 435
Mixed Use with Apartments	Residential	21 Daniel St. Milford, CT	Pin 1	XS-B	South Side 195
Residence 1	Residential	2 Depot St. Milford, CT	Pin 2	Transition Spans	South Side 270
Residential Area 9	Residential	Darina Pl. Milford, CT	Area 8	Transition Spans	North Side 135 to 295
Residential Area 10	Residential	Prospect St. Milford, CT	Area 7	XS-B	North Side 70 to 305
Residence 2	Residential	118 New Haven Ave. Milford, CT	Pin 3	XS-B	South Side 260
Residential Area 11	Residential	New Haven Ave./Buckingham Ave., Milford, CT	Area 6	XS-B	South Side 115 to 330
Residence 3	Residential	88 Gulf St. Milford, CT	Pin 4	XS-B	North Side 280
Residential Area 12	Residential	Buckingham Ave. Milford, CT	Area 5	XS-B	South Side 90 to 380
Residential Area 13	Residential	New Haven Ave. Milford, CT	Area 4	XS-C	South Side 150 to 235
Residence 4	Residential	583 Anderson Ave. Milford, CT	Pin 5	Adjacent Substation	South Side 190

Location Name	Category	Location Address	Measurement Area (Table D-2)	Model XS Number	Distance from New Line (ft)
Residential Area 14	Residential	Heenan Dr. Milford, CT	Area 1	XS-A	North Side 110 to 295
Residential Area 15	Residential	Breezy Ln. Milford, CT	Area 2	XS-A	North Side 283 to 341
Residential Area 16	Residential	Marble Ln. Milford, CT	Area 3	XS-A	North Side 80 to 305
Residence 5	Residential	50 Callegari Dr. West Haven, CT	Pin 6	XS-B	South Side 320
Residential Area 17	Residential	Phipps Lake Area West Haven, CT	Area 17	XS-B	South Side 150 to 480
Residence 6	Residential	18 Hood Terrace West Haven, CT	Pin 7	Transition Span	South Side 280
Residence 7	Residential	62 Phillips Terrace West Haven, CT	Pin 8	Transition Span	North Side 305
Residential Area 18	Residential	South Side of Elm St. West Haven, CT	Area 18	XS-C	South Side 285 to 340
Residential Area 19	Residential	North Side of Elm St. West Haven, CT	Area 19	XS-C and Substation Spans	South Side 135 to 435
Residential Area 20	Residential	Clark St. West Haven, CT	Area 24	XS-C and Substation Spans	North Side 40 to 400
Residential Area 21	Residential	George St., Washington Ave., Wood St., Union Ave., 4th Ave. West Haven, CT	Area 20	XS-C	South Side 190 to 400
Residential Area 22	Residential	Wharton St. West Haven, CT	Area 23	XS-C	North Side 210 to 320
Residential Area 23	Residential	Washington Ave. & N. Union Ave., West Haven, CT	Area 23	XS-C	North Side 160 to 390
Residential Area 24	Residential	Richards St. and Mix Ave. West Haven, CT	Area 22	XS-C	North Side 155 to 335
Residential Area 25	Residential	Wood St. and 1st Ave. West Haven, CT	Area 21	Transition Spans	South Side 240 to 390
Residential Area 26	Residential	Morris St. New Haven, CT	Area 26	Beyond Substation	North Side N/A
Residential Area 27	Residential	Grant St. West Haven, CT	Area 25	Beyond Substation	South Side N/A

Measurements in each of the areas identified in Table D-1 are identified graphically in Figure D-4 – Figure D-14. Table D-2 provides a statistical summary of the EMF measurements performed.

Exponent also measured EMF levels along the Woodmont Road overpass in Milford, where it transects the transmission lines. Figure D-15 depicts this transect measurement path in red overlayed on Google Earth satellite imagery. The EMF transect measurement profiles are provided in Figure D-16.

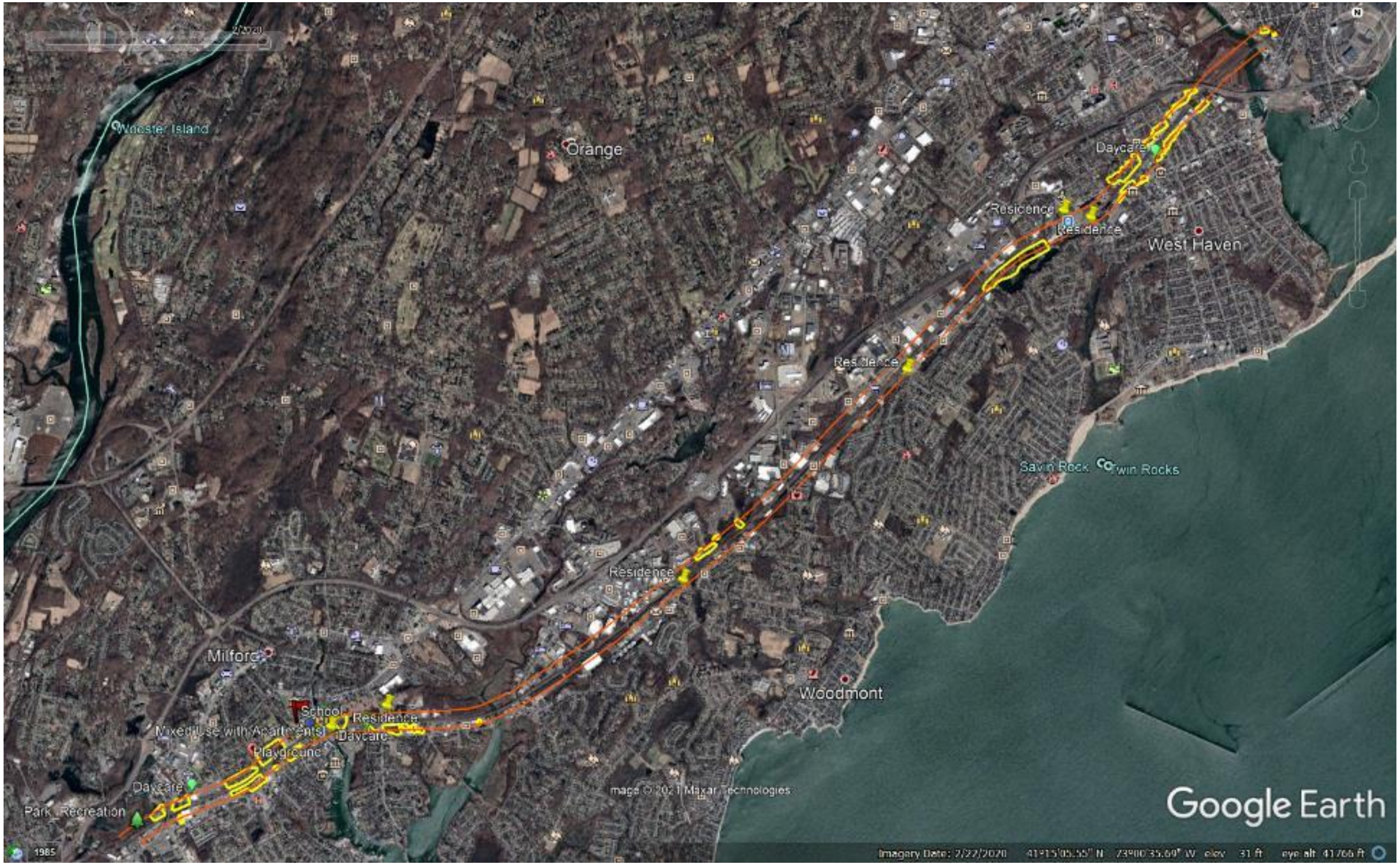

Figure D-1. Google Earth satellite mapping of the transmission line / CT DOT corridor(orange lines) between Milvon Substation and West River Substation. Areas within 300 feet of the proposed transmission line identified by UI are indicated by the yellow areas and pin markings.

Figure D-2. EMF measurements were obtained along approximately 0.6 miles of the northern portion of the proposed route (in West Haven) and on both sides of the CT DOT corridor where possible. The green trace provides the GPS-tracked measurement path.

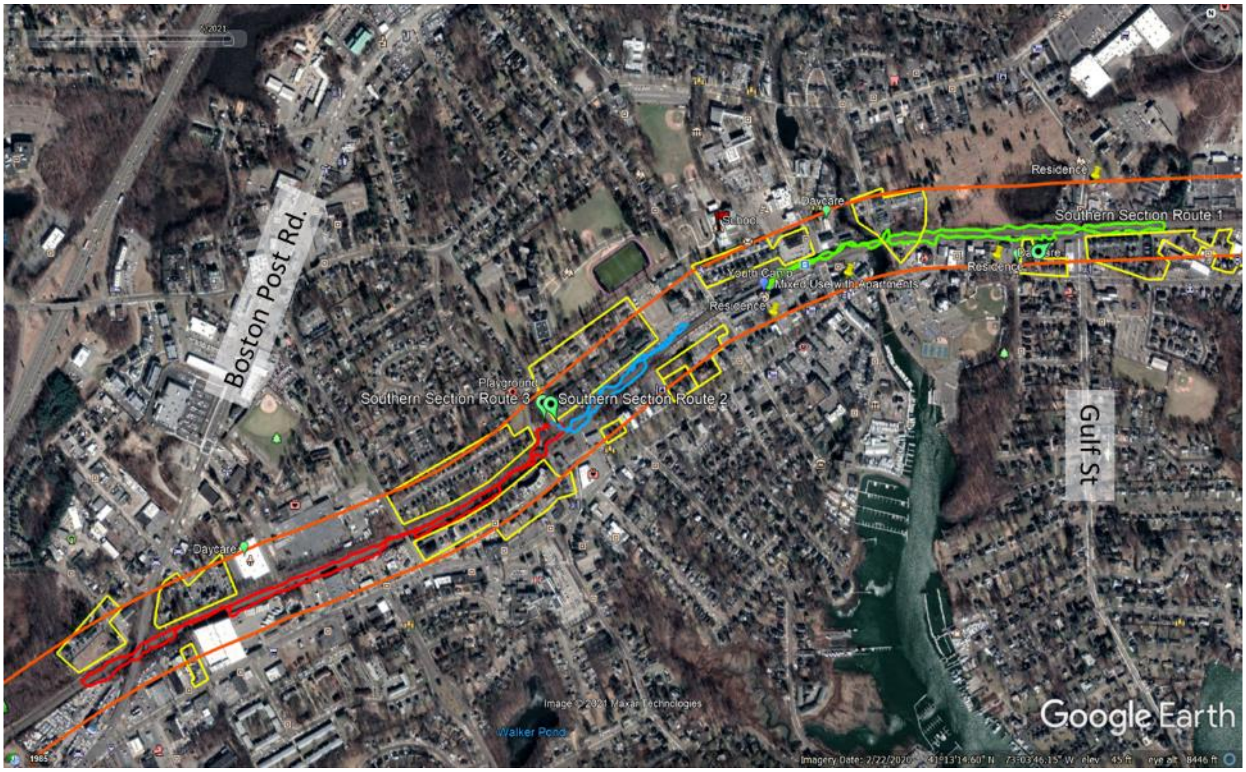

Figure D-3. EMF measurements were obtained along approximately 1.7 miles of the northern portion of the proposed route (in Milford) and on both sides of the CT DOT corridor where possible. The green, blue, and red traces provides the GPS-tracked measurement paths.

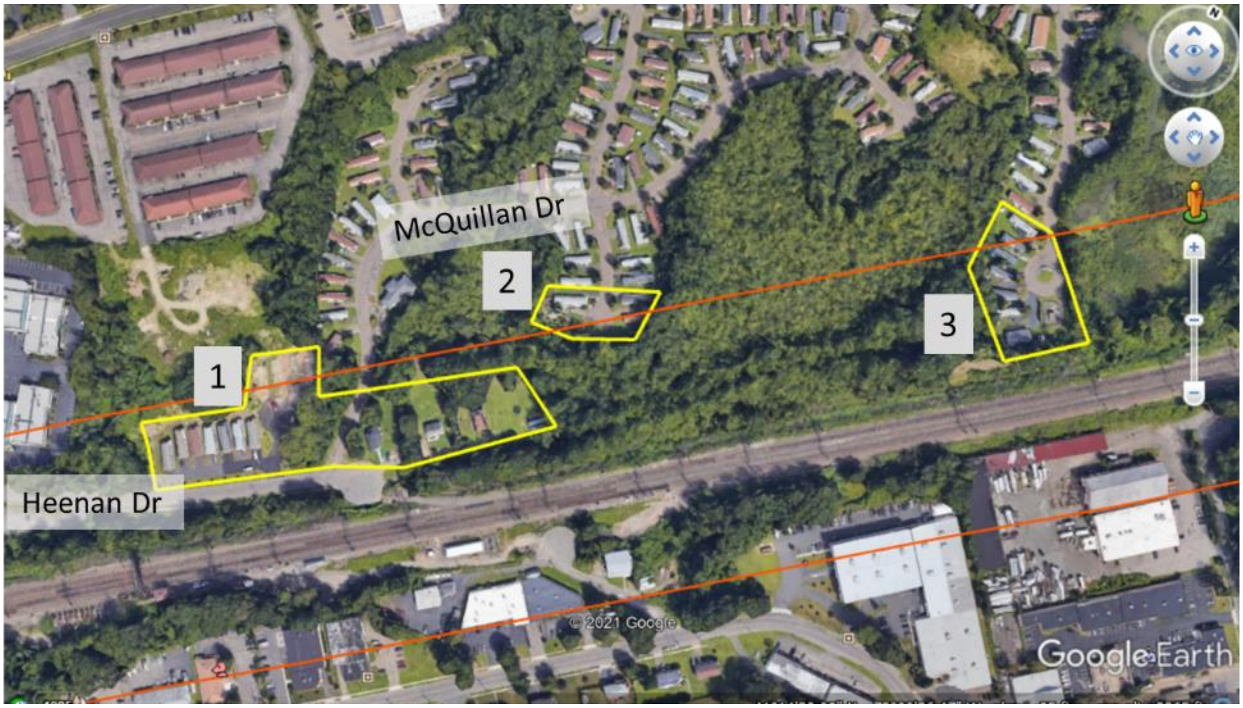

Figure D-4. Areas 1 – 3 (in Milford). Orange lines show the distance of 300 feet from the proposed transmission line.

Figure D-5. Area 4 (in Milford). Orange lines show the distance of 300 feet from the proposed transmission line.

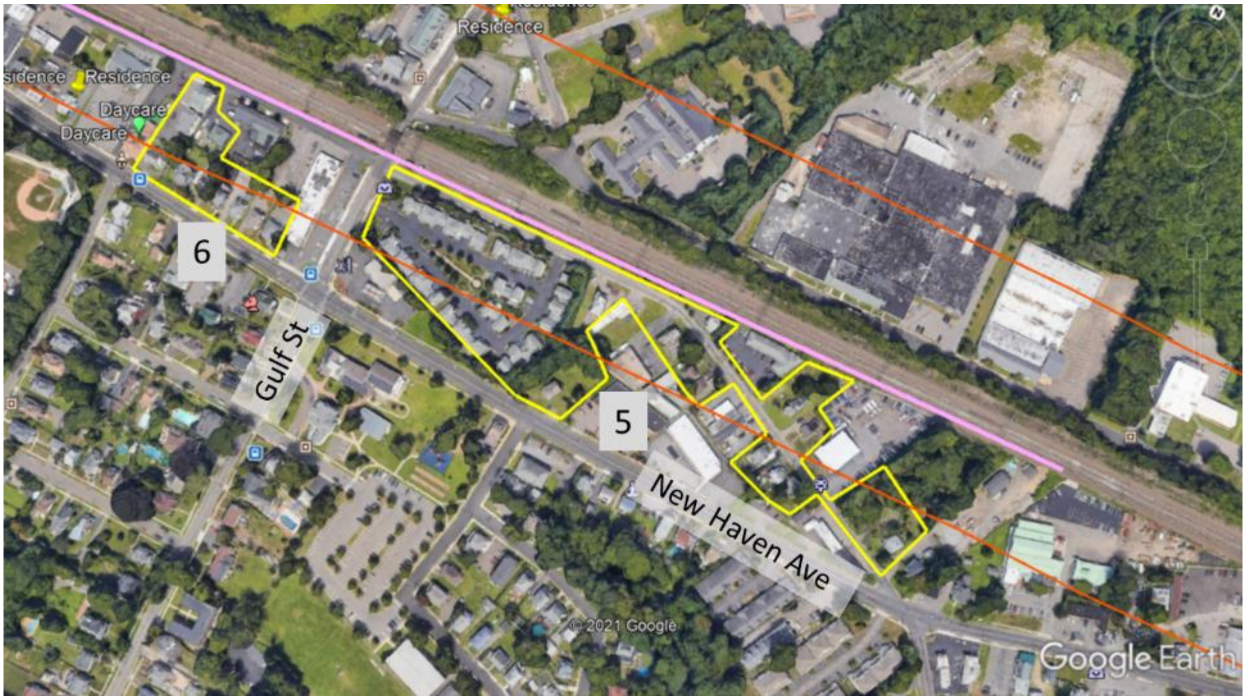

Figure D-6. Areas 5 and 6 (in Milford). Orange lines show the distance of 300 feet from the proposed transmission line.

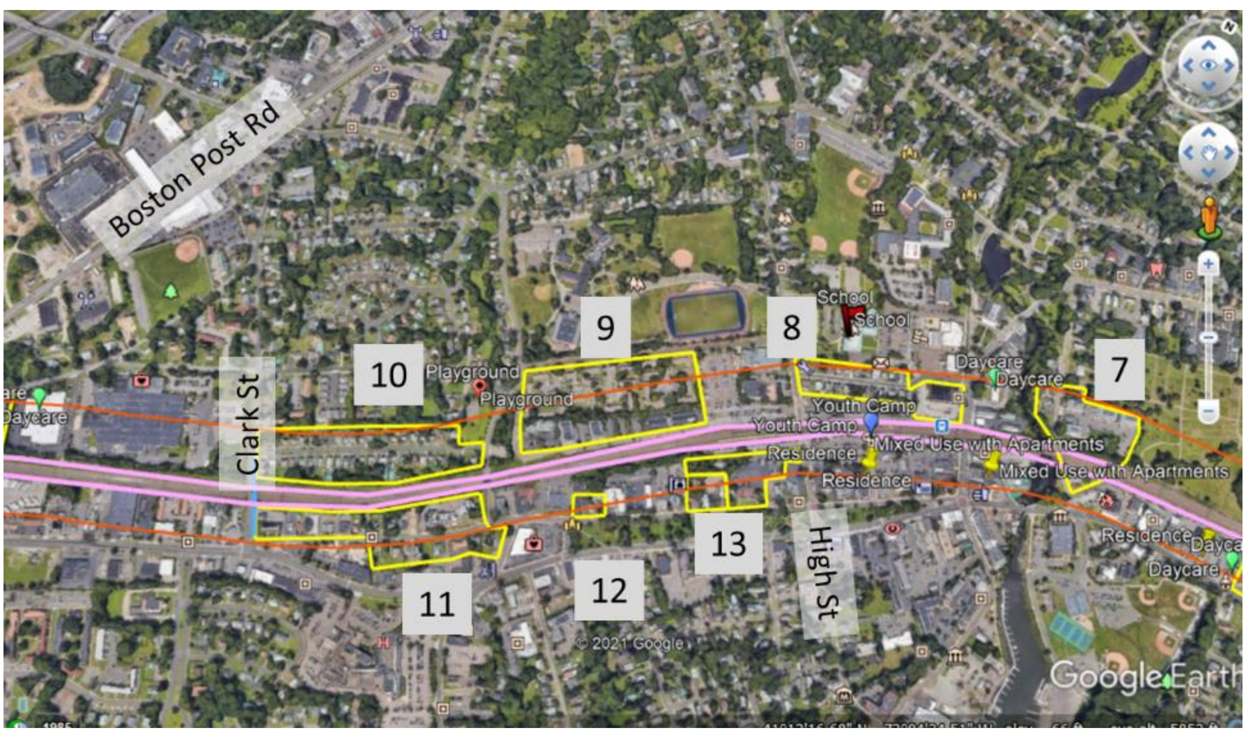

Figure D-7. Areas 7 – 13 (in Milford). Orange lines show the distance of 300 feet from the proposed transmission line.

Figure D-8. Areas 14 – 16 (in Milford). Orange lines show the distance of 300 feet from the proposed transmission line.

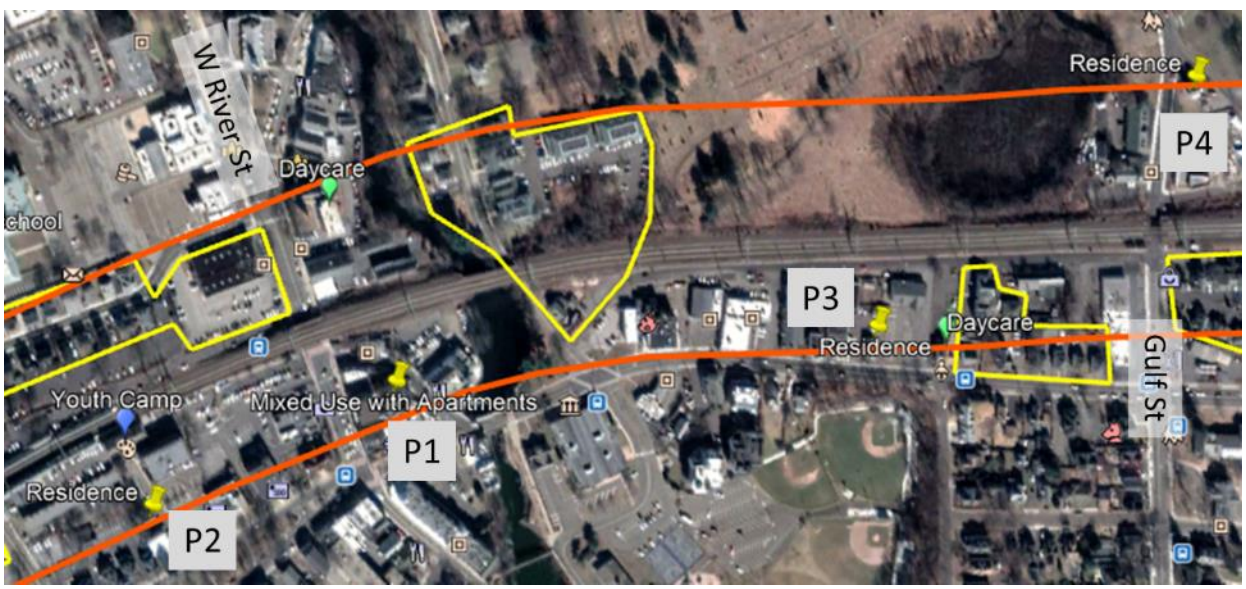

Figure D-9. Pins P1 – P4 (in Milford). Orange lines show the distance of 300 feet from the proposed transmission line.

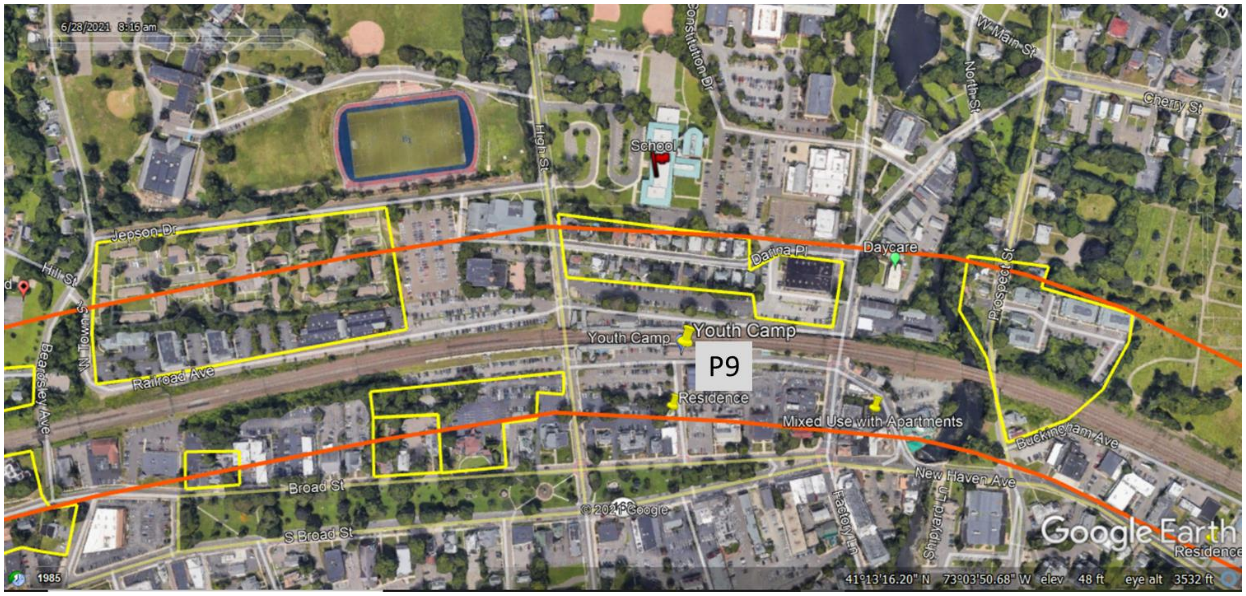

Figure D-10. Pin P9 (in Milford). Orange lines show the distance of 300 feet from the proposed transmission line.

Figure D-11. Pin P5 (in Milford). Orange lines show the distance of 300 feet from the proposed transmission line.

Figure D-12. Pins P6 – P8 and Area 17 (in West Haven). Orange lines show the distance of 300 feet from the proposed transmission line.

Figure D-13. Areas 18 – 24 (in West Haven). Orange lines show the distance of 300 feet from the proposed transmission line.

Figure D-14. Areas 25 and 26 (in West Haven). Orange lines show the distance of 300 feet from the proposed transmission line.

Figure D-15. EMF measurements were obtained along the Woodmont Road overpass (in Milford) and used to generate the transect profile. Orange lines show the distance of 300 feet from the proposed transmission line.

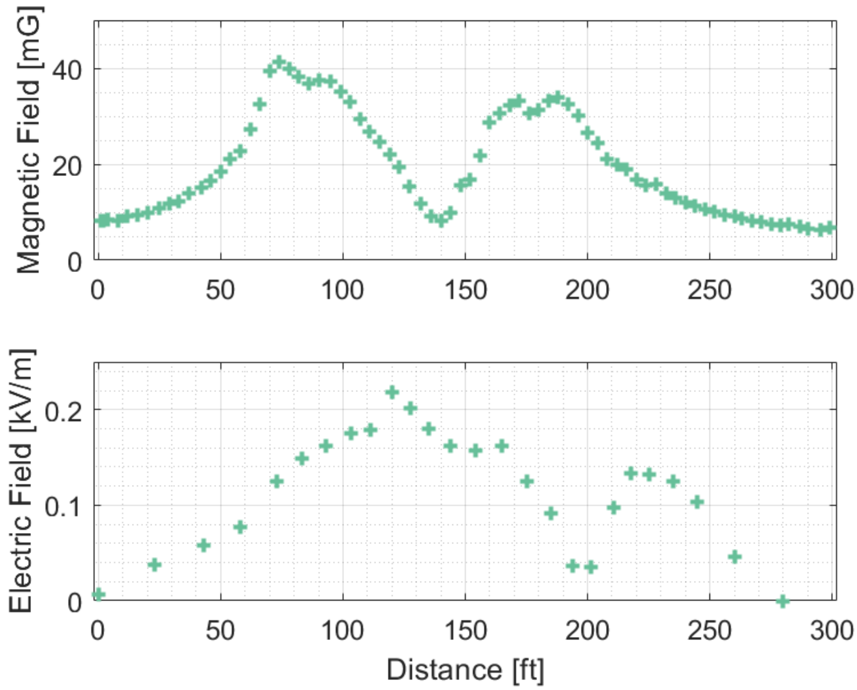

Figure D-16. Electric and magnetic field measurements collected along the transect path depicted in Figure D-15.

Table D-2. Measured magnetic fields and electric fields along the northern and southern sections of the planned route and at measurement locations 1 – 26 and P1 – P8*

Location†	Locations covered	Measured magnetic field (mG)			Measured electric field (kV/m)		
		Min	Mean	Max	Min	Mean	Max
Corridor North	Approximately Campbell Ave. to the CT Turnpike overpass	4.1	22	82	0.22	0.30	0.46
Corridor South 1	Approximately Milford station to Gulf St.	2.0	20	60	0.19	0.31	0.51
Corridor South 2	Approximately Beardsley Road to Milford station	2.2	23	197	0.21	0.24	0.29
Corridor South 3	Approximately Boston Post Road to Beardsley Road	1.3	23	142	0.18	0.25	0.50

Location[†]	Locations covered	Measured magnetic field (mG)			Measured electric field (kV/m)		
		Min	Mean	Max	Min	Mean	Max
Area 1	Heenan Dr., Milford	0.2	1.2	3.4	<0.1	<0.1	<0.1
Area 2	Breezy Ln., Milford	0.1	0.2	0.3		Not measured[‡]	
Area 3	Marble Ln., Milford	0.3	0.4	0.6		Not measured[‡]	
Area 4	New Haven Ave., Milford	0.9	2.3	4.1	<0.1	<0.1	<0.1
Area 5	Buckingham Ave., Milford	1.3	6.9	14		<0.1[§]	
Area 6	New Haven Ave. / Buckingham Ave., Milford	0.3	2.6	4.9		<0.1[§]	
Area 7	Prospect St., Milford	0.2	2.5	12		<0.1[§]	
Area 8	Darina Pl., Milford	0.3	2.7	8.0	<0.1	<0.1	<0.1
Area 9	North of Railroad Ave., Milford	0.1	5.3	16		0.18[§]	
Area 10	Pearl Hill St., Milford	1.1	4.0	19		<0.1[§]	
Area 11	Golden Hill St., Milford	0.5	2.3	9.5		<0.1[§]	
Area 12	Broad St., Milford	0.8	1.5	2.4		Not measured[‡]	
Area 13	Broad St., Milford	0.6	2.0	11		Not measured[‡]	
Area 14	Dorsey Ln., Milford	0.5	1.2	4.3		<0.1[§]	
Area 15	West Ave., Milford	0.1	2.3	10		<0.1[§]	
Area 16	Washington St., Milford	0.6	3.0	13		<0.1[§]	

Location†	Locations covered	Measured magnetic field (mG)			Measured electric field (kV/m)		
		Min	Mean	Max	Min	Mean	Max
Area 17	Around Phipps Lake, West Haven	0.010	1.4	6.2	<0.1	<0.1	<0.1
Area 18	South Side of Elm St., West Haven	0.4	1.4	5.4		Not measured‡	
Area 19	North Side of Elm St., West Haven	1.0	4.7	22		<0.1§	
Area 20	George St., Washington Ave., Wood St. Union Ave., 4th Ave., West Haven	0.4	1.4	5.6		<0.1§	
Area 21	Wood St. and 1st Ave., West Haven	0.4	2.1	3.3		Not measured‡	
Area 22	Richards St. and Mix Ave., West Haven	0.1	2.7	14		<0.1§	
Area 23	Washington Ave. and N. Union Ave., West Haven	0.4	3.0	13		<0.1§	
Area 24	Clark St., West Haven	0.4	2.3	8.1		Not measured‡	
Area 25	Grant St., West Haven	2.3	4.3	6.2		Not measured‡	
Area 26	Morris St., New Haven	1.8	8.7	21		<0.1§	
Pin 1	Mixed use apartments, Daniel St., Milford	1.5	1.8	1.9		Not measured‡	
Pin 2	2 Depot St., Milford	0.6	2.8	5.5		Not measured‡	
Pin 3	118 New Haven Ave., Milford	2.1	3.0	5.2		Not measured‡	
Pin 4	88 Gulf St., Milford	0.3	0.5	0.9		Not measured‡	
Pin 5	Anderson Ave., Milford	5.5	8.4	14		Not measured‡	
Pin 6	50 Callegari Dr., West Haven	0.3	0.4	0.5		Not measured‡	

Location†	Locations covered	Measured magnetic field (mG)			Measured electric field (kV/m)		
		Min	Mean	Max	Min	Mean	Max
Pin 7	18 Hood Terrace, West Haven	0.4	0.5	0.8	Not measured‡		
Pin 8	62 Phillips Terrace, West Haven	0.4	2.0	11	Not measured‡		
Pin 9	40 Railroad Avenue, Milford	15	17	20	Not measured‡		

* Areas with residences within 100 feet of the proposed structure are marked in highlighted text, consistent with labeling in Table D-1.
† Note that UI's proposed new easement extends north from the existing CT DOT corridor.
‡ The electric field was not measured at this location.
§ Maximum and minimum value statistics were not provided for these locations because only a single electric-field measurement was obtained.

Attachment E

Calibration Certificate

Certificate of Calibration

The calibration of this instrument was controlled by documented procedures as outlined on the Certificate of Testing Operations and Accuracy Report using equipment traceable to N.I.S.T., ISO/IEC 17025:2017(E), and ANIZ540-1 COMPLIANT.

Instrument Model: EMDEX II - Standard

Frequency: 60 Hz

Serial Number: 1134

Date of Calibration: 03/19/2021

Re-calibration suggested at one year from above date.

EMDEX LLC

Calibration Inspector: H. Christopher Hooper

EMDEX LLC
1356 Beaver Creek Drive
Patterson, California 95363
(408) 866-7266