FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE CROTON WATER TREATMENT PLANT AT THE HARLEM RIVER SITE

7.17. ELECTRIC AND MAGNETIC FIELDS (EMF) AND EXTREMELY LOW FREQUENCY FIELDS (ELF) ANALYSIS

7.17.1. Introduction

Electric and Magnetic Fields (EMF) surround any electrical devices that carry an electrical charge and/or current. Electric fields exist near electric equipment or devices that carry an electrical current (e.g., home appliances that are plugged into electrical outlets). They are present even when the equipment is turned off, as long as it remains connected to the source of electric power. Magnetic fields are emitted when electrical equipment is operated or the current is being transmitted. Magnetic fields can pass through most materials, while electric fields are easily shielded or weakened by conducting objects such as trees and buildings. Conducting materials also weaken magnetic fields, but not to the same degree as they do it to electric fields. The magnitude of both types of fields decreases with distance from their sources. Fields generated by electric current that is typically transmitted at 50 to 60 cycles per second are considered Extremely Low Frequency (ELF) fields.

An evaluation of electric and magnetic fields under existing and future conditions was conducted to identify potential impacts that could result from the proposed Croton Water Treatment Plant (WTP) project. Measurements were taken along the perimeter of the Harlem River Site and the perimeter of the Con Edison property located at the Harlem River Site. The proposed feeder lines, which would supply power to the proposed project, would extend from the Sherman Creek Substation on the Harlem River waterfront in Manhattan, approximately one mile south of the water treatment plant site. The methodology used to prepare this analysis is presented in Section 4.17, Data Collection and Impact Methodologies, Electric and Magnetic Fields (EMF) and Extremely Low Frequency Fields (ELF) Analysis.

7.17.2. Baseline Conditions

In order to properly evaluate electric and magnetic fields, point sources and line sources measurements were taken. Point sources are specific sources, such as stationary equipment, that emit magnetic and electric fields. Line sources, such as power lines, also emit magnetic and electric fields. The main difference between the two sources is the rate of decay of the magnetic fields they produce (detailed information is presented in Section 4.17, Data Collection and Impact Methodologies, EMF/ELF). Point source magnetic fields decrease inversely with the cube of the distance, while line source magnetic fields decrease inversely with the square of the distance.

While there are no official standards or guidelines, this analysis compares measured electric and magnetic field data to the general guidelines of the International Radiation Protection Association (IRPA) general public limit and the New York State Right-of-way (NYSROW) maximum guidelines for electric and magnetic fields.

7.17.2.1. Existing Conditions

Electric and magnetic field measurements were conducted in June 2002 at the Harlem River Site. The sampling locations at the water treatment plant site, H1 to H20, are indicated on Figure 7.17-1. Measurements for these locations are summarized in Table 7.17-1. The feeder lines locations are also shown on Figure 7.17-2.

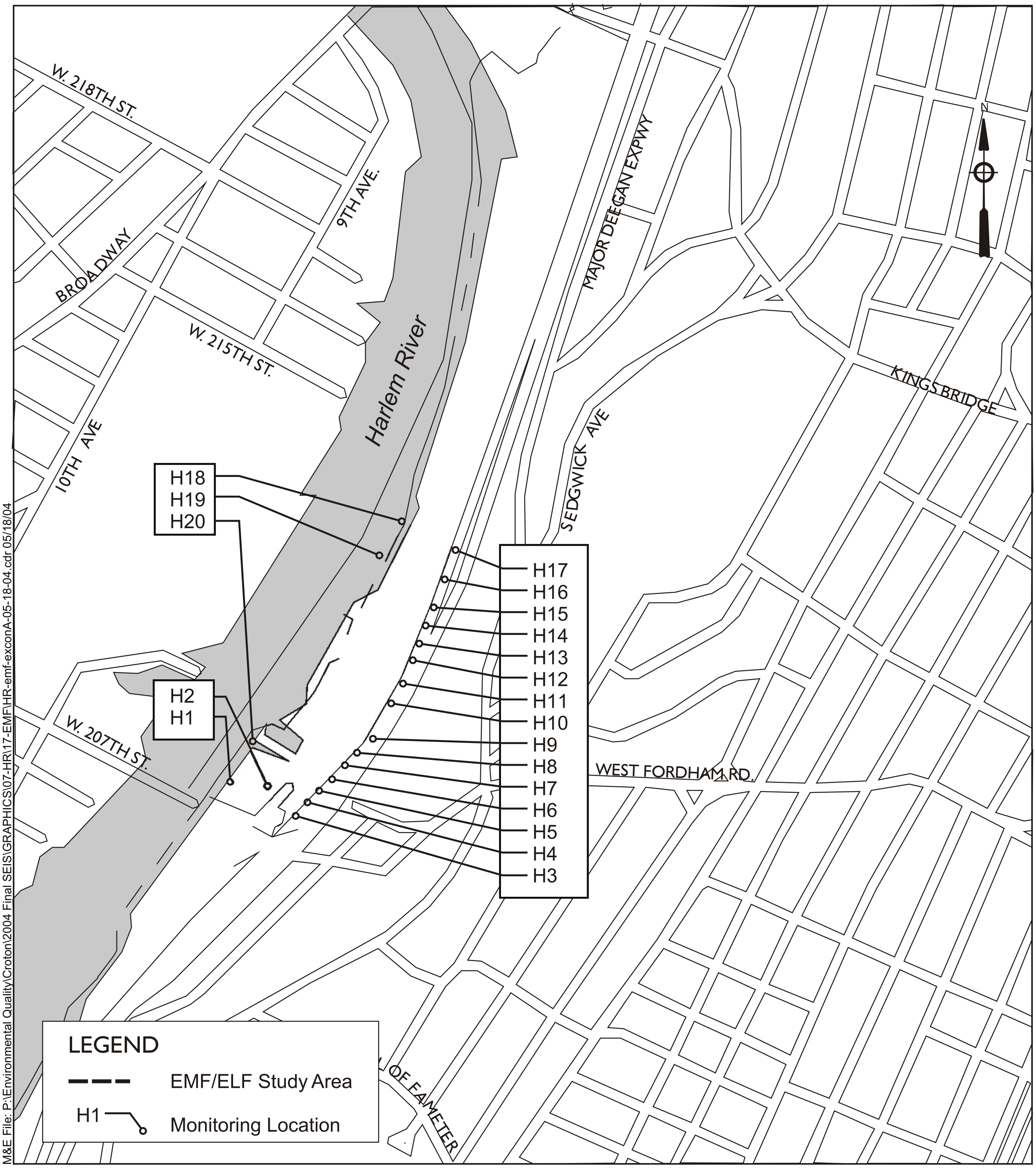
The electric and magnetic field measurements were performed at the water treatment plant site using the Holaday meter, following procedures outlined in Section 4.17, Data Collection and Impact Methodologies, Electric and Magnetic Fields (EMF) and Extremely Low Frequency Fields (ELF) Analysis.

7.17.2.1.1. Point Sources

The magnetic fields measured in June 2002 by the Holaday meter ranged from 0.0002 to 0.0163 Gauss (see Table 7.17-1). The sampling taken along Exterior Street (monitoring locations H3 to H9) captured readings from some existing overhead and below grade electric lines and a transformer, which may have contributed to the higher readings of electric and magnetic fields at those locations.

However, these values are well below the International Radiation Protection Association (IRPA) general public limit of 1.0 Gauss. IRPA issued interim standards for electric and magnetic field exposure limits for the general public in 1990 based upon 1984 World Health Organization guidelines. In addition, New York State (NYS) uses informal guidelines to limit electric and magnetic field strengths along rights-of-way (ROW) for overhead power transmission lines. These guidelines have been designed to ensure that field levels around new transmission lines do not exceed those around existing transmission lines. The magnetic field data are well below the NYSROW maximum guidelines for magnetic field strength of 0.2 Gauss. The higher readings (H3 to H9) result from the underground lines and transformers measured at the perimeter of the Harlem River Site. Currently there are no existing guidelines specifically for underground distribution lines.

The electric fields measured in June 2002 ranged from 1.38 to 9.25 volts/meter (V/m). These values are well below the IRPA general public limit for electric field strength of 5,000 V/m. Likewise, they are below the NYSROW maximum guidelines for an electric field of 11,800 V/m.



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EMF/ELF
Harlem River Site

Croton Water Treatment Plant

Figure 7.17-1

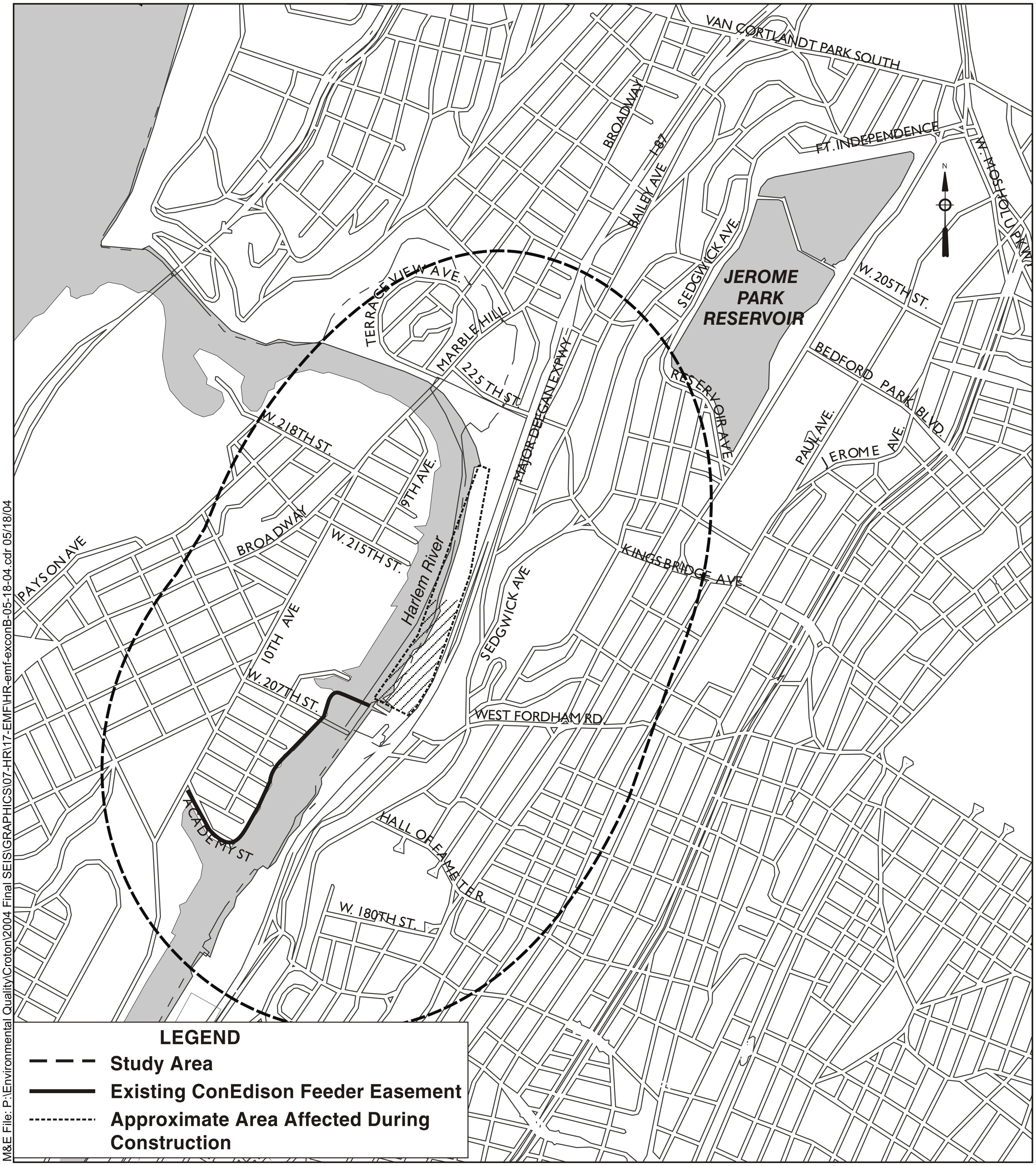
TABLE 7.17-1. EXISTING ELECTRIC AND MAGNETIC FIELD DATA FOR HARLEM RIVER SITE

Sample Location	Holaday Magnetic Field Gauss June 2002	Holaday Electric Field Volts/Meter June 2002
H1	0.000412	1.50
H2	0.000289	1.44
H3	0.002513	2.05
H4	0.006815	1.45
H5	0.002055	1.45
H6	0.003692	9.25
H7	0.016257	4.65
H8	0.004152	1.47
H9	0.005876	1.44
H10	0.000434	1.42
H11	0.000288	1.52
H12	0.000305	1.43
H13	0.000340	1.42
H14	0.000240	1.43
H15	0.000334	1.38
H16	0.000815	1.43
H17	0.000220	1.42
H18	0.000199	1.42
H19	0.000207	1.42
H20	0.000378	1.42

7.17.2.1.2. Line Sources

The Con Edison Sherman Creek Substation would supply the electricity to the Harlem River Site. The Sherman Creek Substation is located on the west bank of the Harlem River in Manhattan, approximately one mile south of the water treatment plant site. The proposed feeder route would be located along the existing Con Edison submersible cables from the Sherman Creek Substation to the Con Edison property at the Harlem River Site. Currently, underground feeders running under the Harlem River supply a quarter of the loads in Riverdale.

The sampling location H9 at the water treatment plant site is located directly above the existing cables and therefore was used to represent the baseline magnetic field measurements. Four 13.2-kV feeder lines would supply electrical power to the proposed plant. No other sampling location was selected along the proposed feeder route because the existing submersible cables in the Harlem River are out of reach by the general public.



Not To Scale

EMF/ELF
Harlem River Site

Figure 7.17-2

The magnetic field measured in June 2002 at H9 was 0.005876 Gauss. The value was well below the IRPA general public limit of 1.0 Gauss and the NYSROW maximum guidelines for magnetic field strength of 0.2 Gauss. The electric field measured at the same location was 1.44 V/m. It was well below the IRPA general public limit for electric field strength of 5,000 V/m. Likewise it was well below the NYSROW maximum guidelines for an electric field of 11,800 V/m.

7.17.2.2. Future Without the Project

The Future Without the Project conditions were developed for the anticipated peak year of construction (2009) and the anticipated year of operation (2011) for the proposed plant. The anticipated peak year of construction is based on the peak number of workers. In the Future Without the Project, electric and magnetic fields at the water treatment plant site and along the proposed feeder route are anticipated to remain at current levels.

7.17.3. Potential Impacts

7.17.3.1. Potential Project Impacts

The anticipated year of operation for the proposed plant is 2011. Therefore, potential project impacts have been assessed by comparing the Future With the Project conditions against the Future Without the Project conditions for the year 2011.

There would be two principal sources of electrical and magnetic fields anticipated at the proposed plant: point sources and line sources. The point sources would include the electrical equipment that operates within and/or around the proposed plant (e.g., raw water turbine station, and treated water pumping station). The line sources would include the feeder lines that bring power to the proposed plant.

7.17.3.1.1. Point sources

Magnetic field levels were measured at two existing New York City-owned facilities, the Wards Island and North River Water Pollution Control Plants (WPCP). These two plants house electrical equipment similar to the proposed electrical equipment requirements for the proposed plant. Measurements were taken at varying distances from the equipment to determine how the magnetic fields would decrease with distance based on the inverse cube relationship. The maximum magnetic fields and measurement distances from each type of equipment at the two WPCPs are presented below in Table 7.17-2. These maximum magnetic fields in Gauss (Table 7.17-2) were used to estimate the magnetic fields strength from the point sources at the proposed plant, shown on Table 7.17-3.

According to the estimated magnetic fields shown in Table 7.17-3, the proposed plant would have negligible effects on the existing magnetic fields. The maximum magnetic fields strength would potentially increase by less than 0.0001 Gauss; the estimated strengths would be well below the IPRA general public limit of 1.0 Gauss.

TABLE 7.17-2. MAGNETIC FIELD LEVELS FROM POINT SOURCES IN THE EXISTING WPCPs

Equipment	Measurement Distance from Equipment (ft)	Potential Max. Magnetic Field Measurement (Gauss) [1]
2,000 HP Motor [2]	1.6	0.0985
4.16 kV Switchgear [2]	1.6	0.0133
13.2 kV Switchgear [2]	1.6	0.0156
Transformer (7,500 kVA)	1.6	0.0725
Inductor	1.0	0.1170

Notes:
1. Maximum magnetic field measured at either Wards Island or North River WPCP
2. hp = horse power; kV = kilo-Volt

TABLE 7.17-3. ESTIMATED MAGNETIC FIELD LEVELS FROM POINT SOURCES IN THE PROPOSED PLANT

Equipment	Estimated Distance to Nearest Receptor Location [1] (ft)	Estimated Potential Increase Magnetic Field Strength [2] (Gauss)
2,000 hp Motor	30	1.5×10^{-5}
4.16 kV Switchgear	30	2.0×10^{-6}
13.2 kV Switchgear	30	2.4×10^{-6}
Transformer (10,000 kVA)	30	1.5×10^{-5}
Transformer[3] (15,000 kVA)	30	2.2×10^{-5}
Inductor	30	4.3×10^{-6}

Notes:
1. Distance to nearest receptor location (proposed public walkway route) from similar equipment planned in the proposed plant.
2. Estimated EMF strength derived from $[X_1 \times (d_1/d_2)^3]$, where X_1 = Max. Magnetic Field measured at WPCPs (Table 7.17-2), d_1 = distance (m) to the receptor from a point source at WPCPs, and d_2 = distance (m) to the receptor from a point source at the proposed plant.
3. The transformer 15,000 kVA point source magnetic field was calculated is the following way: power capacity of 15,000 kVA/power capacity 10,000 kVA = kVA_1/kVA_2. The magnetic field strength of 15,000 kVA = (magnetic field strength of 10,000 kVA) x (kVA_2/kVA_1).

Extrapolating from the actual measurements taken at the two WPCPs and using the previously discussed decay equation, point sources would not create any measurable increases in the magnetic field levels surrounding the proposed project. Since the electrical equipment is located approximately 30 feet away from the nearest receptor locations, there would be no significant increase in existing magnetic field levels. In addition, all electrical equipment would be housed within the main treatment building and pump station, which would further attenuate the magnetic field levels.

Although magnetic fields near the transformer and the inductor listed in Table 7.17-2 have the highest magnetic fields strengths the structures are small and their field strength diminish rapidly with distance, as it does from any point source. For this reason, having a transformer located near the proposed plant would not be a major source of concern to the operators on-site or the visitors. In addition to the rapidly diminishing field strength with the increased distance between the potential point sources and the receptor, all major electrical equipment would be located indoors in dedicated electrical rooms. Therefore, no significant adverse impacts are anticipated from magnetic fields.

Point sources would not create any measurable increases in the electric field levels surrounding the proposed project. All major electrical equipment would be located indoors in dedicated electrical rooms. Electric fields would be shielded and weakened by conducting material between the sources and the closest public access area. Therefore, no significant adverse impacts are anticipated from electric fields.

Emergency power would be provided on-site to supply life safety and critical systems (i.e. lighting) in the event of total power failure; no emergency power would be provided to operate the proposed plant. The emergency system would include two diesel emergency generators, rated at about 1,500-kW; one of the generators would serve as a backup, and a 3,000-gallon fuel storage tank (generators would be operated on a monthly basis for testing). The proposed emergency system would be smaller than a standard 10,000-kVA transformer (in terms of its electric power) that may potentially contribute approximately $1.5x10^{-5}$ Gauss at the nearest sensitive receptor. From this example it could be concluded that the proposed system would result in less than a $1.5x10^{-5}$ Gauss reading at the nearest sensitive receptor; therefore, no significant impacts on the surrounding magnetic fields are anticipated from the emergency power system. In addition, since the proposed emergency power system would be housed within the proposed facility, electric fields would be shielded and weakened by conducting material between the sources and the closest public access area. Therefore, no significant impacts on the surrounding electric fields are anticipated from the emergency power system.

When considered together the point source magnetic fields (the proposed plant and the emergency power system) would have negligible effects on the existing magnetic fields. The maximum magnetic fields strength would add up to less that 0.0001 Gauss. The estimated strengths would be well below the IPRA general public limit of 1.0 Gauss and the NYSROW maximum guidelines for magnetic field strength of 0.2 Gauss. All electric fields associated with the proposed project (i.e. the proposed plant and emergency power system) would be contained within a building shielding the electric fields from the closest public access area. Therefore, no significant adverse impacts are anticipated from the cumulative effects of magnetic and electric fields point sources.

7.17.3.1.2. Line Sources

An existing Con Edison Sherman Creek substation, which is located approximately one mile across the Harlem River and to the south of the water treatment plant site in Manhattan, would provide power to the proposed plant. Up to six 13.2-kV feeders would be used at the same time for operating plant power. They would exit the Con Edison Sherman Creek Substation and cross under the Harlem River to the water treatment plant site to the existing Con Edison property. The feeders would be submersible cables in the Harlem River and remain underground at the point of entry into the water treatment plant site. These feeders would be Triplex-shielded cables installed within rigid steel conduits where appropriate. The Triplex-shielded cables would adsorb the electric fields emitted from the 13.2 kV feeders and prevent public exposure to lines sources related to the proposed project. Any increases in electric field levels would be zero because of shielding and/or the rapid decrease in field strength from the electrical source.

The service feeders would be underground in concrete-encased steel conduits. The magnetic fields generated by the currents in each of the three conductors within each of the service feeders would cancel each other out. Therefore, the magnetic fields at maximum operating condition would have a negligible increase on the existing magnetic field at the water treatment plant site.

To calculate the projected magnetic field strengths from underground feeders associated with the proposed plant, additional field measurements were taken at the Wards Island and North River WPCPs. Since the proposed plant would use 13.2 kV feeders, similar to those already existing at the two WPCPs, the field measurements at the WPCPs are considered representative of field measurements that would occur with the proposed plant. The maximum background magnetic field reading of 0.002 Gauss at a distance of 2.0 meters away from sources was used to predict magnetic field levels for the proposed plant. The projected magnetic fields were derived using the baseline magnetic field of 0.005876 Gauss (from the H9 sampling location, Table 7.17-1) in combination with the decay formula[1] described in Section 4.17, Data Collection and Impact Methodologies, EMF/ELF. The results of these calculations indicate that the magnetic field level would increase from 0.005876 to 0.005897 Gauss. The calculation shows on a quantitative basis that the magnetic field strength from line sources for the proposed plant would not increase at 13 feet above the easement (above the H9 sampling location) on the proposed public walkway. The electric and magnetic fields potential project impacts are insignificant individually as discussed above. The magnetic fields generated would be calculated by multiplying the new magnetic field level calculated for the H9 sampling location by six (the maximum number of feeder lines). The feeder lines would be able to cumulatively emit a magnetic field of 0.035385 Gauss, still an insignificant exposure. Although the projected levels by the magnetic fields are well below the IRPA general public limit of 1.0 Gauss, the following features would be incorporated in the design to ensure that the prospective electric and magnetic fields would be minimized further:

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[1] Projected magnetic field strength from the proposed plant. Calculated using the formula $x_1(d^1/d^2)^2=x_2$. Then, $[(x_2)^2+(x_3)^2]^{½}$ was used, where x_1=0.002 Gauss, d_1=2.0 m (distance from feeder at the North River WPCP), d_2= 4 m (public walkway above proposed feeders), and x_3=existing conditions value above.

- Providing remote control/monitoring for personnel to minimize time in electrical equipment rooms.

- Specifying equipment that has negligible harmonic voltages and currents and providing tuned harmonic filters (to prevent/minimize harmonic fields).

- Using computer monitors designed for low magnetic field emissions and active power line conditioners for groups of computers.

- Balancing of electrical systems, as much as possible, such that fields would cancel each other or the residual field would be minimized.

- Energy conservation and power factor correction, which would reduce the field-producing line currents.

Project plans include shielded and underground cables and isolating ELF/EMF sources so that the public would not be exposed to significant increases in EMF/ELF. The goal would be to avoid a measurable increase above local background levels.

7.17.3.2. Potential Construction Impacts

The anticipated year of peak construction for the proposed plant is 2009. Therefore, potential construction impacts have been assessed by comparing the Future With the Project conditions against the Future Without the Project conditions for the year 2009.

7.17.3.2.1. Point Sources

A number of 1,500-kVA diesel generators would be available on a temporary basis during construction for uses in a localized construction area such as for providing power to an emergency escape elevator and dewatering from deep excavation. The generators' power capacity is much less than the 7,500-kVA transformer and therefore the magnetic field from the generators would contribute less than 0.0725 Gauss (background level measured near a 7,500-kVA transformer). The diesel generators would be in a building that would shield electric fields.

Any increases in electric field levels would therefore be zero because of shielding and also the rapid decrease in field strength from the electrical source. Therefore, no significant impacts on the surrounding magnetic and electric fields are anticipated from the generators.

7.17.3.2.2. Line Sources

Four temporary feeders (three online, one backup), each supplying 2,500 kVA, would be provided by Con Edison to supply power during the construction period at the water treatment plant site. The temporary feeders would originate from the Con Edison Sherman Creek Substation, located approximately one mile to the south of the water treatment plant site in Manhattan and end at the Harlem River Site temporary substation. 5,000 kVA of the total temporary demand would supply the tunnel work that includes the tunnel boring machine (TBM) and welding. The additional 2,500 kVA would supply electricity to other construction equipment, site lighting, and field offices for contractors, resident engineers, and NYCDEP personnel.

The temporary feeders (total 5,000-kVA) source magnetic field strength is anticipated to be less than 0.0059 Gauss, based on an estimated magnetic field strength above the existing easement (H9 sampling location) of the larger Con Edison existing feeders (submersible 15,000-kVA cables). The distribution feeders would provide electrical power to the temporary on-site substation. These feeders would be submersible cables under the Harlem River and buried underground at the point of entry to the Harlem River Site and, where appropriate, the cable would be enclosed in steel conduits that would shield electric and magnetic fields. These feeders would be Triplex-shielded cables installed within rigid steel conduits where appropriate. The Triplex-shielded cables would adsorb the electric fields emitted from the four feeders and prevent public exposure to the line sources related to the proposed project. Any increases in electric field levels would be zero because of shielding and/or the rapid decrease in field strength from the electrical source.

The four temporary feeders would each be made of three conductors, and these conductors would each produce magnetic fields. In each feeder, the magnetic fields of its conductors would cancel each other out. Therefore, the magnetic fields at maximum operating condition would have a negligible increase on the existing magnetic field at the water treatment plant site. The projected line source magnetic field is anticipated to be well below the IRPA general public limit of 1.0 Gauss. Therefore, the contribution of the feeders to the line source magnetic and electric fields are anticipated to be negligible, and no significant impacts are anticipated.