METROLINX

GO Rail Network Electrification

Transit Project Assessment Process
Environmental Project Report

October, 2017

MORRISON HERSHFIELD

Gannett Fleming

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- **Appendix A - Natural Environment Assessment Report**: is composed of two parts including *Part A1 - Natural Environment Baseline Conditions Report*, and *Part A2 - Natural Environment Impact Assessment Report.*
- **Appendix B – Preliminary Environmental Site Assessment (ESA) Reports:** is composed of two parts including: *Preliminary ESA Gap Analysis Report (Rail Corridors),* and *Preliminary ESA Report (Taps & Traction Power Facilities).*
- **Appendix C - Cultural Heritage Assessment Report:** is composed of two parts including *Part C1 – Cultural Heritage Screening Report*, and *Part C2 – Cultural Heritage Impact Assessment Report.*
- **Appendix D - Archaeological Assessment Report:** is composed of two parts including *Part D1 – Archeological Baseline Conditions Report*, and *Part D2 – Stage 1 Archaeological Assessment Report.*
- **Appendix E - Land Use and Socio-Economic Assessment Report:** is composed of two parts including *Part E1 – Land Use and Socio-Economic Baseline Conditions Report*, and *Part E2 – Land Use and Socio-Economic Impact Assessment Report.*
- **Appendix F - Air Quality Assessment Report:** is composed of two parts including *Part F1 – Air Quality Baseline Conditions Report, and Part F2 – Air Quality Impact Assessment Report.*
- **Appendix G - Noise and Vibration Modelling Reports:** is composed of six parts including *G1 – USRC Impact Assessment Report, G2 – LSW Impact Assessment Report, G3 – Kitchener Impact Assessment Report, G4 – Barrie Impact Assessment Report, G5 – Stouffville Impact Assessment Report,* and *G6 – LSE Impact Assessment Report*
- **Appendix H - Visual Assessment Report:** is composed of two parts including *Part H1 – Visual Baseline Conditions Report,* and *Part H2 – Visual Impact Assessment Report.*
- **Appendix I - Utilities Report:** is composed of two parts including *Part I1 – Utilities Baseline Conditions Report,* and *Part I2 – Utilities Impact Assessment Report.*
- **Appendix J - Electromagnetic Interference/Electromagnetic Fields (EMI/EMF) Report:** is composed of two parts including *Part J1 – EMI/EMF Baseline Conditions Report,* and *Part J2 – EMI/EMF Impact Assessment Report.*
- **Appendix K – Preliminary Stormwater Management Report (Traction Power Facility Sites):** summarizes the results of carrying out the preliminary Stormwater Management (SWM) Assessment for each of the Tap and Traction Power Facility sites; it is composed of: an overview of background data collected/reviewed, results of initial SWM analysis for each tap/traction power facility site, and recommendations for further work.
- **Appendix L - Consultation Record:** summarizes the consultation activities carried out by Metrolinx and Hydro One as part of the GO Rail Network Electrification TPAP including the various consultation events held, feedback/comments received from review agencies, Aboriginal Communities, and other stakeholders including members of the public, and how those comments were considered as part of the TPAP.

- **Appendix M – Cultural Heritage Evaluation Reports (CHERs), Heritage Impact Assessment Reports (HIAs) and Statements of Cultural Heritage Value (SCHV):** includes copies of the CHERs, HIAs and SCHVs carried out for various heritage properties as part of the GO Rail Network Electrification TPAP.
- **Appendix N - Conceptual electrification corridor plans**. Conceptual electrification corridor plans were developed to illustrate the Overhead Contact System (OCS) Impact Zone and Vegetation/Tree Removal Zone along each of the corridors to be electrified.
- **Appendix O - Conceptual Traction Power Facility Plans.** Conceptual Traction Power Facility Plans were developed to illustrate the Traction Power Facility sites and 25kV Feeder Routes.
- **Appendix P – P1: Mapping of Ecological Land Classification Areas and P2: Mapping of Terrestrial and Aquatic Features** along each rail corridor within the GO Rail Network Electrification Study Area have been included for reference.
- **Appendix Q - Mapping of Identified Cultural Heritage Resources**. Mapping of Identified Cultural Heritage Resources within the GO Rail Network Electrification Study Area have been included for reference.
- **Appendix R - Mapping of Land Use Designations.** Mapping of Land Use designations along each rail corridor within the GO Rail Network Electrification Study Area have been included for reference.
- **Appendix S** - **Mapping of Noise/Vibration Receptors and Recommended Locations for Noise/Vibration Mitigation.** Mapping of Noise and Vibration Receptors that were examined in the Noise and Vibration modelling study, as well as areas where noise and vibration mitigation locations were identified along each rail corridor within the GO Rail Network Electrification Study Area have been included for reference.
- **Appendix T - Mapping of Viewsheds and Potential Visual Impact Areas.** Mapping of viewsheds and potential visual impact areas along each rail corridor within the GO Rail Network Electrification Study Area have been included for reference.
- **Appendix U – List of Technical Reports and Studies Reviewed.** Contains a list of the various technical reports/studies that were reviewed as part of carrying out the TPAP.
- **Appendix V – Groundwater Assessment Report.** Summarizes the results of carrying out the preliminary groundwater assessment, including potential groundwater effects and effects on wells.

Glossary of Terms

Term	Definition
230 kV Aerial Connection	Overhead electrical high voltage connection line from the existing Hydro One tap to the new traction power substation (TPS).
AAQC	The acronym for the Province of Ontario's Ambient Air Quality Criteria.
AC	Alternating Current. Alternating Current is an electric current in which the flow of electric charge periodically reverses direction, whereas in direct current (DC, also dc), the flow of electric charge is only in one direction.
AFP	Alternative Financing and Procurement. An AFP model brings together private and public sector expertise in a unique structure that transfers the risk of project cost increases and scheduling delays typically associated with traditional project delivery.
AG	Agriculture as defined by the Ecological Land Classification System.
ANSI	Area of Natural and Scientific Interest.
APTA	APTA stands for American Public Transportation Association.
Area of Potential Environmental Concern (APEC)	An area within the Study Area where one or more contaminants are potentially present, as determined through the Contamination Overview Study including identification of past or present land uses of concern and/or identification of a Potentially Contaminating Activity (PCA).
AREMA	American Railway Engineering and Maintenance-of-Way Association. AREMA is the organization that represents the engineering function of the North American railroads.
Autotransformer	Apparatus which helps boost the overhead contact system (OCS) voltage and reduce the running rail return current in the 2 X 25 kV autotransformer feed configuration. It is a single winding transformer having three terminals. The intermediate terminal located at the midpoint of the winding is connected to the rail and the static wires, and the other two terminals are connected to the catenary and the negative feeder wires, respectively.
Bare wires	Conductive wires which do not have insulation. These wires may be solid or stranded and are normally self-supporting.
Best Practices	Professional procedures that are accepted or prescribed as being correct or most effective.
Bonding	A low impedance path obtained by permanently joining all normally-non-current carrying conductive parts to ensure electrical continuity and having the capacity to conduct safely any current likely to be imposed on it.
CA	Acronym for Conservation Authority.
CAAQS	Canadian Ambient Air Quality Standards.
Cantilever	A beam that is supported by a pole at only one end and carries the load of the electrification equipment on top of tracks. At multiple track locations where cantilever frames are not practical, portal structures should be utilized.
Catenary System	An assembly of overhead wires consisting of, as a minimum, a messenger wire, carrying vertical hangers that support a solid contact wire which is the

	contact interface with operating electric train pantographs, and which supplies power from a central power source to an electrically-powered vehicle, such as a train.
CEAA	Canadian Environmental Assessment Act.
CGL	Green Lands as defined by the Ecological Land Classification System.
Ch	The contraction of Chainage, measurement in kilometres along the rail corridors, starting at the center of Union Station and radiating outwards along the corridors.
Circuit	A conductor or system of conductors which form an electrical section between two switching points.
Class EA	Under the Ontario Environmental Assessment Act (EA Act), Class Environmental Assessments are those projects that are approved subject to compliance with an approved class environmental assessment process (e.g., Class EA for Minor Transmission Facilities, GO Transit Class EA, etc.) with respect to a class of undertakings.
CLOCA	Central Lake Ontario Conservation Authority.
Combustion	The chemical process where a substance reacts with oxygen to release energy.
Combustion Emissions	The emissions released from the combustion of fossil fuels. These include carbon dioxide (CO_2), carbon monoxide (CO), oxides of nitrogen (NOx), particulate matter, and volatile organic compounds (VOCs).
Conceptual Design	The conceptual design phase of a project is defined as the first design stage. This stage includes creating ideas and taking into account the pros and cons of those ideas. This is done to minimize project risks and evaluate the overall potential success of the project.
Conditional Heritage Property	A property, including buildings and structures on the property, that is determined to potentially have cultural heritage value or interest and that is not owned by Metrolinx.
Contact Wire	A solid grooved, bare aerial, overhead electrical conductor of an overhead contact system (OCS) that is suspended above the rail vehicles and which supplies the electrically powered vehicles with electrical energy through roof-mounted current collection equipment - pantographs - and with which the current collectors make direct electrical contact.
Control Centre	The building or room location that is used to dispatch trains and control the train and maintenance operations over a designated section of track.
Control Point	An established coordinate location for a physical feature. Control points are used as the basis for improving the spatial accuracy of all other points to which they are connected and for generating other points within an established distance or area around the control point.
COS	Contamination Overview Study.
COSEWIC	Committee on the Status of Endangered Wildlife in Canada.
COTS	Commercial Off-the-Shelf.
Cross Bonds	The method of tying tracks together electrically to equalize traction return currents between tracks. This is done to minimize touch potential.

Cross Feeding System	Overhead feeder lines are provided between the main gantry and strain gantry across the electrified track to feed power to the overhead contact system (OCS) wires.
Cultural Heritage Evaluation Report (CHER)	A report prepared by, or with advice from a qualified heritage professional, who gathered and recorded, through research, site visits and public engagement, enough information about the property to sufficiently understand and substantiate its cultural heritage value.
Cultural Heritage Resource (CHR)	Includes archaeological resources, built heritage resources and cultural heritage landscapes.
Cultural Heritage Screening Report (CHSR)	A report prepared with advice by a qualified person who gathered and recorded, through research, site visits and public engagement enough information about the study area to identify those properties that have potential or known cultural heritage value.
Cultural Heritage Value or Interest	Cultural heritage value or interest: means the cultural heritage value or interest (CHVI) of a property determined in accordance with the "Criteria for Determining Cultural heritage value or interest" set out in Ontario Regulation 9/06 made under the Ontario Heritage Act or, in respect of properties of provincial significance, determined in accordance with the "Criteria for Determining Cultural Heritage Value of Provincial Significance" set out in Ontario Regulation 10/06 made under the Ontario Heritage Act and, for archaeological resources, means the cultural heritage value or interest of any archaeological resource as determined in accordance with the Standards and Guidelines for Consultant Archaeologists prepared and published by MTCS under the Ontario Heritage Act.
CUM	Cultural Meadow as defined by the Ecological Land Classification System.
CUW	Cultural Woodland as defined by the Ecological Land Classification System.
CV	Constructed Lands as defined by the Ecological Land Classification System.
CVC	Commercial and Institutional Lands as defined by the Ecological Land Classification System.
CVC Authority	Credit Valley Conservation Authority.
CVI	Transportation and Utilities as defined by the Ecological Land Classification System.
CVR	Residential Lands as defined by the Ecological Land Classification System.
Data Gap Analysis	An analysis conducted on previously available studies and research to see what information is missing in order to determine what requires further study.
dB/dBAa	A-weighted decibels, abbreviated dBA, or dBa, or dB(a), are an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted system, the decibel values of sounds at low frequencies are reduced, compared with unweighted decibels, in which no correction is made for audio frequency.
Deadhead Movements	Deadhead movements are considered to be empty train movements required to reposition a train before or after revenue service. (Revenue service entails train movements that carry fare paying passengers). Deadhead movements are also referred to as "unproductive moves" as they

	incur the costs of train operations, but are not offset by any revenue from passengers.
Detailed Design	The detailed design phase of a project is defined as the phase of the project where design is refined past the conceptual phase, when plans, specifications, and estimates are created. This will take place after the TPAP is completed and before the construction phase.
DFO	Department of Fisheries and Oceans.
Disconnect Switches	An electrical switch for disconnecting electrical power from a line section.
Distribution Line (DL)	Electrical line conveying electricity at voltages less than 50kV.
DMU	Diesel Multiple Unit; a train comprising single self -propelled diesel units.
Double Stacked Freight (DSF)	Freight trains carrying double stack containers.
Duct Bank	A duct bank is an assembly of electrical conduits that are either directly buried or encased in concrete. The purpose of the duct bank and associated conduit is to protect and provide defined routing of electrical cables and wiring. It also provides physical separation and isolation for the various types of cables.
ELC	Ecological Land Classification. The system in place in Ontario for defining ecological units on the basis of bedrock, climate, physiology, and vegetation.
Electric Traction Facility	A traction substation, paralleling station, or switching station.
Electrical Potential	A measurement of the voltage (or potential difference) between two points in a system. For UP Express electrification, electrical potential is the electrical charge difference between the electrified UP Express railway and the ground. The unit for electrical potential is expressed in volts.
Electrical Section	This is the entire section of the overhead contact system (OCS) which, during normal system operation, is powered from a traction power substation (TPS) circuit breaker. The TPS feed section is demarcated by the phase breaks of the supplying TPS and by the phase breaks at the nearest SWS or line end. An electrical section may be subdivided into smaller elementary electrical sections.
Elementary Electrical Section	The smallest section of the overhead contact system (OCS) power distribution system that can be isolated from other sections or feeders of the system by means of disconnect switches and/or circuit breakers.
ELF	Extremely Low Frequency. ELF is the International Telecommunication Union (ITU) designation for electromagnetic radiation (radio waves) with frequencies from 3 to 30 Hz, and corresponding wavelengths from 100,000 to 10,000 kilometers.
EMC	Electromagnetic Compatibility. Electromagnetic compatibility is the ability of a device, equipment, or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.
EMF	Electric and Magnetic Field. Electric and magnetic fields arise from natural forces and permeate our environment. In addition to natural background EMF, anthropogenic sources include electric fields which arise anywhere

	electricity or electrical components are used and magnetic fields which arise wherever there is a flow of electric current. Common manmade sources of EMF include: electronics, power stations, transmission lines, telecommunication infrastructure, electric motors, etc. The strength of man-made EMF depends on the characteristics of the source including amongst others, voltage, current strength and frequency.
EMI	Electromagnetic Interference. Electromagnetic interference is a disturbance that affects an electrical circuit due to either electromagnetic induction or radiation from an external source.
EMI Noise	Unwanted electrical signals that produce undesirable effects in the circuits of the control system in which they occur.
EMU	Electric Multiple Unit; a train comprising single self-propelled electric units.
END	Endangered, a designation for a Species at Risk.
EPR	Environmental Project Report. The proponent is required to prepare an Environmental Project Report to document the Transit Project Assessment Process followed, including but not limited to: a description of the preferred transit project, a map of the project, a description of existing environmental conditions, an assessment of potential impacts, description of proposed mitigation measures, etc. The EPR is made available for public review and comment for a period of 30 calendar days. This is followed by a 35-day Minister's Decision Period.
ESA	Environmentally Significant Area. These are natural areas which are particularly significant or sensitive requiring additional protection to preserve their environmental qualities and significance.
ESA, 2007	The *Ontario Endangered Species Act, 2007*.
ESAs	Environmental Site Assessments The study of a property to determine if contaminants are present and, if so, the location and concentration of these contaminants. This study includes a phase one environmental site assessment and where required a phase two environmental site assessment.
Feeder	A current-carrying electrical connection between the overhead contact system and a traction power facility (substation, paralleling station or switching station).
Flash Plate	A flash plate is a conductive plate installed above a bare energized wire and below reinforced concrete. The intent is to prevent 'flash over' which is where current finds its way into the reinforcing steel. Usually this is via water dripping, ice, or animals making the bridge between wire and concrete. The plate is bonded to the static wire.
FOD	Deciduous Forest as defined by the Ecological Land Classification System.
FOM	Mixed Forest as defined by the Ecological Land Classification System.
Fossil Fuels	A group of combustible materials that have been formed from decayed plants and animals. These materials are often used as fuel by combusting them to release energy. Fossil fuels include oil, coal, and natural gas.
FTA	FTA stands for Federal Transit Administration, a United States federal agency.
FWCA	Fish and Wildlife Conservation Act.

Gantry	The feeder wires from the traction power substation (TPS) will be connected to the overhead contact system (OCS) with the help of gantries. The main gantry (also referred to as the catenary feeding gantry) is the one parallel to the track and closest to the TPF. Gantries are also used for traction power distribution. The feeder wires from the facility will be connected to the OCS with the help of gantries.
GIS	Geographic Information Systems. GIS systems are designed to capture, store, visualize, manipulate, analyze, manage, and present spatial or geographical data.
Greenhouse Gases	Greenhouse gases are those gases that absorb infrared radiation emitted from the Earth thus containing the energy within the atmosphere. Total greenhouse gases are typically expressed as carbon dioxide equivalent (CO_2e), which is the total mass of CO_2 that would have the same impact on climate change as a mixture of greenhouse gases.
Grounding	Connecting to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to limit the build-up of voltages to levels below that which may result in undue hazard to persons or to connected equipment.
Grounding Grid	A system of horizontal ground electrodes that consists of a number of interconnected, bare conductors buried in the earth, providing a common ground for electrical devices or metallic structures, usually in one specific location.
Heavy Maintenance	Heavy maintenance includes: replacement of engine traction motors, replacement of diesel engines on DMUs, replacement of transformers and ac propulsion systems on EMUs and replacement of wheel sets on engines. On railcars, heavy maintenance includes the replacement of wheel sets, repairs to windows and brake lines, and body repairs.
HiRail Vehicle	A road-rail vehicle which can operate both on rail tracks and a conventional road.
HRCA	Halton Region Conservation Authority.
HV	High Voltages, high voltages refers to electrical energy at voltages high enough to cause injury and harm to human beings and living species. Voltages over 1000 for alternating current, and 1500 V for direct current is considered high voltage.
Hydro One	Hydro One Incorporated delivers electricity across the province of Ontario. Hydro One has four subsidiaries, the largest being Hydro One Networks. They operate 97% of the high voltage transmission grid throughout Ontario.
ICNIRP	International Commission on Non-Ionizing Radiation Protection. The ICNIRP is an international commission specialized in non-ionizing radiation protection. ICNIRP is an independent nonprofit scientific organization chartered in Germany. It was founded in 1992 by the International Radiation Protection Association (IRPA) to which it maintains close relations.
Immunity	The ability of equipment to perform as intended without degradation in the presence of an electromagnetic disturbance.

Impedance Bonds	An electrical device located between the rails consisting of a coil with a centre tap used to bridge insulated rail joints in order to prevent track circuit energy from bridging the insulated joint, while allowing the traction return current to bypass the insulated joint. The centre tap can also be used to provide a connection from the rails to the static wire and/or traction power facilities for the traction return current.
Insulated Wires	Conductive wires which are covered in a layer of insulating material to provide protection that will increase safety and efficiency, and is used to stop the passage of electricity, heat, or sound from one conductor to another. These wires are normally supported on a weight-carrying messenger wire.
IPCC	The Intergovernmental Panel on Climate Change.
kV	Abbreviation for kilovolt (equal to 1000 volts).
LIO	Land Information Ontario.
LSRCA	Lake Simcoe Region Conservation Authority.
LV	Low Voltage, according to the International Electrotechnical Commission (IEC) voltages between 50-1000 V for alternating current, and between 120-1500 V for direct current is considered low voltage.
MA	Marsh as defined by the Ecological Land Classification System.
Main Gantry	These 25 kV feeders from the traction power facility (TPF) will be connected to the overhead contact system (OCS) with the help of main and strain gantries and a cross feeder arrangement. The main gantry also referred to as the catenary feeding gantry is the one parallel to and toward the TPF side of the track.
Maintenance Facility	A mechanical facility for the maintenance, repair, and inspection of engines and railcars.
MAM	Meadow Marsh as defined by the Ecological Land Classification System.
MAS	Shallow Marsh as defined by the Ecological Land Classification System.
MBCA	Migratory Birds Convention Act.
MEM	Mixed Meadow as defined by the Ecological Land Classification System.
Messenger Wire	In catenary construction, the overhead contact system (OCS) Messenger Wire is a longitudinal bare stranded conductor that physically supports the contact wire or wires either directly or indirectly by means of hangers or hanger clips and is electrically common with the contact wire(s).
Mi.	The contraction of Mileage, measurement in miles along the rail corridors. This is determined by historical corridor ownership and is not consistent throughout the network.
Mid-span	Area between two overhead contact system (OCS) registration points.
Milligauss	In electricity, a practical unit of magnetic induction equal to a thousandth of one gauss or of one c. g. s. electromagnetic unit.
Minister	Ontario Minister of the Environment and Climate Change.
Mitigation Measure	Actions that remove or alleviate, to some degree, the negative effects associated with the implementation of an alternative.
MNRF	Ontario Ministry of Natural Resources and Forestry.

Modelling	The process of using collected data and information to generate rational predictions regarding the future implementation of project components.
MOECC	Ontario Ministry of the Environment and Climate Change.
MTCS	Ontario Ministry of Tourism, Culture, and Sport is responsible for the administration of the Ontario Heritage Act and may determine policies, priorities and programs for the conservation, protection and preservation of Ontario's heritage.
MTO	Ontario Ministry of Transportation.
MVA	Megavolt-Ampere. This is a unit for measuring the apparent power in an electrical circuit equivalent of one million watts.
NAPS	National Air Pollution Surveillance program.
Negative Feeder	Negative feeder is an overhead conductor supported on the same structure as the catenary conductors, which is at a voltage of 25 kV with respect to ground but 1800 out-of-phase with respect to the voltage on the catenary. Therefore, the voltage between the catenary conductors and the negative feeder is 50 kV nominal. The negative feeder connects successive feeding points, and is connected to one terminal of an autotransformer in the traction power facilities (TPF) via a circuit breaker or disconnect switch. At these facilities, the other terminal of the autotransformer is connected to a catenary section or sections via circuit breakers or disconnects.
NEP	Niagara Escarpment Plan areas, part of the Greenbelt Plan.
Net Effect	The effect (positive or negative) associated with an alternative after the application of avoidance/mitigation/compensation/enhancement measures.
NHIC	Natural Heritage Information Centre.
NIEHS	National Institute of Environmental Health Sciences, a division of the United States National Institute of Health (NIH).
Notice of Commencement	The Proponent is required to prepare and distribute a Notice of Commencement, which "starts the clock ticking" for the 120-day portion of the transit project assessment process. Proponents must prepare and distribute a Notice of Commencement to indicate that the assessment of a transit project is proceeding under the transit project assessment process. Proponents must complete their documentation (the Environmental Project Report) of the transit project assessment process within 120 days of distributing the Notice of Commencement.
Notice of Completion	The Notice of Completion must be given within 120 days of the distribution of the Notice of Commencement (not including any "time outs" that might have been taken). The Notice of Completion of Environmental Project Report signals that the Environmental Project Report has been prepared in accordance with section 9 of the regulation and indicates that the Environmental Project Report is available for final review and comment (for 30 calendar days). Following the 30-day public review period, there is a 35-day Minister's decision period.
OA	Open Water as defined by the Ecological Land Classification System.
OAO	Open Aquatic Area

OBBA	Ontario Breeding Bird Atlas.
Ohms	Unit of electrical resistance. A low electrical resistance indicates a strong path which current can easily flow.
Ontario Heritage Act (OHA)	The Ontario Heritage Act provides the framework for provincial and municipal responsibilities and powers in the conservation of cultural heritage resources: https://www.ontario.ca/laws/statute/90o18.
OP	Municipal Official Plan.
Open Route	An area of tracks where there is no vertical conflicts to the overhead contact system (OCS).
ORMCP	Oak Ridges Moraine Conservation Plan.
ORRA	Ontario Reptile and Amphibian Atlas.
Overhead Contact System (OCS)	The acronym for the Overhead Contact Systems (OCS), which is comprised of: 1.The aerial supply system that delivers 2x25 kV traction power from traction power substations to the pantographs of Metrolinx electric trains, comprising the catenary system messenger and contact wires, hangers, associated supports and structures including poles, portals, head spans and their foundations), manual and/or motor operated disconnect switches, insulators, phase breaks, section insulators, conductor termination and tensioning devices, downguys, and other overhead line hardware and fittings. 2. Portions of the traction power return system consisting of the negative feeders and aerial static wires, and their associated connections and cabling.
Overhead Contact System (OCS) Impact Zone	The defined zone within which Overhead Contact System (OCS) infrastructure will be built (e.g., OCS foundations, portal/cantilever poles, etc.).
Overhead Structure	A structure that allows a road to cross over a railway underneath.
Overpass	A structure that allows a railway to cross over a road or watercourse underneath.
OWES	Ontario Wetland Evaluation System.
Pantograph	Device on the top of a train that slides along the contact wire to transmit electric power from the catenary to the train.
Paralleling Station (PS)	This type of traction power facility contains an autotransformer which helps support the overhead contact system (OCS) voltage in the electrified system.
Particulate Matter (PM)	Microscopic solid or liquid matter suspended in the atmosphere.
Performance Standards	General specifications and criteria that define the parameters and requirements of a particular system.
Phase Break	An arrangement of insulators and grounded or non-energized wires or insulated overlaps, forming a neutral section, which is located between two sections of overhead contact system (OCS) that are fed from different phases

	or at different frequencies or voltages, under which a pantograph may pass without shorting or bridging the phases, frequencies, or voltages.
Phase Break	An arrangement of insulators and grounded or non-energized wires or insulated overlaps, forming a neutral section, which is located between two sections of overhead contact system (OCS) that are fed from different phases or at different frequencies or voltages, under which a pantograph may pass without shorting or bridging the phases, frequencies, or voltages.
Pipeline	A line that is used or to be used for the transmission of oil, gas or any other commodity and that connects a province with any other province or provinces or extends beyond the limits of a province or the offshore area and includes all branches, extensions, tanks, reservoirs, storage facilities, pumps, racks, compressors, loading facilities, interstation systems of communication by telephone, telegraph or radio and real and personal property, or immovable and movable, and works connected to them, but does not include a sewer or water pipeline that is used or proposed to be used solely for municipal purposes.
Polycyclic Aromatic Hydrocarbons (PAH)	A group of compounds that contain only carbon and hydrogen and are composed of multiple aromatic rings. They are released from the burning of fuels.
Portal	Portal is an overhead contact system (OCS) structure that spans over the tracks between two OCS support poles located on the sides of the tracks in order to support the electrification equipment. The portal structure is used at multiple track locations where cantilever frames are not practical.
Portal Boom	Top steel section or truss/lattice at the top of the portal structure, supported by two columns placed either side of the railway. The “portal boom” provides support points for the overhead contact system (OCS) conductors.
Positive Train Control	A signaling system using on board and wayside equipment to automatically reduce the speed, or stop a train depending on the conditions on the track ahead.
Potential Effect	A possible or probable effect of implementing a particular alternative.
Potential Provincial Heritage Property (PPHP)	A property which has the potential to fulfill the requirements of a Provincial Heritage Property.
Potentially Contaminating Activity (PCA)	Use or activity at a site that has the potential to result in soil and/or groundwater contamination. Examples of PCAs are set out in Table 2, Schedule D of *O.Reg. 153/04.*
Preliminary Design	The design of a proposed project (including a detailed cost estimate) to a level that demonstrates that the project is buildable within the given parameters of the design scope.
Preventive Maintenance	Preventive maintenance includes items such as: replacing brake pads, measuring wheels, inspection of running gear, inspection and repair of central air conditioning, check radios and repair/replace, repair broken windows and doors, etc.

Proponent	A person who carries out or proposes to carry out an undertaking or is the owner or person having charge, management or control of an undertaking.
Provincial Heritage Property of Provincial Significance (PHPPS)	A provincial heritage property that has been evaluated using the criteria found in Ontario Heritage Act O. Reg. 10/06 and has been found to have cultural heritage value or interest of provincial significance.
Provincial Heritage Property (PHP)	A real property, including buildings and structures on the property, that has cultural heritage value or interest and that is owned by the Crown in right of Ontario or by a prescribed public body; or that is occupied by a ministry or a prescribed public body if the terms of the occupancy agreement are such that the ministry or public body is entitled to make the alterations to the property that may be required under these heritage standards and guidelines (Standards and Guidelines for Conservation of Provincial Heritage Properties, Ontario Heritage Act).
Provincially Significant Wetland (PSW)	Wetlands deemed by the province to be ecologically significant in nature and thus protected from all development activities.
Rail Potential	The voltage between running rails and ground occurring under operating conditions when the running rails are utilized for carrying the traction return current or under fault conditions.
Receptor	Locations, structures, or facilities that have the potential to be impacted by or interact with the project.
RER	Acronym for Regional Express Rail. RER is the 10 year transit plan for the Greater Toronto Hamilton Area that is being implemented by Metrolinx. Electrification is a component of the RER plan.
Resilient Arm	A combined registration and support assembly with vertical resilience, used for support of catenary conductors in situations with restricted clearance such as tunnels and overhead bridges.
Resultant Flux Density	The mathematical computation from the combination of the measured X, Y, and Z readings of milligauss (mG). It could be approximated using a sum of squares of these readings and then taking the square root, but in the case of all readings shown in this report, the device used computed this number automatically and presented it as the Resultant Flux Density.
ROW	Right of Way, the portion of land adjacent to tracks owned by the Railway (Metrolinx, Canadian Pacific Railway (CP), Canadian National Railway (CN), etc.). Can be synonymous with rail corridor.
Running Rails	Rails that act as a running surface for the flanged wheels of a car or locomotive.
SAR	Species at Risk. These are plants or animals that are considered by the Government of Ontario to be endangered, threatened, of special concern, or extirpated.
SARA	Species at Risk Act.
SC	Species Concern, a designation for a Species at Risk.
SCADA	System Control And Data Acquisition. SCADA is a control system that controls and monitors the status of the industrial processes and devices for the

	electrification system. These devices may include motor operated disconnect switch, relay, meter and circuit break, of the Electrification System.
Screening	The process of applying criteria to a set of alternatives in order to eliminate those that do not meet minimum conditions or requirements.
Secondary Voltage	Typically less than 750V.
Service Maintenance	Service maintenance is the light maintenance of engines (i.e., window cleaning, check oil levels and sand levels, clean engine cab, refill potable water, and empty washroom holding tanks).
Shield	As normally applied to instrumentation cables, refers to a conductive sheath (usually metallic) applied, over the insulation of a conductor or conductors, for the purpose of providing means to reduce coupling between the conductors so shielded and other conductors that may be susceptible to, or which may be generating, unwanted electrostatic or electromagnetic fields (noise).
Shielding	Shielding is the use of the conducting and/or ferromagnetic barrier between a potentially disturbing noise source and sensitive circuitry. Shields are used to protect cables (data and power) and electronic circuits. They may be in the form of metal barriers, enclosures, or wrappings around source circuits and receiving circuits. Additionally shielding is used to protect overhead transmission lines or overhead contact system (OCS) from incidents of lightning, in regions of high isoceraunic activity. Shield wire is located above the exposed current carrying wires to provide a 45 degree angle of protection. In sensitive applications, the angle is reduced to 30 degrees for more conservative design.
SHO	Open Shoreline as defined by the Ecological Land Classification System.
Signal System	The rail signal system is a combination of wayside and on board equipment and/or software to provide for the routing and safe spacing of trains or rail vehicles.
Signal Bridges	A structure for mounting signals that spans one or more tracks. Signal bridges may be footed on both ends, or they may be 'cantilever signal bridges', footed only on one end.
Spur	A railroad track that diverges from the main track to service a specific location or industry.
Static Wire	A wire, usually installed aerially adjacent to or above the catenary conductors and negative feeders, that connects overhead contact system (OCS) supports collectively to ground or to the grounded running rails to protect people and installations in case of an electrical fault.
Strain Gantry	These 25 kV feeders from the traction power facility (TPF) will be connected to the overhead contact system (OCS) with the help of main and strain gantries and a cross feeder arrangement. The strain gantry is located within the right-of-way (ROW) parallel to and on the opposite side of the track from the TPF, with footprints exactly equal to that of the main gantry.
Study Area	The study area references to geographic space that is being examined for the Metrolinx Network Electrification Environmental Assessment.

SW	Swamp as defined by the Ecological Land Classification System.
SWD	Deciduous Swamp as defined by the Ecological Land Classification System.
Switching Station (SWS)	Switching stations are traction power facilities that are required approximately mid-way between Traction Power Substations in order to split the electrical sections.
TAG	Treed Agriculture as defined by the Ecological Land Classification System.
THD	Deciduous Thicket as defined by the Ecological Land Classification System.
Third Rail	A third rail is a way of providing electric power to a railway train, through a semi-continuous rigid conductor placed alongside or between the rails of a railway track. Third rail systems are always supplied from direct current electricity as opposed to alternating current electricity.
THR	Threatened, a designation for a Species at Risk.
Top of Rail	Top of Rail is defined as the highest point in a running rail profile.
Touch/Step Potential	Touch potential is defined as the voltage between the energized object and the feet of a person in contact with the object. Step potential is defined as the voltage between the feet of a person standing near an energized grounded object.
Traction Power Return System	The traction power return system includes all conductors (including the grounding system) for the electrified railway tracks, which form the intended path of the traction return current from the electrified rolling stock to the traction power substations. Conductors may include: • Running rails • Impedance bonds • Static wires, and buried ground or return conductors • Rail and track bonds • Return cables, including all return circuit bonding and grounding interconnections • Ground • Negative feeders due to the configuration of autotransformer connections.
Traction Power Facility (TPF)	A general term to classify Traction Power Substations, Paralleling Stations, and Switching Stations.
Traction Power Substation (TPS)	Part of the power supply components of the system; it is a traction power facility (TPF) that transforms the utility supply voltage for distribution to the trains via overhead contact system (OCS).
Transmission Line (TL)	Electrical line conveying electricity at voltages more than 50kV.
Transmission Tap	The point at which electric power is 'tapped' from the existing Hydro One power source.
TRCA	Toronto and Region Conservation Authority.
Underground Feeder Connection	An underground conduit carrying electrical connection between the overhead contact system and a traction power facility (i.e., traction power substation, paralleling station or switching station).

Utility	A utility is an entity that generates, transmits and/or distributes electricity, water and/or gas from facilities that it owns and/or operates, including electrical transmission and distribution companies, communication companies, community antenna distribution systems and regional / municipal authorities.
View-shed	The area of visual influence of the project components.
Volatile Organic Compounds (VOCs)	A class of chemicals that contain carbon, hydrogen, and oxygen atoms and have high vapour pressures at room temperature, and therefore exist predominantly in the gas phase.
Wayside Power Control Cubicles (WPCs) and Signal Cases	A wayside installation that houses remote terminal unit (RTU) and dc power supply unit for motor operated disconnect switches at locations other than traction power facilities.
WOD	Woodland as defined by the Ecological Land Classification System.

Executive Summary

Purpose of the Undertaking

The population of the Greater Toronto Hamilton Area is increasing, and with it, traffic congestion. As part of *Moving Ontario Forward*, Metrolinx is committed to electrifying the GO Transit system to bring 15-minute, two-way electrified service to core parts of the network through the Regional Express Rail (RER) program. As a component of the regional transportation plan, *The Big Move,* this program supports Metrolinx's goal of transforming the GO system into a comprehensive regional rapid transit network. Electrification of the GO network is a key component of the RER program.

The purpose of the GO Rail Network Electrification project is to convert six GO-owned rail corridors from diesel to electric propulsion, including: Union Station Rail Corridor, Lakeshore West Rail Corridor, Kitchener Rail Corridor (a portion of the Kitchener Corridor), Barrie Rail Corridor, Stouffville Rail Corridor, and Lakeshore East Rail Corridor. Once electrification is implemented, the system will operate with a mixed fleet of diesel and electric trains, as not all tracks on all corridors will be electrified.

Project Proponents

Metrolinx and Hydro One, as Co-Proponents, are carrying out the Transit Project Assessment Process (TPAP) under *O. Reg. 231/08* for the GO Rail Network Electrification Project (the Project).

Project Scope

The scope of the Project involves electrification of the following GO Transit rail corridors:

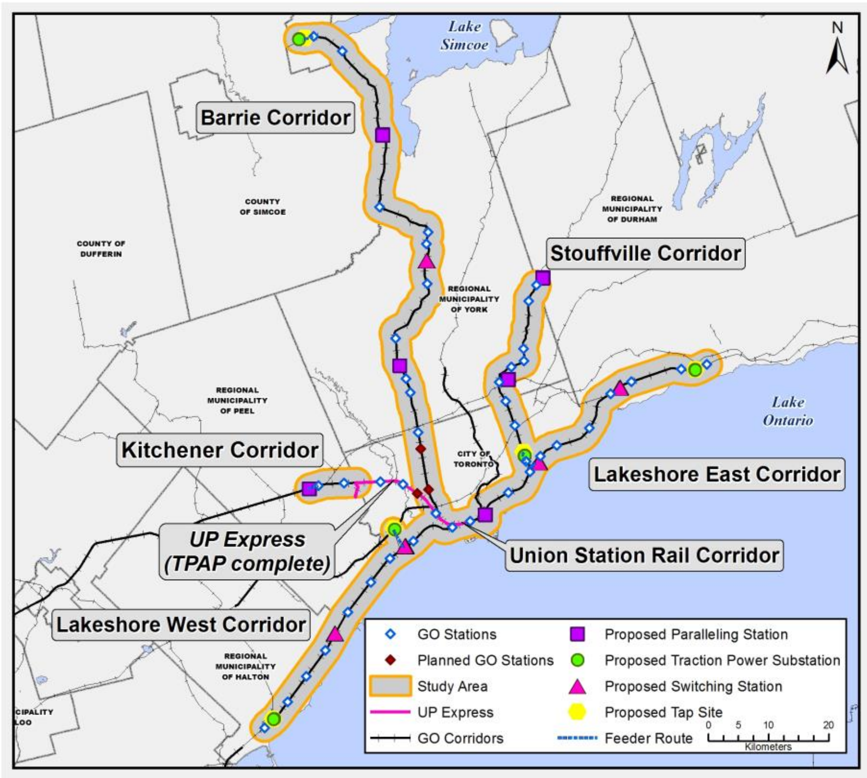
1. Union Station Rail Corridor – From UP Express Union Station to Don Yard Layover
2. Lakeshore West Corridor – From just west of Bathurst St (Mile 1.20) to Burlington
3. Kitchener Corridor – From UP Express Spur[1] (at Highway 427) to Bramalea
4. Barrie Corridor – From Parkdale Junction (off Kitchener Corridor) to Allandale GO Station
5. Stouffville Corridor – From Scarborough Junction (off Lakeshore East Corridor) to Lincolnville GO Station
6. Lakeshore East Corridor – From Don Yard Layover to Oshawa GO Station

In order to electrify the system, there is new infrastructure that needs to be built as well as modifications to existing infrastructure (such as existing GO Stations and Maintenance Facilities).

[1] *The portion of the Kitchener corridor from Strachan Ave. to the airport spur (at Highway 427) was previously assessed/approved as part of the Metrolinx UP Express Electrification TPAP.*

Study Area

The Study Area for the GO Rail Network Electrification TPAP is generally defined as the existing GO rail right-of-ways (ROW) to be electrified plus the 7m Overhead Contact System (OCS)/Vegetation Clearing Zone (as below), the Tap and Traction Power Facility sites, as well as Tap/TPF ancillary components such as access roads.



Key Project Components

The scope of the GO Rail Network Electrification TPAP includes examining the potential environmental effects of building, operating and maintaining the electrified GO system, including the various project components listed below.

- **Traction Power Supply**
    - 5 Hydro One Tap Locations
    - Hydro One Tap Structures
    - High Voltage Connection Routes
- **Traction Power Distribution**
    - 5 Traction Power Substations (TPS)
    - 5 Switching Stations (SWS)
    - 6 Paralleling Stations (PS)

  - Gantries
  - Access Roads
  - Underground Duct Banks and Aerial Supply
  - Overhead Contact System (OCS)
  - 25 kV Feeder Routes

- **Ancillary Components**
  - Grounding and Bonding
  - Bridge Modifications
  - Existing Maintenance Facility Modifications
  - GO Layover Facility Modifications
  - GO Station Modifications

It is important to note that the scope of the Project does *not* include/address the new track, grade separation, new GO Stations, etc. infrastructure required to provide increased GO service levels associated with Regional Express Rail such as track expansions, etc. Rather, these aspects are currently being (or will be) designed and assessed as part of separate Metrolinx projects that are (or will be) subject to separate Environmental Assessments.

Hydro One Tap Locations - Power Supply

Electrical power will be supplied from Hydro One's existing 230kV high voltage grid (i.e., transmission lines). Specifically, power will be tapped from the grid at a voltage of 230kV and routed either aerially or underground to the new Metrolinx Traction Power Substations, where it will be stepped down to a lower voltage (i.e., 25kV) for distribution along the electrified GO system. The following sections provide further detail on the Hydro One tap locations, high voltage connection routes and associated infrastructure that will need to be built.

The tap locations are the areas where power will be drawn from the existing Hydro One Network. There are five locations as follows where taps must be made in order to supply the necessary 230kV power to the electrified GO system:

1. Mimico Tap Location (Lakeshore West Corridor)
2. Burlington Tap Location (Lakeshore West Corridor)
3. Allandale Tap Location (Barrie Corridor)
4. Scarborough Tap Location (Stouffville Corridor)
5. East Rail Maintenance Facility Tap Location (Lakeshore East Corridor)

Each tap location will consist of at least two tap structures (approximately 10m^2, up to 30m tall). Each of the tap structures will be located under/adjacent to existing Hydro One 230kV transmission lines to facilitate tapping the transmission circuits. For purposes of the TPAP environmental studies, a more conservative area was delineated around the proposed locations of the tap points in order to account for the fact that the precise locations of the tap structures won't be determined until detailed design. From the tap structures, a high voltage connection route will be constructed that may be aerial (overhead wires) or underground (via duct bank) that will extend to the demarcation point. The demarcation point is essentially a disconnect switch that will represent the point at which the new infrastructure will switch from being Hydro One controlled to Metrolinx controlled.

Table E- 1: Summary of Traction Power Facilities by Corridor

GO Corridor	Type of Facility	Location(s)
Union Station	Tap Point	• None
	TPS	• None
	SWS	• None
	PS	• None
	Feeder Route	• None
Lakeshore West	Tap Point	• Burlington Tap • Mimico Tap
	TPS	• Burlington • Mimico
	SWS	• Mimico • Oakville
	PS	• None
	Feeder Route	• Canpa 2X25kV Feeder Route
Kitchener	Tap Point	• None
	TPS	• None
	SWS	• None
	PS	• Bramalea
	Feeder Route	• Bramalea 2X25kV Feeder Route
Barrie	Tap Point	• Preferred Allandale Tap • Alternative Allandale Tap
	TPS	• Allandale
	SWS	• Newmarket
	PS	• Gilford • Maple
	Feeder Route	• Barrie-Collingwood Railway 2x25kV Feeder Route
Stouffville	Tap Point	• Scarborough Tap
	TPS	• Scarborough

GO Corridor	Type of Facility	Location(s)
	SWS	• None
	PS	• Unionville • Lincolnville
	Feeder Route	• Scarborough 2X25kV Feeder Route
Lakeshore East	Tap Point	• East Rail Maintenance Facility (ERMF) Tap
	TPS	• ERMF
	SWS	• Scarborough • Durham
	PS	• Don Yard
	Feeder Route	• Scarborough 2X25kV Feeder Route

Conceptual Electrification Design

The following outlines the specific assumptions that were established to prepare the conceptual designs for each corridor to be electrified, including: start and end points, number of tracks to be accommodated within the electrification design, and number of tracks to be electrified.

Union Station Rail Corridor

- The Union Station Rail Corridor electrification limits were defined as: beginning at UP Express Union Station Mile Point (MP) 0.00 and continuing east to the Don Yard Layover at MP 1.65 on the USRC subdivision.
- A conceptual design was prepared that consisted of all tracks in the USRC being electrified. A freight route will be maintained through USRC and the design will include the provision for a route for Double-Stacked Freight.

Lakeshore West Corridor

- The Lakeshore West Corridor electrification limits were defined as: beginning at Mile 1.20 and continuing west to Burlington GO Station MP 31.5 on the Oakville subdivision.
- A conceptual design was prepared that consisted of five tracks[2] from sta. 2+500 (mile 1.6) to 10+900 (mile 6.7), and four tracks from sta. 10+900 (mile 6.7) to 51+000 (mile 31.7) at Burlington GO Station.
- Conceptual Design incorporated the existing GO stations at: Exhibition, Mimico, Long Branch, Port Credit, Clarkson, Oakville, Bronte, Appleby and Burlington.

[2] For the purposes of the TPAP, 5 tracks were assumed for this section for ultimate build out, however for RER expansion over the next 30 years, 4 tracks are proposed.

- Service will consist of a mix of electric and diesel trains. Electric trains will operate between Union Station and Burlington GO Station. Diesel trains will operate over the entire corridor extending to Hamilton GO Station.

Kitchener Corridor

- The Kitchener Corridor electrification limits were defined as: beginning at the limits of the UP Express Spur (west of Highway 427)[3] located at MP 13.4 on the Weston subdivision and continuing west to Bramalea.
- A conceptual design was prepared that consisted of three tracks from sta. 21+500 (mile 13.4) to 26+200 (mile 16.3), two tracks from sta. 26+200 (mile 16.3) to 28+700 (mile 17.8), and a third turn back track at Bramalea Station.
- Conceptual Design incorporated the existing GO stations at: Malton and Bramalea.
- Service will consist of a mix of electric and diesel trains. Electric trains that will operate from the eastern limits of the corridor to Bramalea. Diesel trains will operate over the entire corridor extending to Kitchener GO Station.

Barrie Corridor

- The Barrie Corridor electrification limits were defined as: beginning at the limits of the Parkdale Junction (off Kitchener Corridor) at MP 3.0 and continuing north to Allandale Waterfront GO Station MP 63.00 on the Newmarket subdivision.
- A conceptual design was prepared that consisted of two tracks from sta. 4+900 (mile 3.0) to sta. 101+500 (mile 63.0)
- Conceptual Design incorporated the existing GO stations at: Rutherford, Maple, King City, Aurora, Newmarket, East Gwillimbury, Bradford, Barrie South and Allandale.
- Design incorporated the provision of two future GO Stations at: Caledonia and Downsview Park.
- Service will consist of electric trains over the entire corridor.

Stouffville Corridor

- The Stouffville Corridor electrification limits were defined as: beginning at the limits of the Scarborough Junction (off Lakeshore East Corridor) located at MP 61.0 and continuing north to Lincolnville Station MP 38.9 on the Uxbridge subdivision.
- A conceptual design was prepared that consisted of two tracks from sta. 14+000 (mile 60.5) to 30+300 (mile 50.4), and a single track from sta. 30+300 (mile 50.4) to Lincolnville Station.
- Conceptual Design incorporated the existing GO stations at: Scarborough, Kennedy, Agincourt, Milliken, Unionville, Centennial, Markham, Mount Joy, Stouffville, and Lincolnville.

[3] Excluding Highway 427 bridges that were previous assessed under the UP Express Electrification TPAP (Metrolinx, 2014).

- Service will consist of electric trains over the entire corridor.

Lakeshore East Corridor

- The Lakeshore East Corridor electrification limits were defined as: beginning at the limits of the Don Yard Layover located at MP 332.19 on the Kingston Subdivision and continuing east to Oshawa Station MP 11.6 on the GO Subdivision.
- A conceptual design was prepared that consisted of four tracks from sta. 2+700 (mile 332.2) to 32+100 (mile 313.9/mile 0), and three tracks from sta. 32+100 (mile 313.9/mile 0) to Oshawa Station, with one passing siding.
- Conceptual Design incorporated the existing stations at: Danforth, Scarborough, Eglinton, Guildwood, Rouge Hill, Pickering, Ajax, Whitby, and Oshawa.
- Service will consist of electric trains over the entire corridor.

OCS Impact Zone

For purposes of assessing potential impacts as part of the TPAP, a conservative OCS Impact Zone was established that reflects an area spanning the tracks to be electrified plus a 5 metre offset from the centerline of the outermost track to be electrified on either side of each rail corridor. This impact zone accounts for the following OCS elements:

- OCS pole foundations
- Portal/cantilever poles
- Grounding and bonding requirements
- Contact, autotransformer, and feeder wires

A series of plans were prepared depicting the OCS Impact Zone for each corridor and have been included as **Appendix N**.

Vegetation Clearing Zone

A Vegetation Clearing Zone is required in order to provide safe electrical clearances to any existing vegetation along the rail corridors. The Vegetation Clearing Zone entails vegetation removals within the area encompassed by the overhead contact system plus an additional 2 metre offset area on either side of the OCS components. As a result, the total clearing area is defined as 7m measured from the centerline of the outermost tracks to be electrified on either side of each rail corridor. The 7m zone is considered a maximum removal zone; during detailed design, the 7m zone may be reduced in certain areas where/if possible based on the final OCS design.

Vegetation clearing is required to:

- Minimize the risk of tree limbs falling on the track or overhead wires, thus potentially causing a conflict with the electrified system resulting in loss of service and revenue; and

- Accommodate a mandatory clearance zone to ensure maintenance workers are safe when working in an electrified environment.

The project will comply with the *European standard EN50122-1:211+A1:2011 (E) Paragraph 5.2.6: Railway Applications - Fixed installations.* This European Standard specifies requirements for the protective provisions relating to electrical safety in fixed installations associated with alternating current (AC) traction systems and to any installations that can be endangered by the traction power supply system.

The 7 m vegetation clearing zone is made up of:

- 2.9 m clearance from the track to the OCS pole to ensure clearance of the train to the OCS pole.
- 2.5 m vegetation clearance from the electrical components to the limits of the trees.
- Up to 1.6 m to account for tree grow back (regrowth zone).

A series of conceptual plans were prepared depicting the Vegetation Clearing Zone for each corridor and have been included as **Appendix N.**

Bridge Modifications

Modifications to Achieve Vertical Clearance Requirements

As part of the conceptual design prepared during the TPAP, a preliminary investigation was undertaken to examine possible design solutions for overhead bridges that do not meet the required minimum vertical clearance (RMVC) needed to accommodate electrification of the Metrolinx rail corridors.

A clearance plate defines the maximum height and width for railway vehicles to ensure safe passage through bridges, tunnels and other structures. Standard plates are used throughout North America so that train operators know what size equipment will safely pass on a given line. Because there are several tenant railroads, including CP & CN, operating over Metrolinx territory, Metrolinx uses two different plates. A plate F is used in areas where standard freight cars and MX's bi-level coaches operate, plate H is used where double stack freight cars operate.

The following key assumptions were established to guide the investigations:

- Electrification is to accommodate GO MP-40, Bi-level, and Wayfreight vehicles (encompassed under AAR Plate F) on all corridors to be electrified.
- Protection for double stack trains and Automax cars (encompassed under AAR Plate H) along the corridors to be electrified.

The required Absolute Minimum Vertical Clearances (AMVCs) for overhead bridges are defined as follows:

	Plate F	Plate H
Steel bridges:	5946 mm	6937 mm
Concrete bridges:	5959 mm	6950 mm

These AMVCs were used as a “trigger” to determine the need to address an inadequate vertical clearance in terms of raising/replacing the bridge or lowering the track, where an OCS modification/solution cannot otherwise be provided.

Based on the analysis completed, the required MVC can be accomplished through OCS design modifications (such as reducing the structure spacing and reducing the system height of the OCS) for several overhead bridge structures. Based on the analysis completed, there are fourteen (14) overhead bridges that do not meet the RMVC for Plate H and which therefore require modification to achieve the RMVC:

- **Nine (9) overhead bridges on the Lakeshore West Corridor**
  - OH Bridge 1.57 Strachan Avenue
  - OH Bridge 2.38 Dufferin Street
  - OH Bridge 2.69 Dunn Avenue
  - OH Bridge 2.85 Jameson Avenue
  - OH Bridge 9.41 Browns Line
  - OH Bridge 31.28 Drury Lane Pedestrian Bridge
  - OH Bridge 3.54 Sunnyside Pedestrian Bridge
  - OH Bridge 5.61 Gardiner Expressway
  - OH Bridge 18.77 Royal Windsor Drive

- **Two (2) overhead bridges on the Barrie Corridor**
  - OH Bridge 3.37 Dundas Street
  - OH Bridge 8.80 Highway 401

- **Three (3) overhead bridge on the Lakeshore East Corridor**
  - OH Bridge 314.95 Granite Crt.
  - OH Bridge 328.64 Main St.
  - OH Bridge 326.50 Birchmount Road

It is further noted that unless a waiver is requested and justified by the bridge owner and granted by Metrolinx, all new or replacement overhead bridges (i.e., future bridges to be constructed) will be required to provide a preferred MVC of 7.584m to maintain clearance requirements set by Transport Canada and clearance requirements of the OCS to avoid the need for OCS attachments to the overhead structure.

There are several possible engineering solutions that may be implemented to achieve the required MVC for the overhead bridges including the following: i) raise/modify the existing bridge, ii) lower the tracks, iii) improve quality of maintenance to reduce track maintenance allowance, iv) freight restrictions to certain tracks, v) replace the bridge, or some combination of these solutions.

An overview of these structures as well as the proposed engineering solution to achieve the required MVC has been described in further detail in Section 3.9.

Bridge Protection Barriers

The purpose of a bridge protection barrier is to protect pedestrians and travelers/infrastructure users within the public right-of-way on bridges from direct contact with adjacent live parts of the OCS for voltages up to 25 kV to ground. In addition, these barriers protect against damage to the OCS passing under bridges by providing an obstacle to debris that may be thrown onto the railway from overhead.

Bridge Protection Barrier Design Options

As part of detailed design, Metrolinx's Design Excellence Committee will be engaged to review possible design treatments/option for enhancing the aesthetics of bridge barriers where feasible/required. It is anticipated that the basis of the protection barrier will be a post and panel (solid-faced) design with customizable panels to suit visual preferences (in consultation with the applicable bridge owners as appropriate), such as:

- Multilane, restricted access highways and non-visually sensitive locations;
- Visually sensitive locations;
- Structures of heritage value or sensitivity.

Pedestrian Bridge Modifications

Structural evaluations were performed as part of the conceptual design phase/TPAP to assess the load carrying capacity/structural adequacy of the following existing ten (10) pedestrian bridges, as they were affected by requirement of the Electrification project to incorporate a protection barrier:

- **Four (4) overhead pedestrian bridges on Lakeshore West Corridor**
  - OH Bridge 3.02 Dowling Avenue
  - OH Bridge 3.54 Sunnyside
  - OH Bridge 31.28 Drury Lane
  - OH Bridge 31.65 GO Station Burlington

- **One (1) overhead pedestrian bridge on Barrie Corridor**
  - OH Bridge 5.65 Innes Avenue

- **One (1) overhead pedestrian bridge on Stouffville Corridor**
  - OH Bridge 58.79 Mooregate / Tara Avenue

- **Four (4) overhead pedestrian bridges on Lakeshore East Corridor**
  - OH Bridge 1.09 GO Station Pickering North
  - OH Bridge 8.87 GO Station Whitby

- OH Bridge 326.15 Woodrow Avenue
- OH Bridge 330.96 Pape Avenue

Based on the conceptual engineering work completed to assess potential modifications to the pedestrian bridges, it was established that several of these pedestrian bridges will need to be either replaced or modified to incorporate a protection barrier, as described in each respective section below.

Grounding and Bonding

To ensure safe touch-and-step potential in accordance with permissible limits (as per applicable international electrical safety codes and standards including AREMA, CSA, EN and IEEE), a grounding and bonding system will be implemented as part of the electrification project. Touch potential is defined as the voltage between an energized object and the feet of a person in contact with the object. Step potential is defined as the voltage between the feet of a person standing near an energized grounded object. Grounding and bonding will be installed within 4 meters of the track; notwithstanding this, an evaluation out to 10m of the track will be undertaken during detailed design to determine if anything else will require grounding.

Grounding and bonding systems serve two primary functions:

- Minimize touch voltage, step voltage and ground return currents caused by the electrified system to provide for the safety of passengers, operating personnel and other wayside public, and to provide protection from the risk of electrical shock; and
- Provide the means to carry electric currents into the earth under normal and fault conditions without exceeding operating and equipment limits, or adversely affecting continuity of service.

1 Introduction

As part of the Regional Express Rail (RER) initiative (see Section 1.6.3), Metrolinx is proposing to convert several rail corridors within the GO Transit network (see **Figure 1-1**) from diesel to electric propulsion. This will require electrical power to be supplied from Ontario's electrical system through Hydro One's existing high voltage grid. As a result Metrolinx and Hydro One (as co-proponents) are jointly carrying out the Transit Project Assessment Process (TPAP) in accordance with *Ontario Regulation 231/08 - Transit Projects and Metrolinx Undertakings.* The undertaking will entail design and implementation of traction power supply and traction power distribution components including an Overhead Contact System (OCS) along the rail corridors, electrical feeder routes, as well as a number of electrical power supply/distribution facilities (referred to as Traction Power Facilities) located in the vicinity of the rail corridors. The scope of the TPAP includes assessment of noise and vibration effects associated with increased service levels across the network (refer to Volume 3).

Figure 1-1: GO Transit Network

1.1 Project Proponents

1.1.1 Co-Proponency - Metrolinx and Hydro One

Since Metrolinx requires the necessary power supply from Hydro One in order to electrify the network, Metrolinx and Hydro One are co-proponents for purposes of the Transit Project Assessment Process. More specifically, one Environmental Assessment (EA) process has been undertaken to assess all electrification infrastructure and environmental impacts under one process and one inclusive stakeholder consultation program.

1.2 Environmental Assessment Process

1.2.1 Ontario Regulation 231/08 – Transit Project Assessment Process

The proposed conversion of the GO Rail Network from diesel to electric power falls under *Schedule 1, 2.1 Subsection 2 (1) of O.* Reg. 231/08 (July 1, 2015). This Regulation applies to a transit project that is carried out by any proponent or any of its successors, or assigns if the transit project includes any one or more of the following in relation to the electrification of a new or existing commuter rail corridor:

The electrification of rail equipment propulsion. May include planning, designing, establishing, constructing, operating, changing or retiring an associated power distribution system. (i.e., Metrolinx project components).

The planning, designing, establishing, constructing, operating, changing or retiring of power supply infrastructure. (i.e., Hydro One project components)

By following the Transit Project Assessment Process (TPAP) for the GO Rail Network Electrification, the Transit Projects Regulation exempts Metrolinx and Hydro One from the requirements under Part II of the *Environmental Assessment Act (EA Act)*. The TPAP entails a defined timeline of 120 days for the proponent to complete the assessment of environmental effects, prepare the Environmental Project Report (EPR), and carry out consultation activities. **Figure 1-2** illustrates the TPAP steps.

Pre-Planning Phase

Due to the accelerated 120 day timeline associated with the TPAP, proponents are encouraged to carry out background studies and preliminary consultation activities prior to issuing a Notice of Commencement (which officially starts the 120-day TPAP Phase). With this in mind, the following activities were carried out during the Pre-Planning Phase.

- Collection and documentation of baseline environmental conditions information;
  - Preparation of the GO Rail Network Electrification Conceptual Design, including:
  - Identification of project impact zones around the corridors;
  - Identification of traction power facility locations;
  - Identification of Hydro One tap locations;

  - Identification of locations/routing for ancillary components including gantries, duct banks, aerial feeders, etc.; and
  - Identification of bridge modifications required for electrification.
- Initial communications and follow up consultation efforts with Indigenous Communities;
- Meetings with stakeholders (e.g., Review Agencies, Municipalities, Indigenous communities, Utility companies);
- Initial meetings with affected property owners identified for traction power facilities;
- Public Meeting Round #1;
- Public Meeting Round #2;
- Pre-submission Circulation of Draft EPR;
- Consideration of stakeholder comments received and follow-up efforts;
- Impact assessment studies and development of mitigation measures; and
- Preparation of Draft Environmental Project Report (EPR).

TPAP Phase

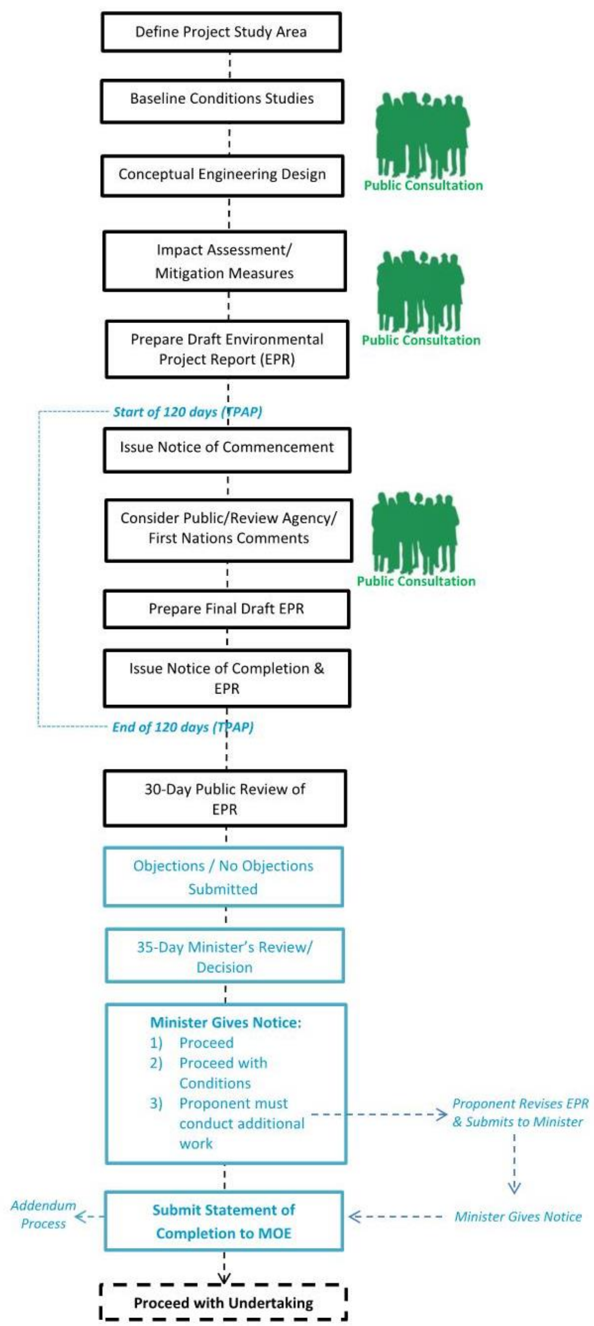
Following completion of the Pre-Planning phase, a Notice of Commencement was issued to commence the TPAP Phase, which involved the following activities:

- Issue Notice of Commencement;
- Public Consultation;
- Meetings with stakeholders (e.g., Review Agencies, Municipalities, Indigenous communities, Utility companies);
- Finalization of the EPR; and
- Issue Notice of Completion (within 120 days of Notice of Commencement).

Upon issuing the Notice of Completion, the EPR will be made available for 30 days for review by the Public (including property owners), Indigenous Communities, Review Agencies, and other Stakeholders. During this review period, if there are concerns pertaining to the potential for a negative impact on a matter of Provincial importance that relates to the natural environment or has cultural value or interest, or on a constitutionally protected Aboriginal or treaty right, an objection may be submitted to the Minister of the Environment and Climate Change (Minister). Following the 30 day review period, the Minister has 35 days within which to issue one of three notices:

- Proceed with the Project in accordance with the EPR; or
- Proceed with the Project in accordance with the EPR subject to conditions; or
- Require the proponent to conduct further work and submit a revised EPR.

Figure 1-2: Transit Project Assessment Process



1.3 Purpose of the Project

The purpose of the GO Rail Network Electrification project is to convert six GO rail corridors from diesel to electric propulsion including: Union Station Rail Corridor, Lakeshore West Rail Corridor, a portion of the Kitchener Rail Corridor, Barrie Rail Corridor, Stouffville Rail Corridor, and Lakeshore East Rail Corridor (see Section 2.3 for a map of the Study Area). Once electrification is implemented, the system will operate with a mixed fleet of diesel and electric trains, as not all tracks on all corridors will be electrified. This is further detailed in Section 3.3.2.

The population of the Greater Toronto Hamilton Area is increasing, and with it, traffic congestion. As part of *Moving Ontario Forward*, Metrolinx is committed to electrifying the GO Transit system to bring 15-minute, two-way electrified service to core parts of the network through the Regional Express Rail (RER) program. A component of the regional transportation plan, *The Big Move,* this program supports Metrolinx's goal of transforming the GO system into a comprehensive regional rapid transit network. Electrification of the GO network is a key component of the RER program.

Electrification, combined with other RER initiatives such as building new tracks, new stations, etc. makes it possible to increase service levels and offers several other benefits (compared to diesel service) as described in the following section.

1.3.1 Benefits of Electrification

There are several operational, socio-economic and environmental benefits of electrification:

A faster, more attractive service:

- Electric trains can accelerate faster and stay at top speed for longer, saving time for customers;
- By attracting additional riders, frequent electric train service reduces road congestion and reduces greenhouse gas emissions from automobiles;
- Regenerative braking puts energy back into the system.

A more efficient, reliable service:

- More frequent service reduces reliance on scheduled trips and increases the number of available seats;
- Lower operating and maintenance costs will allow for increased frequency of service.

Environmental benefits:

- Reductions in rail greenhouse gas emissions, which form a minor part of the regional emissions total (when compared with diesel locomotives, even when the emissions of electrical power generation are included in the analysis);
- Improved local air quality for local residents and customers.

1.4 Report Organization

Table 1-1 summarizes the key documentation requirements associated with *O. Reg. 231/08 - Transit Project Assessment Process*, as well as the corresponding section of this EPR document where the requirement has been addressed.

Table 1-1: Summary of TPAP Documentation Requirements

EPR Requirement	Section of EPR where requirement is addressed
Statement of purpose for the transit project and summary of background information	Volume 1
Map showing the site of the transit project	Volume 1
Description of all studies carried out, including summary of data collected or reviewed and summary of results/conclusions	Volume 1, Volume 2, Volume 3
Description of local environmental conditions within the study area	Volume 2
Final description of transit project including preferred design, and description of other design methods considered	Volume 1
Assessment of impacts on the environment associated with the preferred design (and other methods), and criteria applied for assessment of impacts	Volume 3
Description of proposed measures for mitigating potential negative impacts on the environment	Volume 3
If mitigation measures are proposed, a description of the proposed monitoring activities for verifying effectiveness of mitigation, description of commitments to be fulfilled (as applicable)	Volume 3 and Volume 5
Description of any municipal, provincial, federal or other approvals or permits anticipated to be required	Volume 5
Consultation record	Volume 4, Appendix L

As part of documenting the TPAP, this EPR has been structured into five (5) volumes along with supporting technical reports (included as appendices), to address the requirements set out in *O. Reg. 231/08*. The EPR document primarily summarizes the EA planning process followed and conclusions reached, with additional detail provided within the respective technical reports (appendices).

The following provides a brief overview of the contents found within each EPR section and supporting technical report (included as Appendices) for reference purposes.

EPR Volumes

- **Volume 1** – describes the *EA Act* requirements and process followed, provides a brief project background and associated planning context, summarizes the process followed for assessing alternative facility locations leading to the recommended sites, describes the scope of the project, provides a detailed description of the Study Area (including map), and provides a detailed description of the GO Rail Network Electrification project, including traction power supply, power distribution and maintenance requirements associated with the electrification infrastructure and equipment.

- **Volume 2** – provides a detailed description of the baseline environmental conditions (environment potentially affected) within the Study Area.

- **Volume 3** – describes the potential environmental effects, recommended mitigation measures, net environmental effects, and monitoring activities associated with implementation of the project.

- **Volume 4** – describes the consultation process and activities that were undertaken as part of the GO Rail Network Electrification TPAP including key consultation milestones. This chapter provides an overview of the input/comments/feedback received from various stakeholders (i.e., Review Agencies, Indigenous Communities, the Public, Property Owners, etc.) and how they were considered by Metrolinx as part of the TPAP.

- **Volume 5** – describes the proposed commitments and future work to be carried out during future project phases (e.g., detailed design, construction), and outlines the additional anticipated approvals and permits required for implementing the project beyond *EA Act* requirements.

List of EPR Appendices

- **Appendix A - Natural Environment Assessment Report:** is composed of two parts including *Part A1 - Natural Environment Baseline Conditions Report*, and *Part A2 - Natural Environment Impact Assessment Report.*

- **Appendix B – Preliminary Environmental Site Assessment (ESA) Reports:** is composed of two parts including: Preliminary ESA Gap Analysis Report (Rail Corridors), and Preliminary ESA Report (Taps & Traction Power Facilities).

- **Appendix C - Cultural Heritage Assessment Report:** is composed of two parts *including Part C1 – Cultural Heritage Screening Report, and Part C2 – Cultural Heritage Impact Assessment Report*.

- **Appendix D - Archaeological Assessment Report:** is composed of two parts including *Part D1 – Archeological Baseline Conditions Report,* and *Part D2 – Stage 1 Archaeological Assessment Report.*
- **Appendix E - Land Use and Socio-Economic Assessment Report:** is composed of two parts including *Part E1 – Land Use and Socio-Economic Baseline Conditions Report*, and *Part E2 – Land Use and Socio-Economic Impact Assessment Report.*
- **Appendix F - Air Quality Assessment Report:** is composed of two parts including *Part F1 – Air Quality Baseline Conditions Report*, and *Part F2 – Air Quality Impact Assessment Report.*
- **Appendix G - Noise and Vibration Modelling Reports:** is composed of six parts including *G1 – USRC Impact Assessment Report, G2 – LSW Impact Assessment Report, G3 – Kitchener Impact Assessment Report, G4 – Barrie Impact Assessment Report, G5 – Stouffville Impact Assessment Report,* and *G6 – LSE Impact Assessment Report.*
- **Appendix H - Visual Assessment Report:** is composed of two parts including *Part H1 – Visual Baseline Conditions Report,* and *Part H2 – Visual Impact Assessment Report.*
- **Appendix I - Utilities Report:** is composed of two parts including *Part I1 – Utilities Baseline Conditions Report,* and *Part I2 – Utilities Impact Assessment Report.*
- **Appendix J- Electromagnetic Interference/Electromagnetic Fields (EMI/EMF) Report:** is composed of two parts *including Part J1 – EMI/EMF Baseline Conditions Report*, *and Part J2 – EMI/EMF Impact Assessment Report.*
- **Appendix K – Preliminary Stormwater Management Report (Traction Power Facility Sites):** summarizes the results of carrying out the preliminary Stormwater Management (SWM) Assessment for each of the Tap and Traction Power Facility sites; it is composed of: an overview of background data collected/reviewed, results of initial SWM analysis for each tap/traction power facility site, and recommendations for further work.
- **Appendix L - Consultation Record:** summarizes the consultation activities carried out by Metrolinx and Hydro One as part of the GO Rail Network Electrification TPAP including the various consultation events held, feedback/comments received from review agencies, Indigenous Communities, and other stakeholders including members of the public, and how those comments were considered as part of the TPAP.
- **Appendix M – Cultural Heritage Evaluation Reports, Heritage Impact Assessment Reports and Statements of Cultural Heritage Value**: includes copies of the CHERs, HIAs and SCHVs carried out for various heritage properties as part of the GO Rail Network Electrification TPAP.
- **Appendix N - Conceptual electrification corridor plans**. Conceptual electrification corridor plans were developed to illustrate the Overhead Contact System (OCS) Impact Zone and Vegetation/Tree Removal Zone along each of the corridors to be electrified.
- **Appendix O - Conceptual Traction Power Facility Plans.** Conceptual Traction Power Facility Plans were developed to illustrate the Traction Power Facility sites and 25kV Feeder Routes.

- **Appendix P – P1**: **Mapping of Ecological Land Classification Areas and P2: Mapping of Terrestrial and Aquatic Features** along each rail corridor within the GO Rail Network Electrification Study Area have been included for reference.
- **Appendix Q - Mapping of Identified Cultural Heritage Resources**. Mapping of Identified Cultural Heritage Resources within the GO Rail Network Electrification Study Area have been included for reference.
- **Appendix R - Mapping of Land Use Designations.** Mapping of Land Use designations along each rail corridor within the GO Rail Network Electrification Study Area have been included for reference.
- **Appendix S - Mapping of Noise/Vibration Receptors and Recommended Locations for Noise/Vibration Mitigation.** Mapping of Noise and Vibration Receptors that were examined in the Noise and Vibration modelling study, as well as areas where noise and vibration mitigation locations were identified along each rail corridor within the GO Rail Network Electrification Study Area have been included reference.
- **Appendix T - Mapping of Viewsheds and Potential Visual Impact Areas.** Mapping of viewsheds and potential visual impact areas along each rail corridor within the GO Rail Network Electrification Study Area have been included for reference.
- **Appendix U – List of Technical Reports and Studies Reviewed.** Contains a list of the various technical reports/studies that were reviewed as part of carrying out the TPAP.
- **Appendix V – Groundwater Assessment Report**. Summarizes the preliminary groundwater assessment undertaken as part of the TPAP.

1.4.1 Report Purpose

The purpose of this EPR document is to document the Transit Project Assessment Process undertaken by Metrolinx and Hydro One in accordance with the requirements of *O. Reg. 231/08* for the GO Rail Network Electrification undertaking.

1.5 Project Team

The following multi-disciplinary team was retained by Metrolinx to carry out the GO Rail Network Electrification project:

- **Gannett Fleming** – responsible for overall project management and leading the engineering conceptual design and Visual Impact Assessment study.
- **Morrison Hershfield** – responsible for leading the environmental assessment process, managing the consultation/stakeholder engagement process, carrying out the Natural Environmental, Land Use & Socio-Economic, Preliminary Environmental Site Assessment, Climate Change, Groundwater Assessment, Stormwater Management, and Utilities studies.

- **Archaeological Services Inc.** – responsible for leading the Cultural Heritage Resource Assessment and Archaeological Assessment studies.
- **Golder Associates** – responsible for leading the Preliminary Environmental Site Assessment Study.
- **Rowen Williams Davies & Irwin Inc. (RWDI)** – responsible for leading the Air Quality and Noise and Vibration studies.
- **TUV Rheinland** – responsible for leading the EMI/EMF/EMC Study.
- **Swerhun Inc. -** responsible for supporting the public/stakeholder engagement and communications program.

1.6 Background

1.6.1 GO Transit Electrification Study (2010)

Metrolinx completed the GO Transit Electrification Study in December 2010, which examined electrification of the entire GO Transit rail system as a future alternative to diesel trains currently in service. This was a unique study, as it examined the entire GO system and included a comprehensive approach to assess the impact of different technologies. It also involved a comprehensive stakeholder engagement and communications program to consult with stakeholders throughout the study process. The purpose of the GO Transit Electrification Study was to provide Metrolinx's Board of Directors with the information needed to decide how the GO Transit trains will be powered in the future – using electricity, enhanced diesel technology, or other technologies.

The study was based on the following considerations and approach:

- Development of the operating plan for the Reference Case[4];
- A comprehensive rolling stock technology assessment, which examined the technologies – electric, diesel and alternative fuel sources – that could be used to provide future GO Transit service;
- Consideration of power supply and distribution options – overhead wires, third-rail, and others – to deliver electricity to a potential future electrified rail service;
- Identification and evaluation of network options for electrifying part or all of the GO Transit rail network;
- Detailed assessment of a "short list" of network options; and

[4] *The Electrification Study used an expanded and enhanced GO Transit rail network from the network of today as a basis of comparison. This Reference Case network was intended as one potential medium term scenario for GO Transit rather than a firm expansion plan, and assumed extensive additional investment in infrastructure to have been made.*

- Development of findings and conclusions.

Some of the noteworthy findings of the study were:

- More journey time savings can be achieved with electric locomotives compared to diesel locomotives;
- Pursuing electrification of both the Kitchener and Lakeshore corridors results in capital cost savings;
- Electrification would offer annual operating and maintenance cost savings compared to a comparable diesel network, while the cost of electricity is expected to increase at a slower rate compared to diesel; and
- Electrification would not significantly reduce regional greenhouse gas emissions and offer only marginal public health benefits.

In addition, one of the key recommendations outlined in the 2010 Electrification Study was for Metrolinx to proceed with electrification of the GO Kitchener (formerly Georgetown) and GO Lakeshore corridors in phases, beginning with the Union Pearson (UP) Express service. Based on these findings, the Metrolinx Board of Directors made a decision in January 2011 to initiate *Phase 1: Electrification of the UP Express service from Union Station to Pearson International Airport*, including carrying out the engineering design and EA study (which was subsequently completed in 2014).

1.6.2 Union Pearson (UP) Express Electrification TPAP (2014)

Metrolinx completed a TPAP for electrification of the UP Express service beginning at UP Express Union Station (just west of the Union Station Train Shed) to Terminal 1 Station at Toronto Pearson International Airport. The project involved the electrification of approximately 25 km of track along a portion of the Union Station Rail Corridor (USRC) and Kitchener corridor to Highway 427, where the route then follows the new UP Express spur line into Pearson Airport. The study included the assessment of traction power supply, power distribution components, and ancillary works. The Statement of Completion for the TPAP was filed in June 2014.

1.6.3 Regional Express Rail

The 'Big Move', the Regional Transportation Plan for the Greater Toronto and Hamilton Area (GTHA), identifies the need for a significant increase in rail service across the entire GO Transit network. To this end, Metrolinx will introduce an expanded service that will provide new travel choices on the GO Transit network across the GTHA, including two way, all day transit service on five GO lines with electrified service in core areas.

Regional Express Rail (RER) will provide more frequent, faster and higher capacity service with an upgrade of existing fleet to include electric propulsion. With electric locomotives replacing existing diesels with bi-level cars, along with other changes to track, signaling and operating procedures, peak trip times would be reduced by approximately 8%. Where off-peak and other services are operated with new EMUs, trip times would be between 5% and 20% faster.

Expanded and improved rail service across the GO Transit network will mean passengers have more options and reduced travel times during weekdays, evenings and on weekends. This will also mean an improved service, shorter travel times for passengers and lower operating costs. More people will make GO Transit their transportation of choice – meaning fewer cars congesting our road networks, less time spent commuting and cleaner air.

Over the next ten years, the GO rail network is planned to be:

- Expanded to enable electrified train service in core areas at 15-minute frequency or better;
- Increase of up to four times the number of train trips during off-peak hours; and
- Twice the current number of trips during peak hours throughout the network.

Electrification of the system is one component of RER and is being undertaken in parallel with other projects in order to build all the infrastructure needed to increase service and electrify the corridors. Provincial Funding for RER (including electrification) was announced in April 2015.

1.7 Planning Context

1.7.1 Growth Plan for the Greater Golden Horseshoe

The Growth Plan for the Greater Golden Horseshoe (2006) is a framework for implementing the Government of Ontario's vision for building stronger, prosperous communities by better managing growth in the region to 2031 (Ministry of Infrastructure, 2006). It has been prepared under the *Places to Grow Act (2005)* and is intended to guide decisions on a variety of issues, including the planning and management of transportation. Metrolinx's planning work is coordinated with the Growth Plan for the Greater Golden Horseshoe to tackle congestion and create an integrated, user-friendly transit system in the Greater Toronto and Hamilton Area (GTHA).

1.7.2 Regional Transportation Plan: The Big Move

In November, 2008, Metrolinx adopted the GTHA's first ever Regional Transportation Plan (RTP), *The Big Move: Transforming Transportation in the Greater Toronto and Hamilton Area*. The RTP provides direction and sets priorities for decision-making on transportation in the GTHA so as to deliver a high quality of life; a thriving, sustainable and protected environment; and a strong, prosperous and competitive economy.

The Big Move provides the blueprint for transforming the regional transportation system over the next 25 years. Its proposed future regional transportation network (**Figure 1-3**) includes "regional rail" and "express rail" services. *The Big Move* notes that regional rail service can be delivered by either diesel-electric or electric trains, with the latter demonstrating certain performance benefits, while express rail systems such as the Paris region's Réseau Express Regional (RER) are "typically electric".

Of the 92 Priority Actions and Supporting Policies in *The Big Move*, nine are, highlighted as 'Big Moves'. These priority actions are intended to have the largest and most transformational impacts on the GTHA's transportation system.

In February 2013, the Metrolinx Board of Directors approved a series of amendments to *The Big Move*. This technical update was done to keep the plan relevant, incorporating decisions taken since 2008 including the 2010 Electrification Study.

Presently, a review and update of the RTP is underway to ensure it reflects the current trends and conditions. The review is being undertaken in a three phase approach with completion anticipated for the end 2017. A more detailed description of the phasing approach is provided below:

- Phase 1 (2015 to mid-2016): Will review and update Vision, Goals and Objectives and Strategic Evaluation Framework
- Phase 2 (2016): Will integrate existing plans and study test scenarios related to Transportation Network Development, Update RTP Strategies, and preparation of the Draft RTP.
- Phase 3 (2017): Will involve consultation on the draft RTP and finalization of the RTP for implementation.

Figure 1-3: 25 Year Plan for the Regional Rapid Transit and Highway Network from *The Big Move*

1.7.3 Metrolinx Investment Strategy: Investing in Our Region; Investing in Our Future

In fulfillment of section 32.1 of the *Metrolinx Act*, on May 27 2013 the Metrolinx Board of Directors adopted the Investment Strategy and relayed it to the Minister and the heads of councils of the municipalities of the GTHA as the corporation's formal advice.

The Investment Strategy proposes a series of 24 recommendations to Government as part of a four-part plan to integrate transportation, growth and land use planning in the GTHA, maximize the value of public infrastructure investment, optimize system and network efficiencies, and dedicate new revenue sources for transit and transportation.

The Investment Strategy identifies a 'Next Wave' of Big Move projects—a transformative slate of infrastructure projects and new programs that will continue Metrolinx's transformation of the GTHA's transportation system by expanding the regional transit network and providing resources for local transit, roads, walking and cycling, and more. It proposes that the Next Wave be fully funded by a Transportation Trust Fund that collects and administers new revenues generated by dedicated investment tools. Electrification is included in the Next Wave of projects.

1.7.4 Regional Express Rail Business Case

The GO Regional Express Rail Initial Business Case (2015) provides an overview of the RER program, demonstrating how expanding and electrifying the GO rail network has the potential to greatly enhance the quality of life for GTHA residents by significantly boosting mobility and strengthening the regional economy. Strong evidence is documented that the RER program would benefit the region, including:

- The program as a whole generates benefits over costs of over 3:1, meaning for every dollar the program would cost, it would generate three dollars in economic benefits.
- By 2029, it is forecast that ridership would grow to approximately 127 million customers, representing a 142% increase in ridership from 2014.
- New services would be provided throughout the weekday, evenings and weekends, leading to substantial increases in ridership in the off-peak periods, augmenting already significant ridership in the peak periods.

These outcomes and others contained in the Initial Business Case provide the evidence and rationale to proceed with the RER program, estimating the total benefits of our 10-year plan, including time savings to transit riders and motorists on less congested highways, are worth $33 billion with net benefits of $23 billion.

Electrification is a critical component of RER by providing faster service, lower operating costs and a greener environment. Currently, GO operates most rail services with 10- or 12-car trains powered by diesel locomotives. This is an efficient way to move large numbers of commuters during rush hour, but diesel locomotives are not able to accelerate as quickly as electric alternatives, limiting their ability to travel at top speeds for longer periods.

Journey times can be reduced with electric traction, depending on route, stopping pattern and equipment, as well as technology and equipment improvements that RER will facilitate.

A shift toward more electrified service will lead to a reduction in greenhouse gas emissions, from the conversion of the trains themselves, from the resulting higher ridership and reduced car use in the region, and from the benefits resulting from the urban region growing in a way that is aligned with the significantly improved rail system.

1.7.5 Other Ongoing Metrolinx TPAP Studies

In addition to the GO Rail Network Electrification TPAP, it is important to note there are several other separate TPAP/design projects currently being carried out by Metrolinx in relation to RER. Where possible, consultation efforts (public meetings) were coordinated amongst the various active TPAP projects in order to allow interested persons to attend combined sessions where all Metrolinx expansion and electrification work was presented.

1.7.5.1 Barrie Rail Corridor Expansion TPAP

This TPAP study examined additional tracks and appropriate supporting rail corridor infrastructure along the Barrie GO rail corridor to support the increased level of GO train service planned as part of RER. The project study area is between Landsdowne Avenue in the City of Toronto and the Allandale Waterfront GO Station in the City of Barrie. The project included study of additional tracks along the corridor, improvements to existing GO stations, a new layover facility for the overnight storage of trains in the Town of Bradford West Gwillimbury and a feasibility review of existing at-grade rail-to-rail crossings. The Notice of Completion for the TPAP was issued by Metrolinx on August 8, 2017.

1.7.5.2 Lakeshore East Rail Corridor Expansion (Don River to Scarborough GO Station)

The scope of this TPAP study is to evaluate the implementation of a new fourth track along the Lakeshore East GO rail corridor between the Don River Bridge and the Scarborough GO Station in the City of Toronto. The additional track capacity will support the increased levels of service planned along the Lakeshore East corridor as part of RER. The new fourth track is to be located on the south side of the existing tracks between the Don River Bridge and Gerrard Street shifting to the north side of the existing tracks between Pape Avenue and Scarborough GO Station. The Notice of Completion for the TPAP was issued by Metrolinx on September 4, 2017.

1.7.5.3 Lakeshore East Rail corridor Expansion (Guildwood to Pickering) TPAP

This TPAP study which was approved/completed January 2017 involved expanding and improving the Lakeshore East GO corridor at Scarborough Golf Club Road in the City of Toronto up to Pickering GO

Station in the City of Pickering. A new third track is required to increase track capacity and enable the increased levels of service planned along the corridor as part of RER. The scope included review of an additional third track between Guildwood GO Station and Pickering GO Station, grade separations at Scarborough Golf Club Road Morningside Avenue and Galloway Road in the City of Toronto, additional road and rail crossings, and bridge widenings and/or replacements at the Highland Creek and Rouge River rail crossings.

1.7.5.4 Union Station Rail Corridor (USRC) East Enhancements TPAP

The scope of the ongoing USRC East Enhancements Project includes:

- Additional tracks – One on the north side and two on the south side of the USRC
- Extension of bridges to accommodate new tracks
    - Lower Jarvis Street (south side only)
    - Lower Sherbourne Street (north and south sides)
    - Parliament Street (north side only)
    - Cherry Street (north side only)
    - Lower Don River Trail Pedestrian Underpass (west side only)
- Add train storage capacity – Up to 5 new tracks and 3 reconfigured tracks (Wilson Yard)

The study area for this project includes the existing rail right-of-way (ROW) from east of Yonge Street to just south of Eastern Avenue (approximately mile 0.35 to mile 1.95).

1.7.5.5 Future GO Service Extensions

The study area limits associated with the GO Rail Network Electrification TPAP are described in Section 2.3 below. It is noted that future GO service extensions such as Niagara (Lakeshore West), Oshawa to Bowmanville (Lakeshore East), etc. will be assessed by Metrolinx as part of separate undertakings/ Environmental Assessments and will consider electrification requirements as appropriate.

1.7.5.6 Burloak Drive Grade Separation TPAP

The scope of this TPAP study is to evaluate a road under rail grade separation at Burloak Drive (Lakeshore West rail corridor). The grade separation will provide for:

- a rail corridor that continues to include three mainline tracks;
- a widened arterial road that includes six traffic lanes, multi-use paths and/or sidewalks, bicycle lanes, and roadway intersection improvements;
- retaining walls; and
- rail electrification provisions.

The grade separation will serve to separate vehicles, pedestrians and cyclists from rail traffic, thereby improving roadway travel speed and capacity, rail on time performance and operational flexibility/ reliability, and road and rail safety by reduced risk of collisions. This is of primary importance for the rail crossing of Burloak Drive / Lakeshore West Rail Corridor, both of which accommodate high traffic volumes with plans for increased train volumes along the Lakeshore West Rail Corridor as part of RER. The Burloak Drive grade separation Study Area is comprised the Lakeshore West Rail Corridor from Mi. 26.50 to Mi. 27.30, and along Burloak Drive from the Harvester Road / Wyecroft Road intersection to the north and Prince William Drive / Superior Court intersection to the south. The TPAP is currently in the pre-planning phase, with the Notice of Commencement currently planned for early Winter 2017.

1.7.5.7 Future Grade Separations

A Metrolinx Board Announcement regarding grade separations was made in February 2017. For the initial phase of this work (Level Crossings Plan), a draft plan for crossing improvements is planned for late 2017.

With 185 level crossings in the GO Transit network, a comprehensive approach is required to manage projected increases in road and rail traffic that will ensure continued safe operations.

Within the context of the RER business case, Metrolinx will continue to work towards advancing a select number of grade separations as part of construction, with a focus on those projects that support the RER program. More generally, subject to funding, Metrolinx will plan for future projects by anticipating future grade separations with a program of planning and design. It is noted that future grade separations will be assessed by Metrolinx as part of separate undertakings/Environmental Assessments as required and will consider electrification requirements as appropriate.

1.7.5.8 New GO Stations/Smart Track Stations

As per the Metrolinx Board Report "New Stations Update" issued December 2016[5], it was announced that twelve new stations identified in the June 28, 2016 Board presentation from the President and CEO, entitled "GO Regional Express Rail Update", will be incorporated into the GO RER program and that appropriate agreements with municipalities are to be developed.

The 12 new GO Stations are as follows and are depicted on **Figure 1-4.**

1. Bresleau (Kitchener, GO Kitchener Corridor; it is noted this is outside of the GO Rail Network Electrification TPAP Study Area)
2. St. Clair West (Toronto, GO Kitchener Corridor) – SmartTrack Station

[5] December 2016 Metrolinx Board report is available at: http://www.metrolinx.com/en/docs/pdf/board_agenda/20161208/20161208_BoardMtg_New_Stations_Report_EN.pdf

3. Liberty Village (Toronto, GO Kitchener Corridor) – SmartTrack Station[6]
4. Spadina (Toronto, GO Barrie Corridor) – SmartTrack Station
5. Bloor-Davenport (Toronto, GO Barrie Corridor)
6. Kirby (Vaughan, GO Barrie Corridor)
7. Mulock (Newmarket, GO Barrie Corridor)
8. Innisfil (Innisfil, GO Barrie Corridor)
9. Don Yard/Unilever (Toronto, GO Lakeshore East Corridor) – SmartTrack Station
10. Gerrard (Toronto, GO Lakeshore East Corridor) – SmartTrack Station
11. Lawrence East (Toronto, GO Stouffville Corridor) – SmartTrack Station
12. Finch East (Toronto, GO Stouffville Corridor) – SmartTrack Station

As part of implementing electrification, GO Stations will require the following modifications:

- Integration of OCS support structures into platform areas; and
- Grounding and Bonding.

The environmental impacts of electrifying any new GO stations will be addressed through the future EAs/TPAPs that will be undertaken for design and construction of the new stations.

[6]The future Liberty Village station is outside of the GO Rail Network Electrification TPAP study area.

Figure 1-4: New GO/SmartTrack Stations

1.8 Alternative Technologies

The Ontario Ministry of Transportation (MTO) is currently examining the feasibility of hydrogen fuel cell technology/hydrogen powered vehicles through a pilot project to assess the viability of hydrogen propulsion locomotives for the GO network. The output of this study will be used to inform the decision regarding which technology will be used to electrify the GO network, prior to commencement of construction.

As part of the 2010 Metrolinx Electrification Study[7], one of several alternatives for train propulsion Metrolinx examined was trains powered using hydrogen fuel cell technology or from batteries that store energy. The conclusion of the assessment in 2010 (which looked at technical, commercial and compatibility criteria) was that the power supply option most appropriate for the GO Transit rail network (including Union Pearson Express) was the use of an overhead contact system. The current GO Rail Network Electrification TPAP is based on the implementation of this type of system (see Sections 3.5 and 3.6 for further detail).

Infrastructure proposed as part of the GO Rail Network Electrification TPAP as documented in this EPR in no way precludes future technological advances, such as hydrogen propulsion locomotives. Metrolinx will continue to monitor the developments of advances in new rail propulsion technology as they become more viable systems in the future.

1.9 List of Studies and Technical Documents Prepared/Reviewed

The comprehensive list of studies and technical reports that were reviewed as part of the Transit Project Assessment Process is contained in **Appendix U**.

2 Project Scope

The scope of the Project involves electrification of the following GO Transit rail corridors:

1. Union Station Rail Corridor – From UP Express Union Station to Don Yard Layover
2. Lakeshore West Corridor – From just west of Bathurst St (Mile 1.20) to Burlington
3. Kitchener Corridor – From UP Express Spur[8] (at Highway 427) to Bramalea
4. Barrie Corridor – From Parkdale Junction (off Kitchener Corridor) to Allandale GO Station
5. Stouffville Corridor – From Scarborough Junction (off Lakeshore East Corridor) to Lincolnville GO Station

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[7] http://www.gotransit.com/electrification/en/project_history/docs/ElectricificationStudy_FinalReport.pdf

[8] *The portion of the Kitchener corridor from Strachan Ave. to the airport spur (at Highway 427) was previously assessed/approved as part of the Metrolinx UP Express Electrification EA.*

6. Lakeshore East Corridor – From Don Yard Layover to Oshawa GO Station

In order to electrify the system, there is new infrastructure that needs to be built as well as modifications to existing infrastructure that are required which have been summarized below and described in further detail within **Section 3**.

The scope of the GO Rail Network Electrification TPAP includes examining the potential environmental effects of building, operating and maintaining the electrified GO system including the various project components listed below.

- **Traction Power Supply**
  - 5 Hydro One Tap Locations
  - Hydro One Tap Structures
  - High Voltage Connection Routes
- **Traction Power Distribution**
  - 5 Traction Power Substations (TPS)
  - Gantries
  - Access Roads
  - Underground Duct Banks and Aerial Supply
  - Overhead Contact System (OCS)
  - 5 Switching Stations (SWS)
  - 6 Paralleling Stations (PS)
  - 25 kV Feeder Routes
- **Ancillary Components**
  - Grounding and Bonding
  - Bridge Modifications
  - Existing Maintenance Facility Modifications
  - GO Layover Facility Modifications
  - GO Station Modifications

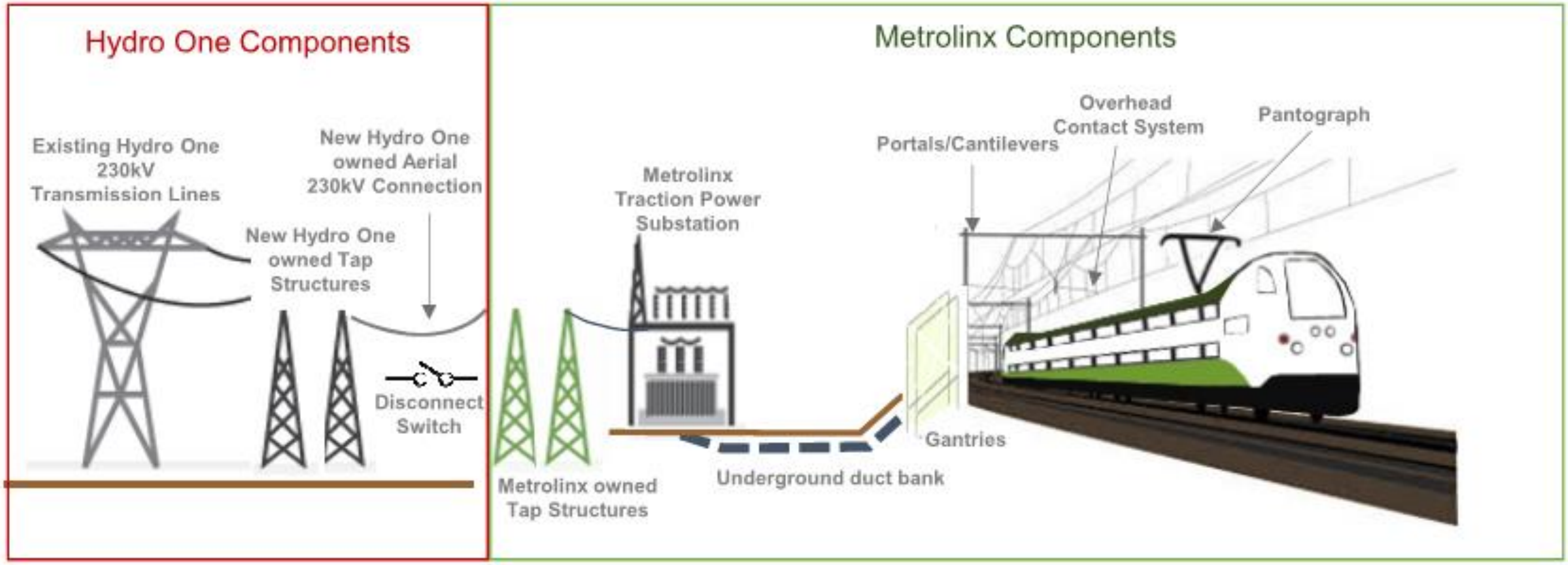
It is important to note that the scope of the Project does *not* include/address the new infrastructure required to provide increased GO service levels associated with Regional Express Rail such as track expansions, etc. Rather, these aspects are currently being (or will be) designed and assessed as part of separate Metrolinx projects that are (or will be) subject to separate Environmental Assessments.

2.1 Hydro One Project Components

Electrification of the GO Transit network requires electrical power to be supplied from Ontario's electrical system through Hydro One's existing high voltage grid. This will entail construction of new tap structures that will draw the necessary electrical power from Hydro One's existing 230kV grid. From there, the power will be conveyed to new Traction Power Substations (TPS) via 230kV high voltage connections routes (either aerial or underground), where it will then be stepped down to the appropriate voltage of 25kV for distribution along the electrified GO system. **Figure 2-1** provides a simplified graphic of how the system will work and the distinction between Hydro One's and Metrolinx's project components.

Hydro One's components essentially include all of the 'upstream elements' of the system, i.e., the entire 230kV infrastructure up to the disconnect switch which represents the demarcation point between Hydro One and Metrolinx project components. The exact location of the demarcation point as well as who will build and own the disconnect switch will be determined during detailed design as agreed by Metrolinx and Hydro One.

Figure 2-1: How the System Will Work



2.2 Metrolinx Project Components

As depicted in **Figure 2-1**, Metrolinx will be responsible for all of the 'downstream elements' of the system, from the demarcation point, including all traction power distribution components and ancillary works (refer to Section 2 above) required for operation of the electrified system.

2.3 Study Area

The Study Area for the GO Rail Network Electrification TPAP is generally defined as the existing GO rail right-of-ways (ROW) to be electrified plus the 7m OCS/Vegetation Clearing Zone (as detailed in Sections 3.6.3 and 3.6.4), 25kV feeder routes (plus 7m Vegetation Clearing Zone), the Tap and Traction Power Facility sites, and the Tap/TPF ancillary components such as access roads (see **Figure 2-2**):

1. Union Station Rail Corridor (USRC) – From UP Express Union Station to Don Yard Layover.
   - i. Lakeshore West Corridor – From just west of Bathurst (Mile 1.20) to Burlington
   - ii. Mimico Tap Location
   - iii. Burlington Tap Location
   - iv. 2 X 25kV Feeder Route
   - v. Mimico TPS
   - vi. Mimico SWS
   - vii. Burlington TPS
   - viii. Oakville SWS
   - ix. Gantries, duct banks, access routes
2. Kitchener Corridor – From UP Express Spur[9] (at Highway 427) to Bramalea
   - i. Bramalea PS
   - ii. Gantries, duct banks, access routes
   - iii. 2 X 25kV Feeder Route
3. Barrie Corridor – From Parkdale Junction (off Kitchener Corridor) to Allandale Station
   - i. Allandale Tap Location
   - ii. Allandale TPS
   - iii. 2 X 25kV Feeder Route
   - iv. Gilford PS
   - v. Newmarket SWS
   - vi. Maple PS
   - vii. Gantries, duct banks, access routes

[9] *The portion of the Kitchener corridor from Strachan Ave. to the airport spur (at Highway 427) was previously assessed/approved as part of the Metrolinx UP Express Electrification EA.*

4. Stouffville Corridor – From Scarborough Junction (off Lakeshore East Corridor) to Lincolnville Station
    i. Scarborough Tap Location
    ii. Scarborough TPS
    iii. 2 x 25 kV Feeder Route
    iv. Unionville PS
    v. Lincolnville PS
    vi. Gantries, duct banks, access routes
5. Lakeshore East Corridor – From Don Yard Layover to Oshawa Station
    i. East Rail Maintenance Facility (ERMF) Tap Location
    ii. ERMF TPS
    iii. 2 x 25 kV Feeder Route
    iv. Scarborough SWS
    v. Durham SWS
    vi. Don Yard PS
    vii. Gantries, duct banks, access routes

It should be noted that the electrification of the UP Express Route (along a portion of the Union Station Rail Corridor and Kitchener Corridor) from UP Express Station (just west of the Union Station Train Shed) to Terminal 1 Station at Pearson International Airport, including power supply and power distribution components, was previously assessed as part of the two previous EA projects:

- Metrolinx Union Pearson Express Electrification Transit Project Assessment (June, 2014)
- Hydro One Union Pearson Express Traction Power Substation Class Environmental Assessment - Environmental Study Report (2014)

2.3.1 Study Area Buffer Zones

As described further in **Volume 2**, a more conservative study area buffer of 30m around the rail ROWs and Tap/TPF sites was applied for purposes of initial baseline conditions data collection.

Once the conceptual design was further advanced and the OCS/Vegetation Removal Zone was defined, the study area for impact assessment study purposes (**refer to Volume 3**) was refined to: a 7m zone/buffer around the rail corridors, plus the sites where Tap locations and Traction Power Facilities are proposed. In other words, all environmental impact assessment studies were carried out for each Tap and TPF site, as well as for the 7m impact zone around all rail corridors with the following discipline-specific exceptions noted (refer to **Volume 3** for further detail):

Air Quality

- Data from Air Quality monitoring stations of up to 10kms from the rail corridors was utilized as part of assessing Air Quality Baseline Conditions

Visual

- *Areas of Low Potential Impacts*: Residential areas where homes are more than 20 metres from the railroad right-of-way (ROW), most GO stations, bridges without significant views, Tap Locations and/or Traction Power Facilities that may be visible from surrounding development but where the existing visual environment is already compromised by other existing electric facilities such as major transmission line and power plants
- *Areas of Moderate Potential Impacts:* residential areas where homes are between 8 and 20 meters from the railroad ROW, areas where high-rise buildings in a natural setting are closer than 30 metres to the railroad ROW, scenic areas, scenic overpasses, GO Stations with visual integrity, bridges with interesting or scenic views, pedestrian bridges, Tap Locations and/or Traction Power Facilities that are over 150 metres from surrounding development and have some existing vegetation or other screening.
- *Areas of High Potential Impacts: r*esidential areas where homes are within 8 metres of the railroad ROW, significant scenic, cultural or historic environments adjacent to the rail corridor, Tap Locations and/or Traction Power Facilities that are located within close proximity (i.e., within 30 metres) to residential areas and have potential to adversely affect the current viewshed.

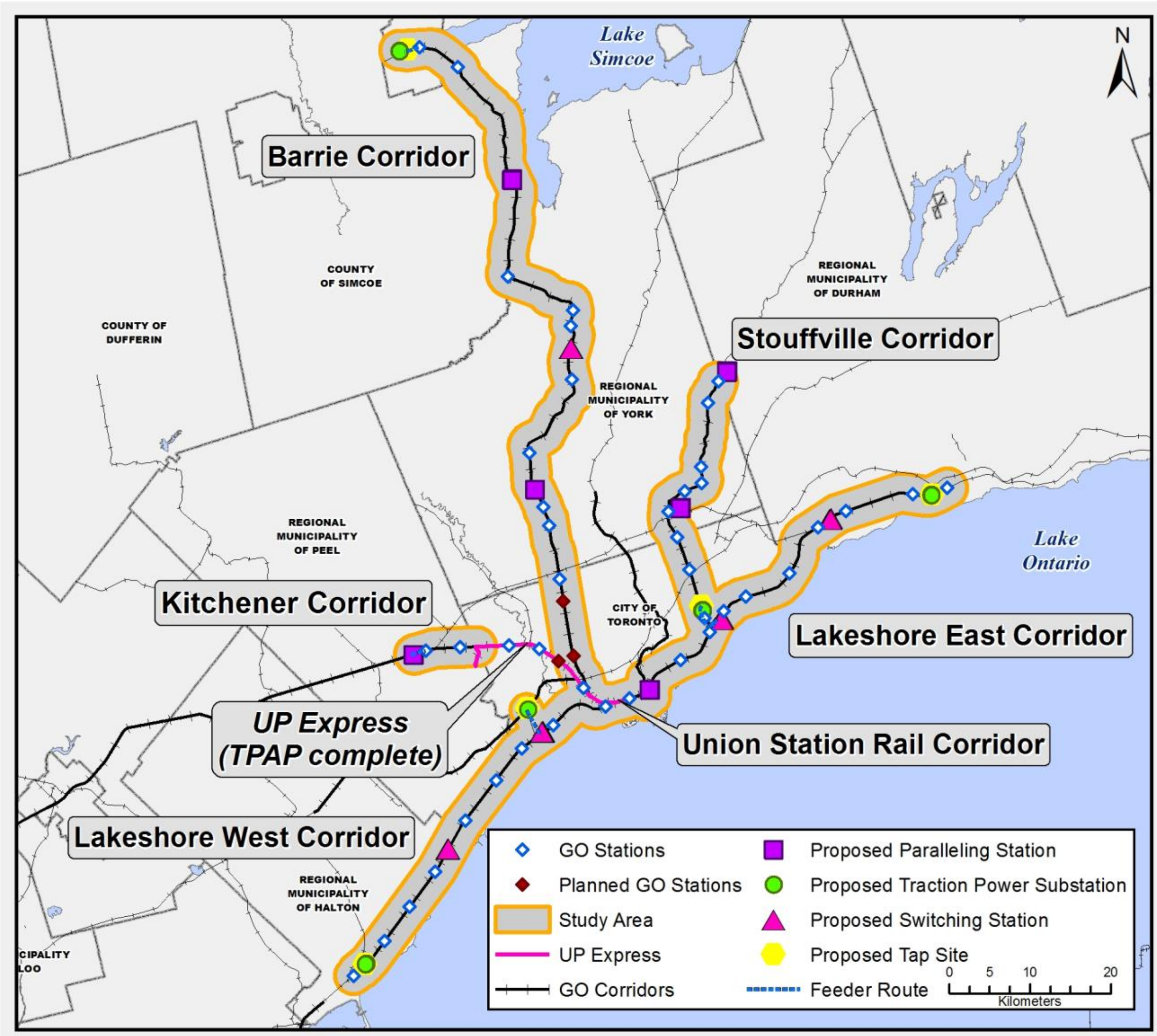
Noise and Vibration

- Noise and vibration receptors were identified as per NPC-300 (i.e., Receptors within the Study Area were established through the identification of Noise Sensitive Land Uses and are mainly residential houses located adjacent to the corridors. It should be noted that residences have different setback distances however the setback distance used to identify receptors was approximately 500 m.

Groundwater

- The groundwater impact assessment scope considered water supply wells and groundwater dependent natural heritage features (i.e., identified waterbodies) identified within 500 m of the rail corridors.

Figure 2-2: GO Rail Network Electrification TPAP Study Area



2.4 Project Timelines

The Pre-Planning Phase of the Electrification TPAP commenced in Summer 2015. The TPAP is an expedited Environmental Assessment process involving a pre-planning phase (no regulated timeline) followed by a regulated (up to 120-day) TPAP Phase. Upon completion of the TPAP, the project will proceed to the detailed design phase, followed by construction. Anticipated timelines (at the time of writing this EPR) for the GO Rail Network Electrification project and a more description of each phase is briefly summarized in **Table 2-1**.

Table 2-1: Summary of Anticipated Project Timelines

Phase	Description	Timeline
Pre-Planning/Conceptual Design	No regulated timeline. Completion of technical, engineering and environmental studies as well as consultation with Review Agencies, Indigenous communities, the public and other stakeholders. Public Meeting Round #1 (February - March 2016). Public Meeting Round #2 (November 2016). Public Meeting Round #3 (June - July 2017). Draft Environmental/Technical Study Reports (to support EPR) posted to Metrolinx's website (July 2017). Development of Draft EPR/circulation of Draft EPR to 80+ Federal, Provincial, Municipal, Review Agencies for review and comment (January – February 2017).	2015-2017
TPAP & Statement of Completion	Regulated 120-day process with mandatory consultation requirements. Notice of Commencement (issued June 14, 2017). Ongoing stakeholder consultation. Notice of Completion (issued October 11, 2017). Statement of Completion (Anticipated date - December 2017).	June 14 – October 11 2017
Procurement Process/ Detailed Design	Metrolinx will establish the scope of the project through issuance of a Request for Proposals. A detailed design for the electrification project will be prepared.	2017 - 2019
Construction	Construction will be phased across the GO Rail Network, starting with a commissioning track.	2020-2025

3 Detailed Project Description

3.1 Background

3.1.1 Standards and Codes

The Electrification system has been designed in accordance with industry best practices, including adherence to applicable codes and standards, including but not limited to:

- Ontario Electrical Safety Code;
- CSA Standards (Codes and Standards Group);
- American Railway Engineering and Maintenance-of-Way Association (AREMA) standards; and
- Ontario Building Code.

3.1.2 Performance Specifications

As the first step to establishing the high level requirements and mandatory criteria for design and implementation of the electrified system, Metrolinx established a comprehensive set of Electrification Performance Specifications (EPS). These EPS were based on the combination of available knowledge, experience, industry best practice and worldwide standards. These EPS outline the applicable design standards to be complied with and performance requirements to be met as part of delivering a safe, efficient and reliable electrified system. Accordingly, these specifications provided the context for the subsequent preparation of the GO Rail Network Electrification conceptual design.

3.1.3 Conceptual Design

Building on the previous studies including the 2010 Electrification Study & the 2014 UP Express Electrification Transit Project Assessment Process, a conceptual electrification design was prepared which was comprised of the following seven parts:

- *Part 1 – Network Wide Indicative Design*
- *Part 2 - Lakeshore West Corridor Conceptual Design*
- *Part 3 - Kitchener Corridor Conceptual Design*
- *Part 4 - Barrie Corridor Conceptual Design*
- *Part 5 – Stouffville Corridor Conceptual Design*
- *Part 6 - Lakeshore East Corridor Conceptual Design*
- *Part 7 - Union Station Rail Corridor Conceptual Design*

Part 1- Network Wide Indicative Design provided the overall design basis for developing each of the corridor specific designs as listed above (i.e., Parts 2, 3, 4, 5, 6 and 7 respectively). More specifically, Part 1 set the framework and established the following key common inputs for the individual corridor-specific designs:

- Basis of Design (existing and future infrastructure conditions, rolling stock assumptions, conceptual design principles and practices);
- Conceptual Design for:
  - Traction Power Supply System (Tap locations, etc.)
  - Traction Power Distribution System (Overhead Contact System, Traction Power Facilities, etc.)
  - Grounding and Bonding
  - Modifications to Train Maintenance and Storage Facilities
- Systems to support the conceptual design:
  - Electromagnetic Compatibility
  - Operations and Maintenance
  - System Integration
  - System Assurance
  - Safety and Security
  - Sustainability
  - Supervisory control and data acquisition (SCADA) System

3.2 Base Case Scenario

The following provides an overview of the "base case scenario" (i.e., baseline condition prior to implementing electrification) in order to describe the context within which the conceptual design was prepared and the potential environmental impacts of the project were assessed for the TPAP.

- The base case scenario for the TPAP is the year 2025 (as per the RER business case), with any additional /planned RER expansion/infrastructure works (new tracks, grade separations, etc.) in place. Electrification infrastructure is essentially being 'added to' the other expansion works (e.g., new tracks). The building of new tracks, grade separations, new GO Stations, etc. are not included in the scope of the GO Rail Network Electrification TPAP; rather they have been/are being assessed as part of other Metrolinx undertakings.
- The electrification system (including the Overhead Contact System) has been designed to accommodate track expansions planned for implementation by 2025, as well as protect for additional/future track expansions to be implemented beyond 2025 (no funding/EA approval yet).
- The scope of this TPAP is focused on the environmental impacts of the electrification undertaking and does not include an assessment of the impacts due to other RER related works such as track expansions, etc. The impacts of track expansion are/will be assessed as part of separate EA/TPAP projects.

3.3 Key Electrification Design Assumptions

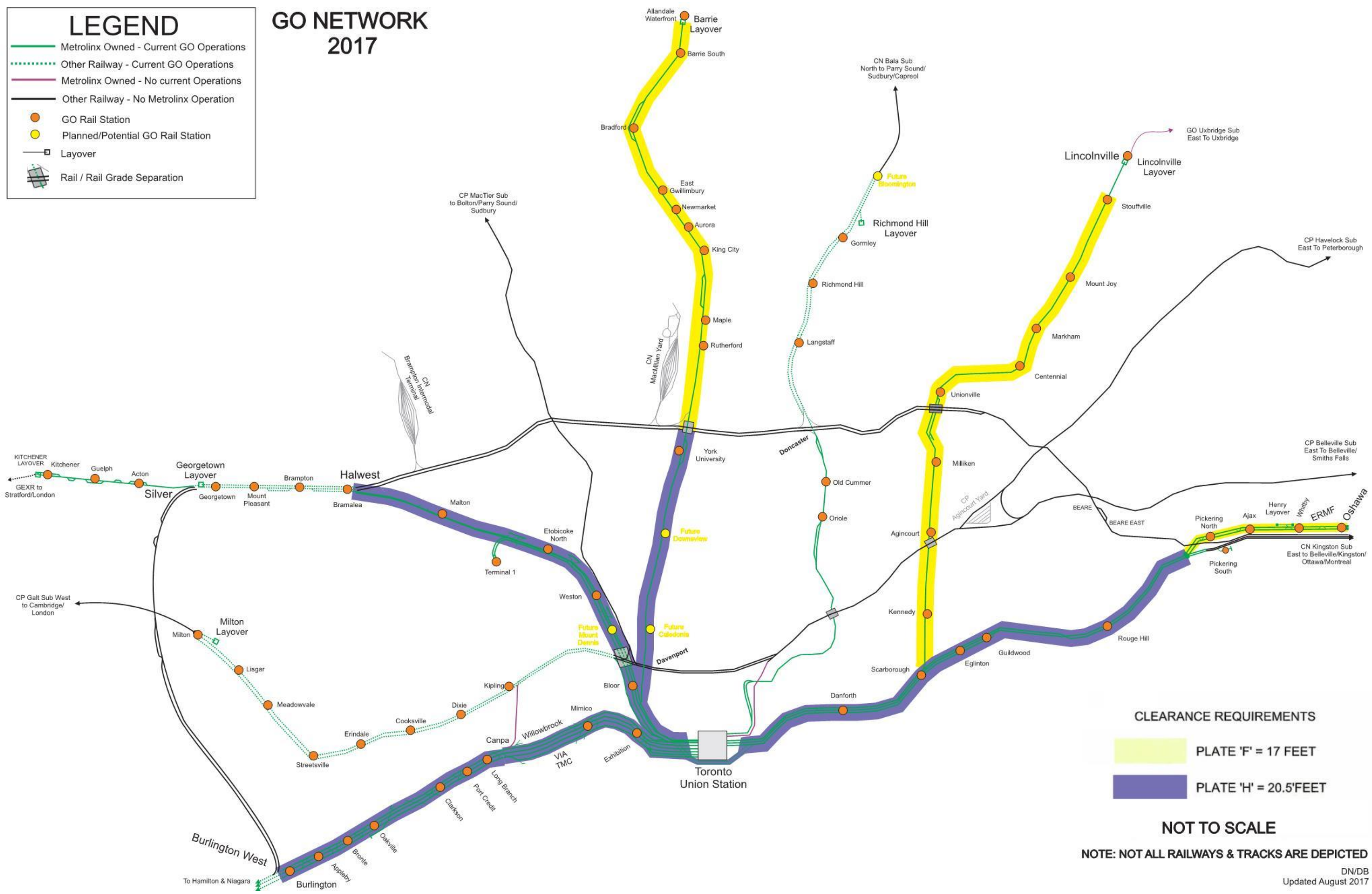
With the base case scenario defined, the following sections outline the additional assumptions that guided the conceptual engineering design for electrification of the GO system.

3.3.1 System Wide Assumptions

The following key assumptions were established that are applicable system wide:

- The design will include the provision for a route for Double-Stacked Freight (see **Figure 3-1**);
- The design will accommodate electric locomotive and/or bi-level EMU for GO Trains;
- The OCS will be designed to protect for future track expansions and improvements along the corridors;
- The Traction Power System will be designed for the RER service plan with the ability to handle estimated service and ridership increases for a minimum period of 30 years
- All existing and planned RER layover facilities within the electrified territory will be designed to accommodate electric trains.
- The design will take into account safe dynamic and electrical clearances to all structures (bridges & rail overpasses, stations and station canopies & poles, utilities and utility poles, etc.) within the rail ROW.
- OCS Maintenance-of-Way facilities will be needed for the operation of Traction Power. A location of one or more will be determined during detailed design.
- A conservative OCS Impact Zone and Vegetation Removal Zone will be established as part of the TPAP for purposes of assessing potential environmental effects. The exact locations of OCS foundations and poles will be determined during detailed design.
- The Electrification Control Centre will be co-located with the new Network Operation Centre in Oakville.

Figure 3-1: Double Stacked Freight Routes



3.3.2 Corridor Assumptions

The following outlines the specific assumptions that were established to prepare the conceptual designs for each corridor to be electrified including: start and end points, number of tracks to be accommodated within the electrification design, and number of tracks to be electrified.

Union Station Rail Corridor

- The Union Station Rail Corridor electrification limits were defined as: beginning at UP Express Union Station Mile Point (MP) 0.00 and continuing east to the Don Yard Layover at MP 1.65 on the USRC subdivision.
- A conceptual design was prepared that consisted of all tracks in the USRC being electrified. A freight route will be maintained through USRC and the design will include the provision for a route for Double-Stacked Freight.

Lakeshore West Corridor

- The Lakeshore West Corridor electrification limits were defined as: beginning at Mile 1.20 and continuing west to Burlington GO Station MP 31.5 on the Oakville subdivision.
- A conceptual design was prepared that consisted of five tracks[10] from sta. 2+500 (mile 1.6) to 10+900 (mile 6.7), and four tracks from sta. 10+900 (mile 6.7) to 51+000 (mile 31.7) at Burlington GO Station.
- Conceptual Design incorporated the existing GO stations at: Exhibition, Mimico, Long Branch, Port Credit, Clarkson, Oakville, Bronte, Appleby and Burlington.
- Service will consist of a mix of electric and diesel trains. Electric trains will operate between Union Station and Burlington GO Station. Diesel trains will operate over the entire corridor extending to Hamilton GO Station.

Kitchener Corridor

- The Kitchener Corridor electrification limits were defined as: beginning at the limits of the UP Express Spur (west of Highway 427)[11] located at MP 13.4 on the Weston subdivision and continuing west to Bramalea.
- A conceptual design was prepared that consisted of three tracks from sta. 21+500 (mile 13.4) to 26+200 (mile 16.3); two tracks from sta. 26+200 (mile 16.3) to 28+700 (mile 17.8) and a third turn back track at Bramalea Station.
- Conceptual Design incorporated the existing GO stations at: Malton and Bramalea.

[10] For the purposes of the TPAP, 5 tracks were assumed for this section for ultimate build out, however for RER expansion over the next 30 years, 4 tracks are proposed.
[11] Excluding Highway 427 bridges that were previous assesse under the UP Express Electrification TPAP (Metrolinx, 2014).

- Service will consist of a mix of electric and diesel trains. Electric trains that will operate from the eastern limits of the corridor to Bramalea. Diesel trains will operate over the entire corridor extending to Kitchener GO Station.

Barrie Corridor

- The Barrie Corridor electrification limits were defined as: beginning at the limits of the Parkdale Junction (off Kitchener Corridor) at MP 3.0 and continuing north to Allandale Waterfront GO Station MP 63.00 on the Newmarket subdivision.
- A conceptual design was prepared that consisted of two tracks from sta. 4+900 (mile 3.0) to sta. 101+500 (mile 63.0).
- Conceptual Design incorporated the existing GO stations at: Rutherford, Maple, King City, Aurora, Newmarket, East Gwillimbury, Bradford, Barrie South and Allandale.
- Design incorporated the provision of two future GO Stations at: Caledonia and Downsview Park.
- Service will consist of electric trains over the entire corridor.

Stouffville Corridor

- The Stouffville Corridor electrification limits were defined as: beginning at the limits of the Scarborough Junction (off Lakeshore East Corridor) located at MP 61.0 and continuing north to Lincolnville Station MP 38.9 on the Uxbridge subdivision.
- A conceptual design was prepared that consisted of two tracks from sta. 14+000 (mile 60.5) to 30+300 (mile 50.4), a single track from sta. 30+300 (mile 50.4) to Lincolnville Station.
- Conceptual Design incorporated the existing GO stations at: Scarborough, Kennedy, Agincourt, Milliken, Unionville, Centennial, Markham, Mount Joy, Stouffville, Lincolnville.
- Service will consist of electric trains over the entire corridor.

Lakeshore East Corridor

- The Lakeshore East Corridor electrification limits were defined as: beginning at the limits of the Don Yard Layover located at MP 332.19 on the Kingston Subdivision and continuing east to Oshawa Station MP 11.6 on the GO Subdivision.
- A conceptual design was prepared that consisted of four tracks from sta. 2+700 (mile 332.2) to 32+100 (mile 313.9/mile 0), and three tracks from sta. 32+100 (mile 313.9/mile 0) to Oshawa Station, with one passing siding.
- Conceptual Design incorporated the existing stations at: Danforth, Scarborough, Eglinton, Guildwood, Rouge Hill, Pickering, Ajax, Whitby, Oshawa.
- Service will consist of electric trains over the entire corridor.

3.4 Siting of Tap & Traction Power Facility Locations

As part of the Pre-Planning Phase of the TPAP, a significant amount of conceptual engineering and environmental work was completed in order to arrive at the preferred Tap locations and Traction Power Facility sites. It was previously determined through the GO Electrification Study (2010) and the subsequent UP Express Electrification Preliminary Design process (2014) that the electrical power supply will be provided by Hydro One. Therefore, for Tap and TPS locations, Metrolinx and Hydro One worked together closely to ensure that the locations identified were technically feasible from a power supply and system reliability standpoint.

3.4.1 Step 1 – Review Previously Completed Studies

Prior to initiating the GO Rail Network Electrification TPAP in 2015, Metrolinx completed three studies which examined the traction power supply and distribution requirements for electrifying the GO system, as follows:

- GO Electrification Study Final Report – December 2010
- Traction Power System Simulations of the Metrolinx Airport Rail Link, Lakeshore Lines and Kitchener Line – Draft Report 2012
- UP Express Traction Power Supply System Preliminary Design – 2014

A summary of the findings associated with each of these studies has been provided below for context.

3.4.1.1 GO Transit Electrification Study Final Report (2010)

The overriding purpose of the Electrification Study was to examine how GO trains will be powered in the future – using electricity, enhanced diesel technology or other means. The study was guided by the Electrification Study Terms of Reference, and the scope included the entire GO Transit rail network – all seven corridors – as well as the UP Express service (formerly called "Airport Rail Link") between Union Station and Pearson International Airport. The study used an expanded and enhanced GO Transit rail network as the "Reference Case" which assumed that additional tracks and some of GO's proposed line extensions (to St. Catharines, Kitchener, etc.) would be constructed in the coming years, resulting in increased service and train volumes.

As part of this comprehensive study, the traction power supply and power distribution requirements of the GO network were examined for a future electrified GO service. This involved a comprehensive computer-aided train operation simulation and electrical system load-flow modeling which was performed for the operating schedule included in the Reference Case.

The following summarizes the five key findings of the 2010 GO Transit Electrification Study.

1. Recommended technology is a 2 x 25 kV autotransformer-fed system for the electrification of the GO Network.

2. Traction Power Substations would need to be connected to Hydro One's high voltage transmission network.

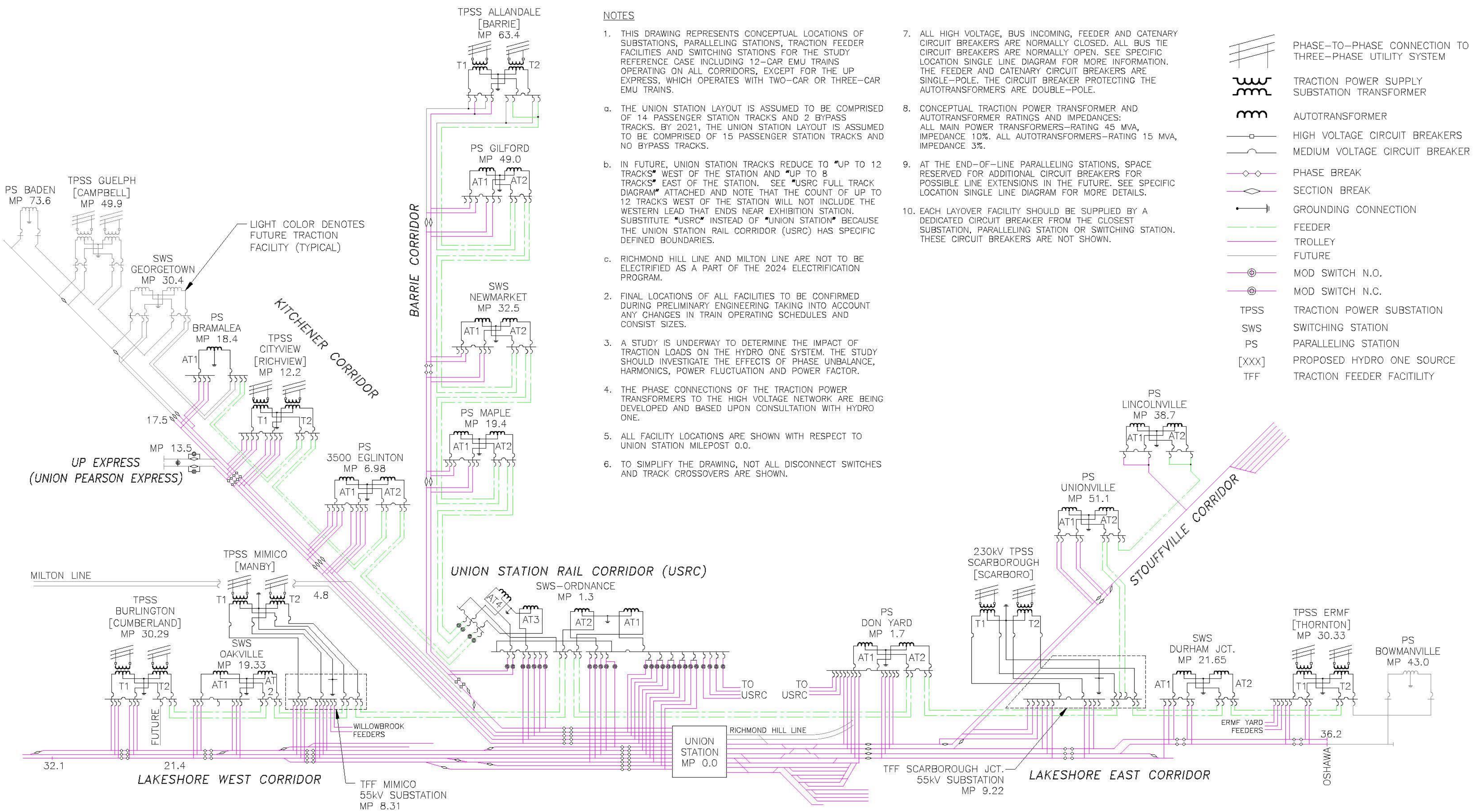
3. To ensure sufficient power load and to maintain high reliability of the power supply, TPSs should be located as close as possible to existing Hydro One transformer stations and to the rail corridor.

4. Siting TPSs as close as possible to existing Hydro One transformer stations will help limit the cost of high voltage transmission lines or cables required for connection.

5. The spacing of Traction Power Facility sites was established as follows:
   - TPSs should be spaced at approximately 50-60 km intervals;
   - Switching stations are typically required between any two substations; and
   - Paralleling stations would be required to prevent power voltage from dropping below permissible levels.

Based on the train simulation system modeling and assuming electrification of all seven GO corridors (including UP Express), it was concluded that the system can be supplied with power using the traction power facilities as shown in see **Figure 3-2**. As mentioned, the locations and types of facilities identified through this earlier work were further reviewed and refined as required as part of the GO Rail Network Electrification TPAP.

Figure 3-2: GO Corridor Electrification – *Traction Power Facility Requirements*



3.4.1.2 Traction Power Systems Simulations Report (2012)

Following completion of the 2010 GO Transit Electrification Study, the decision was made by the Metrolinx Board of Directors to proceed with electrification of UP Express as Phase 1, followed by the Kitchener and Lakeshore corridors. As a result, Metrolinx initiated the Conceptual Design for the Kitchener corridor (including UP Express), Lakeshore East and Lakeshore West corridors, as well as the Environmental Assessment (EA) for UP Express Electrification.

During the conceptual design phase, a traction power system simulation study (Traction Power System Simulations Report - LTK Engineering Services, 2012) was carried out to perform computer-aided train operation simulations and traction electrification system load flow studies for electrification of the UP Express, Lakeshore East, Lakeshore West and Kitchener corridors.

Locations of TPS, PS (referred to as autotransformer stations), and SWS were identified to enable the system to operate reliably during both normal and contingency conditions. It was determined that minor changes in TPS, PS, and SWS locations may be made to satisfy factors such as operational requirements, real estate availability constraints, etc.

3.4.1.3 UP Express Electrification - Preliminary Design & TPAP (2014)

Following the conceptual design phase for the Kitchener corridor, Lakeshore corridors, and UP Express, a preliminary electrification design was completed for the UP Express route from UP Express Union Station to Pearson International Airport to support the UP Express Electrification TPAP. The result of this was slight modifications to the location of the proposed Ordnance SWS and CityView TPS (compared to the recommended locations from the 2010 Electrification Study). Three TPF locations (i.e., CityView TPS, Eglinton PS, and Ordnance SWS) were carried forward and included in the UP Express Electrification Final Environmental Project Report, June 2014 and Hydro One Union Pearson Express Traction Power Substation Class Environmental Assessment - Draft Environmental Study Report, 2014.

Based on the recommended general locations determined through the previous studies and power simulations modelling work described above, the required number of traction power supply facilities and their general locations were established. These locations became the starting point for the process of identifying possible Tap/TPF sites for each facility as part of the GO Rail Network Electrification TPAP.

3.4.2 Step 2 – Identify Possible Tap/TPF Sites

With the recommended general locations determined through previous studies and power simulations modelling work (as outlined above), the next step was to identify potential Tap/TPF sites in the vicinity of these locations. Using the previously established locations as the control points, alternative sites were subsequently identified through desktop mapping and aerial photo review. The process followed and criteria applied for each type of TPF is detailed below.

3.4.2.1 Siting Criteria - Taps/Traction Power Substations

The following criteria were applied as part of the TPAP in order to identify alternative Tap/TPS sites.

1. Is the site situated in the vicinity of Hydro One's 230kV high voltage lines?
    a. To ensure sufficient power capacity is available and to maintain high reliability of the power supply, TPS should be located as close as possible to existing Hydro One transformer stations and to the rail corridor.
    b. Siting TPSs as close as possible to existing Hydro One transformer stations will help limit the cost of high voltage transmission lines or cables required for connection.
2. Is the site situated in the vicinity of the GO rail corridor?
    a. To ensure sufficient power capacity is available and to maintain high reliability (as noted above).
3. Does the site satisfy minimum size requirements of approximately 50 m X 75 m for a TPS?
    a. The site needs to be of sufficient size to accommodate the electrical equipment.
4. Consideration of track geometry
    a. TPFs need to be located at or near tangent (straight, not curved track) due to the required phase breaks.
5. Locations of phase breaks
    a. TPFs need to be located at or near tangent (straight, not curved track) due to the required phase breaks.
6. Proximity to GO stations
    a. Because there is a temporary loss of power to the train while traversing a phase break, TPFs need to be spaced sufficiently away from train stations and other locations where the trains make stops. The train requires a certain level of speed and momentum to "coast" through the phase break.

3.4.2.2 Siting Criteria - Switching Stations and Paralleling Stations

The following criteria were applied as part of the TPAP in order to identify alternative SWS/PS sites.

1. Is the site situated in the vicinity of the GO rail corridor?
    a. Personnel must have immediate access to these high voltage facilities in order to perform normal and emergency maintenance duties, therefore locating the facilities close to the rail ROW is ideal. Further, a clear view of the facilities which are being fed from the facility (i.e., the OCS) is required.
    b. 25 kV catenary and autotransformer feeders need clear access to the OCS over property owned by the railroad and ideally should not have to traverse long stretches of public or private property.

2. Does the site satisfy minimum size requirements of 24 m X 46 m for an SWS and 21 m X 30 m for a PS?
    a. The site needs to be of sufficient size to accommodate the electrical equipment.

This exercise resulted in approximately 60 alternative sites being identified, which were further assessed based on the following evaluation criteria in order to arrive at recommended Tap/TPF sites.

3.4.3 Step 3 – Comparatively Evaluate Tap/TPF Sites

As part of the TPAP, In order to comparatively evaluate the alternative TPF sites (including Tap locations), a set of criteria (see **Table 3-1**) aimed at satisfying the key environmental/land use & socio-economic/ cultural heritage/technical factors was developed and applied.

Table 3-1: TPF Sites Evaluation Criteria & Descriptions

Evaluation Criteria	Description
Environmental Considerations	
Natural Environmental	Consideration of natural environmental features in the vicinity of the facility location with particular emphasis on features of *provincial importance* as defined in O. Reg. 231/08 (e.g., Provincially Significant Wetland, Species at Risk habitat, etc.).
Cultural Heritage	Consideration of cultural heritage/archaeological features in the vicinity of the facility location with particular emphasis on features that have *provincial value or interest*[12], as defined in O. Reg. 231/08.
Land Use & Socio-Economic Considerations	
Land Use/Socio-Economic	Consideration of existing/planned land use in the vicinity of the facility location (i.e., industrial areas preferred over residential areas); and consideration of social features (i.e., residences, schools, daycares, etc.) in the vicinity of the facility location.
Development Applications	Consideration of active development applications on the site.
Property Ownership	Consideration of property acquisition requirements. Sites already owned by Metrolinx are preferred over sites that are not owned by Metrolinx.
Technical Considerations	

[12] Examples of features of “Provincial importance” include: protected heritage property, built heritage resources, cultural heritage landscapes, archaeological resources and areas of potential archaeological interest.

Evaluation Criteria	Description
Property shape/configuration	Consideration of the site shape/configuration. Square/rectangular sites are preferred over irregularly shaped sites in order to provide the most ideal space for the configuration of the electrical equipment on the site.
Access for Construction, Maintenance and Emergency Vehicles	Consideration of the accessibility of the site in relation to construction, maintenance and emergency services.
Type/length of 230kV high voltage connection	Applicable to TPS locations only. Shorter, aerial high voltage connection routes are preferred over longer, underground cable connections which are far more costly/difficult to maintain.
Type/length of 25kV feeder route	Shorter, aerial feeder routes are preferred over longer, underground cable connections which are far more costly and less reliable/more difficult to maintain.

Subsequently, the list of possible TPF sites were comparatively evaluated based on the evaluation criteria outlined above using a reasoned argument approach in order to identify the recommended Tap/TPF sites. A detailed description of the 15 preferred Tap/TPF sites has been provided in Section 3.5.1 and Sections 3.6.9 – 3.6.14 below.

Further detail summarizing the consultation process and stakeholder input considered as part of determining the recommended Tap/TPF locations has been included in EPR Volume 4.

3.4.4 Provincial Policy Statement Considerations

This section outlines the 2014 Provincial Policy Statement (PPS) (Ministry of Municipal Affairs & Housing, 2014) clauses regarding development within a floodplain and discusses the compliance of the GO Rail Network Electrification Traction Power Facilities (Taps/TPFs) with respect to these clauses.

The PPS generally encourages development to occur outside of floodplains, stating in PPS Section 3.1.1 that *"development shall generally be directed to areas outside of… hazardous lands adjacent to river, stream and small inland lake systems which are impacted by flooding hazards and/or erosion hazards"*.

Regarding specific uses that are not permitted, the PPS states:

"Development shall not be permitted to locate in hazardous lands and hazardous sites where the use is:
…

> *b) an essential emergency service such as that provided by fire, police and ambulance stations and electrical substations (PPS Section 3.1.5)."*

Regarding the uses that *are* allowed within floodplains, the PPS states (PPS Section 3.1.7):

> *…development and site alteration may be permitted in those portions of hazardous lands and hazardous sites where the effects and risk to public safety are minor, could be mitigated in accordance with provincial standards, and where all of the following are demonstrated and achieved:*
>
> *a) development and site alteration is carried out in accordance with floodproofing standards, protection works standards, and access standards;*
>
> *b) vehicles and people have a way of safely entering and exiting the area during times of flooding, erosion and other emergencies;*
>
> *c) new hazards are not created and existing hazards are not aggravated; and*
>
> *d) no adverse environmental impacts will result.*

The electrical taps/traction power facilities proposed as part of the Electrification project are not considered essential emergency services and thus are not subject to the prohibition in PPS Section 3.1.5. Rather, the Taps/TPFs needed for the electrified GO Transit system will transform the utility supply voltage from 230 kV to 2X25 kV and distribute power along the system to power the electric GO Trains. These facilities are not being built as part of the emergency power supply for Ontario. In addition, the finished floor of the facilities will be designed/built above the 100yr flood level, therefore there are no anticipated environmental impacts associated with placement of these facilities in a floodplain.

The following table outlines how the requirements stated in *Section 3.1.7* of the PPS will be fulfilled with respect to the electrification project.

Table 3-2: Summary of PPS Requirements

PPS Requirement	How Requirement will be Addressed
Development and site alteration is carried out in accordance with flood-proofing standards, protection works standards, and access standards	The Tap/Traction Power Facilities will be built such that the finished floor (and hence all equipment) will be set at a minimum above the 100-year floodplain. For flood-proofing of sites, the facilities will be built 0.3m above the floodplain. Best practices for site access will be implemented during construction and operations. Additional more detailed SWM analyses will be undertaken as part of detailed design, and relevant Conservation Authorities will be further engaged in this process as appropriate.

PPS Requirement	How Requirement will be Addressed
Vehicles and people have a way of safely entering and exiting the area during times of flooding, erosion and other emergencies	Access routes for each facility will be designed/built to ensure access to the site during emergency conditions.
New hazards are not created and existing hazards are not aggravated.	The Taps/TPFs will be designed such that they will not cause any new hazards and will not increase the risk of flooding. An initial Stormwater Management assessment study was carried out for each Tap/TPF as part of the TPAP and is summarized in Volume 3 and Appendix K. The results of this initial assessment did not identify that any new hazards will be created; nor that existing hazards will be aggravated as a result of constructing/operating the Taps/TPFs. This will be further reviewed during the detailed design phase to ensure compliance.
No adverse environmental impacts will result.	Each Tap/TPF site has been assessed from a natural environmental impact perspective as part of the TPAP; refer to Appendix A for the assessment of effects and detailed list of mitigation measures that will be implemented to ensure no net adverse natural environmental effects.

Taps/TPF Sites Within Floodplains

Based on the SWM assessment undertaken as part of the TPAP and consultation with Conservation Authorities (CA), there are six Tap/TPF sites that fall partially within CA Regulated Areas and one TPF site that is situated entirely within a CA Regulated Area (see **Table 3-3**):

- Bramalea PS;
- Gilford PS;
- Preferred Allandale Tap;
- Lincolnville PS;
- Scarborough Tap/TPS;
- Don Yard PS; and
- ERMF Tap/TPS.

Table 3-3: Summary of Tap/TPF Sites within Regulated Areas

Conservation Authority	Site	Watershed	Sub-Watershed	Within Regulated Area[13]?
CLOCA	EAST RAIL MAINTENANCE FACILITY TAP/TPS	Corbett Creek	West Corbett Creek	YES – PORTION OF THE SITE IS IN A REGULATED AREA
HRCA	BURLINGTON TAP/TPS	Burlington Urban Creek	Between Roseland Creek & Tuck Creek	NO
HRCA	OAKVILLE SWS	Oakville East Urban Creeks	Joshua's Creek	NO
LSRCA	PREFERRED ALLANDALE TAP	Barrie Creeks	HotchKiss Creek	YES – PORTION OF THE SITE IS IN A REGULATED AREA
LSRCA	ALTERNATE ALLANDALE TAP	Barrie Creeks	HotchKiss Creek	NO
LSRCA	ALLANDALE TPS	Barrie Creeks	HotchKiss Creek	NO
LSRCA	GILFORD PS	Innisfil Creeks	Gilford Creek	YES – PORTION OF THE SITE IS IN A REGULATED AREA
LSRCA	NEWMARKET SWS	East Holland River	Weslie Creek	NO
TRCA	MIMICO TAP/TPS	Lake Ontario Waterfront	Between ETOB / MIM	NO
TRCA	MIMICO SWS	Lake Ontario Waterfront	Between ETOB / MIM	NO
TRCA	BRAMALEA PS	Etobicoke Creek	Spring Creek (Etob. 25/26/28A)	YES – PORTION OF THE SITE IS IN A REGULATED AREA
TRCA	MAPLE PS	Don River	Don East (23W)	NO
TRCA	SCARBOROUGH TAP/TPS	Highland Creek	HIG14	YES – PORTION OF THE SITE IS IN A REGULATED AREA

[13] Based on information available at the time of preparing the GO Rail Network Electrification EPR.

Conservation Authority	Site	Watershed	Sub-Watershed	Within Regulated Area[13]?
TRCA	UNIONVILLE PS	Rouge River	ROU69/53	NO
TRCA	LINCOLNVILLE PS	Duffins Creek	DUF45(East)	YES – PORTION OF THE SITE IS IN A REGULATED AREA
TRCA	DURHAM SWS	Duffins Creek / Krosno Creek	KRO2 / DUF6	NO
TRCA	SCARBOROUGH SWS	Don River	DON M3/M4	NO
TRCA	DON YARD PS	Don River	DON1	YES - SITE IS SITUATED IN A REGULATED AREA

A preliminary Stormwater Management (SWM) Assessment for each Tap/TPF site was carried out as part of the Electrification TPAP that involved engagement with Conservation Authorities (see Appendix K). Further more detailed SWM analyses will be undertaken as part of detailed design, and relevant Conservation Authorities will be further engaged in this process as appropriate. Refer to Volume 3 Sections 3.13, 4.13, 5.13, 6.13, 7.13, 8.13 for additional detail.

3.5 Traction Power Supply – Hydro One

Electrical power will be supplied from Hydro One's existing 230kV high voltage grid (i.e., transmission lines). Specifically, power will be tapped from the grid at a voltage of 230kV and routed either aerially or underground to the new Metrolinx Traction Power Substations where it will be stepped down to a lower voltage (i.e., 25kV) for distribution along the electrified GO system. The following sections provide further detail on the Hydro One tap locations, high voltage connection routes and associated infrastructure that will need to be built.

3.5.1 Tap Locations

The tap locations (see **Figure 3-4** to **Figure 3-8**) are the areas where power will be drawn from the existing Hydro One Network.

There are five locations as follows where taps must be made in order to supply the necessary 230kV power to the electrified GO system:

1. Mimico Tap Location (Lakeshore West Corridor)
2. Burlington Tap Location (Lakeshore West Corridor)

3. Allandale Tap Location[14] (Barrie Corridor)
4. Scarborough Tap Location (Stouffville Corridor)
5. East Rail Maintenance Facility Tap Location (Lakeshore East Corridor)

Each tap location will consist of at least two tap structures (approximately $10m^2$, up to 30m tall). Each of the tap structures will be located under/adjacent to existing Hydro One 230kV transmission lines to facilitate tapping the transmission circuits. It should be noted that for purposes of the TPAP environmental studies, a more conservative area was delineated around the proposed locations of the tap points (see pink hatched areas on **Figure 3-4)** in order to account for the fact that the precise locations of the tap structures won't be determined until detailed design. From the tap structures, a high voltage connection route will be constructed that may be aerial (overhead wires) or underground (via duct bank) that will extend to the demarcation point. The demarcation point is essentially a disconnect switch that will represent the point at which the new infrastructure will switch from being Hydro One controlled to Metrolinx controlled. The purpose of a disconnect switch is to allow Hydro One to disconnect the Metrolinx system from the Hydro One system for cases of maintenance and emergency situations. The precise location of the disconnect switch will be determined during detailed design, however for the purposes of the conceptual engineering design for the TPAP it has been assumed to be in the general location of the TPS fence line. Hydro One will own/control the entire 230kV infrastructure (tap structures, disconnect switch, and high voltage connection route) up to the demarcation point.

[14] As outlined in Section 3.5.1.3, two possible locations for the Allandale Tap have been carried as part of the TPAP, one preferred site and one alternate site.

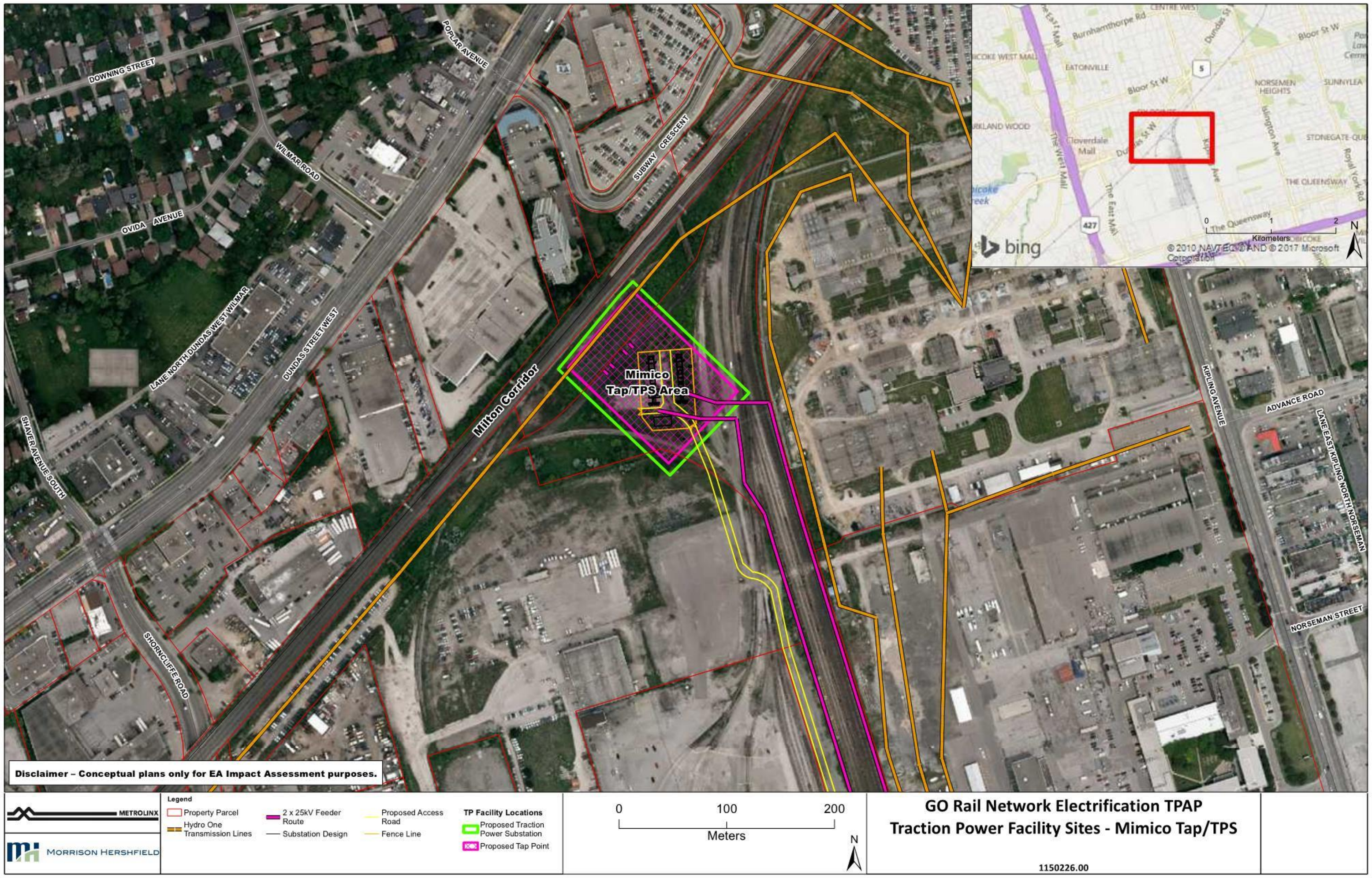
Figure 3-3: Tap Structure Example

3.5.1.1 Mimico Tap Location (Lakeshore West Corridor)

Figure 3-4 show the proposed site for locating the Mimico Tap/230kV connection (Mimico TPS is further described in **Section 3.6.10.1**). The location and infrastructure required for the Mimico Tap is described as follows:

- Tapping from existing Hydro One 230kV transmission line. Final tapped circuits will be determined by Hydro One.
  - *The proposed Mimico Tap location is owned by Hydro One*
- Two Hydro One owned/constructed structures required at tap point, located to be determined by Hydro One (each approx. 10m2, up to 30m tall) under/adjacent to the Hydro One 230kV transmission lines to facilitate tapping the 230kV transmission circuits.
- Aerial 230kV connection and transmission from the Hydro One structures to two new Metrolinx tap structures in (or immediately adjacent to) the TPS. These structures will also be approximately 10m2, up to 30m tall.
  - *The proposed Mimico TPS site is privately owned*
- From the Mimico TPS, install two aerial 2x25kV feeders on top of independent single pole OCS structures (approx. 13m in height, 65m apart) along the Canpa rail ROW for approximately 3.5 kms. The aerial feeders will transition to underground when nearing the TPS facility.
  - *Canpa ROW is owned by Metrolinx*

Figure 3-4: Mimico Tap & TPS Location

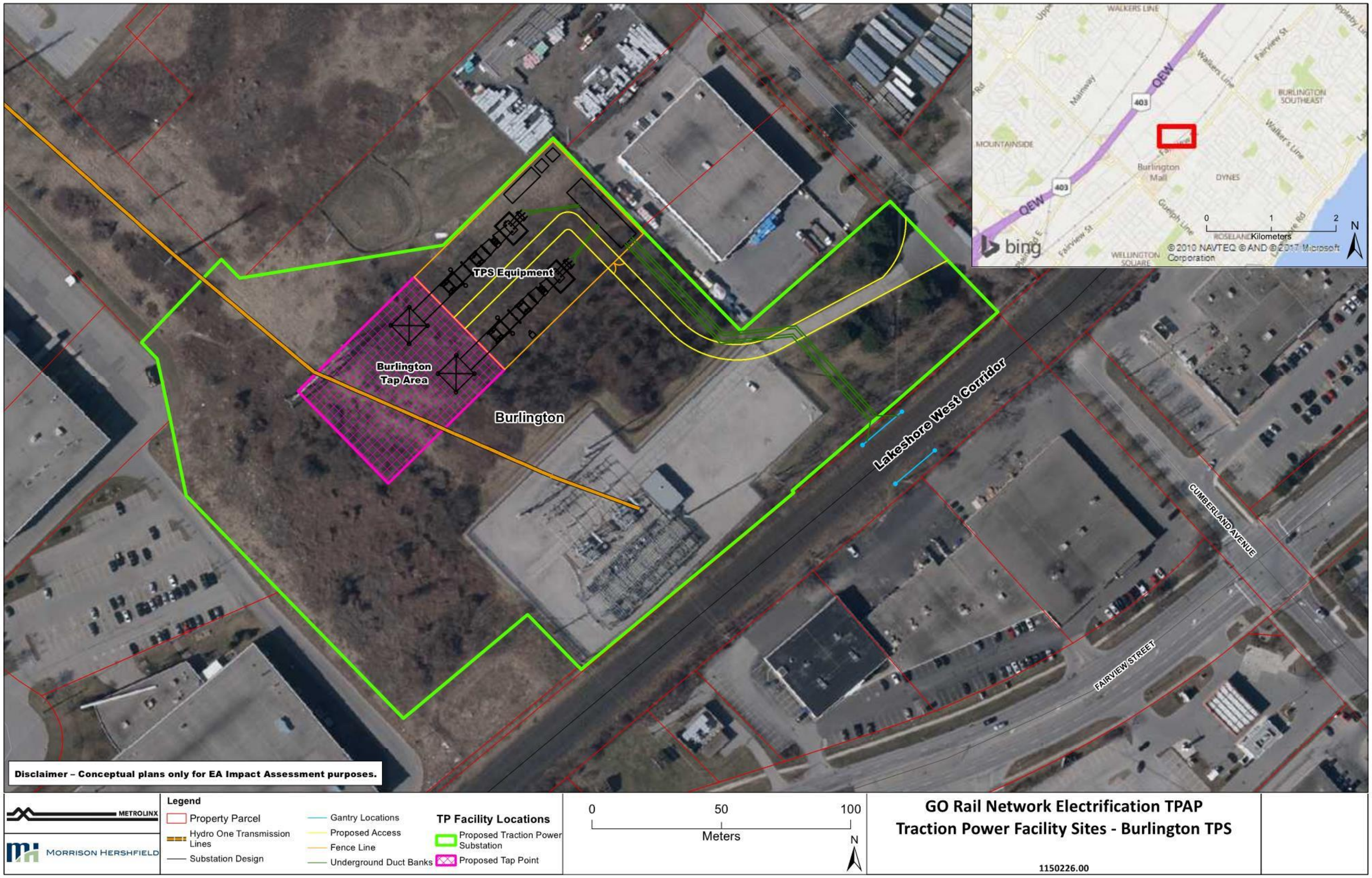


3.5.1.2 Burlington Tap Location (Lakeshore West Corridor)

Figure 3-5 shows the proposed site for locating the Burlington Tap/230kV connection (Burlington TPS is further described in **Section 3.6.10.3**). The location and infrastructure required for the Burlington Tap is described as follows:

- Tapping from existing Hydro One 230kV transmission line –Final tapped circuits will be determined by HONI.
- Two Hydro One owned/constructed structures required at tap point, location to be determined by Hydro One (each approx. 10m2, up to 30m tall) under/adjacent to the Hydro One 230kV transmission lines to facilitate tapping the 230kV transmission circuits.
- Aerial 230kV connection and transmission from the Hydro One structures to two new Metrolinx tap structures in (or immediately adjacent to) the TPS. These structures will also be approximately 10m2, up to 30m tall.
- The Tap point can be accommodated within same property boundary as the TPS.
- *The proposed site for the Burlington Tap/TPS is jointly owned by Hydro One/Private Owner.*

Figure 3-5: Burlington Tap & TPS Location



3.5.1.3 Preferred Allandale Tap Location (Barrie Corridor)

Hydro One is planning to upgrade their existing transmission line between Essa and Barrie Transformer Stations in the vicinity of the proposed tapping area from 115kV to 230kV. As part of discussions with Hydro One, the Preferred Allandale Tap location is north of Tiffin St. as shown in **Figure 3-6.** Final tapped circuits will be determined by Hydro One. The agreed to approach reflects two new tapping structures on Hydro One property.

The Allandale TPS are described in **Section 3.6.12.1**). The infrastructure required for the Allandale Tap is described as follows:

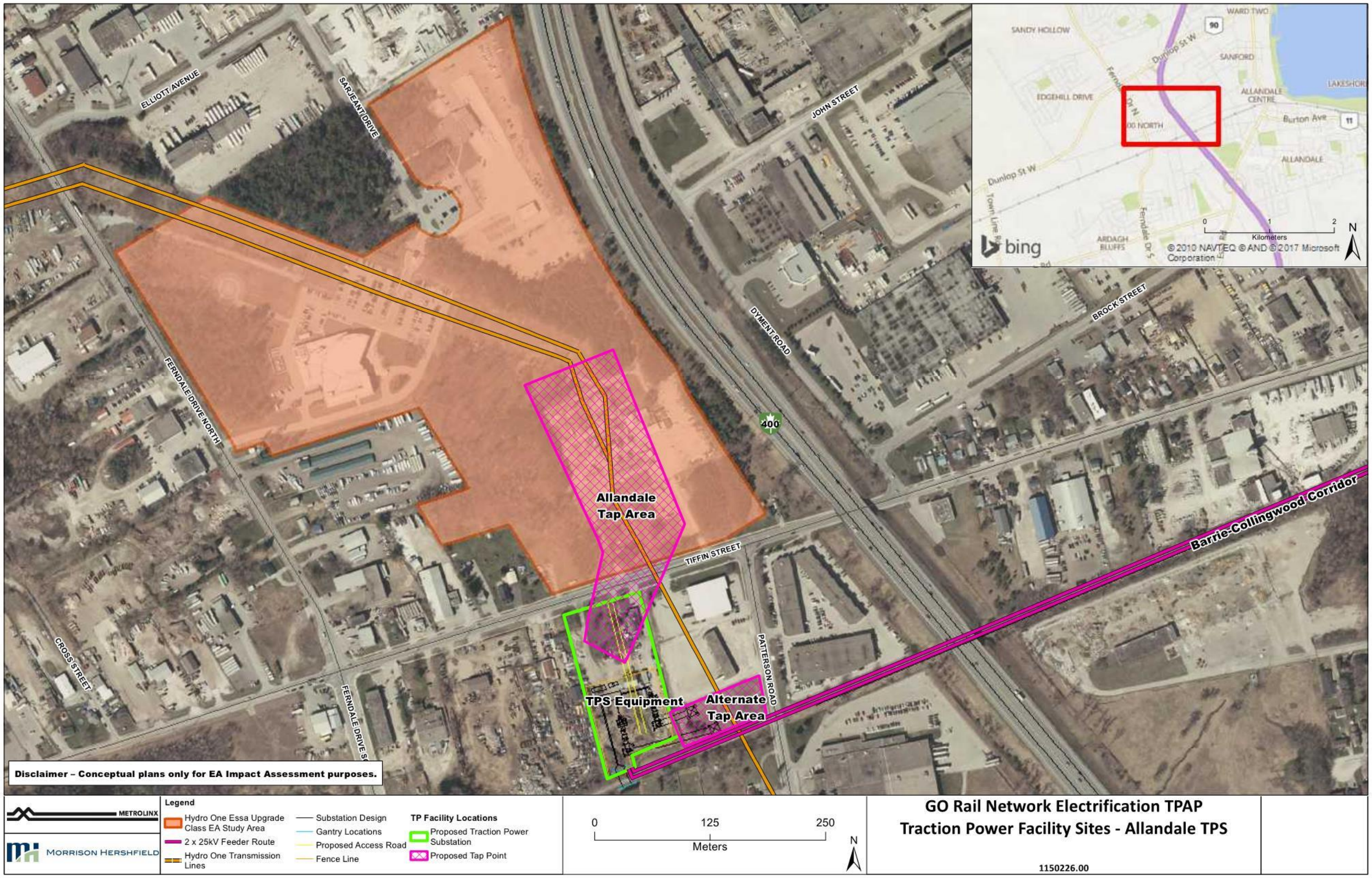
- Total of two new Hydro One towers (final location to be determined by Hydro One):
    - Two Hydro One owned/constructed structures required at tap point, location to be determined by Hydro One (each approx. 10m2, up to 30m tall) adjacent to the Hydro One 230kV transmission lines to facilitate tapping the 230kV transmission circuits.
    - Aerial 230kV connection and transmission from the Hydro One structures to two new Metrolinx tap structures (each approximately 10m2, up to 30m tall) in the Metrolinx TPS.
- *The Preferred Allandale Tap location area (north of Tiffin St.) is owned by Hydro One.*
- *The proposed Allandale TPS location is owned by private owners.*

3.5.1.4 Alternate Allandale Tap Location (Barrie Corridor)

In addition to the Preferred Tap Location described above, an alternate location for the Allandale Tap was identified in discussions with Hydro One south of Tiffin St. to the east of the proposed TPS facility as shown in **Figure 3-6** Final tapped circuits will be determined by Hydro One. The agreed to approach reflects two new tapping structures on Hydro One property adjacent to proposed Metrolinx traction power substation site. The final location and equipment design of the Tap infrastructure will be determined during detailed design.

- *The Alternate Allandale Tap location area (south of Tiffin St.) is owned by Hydro One.*
- *The proposed Allandale TPS location is owned by private owners.*

Figure 3-6: Preferred & Alternate Allandale Tap Locations

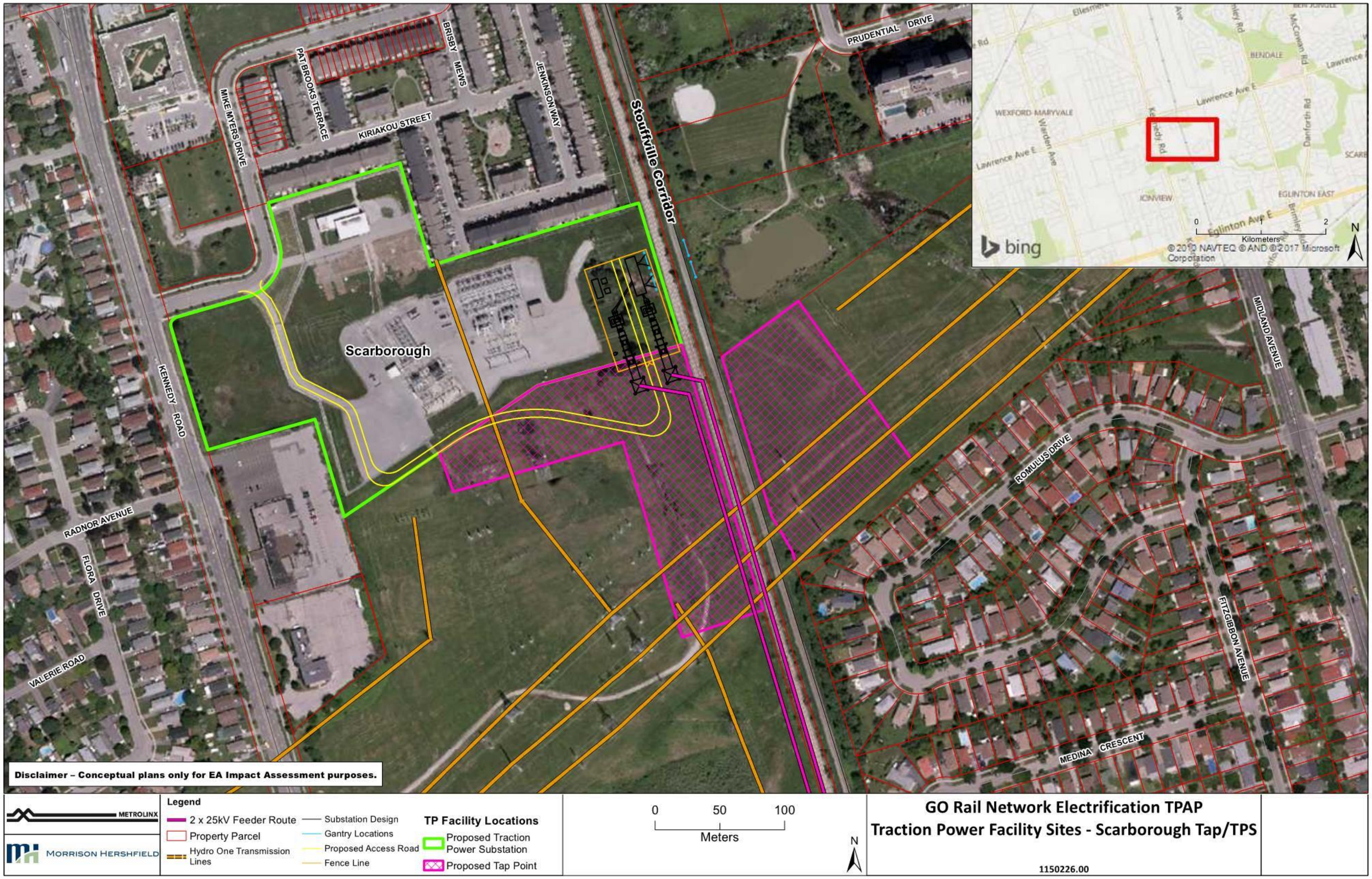


3.5.1.5 Scarborough Tap Location (Stouffville Corridor)

Figure 3-7 shows the proposed site for locating the Scarborough Tap/230kV connection (Scarborough TPS is further described in **Section 3.6.13.1**). The location and infrastructure required for the Scarborough Tap is described as follows

- Tapping from existing Hydro One 230kV transmission line (Circuits to be tapped will be determined by Hydro One) at location south of Lawrence Ave E. in the vicinity of the Stouffville rail corridor (see pink hatched area on **Figure 3-7**).
  - *The three potentially affected properties for the Tap location are owned by Hydro One*
- Two Hydro owned/constructed structures required at tap point, location to be determined by Hydro One (each approximately 10m^2, up to 30m tall) under/adjacent to the Hydro One 230kV transmission lines to facilitate tapping the 230kV transmission circuits.
- Aerial 230kV connection from the Hydro One structures to two new Metrolinx tap structures in (or immediately adjacent to) the TPS. These structures will also be approximately 10m^2, up to 30m tall.
- From the Metrolinx TPS, there will be two aerial 2x25kV aerial feeders, with each circuit supported by and positioned at the top of independent OCS structures (approximately 13m in height, 65m apart) along the Stouffville rail ROW to the point where Stouffville and Lakeshore East corridors converge. The aerial feeder route then extends north up the Lakeshore East corridor to the Scarborough TPS. The aerial feeders will transition to underground when nearing the TPS facility.
  - *The proposed Scarborough Tap/TPS site is owned by Hydro One*

Figure 3-7: Scarborough Tap Location

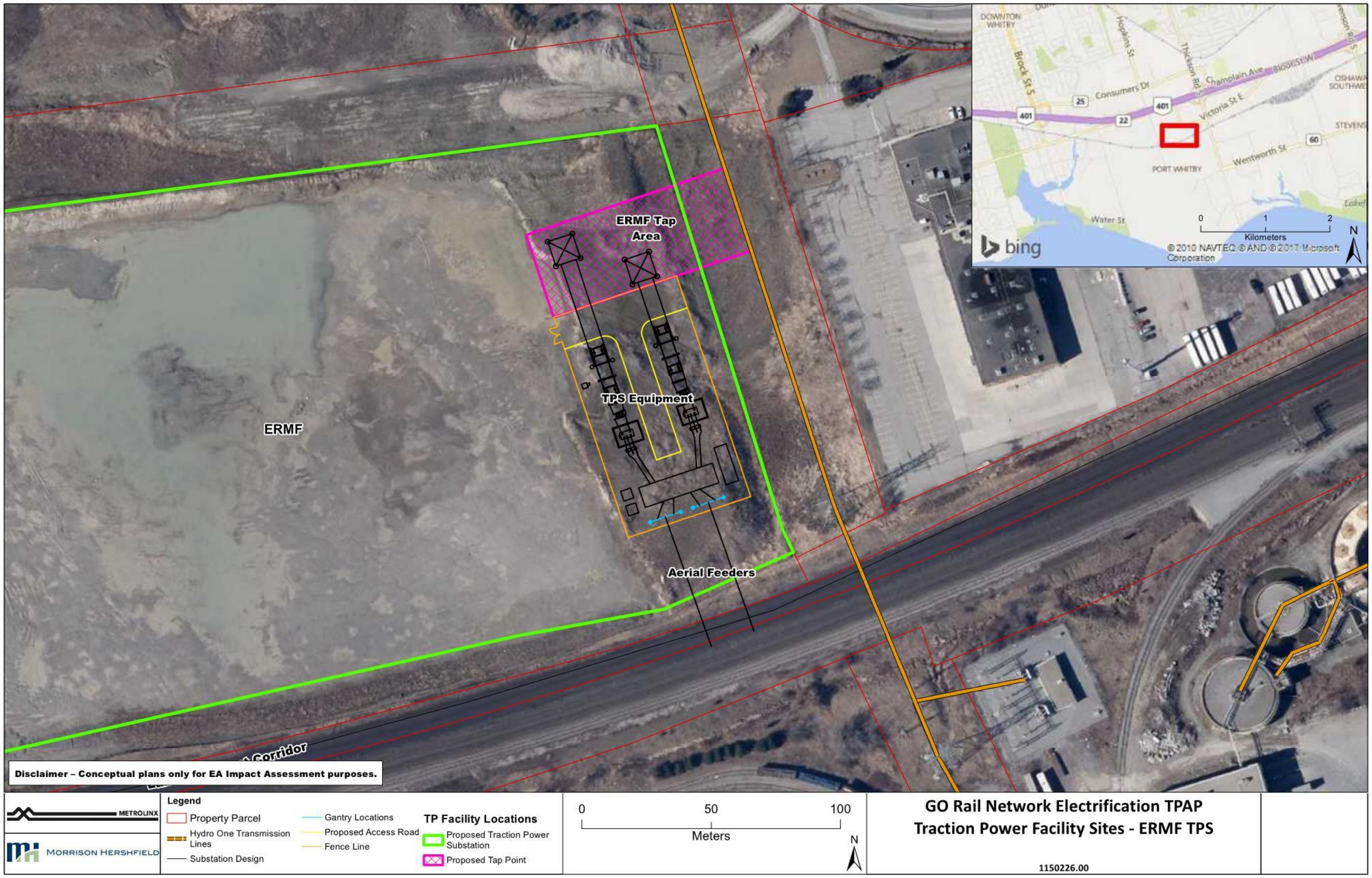


3.5.1.6 East Rail Maintenance Facility Tap Location (Lakeshore East Corridor)

Figure 3-8 shows the proposed site for locating the East Rail Maintenance Facility (ERMF) Tap/230kV connection (the ERMF TPS is described in **Section 3.6.14.1**). It should be noted that the ERMF is currently under construction by Metrolinx on this site. The location and infrastructure required for the ERMF Tap is described as follows:

- Tapping from existing Hydro One 230kV transmission line.
- Two Hydro One owned/constructed structures will be required at tap point, location to be determined by Hydro One (each approximately $10m^2$, up to 30m tall) under/adjacent to the Hydro One 230kV transmission lines to facilitate tapping the 230kV transmission circuits.
- For purposes of the TPAP/conceptual design phase, it was assumed that underground 230kV connection cables via two duct banks (approx. 2m X 2m, 1m depth) will be installed from the Hydro One tap structures to two new Metrolinx tap structures (approximately $10m^2$, up to 30m tall). If deemed feasible during detailed design, the connection may be installed via aerial feeders at this location, however no change to the potential environmental effects are anticipated in this scenario since the underground option is more intrusive.
- The tap location can be accommodated within same property boundary as the TPS facility.
- *The proposed site for the TPS and Tap is owned by Metrolinx.*

Figure 3-8: East Rail Maintenance Facility Tap Location



3.6 Traction Power Distribution System – Metrolinx

3.6.1 2X 25kV Electrification System

As established through the *GO Transit Electrification Study* (Metrolinx, 2010) electrification will be achieved through a 2x25 kV *ac* autotransformer fed electrification system.

The 2 x 25 kV distribution system will consist of two 25 kV circuits: the 25 kV Overhead Contact System and the 25 kV Autotransformer feeder.

- The OCS will consist of a bare contact wire or a bare contact wire and a bare messenger cable, The OCS is installed over the center line of electrified track that the train's pantograph interfaces with.
- The autotransformer feeder cables (wires) are located atop the OCS structures, along with the static wire. Feeders are typically bare conductors, but can be insulated in locations where space is limited, such as bridges.
- The train track's rails themselves are also part of the electrical 2x25kV system, in addition to the aerial static wire, is used to carry traction power return currents bank to the substation.

3.6.2 Overhead Contact System (OCS)

The Overhead Contact System (OCS) is a fundamental component of the traction power distribution system. The OCS consists of a wiring system (i.e., messenger wire and contact wire) that provides efficient transfer of traction power to the pantograph (mounted on the train), and then to the electric drive motors (see **Figure 3-9**).

The OCS configuration is generally dependent on a combination of factors including: train speed, wire size, system height (i.e., maximum space between contact wire and messenger wire), climatic conditions, the height of the wire above the track, and track alignment.

In order to ensure efficient transmission of electric traction power to the trains, the contact wire and the pantograph mounted on the train must remain in contact during train operation. While there are many factors that go into achieving good train to OCS dynamics, one of the key components is to control the height of the contact wire above the top of rail. Ideally the contact wire is kept parallel to the tracks. Changes in contact wire height are gradual and controlled. Abrupt changes in the height of the contact wire cause the pantograph to lose contact with the wire. The effects are increased maintenance to both the OCS and the pantograph, decreased useful life, and in extreme conditions, the train will lose power and come to a stop. Proper OCS design takes into account the maximum operating train speed. The higher the train speed the lower the tolerances is to changes in the contact wire height.

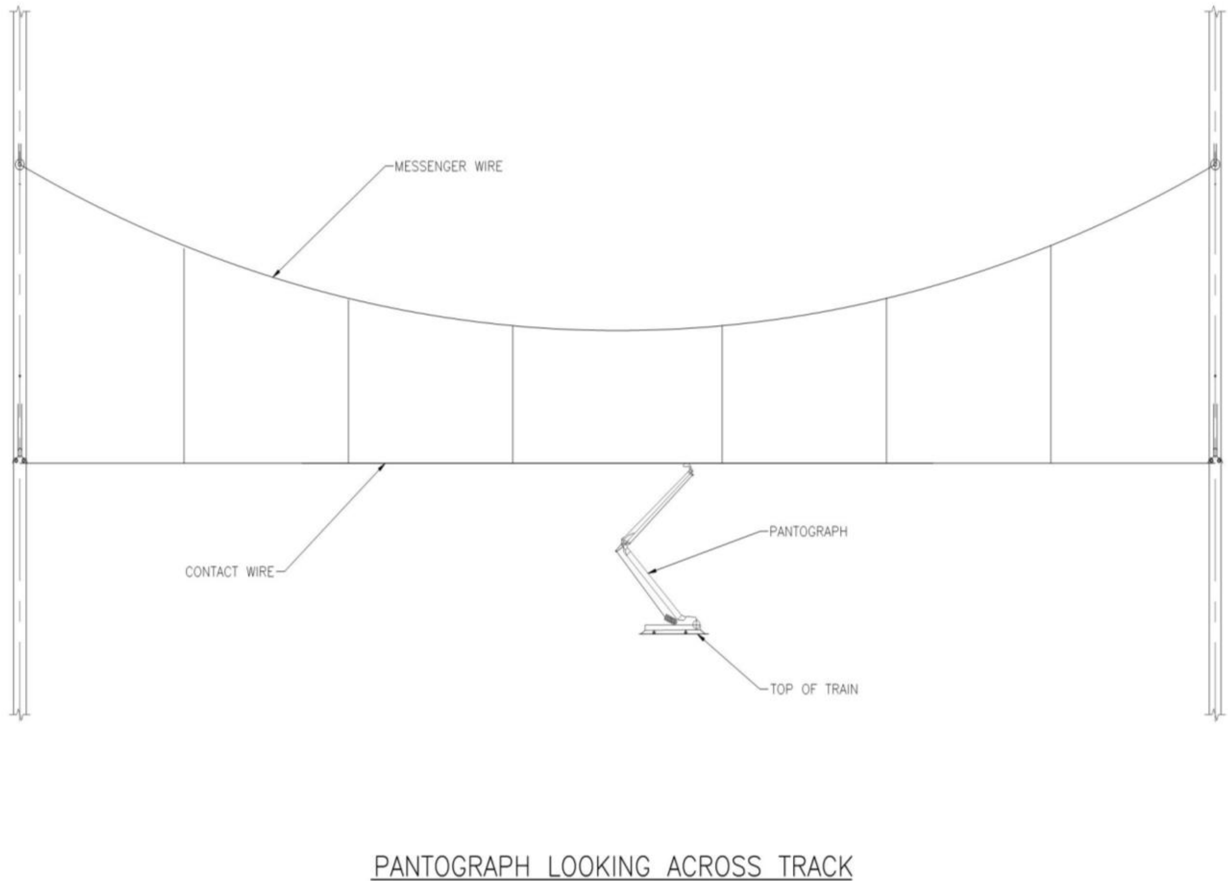
The height of the OCS wire along a track is known as the wire profile. Just like a cable supports the roadway on a suspension bridge, the messenger cable supports and controls the profile of the Contact Wire. The messenger is supported by OCS structures, the support structure serves two purposes, it supports the wires above the track and it provides horizontal control of the OCS, which controls things like blow off from wind, and allows the wire to follow curves in the track. Tension is applied to both the Contact and the messenger to allow the structures to be spaced as far apart as possible while maintaining the tolerances in the contact wire profile. Because metals expand and contract with changes in temperatures, the wires of an OCS system will expand when temperature rise, and contract when temperatures drop. There are two ways to deal with this expansion and contraction of the wires, one is to fix both ends off the OCS wires and allow the wires to sag when it get warmer and rise when it cools. The other is to fix one end of the OCS wires, while the other is connected to a tensioning device. The first style is known as fixed termination or variable tension, while the second it referred to as Constant Tension or Auto Tension. Both styles will be used on this system.

It is noted that no additional lighting is anticipated to be required along the rail corridors as a result of implemented OCS infrastructure.

Auto or constant tension will be used where possible. The benefits of constant tension is that spacing between structures can be maximized while maintaining contact profile tolerances of high train speeds. Fixed termination or variable tension will be used in locations where high speed train operation is not needed and the complexity of the OCS installation requires frequent placement of support structures. Examples of this would be train storage yards and the USRC, particularly between the east and west ladders on both sides of the depot.

The OCS will be designed to meet the climatic conditions of the GTHA. This includes the extreme temperature, wind, ice conditions as required by the Canadian Standards Association (CSA) for the design and installation of overhead utility lines.

Figure 3-9: Typical OCS Contact Wire, Messenger Wire and Pantograph



3.6.2.1 OCS Support Structures

The OCS will be suspended from a number of steel support structures (i.e., portals and cantilevers) placed along the corridors, including on bridges and overpasses where required (see **Figure 3-10** and **Figure 3-11**). Generally, the number of tracks to be spanned dictates the type of structure required, i.e., portals are typically used when spanning three or more tracks, whereas cantilevers are used when two or less tracks are spanned. It is noted that, based on conceptual design, culverts along the rail ROWS will be avoided through engineering solutions with respect to placement of OCS foundations.

Figure 3-10: Typical Portal Structure

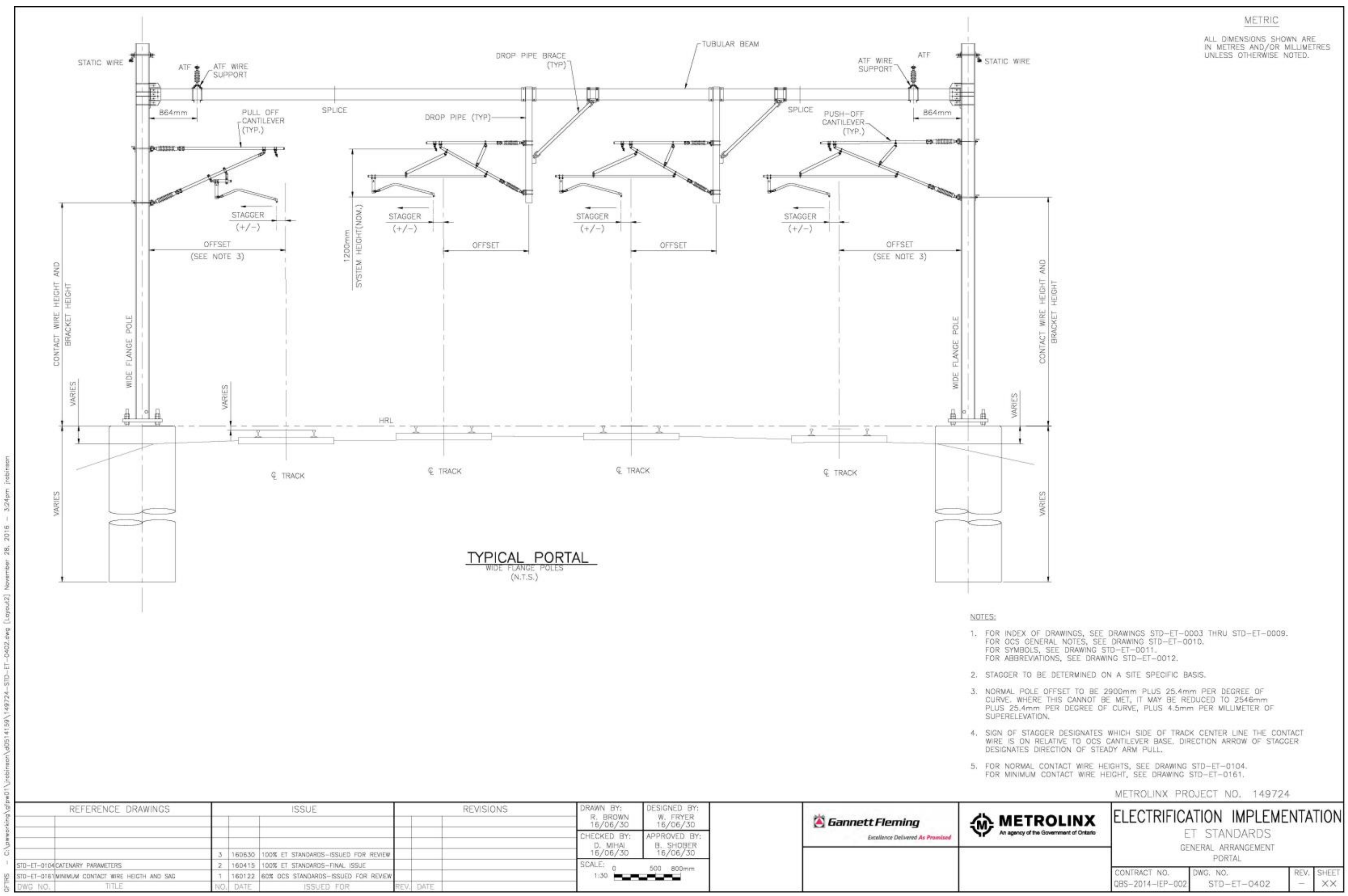
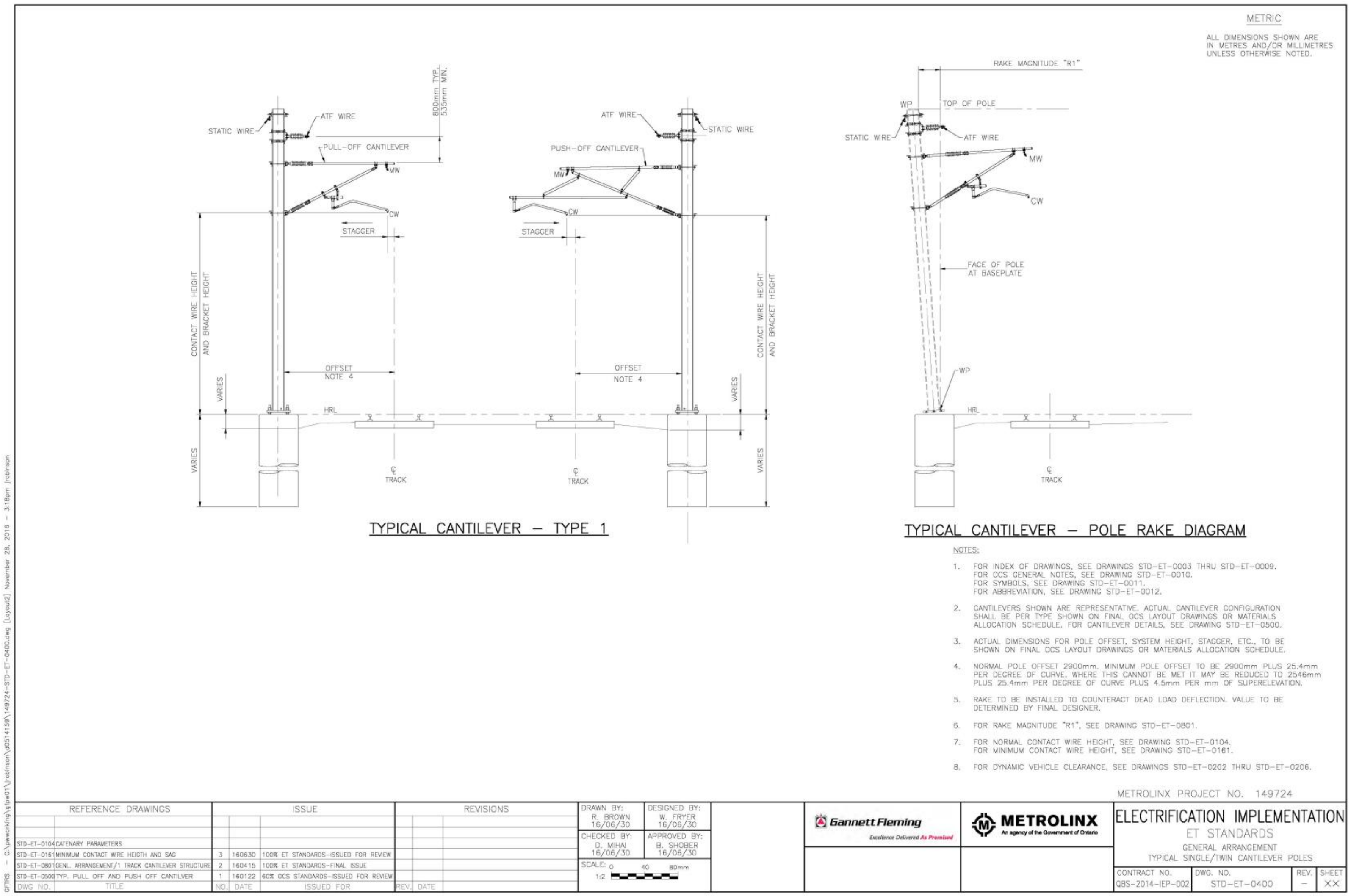


Figure 3-11: Typical Cantilever Structure

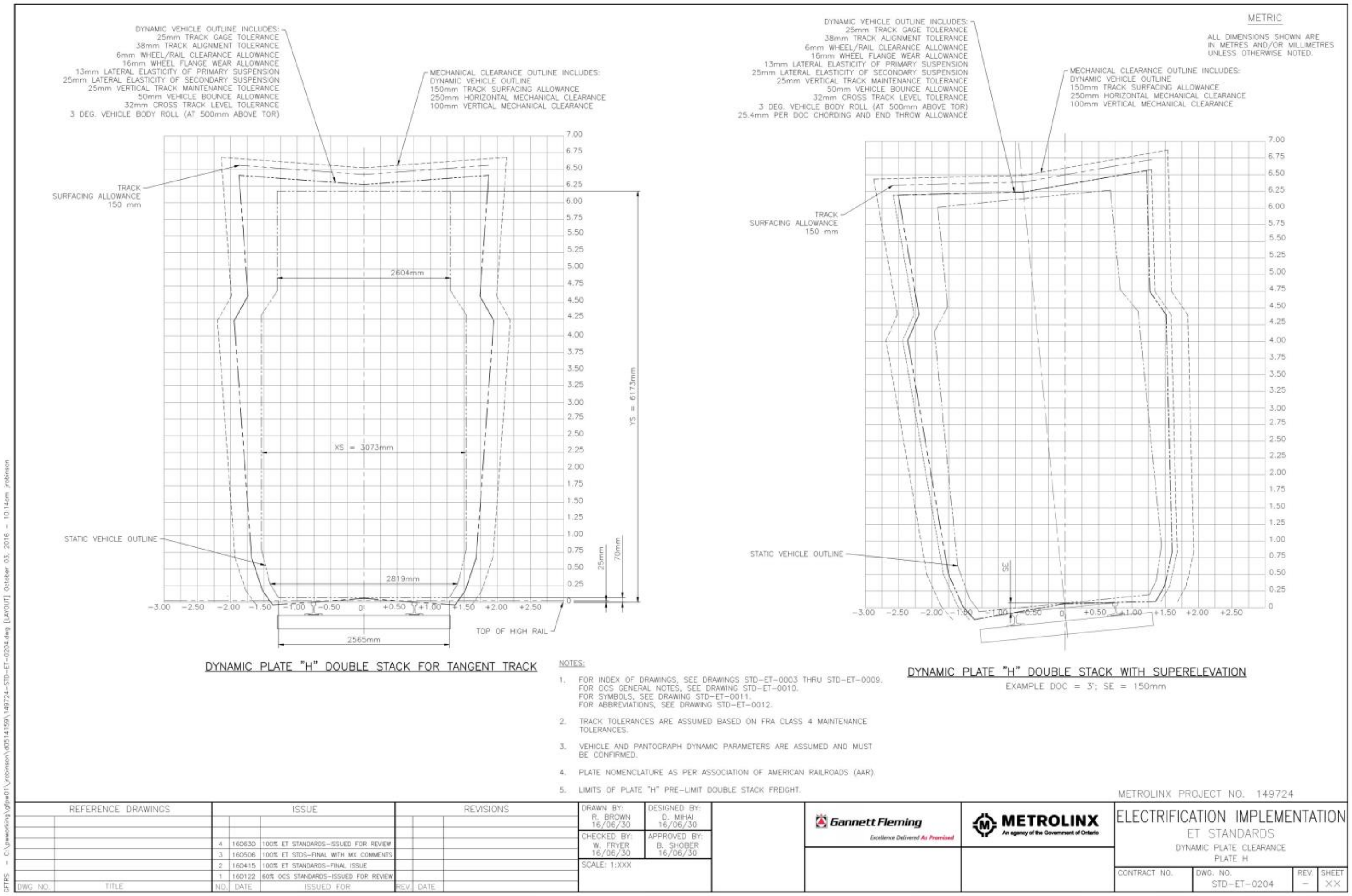


3.6.2.2 OCS Vertical Clearance

The contact wire height needs to be designed to accommodate the multiple types of trains that operate along the GO corridors (i.e., Double Stacked Freight, GO Electric Multiple Units (EMUs), GO Bi-level trains, VIA Rail, etc.). Therefore, the height of the contact wire was designed to accommodate the highest vertical clearance, which is Double Stacked Freight and GO Bi-Levels (see **Figure 3-12**).

The height of the portals/cantilevers used to support the OCS wires over the electrified tracks will range between approximately 7.6m to 12m above the top of the highest rail. Contact wire height will range from 6m to 7.6m.

Figure 3-12: Dynamic Clearance



3.6.2.3 OCS Horizontal Clearance

Based on the conceptual design developed, the OCS pole foundations can generally be accommodated within Metrolinx owned rail ROW, and no property impacts/conflicts are anticipated due to placement of OCS infrastructure along the corridors. Refer to Section 3.6.3 for further detail regarding the OCS Impact Zone.

3.6.2.4 Spacing of OCS Support Structures

The OCS support structures will be positioned along the track at a maximum spacing of approximately 65m. The maximum 65m maximum span is dictated by four factors:

- **Track Geometry -** The contact wire must always be in contact with the pantograph such that electric power traction can be maintained. The maximum poles spacing can only be achieved on straight track. As the curves on the track become tighter, the spacing between the poles decreases.
- **Dynamic, Construction and Maintenance tolerances -** Several other variables must be taken into account when determining maximum pole spacing including: dynamic tolerances for the train and the pantograph, maintenance tolerance for the track, and dynamic and construction tolerances for the OCS itself.
- **OCS System Height**- The system height is the measured distanced between the messenger and the contact wire at the supporting structures. The system height essentially determines how far apart support structures can be placed.
- **Other rail ROW aspects** – Other ROW aspects that will decrease structure spacing include overhead structures, undergrade structures, track crossovers and turnouts, stations.

The following sections briefly describe the types of OCS support structures that will be implemented along each corridor. The OCS design including placement of support structures, etc. will be finalized during the detailed design phase.

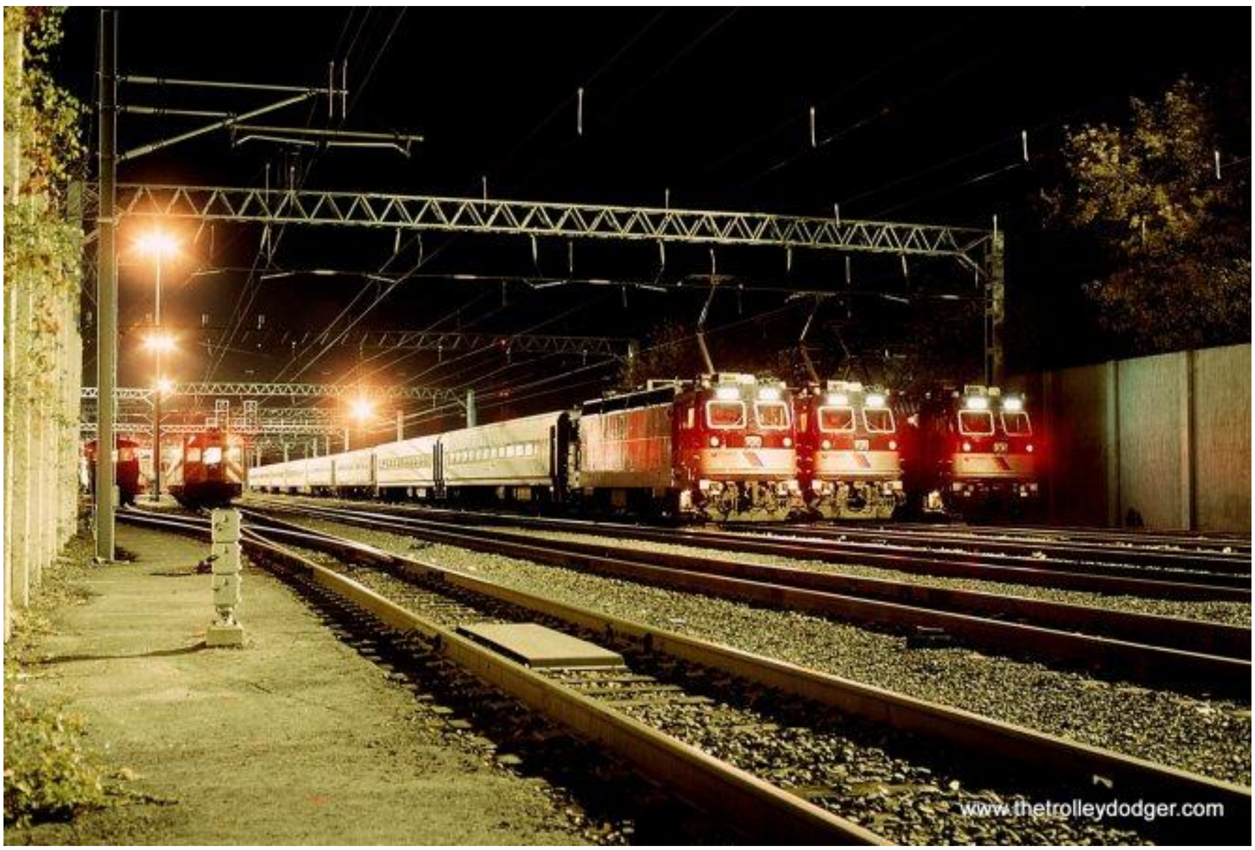
3.6.2.5 Overhead Contact System – Union Station Rail Corridor

All tracks within the USRC (**Figure 3-13**) will be electrified. Therefore the type of OCS support structures to be used will be portals (**Figure 3-14)** provides an example of portal structures spanning multiple tracks).

A freight route will be maintained through USRC and the design will include the provision for a route for Double-Stacked Freight. Specifically all tracks within USRC will be electrified, and a route will be maintained that will meet the clearance requirements for double stack freight trains ensuring the ability to traverse the USRC from north to south and south to north in order to connect between the Lower Galt, Weston, Bala, Lakeshore West and Lakeshore East Subs.

Figure 3-13: USRC

Figure 3-14: Example of OCS Spanning Multiple Tracks



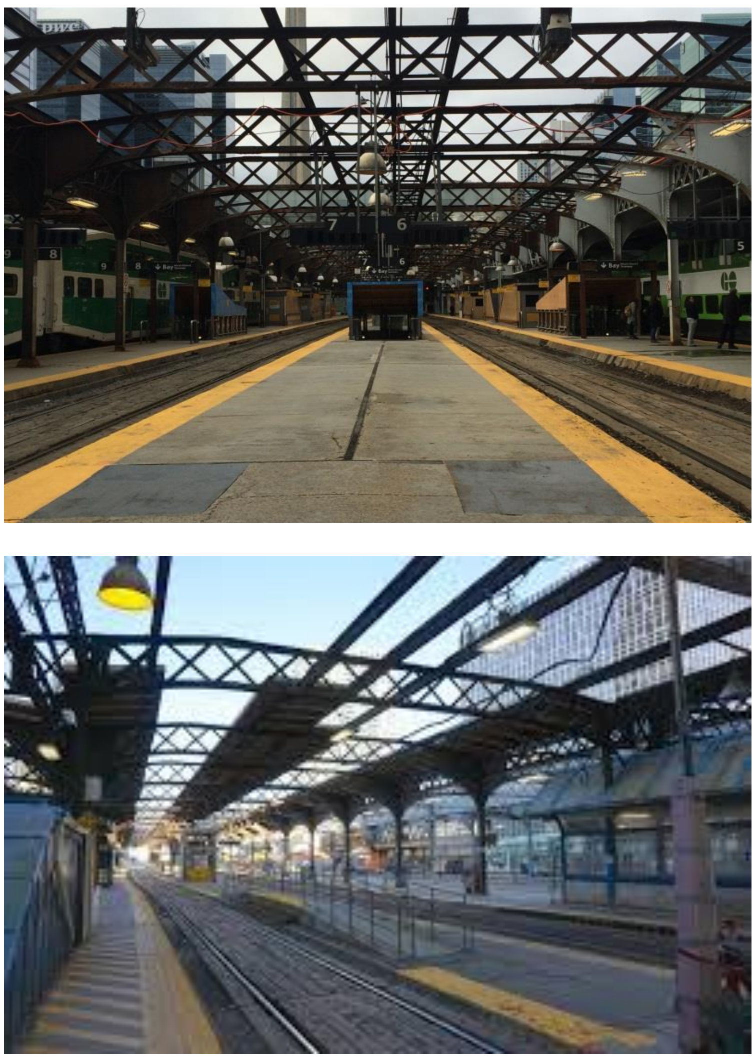
Union Station Train Shed

The Union Station Train Shed consists of 16 tracks as previously mentioned, and is comprised of three sections:

- West train shed
- Glass atrium
- East train shed

The overhead structure in the west and east train shed consist of steel trusses crossing the tracks supporting concrete roof. Over each track is a roof vent which runs the length of the east and west section of the train shed (**Figure 3-15**).

Figure 3-15: Union Station Train Shed



Union Station is currently undergoing a major update and upgrade to improve its capacity and amenity as part of the Union Station Revitalization project (see **Figure 3-16** and **Figure 3-17**).

Figure 3-16: Union Station Revitalization Works

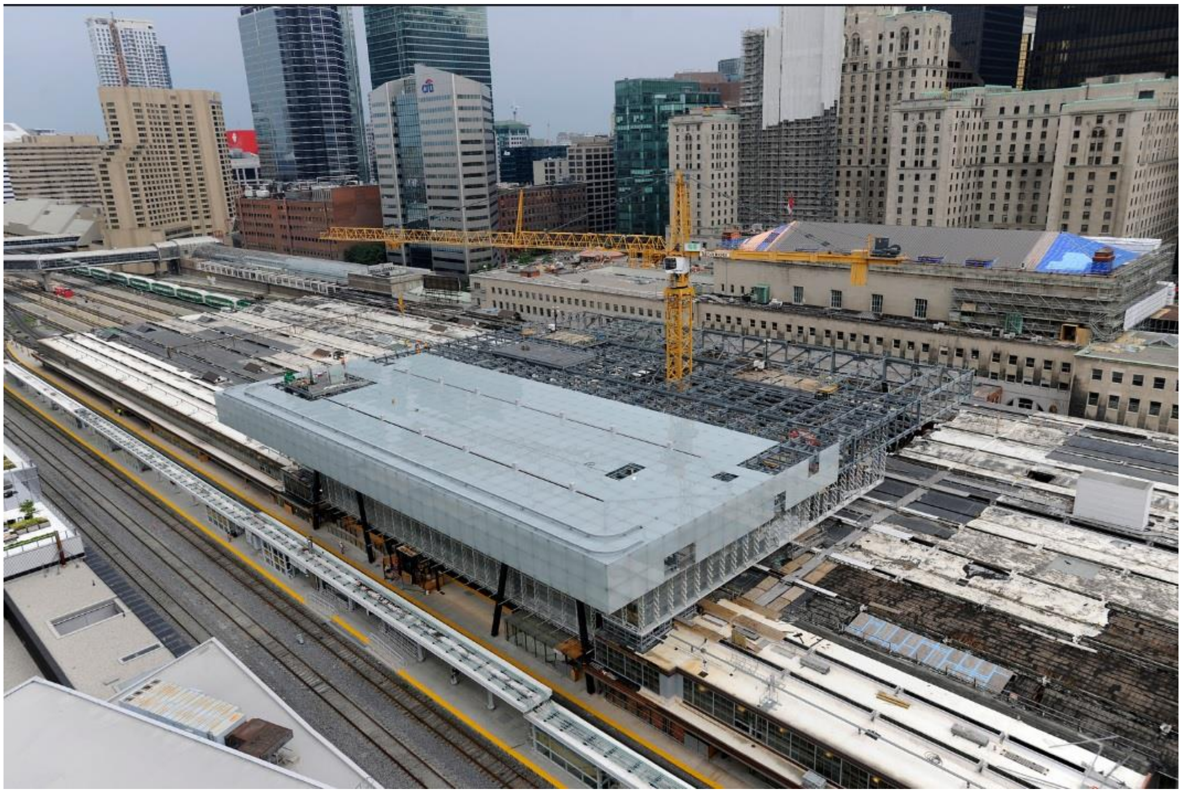


Figure 3-17: Union Station Revitalization Rendering

The central portion of the train shed roof will be replaced with a glass atrium. The train shed roof poses a constraint on the vertical clearance, and will require special design considerations for the implementation of the electrification system in the train shed area.

Modifications Required for Electrification

Based on the conceptual design developed as part of the TPAP, the following modifications to Union Station and the Union Station Train Shed will be required as part of the electrification undertaking:

Installation of OCS

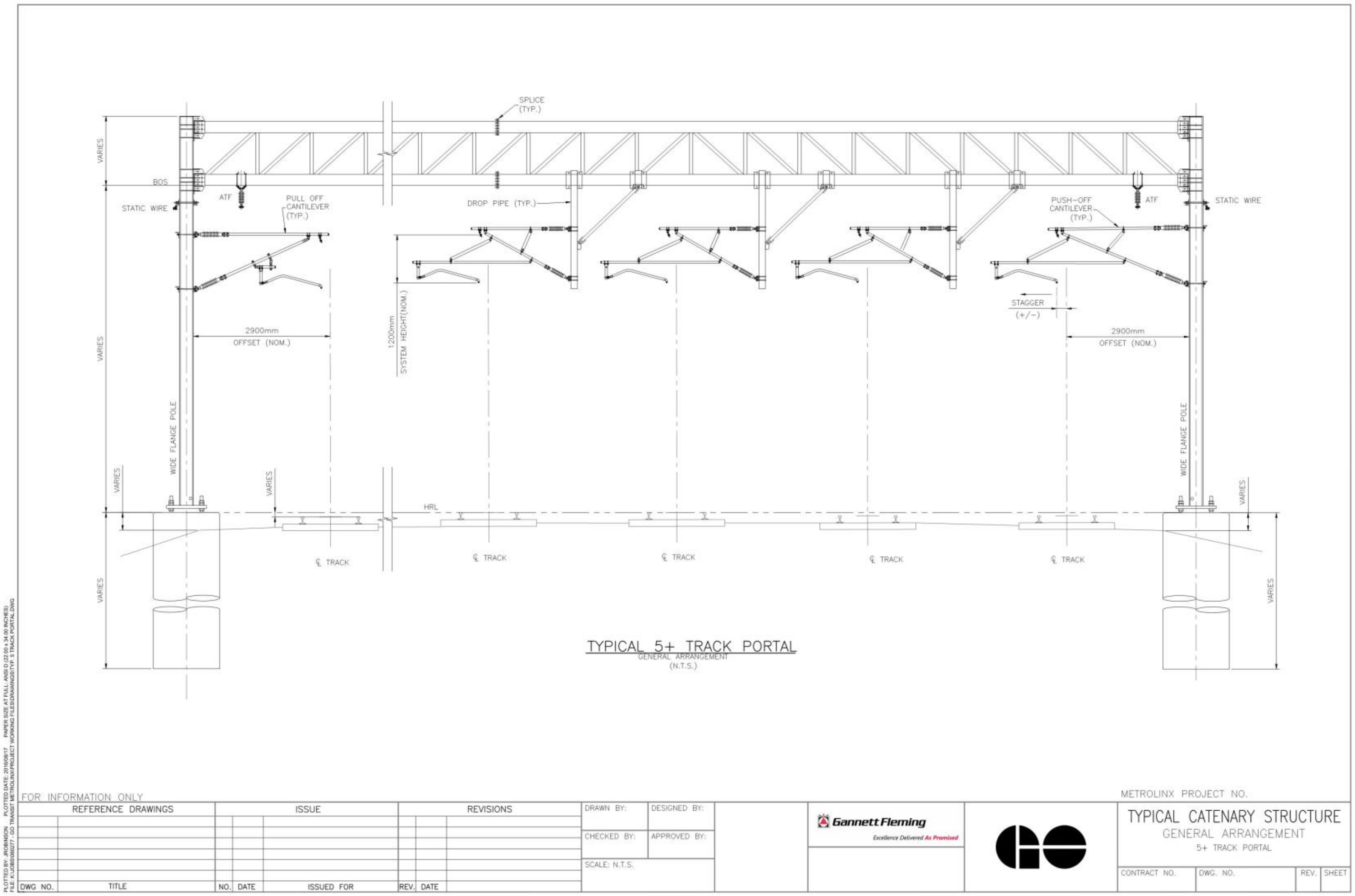
Vertical clearances though the train shed restricts the number of options for installing OCS. In order to install OCS through the limits of the train shed safely, safe clearances to the trains below the OCS must be maintained as well as to the structural elements of the train shed above the wires. The number of, and type of OCS supports needed within the train shed is due to the limited clearances.

Portal structures will be installed to span 16 tracks over the approaches to the train shed, not within the train shed itself. Placement of OCS poles on station platforms will be avoided wherever possible, however factors such as platform layout, number of tracks, and spacing between tracks will dictate the design.

Due to the special design considerations, it is envisioned that variable tension (vs. constant tension) OCS will be implemented within the Union Station Train Shed. Variable tension OCS allows wiring of all crossovers and switches. Visually, variable tension OCS looks like constant tension OCS with the exception of the terminations.

Cross span arrangements will be used (i.e., OCS overhead wires) anywhere within the USRC where enough clearance exists (see **Figure 3-18**).

Figure 3-18: Typical OCS Structure



OCS attachments to smoke ducts

Depending upon the final support arrangement for the catenary system in the Train Shed, it is assumed that the supports may need to accommodate along track movement associated with a constant tension catenary system. This will require one of the following:

- A trimmed smoke vent panels that will allow for along-track movement of a swinging arm support. See **Figure 3-19**.
- A smoke vent attachment vertically within the smoke vent or attached to the cast-in-place bulkhead. See **Figure 3-20**.

Figure 3-19: Typical Smoke Duct Attachment – Option 1

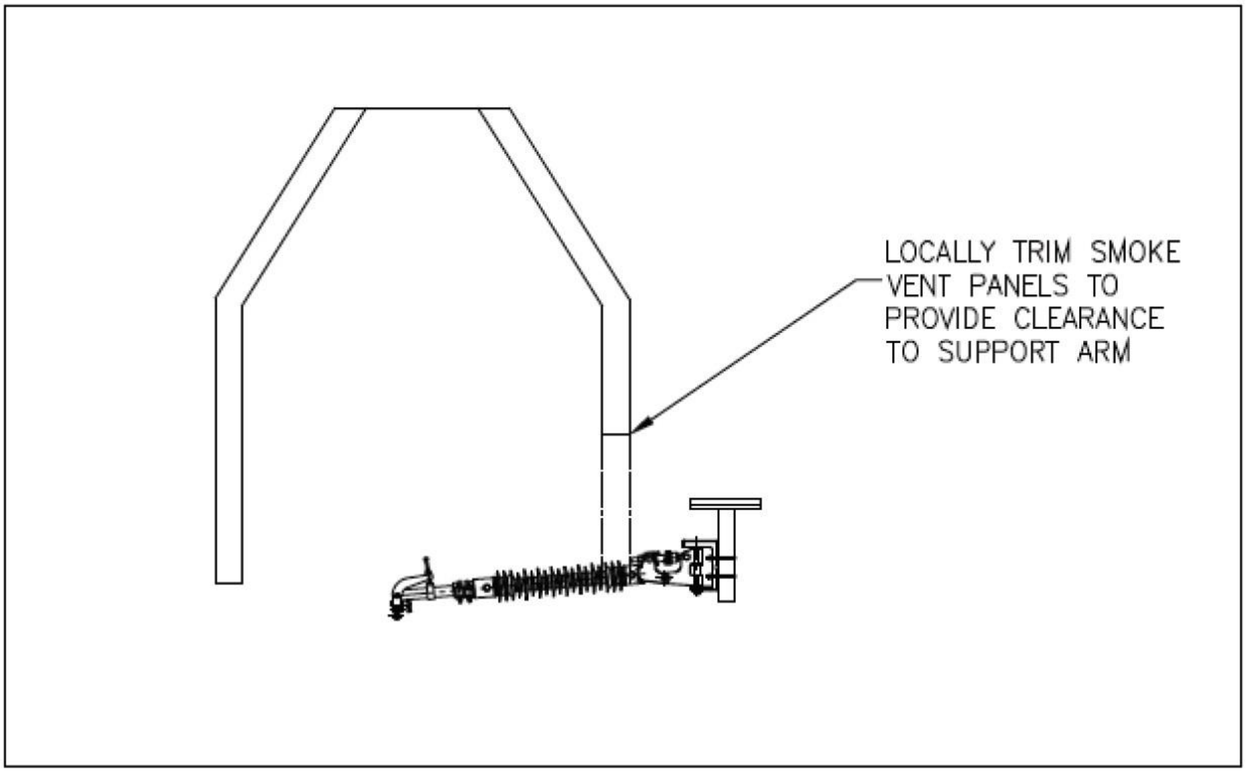
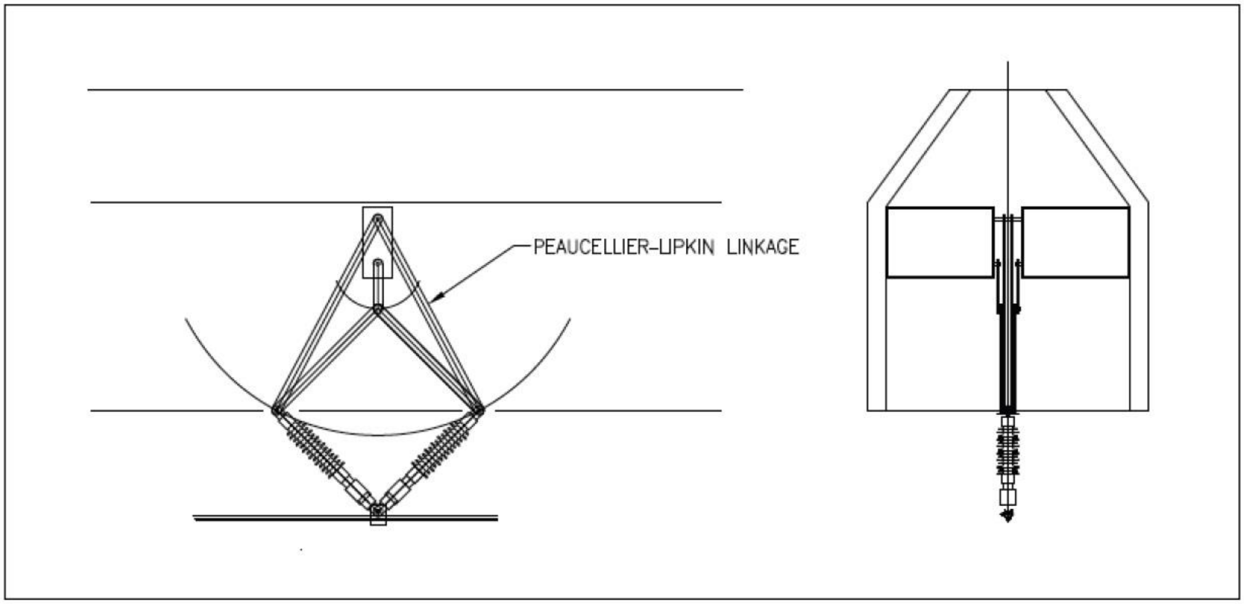


Figure 3-20: Typical Smoke Duct Attachment – Option 2



3.6.2.6 Overhead Contact System – Lakeshore West Corridor

The number of tracks to be accommodated in the electrification design for the Lakeshore West corridor includes four to five tracks to be electrified. Therefore the type of OCS support structures to be used will be portals (see **Figure 3-21**).

Figure 3-21: Example of a Multi-Track Portal Structure

3.6.2.7 Overhead Contact System – Kitchener Corridor

The number of tracks to be accommodated in the electrification design for the Kitchener corridor includes two to three tracks to be electrified. Therefore the type of OCS support structures to be used will be a mixture of cantilevers and portals (see **Figure 3-22**).

Figure 3-22: Example of a Two Track Cantilever Structure

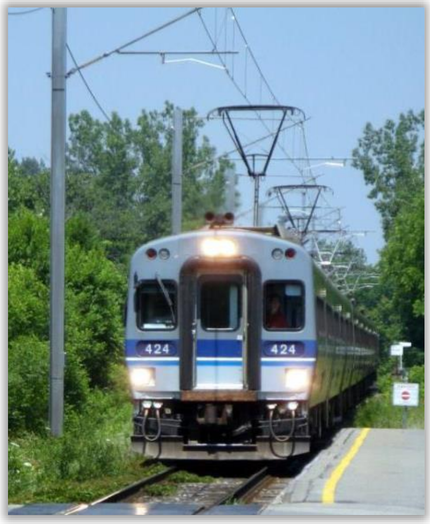
3.6.2.8 Overhead Contact System – Barrie Corridor

The number of tracks to be accommodated in the electrification design for the Barrie corridor includes two tracks to be electrified. Therefore the majority of the type of OCS support structures to be used will be cantilevers (see **Figure 3-22**), but there may be locations where a portal could be utilized (see **Figure 3-24)**.

3.6.2.9 Overhead Contact System – Stouffville Corridor

The number of tracks to be accommodated in the electrification design for the Stouffville corridor includes one to two tracks to be electrified. Therefore the type of OCS support structures to be used will be cantilevers (**Figure 3-23** provides an example of a one track cantilever structure).

Figure 3-23: Example Single Track Cantilever Structure



3.6.2.10 Overhead Contact System – Lakeshore East Corridor

The number of tracks to be accommodated in the electrification design for the Lakeshore East corridor includes three to four tracks to be electrified. Therefore the type of OCS support structures to be used will be portals (see **Figure 3-24**).

Figure 3-24: Example Portal Structure

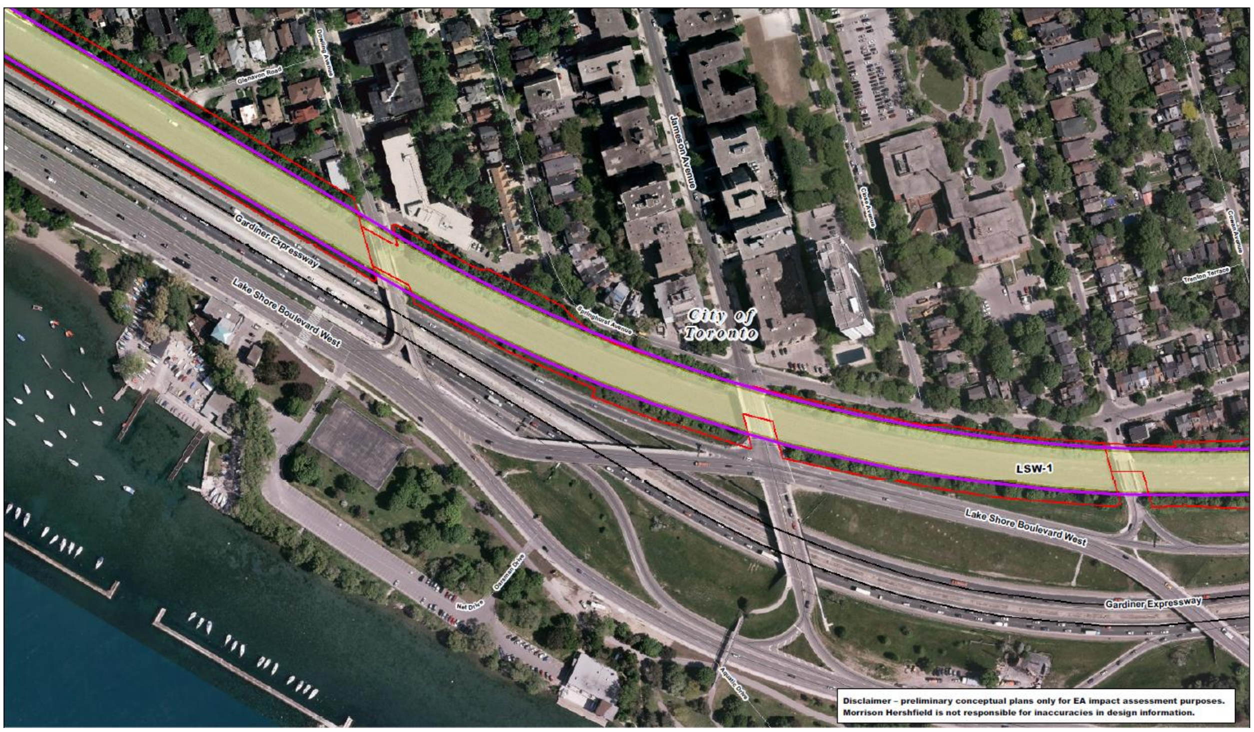
3.6.3 OCS Impact Zone

For purposes of assessing potential impacts as part of the TPAP, a conservative OCS Impact Zone was established that reflects an area spanning the tracks to be electrified plus a 5 metre offset from the centerline of the outermost track to be electrified on either side of each rail corridor. This impact zone accounts for the following OCS elements:

- OCS pole foundations;
- Portal/cantilever poles;
- Grounding and bonding requirements; and
- Contact, autotransformer, and feeder wires.

A series of plans were prepared depicting the OCS Impact Zone for each corridor and have been included as **Appendix N** to this EPR. A sample has been provided for reference in **Figure 3-25.**

Figure 3-25: Conceptual Electrification Corridor Plans Sample



3.6.4 Vegetation Clearing Zone

A Vegetation Clearing Zone is required in order to provide safe electrical clearances to any existing vegetation along the rail corridors. The Vegetation Clearing Zone entails vegetation removals within the area encompassed by the overhead contact system/2 X 25 kV feeders plus an additional 2 metre offset area on either side of the OCS components or 2 X 25 kV feeders. As a result, the total clearing area is defined as 7m measured from the centerline of the outermost tracks to be electrified on either side of each rail corridor. The 7m zone is considered a maximum removal zone; during detailed design, the 7m zone may be reduced in certain areas where/if possible based on the final design.

Vegetation clearing is required to:

- Minimize the risk of tree limbs falling on the track or overhead wires, thus potentially causing a conflict with the electrified system resulting in loss of service and revenue.
- Accommodate a mandatory clearance zone to ensure maintenance workers are safe when working in an electrified environment;

The project will comply with the *European standard EN50122-1:211+A1:2011 (E) Paragraph 5.2.6: Railway Applications - Fixed installations.* This European Standard specifies requirements for the protective provisions relating to electrical safety in fixed installations associated with alternating current (AC) traction systems and to any installations that can be endangered by the traction power supply system.

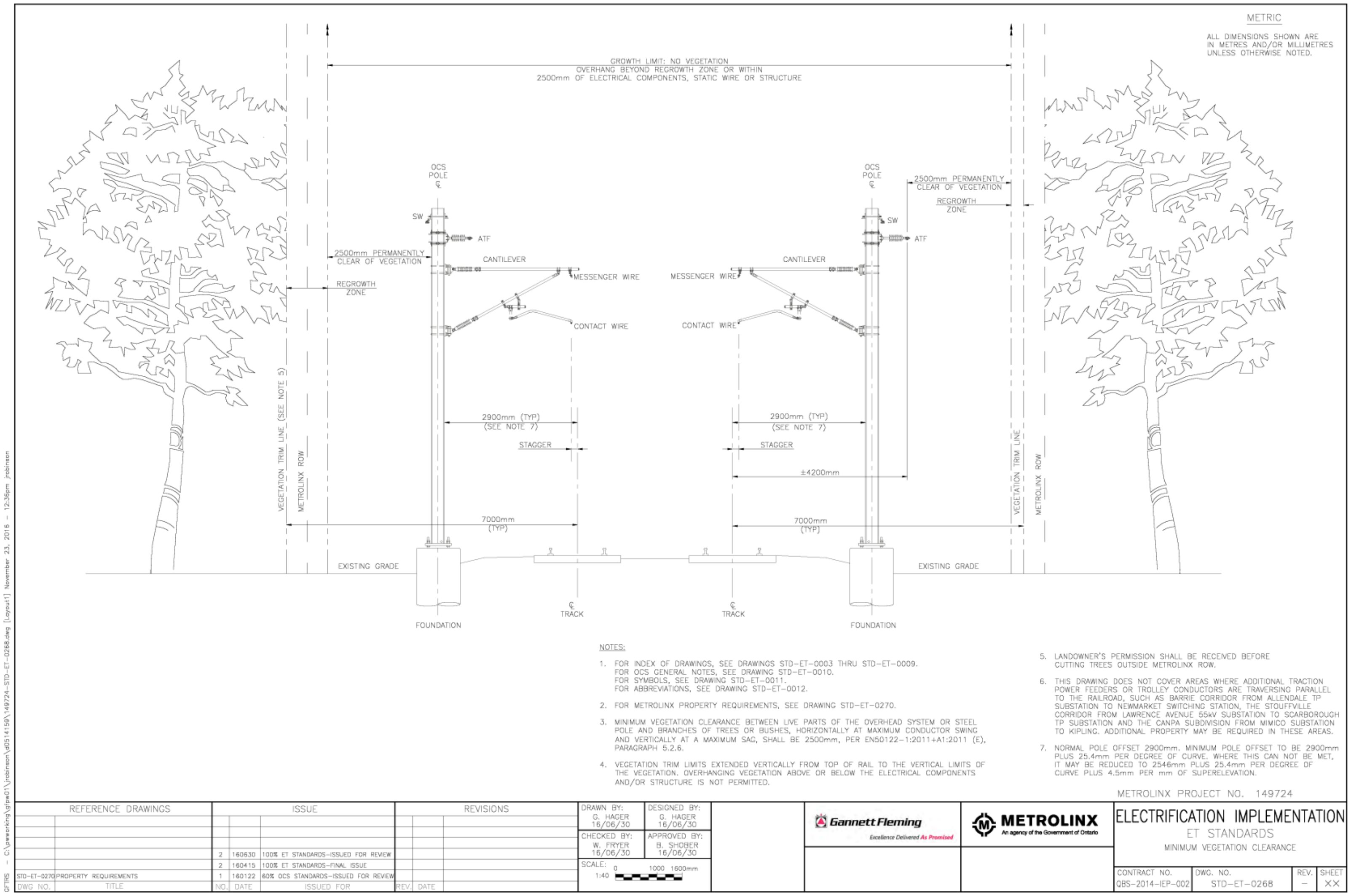
The 7 m vegetation clearing zone is made up of (see **Figure 3-26)**:

- 2.9 m clearance from the track to the OCS pole to ensure clearance of the train to the OCS pole.
- 2.5 m vegetation clearance from the electrical components to the limits of the trees.
- Up to 1.6 m to account for tree grow back (regrowth zone).

A series of conceptual plans were prepared depicting the Vegetation Clearing Zone for each corridor and have been included as Appendix N to this EPR.

Trees and vegetation within and adjacent to Metrolinx rail corridors consist of various levels of canopy/vegetation cover that vary by corridor and by specific areas along each corridor depending on whether the surrounding setting is either urban, rural, agricultural, industrial, etc. The vegetation/tree removal impacts have been documented in detail in EPR Volume 3.

Figure 3-26: Typical Tree Removal Drawing



3.6.5 Traction Power Substations

The electrified GO Transit Network will be a 2 x 25 kV AC autotransformer fed electrification system which will be connected directly to a high voltage system. The Traction Power Substations (TPS) will transform the utility supply voltage of 230 kV to 2 x 25 kV for distribution to the electric trains via the OCS.

The TPS facilities will contain the following components/equipment as depicted in **Figure 3-27:**

- Substation equipment (approximate footprint size 75 m X 50 m) including breakers, switchgear two main transformers of 45 MVA capacity each;
- Two Metrolinx tap structures in or immediately adjacent to the TPS. These structures will be approximately $10m^2$, up to 30m tall;
- Lighting;
- Gantries;
- Fencing;
- Aerial feeders connecting to the OCS; and
- Access route.

Figure 3-27: Typical Traction Power Substation

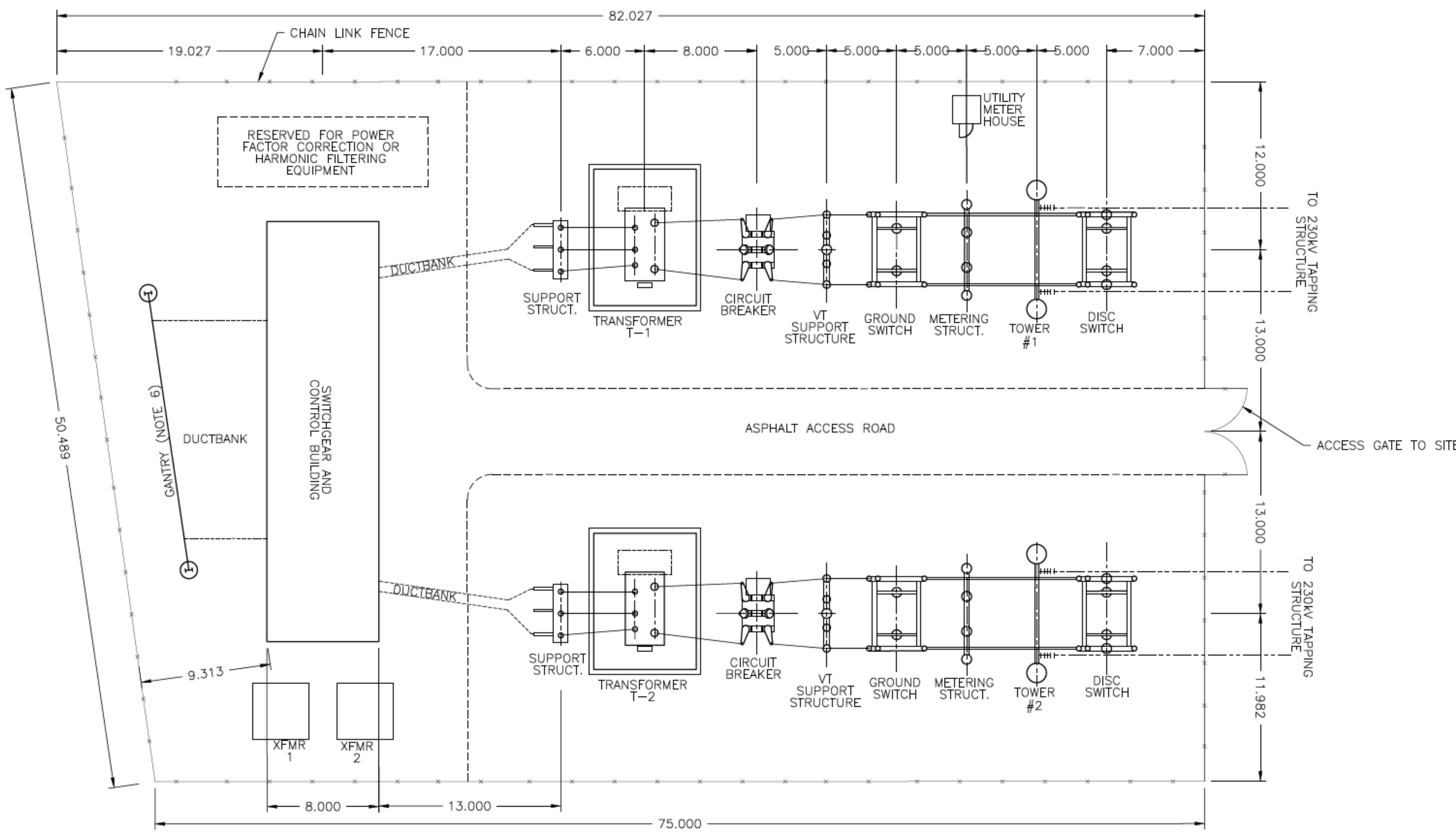


Figure 3-28: Example of a Traction Power Substation

There are five TPS facilities required as part of the GO Rail Network Electrification undertaking, which are further elaborated on below in Sections 3.6.9 – 3.6.13.

3.6.6 2 X 25kV Feeder Routes

In cases where a connection is needed to distribute power between two traction power facilities (e.g., between a TPS and SWS) or where a connection is needed to distribute power between a traction power facility and a Metrolinx rail corridor, 2 X 25kV feeder routes are required. There are four cases where this is required as described in the following subsections.

3.6.6.1 Canpa Feeder Route

The Canpa 2X25kV Feeder route will connect the Mimico Tap/TPS to the Mimico SWS as shown in **Figure 3-30**. The Canpa feeder route will commence at the Mimico TPS location and will run south via aerial cables along the Canpa Rail ROW to the Mimico SWS site. The aerial feeder will be supported by poles similar to typical hydro poles. The Canpa Rail ROW is owned by Metrolinx. **Figure 3-31** shows a typical 2 X 25kV aerial installation.

The installation of the Canpa feeder route the Gardiner Expressway and Queensway (which are owned/maintained by City of Toronto) will require mechanical fastening of feeder cable due to the existing bridge clearance and width of multi lane bridges. See **Figure 3-29.**

Figure 3-29: Typical Fastening of a Feeder Cable

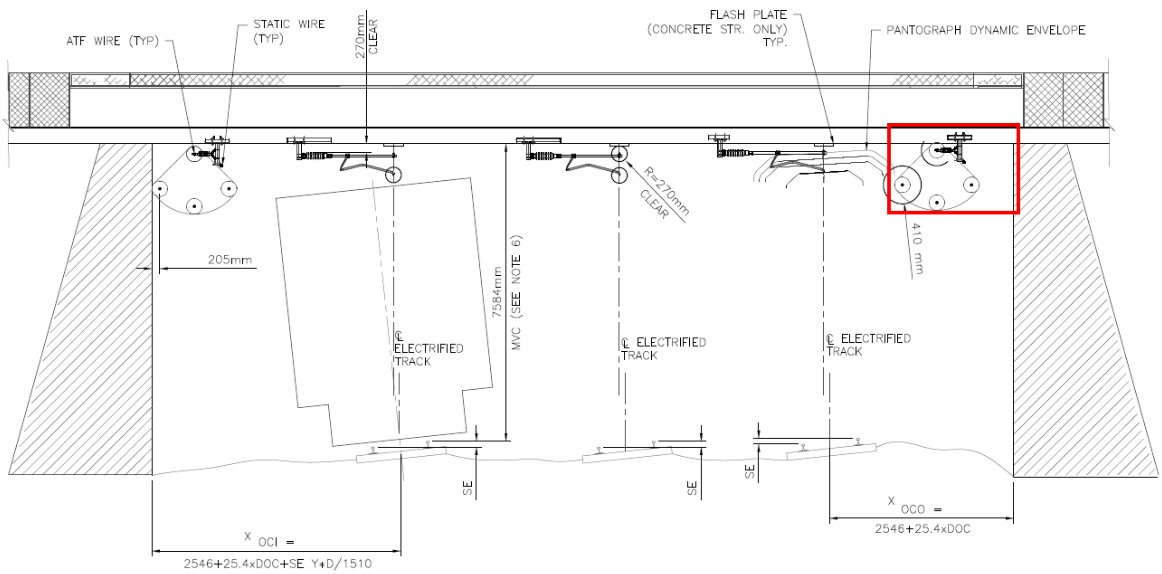
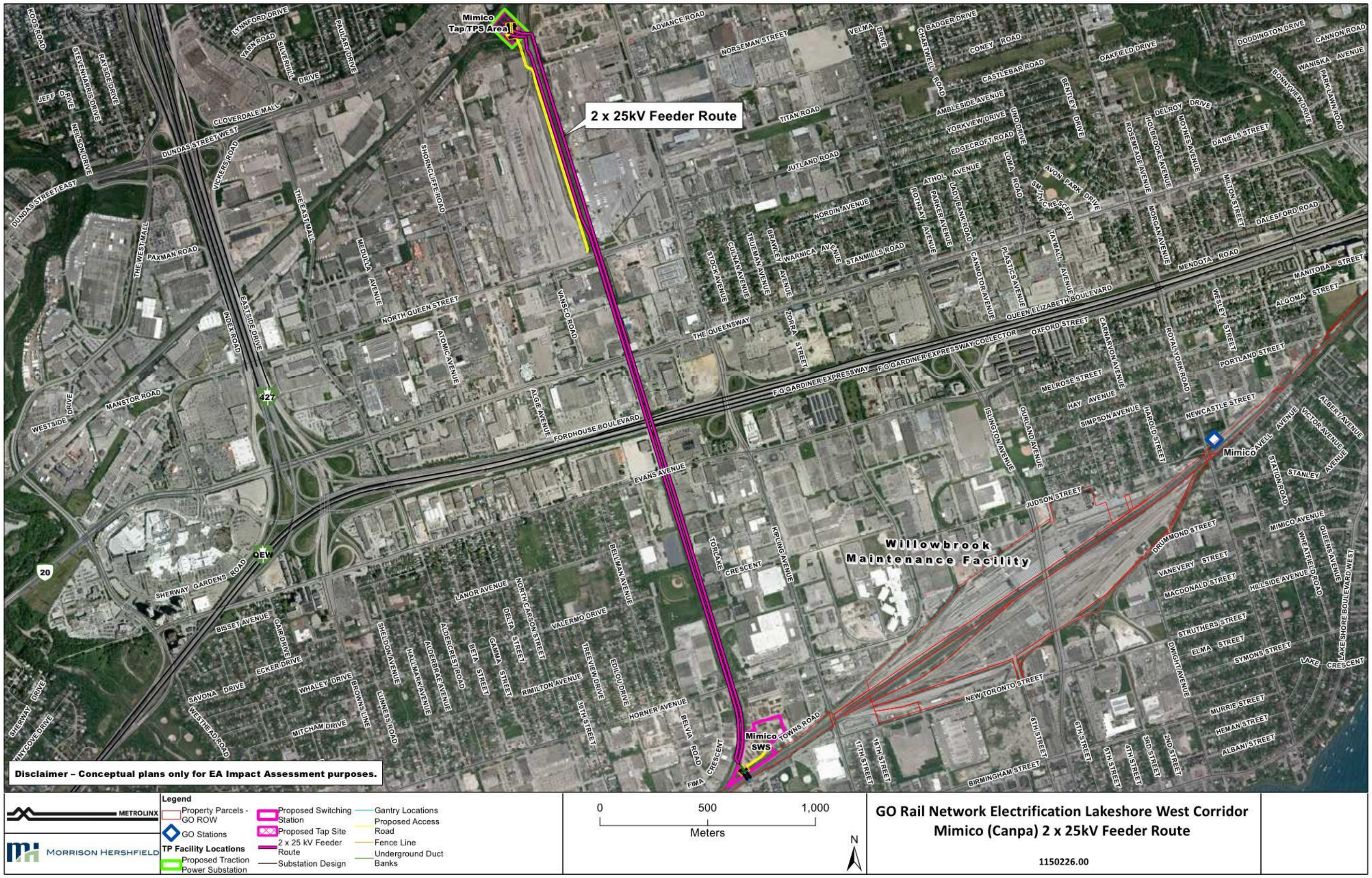


Figure 3-30: Canpa 2X25kV Feeder Route



3.6.6.2 Bramalea 2X25kV Feeder Route

The Bramalea 2X25kV Feeder route (see **Figure 3-32**) will connect the Bramalea PS along the GO Kitchener rail corridor to limit of Kitchener GO rail corridor electrification (i.e., just beyond Bramalea GO Station). **Figure 3-31** shows a typical 2 x 25kV aerial installation. Agreements or easements from CN will be required in order to implement this project components as part of detailed design/implementation.

Figure 3-31: Typical 2X25kV Feeder Arrangements

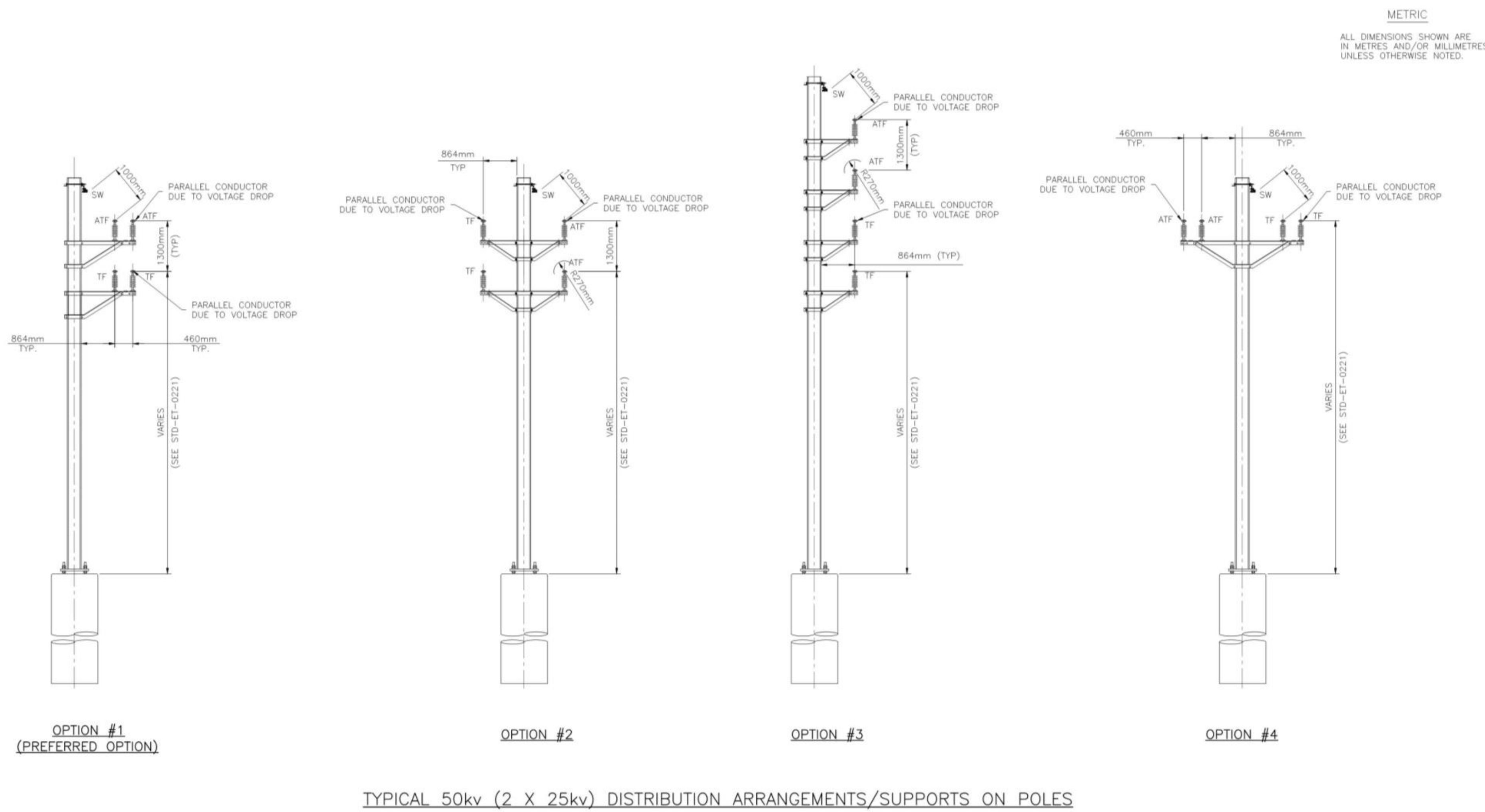
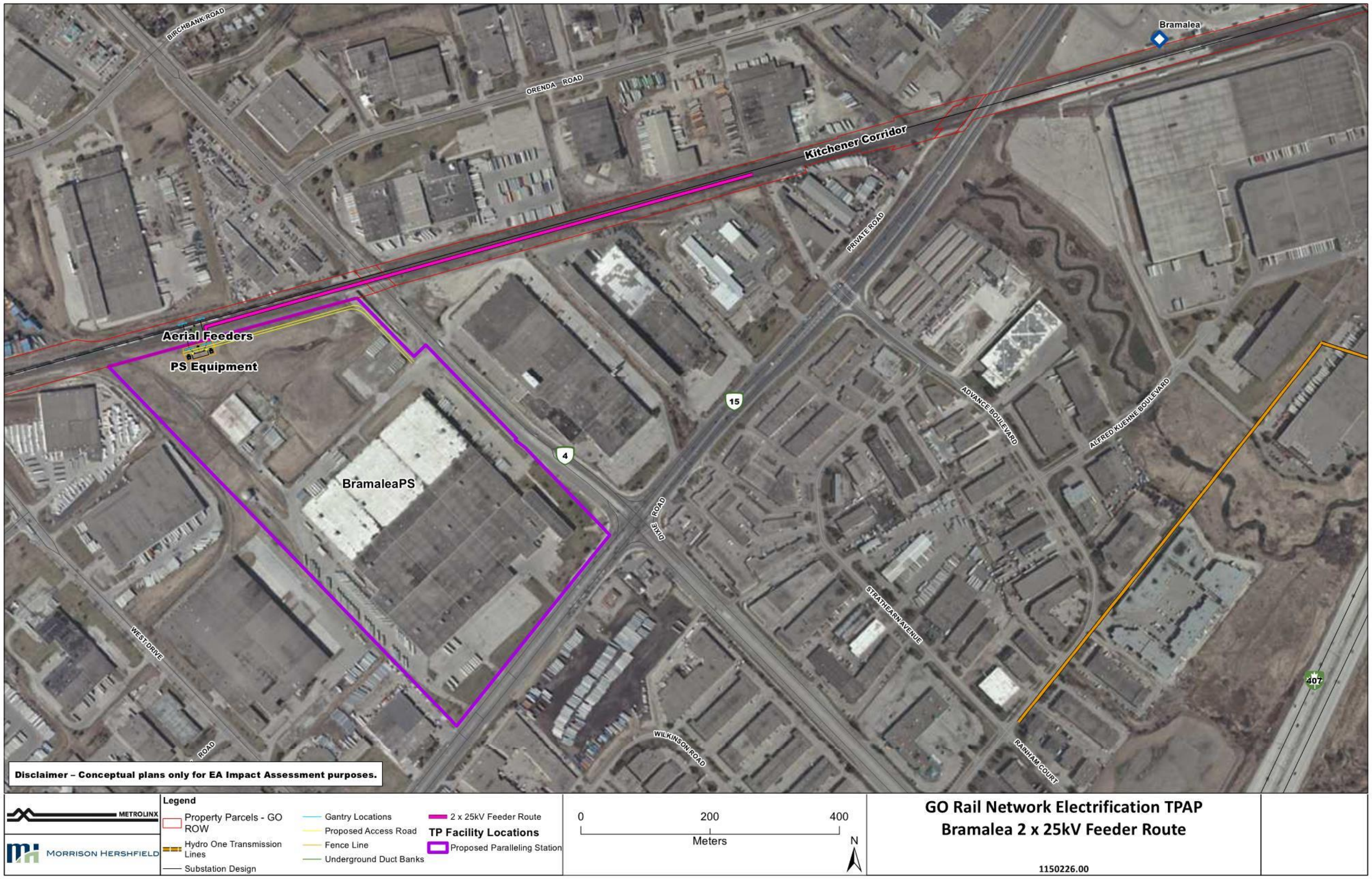


Figure 3-32: Bramalea 2X25kV Feeder Route9



3.6.6.3 Barrie-Collingwood 2X25kV Feeder Route

The Barrie-Collingwood feeder route (see **Figure 3-34**) will commence at the Allandale TPS location and will run east along the Barrie-Collingwood Railway (BCRY) ROW under Highway 400 (which will require mechanical fastening of feeder cable) to the termination limit of electrification on the Barrie Corridor (i.e. Allandale Waterfront GO Station). During detailed design, either the aerial or underground cable design option will be confirmed. The BCRY is not owned by Metrolinx, therefore an agreement will be required from the City of Barrie for the installation of the feeder route along the rail ROW. **Figure 3-31** shows a typical 2 x 25kV aerial installation and **Figure 3-33** shows a typical 2 X 25kV underground installation.

For the Barrie Collingwood Feeder Route, it should be noted that if the aerial option is implemented, attachment of the feeder cabling to the underside of the 400 bridge structure is anticipated to be required (see **Figure 3-29**).

Figure 3-33: Typical Underground 25kV Feeder Route

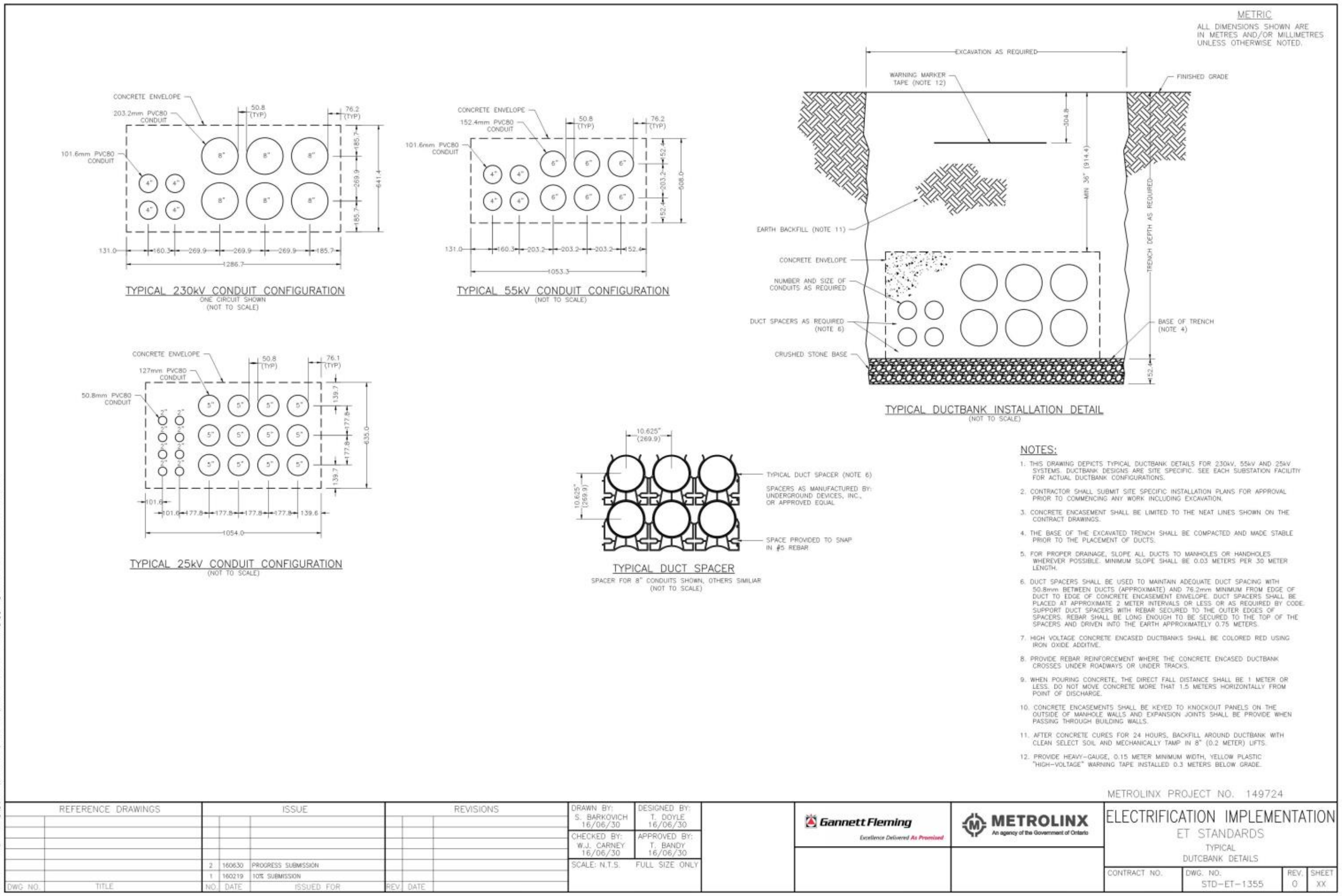
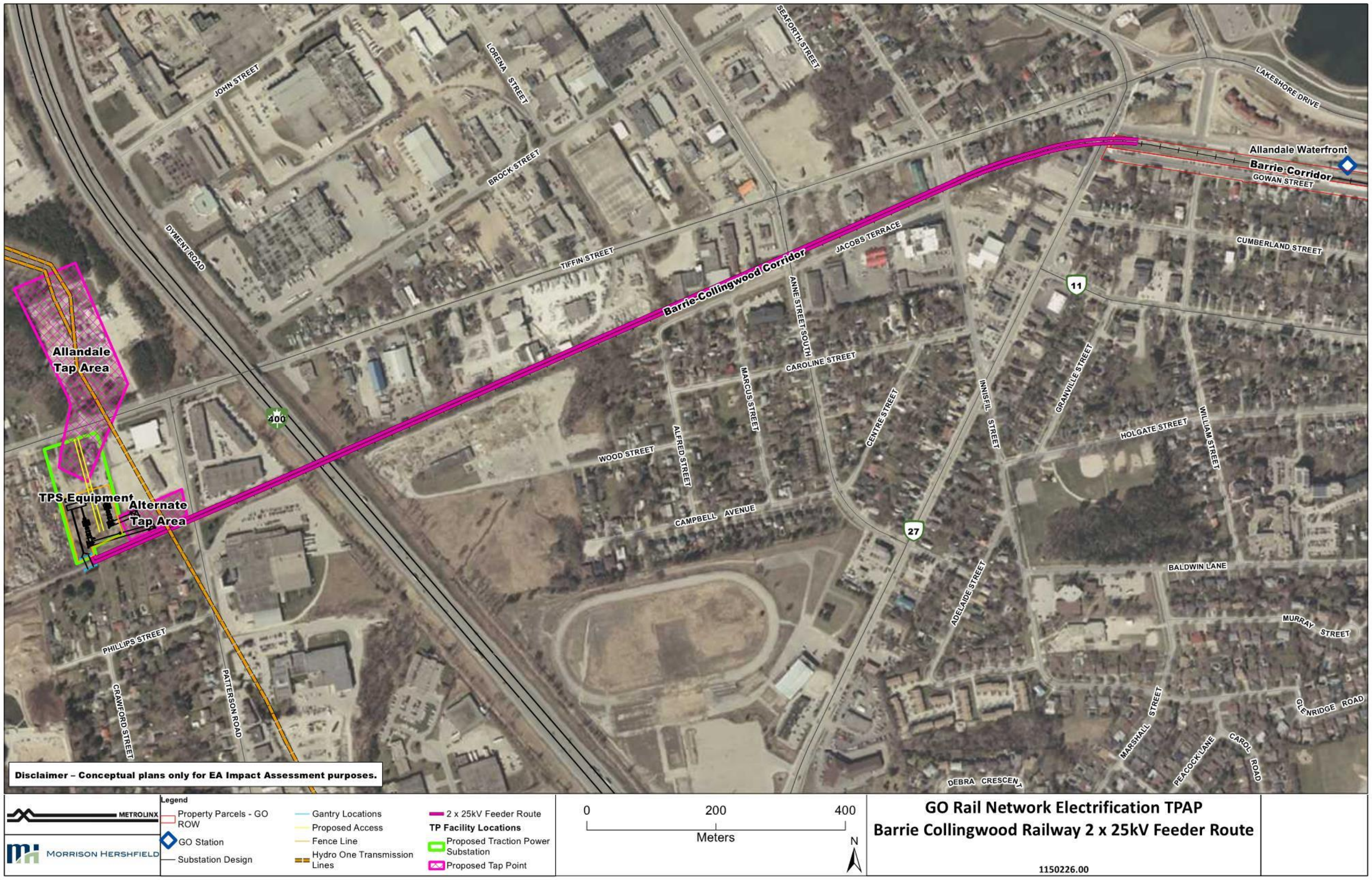


Figure 3-34: Barrie Collingwood Railway 2X25kV Feeder Route



3.6.6.4 Scarborough 2X25kV Feeder Route

The Scarborough feeder route will commence at the Scarborough TPS location and will run south via aerial cables mounted on top of the proposed OCS along the Stouffville corridor to the point where the Stouffville corridor converges with the Lakeshore East Corridor (see **Figure 3-35**). From there the 2 X 25kV feeder route continues east along the Lakeshore East Corridor where it connects into the Scarborough SWS (see **Figure 3-36**).

Figure 3-35: Typical 2X25kV Aerial Feeder Route & OCS

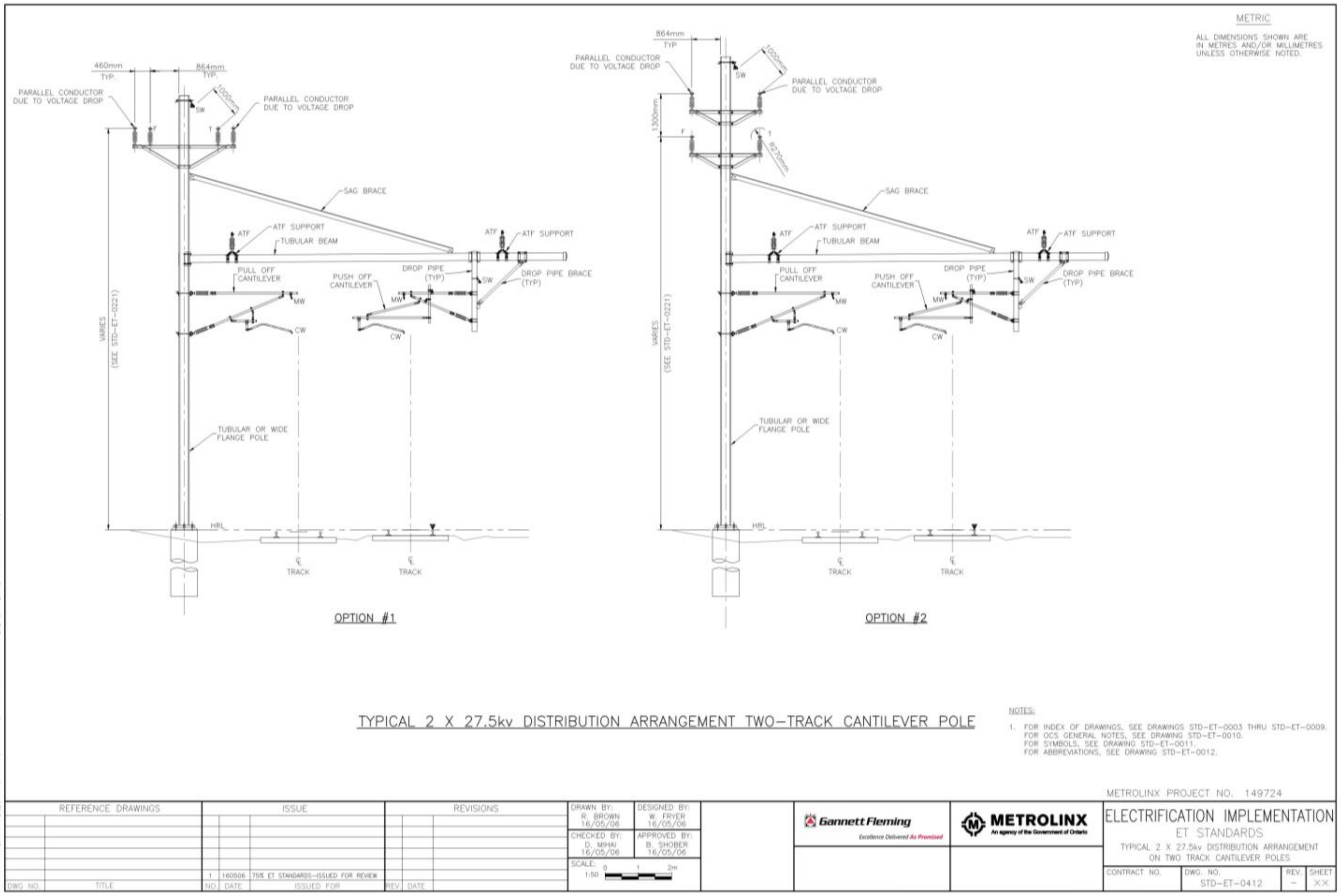
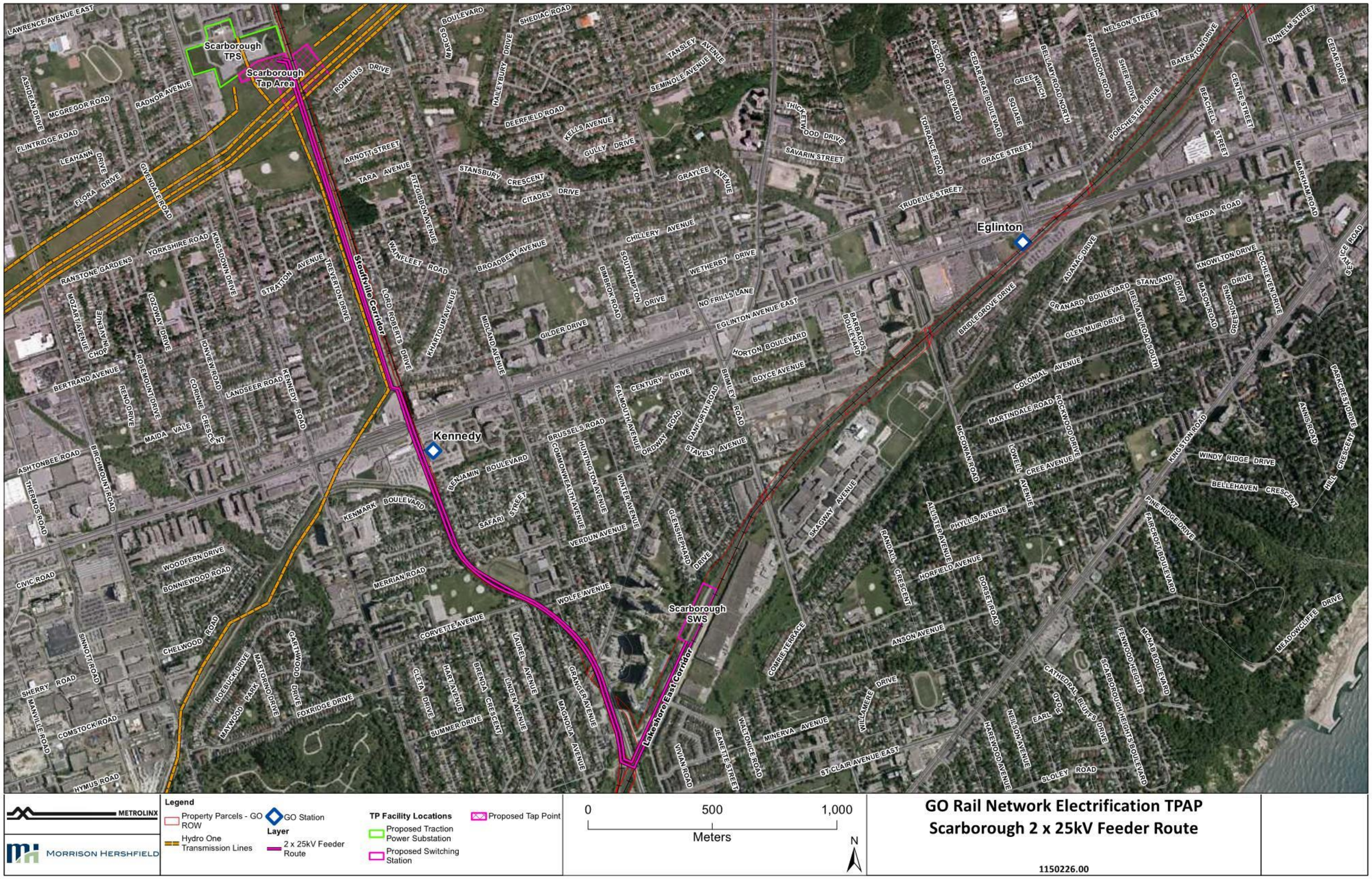


Figure 3-36: Scarborough 2X25kV Feeder Route



3.6.7 Switching Stations

Switching Stations (SWS) are traction power facilities that are located between Traction Power Substations (TPS) to segregate power flow on the network. This is necessary to manage the utility power that supplies the railroad systems. Under normal operating conditions, the two supplies are separated by phase breaks. The SWS enables electrical energy to be supplied to an adjacent but normally separated electrical section during contingency power supply conditions. In the event there is a utility outage or failure of a supply transformer, the breakers/switches at the SWS can be closed to continue to supply power to the trains and maintain operational service for the public.

The following equipment is associated with the SWS facilities as depicted in **Figure 3-37**:

- SWS equipment (requiring an approximate footprint size of 22m X 55 m) including two 15 MVA autotransformers, medium voltage switchgear for connections to the OCS.
- Gantries;
- Lighting;
- Fencing;
- Aerial or underground feeders connecting to the OCS;
- Access route.

There are four SWS facilities required as part of the GO Rail Network Electrification undertaking, which are further detailed below in **Sections 3.6.9 – 3.6.13**.

Figure 3-37: Typical Switching Station

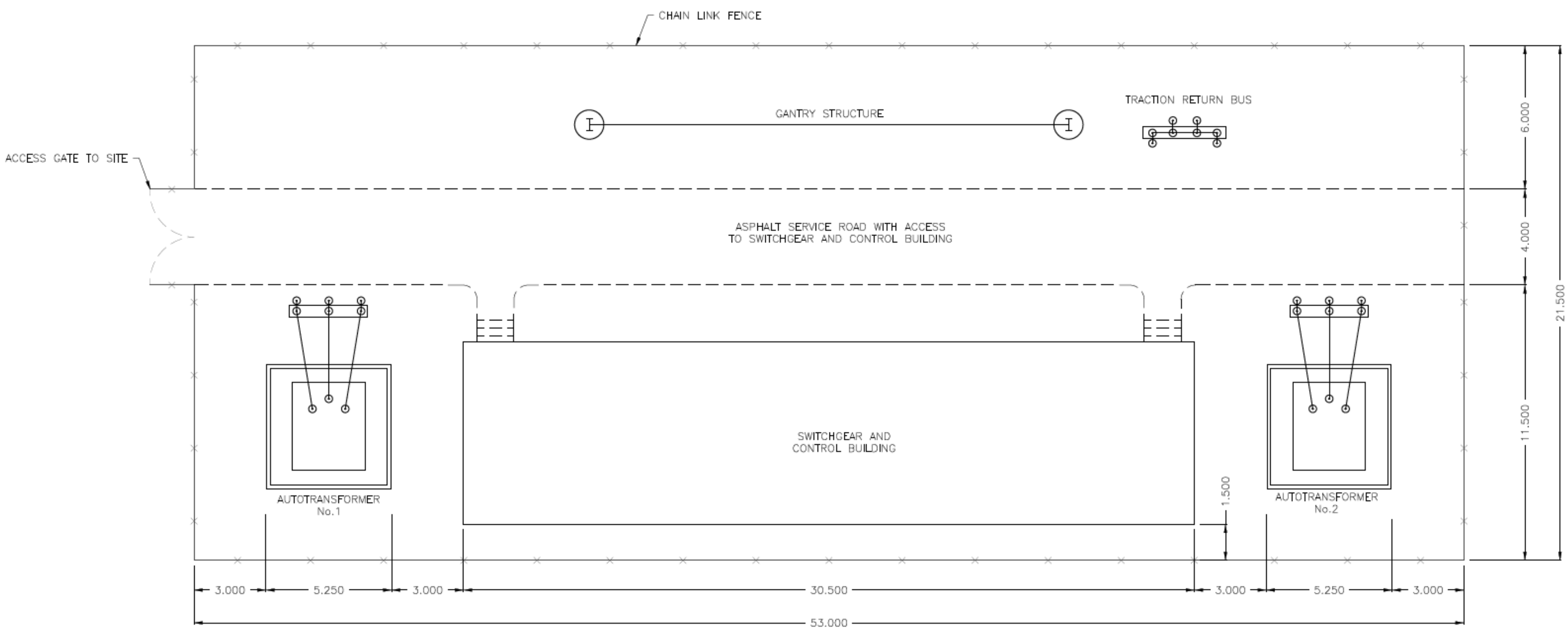


Figure 3-38: Example of a Switching Station

3.6.8 Paralleling Stations

Each Paralleling Station (PS) will contain two 15 MVA autotransformer that helps support the OCS voltage in the electrified system. As the train moves away from the source of power, the OCS voltage drops. Electric trains can only operate if the OCS voltage remains within acceptable limits. In addition, these facilities help reduce flow of return current in rails and therefore contribute to the overall safety of the system.

The following equipment is associated with the PS facilities as depicted in **Figure 3-39**:

- PS equipment (requiring an approximate footprint size of 22m X 47 m) including two 15 MVA autotransformer, medium voltage switchgear for connections to the OCS.
- Gantries;
- Lighting;
- Fencing;
- Aerial or underground feeders connecting to the OCS;
- Access route.

There are six (6) PS facilities required as part of the GO Rail Network Electrification undertaking, which are further elaborated on in **Sections 3.6.9 – 3.6.13**. It is noted that two additional PS facilities are required at the Eglinton and Ordnance locations on the Kitchener corridor, however these facilities were previously assessed as part of the UP Express Electrification TPAP (2014).

Figure 3-39: Typical Paralleling Station

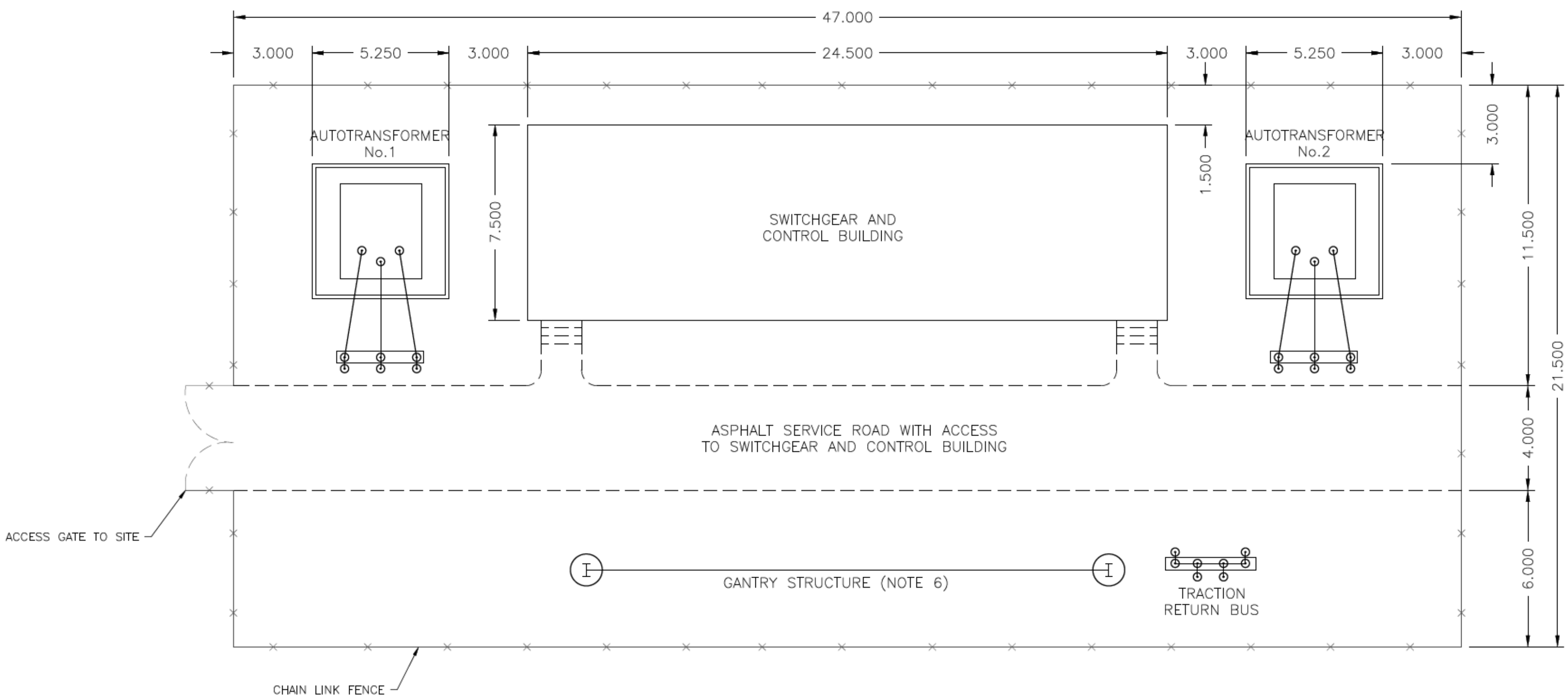


Figure 3-40: Example of a Paralleling Station

3.6.9 Traction Power Facilities – Union Station Rail Corridor

There are no traction power facilities proposed in the vicinity of the USRC.

3.6.10 Traction Power Facilities – Lakeshore West Corridor

3.6.10.1 Mimico TPS

The Mimico TPS location is located approximately 3 km north of the Lakeshore West Corridor, in the City of Toronto on lands adjacent to the Milton Corridor (**Figure 3-41**). The site is also approximately 110 m west of the existing Manby Transformer Station. The site primarily consists of vacant lot / open space, with a building and associated parking lots/storage areas. It is in an area generally characterized by rail infrastructure and commercial/industrial buildings, with no recreational amenities nearby.

3.6.10.2 Mimico SWS

The Mimico SWS is to be located on a parcel of land (**Figure 3-42**) at 36 Towns Road in Toronto, just west of the GO Transit Willowbrook Rail Maintenance Facility and north of the rail corridor. Towns Road is an industrial cul de sac, and the parcel is surrounded by industrial development. The parcel is currently being used as an industrial storage area, with some vegetation cover adjacent to the rail corridor.

Based on the conceptual design, the proposed positioning of the SWS within this parcel is adjacent to the rail corridor and is currently storage area and vegetation (**Figure 3-42**).

3.6.10.3 Burlington TPS

The Burlington TPS is to be located on a parcel of land (**Figure 3-43**) situated west of Cumberland Drive, and includes the existing Hydro One Cumberland Transformer Station (TS). The site is accessed via Cumberland Avenue, which does not cross the railroad and terminates at the existing Hydro One Cumberland TS. The parcel is in the Cumberland TS with associated transmission lines, and open space/vegetation. It is located between a building supply operation to the east and existing Hydro One Cumberland TS to the west.

Based on the conceptual design, the proposed positioning of the TPS is at the southwest corner of the parcel, adjacent to an industrial building, and is currently open space/vegetation (**Figure 3-43**).

3.6.10.4 Oakville SWS

The Oakville SWS is to be located on a parcel of land (**Figure 3-44**) at 560 Maple Grove Drive in Oakville. The site is southeast of the rail corridor and is currently an intermodal facility (parking/storage area), with a shopping plaza and office buildings to the south.

Based on the conceptual design, the proposed positioning of the SWS is at the northwest side of the parcel adjacent to the rail corridor (**Figure 3-44**).

Figure 3-41: Location of Proposed Mimico TPS Site

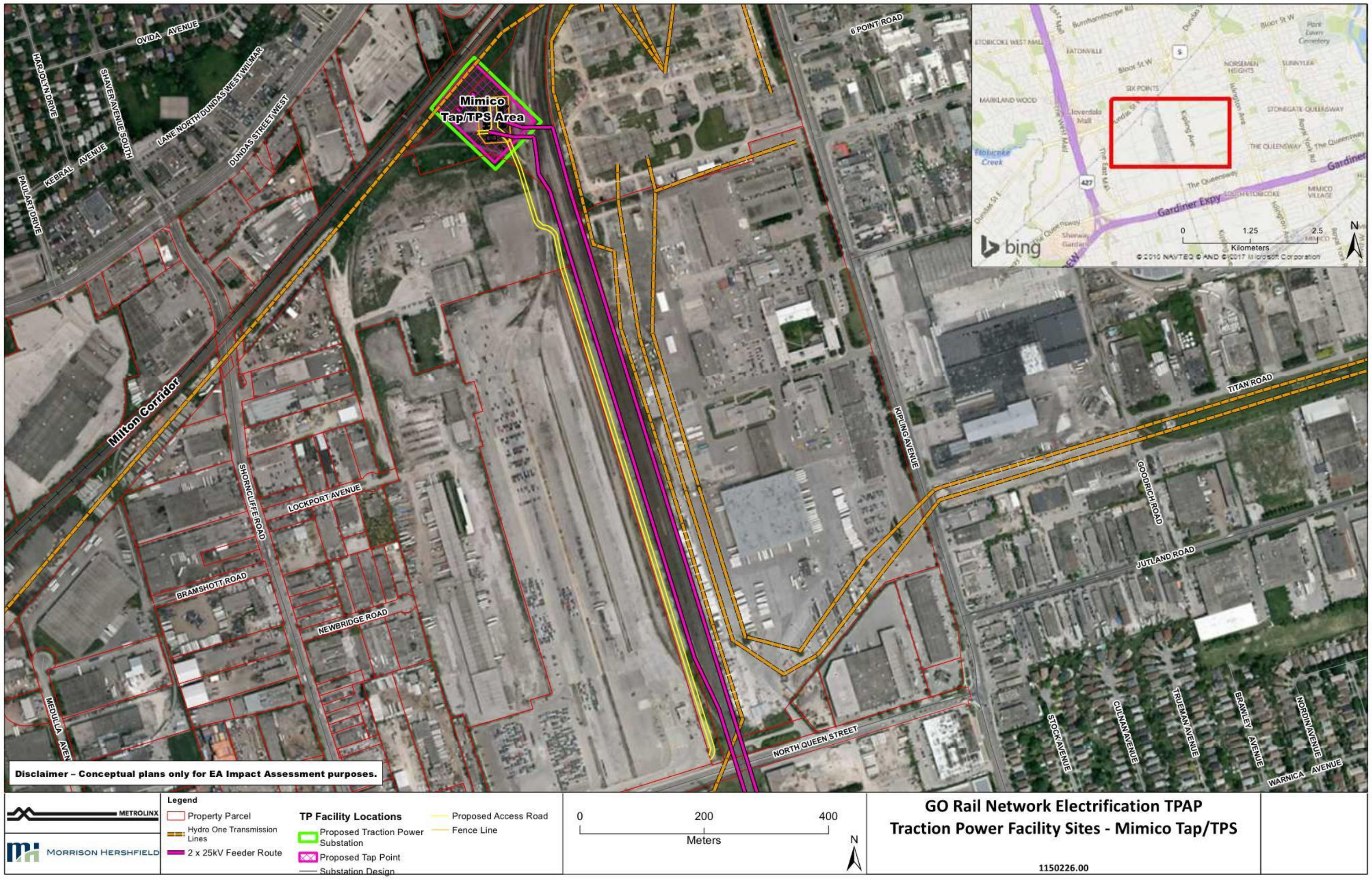


Figure 3-42: Location of Proposed Mimico SWS

Figure 3-43: Location of Proposed Burlington TPS Site

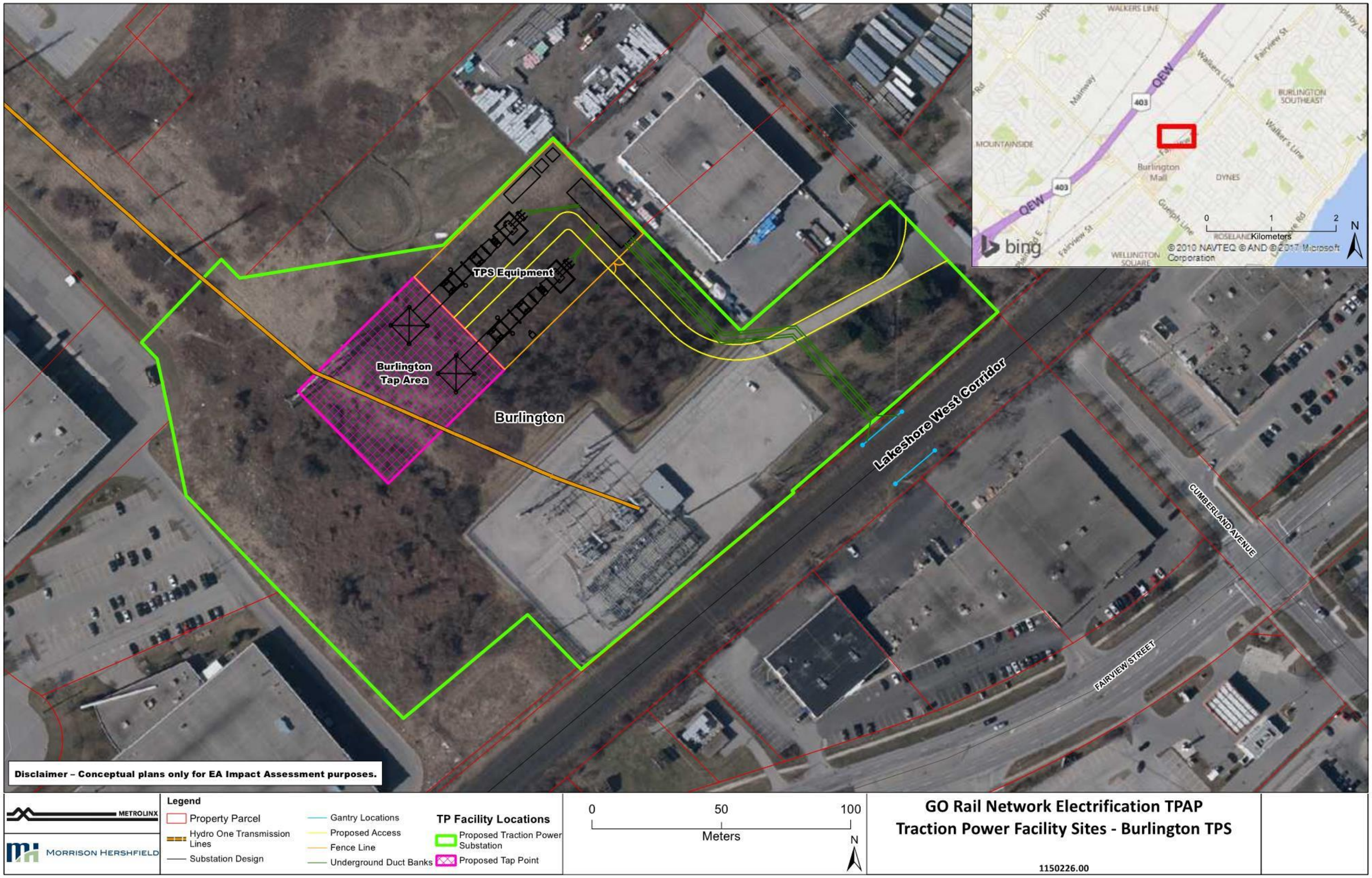
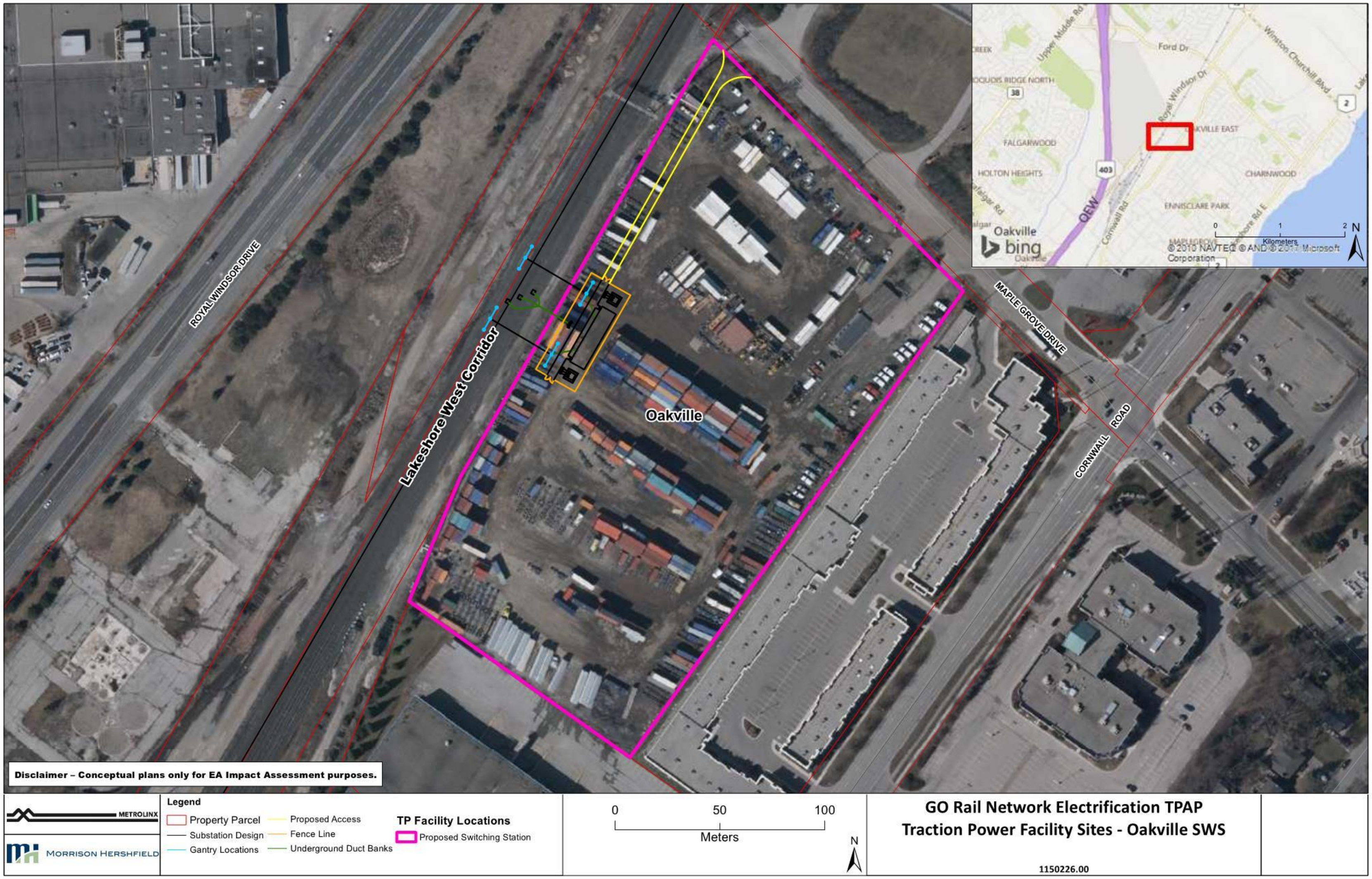


Figure 3-44: Location of Proposed Oakville SWS Site



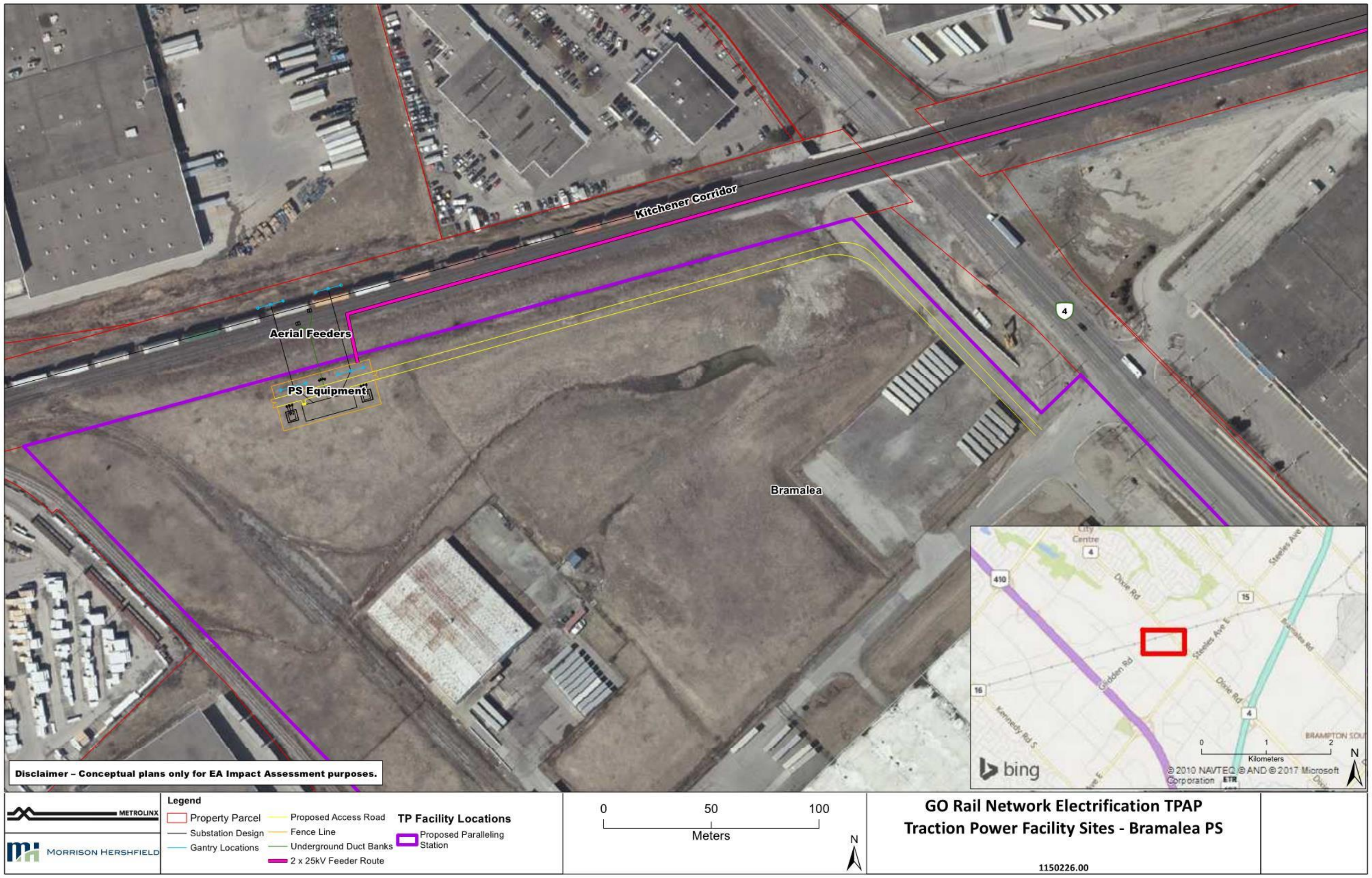
3.6.11 Traction Power Facilities – Kitchener Corridor

3.6.11.1 Bramalea PS

The Bramalea PS is to be located on a parcel of land (**Figure 3-45**) situated at the southwest corner of Dixie Road and the rail corridor in Brampton. The parcel currently consists of vacant land, a silo, and the warehouses and parking lots of the Ford Parts and Distribution Centre. It is surrounded by other commercial uses.

Based on the conceptual design, the proposed positioning of the PS facility is at the northern edge of the parcel adjacent to the rail corridor, in an area that is currently vacant (**Figure 3-45**).

Figure 3-45: Location of Proposed Bramalea PS Site



3.6.12 Traction Power Facilities – Barrie Corridor

3.6.12.1 Allandale TPS

The Allandale TPS is to be located on a parcel of land (**Figure 3-46**) situated at the northwest corner of Patterson Road and the Barrie-Collingwood Rail corridor in Barrie. The parcel is currently a vacant lot with industrial facilities to the immediate north, east and west. To the south, on the opposite side of the railroad, there are residential homes.

3.6.12.2 Gilford PS

Gilford PS is to be located on a parcel of land situated at the southeast corner of Gilford Road and the rail corridor in Innisfil. It is comprised largely of open space covered with vegetation and trees. It is surrounded by open space to the west and south, and residential properties to the immediate east of the site.

Based on the conceptual design, the proposed positioning of the PS facility is located at the northeast corner of the parcel, where the rail corridor meets Gilford Road (**Figure 3-47**).

3.6.12.3 Newmarket SWS

The Newmarket SWS is to be located on parcel of land (**Figure 3-48**) at 590 Steven Court in Newmarket. Steven Court is an industrial cul-de-sac east of the rail corridor and south of Mulock Drive. The northern portion of the parcel is currently a public utility building (Newmarket Hydro) and associated parking lot/storage area. The southern portion is open space with some trees and manicured grass. The parcel is surrounded by industrial buildings, with a hydro corridor to the west.

Based on the conceptual design, the proposed positioning of the SWS facility is located in the southern portion of the parcel, and is currently open space/vegetation (**Figure 3-48**).

3.6.12.4 Maple PS

The Maple PS is to be located on a parcel of land (**Figure 3-49**) along the west side of Keele Street, north of Teston Road in the City of Vaughan. The site is surrounded by industrial development to the east and agriculture to the north and west.

Based on the conceptual design, the proposed positioning of the PS facility is located in the southern portion of the triangular parcel, and is currently a vacant lot with active agriculture (**Figure 3-49**).

Figure 3-46: Location of Proposed Allandale TPS

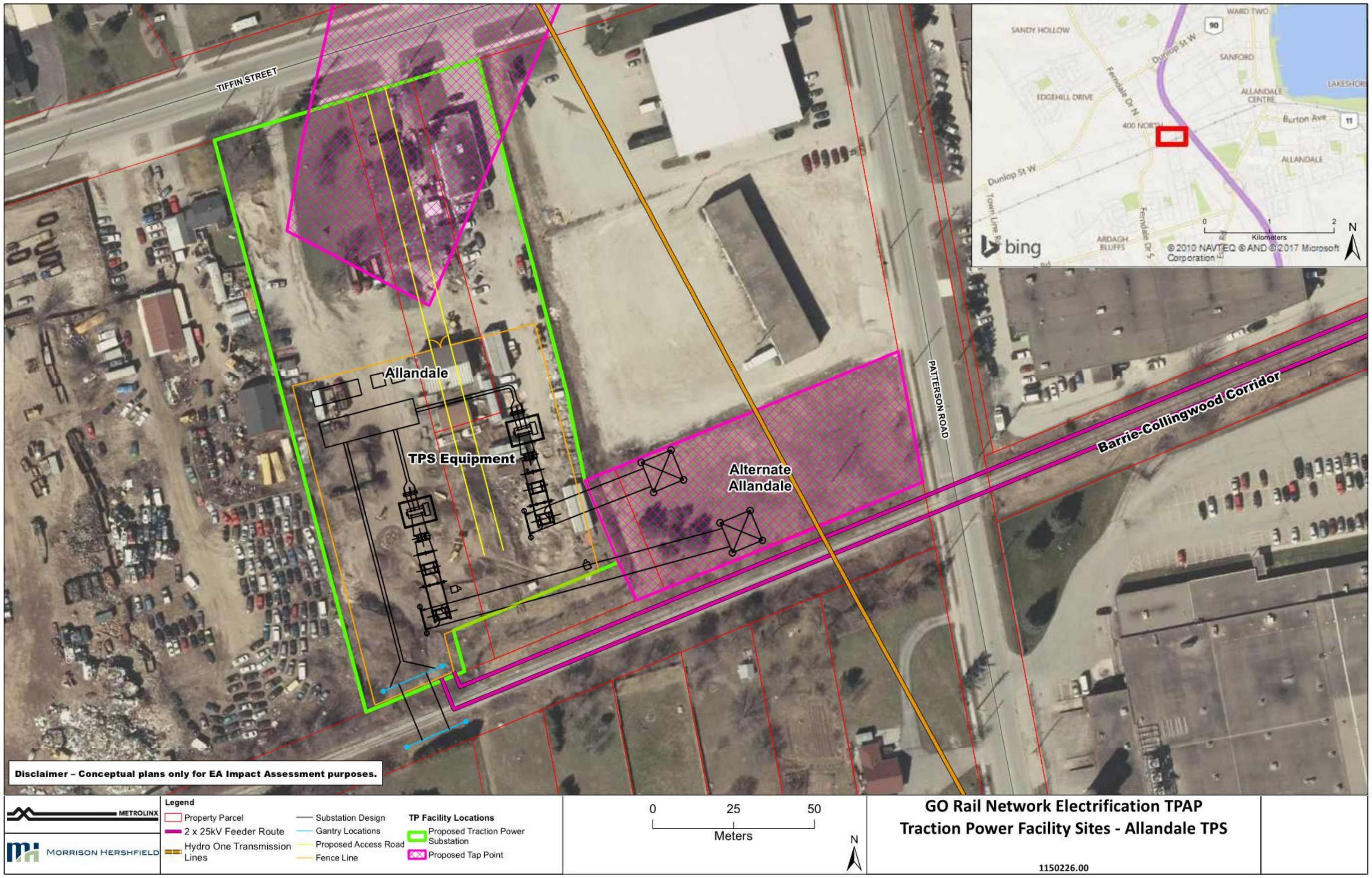


Figure 3-47: Location of Proposed Gilford PS

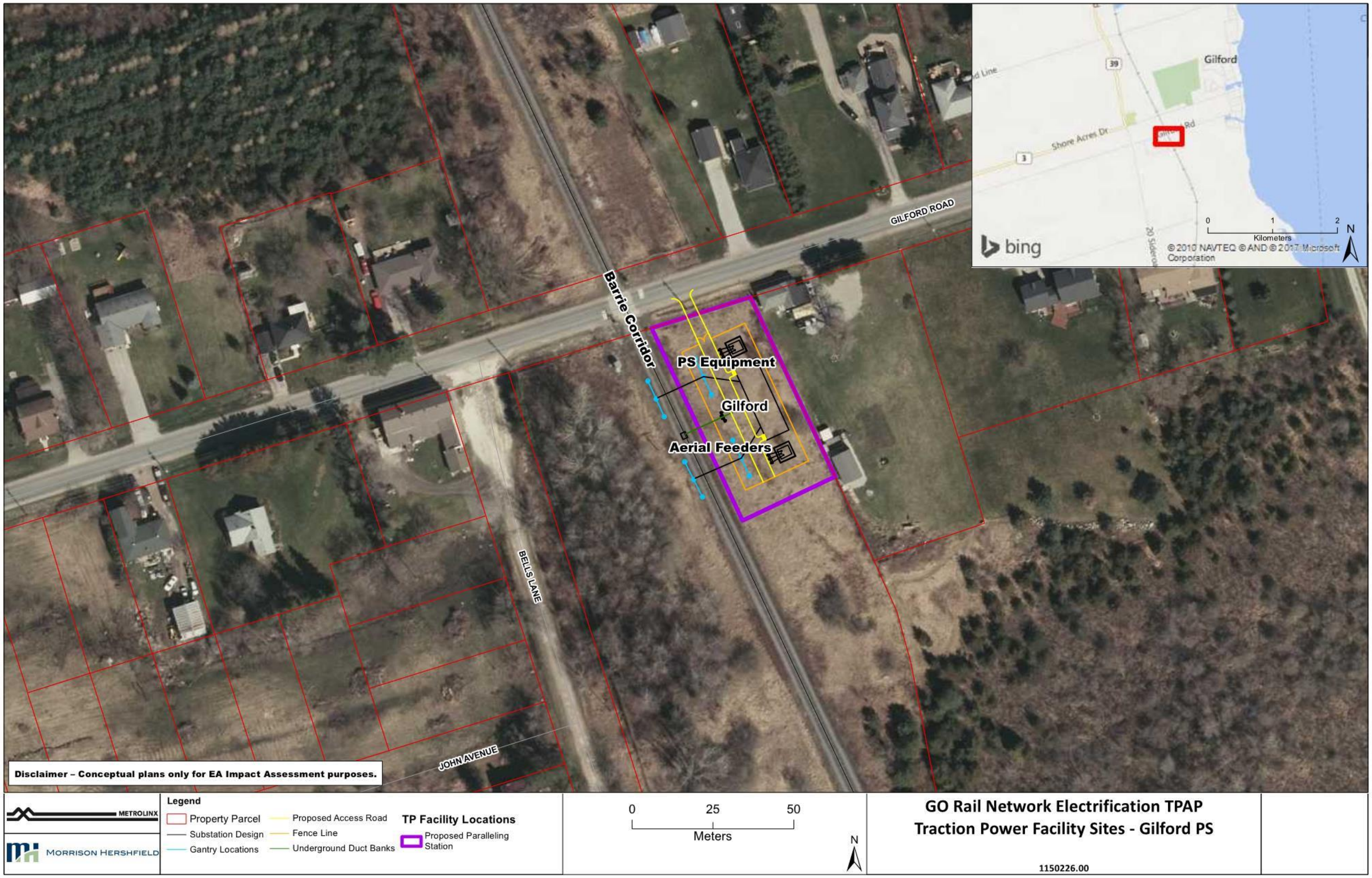


Figure 3-48: Location of Proposed Newmarket SWS

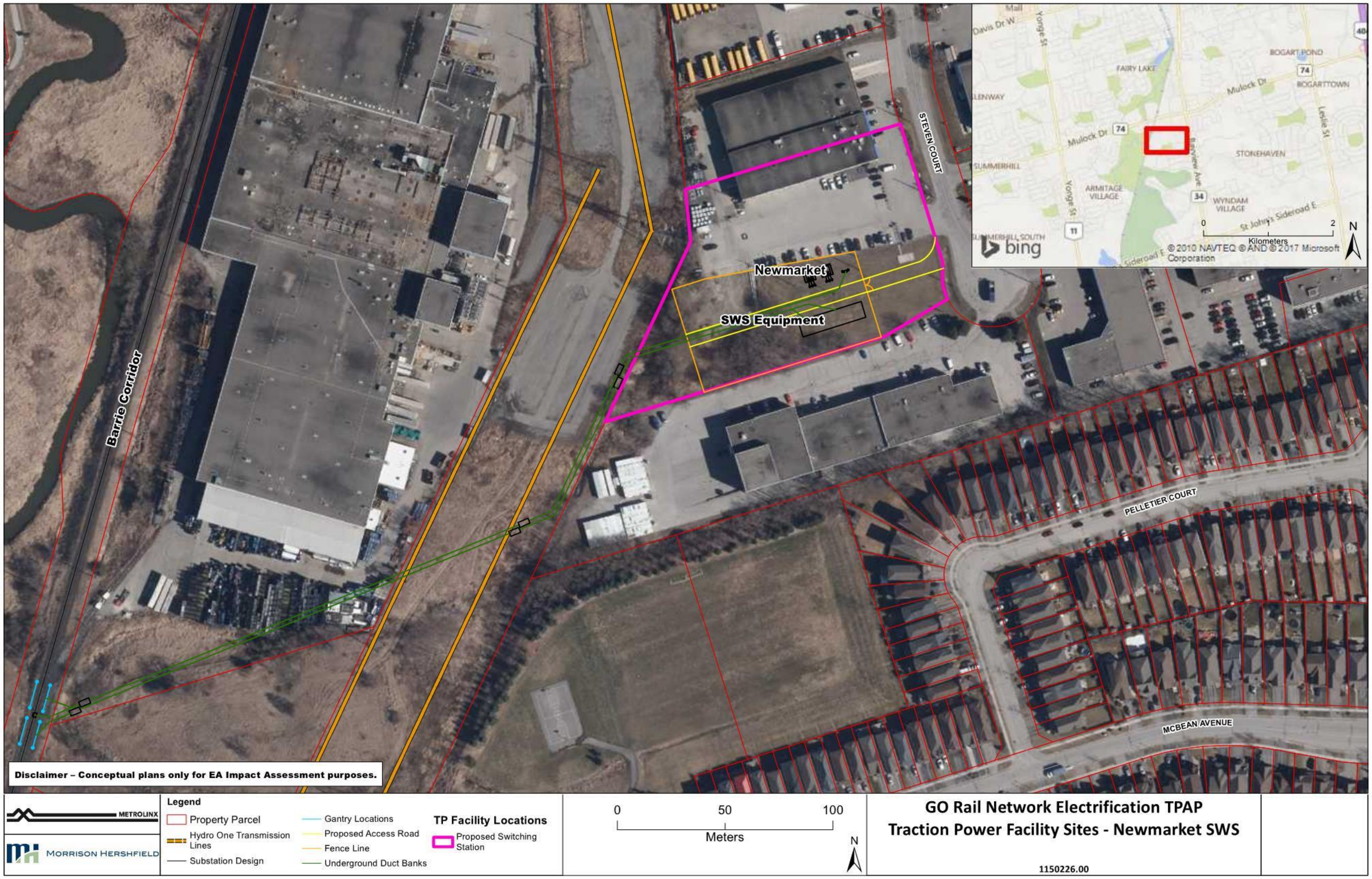
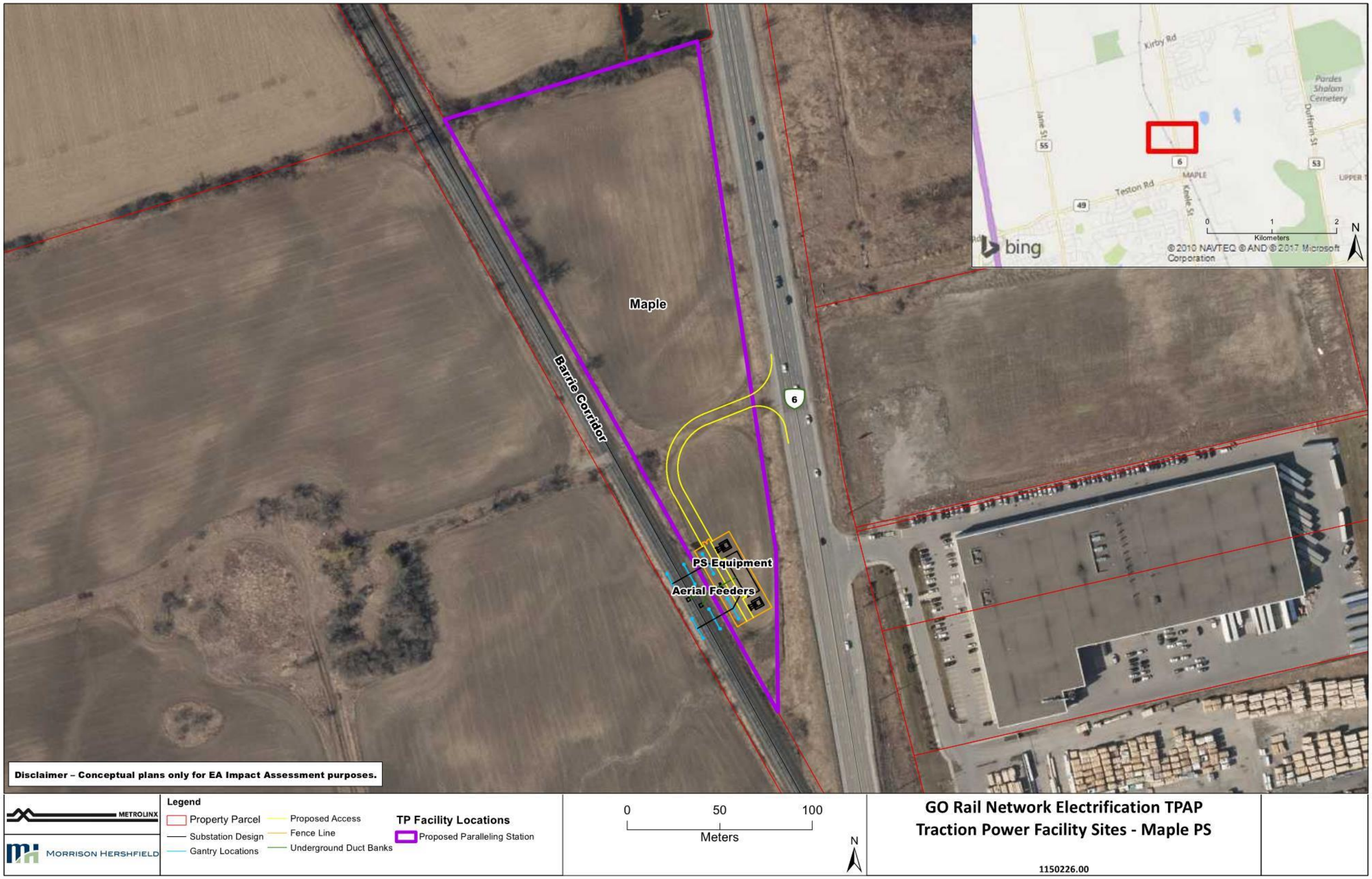


Figure 3-49: Location of Proposed Maple PS



3.6.13 Traction Power Facilities – Stouffville Corridor

3.6.13.1 Scarborough TPS

The Scarborough TPS is to be located on a parcel of land situated on a HONI property southeast of Kennedy Road and Mike Myers Drive (**Figure 3-50**). It is comprised of open space and an existing hydro-electric transformer station. There are also residential areas immediately to the north and west of the site, with hydro corridor/open space and institutional uses to the south/southwest.

Based on the conceptual design, the proposed positioning of the TPS facility is located on the eastern portion of the parcel, adjacent to the rail corridor (**Figure 3-50**).

3.6.13.2 Unionville PS

The Unionville PS is to be located on a parcel of land (**Figure 3-51**) that is currently (mainly) open space / vacant lot located to the south of Highway 407, with the Stouffville GO rail corridor to the west.

Based on the conceptual design, the proposed positioning of the PS facility is adjacent to the rail corridor just south of Highway 407, and is currently a vacant lot (**Figure 3-51**).

3.6.13.3 Lincolnville PS

The Lincolnville PS is to be located on a parcel of land (**Figure 3-52**) at 13120 York Durham Line in Whitchurch-Stouffville. The parcel is primarily a vacant lot immediately north of the Lincolnville GO station behind the GO Transit Lincolnville Rail and Bus Facility, and includes parts of the rail and bus facility, driveway to the GO station parking lot, and the rail corridor. The parcel is surrounded by the Lincolnville GO Station / rail and bus facility and associated structures, rail corridor, and agricultural fields.

Based on the conceptual design, the proposed positioning of the PS facility is adjacent to the rail corridor, and is currently a vacant lot (**Figure 3-52**).

Figure 3-50: Location of Proposed Scarborough Tap/TPS

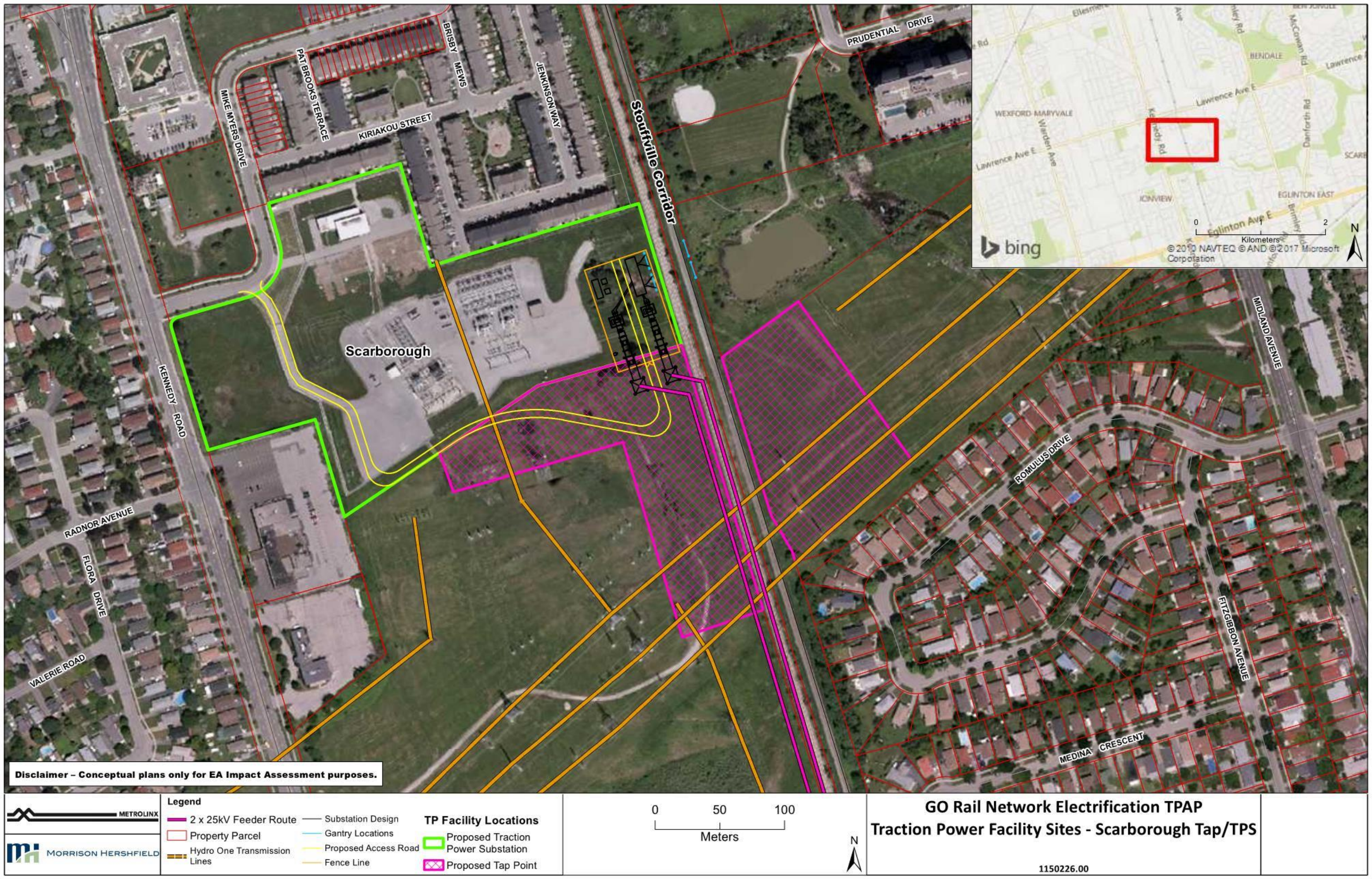
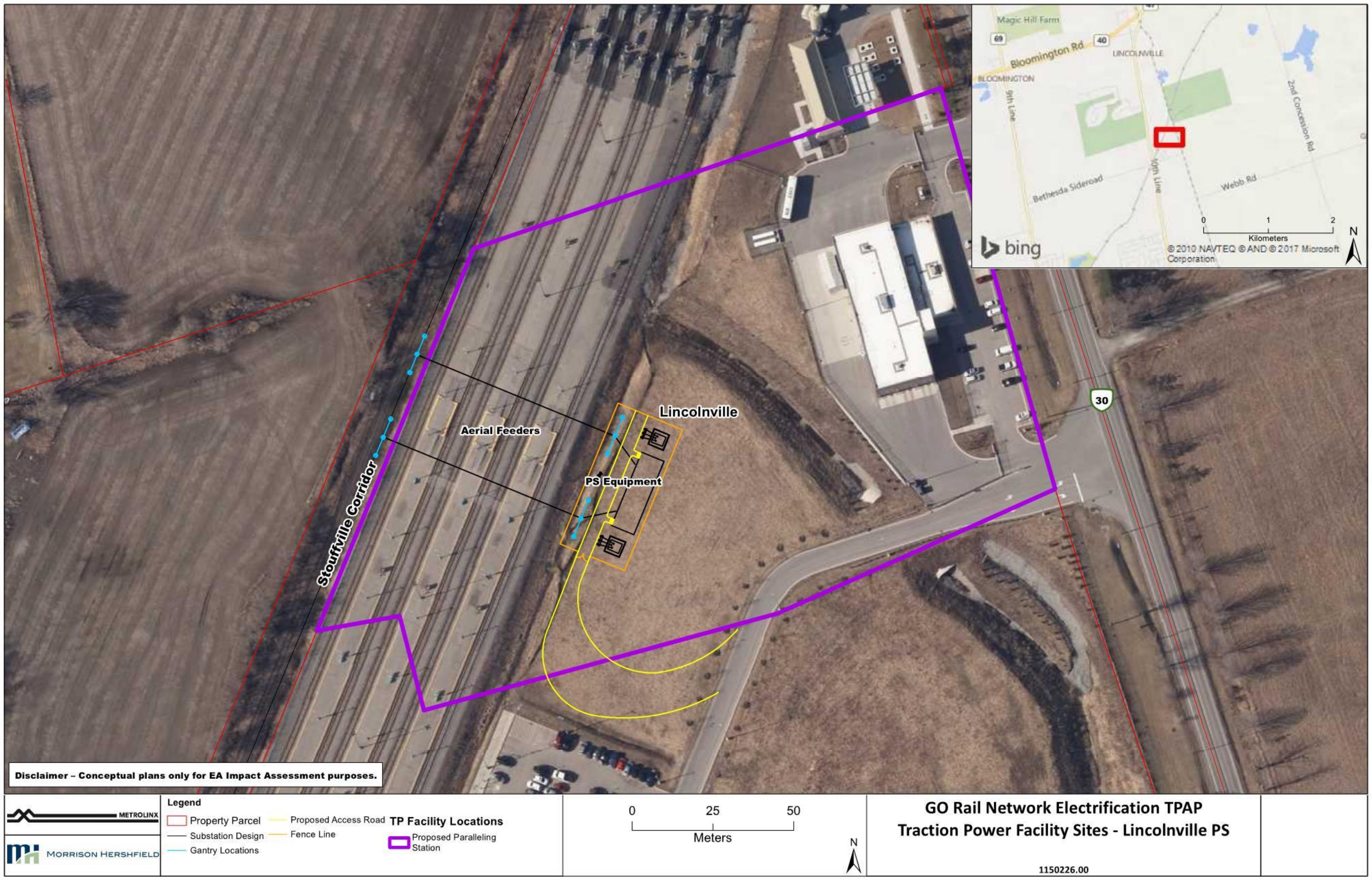


Figure 3-51: Location of Proposed Unionville PS

Figure 3-52: Location of Proposed Lincolnville PS



3.6.14 Traction Power Facilities – Lakeshore East Corridor

3.6.14.1 East Rail Maintenance Facility (ERMF) TPS

The ERMF TPS is to be located on a parcel of land (**Figure 3-53**) situated on a vacant piece of land north of the rail corridor and east of Hopkins Street. The ERMF, which is currently under construction, will be located on the opposite side of Hopkins Street. All development in the immediate surrounding area is industrial, with a hydro corridor bordering the site to the east. There is also a combination of commercial and retail uses further to the north and east of the site.

Based on the conceptual design, the proposed positioning of the TPS facility is located on the eastern side of the parcel, adjacent to the hydro corridor (**Figure 3-53**).

3.6.14.2 Scarborough SWS

The Scarborough SWS is to be located on a parcel of land (**Figure 3-54**) situated to the north of 260 Brimley Road in Toronto, behind a high rise apartment complex off of Danforth Road. The parcel is currently open space / storage area and rail corridor, and is surrounded by open space, park, and storage areas, with high rise residential areas to the north and commercial warehousing to the south.

Based on the conceptual design, the proposed positioning of the SWS facility is at the southwest corner of the parcel, adjacent to the rail corridor. It is currently storage area with some vegetation (**Figure 3-54**).

3.6.14.3 Durham SWS

The Durham SWS is to be located on a parcel of land (**Figure 3-55**) at 1610 Bayly Street in the City of Pickering. The site is primarily open space / hydro corridor, with recreational buildings / amenities (Pickering Playing Fields) in the southeast corner. The northeast corner has some tree cover / vacant lots, with ponding of water in a man-made structure. The site is entirely surrounded by industrial development and Highway 401.

Based on the conceptual design, the proposed positioning of the SWS facility is located in the triangular northeast corner of the parcel, adjacent to the rail corridor. It is currently vacant lot with some vegetation (**Figure 3-55**).

It is noted that based on discussions with the City of Pickering, the proposed future extension of Plummer Street crosses the proposed access road to the Durham SWS site. Further consultation will be undertaken with the City of Pickering during detailed design to better understand the timeline for the City's future study/plans/implementation in order to establish a solution, if required, for any potential conflicts.

3.6.14.4 Don Yard PS

The Don Yard PS is to be located on a rectangular parcel of land (**Figure 3-56**) situated north of the rail corridor east of the Don Valley Parkway in Toronto. The parcel is currently treed area, and surrounded by parking lots / commercial buildings and the Don Valley Parkway and Don River.

Based on the conceptual design, the proposed positioning of PS facility is currently treed area between the rail corridor and parking lot (**Figure 3-56**).

Figure 3-53: Location of Proposed ERMF TPS

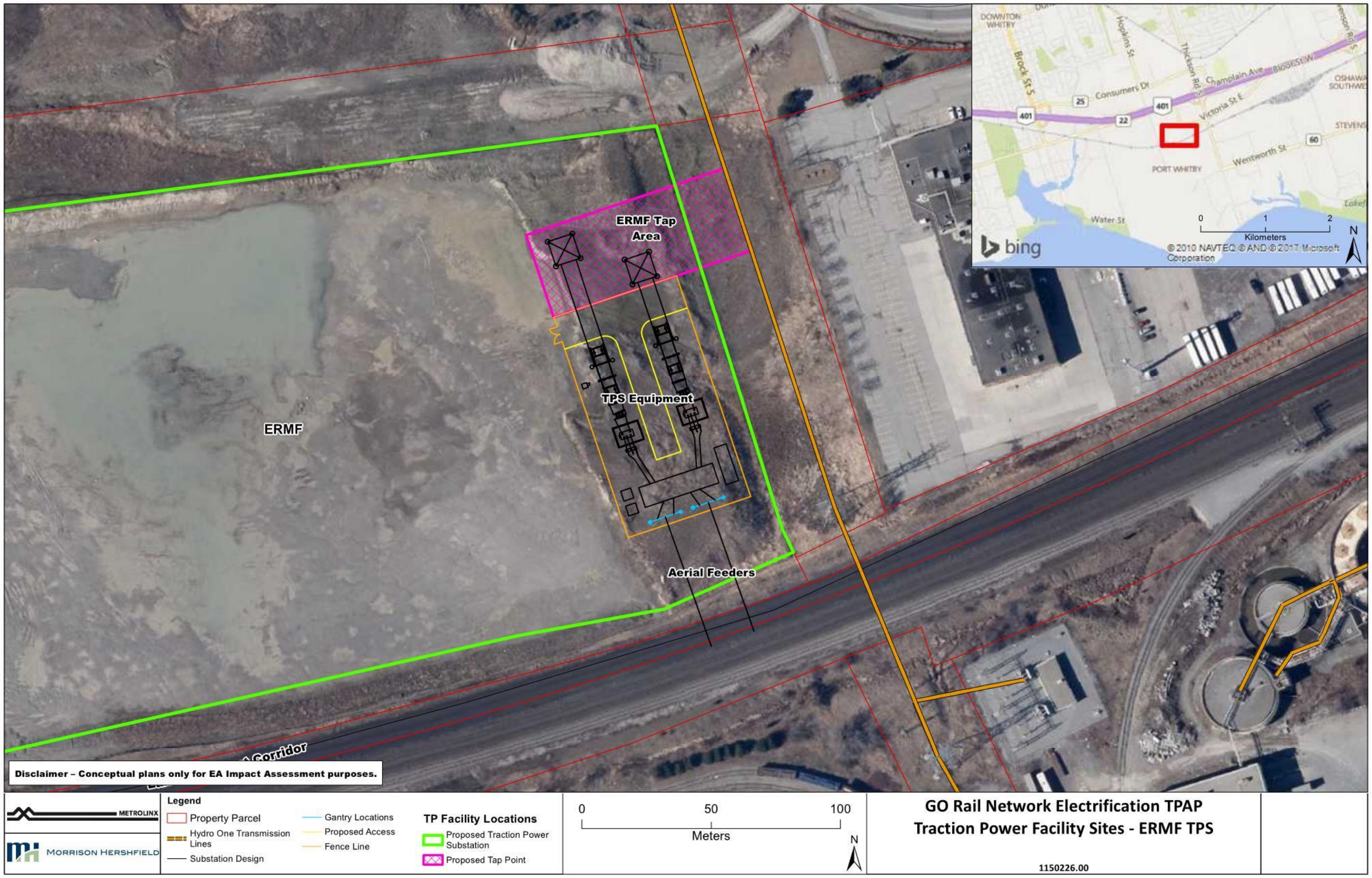


Figure 3-54: Location of Proposed Scarborough SWS

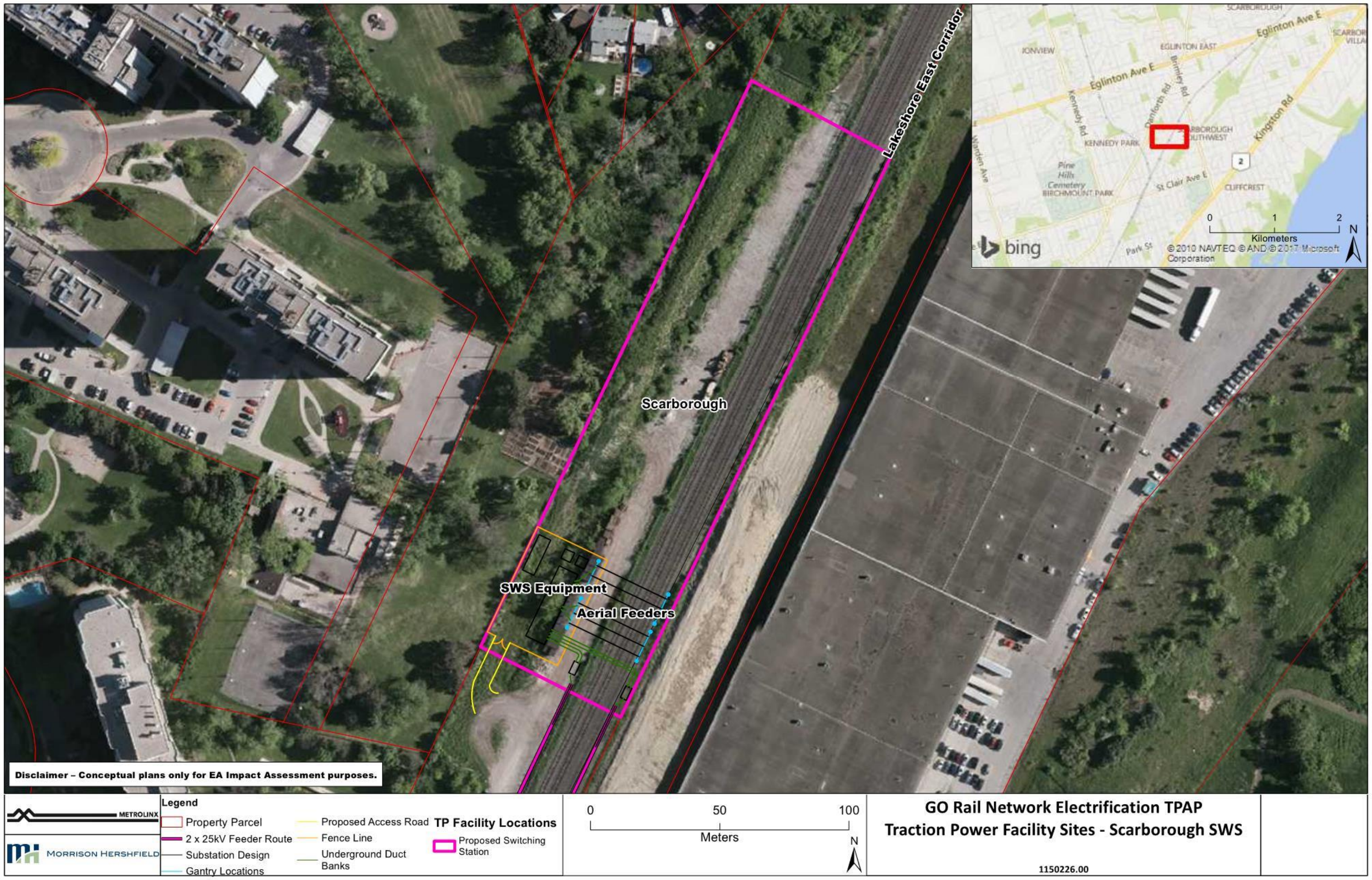


Figure 3-55: Location of Proposed Durham SWS

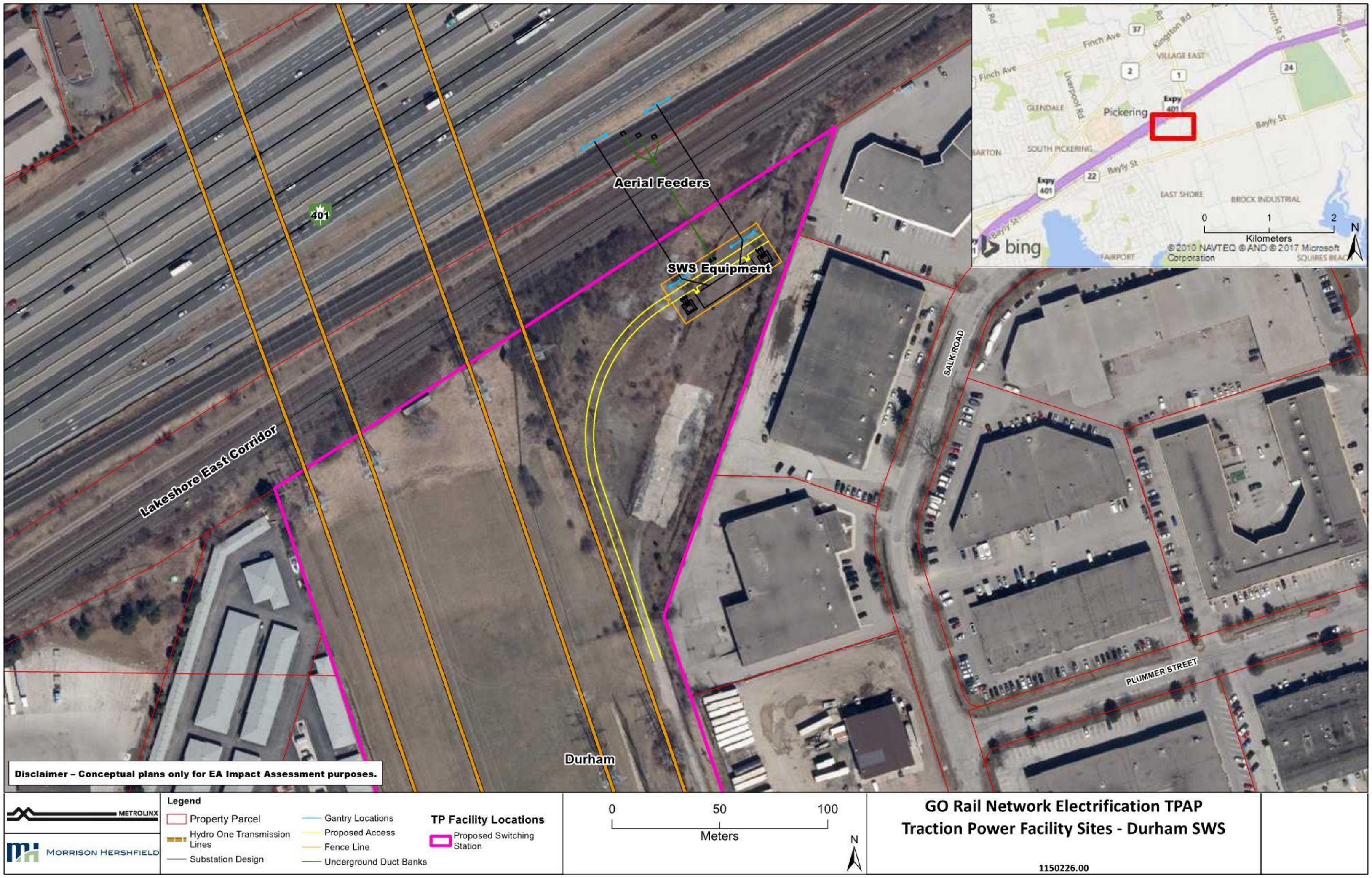
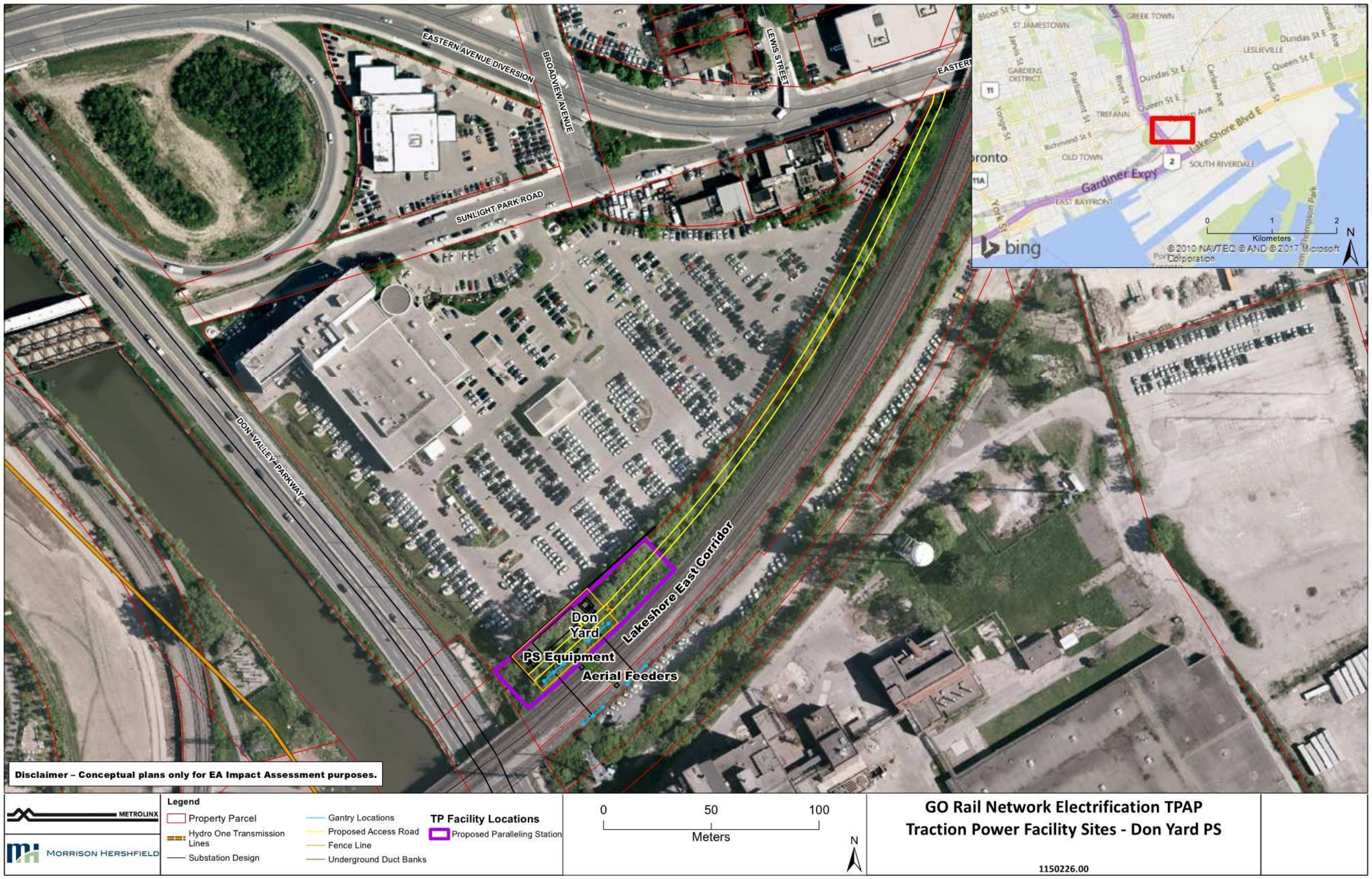


Figure 3-56: Location of Proposed Don Yard PS



3.6.15 25 kV OCS Feeders

25 kV OCS feeders are cables that convey power from the Traction Power Facility (i.e., TPS, SWS, PS) to the OCS via gantries and will be routed either aerially (wires) or underground in duct banks.

3.6.15.1 Aerial Option

When the aerial option is used, aerial 25kV taps (or wires) will connect the traction power facility to the gantry.

3.6.15.2 Underground Option

When the underground option is used, 25kV cables will be installed in underground duct banks (approximate dimensions 4m wide, 1m deep) from the switchgear to the gantries. The concrete encased duct banks will have a 75mm (3-inch) minimum protective cover on all sides. Underground duct banks will be sloped toward the adjacent underground structure (e.g., vault, manhole, or box) from which water may be drained from the manholes to perform maintenance. It is noted that underground duct banks will be equipped with a sump area for drainage by gravity or application of portable or fixed pumps, as required.

Vault and/or manholes will be installed to provide access to the duct banks/feeders at a maximum spacing of approximately 150m apart. The interior length, width, and depth of vaults and manholes will be sufficient for cable pulling and splicing and for cable expansion and contraction. In addition, the design of vaults and manholes will incorporate the following:

- Non-metallic or fiberglass cable support insulators
- Cable pulling hooks
- Grounding provisions

3.6.16 Catenary Feeding Gantries

One or two catenary feeding gantries are required in the vicinity of each TPF. The gantries will be approximately 13m above the top of rail, and 14m long; their primary function is to convey power to the overhead contact system (see **Figure 3-57** and **Figure 3-58**). For this reason, the gantries are located parallel to the tracks (within the rail ROW).

Figure 3-57: Typical Catenary Feeding Gantry

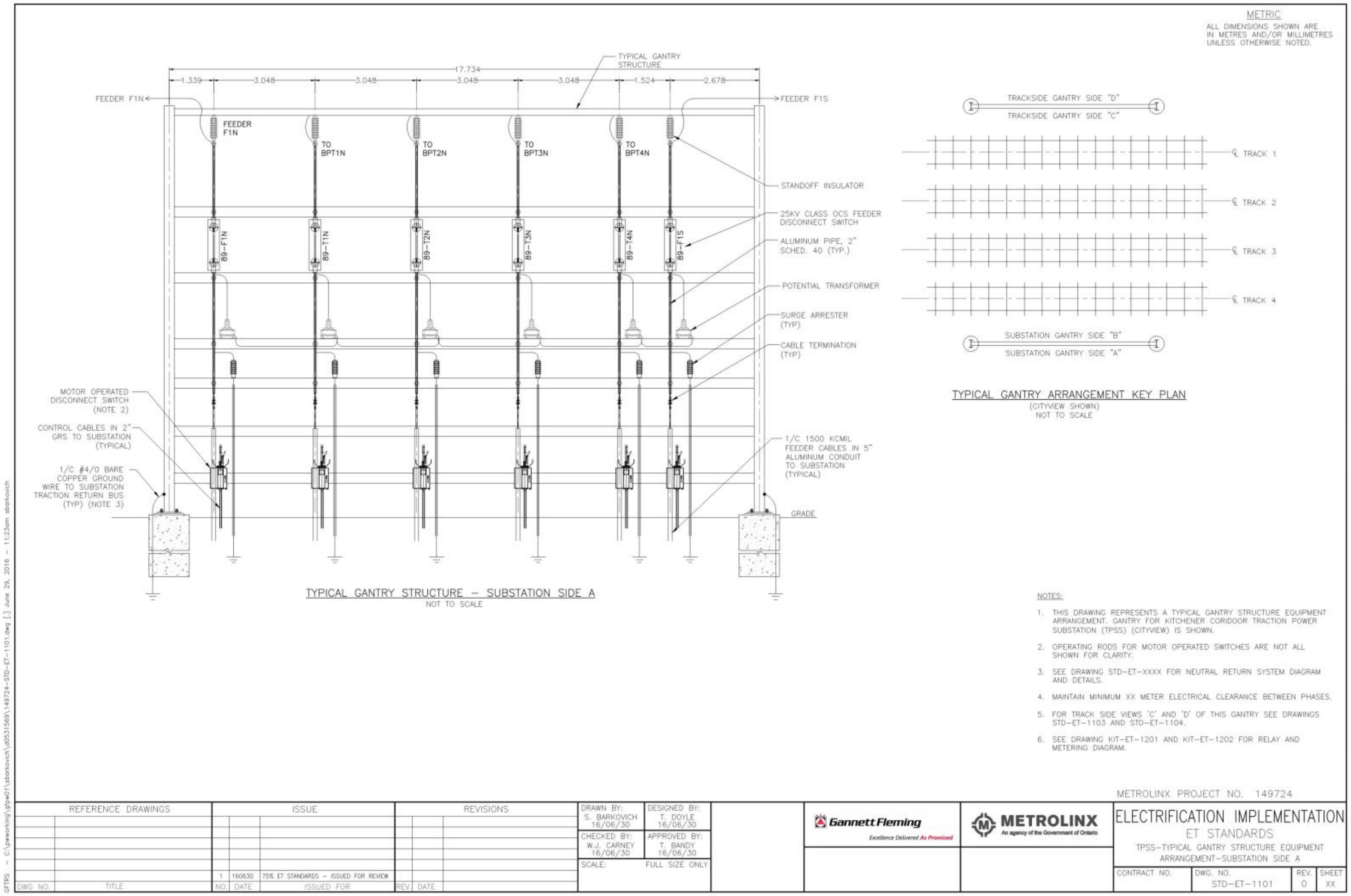


Figure 3-58: Example of a Gantry

3.7 Property

3.7.1 OCS Infrastructure

Based on the conceptual design developed, there are no anticipated property takings/impacts associated with implementing OCS infrastructure along the rail corridors. In cases where there are "pinch points" and the OCS infrastructure falls outside of MX owned ROW, an engineering solution will be implemented during detailed design to avoid property impacts. Furthermore, OCS attachments to third party property along the corridors is not anticipated based on the conceptual design. Notwithstanding this, the need for any attachments will need to be verified during detailed design based on the established track configurations. If either property impacts or the need for attachments are identified during detailed design, Metrolinx will proceed with the acquisition/easement in accordance with Metrolinx's approved property acquisition process.

3.7.2 Freight Easements

Based on the current conceptual design, a preliminary assessment of areas where OCS structures may be required to span over non-electrified freight-owned tracks (i.e., where there is not enough space between the freight tracks and GO tracks to place an OCS foundation) was carried out and the following areas were identified. In addition, an agreement with the CN will be required in order to implement/operate the 25kV Bramalea feeder route along the Kitchener rail corridor.

- Lakeshore East Corridor – GO Sub. South track starting at Oshawa GO Station heading west – mile 303.3 to 304.5– CN tracks on the south side.
- Bramalea 25kV Feeder Route - an agreement with the CN will be required in order to implement/operate the feeder route along the rail corridor right-of-way.

Agreements or easements from CN will be required in order to implement these project components as part of detailed design/implementation.

3.7.3 Tap Locations, Traction Power Facility Sites and Ancillary Components

The following table summarizes the potential property acquisition and easement requirements associated with the Tap locations, Traction Power Facilities, and their ancillary components (i.e., access roads, underground duct banks, gantries).

It should be noted that there may be additional property easements required for access to the gantries for maintenance purposes, however this cannot be determined until during detailed design. If these additional easements are required, they will be obtained prior to project implementation.

Table 3-4: Tap Locations, Traction Power Facilities and Ancillary Components – Potential Property Acquisition and Easements

Traction Power Facilities & Ancillary Components	Property Owner	Acquisition/Easement Required?
Mimico Tap/TPS	Metrolinx	No – on Metrolinx property
Access Road	Canadian Pacific Railway, City of Toronto and Hydro One	Yes – easement off N. Queen Street
Underground Duct Banks	Metrolinx	No – on Metrolinx property
Gantries	Metrolinx	No – on Metrolinx property
Mimico SWS	Privately Owned	Yes – acquisition
Access Road	Privately Owned	Yes – acquisition
Underground Duct Banks	Privately Owned	Yes – acquisition
Gantries	Privately Owned	Yes – acquisition

Traction Power Facilities & Ancillary Components	Property Owner	Acquisition/Easement Required?
Canpa 25kV Feeder Route	Metrolinx	No – on Metrolinx property
Burlington Tap/TPS	Hydro One	Yes – acquisition or easement
Access Road	Hydro One	Yes – easement off Cumberland Ave to site through HONI property
Underground Duct Banks	Hydro One	Yes – easement through HONI property
Gantries	Metrolinx	No – in MX railway right of way
Oakville SWS	Metrolinx	No – on Metrolinx property
Access Road	Metrolinx	No – on Metrolinx property
Underground Duct Banks	Metrolinx	No – on Metrolinx property
Gantries	Metrolinx	No – on Metrolinx property
Bramalea PS	Privately Owned	Yes – acquisition
Access Road	Privately Owned	Yes – easement off Dixie Road through private property
Underground Duct Banks	Privately Owned	Yes – acquisition
Gantries	Privately Owned	Yes – acquisition
Bramalea 25kV Feeder Route	Canadian National Railway	Yes – easement or agreement
Barrie Collingwood Railway 25kV Feeder Route	City of Barrie	Yes – easement or agreement
Allandale Tap	Hydro One	Yes – acquisition or easement
Alternate Allandale Tap	Hydro One	Yes – acquisition or easement
Allandale TPS	Privately Owned	Yes - acquisition
Access Road	Privately Owned	Yes - acquisition
Underground Duct Banks	Privately Owned	None

Traction Power Facilities & Ancillary Components	Property Owner	Acquisition/Easement Required?
Gantries	Privately Owned	Yes – acquisition
Gilford PS	Metrolinx	No – on Metrolinx property
Access Road	Metrolinx	No – on Metrolinx property
Underground Duct Banks	Metrolinx	No – on Metrolinx property
Gantries	Metrolinx	No – on Metrolinx property
Newmarket SWS	Privately Owned	Yes – acquisition
Access Road	Privately Owned	Yes – acquisition
Underground Duct Banks	Hydro One / Privately Owned	Yes – easement on HONI property and private property
Gantries	Metrolinx	No – on Metrolinx property
Maple PS	Privately Owned	Yes - acquisition
Access Road	Privately Owned	Yes - acquisition
Underground Duct Banks	Privately Owned	Yes - acquisition
Gantries	Privately Owned	Yes – acquisition
Scarborough Tap and TPS	Hydro One	Yes – acquisition or easement
Access Road	Hydro One	Yes – easement off Mike Myers Drive to site through HONI property
Gantries	Hydro One	Yes – easement
Scarborough 25kV Feeder Route (STV and LSE corridors)	Metrolinx	No – on Metrolinx property
Unionville PS	Publically Owned	Yes - acquisition
Access Road	Publically Owned	Yes – easement off Kennedy Road to site through IO property
Underground Duct Banks	Publically Owned	Yes – acquisition
Gantries	Publically Owned	Yes – easement

Traction Power Facilities & Ancillary Components	Property Owner	Acquisition/Easement Required?
Lincolnville PS	Metrolinx	No – on Metrolinx property
Access Road	Metrolinx	No – on Metrolinx property
Gantries	Metrolinx	No – on Metrolinx property
East Rail Maintenance Facility (ERMF) Tap and TPS	Metrolinx	No – on Metrolinx property
Access Road	Metrolinx	No – on Metrolinx property
Gantries	Metrolinx	No – on Metrolinx property
Scarborough SWS	Metrolinx	No – on Metrolinx property
Access Road	Metrolinx	No – on Metrolinx property
Underground Duct Banks	Metrolinx	No – on Metrolinx property
Gantries	Metrolinx	No – on Metrolinx property
Durham SWS	Hydro One	Yes – acquisition
Access Road	Hydro One	Yes – easement off Bayly Street through HONI property
Underground Duct Banks	Hydro One	Yes – acquisition
Gantries	Hydro One	Yes – acquisition
Don Yard PS	Metrolinx	No – on Metrolinx property
Access Road	Metrolinx	No – on Metrolinx property
Underground Duct Banks	Metrolinx	No – on Metrolinx property
Gantries	Metrolinx	No – on Metrolinx property

3.7.4 2 X 25kV Feeder Routes

With regard to installation of the 2X25kV feeder routes the following agreements will need to be obtained prior to project implementation:

- **Canpa Feeder Route** – no agreement/approval required, as the feeder route will be built within Metrolinx owned Canpa rail right-of-way.
- **Bramalea Feeder Route** - an agreement with the Canadian National Railway will be required in order to implement/operate the feeder route along the rail corridor right-of-way.
- **Barrie Collingwood Railway Feeder Route** – an agreement with the Barrie Collingwood Railway (BCRY) will be required in order to implement/operate the feeder route along the BCRY right-of-way.
- **Scarborough Feeder Route** - no agreement/approval required, as the feeder route will be built within Metrolinx owned Stouffville and Lakeshore East rail right-of-ways.

3.7.5 Parallel Barriers

As outlined below, as part of the conceptual design phase, an initial assessment of areas that may require installation of a parallel barrier or other form of mitigation for safety was undertaken. It should be noted that the list of locations anticipated to require parallel barriers are distinct/different than the bridge protection barriers identified for overhead bridges along the corridors. If there are any property acquisition or easement requirements identified in order to install the barriers, Metrolinx will proceed with the acquisition/easement in accordance with Metrolinx's approved property acquisition process.

3.8 Grounding and Bonding

To ensure safe touch-and-step potential in accordance with permissible limits (as per applicable international electrical safety codes and standards including AREMA, CSA, EN and IEEE), a grounding and bonding system will be implemented as part of the electrification project. Touch potential is defined as the voltage between an energized object and the feet of a person in contact with the object. Step potential is defined as the voltage between the feet of a person standing near an energized grounded object. Grounding and bonding will be installed within 4 meters of the track; notwithstanding this, an evaluation out to 10m of the track will be undertaken during detailed design to determine if anything else will require grounding.

With this in mind, grounding and bonding systems serve two primary functions:

- Minimize touch voltage, step voltage and ground return currents caused by the electrified system to provide for the safety of passengers, operating personnel and other wayside public, and to provide protection from the risk of electrical shock; and
- Provide the means to carry electric currents into the earth under normal and fault conditions without exceeding operating and equipment limits, or adversely affecting continuity of service.

The grounding and bonding system has been designed according to the applicable standards where applicable (i.e., IEEE Standards, Ontario Electrical Safety Code, CAN/CSA C22.1 Canadian Electrical Code, CAN/CSA C22.3–1 Overhead Systems, CAN/CSA C22.3-7 Underground Systems, EN 50122-1, AREMA-Manual for Railway Engineering, Transmission System Code, etc.). Proper grounding and bonding systems will be engineered and installed throughout the entire electrified corridor to provide proper return circuits for the normal traction power currents and fault currents, with grounding connections.

The broad concepts surrounding "grounding" is to create a mechanism to allow current to flow from metallic objects that are not meant to carry current or otherwise become energized to protect personnel from the hazards of electricity. This is accomplished by establishing a system of aerial and buried grounding conductors and ground rods with connections from the metallic object to the earth/ground to dissipate the energy. In some instances, copper cables are used to be interconnect (or "bond") the metallic object to another component that is part of the traction return system. The grounding electrodes shall be contained within the right of way confines. The bonding material shall be capable of sustaining the short-circuit currents for up to the total switch-off (trip) time imposed on the system without thermal degradation or mechanical breakdown. The traction equipment bonding shall be capable of discharging a 15 kA fault from the OCS within 0.5 seconds.

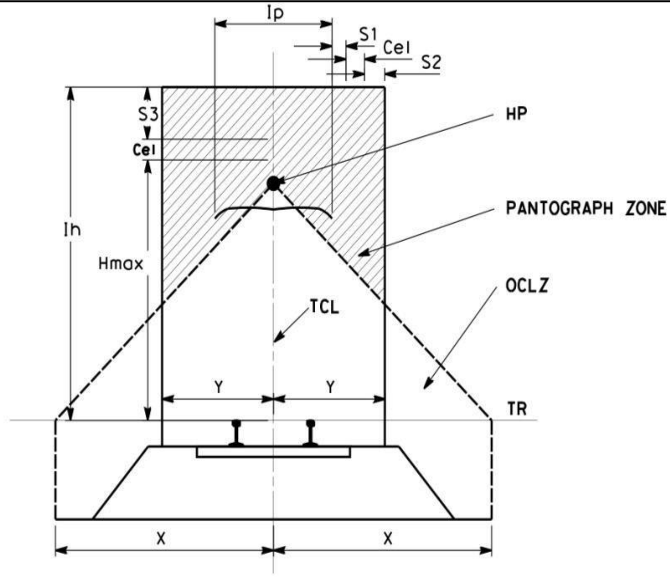
3.8.1 Overhead Contact Line Zone (OCLZ)

A live broken contact line, or live parts of a broken or de-wired pantograph or energized fragments, may accidentally come into contact with wayside structures and equipment. As derived from European standard EN 50122-1, the overhead contact line zone (OCLZ) is used to define the area in which normally non-current-carrying metallic components in this zone are to be either directly grounded or bonded to the traction power return system to provide for personnel safety (see **Figure 3-59**). Metallic objects and equipment at passenger stations are within the OCLZ and are to be properly grounded and bonded. The grounding and/or bonding configuration to be employed is dependent upon the equipment involved. Special considerations are given to railroad signal, railroad communications and 3rd party utilities.

The limits of the overhead contact line zone below the top of the rail extend vertically down to the earth surface, except where the tracks are located on an aerial structure where they extend down to the aerial structure deck. In the case of energized out-of-running OCS conductors, the overhead contact line zone shall be extended accordingly.

Normally-non-current-carrying metallic components that lie within the overhead contact line and pantograph zone shall be either directly grounded or bonded to the static wire to provide for personnel safety.

Figure 3-59: Overhead Contact Line Zone and Pantograph Zone



KEY

TR	TOP OF RAIL
HP	HIGHEST POINT OF OVERHEAD CONTACT LINE
OCLZ	OVERHEAD CONTACT LINE ZONE
TCL	TRACK CENTER LINE
X	MAXIMUM UNIDIRECTIONAL (HALF) HORIZONTAL OCLZ, TOP OF RAIL LEVEL
Y	MAXIMUM UNIDIRECTIONAL (HALF) HORIZONTAL PANTOGRAPH ZONE
S1	WIDTH OF LATERAL MOVEMENT OF THE CURRENT COLLECTOR
S2	HORIZONTAL SAFETY DISTANCE FOR THE BROKEN OR DEWIRED CURRENT COLLECTOR
S3	VERTICAL SAFETY DISTANCE FOR THE BROKEN OR DEWIRED CURRENT COLLECTOR
Cel	ELECTRICAL CLEARANCE
Ih	MAXIMUM HEIGHT OF CURRENT COLLECTOR ZONE
Ip	CURRENT COLLECTOR WIDTH
Hmax	MAXIMUM HEIGHT OF THE FULLY UPLIFTED CURRENT COLLECTOR

For the MX electrification project, the following values have been retained:

- X = 4 meters;
- Y = 2 meters (shall be determined based on the rolling stock characteristics; meanwhile, these are assumed to be 2 meters); and
- Ih = 8 meters

All metallic equipment within the OCLZ or the pantograph zone is potentially at risk of being in contact with the OCS or at risk to carry the short-circuit current. Consequently all metallic structures in this area are to be connected to grounded and/or bonded to the traction return system.

3.8.2 Step and Touch Potentials

An electrical safety analysis and ground potential rise study shall take into account criteria for the ground potential rise (refer to IEEE Standard – 80). The analysis shall be undertaken to assess which normally non-current carrying conductive parts need to be grounded and bonded, and the appropriate method of implementation shall be identified to ensure that the step and potentials are within permissible limits.

The grounding and bonding of other non-current carrying equipment, enclosures and associated structure, including the overhead contact system (OCS) structures, rails, station platform metallic objects, and other conductive trackside equipment, shall be designed such that touch voltages do not exceed the values indicated below, which has been derived from EN 50122-1: 2011 section 9.2.2.

Table 3-5: Touch Voltage Limits

Duration of Current Flow (seconds)	Permissible Voltage in V (rms)
0.02	865
0.05	835
0.1	785
0.2	645
0.3	480
0.4	295
0.5	220
0.6	180
< 0.7	155
0.7	90
0.8	85

Duration of Current Flow (seconds)	Permissible Voltage in V (rms)
0.9	80
1.0	75
≤ 300	65
> 300 (where accessible to the public under all power supply feeding conditions)	60
> 300 (in workshops and similar locations)	25

3.8.3 Traction Power Facility Grounding & Bonding

All traction power facilities will be enclosed by a metallic perimeter fence. The perimeter fence will be 1m (3') within the perimeter of the ground grid and bonded to the ground grid at regular intervals. The grounding system at these facilities will meet comply with IEEE 80 and OESC requirements.

3.8.4 Passenger Train Station Grounding & Bonding

Station platform areas require special consideration to mitigate step and touch potentials where passengers could simultaneously come in contact with rolling stock car bodies and metallic objects on the platform. In addition, the need to protect personnel and equipment against traction power fault conditions if the OCS or auto-transformer feeder wire were to fall/energize this area. The configuration defined in AREMA, Chapter 33, Section 7.5.1.1 Method B, shall be employed at passenger station areas. Different combinations of grounding conductor and ground rod layouts and sizes will be used depending on the station and will be completed during final design.

3.8.5 Grounding of Wayside Structures & Equipment

The following wayside equipment located within the electrified railway ROW and on Metrolinx property will require grounding and bonding provisions:

- Metal Bridges
- Overhead contact system (OCS) supports
- Running rails/ railway tracks
- Signal bridges
- Wayside power control cubicles/signal cases
- Catenary feeding gantries
- Metallic components of retaining walls

- Metallic screens, noise walls, metallic fences/gates and safety barriers
- Metallic third party utilities

3.9 Bridges and Rail Overpasses

There are numerous overhead (OH) bridges (i.e., roadway, pedestrian walkway, or railroad traffic over GO rail corridors) and rail overpass bridges (i.e., bridges carrying GO rail corridors to over roadways, pedestrian tunnels, or waterways) along the rail corridors to be electrified. While there are some structures that will not require any type of modification to facilitate electrification, there are several that will require one or more modifications as follows:

i. *OCS Attachments*
   - to allow for electrification through/under the structure

ii. *Bridge Protection Barriers*
   - to protect pedestrians and travelers/infrastructure users within the public right-of-way, and electrification equipment

iii. *Modifications to Achieve Minimum Clearance*
   - Options include raising or replacing the overhead bridge structure and/or, lowering the tracks in order to achieve minimum vertical clearance requirements

iv. *Grounding and Bonding*
   - to prevent damage from flashovers to the bridge structures
   - to prevent step and touch potential from exceeding permissible limits as defined in the applicable standards.

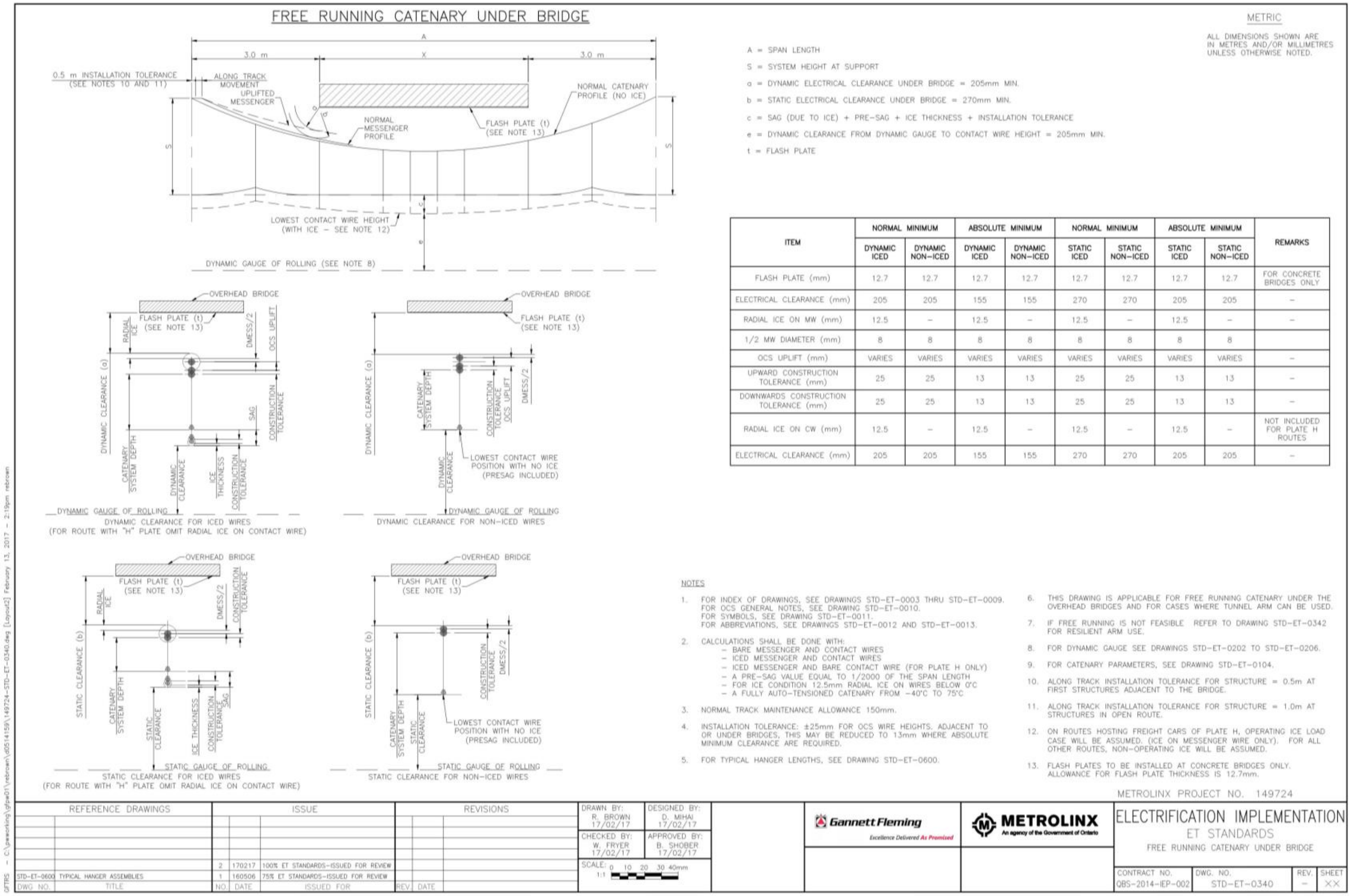
3.9.1 OCS Attachments

In order to run OCS wires under overhead bridges without attachments, there must be sufficient clearance between the messenger wire/catenary and the lowest part of the bridge structure. Where sufficient clearance does not exist, attachments (e.g., tunnel arms,) on the structure are required in order to support the OCS. In addition, for rail overpass structures, OCS support structures (portals/cantilevers) may need to be installed on the structure to support the OCS system.

There are four design options for installing OCS to bridge/rail overpass structures:

1. Wires 'free run' under the bridge with no modification required (see **Figure 3-60**)
2. Install attachments to bridge to support OCS wires running under the bridge (see **Figure 3-61**)
3. Install OCS support structures on rail overpass structures (see **Figure 3-62**)
4. Attach to tunnel with tunnel arm(s) (see **Figure 3-63)**

Figure 3-60: Typical Free Run Catenary Under Bridge



ITEM	NORMAL MINIMUM DYNAMIC ICED	NORMAL MINIMUM DYNAMIC NON-ICED	ABSOLUTE MINIMUM DYNAMIC ICED	ABSOLUTE MINIMUM DYNAMIC NON-ICED	NORMAL MINIMUM STATIC ICED	NORMAL MINIMUM STATIC NON-ICED	ABSOLUTE MINIMUM STATIC ICED	ABSOLUTE MINIMUM STATIC NON-ICED	REMARKS
FLASH PLATE (mm)	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	FOR CONCRETE BRIDGES ONLY
ELECTRICAL CLEARANCE (mm)	205	205	155	155	270	270	205	205	–
RADIAL ICE ON MW (mm)	12.5	–	12.5	–	12.5	–	12.5	–	–
1/2 MW DIAMETER (mm)	8	8	8	8	8	8	8	8	
OCS UPLIFT (mm)	VARIES	VARIES	VARIES	VARIES	VARIES	VARIES	VARIES	VARIES	–
UPWARD CONSTRUCTION TOLERANCE (mm)	25	25	13	13	25	25	13	13	–
DOWNWARDS CONSTRUCTION TOLERANCE (mm)	25	25	13	13	25	25	13	13	–
RADIAL ICE ON CW (mm)	12.5	–	12.5	–	12.5	–	12.5	–	NOT INCLUDED FOR PLATE H ROUTES
ELECTRICAL CLEARANCE (mm)	205	205	155	155	270	270	205	205	–

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Figure 3-61: Typical OCS Bridge Attachments

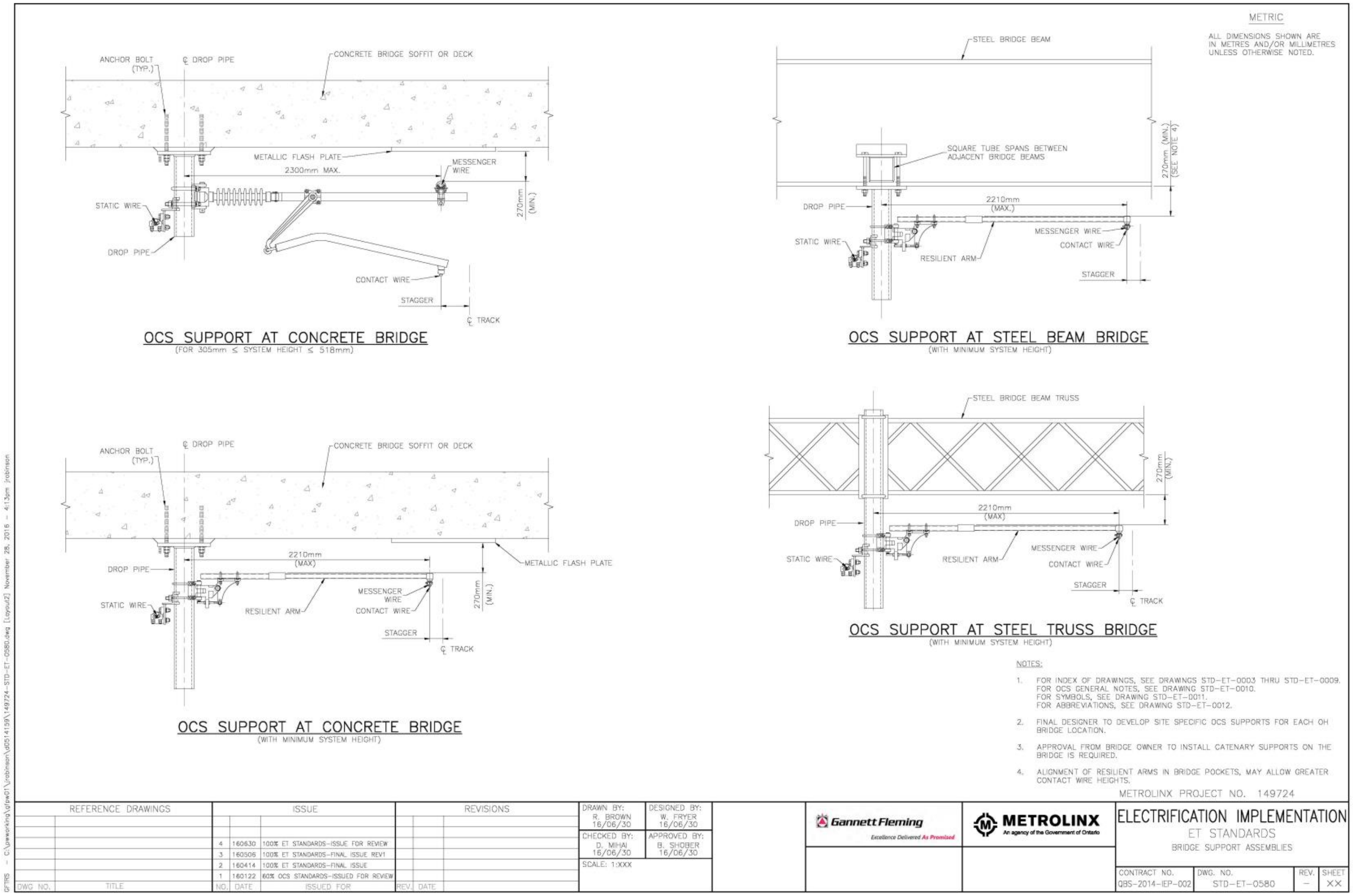


Figure 3-62: Typical OCS Support Structure on Rail Overpass

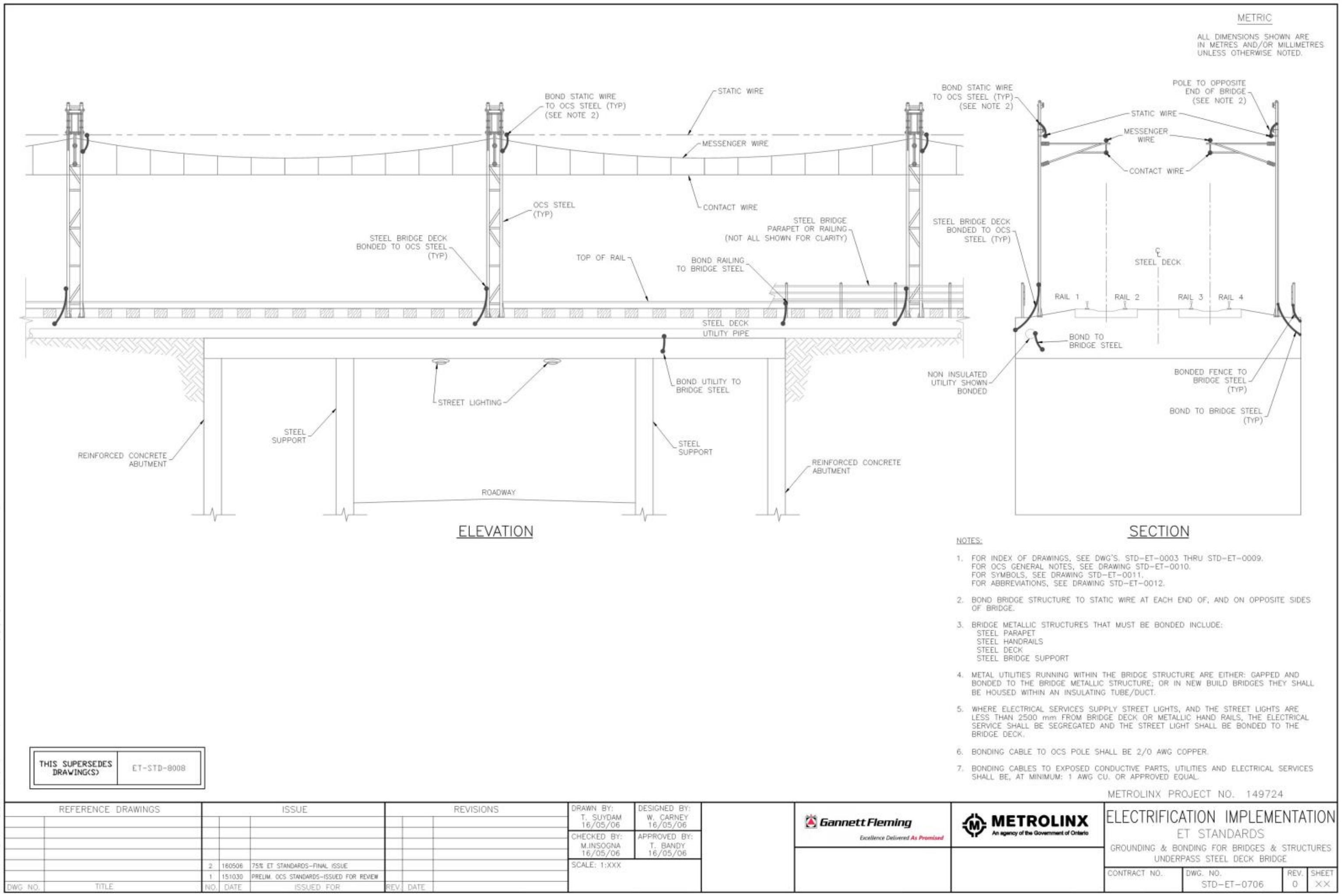
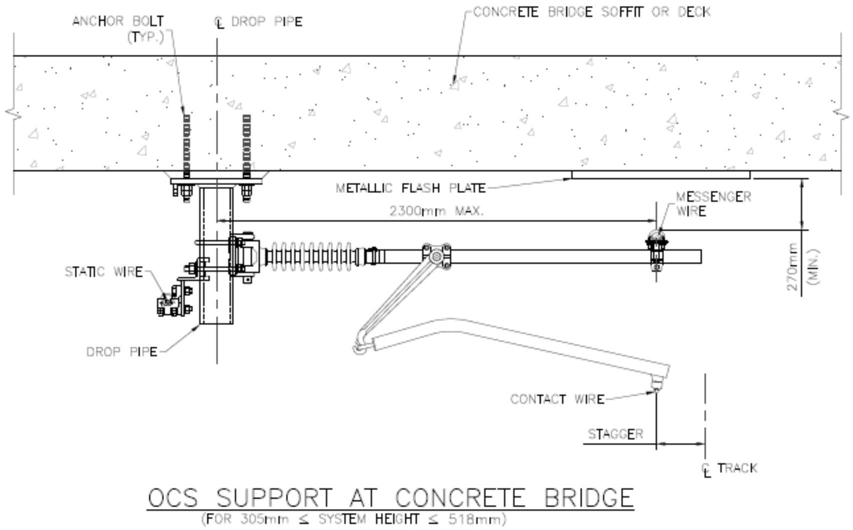


Figure 3-63: Typical Tunnel Arm Attachment



3.9.2 Flash Plates

In the case of concrete bridges, if the vertical clearance between OCS conductors and concrete overpasses is less than 1m (3'3"), protection panels (flash plates) will be installed above the OCS, attached to the underside of the bridge, and interconnected to the static wire. Flash plates are metallic plates that are grounded. For steel overpasses, the steel girders will be interconnected and bonded to the static wire. **Figure 3-64** and **Figure 3-65** depict a typical flash plate installation.

Figure 3-64: Typical Flash Plate Drawing

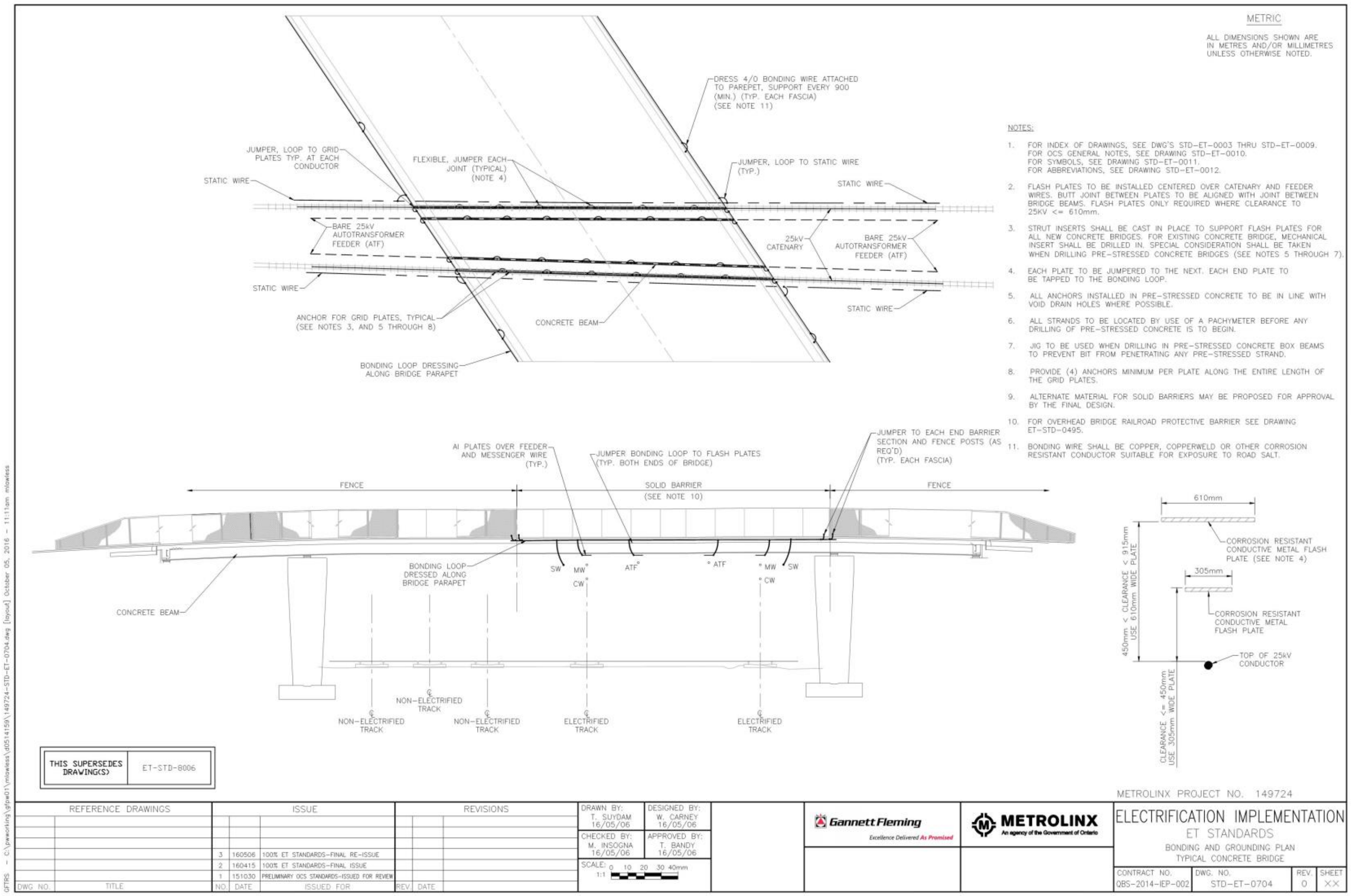


Figure 3-65: Example Flash Plate

3.9.3 Bridge Protection Barriers

The purpose of a bridge protection barrier is to protect pedestrians and travelers/infrastructure users within the public right-of-way on bridges from direct contact with adjacent live parts of the OCS for voltages up to 25 kV to ground. In addition, these barriers protect against damage to the OCS passing under bridges by providing an obstacle to debris that may be thrown onto the railway from overhead. **Figure 3-66** and **Figure 3-67** depict a typical bridge barrier.

Figure 3-66: Typical Bridge Barrier Drawing

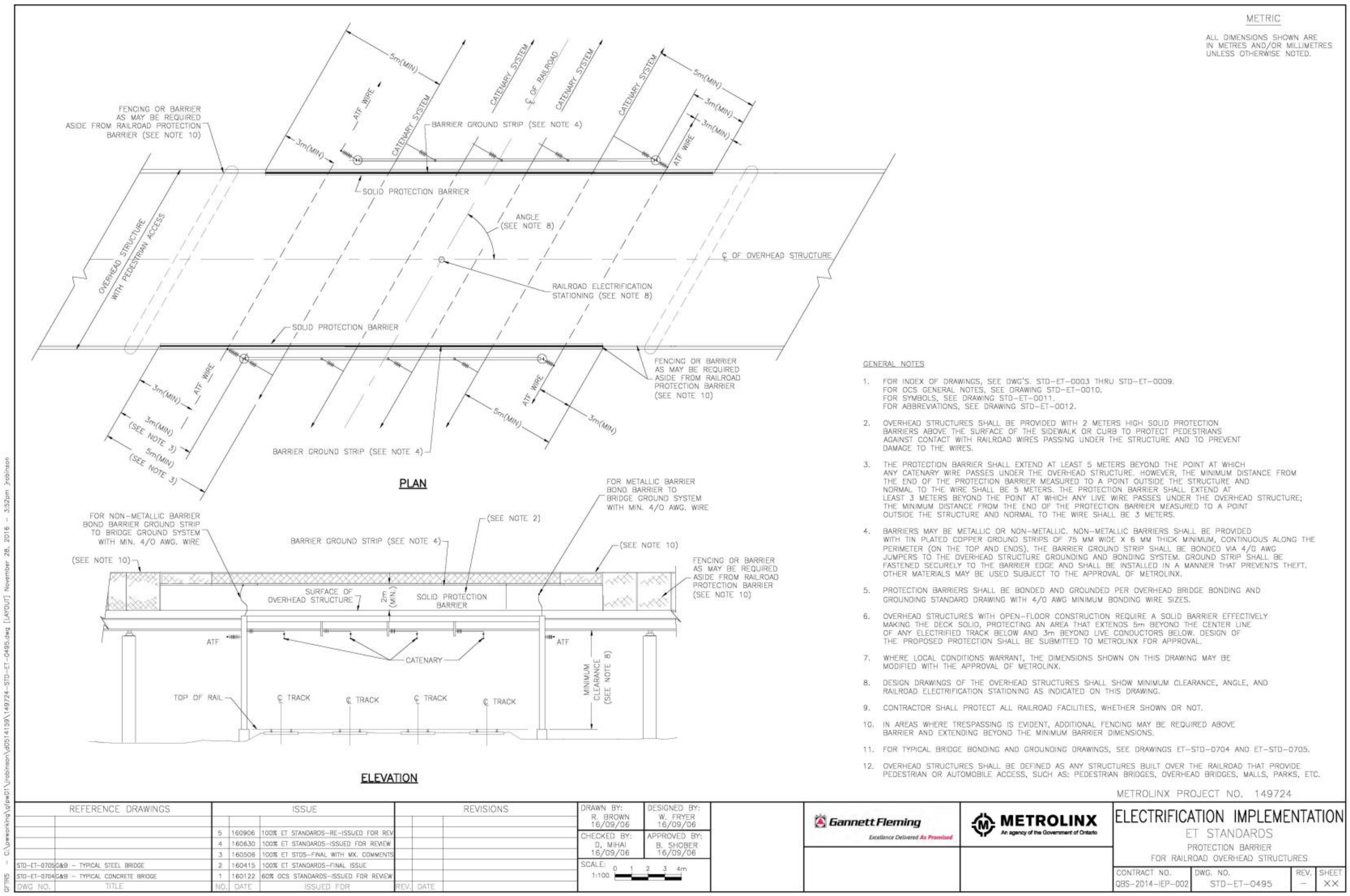


Figure 3-67: Example of a Bridge Barrier in a Non-Visually Sensitive Location

The length of the protection barrier will extend a minimum of approximately 3m laterally beyond the live parts of the overhead contact system, on either side the bridge. The barriers will be made of solid-faced material, and will be a minimum height of approximately 2m (barriers of greater heights may be required in areas where vandalism is prevalent). High voltage signage will also be provided as an additional safety measure.

Metallic elements of the protection barriers will be grounded and bonded to the static wire in minimum two locations, as previously described.

3.9.3.1 Bridge Barrier Design Options

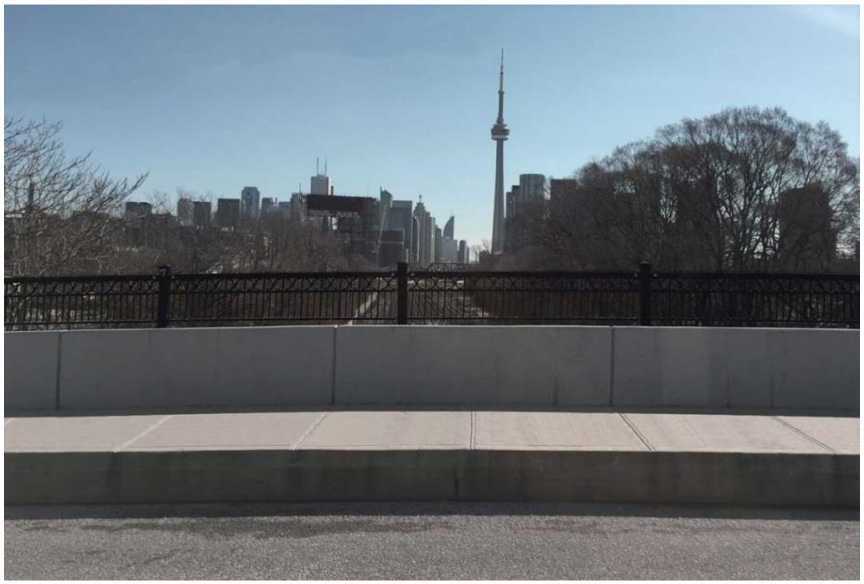
As part of detailed design, Metrolinx's Design Excellence Committee will be engaged to review possible design treatments/option for enhancing the aesthetics of bridge barriers where feasible/required. It is anticipated that the basis of the protection barrier will be a post and panel (solid-faced) design with customizable panels toward suiting visual preferences (in consultation with the applicable bridge owners as appropriate), such as:

- Multilane, restricted access highways and non-visually sensitive locations;
- Visually sensitive locations;
- Structures of heritage value or sensitivity.

An illustrative example of a bridge barrier in a visually sensitive location has been provided in **Figure 3-68.** Additional illustrative examples of possible bridge barriers have been provided in **Figure 3-69** and **Figure 3-70.** It is noted that the final design of each bridge barrier will be determined during detailed design in consultation with relevant municipalities as appropriate.

Figure 3-68: Example of a Bridge Barrier in a Visually Sensitive Location

Before



After

Figure 3-69: Bridge Barrier Design Options (Examples)

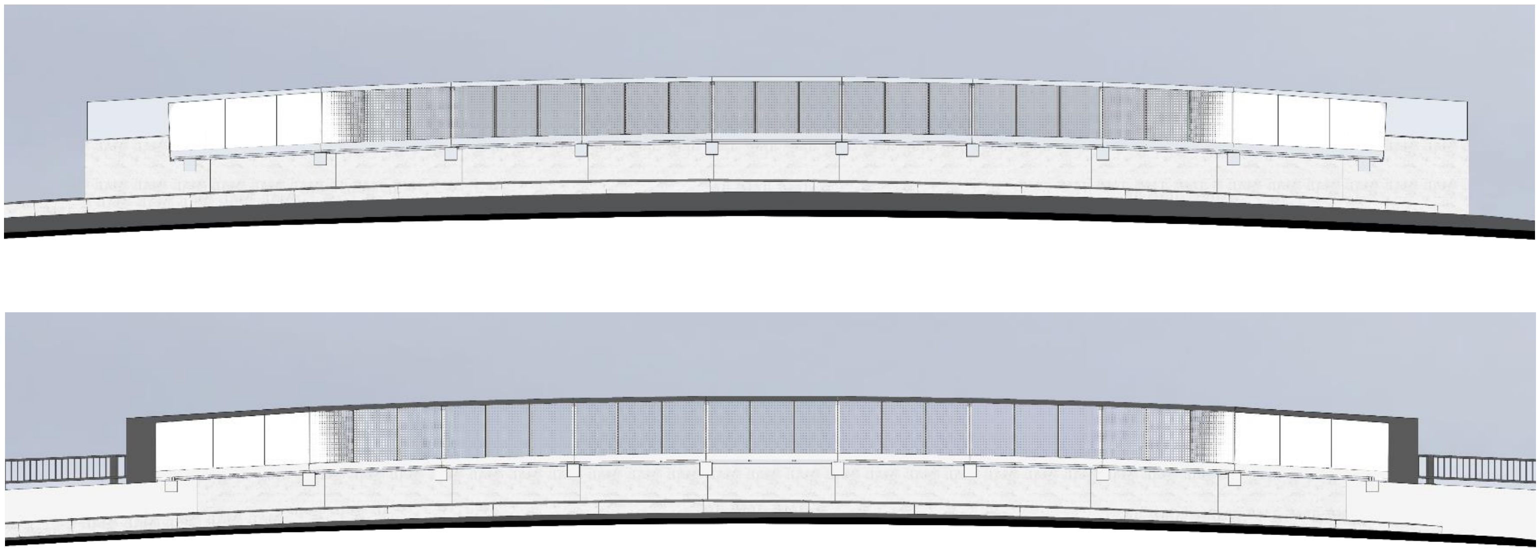


Figure 3-70: Bridge Barrier Design Option Example (Glass Back View)

3.9.4 Modifications to Achieve Minimum Vertical Clearance

As part of the conceptual design prepared during the TPAP, a preliminary investigation was undertaken to examine possible design solutions for overhead bridges that do not meet the required minimum vertical clearance (MVC) needed to accommodate electrification of the Metrolinx rail corridors.

A clearance plate defines the maximum height and width for railway vehicles to ensure safe passage through bridges, tunnels and other structures. Standard plates are used throughout North America so that train operators know what size equipment will safely pass on a given line. Because there are several tenant railroads, including CP & CN, operating over Metrolinx territory, Metrolinx uses two different plates. A plate F is used in areas where standard freight cars and MX's bi-level coaches operate, plate H is used where double stack freight cars operate.

The following key assumptions were established to guide the investigations:

- Electrification is to accommodate GO MP-40, Bi-level, and Wayfreight vehicles (encompassed under AAR Plate F) on all corridors to be electrified.
- Protection for double stack trains and Automax cars (encompassed under AAR Plate H) along the corridors to be electrified, as described in Section 3.3.1.

The required Absolute Minimum Vertical Clearances (AMVCs) for overhead bridges are defined as follows:

	Plate F	**Plate H**
Steel bridges:	5946 mm	6937 mm
Concrete bridges:	5959 mm	6950 mm

These AMVCs were used as an initial "trigger" to determine the need to address an inadequate vertical clearance in terms of raising/replacing the bridge or lowering the track, where an OCS modification/solution cannot otherwise be provided.

Subsequent investigations were performed todefine the *required* MVCs (i.e., RMVCs) based on site-specific OCS requirements, which can be greater than AMVCs in some cases. Opportunies to implement improvements to the quality of maintenance practices in order to reduce track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired), as well as freight restrictions in some cases, were also considered as solutions for minimizing the number of bridges requiring more substantive forms of modification in order to achieve the required minimum vertical clearance.

Based on the analysis completed, there are fourteen (14) overhead bridges that do not meet the RMVC for Plate H and which therefore require modification to achieve the required RMVC:

- **Nine (9) overhead bridges on the Lakeshore West Corridor**
  - OH Bridge 1.57 Strachan Avenue
  - OH Bridge 2.38 Dufferin Street
  - OH Bridge 2.69 Dunn Avenue
  - OH Bridge 2.85 Jameson Avenue
  - OH Bridge 9.41 Browns Line
  - OH Bridge 31.28 Drury Lane Pedestrian Bridge
  - OH Bridge 3.54 Sunnyside Pedestrian Bridge
  - OH Bridge 5.61 Gardiner Expressway
  - OH Bridge 18.77 Royal Windsor Drive

- **Two (2) overhead bridges on the Barrie Corridor**
  - OH Bridge 3.37 Dundas Street
  - OH Bridge 8.80 Highway 401

- **Three (3) overhead bridges on the Lakeshore East Corridor**
  - OH Bridge 314.95 Granite Crt.
  - OH Bridge 328.64 Main St.
  - OH Bridge 326.50 Birchmount Road

There are several possible engineering solutions that may be implemented to achieve the required MVC for the overhead bridges including the following: i) raise/modify the existing bridge, ii) lower the tracks, iii) improve quality of maintenance to reduce track maintenance allowance, iv) freight restrictions to certain tracks, v) replace the bridge, or some combination of these solutions.

With respect to track lowering, it is noted that no adverse impacts to watercourses are anticipated in based on the conceptual design developed as part of the TPAP. Similarly, with respect to drainage and stormwater management, quantity and drainage patterns are not anticipated to be affected due to track lowering activities based on the preliminary analysis undertaking as part of the conceptual design work. Notwithstanding this, if environmental impacts are subsequently identified as part of detailed design, applicable legislation will be adhered to and all applicable environmental permits and/or approvals will be obtained prior to construction.

Based on the conceptual design prepared as part of the TPAP, preliminary solutions to these clearance issues have been established as outlined in the relevant sections that follow and may involve: bridge raise/replacement, tracker lowering, reduction in track maintenance allowance, restricting freight to certain tracks, or other engineering solution. It should be noted that the design solutions for each of the bridges will need to be finalized as part of the subsequent detailed design phase of the project. As part of the TPAP, for each of these proposed solutions for bridge structures requiring replacement, it was assumed that any/all environmental impacts would be confined to within the Metrolinx owned rail ROW/existing pedestrian bridge footprint. . Notwithstanding this, any potential environmental/land use/property impacts that may occur outside of Metrolinx's ROW/exiting pedestrian bridge footprintas a result of the final design solution will need to be confirmed as part of the detailed design phase, which may entail carrying out additional EA/TPAP studies and/or EA/TPAP Addendum(s).

3.9.4.1 Construction of Future/New Bridges

It is further noted that unless a waiver is requested and justified by the bridge owner and granted by Metrolinx, all new or replacement overhead bridges (i.e., future bridges to be constructed) will be required to provide a preferred MVC of 7.584m to maintain clearance requirements set by Transport Canada and clearance requirements of the OCS to avoid the need for OCS attachments to the overhead structure.

The following sections provide further detail on the types of modifications required to address the MVC issues associated with the 14 above noted overhead structures.

3.9.4.2 Strachan Ave. Overhead Bridge (MP 1.57, City of Toronto) – Lakeshore West Corridor

An initial site assessment was performed and an OCS clearance/layout was investigated conceptually at this bridge location. Due to the bridge type and its proximity to other structures and roadway geometry, the extent of expected impacts were such that the preliminary solution to attain adequate vertical clearance was determined to be lowering the tracks, with the expectation that the existing bridge will be retained/modified taking into consideration track lowering, and the incorporation of a protection barrier.

3.9.4.3 Dufferin Ave. Overhead Bridge (MP 2.38, City of Toronto) – Lakeshore West Corridor

A study was undertaken to determine the feasibility of attaining adequate vertical clearance and incorporating a protection barrier to the bridge to meet the requirements of the Electrification project. "Roadway/bridge raise/replace" and "track lower" scenarios were studied for attaining an adequate vertical clearance. Sufficient information on the existing modular truss superstructures was not available to determine if the existing bridge was structurally adequate for the addition of the protection barrier, or if it is feasible. As expressed by the City of Toronto (bridge owner) during a coordination meeting on August 5, 2016, the existing modular truss superstructure is considered "temporary" and is not capable of accommodating the required protection barrier, or resisting the resulting additional induced forces. Also, the condition of the abutments is poor to the point that the City would not consider reusing/modifying the abutments; the existing bridge should be completely replaced, as is the City's current expectation, irrespective of Metrolinx's electrification project. Furthermore, the bridge replacement would be more difficult if performed post-electrification due to the presence of electrified tracks and Metrolinx's intended more frequent GO Transit headways.

The *City of Toronto Dufferin Street Bridge Class Environmental Assessment (July 14, 2011*) was reviewed relative to the requirements of the Electrification project. The preferred solution identified through the Class EA included replacing both Dufferin Street bridges over the Gardiner Expressway and rail corridor along the existing alignment. The proposed minimum vertical clearance of 7.01m for the Dufferin St. bridge over the rail corridor presented in the City's Class EA does not require modification for Electrification. Specifically, the proposed design for the structure included spanning a 6-track section of the GO rail corridor. Therefore the only additional requirements for the new Dufferin St. bridge over the rail corridor to accommodate electrification are the inclusion a protection barrier and potentially flash plates depending on the final proposed structure type e.g., (steel, concrete).

Based on the results of the structural assessment, current lack of available information on the existing bridge, and coordination with the City of Toronto, it was determined that it is unfeasible to retain/modify the existing bridge. Consequently, the bridge will require complete replacement.. It was determined feasible to raise the roadway profile and replace the bridge. As such, the preliminary solution is to raise the roadway profile and replace the bridge toward attaining adequate vertical clearance and incorporate a protection barrier in order to meet the requirements of the electrification project. In order to accommodate the vertical clearance of 7.01m proposed in the City of Toronto's preliminary 2011-2012 design, the tracks will be lowered approximately 200mm in order to attain an overall MVC of 7.2m as required by OCS at this site. This work will consequently require the replacement of the abutting bridge over the Gardiner Expressway just south of the rail corridor.

Future TPAP Addendum Work

If required, the detailed assessment of environmental impacts and public/stakeholder consultation related to modifications to Dufferin Ave. Bridge will be carried out as part of an Addendum to the GO Rail Network Electrification TPAP (once approved), based on the preparation of a more detailed level of design. It is noted that if the TPAP Addendum is required, the City of Toronto and TTC will be engaged as appropriate.

3.9.4.4 Dunn Ave. Overhead Bridge (MP 2.69, City of Toronto) – Lakeshore West Corridor

A study was undertaken to determine the feasibility of attaining adequate vertical clearance and incorporating a protection barrier to the bridge to meet the requirements of the Electrification project. "Roadway/bridge raise/replace" and "track lower" scenarios were studied for attaining an adequate vertical clearance. Sufficient information on the existing modular truss superstructures was not available to determine if the existing bridge was structurally adequate for the addition of the protection barrier, or if it is feasible. As expressed by the City of Toronto (bridge owner) during a coordination meeting on August 5, 2016, the existing modular truss superstructure is considered "temporary" and is not capable of accommodating the required protection barrier, or resisting the resulting additional induced forces.

Also, the condition of the abutments is poor to the point that the City would not consider reusing/modifying the abutments; the existing bridge should be completely replaced, as is the City's current expectation, irrespective of Metrolinx's electrification project. Furthermore, the bridge replacement would be more difficult if performed post-electrification due to the presence of electrified tracks and Metrolinx's intended more frequent GO Transit headways.

Based on the results of the structural assessment, current lack of available information on the existing bridge, and coordination with the City of Toronto, it has been determined that it is unfeasible to retain/modify the existing bridge. Consequently, the bridge will require complete replacement. As such, the preliminary solution is to raise the roadway profile and replace the bridge toward attaining adequate vertical clearance and incorporate a protective barrier in order to meet the requirements of the electrification project. In order to reduce the magnitude of the bridge/roadway profile raise, the tracks will be lowered approximately 200mm in order to attain an overall MVC of 7.2m as required by OCS at this site.

Future TPAP Addendum Work

The detailed assessment of environmental impacts and public/stakeholder consultation related to modifications to Dunn Ave. Bridge will be carried out as part of an Addendum to the GO Rail Network Electrification TPAP as required (once approved), based on the preparation of a more detailed level of design.

3.9.4.5 Jameson Ave. Overhead Bridge (MP 2.85, City of Toronto) – Lakeshore West Corridor

A study was undertaken to determine the feasibility of attaining adequate vertical clearance and incorporating a protection barrier to the bridge to meet the requirements of the Electrification project. "Roadway/bridge raise/replace" and "track lower" scenarios were studied for attaining an adequate vertical clearance. Consequently, the preliminary solution identified is to raise the roadway profile and replace the bridge toward attaining adequate vertical clearance and incorporate a protection barrier in order to meet the requirements of the electrification project. In order to reduce the magnitude of the bridge/roadway profile raise, the tracks will need to be lowered approximately 200mm in order to attain an overall MVC of 7.2m as required by OCS at this site.

Future TPAP Addendum Work

The detailed assessment of environmental impacts and public/stakeholder consultation related to modifications to Jameson Ave. Bridge will be carried out as part of an Addendum to the GO Rail Network Electrification TPAP as required (once approved), based on the preparation of a more detailed level of design.

3.9.4.6 Browns Line Overhead Bridge (MP 9.41, City of Toronto) – Lakeshore West Corridor

An initial site assessment was performed and an OCS clearance/layout was investigated conceptually at this bridge location. The preliminary solution to achieve adequate vertical clearance was determined to be lowering the tracks, with the expectation that the existing bridge will be retained/modified taking into consideration track lowering, and the incorporation of a protection barrier.

3.9.4.7 Drury Lane Pedestrian Bridge (MP 31.28, City of Burlington) – Lakeshore West Corridor

An initial site assessment was performed and an OCS clearance/layout was investigated conceptually at this bridge location. In addition, a structural assessment was performed. Based on the results of the structural assessment, the preliminary solution to achieve adequate vertical clearance and add a protection barrier was determined to be replacement of the bridge. The results of the structural assessment indicate that the bridge, under existing conditions, requires major modification that would alter the aesthetics of the structure; and, the addition of a protection barrier will exacerbate the extent of the modifications. Furthermore, additional modifications may be needed to the bridge substructures, such as enlarging the existing footings and the strengthening of the piers, which would be a major modification. Although the extent of the modifications cannot be confirmed until further design work is done, the preliminary solution for this bridge is to replace it in order to be code compliant, and incorporate a protection barrier to meet the requirements of the Electrification project.

Future TPAP Addendum Work

If required (if there are environmental/other impacts identified that extend beyond the current footprint of the existing pedestrian bridge), the detailed assessment of environmental impacts and public/stakeholder consultation related to modifications to Drury Lane Bridge will be carried out as part of an Addendum to the GO Rail Network Electrification TPAP (once approved), based on the preparation of a more detailed level of design.

3.9.4.8 Sunnyside Pedestiran Bridge (MP 3.54, City of Toronto)– Lakeshore West Corridor

To address the vertical clearance issue at Sunnyside Pedestrian Bridge, improvements to the quality of maintenance practices will be implemented by Metrolinx in order to reduce track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired).

In addition, the results of the structural assessment indicate that the bridge, under existing conditions, requires modification, and the addition of a protection barrier will exacerbate the extent of the modifications. Furthermore, additional modifications may be needed to the bridge substructures, such as enlarging the existing footings and the strengthening of the piers. This would be a major endeavor that could alter the aesthetics of the structure or necessitate the replacement of the structure altogether. Also, under existing conditions and with the addition of a protection barrier, the frequency of the structure is within the approximate frequency range of typical human footfall (i.e. between 2 and 2.5 Hz), and therefore, the vibration of the structure may have to be addressed. Although the extent of the modifications cannot be confirmed until further detailed design work is done, the preliminary solution for this bridge is to retain/modify it in order to be code compliant, and incorporate a protection barrier and meet the requirements of the Electrification project.

3.9.4.9 Gardiner Expressway Bridge (MP 5.61, City of Toronto)– Lakeshore West Corridor

An initial site assessment was performed and an OCS clearance/layout was investigated conceptually at this bridge location. To address the vertical clearance issue at the Gardner Expressway Bridge, improvements to the quality of maintenance practices will be implemented by Metrolinx in order to reduce track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired).

As noted above in Section 3.9.4.3, this particular structure has already been identified for replacement by the City of Toronto through the *City of Toronto Dufferin Street Bridge Class Environmental Assessment (July 14, 2011*).

3.9.4.10 Royal Windsor Drive Bridge (MP 18.77, Town of Oakville) - Lakeshore West Corridor

An initial site assessment was performed and an OCS clearance/layout was investigated conceptually at this bridge location. To address the vertical clearance issue at the Royal Windsor Drive Bridge, improvements to the quality of maintenance practices will be implemented by Metrolinx in order to reduce track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired).

3.9.4.11 Dundas Street (MP 3.37, City of Toronto) – Barrie Corridor

An initial site assessment was performed and an OCS clearance/layout was investigated conceptually at this bridge location. Due to the extent of expected impacts of raising the bridge, the preliminary solution to attain adequate vertical clearance was determined to be lowering the tracks, with the expectation that the existing bridge will be retained/modified taking into consideration track lowering and the incorporation of a protection barrier.

3.9.4.12 Highway 401 (MP 8.80, City of Toronto) – Barrie Corridor

An initial site assessment was performed and an OCS clearance/layout was investigated conceptually at this bridge location. Due to the extent of expected impacts of raising the bridge, the preliminary solution to attain adequate vertical clearance was determined to be lowering the tracks, with the expectation that the existing bridge will be retained/modified taking into consdieration track lowering, if any, and the incorporation of a protection barrier.

3.9.4.13 Granite Crt. Bridge (MP 314.95, City of Pickering) – Lakeshore East Corridor

An initial site assessment was performed and an OCS clearance/layout was investigated conceptually at this bridge location. To address the vertical clearance issue at Granite Crt. Bridge, improvements to the quality of maintenance practices will be implemented by Metrolinx in order to reduce track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired).

3.9.4.14 Main St. Bridge (MP 328.64, City of Toronto) – Lakeshore East Corridor

An initial site assessment was performed and an OCS clearance/layout was investigated conceptually at this bridge location. To address the vertical clearance issue at Main St. Bridge, improvements to the quality of maintenance practices will be implemented by Metrolinx in order to reduce track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired).

3.9.4.15 Birchmount Road (MP 326.50, City of Toronto)- Lakeshore East Corridor

The vertical clearance issue for Birchmount Road bridge is to be mitigated through a combination of: improvements to the quality of Metrolnx's maintenance practice which will allow a reduction to track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired), as well as freight restriction to "future track 4".

In addition, it is noted that modification is needed to the existing bridge to accommodate a future 4th track (the future track is not part of the current scope of the GO Rail Network Electrification TPAP) which entails modifying and augmenting support of the existing north abutment and north pier. It is therefore expected that the existing bridge will be retained/modified taking into consideration incorporation of a protection barrier required for electrification.

3.9.5 Modifications to Pedestrian Bridges

Structural evaluations were performed as part of the conceptual design phase/TPAP to assess the load carrying capacity/structural adequacy of the following existing ten (10) pedestrian bridges, as they are affected by requirement of the Electrification project to incorporate a protection barrier. It is noted that for the Sunnyside and Drury Lane pedestrian bridges (Lakeshore West), these have been discussed in Section 3.9.4 above since they are structures with vertical clearance issues.

- **Four (4) overhead pedestrian bridges on Lakeshore West Corridor**
  - OH Bridge 3.02 Dowling Avenue
  - OH Bridge 3.54 Sunnyside (see section 3.9.4.8 above for details)
  - OH Bridge 31.28 Drury Lane (see section 3.9.4.11 above for details)
  - OH Bridge 31.65 GO Station Burlington

- **One (1) overhead pedestrian bridge on Barrie Corridor**
  - OH Bridge 5.65 Innes Avenue
- **One (1) overhead pedestrian bridge on Stouffville Corridor**
  - OH Bridge 58.79 Mooregate / Tara Avenue
- **Two (4) overhead pedestrian bridges on Lakeshore East Corridor**
  - OH Bridge 1.09 GO Station Pickering North
  - OH Bridge 8.87 GO Station Whitby
  - OH Bridge 326.15 Woodrow Avenue
  - OH Bridge 330.96 Pape Avenue

Based on the conceptual engineering work completed to assess potential modifications to the pedestrian bridges, it was established that several of these pedestrian bridges will need to be either replaced or modified to incorporate a protection barrier, as described in each respective section below.

3.9.5.1 Dowling Avenue Pedestrian Bridge (MP 3.02, City of Toronto) – Lakeshore West Corridor

An initial site assessment was performed at this bridge location to determine the feasibility incorporating a protection barrier to the bridge to meet the requirements of the Electrification project. However, sufficient information on the existing modular truss superstructures was not available to determine if the existing bridge was structurally adequate for the addition of the protection barrier, or if it is feasible. As expressed by the City of Toronto (bridge owner) during a coordination meeting on August 5, 2016, the existing modular truss superstructure is considered "temporary" and is not capable of accommodating the required the protection barrier, or resisting the resulting additional induced forces. Also, the condition of the abutments is poor to the point that the City would not consider reusing/modifying the abutments; the existing bridge should be completely replaced, as is the City's current expectation, irrespective of Metrolinx's electrification project. Furthermore, the bridge replacement would be more difficult if performed post-electrification due to the presence of electrified tracks and Metrolinx's intended more frequent GO Train service.

The target required MVC for this structure over the railroad tracks was identified to be 7.18 m as this height will help reduce the extent of potential impacts to the surrounding road network. Based on the results of the assessment, current lack of available information on the existing bridge, and discussions/coordination with the City of Toronto, it has been determined that it is unfeasible to retain/modify the existing bridge. Consequently, the bridge will require complete replacement. This replacement will incorporate a protection barrier and meet the requirements of the Electrification project.

Future TPAP Addendum Work

If required (i.e., if there are environmental/other impacts that may extend beyond the current footprint of the existing pedestrian bridge), the detailed assessment of environmental impacts and public/stakeholder consultation related to modifications to Dowling Ave Pedestrian Bridge will be carried out as part of an Addendum to the GO Rail Network Electrification TPAP (once approved), based on the preparation of a more detailed level of design.

3.9.5.2 Sunnyside Pedestrian Bridge (MP 3.54, City of Toronto) – Lakeshore West Corridor

Please refer to Section 3.9.4.8 above for a detailed description of the modifications required for Sunnyside Pedestrian Bridge.

3.9.5.3 Drury Lane Pedestrian Bridge (MP 31.28, City of Burlington)- Lakeshore West Corridor

Please refer to Section 3.9.4.7 above for a detailed description of the modifications required for Drury Lane Pedestrian Bridge.

3.9.5.4 GO Station Burlington Pedestrian Bridge (MP 31.65, City of Burlington) - Lakeshore West Corridor

An initial assessment was performed for this bridge location, indicating modifications are needed for the pedestrians/public walkway area; the existing louvered vents between truss panels need to be removed and replaced with solid-faced barrier, preferably in-kind to match/mimic the adjacent with glass panels. However, a maintenance catwalk outside of glass area on either side of bridge exists. The catwalk is an open grid/grating with open railing system and completely exposed over tracks. The grating and the railing will need to be replaced with solid barrier 2m above standing surface to comply with electrification standards, or all maintenance work will need to be done under a full catenary outage.

3.9.5.5 Innes Ave. Pedestrian Bridge (MP 5.65, City of Toronto) – Barrie Corridor

The results of the structural assessment indicate that the bridge, under existing conditions and with the addition of a protection barrier, is adequate to support the intended design loads, with the exception that support reaction forces of the bridge with a protection barrier increased over 10% from the existing condition which may require modification to the bearings and/or substructures, such as enlarging the existing footings. Although the extent of the modifications cannot be confirmed until further detailed design work is done, the preliminary solution for this bridge is to retain/modify it in order to incorporate a protection barrier and meet the requirements of the Electrification project.

3.9.5.6 Mooregate Ave/Tara Ave Pedestrian Bridge (MP 58.79, City of Toronto)– Stouffville Corridor

The initial results of the structural assessment indicate that the bridge, under existing conditions, requires major modification that would alter the aesthetics of the structure; and, the addition of a protection barrier will exacerbate the extent of the modifications. Furthermore, additional modifications may be needed to the bridge substructures, such as enlarging the existing footings and the strengthening of the piers, which would be a major modification. Although the extent of the modifications cannot be confirmed until further detailed design work is done, the preliminary recommended solution for this bridge is to retain/modify it in order to be code compliant, and incorporate a protection barrier to meet the requirements of the Electrification project.

3.9.5.7 GO Station Pickering North Pedestrian Bridge (MP 1.09, City of Pickering) - Lakeshore East Corridor

An initial assessment was performed for this bridge location, indicating no modifications are needed for the pedestrians/public walkway area, as this crossing is completely enclosed. However, a maintenance catwalk outside of glass area on either side of bridge exists. The catwalk is an open grid/grating with open railing system and completely exposed over tracks. The grating and the railing will need to be replaced with solid barrier 2m above standing surface to comply with electrification standards, or all maintenance work will need to be done under a full catenary outage.

3.9.5.8 GO Station Whitby Pedestrian Bridge (MP 8.87, Town of Whitby)- Lakeshore East Corridor

An initial assessment was performed for this bridge location, indicating modifications are needed for the pedestrians/public walkway area; the existing louvered vents between truss panels need to be removed and replaced with solid-faced barrier, preferably in-kind to match/mimic the adjacent with glass panels. However, a maintenance catwalk outside of glass area on either side of bridge exists. The catwalk is an open grid/grating with open railing system and completely exposed over tracks. The grating and the railing will need to be replaced with solid barrier 2m above standing surface to comply with electrification standards, or all maintenance work will need to be done under a full catenary outage.

3.9.5.9 Woodrow Avenue Pedestrian Bridge (MP 326.15, City of Toronto) – Lakeshore East Corridor

The initial results of the structural assessment indicate that the bridge, under existing conditions and with the addition of a protection barrier, is adequate to support the intended design loads, with the exception that support reaction forces of the bridge with a protection barrier increased over 10% from the existing condition which may require modification to the bearings and/or substructures, such as enlarging the existing footings. Although the extent of the modifications cannot be confirmed until further detailed design work is done, the preliminary recommended solution for this bridge is to retain/modify it in order to incorporate a protection barrier to meet the requirements of per the Electrification project.

3.9.5.10 Pape Avenue Pedestrian Bridge (MP 330.96, City of Toronto) – Lakeshore East Corridor

The results of the structural assessment indicate that the bridge, under existing conditions, is adequate to support the intended design loads. However, with the addition of a protection barrier, the bridge is inadequate and requires major modification. Also, under existing conditions and with the addition of a protection barrier, the frequency of the structure is within the approximate frequency range of typical human footfall (i.e. between 2 and 2.5 Hz), and therefore, the vibration of the structure may have to be addressed. Although the extent of the modifications cannot be confirmed until further detailed design work is done, the preliminary solution for this bridge is to retain/modify it in order to incorporate a protection barrier and meet the requirements of the Electrification project.

3.9.6 Summary of Bridge Modifications by Corridor

The sections below provide summaries (by rail corridor) of the proposed bridge modifications required for each bridge and rail overpass structure.

3.9.6.1 Union Station Rail Corridor

Table 3-6 summarizes the proposed bridge modifications required for each bridge and rail overpass structure along the Union Station Rail Corridor.

Table 3-6: Union Station Rail Corridor – Summary of Bridge Modifications

Corridor	Mile	Primary Name	Type of Structure[15]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
USRC	0.09	York Street	Rail Overpass (Road)	N/A	No	No	No
USRC	332.60	Cherry Street	Rail Overpass (Road)	N/A	No	Yes	No
USRC	332.85	Parliament Street	Rail Overpass (Road)	N/A	No	No	No
USRC	333.12	Sherbourne Street	Rail Overpass (Road)	N/A	No	No	No
USRC	333.32	Jarvis Street	Rail Overpass (Road)	N/A	No	No	No
USRC	333.63	Yonge Street	Rail Overpass (Road)	N/A	No	No	No
USRC	333.75	Bay Street	Rail Overpass (Road)	N/A	No	No	No

[15] Bridge is defined as rail under road or pedestrian walkway. Rail overpass is defined as rail over road or water.

3.9.6.2 Lakeshore West Corridor

Table 3-7 summarizes the proposed bridge modifications required for each bridge and rail overpass structure along the Lakeshore West Rail Corridor.

Table 3-7: Lakeshore West Rail Corridor – Summary of Bridge Modifications

Corridor	Mile	Primary Name	Type of Structure[16]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
LSW	1.57	Strachan Avenue (#559)	Bridge	Yes. Due to the bridge type and its proximity to other structures and roadway geometry, the extent of expected impacts were such that the preliminary solution to attain adequate vertical clearance was determined to be lowering the tracks.	No	Yes	Yes. The existing bridge will be retained/modified taking into consideration track lowering, and the incorporation of a protection barrier.
LSW	2.38	Dufferin Street (#509)	Bridge	Yes. The preliminary solution is to raise the roadway profile and replace the bridge (as already approved through the City of Toronto MEA Class EA, 2011) toward attaining	No	Yes	Yes. The new bridge will be built with the required barrier.

[16] Bridge is defined as rail under road or pedestrian walkway. Rail overpass is defined as rail over road or water.

Corridor	Mile	Primary Name	Type of Structure[16]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
				adequate vertical clearance.			
LSW	2.69	Dunn Avenue (#511)	Bridge	Yes. The preliminary solution is to raise the roadway profile and replace the bridge toward attaining adequate vertical clearance. In order to reduce the magnitude of the bridge/roadway profile raise, the tracks will be lowered.	No	Yes	Yes. The new bridge will be built with the required barrier.
LSW	2.85	Jameson Avenue (#533)	Bridge	Yes. The preliminary solution is to raise the roadway profile and replace the bridge toward attaining adequate vertical clearance. In order to reduce the magnitude of the bridge/roadway profile raise, the tracks will be lowered.	No	Yes	Yes. The new bridge will be built with the required barrier
LSW	3.02	Dowling Avenue (#507)	Bridge	Yes. Based on the results of the assessment and discussions/coordination	No	No	Yes. Preferred solution to address impacts due to attachment of

Corridor	Mile	Primary Name	Type of Structure[16]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
				with the City of Toronto, it has been determined that it is unfeasible to retain/modify the existing bridge. Therefore preferred solution is to replace the bridge.			protection barrier: replace pedestrian bridge. The new bridge will be built with the required protection barrier.
LSW	3.54	Sunnyside Pedestrian Bridge (#175)	Bridge	Yes. To address the vertical clearance issue, improvements to the quality of maintenance practices will be implemented by Metrolinx in order to reduce track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired).	No	No	Yes. Preferred solution to address impacts due to attachment of protection barrier: modify pedestrian bridge.
LSW	3.89	Parkside Drive	Rail Overpass (Road)	N/A	No	No	No
LSW	4.17	Colborne Lodge Drive	Rail Overpass (Road)	N/A	No	No	No
LSW	4.54	Ellis Avenue	Rail Overpass (Road)	N/A	No	No	No

Corridor	Mile	Primary Name	Type of Structure[16]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
LSW	4.70	Windemere Avenue	Rail Overpass (Road)	N/A	No	No	No
LSW	4.89	Gardiner Expressway Ramp	Rail Overpass (Road)	N/A	No	No	No
LSW	4.90	Riverside Drive	Rail Overpass (Road)	N/A	No	No	No
LSW	5.02	Humber River	Rail Overpass (Watercourse)	N/A	No	Yes	No
LSW	5.15	Queen Street	Rail Overpass	N/A	No	No	No
LSW	5.32	TTC Humber Loop	Rail Overpass (Rail)	N/A	No	No	No
LSW	5.61	Gardiner Expressway (#418)[17]	Bridge	Yes. To address the vertical clearance issue, improvements to the quality of maintenance practices will be implemented by Metrolinx in order to reduce track maintenance allowance (TMA) (i.e., the	Yes	Yes	Yes

[17] This structure was identified to be replaced through the City of Toronto Dufferin Street Bridge Class Environmental Assessment (July 14, 2011).

Corridor	Mile	Primary Name	Type of Structure[16]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
				tolerances that are allowed before the track needs to be repaired).			
LSW	5.82	Park Lawn Road	Rail Overpass (Road)	N/A	No	No	No
LSW	5.94	Mimico Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSW	6.77	Royal York Road	Rail Overpass (Road)	N/A	No	No	No
LSW	7.46	Islington Avenue (#371)	Bridge	No	Yes	Yes - not over LSW tracks[18]	Yes
LSW	7.70	Brant Street	Rail Overpass	N/A	No	No	No
LSW	8.05	Kipling Avenue (#003)	Rail Overpass (Road)	N/A	No	No	No
LSW	8.77	30th Street	Rail Overpass (Road)	N/A	No	No	No
LSW	9.41	Browns Line (#002)	Bridge	The preliminary solution to achieve adequate vertical clearance was determined to be lowering the tracks, with the expectation that the	No	Yes	Yes

[18] The MVC of this bridge over the Willowbrook Yard tracks is not as high and will require OCS attachments.

Corridor	Mile	Primary Name	Type of Structure[16]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
				existing bridge will be retained/modified.			
LSW	9.70	Long Branch	Rail Overpass (Pedestrian Walkway)	N/A	No	No	No
LSW	9.82	Etobicoke Creek	Rail Overpass (Watercourse)	N/A	No	Yes	No
LSW	10.18	Dixie Road	Rail Overpass (Road)	N/A	No	No	No
LSW	11.47	Cawthra Road	Rail Overpass (Road)	N/A	No	No	No
LSW	11.80	Cooksville Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSW	12.73	Hurontario Street	Rail Overpass (Road)	N/A	No	No	No
LSW	13.27	Credit River	Rail Overpass (Watercourse)	N/A	No	Yes	No
LSW	13.39	Mississauga Road	Rail Overpass (Road)	N/A	No	No	No
LSW	16.62	Southdown Road	Rail Overpass (Road)	N/A	No	No	No

Corridor	Mile	Primary Name	Type of Structure[16]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
LSW	16.68	Sheridan Creek divert	Rail Overpass (Watercourse)	N/A	No	No	No
LSW	17.92	Winston Churchill Boulevard	Rail Overpass (Road)	N/A	No	No	No
LSW	18.67	Ford Drive	Rail Overpass (Road)	N/A	No	No	No
LSW	18.77	Royal Windsor Drive	Bridge	Yes. To address the vertical clearance issue, improvements to the quality of maintenance practices will be implemented by Metrolinx in order to reduce track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired).	No	Yes	Yes
LSW	18.90	Joshua Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSW	21.23	Trafalgar Road	Rail Overpass (Road)	N/A	No	No	No
LSW	21.70	Cross Avenue	Rail Overpass (Road)	N/A	No	Yes	No

Corridor	Mile	Primary Name	Type of Structure[16]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
LSW	21.71	Sixteen Mile Creek	Rail Overpass (Watercourse)	N/A	No	Yes	No
LSW	22.59	Dorval Drive	Rail Overpass (Road)	N/A	No	No	No
LSW	22.99	McCraney Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSW	24.18	Fourteen Mile Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSW	24.42	Third Line	Rail Overpass (Road)	N/A	No	No	No
LSW	25.69	Bronte Road	Rail Overpass (Road)	N/A	No	No	No
LSW	25.87	Bronte Creek	Rail Overpass (Watercourse)	N/A	No	Yes	No
LSW	26.71	Sheldon Creek East	Rail Overpass (Watercourse)	N/A	No	No	No
LSW	27.45	Sheldon Creek	Rail Overpass (Watercourse)	N/A	No	No	No

Corridor	Mile	Primary Name	Type of Structure[16]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
LSW	28.25	Appleby Line	Rail Overpass (Road)	N/A	No	No	No
LSW	29.04	Shoreacres Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSW	29.53	Walker's Line	Rail Overpass (Road)	N/A	No	No	No
LSW	29.64	Tuck Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSW	30.67	Roseland Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSW	30.81	Guelph Line	Rail Overpass (Road)	N/A	No	Yes	No
LSW	31.28	Drury Lane Pedestrian Bridge	Bridge	Yes – preferred solution is to replace bridge (see details in last column)	No	No	Preferred solution to address impacts due to attachment of protection barrier and vertical clearance issue: replace bridge. The new bridge will be built with the required barrier.
LSW	31.65	Burlington GO Station Pedestrian Bridge	Bridge	No	No	No	The catwalk is an open grid/grating with open railing system and completely exposed

Corridor	Mile	Primary Name	Type of Structure[16]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
							over tracks. The grating and the railing will need to be replaced with solid barrier 2m above standing surface to comply with electrification standards, or all maintenance work will need to be done under a full catenary outage.

3.9.6.3 Kitchener Corridor

Table 3-8 summarizes the proposed bridge modifications required for each bridge and rail overpass structure along the Kitchener Rail Corridor.

Table 3-8: Kitchener Rail Corridor – Summary of Bridge Modifications

Corridor	Mile	Primary Name	Type of Structure[19]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
Kitchener	16.90	Highway 407 North	Bridge	No	No	Yes	Yes
Kitchener	16.94	Highway 407 South	Bridge	No	No	Yes	Yes
Kitchener	11.39	Bramalea Road	Bridge	No	Yes	Yes	Yes
Kitchener	13.60	Goreway Drive	Rail Overpass (Road)	N/A	No	No	No
Kitchener	13.70	Mimico Creek	Rail Overpass (Watercourse)	N/A	No	No	No
Kitchener	14.80	Derry Road	Rail Overpass (Road)	N/A	No	Yes	No
Kitchener	14.87	Airport Road	Rail Overpass (Road)	N/A	No	Yes	No
Kitchener	11.60	GO Bramalea	Bridge	No	Yes	Yes	Yes

[19] Bridge is defined as rail under road or pedestrian walkway. Rail overpass is defined as rail over road or water.

3.9.6.4 Barrie Corridor

Table 3-9 summarizes the proposed bridge modifications required for each bridge and rail overpass structure along the Barrie Rail Corridor.

Table 3-9: Barrie Rail Corridor – Summary of Bridge Modifications

Corridor	Mile	Primary Name	Type of Structure[20]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge?	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
Barrie	3.12	Lansdowne Avenue (#546)	Rail Overpass (Road)	Anticipated impact from M3.37: the Landsdowne Ave. rail overpass may be impacted due to lowering the tracks at Dundas St. (M3.37). Potential impacts *may* include: using a ballast mat, changing from ballasted deck to direct fixation, and even possibly replacement with a shallower superstructure, or lowering of the roadway under the UG (in this case Dundas St.) to accommodate lowering of the UG Bridge superstructure.	No	No	No

[20] Bridge is defined as rail under road or pedestrian walkway. Rail overpass is defined as rail over road or water.

Corridor	Mile	Primary Name	Type of Structure[20]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge?	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
				However the type of impact(s) cannot be confirmed until further design work is done.			
Barrie	3.37	Dundas Street (#020)	Bridge	Yes. The preliminary solution to attain adequate vertical clearance was determined to be lowering the tracks.	No	Yes	Yes. The existing bridge will be retained/modified taking into consideration track lowering and the incorporation of a protection barrier.
Barrie	3.91	Bloor St W (#063)	Rail Overpass (Road)	N/A	No	No	No
Barrie	4.08	Paton Road	Rail Overpass (Road)	N/A	No	No	No
Barrie	4.51	Dupont Street (#524)	Rail Overpass (Road)	N/A	No	No	No
Barrie	4.87	Davenport Avenue (#516)	Rail Overpass (Road)	N/A	No	No	No
Barrie	5.24	St Clair Ave W (#096)	Rail Overpass (Road)	N/A	No	Yes	No
Barrie	5.65	Innes Ave Pedestrian Bridge (#529)	Bridge	No	No	No	Yes. Preferred solution to address impacts due to attachment of

Corridor	Mile	Primary Name	Type of Structure[20]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge?	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
							protection barrier: retain/modify.
Barrie	5.86	Rogers Road (#710)	Rail Overpass (Road)	N/A	No	No	No
Barrie	6.12	Dunraven Drive	Rail Overpass (Pedestrian Walkway)	N/A	No	No	No
Barrie	6.50	Eglinton Ave (#118)	Bridge	No	Yes	Yes	Yes
Barrie	7.81	Lawrence Ave W	Rail Overpass (Road)	N/A	No	No	No
Barrie	8.80	Hwy 401 (#37-195/1-4)	Bridge	Due to the extent of expected impacts of raising the bridge, the preferred solution to attain adequate vertical clearance was determined to be lowering the tracks.	Yes	Yes	Yes. The existing bridge will be retained/modified taking into consideration track lowering, and the incorporation of a protection barrier.
Barrie	9.12	Wilson Ave	Rail Overpass (Road)	N/A	No	No	No
Barrie	10.87	Sheppard Ave W (#321)	Rail Overpass (Road)	N/A	No	No	No
Barrie	11.65	Finch Ave W (#350)	Rail Overpass (Road)	N/A	No	No	No

Corridor	Mile	Primary Name	Type of Structure[20]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge?	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
Barrie	12.90	York Sub	Rail Overpass (Rail)	N/A	No	No	No
Barrie	12.92	Steeles Ave W	Rail Overpass (Road)	N/A	No	No	No
Barrie	13.81	Hwy 407	Rail Overpass (Road)	N/A	No	Yes	No
Barrie	14.25	Hwy #7	Rail Overpass (Road)	N/A	No	No	No
Barrie	18.10	Major Mackenzie Drive	Rail Overpass (Road)	N/A	No	No	No
Barrie	19.60	Keele St	Bridge	No	Yes	Yes	Yes
Barrie	23.26	King Rd	Bridge	No	Yes	Yes	Yes
Barrie	23.30	Keele St	Bridge	No	Yes	Yes	Yes
Barrie	26.50	Bathurst St.	Bridge	No	Yes	No	Yes
Barrie	28.50	Yonge Street	Rail Overpass (Road)	N/A	No	No	No
Barrie	32.00	Clubinis Creek	Rail Overpass (Watercourse)	N/A	No	No	No
Barrie	33.70	Holland River	Rail Overpass (Watercourse)	N/A	No	No	No
Barrie	33.95	Queen St	Bridge	No	Yes	No	Yes

Corridor	Mile	Primary Name	Type of Structure[20]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge?	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
Barrie	41.00	Holland River	Rail Overpass (Watercourse)	N/A	No	Yes	No
Barrie	53.70	6th Line	Bridge	No	Yes	No	Yes
Barrie	60.30	Big Bay Point Rd.	Bridge	No	Yes	No	Yes
Barrie	61.14	Cox Mill Road	Rail Overpass (Road)	N/A	No	Yes	No
Barrie	61.20	Tollendale Creek	Rail Overpass (Watercourse)	N/A	No	Yes	No

3.9.6.5 Stouffville Corridor

Table 3-10 summarizes the proposed bridge modifications required for each bridge and rail overpass structure along the Stouffville Rail Corridor.

Table 3-10: Stouffville Rail Corridor – Summary of Bridge Modifications

Corridor	Mile	Primary Name	Type of Structure[21]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
Stouffville	44.70	Little Rouge River	Rail Overpass (Watercourse)	N/A	No	No	No
Stouffville	47.30	Robinson Creek	Rail Overpass (Watercourse)	N/A	No	No	No
Stouffville	49.60	Bruce Creek	Rail Overpass (Watercourse)	N/A	No	Yes	No
Stouffville	50.30	Rouge River	Rail Overpass (Watercourse)	N/A	No	No	No
Stouffville	50.59	Enterprise Drive	Rail Overpass (Road)	N/A	No	Yes	No
Stouffville	50.95	Hwy 407 W	Bridge	No	Yes	Yes	Yes
Stouffville	51.01	Hwy 407 E	Bridge	No	Yes	Yes	Yes
Stouffville	51.10	CN York Sub (Over Uxbridge Sub)	Bridge	No	Yes	No	Yes
Stouffville	51.50	14th Ave	Bridge	No	Yes	No	Yes

[21] Bridge is defined as rail under road or pedestrian walkway. Rail overpass is defined as rail over road or water.

Corridor	Mile	Primary Name	Type of Structure[21]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
Stouffville	55.73	Sheppard Avenue E	Rail Overpass (Road)	N/A	No	No	No
Stouffville	55.99	West Highland Creek	Rail Overpass (Watercourse)	N/A	No	Yes	No
Stouffville	56.00	CP Bellville Sub	Bridge	No	No	Yes	Yes
Stouffville	56.30	Hwy 401 (#37-0215)	Bridge	No	Yes	Yes	Yes
Stouffville	56.60	West Highland Creek	Rail Overpass (Watercourse)	N/A	No	No	No
Stouffville	56.66	West Highland Creek	Rail Overpass (Watercourse)	N/A	No	No	No
Stouffville	56.87	TTC RT	Rail Overpass (Rail)	N/A	No	No	No
Stouffville	57.01	Pedestrian underpass at Ellesmere Rd. E. RT Station	Rail Overpass (Pedestrian Walkway)	N/A	No	No	No
Stouffville	57.05	Ellesmere Rd (#098)	Bridge	No	Yes	No	Yes
Stouffville	58.30	Lawrence Ave East (#094)	Bridge	No	Yes	No	Yes

Corridor	Mile	Primary Name	Type of Structure[21]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
Stouffville	58.29	Pedestrian underpass at Lawrence Ave E. RT Station	Rail Overpass (Pedestrian Walkway)	N/A	No	No	No
Stouffville	58.79	Mooregate Ave/Tara Ave Pedestrian Bridge (#601)	Bridge	No	No	No	Yes. Preferred solution to address impacts due to attachment of protection barrier: retain/modify pedestrian bridge.
Stouffville	59.49	Eglinton Ave (#370)	Bridge	No	Yes	Yes	Yes
Stouffville	59.51	Pedestrian underpass at Kennedy Rd RT Station	Rail Overpass (Pedestrian Walkway)	N/A	No	No	No

3.9.6.6 Lakeshore East Corridor

Table 3-11 summarizes the proposed bridge modifications required for each bridge and rail overpass structure along the Lakeshore East Rail Corridor.

Table 3-11: Lakeshore East Rail Corridor – Summary of Bridge Modifications

Corridor	Mile	Primary Name	Type of Structure[22]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
LSE	0.35	CN York Sub	Bridge	N/A	No	No	Yes
LSE	0.84	Liverpool Road	Bridge	No	Yes	No	Yes
LSE	1.09	GO Station Pickering North Pedestrian Bridge	Bridge	No	No	No	Yes. Enclosed pedestrian bridge. There are no modifications required for public walkway area, however, a maintenance catwalk outside of glass area on either side of bridge exists. Catwalk is an open grid/grating with open railing system and completely

[22] Bridge is defined as rail under road or pedestrian walkway. Rail overpass is defined as rail over road or water.

Corridor	Mile	Primary Name	Type of Structure[22]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
							exposed over tracks. The grating and the railing will need to be replaced with solid barrier 2m above standing surface to comply with electrification standards, or all maintenance work will need to be done under a full catenary outage.
LSE	1.92	Brock Road	Bridge	No	Yes	No	Yes
LSE	3.00	Duffins Creek	Rail Overpass (Watercourse)	N/A	No	Yes	No
LSE	3.00	Church Street	Rail Overpass (Road)	N/A	No	Yes	No
LSE	3.67	Westney Road South	Rail Overpass (Road)	N/A	No	No	No
LSE	4.52	Harwood Avenue South	Bridge	No	No	No	Yes
LSE	5.09	Salem Road South	Rail Overpass (Road)	N/A	No	No	No

Corridor	Mile	Primary Name	Type of Structure[22]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
LSE	5.52	Carruthers Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSE	6.60	Lakeridge Road - new	Bridge	No	Yes	No	Yes
LSE	7.62	Lynde Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSE	8.72	Henry Street	Bridge	No	Yes	No	Yes
LSE	8.87	GO Station Pedestrian Bridge	Bridge	No	No	No	Yes. Enclosed pedestrian bridge crossing one electrified track (also crossing two non-electrified tracks and adjacent to one electrified track). No modifications required for public walkway area (besides vents). Has .9m maintenance catwalk on both sides of bridge and open grid/grating with open railing system. Catwalk

Corridor	Mile	Primary Name	Type of Structure[22]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
							railing is 1.1m tall from standing surface. The walkway and This railing will need to be replaced with solid barrier 2m above standing surface to comply with electrification standards, or all maintenance work will need to be done under a full catenary outage.
LSE	9.00	Brock Street South	Bridge	No	Yes	No	Yes
LSE	9.31	Victoria Street	Rail Overpass (Road)	N/A	No	Yes	No
LSE	9.31	Pringle Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSE	9.61	South Blair Street – (new)	Rail Overpass (Road)	N/A	No	No	No
LSE	10.65	Creek	Rail Overpass (Watercourse)	N/A	No	No	No
LSE	10.67	Thickson Road	Rail Overpass (Road)	N/A	No	Yes	No

Corridor	Mile	Primary Name	Type of Structure[22]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
LSE	314.76	Whites Road	Bridge	No	No	No	Yes
LSE	314.95	Granite Court	Bridge	Yes. To address the vertical clearance issue at Granite Crt. Bridge, improvements to the quality of maintenance practices will be implemented by Metrolinx in order to reduce track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired).	Yes	Yes	Yes
LSE	316.10	Rouge River	Rail Overpass (Watercourse)	N/A	No	Yes	No
LSE	316.16	Unnamed Ped Walk	Rail Overpass (Pedestrian Walkway)	N/A	No	No	No
LSE	317.70	Rouge Hill Ped	Rail Overpass (Pedestrian Walkway)	N/A	No	No	No
LSE	318.50	Highland Creek	Rail Overpass (Watercourse)	N/A	No	Yes	No

Corridor	Mile	Primary Name	Type of Structure[22]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
LSE	318.51	Highland Creek Ped	Rail Overpass (Pedestrian Walkway)	N/A	No	No	No
LSE	321.45	Kingston Road (#180)	Bridge	No	Yes	Yes	Yes
LSE	322.51	Markham Road (#129)	Bridge	No	Yes	Yes	Yes
LSE	323.19	Eglinton Avenue	Rail Overpass (Road)	N/A	No	Yes	No
LSE	323.65	McCowan Road (#933)	Rail Overpass (Road)	N/A	No	No	No
LSE	324.22	Brimley Road	Rail Overpass (Road)	N/A	No	No	No
LSE	324.97	Midland Avenue	Rail Overpass (Road)	N/A	No	Yes	No
LSE	325.20	St. Clair Avenue East	Rail Overpass (Road)	N/A	No	Yes	No
LSE	325.76	Kennedy Road (#851)	Bridge	No	Yes	Yes	Yes
LSE	326.15	Woodrow Avenue Pedestrian Bridge (#969)	Bridge	No	No	No	Yes. Railings will need to be replaced with solid barrier 2m above standing surface to comply with electrification

Corridor	Mile	Primary Name	Type of Structure[22]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
							standards. Other modifications may be needed. However, the extent of these modifications cannot be confirmed until further design work is performed.
LSE	326.50	Birchmount Road (#825)	Bridge	Yes. Vertical clearance issue is to be mitigated by a combination of improvements to the quality of maintenance practices will be implemented by Metrolinx in order to reduce track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired), as well as freight restriction to “future track 4”.	Yes	Yes	Yes. The existing bridge will be retained/modified and will incorporate a protection barrier.
LSE	327.01	Danforth Avenue (#089)	Rail Overpass (Road)	N/A	No	Yes	No
LSE	327.16	Warden Avenue	Rail Overpass (Road)	N/A	No	No	No

Corridor	Mile	Primary Name	Type of Structure[22]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
LSE	327.93	Victoria Park Avenue (#046)	Rail Overpass (Road)	N/A	No	No	No
LSE	328.64	Main Street (#541)	Bridge	Yes. To address the vertical clearance issue, improvements to the quality of maintenance practices will be implemented by Metrolinx in order to reduce track maintenance allowance (TMA) (i.e., the tolerances that are allowed before the track needs to be repaired).	Yes	Yes	Yes
LSE	329.23	Woodbine Avenue (#045)	Rail Overpass (Road)	N/A	No	No	No
LSE	329.80	Coxwell Avenue (#514)	Rail Overpass (Road)	N/A	No	No	No
LSE	330.08	Woodfield Road	Rail Overpass (Pedestrian Walkway)	N/A	No	No	No
LSE	330.28	Greenwood Avenue (#534)	Rail Overpass (Road)	N/A	No	No	No

Corridor	Mile	Primary Name	Type of Structure[22]	Vertical Clearance Issue?	Flash Plate to be Attached to Bridge	Wires to Be Attached to Bridge?	Bridge Protection Barrier to Be Added or Modified?
LSE	330.68	Jones Avenue (#540)	Rail Overpass (Road)	N/A	No	No	No
LSE	330.96	Pape Avenue Pedestrian Bridge (#545)	Bridge	No	No	No	Yes. Preferred solution to address impacts due to attachment of protection barrier: retain/modify pedestrian bridge.
LSE	331.09	Gerrard Street East	Rail Overpass (Road)	N/A	No	Yes	No
LSE	331.12	Carlaw Avenue	Rail Overpass (Road)	N/A	No	Yes	No
LSE	331.30	Logan Avenue	Rail Overpass (Road)	N/A	No	No	No
LSE	331.39	Dundas Street East (#043)	Rail Overpass (Road)	N/A	No	No	No
LSE	331.68	Queen Street East	Rail Overpass (Road)	N/A	No	No	No
LSE	331.89	Eastern Avenue	Rail Overpass (Road)	N/A	No	Yes	No
LSE	332.13	Don Valley Parkway (#017)	Rail Overpass (Road)	N/A	No	Yes	No
LSE	332.15	Don River	Rail Overpass (Watercourse)	N/A	No	Yes	No

3.10 Parallel Barriers

The purpose of a protection barrier is to protect pedestrians and travelers/infrastructure users within the public right-of-way on bridges and adjacent walkways from accidental direct contact with adjacent live parts of the OCS for voltages up to 25 kV to ground. There are two types of barriers that will be needed: Bridge Barriers (described in Section 3.8.3 above) and Parallel Barriers (described here). A parallel barrier may be required for safety purposes where other structures run parallel to the electrification system.

As part of the conceptual design phase, an initial assessment of areas that may require installation of a parallel barrier for safety was carried out. It should be noted that the list of locations anticipated to require parallel barriers are distinct/different than the bridge protection barriers identified for overhead bridges along the corridors. An example of a typical parallel barrier is depicted in **Figure 3-71** and **Figure 3-72;** the barriers will be non-climbable**.** Potential locations requiring installation of a parallel barrier have been summarized in **Table 3-12** and associated images of each location have been included as **Figure 3-73** to **Figure 3-87.** As part of detailed design, a more detailed assessment of these locations will be undertaken and confirmed.

3.10.1 Depressed corridors

In areas of depressed corridor (e.g. grade separations/tunnels) where the adjacent accessible walking/standing surface is at an elevation above the top of rail and within 3m of an electrified part, a parallel electrification barrier shall be employed to protect public safety and the safe operation of the railroad. This barrier shall be solid, a minimum of 2m in height (vertical from standing surface) and shall be reasonably unclimbable. This barrier will be installed and maintained by Metrolinx.

3.10.2 Elevated Horizontal Walkways

Horizontal walkways which are elevated such that the walking surface adjacent to the catenary is above the top of rail will require isolation by distance or parallel barrier. No person shall approach within 3m of an unguarded electrified part.

3.10.3 Billboards

Where billboards overhang the corridor, or have accessible surfaces which could allow workers or members of the public to approach 3m of an energized part, these surfaces must either be guarded by isolation barrier, or be made inaccessible. In order to make them inaccessible, parties intending to perform maintenance work on these billboards will need to coordinate with Metrolinx to get isolations (i.e., catenary de-energization) before performing maintenance on the billboard.

3.10.4 Balconies

Balconies associated with high rise buildings such as condominium, apartments, etc. which could allow a person to approach within 3m of an electrified part of the electrification system will require isolation by barrier. Based on the assessment completed as part of the conceptual design phase for the TPAP, there were no existing high rise buildings identified that would require protection via parallel barrier, however it is noted that future track expansion and/or new construction/development may create the need for implementation of parallel barriers in the future. Therefore a subsequent detailed review of these locations will be undertaken as part of detailed design and if required, solutions will be developed for any areas of concern on a case-by-case basis.

Table 3-12: Summary of Potential Locations Requiring Parallel Barriers

Rail Corridor	Mile	Side of Corridor	Type of feature	Closest Distance from Track Centre Line (m)	Parallel Barrier Required?	Proposed Mitigation
Union Station Rail Corridor (USRC) (East)	0+019-0+071	South	Walkway	2.9	Yes	Walkways, stairs and walls in elevated areas adjacent to track will require electrification protection (e.g., parallel barrier).
USRC (West)	0+040-0+110	South	Walkway	3.1	Yes	Walkways, stairs and walls in elevated areas adjacent to track will require electrification protection (e.g., parallel barrier).
USRC (West)	0+100	South	Wall alongside track	3 to 5	Yes	Walkways, stairs and walls in elevated areas adjacent to track will require electrification protection (e.g., parallel barrier).
USRC (West)	2+200	North	Wall alongside track	<3	Yes	Parallel barriers will be required in conjunction with traditional pedestrian bridge barriers wherever the elevated pedestrian surface may bring a person within 3m of an electrified part. Walkways, stairs and walls in elevated areas adjacent to track will require electrification protection (e.g., parallel barrier).
Lakeshore West (LSW)	3+839-3+853	North	Stairs	6.2	Yes	Walkways, stairs and walls in elevated areas adjacent to track will require electrification protection (e.g., parallel barrier).
Barrie	5+445	West	Dundas St. Bridge (Railing)	5.3	Yes	Areas accessible to pedestrians such as landings, stairs or overhangs must be made compliant with the specifications for structures passing over electrified corridors. Where a landing would allow personnel within

Rail Corridor	Mile	Side of Corridor	Type of feature	Closest Distance from Track Centre Line (m)	Parallel Barrier Required?	Proposed Mitigation
						3m of an unguarded electrified part, a barrier should be installed.
Barrie	9+075-9+082	West	Innes Ave. Pedestrian Ramp/Bridge	3.7	Yes	This pedestrian bridge requires parallel horizontal barriers due to stairs/railing/landings that could put a pedestrian within 3m of an unguarded part.
Stouffville	82+760 - 83+125	East/West	Depressed Corridor	3.5	Yes	Depressed corridor will require electrification protection barriers (e.g., parallel barrier).
Stouffville	83+175	West	Wall w/ Fence	3.1	Yes	Depressed corridor will require electrification protection barriers (e.g., parallel barrier).
Stouffville	83+345 - 83+400	West	Wall w/ Fence	3.7	Yes	Depressed corridor will require electrification protection barriers (e.g., parallel barrier).
Stouffville	83+400 - 83+460	West	Wall w/ Fence	3.3	Yes	Depressed corridor will require electrification protection barriers (e.g., parallel barrier).

Figure 3-71: Typical Parallel Barrier Drawing

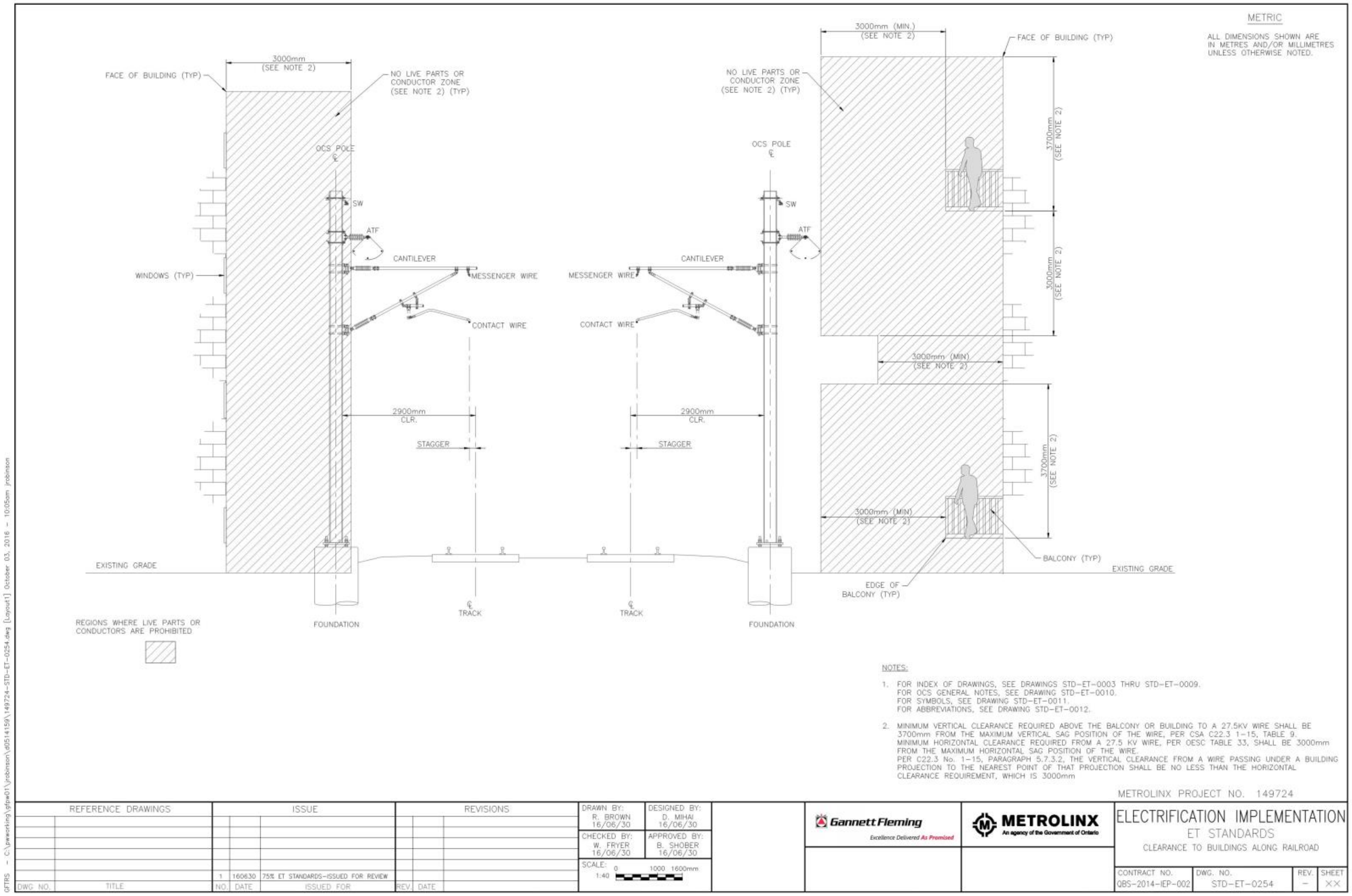


Figure 3-72: Example of a Parallel Barrier

Parallel barriers will be made of mesh or solid material, and will be a minimum height of 2m (barriers of greater heights may be required in areas where vandalism is prevalent). High voltage signage will also be provided as an additional safety measure. Metallic elements of the protection barriers will be grounded by bonding to the static wire at a minimum of two locations, as previously described.

Figure 3-73: USRC East 0+019-0+071 (South Side)

Figure 3-74: USRC East 0+019-0+071 (South Side)

Figure 3-75: USRC West 0+040-0+110 (South Side)

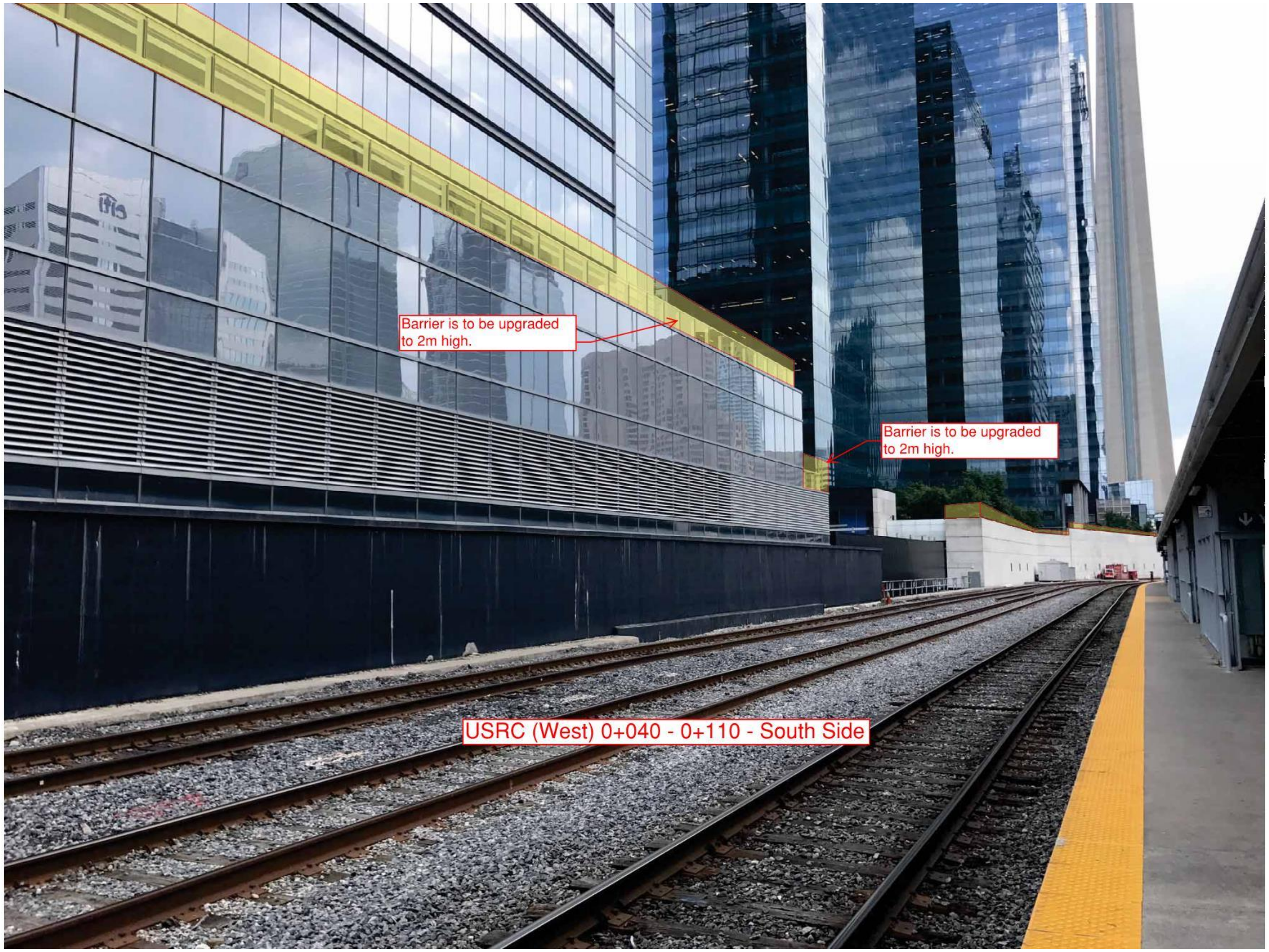


Figure 3-76: USRC West 0+040-0+110 (South Side)

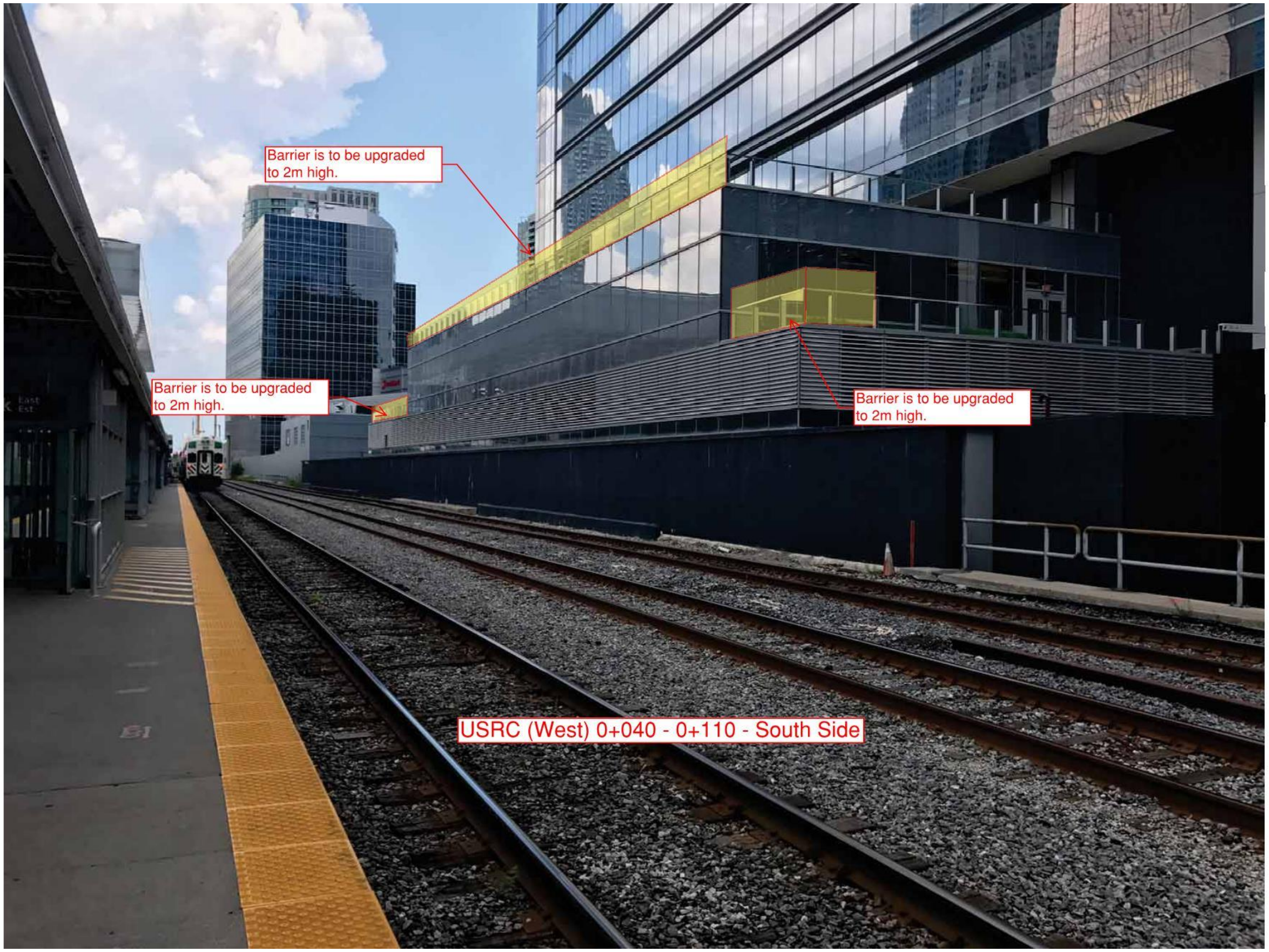


Figure 3-77: USRC West-0+110 (South Side)

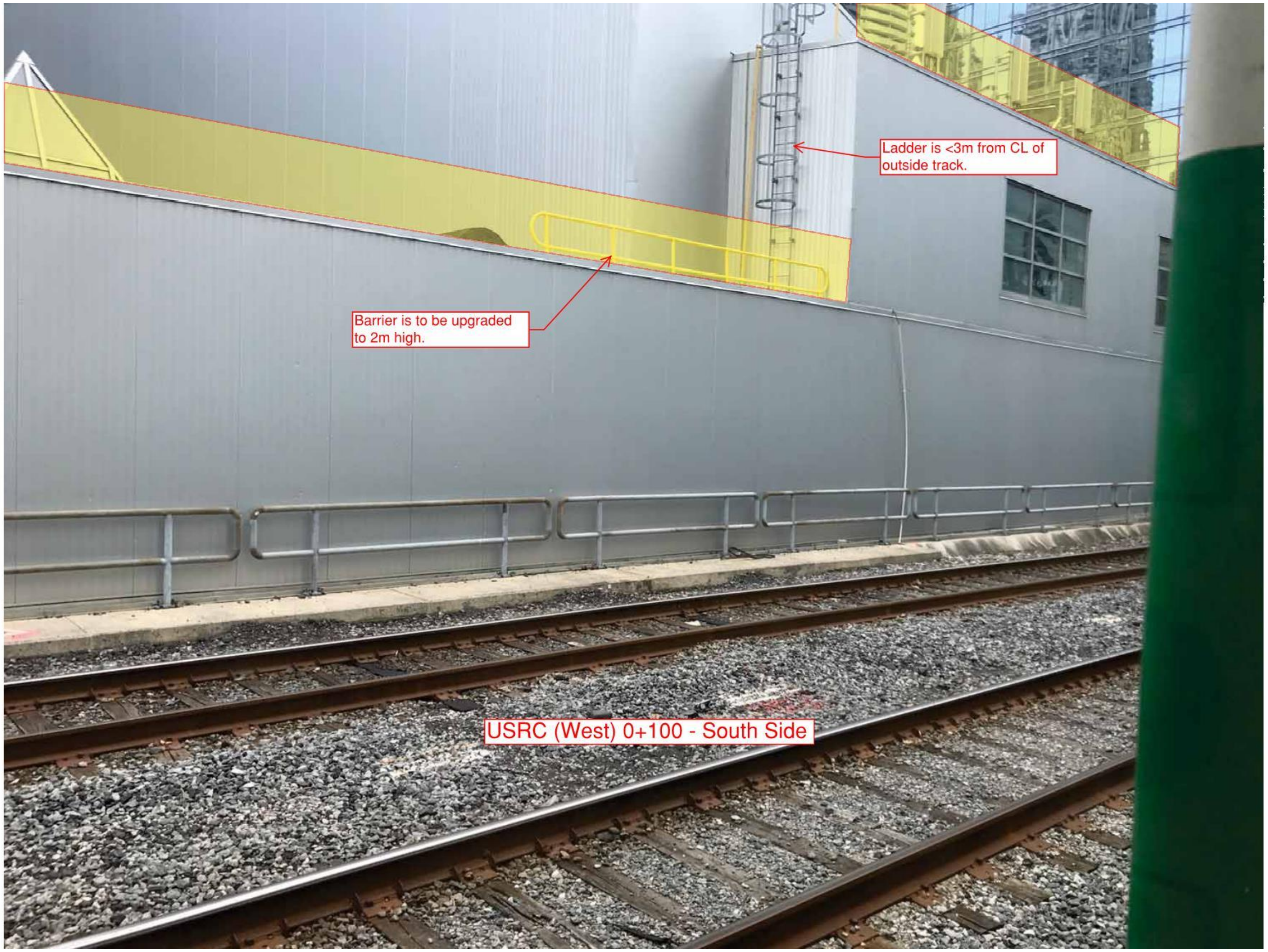


Figure 3-78: USRC West 2+200 (North Side)

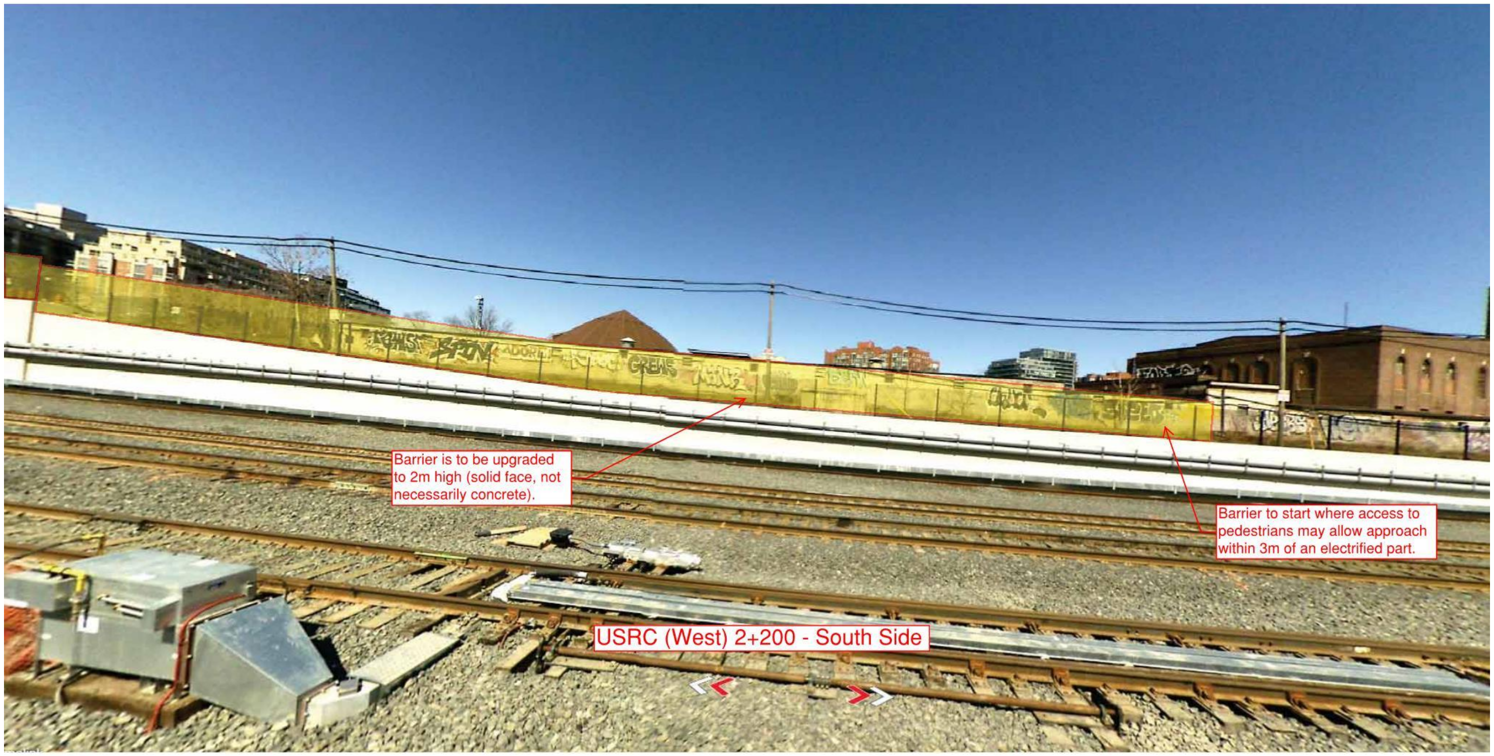


Figure 3-79: Lakeshore West 3+389-3+853 (North Side)

Figure 3-80: Lakeshore West 3+389-3+853 (North Side)

Figure 3-81: Barrie 5+445 (West Side)

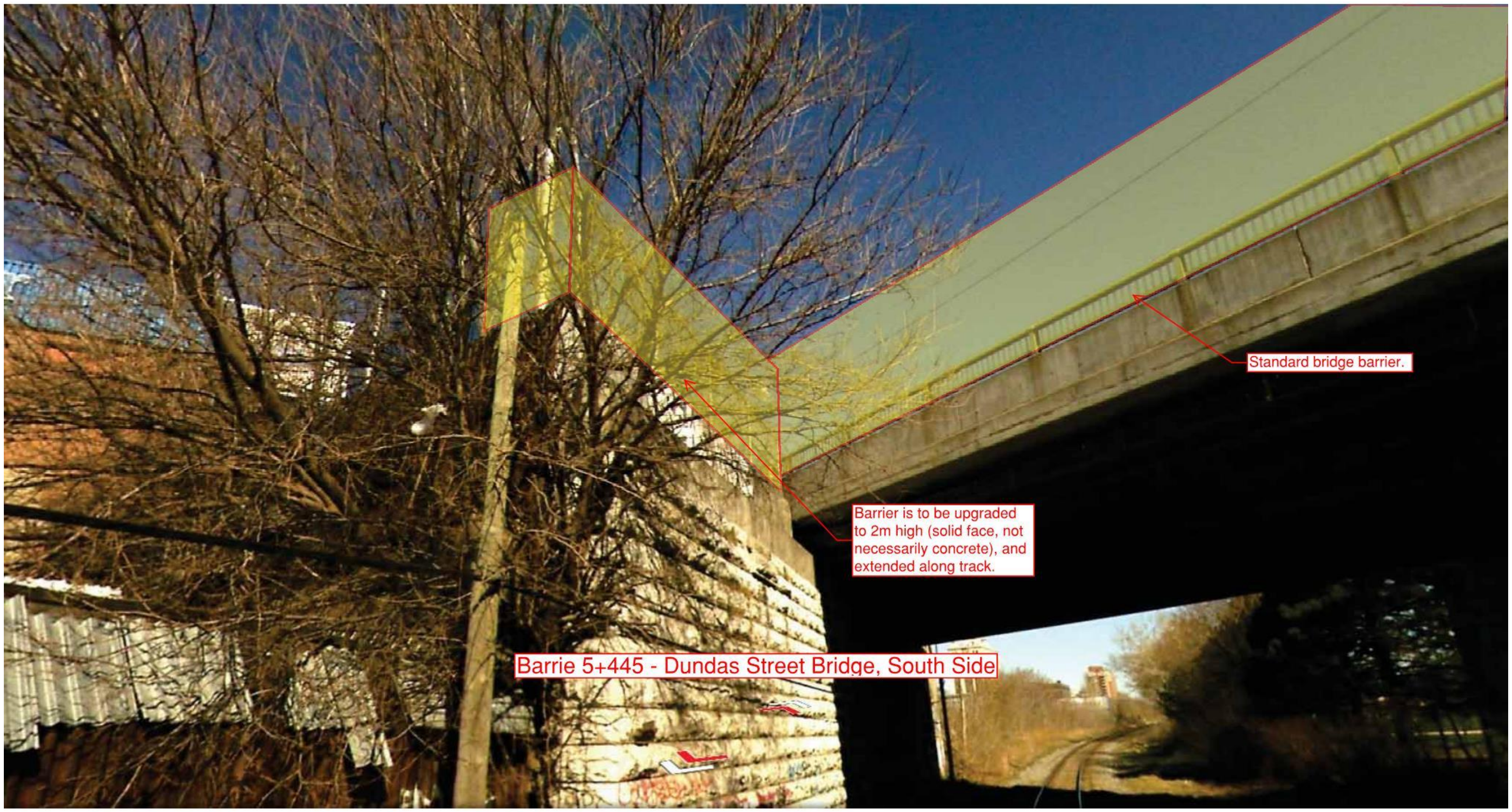


Figure 3-82: Barrie 5+445 (West Side)

Figure 3-83: Barrie 9+075-9+082 (West Side)

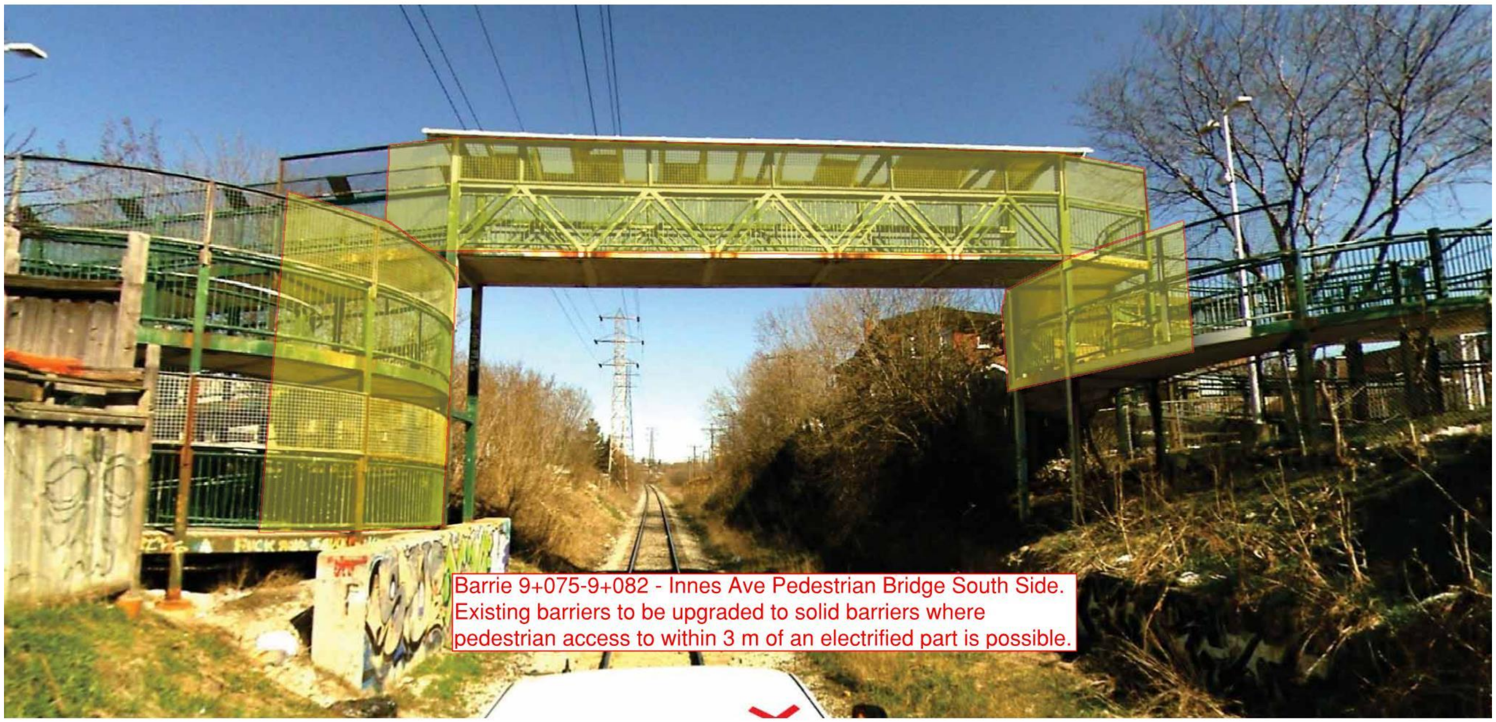


Figure 3-84: Stouffville 82+760 - 83+125 (Depressed Corridor)

Figure 3-85: Stouffville 82+760 - 83+125 (East/West)

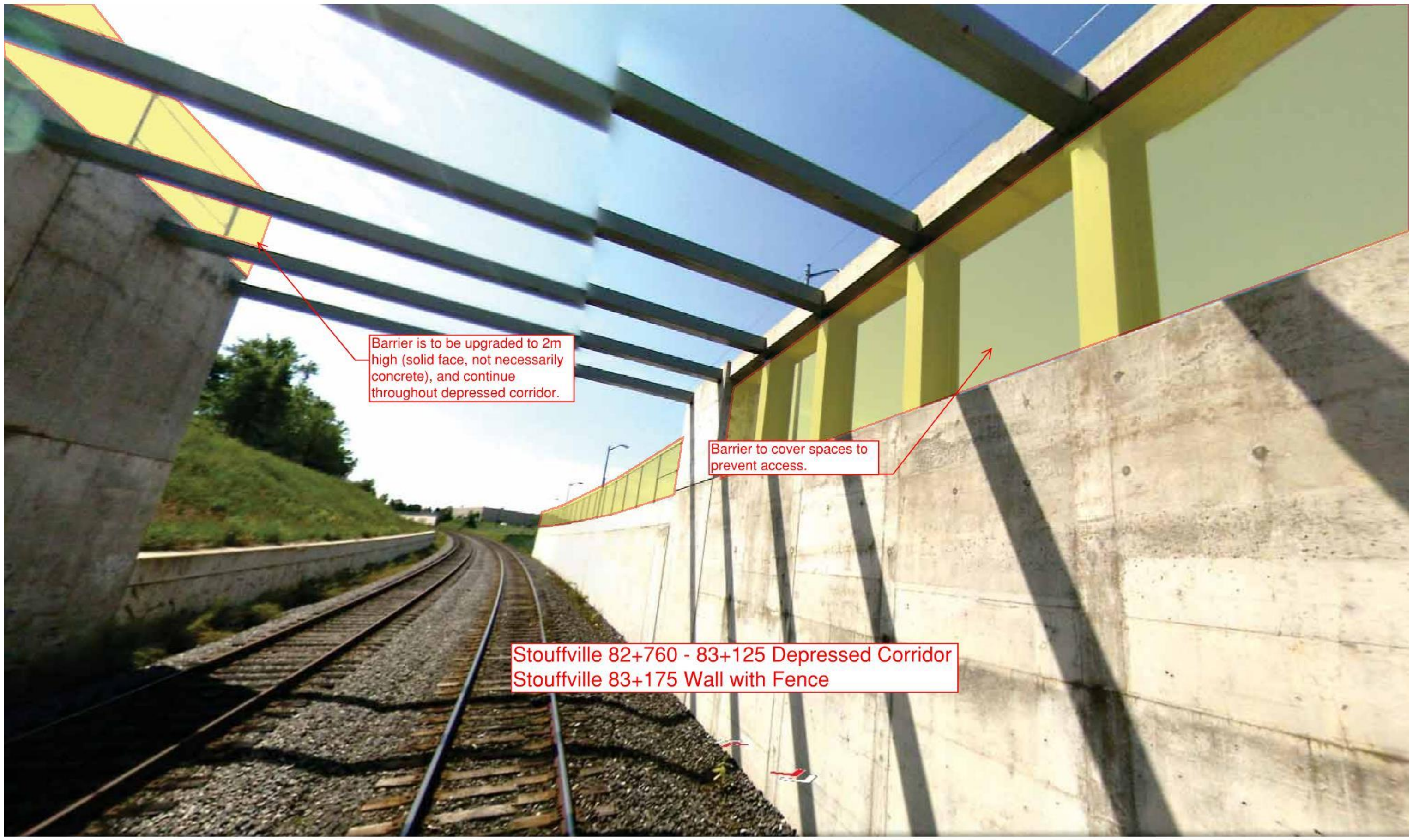


Figure 3-86: Stouffville 83+175 (West Side)

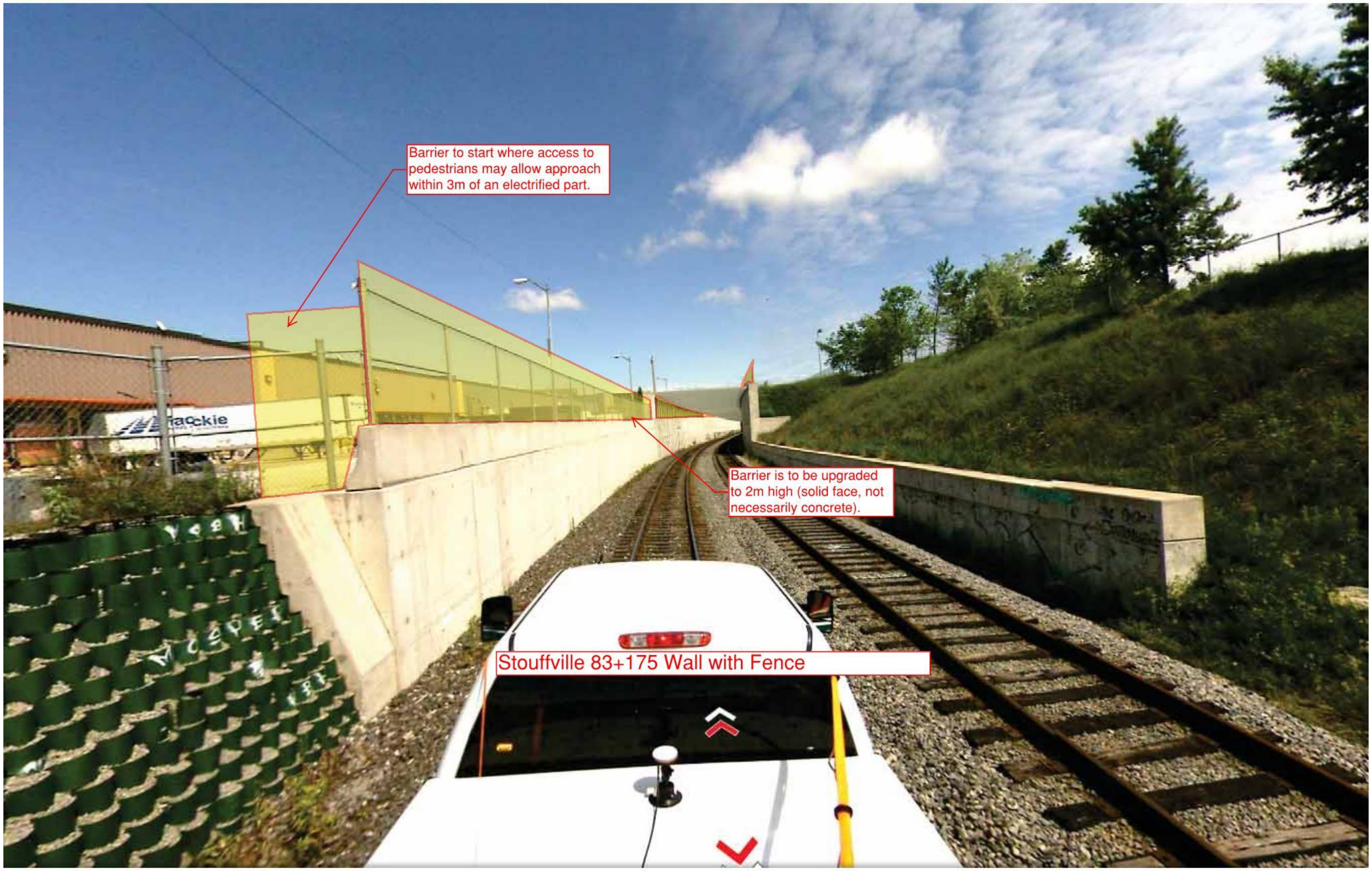
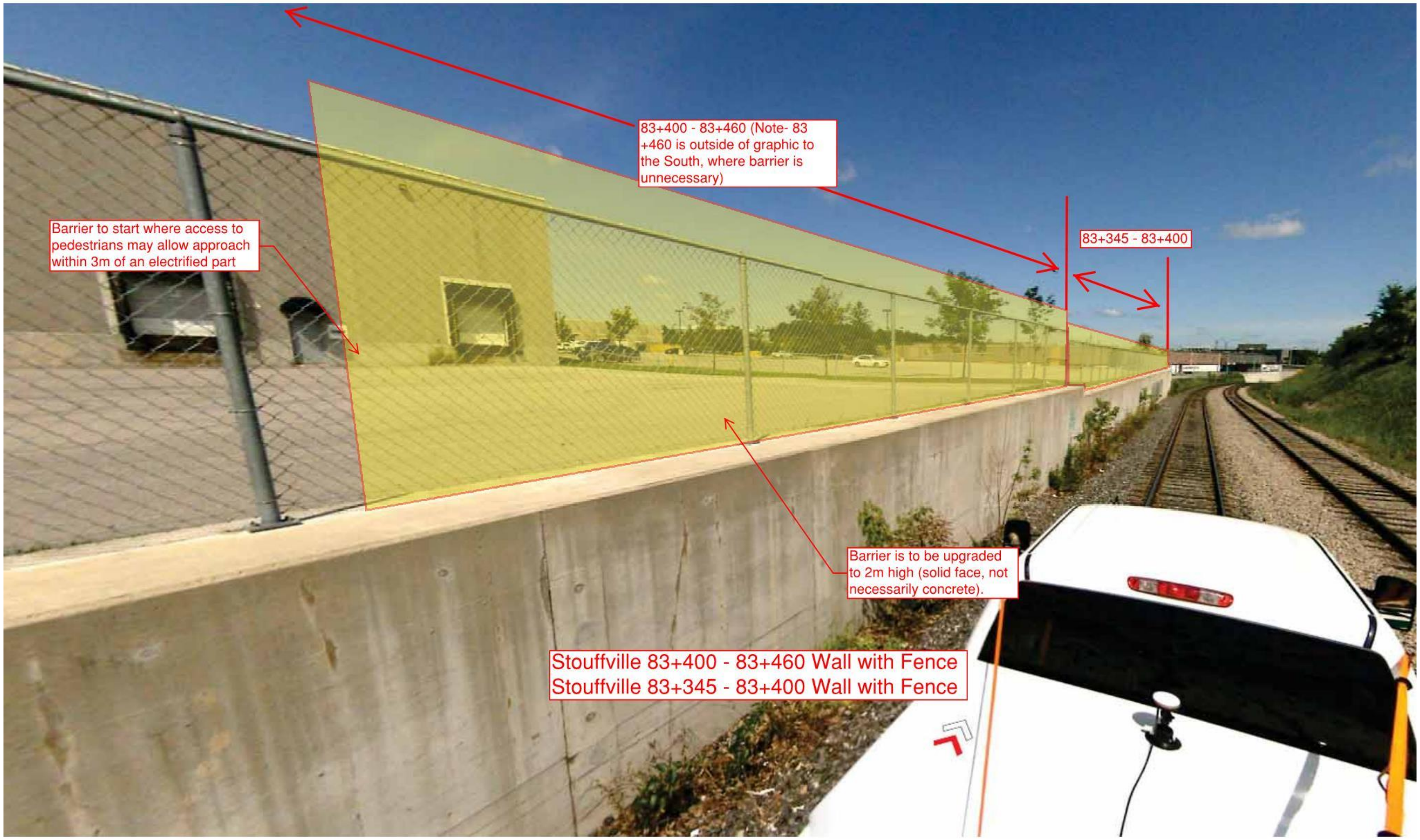


Figure 3-87: Stouffville 83+345 - 83+400 and 83+400 – 83+460 (West Side)



3.11 Maintenance Facility Modifications

OCS will be installed over existing maintenance facility tracks within electrified territory. The same design principles applicable to OCS as outlined in **Section 3.6.2** also apply to existing maintenance facilities. Grounding and Bonding will follow the same principles as described in Section 3.8. Existing maintenance facilities to be electrified include:

- Willowbrook Maintenance Facility (Lakeshore West corridor)
- East Rail Maintenance Facility (Under construction – Lakeshore East corridor)

3.11.1 New OCS Maintenance of Way Facilities

OCS Maintenance-of-Way facilities will be needed for the operation of Traction Power. A location of one or more of these facilities will need to be determined during the detailed design phase as required. These facilities generally entail a building to house maintenance staff as well as meeting rooms, locker rooms, etc. Any potential impacts related to property or any other environment aspects will need to be assessed during detailed design once the preferred locations have been selected and TPAP/EPR Addendum requirements will be confirmed and carried out as appropriate.

3.12 Layover Facility Modifications

OCS will be installed over tracks in the layover facilities within the electrified territory. The same design principles applicable to OCS (see Section 3.6.2) also apply to layover facilities. Grounding and Bonding will follow the same principles as described in Section 3.8.

Existing and planned Layover Facilities that will be modified to accommodate electrification are as follows:

- Willowbrook Rail Maintenance Facility (LSW)
- Mimico Layover (LSW)
- Allandale/Barrie Layover (Barrie)
- Bradford/Barrie Layover (Barrie)
- Lincolnville Layover (Stouffville)
- Henry St./Whitby Layover (LSE)
- Oshawa North Layover (LSE)
- East Rail Maintenance Facility (LSE) (est. opening 2017)
- Don Yard Layover (USRC)

It is noted that electrification of the proposed Wilson Yard Layover (USRC) is not included in the scope of this GO Rail Network Electrification TPAP.

3.13 GO Station Modifications

As part of implementing electrification, GO Stations will require the following modifications:

- Integration of OCS support structures into platform areas; and
- Grounding and Bonding (see Section 3.8)

It is noted that the environmental impacts of electrifying any new GO stations will be addressed through the future EAs/TPAPs that will be undertaken for designing/constructing the new stations.

3.14 Operations and Maintenance

3.14.1 OCS Maintenance Activities

There are three types of OCS maintenance procedures, which are described as follows:

3.14.1.1 Track Patrol Inspection

An important factor in the maintenance of the OCS is an early warning system based on regular inspection that allows faults to be detected and rectified as part of the planned routine maintenance rather than as an emergency. These inspections can be carried out either via visual inspections involving follow-up reporting, or visual inspection with remedial site work. The preferred frequency of track patrol is at four weekly intervals during the first year after commissioning on each section of the electrified line.

3.14.1.2 Routine Maintenance

Routine maintenance is described as the repetitive, periodic overhaul and reconditioning of the OCS to maintain its reliability. Initial operation of the OCS after commissioning requires high level performance monitoring and inspection. After approximately two years of operation, an effective and economic schedule will be established for activities such as protective greasing, examination and cleaning of insulators, contact wire height and stagger checking, contact wire wear checks, etc.

3.14.1.3 Planned Maintenance

Planned maintenance refers to performing detailed inspections in accordance with maintenance procedures related to the OCS. Planned maintenance will include the periodicity of inspection maintenance, the work to be carried out for major OCS maintenance, and the certification to ensure maintenance work has been carried out appropriately with full reporting records.

3.14.2 TPF Maintenance Activities

A comprehensive equipment for control, monitoring and communication system at different levels will be incorporated in the design of the traction power facilities. The TPF equipment control, communication and status will be facilitated by the traction electrification SCADA system at the Network Operation Centre (NOC), Business Resumption Centre (BRC), in TPF's and Traction Wayside Power Cabinets on the corridor. The information from the SCADA system will enable maintenance staff to promptly identify, pinpoint and rectify equipment failures/defects.

Heavy TPF equipment such as high voltage switchgears and transformers will have a 30 year life cycle and replacement during this lifecycle is not anticipated. However, if a catastrophic failure occurs on station equipment and replacement of the equipment is required, a specialized contracting party will be retained to remove and replace the faulty equipment.

The TPFs will be equipped with oil filled transformers, therefore an oil containment system for the maintenance of transformers/autotransformers will be provided, and will conform to applicable codes and standards. All facilities will be fully equipped with spill containment.

3.14.3 Vegetation Management

Vegetation management will consist of a vegetation trimming program that will consist of two parts. The first phase will cut back trees and other vegetation within the vegetation clearance zone to a maximum of 7 meters from the center of the outer most track. The second phase will be a reoccurring maintenance phase that will involve trimming branches that may grow back into the vegetation clearance zone over time. The frequency between vegetation trimming activities will depend on the rate that the vegetation grows back and the allowable space within Metrolinx ROW. Vegetation trimming is accomplished using trucks and equipment such as wood chippers that will work from within the track area.

3.14.4 Effects on Freight Operators and VIA Rail

Electrification of the GO Network will entail certain modifications to the operations/maintenance practices of freight operators (Canadian National Railway, Canadian Pacific Railway) and VIA Rail which may include the following. Metrolinx will continue to coordinate and consult with CN, CP, and VIA as appropriate during detailed design where there are interfaces with freight/VIA territory.

- Track Circuits & Grade Crossings will need to be immunized (this will be included in the provisions of the EMC Control Plan to be developed during detailed design).
  - Where track is adjacent to Metrolinx electrification
    - Within Overhead Contact Line Zone (OCLZ).
    - Possibly beyond the OCLZ for induced effects (range will be confirmed during detailed design).
  - Where electrified track crosses over (considered within OCLZ)
  - Where electrified track abuts non-electrified track
    - Electrified track to third party owned interface locations.
    - Electrified track to third party unsignalled track (e.g. yards) requires TPS return.
- Immunization includes compatible track circuits, impedance bonds as well as bonding & grounding for TPS currents (this will be included in the provisions of the EMC Control Plan to be developed during detailed design).
- Rail operations:

- Crew Safety Training will be required (various safety, training, and protocols will need to be established as required, with respect to operating in an electrified railway environment).

Canadian Pacific Railway

It is noted that Metrolinx is entering into a Cooperation Agreement with CP with respect to the Metrolinx electrification project. This Agreement will cover operating restrictions.

3.15 Construction Activities

The following section provides a summary of the proposed construction methods/activities related to the various Electrification project components.

3.15.1 Construction Management Plans

Construction Management Plans will be developed and implemented during construction and will take into consideration applicable legislation as appropriate.

3.15.2 Traffic Management Plans

Metrolinx will coordinate with Municipalities and road authorities, as appropriate during detailed design, to develop traffic, parking, transit, cycling and pedestrian management strategies prior to commencement of construction to avoid/minimize interferences to traffic to the extent possible.

3.15.3 Overhead Contact System (OCS)

There are four main construction activities associated with OCS construction described as follows:

3.15.3.1 OCS Foundation Installation

The OCS foundation sizes are dependent on the type of OCS structure to be installed (i.e., portal, cantilever), however typical sizes are estimated to be as follows be: 36” (900mm) diameter (single track cantilever), 42” (1050mm) diameter (two track cantilever), 42” (1050mm) diameter (portal structure<24 meters wide), 48” (1200mm) (portal structure >24 meters wide). Excavation will be required to install OCS foundations at an approximate depth of 5m.

3.15.3.2 Install OCS Support Structures

Once foundations have been established, OCS support structures will be installed. For both portal and cantilevers, the structures are pre-assembled and ready to lift using a rail crane. For cantilevers, brackets can be installed on the poles before sending to the site, whereas portals are more complex to install, as they require access to all lines (similar to a signal bridge).

3.15.3.3 Install OCS Wiring

The installation of OCS wiring involves running the contact and messenger wires together under tension along the corridor. This is typically completed using a four vehicle wiring unit, where the base vehicle dispenses wire, the second vehicle with working platform is equipped to allow messenger to be installed onto cantilever, the third vehicle with working platform is equipped to allow contact wire to be installed, and a fourth vehicle installs hangers.

3.15.3.4 Installation of Grounding and Bonding of the OCS along Rail ROW

Grounding and bonding within the rail ROW is required for OCS support structure locations. The construction of grounding and bonding elements will occur concurrently with OCS structure foundation installation and OCS wiring installation, since each OCS structure will be individually grounded and interconnected through the static wire.

3.15.3.5 OCS Testing and Commissioning

After the overhead contact system (OCS) is installed and all adjustments made, test runs with the electric locomotives shall be made. The contractor shall make all corrections, as determined necessary by such test runs.

The OCS shall then be energized and tested for sectionalization. Any defects in the OCS revealed by these energization tests shall be corrected by the contractor, prior to commissioning the overhead contact system.

3.15.4 Taps and High Voltage Connections

The line connections will be provided with air insulated overhead line connections or in combination with cable connections or duct connections. The overhead connections will have RIV free (Radio Interference Voltage) free connectors to avoid aircraft and railway communication interference in the vicinity of airport and passenger rail. When cable option is chosen, duct installation will be provided, excavation will be needed, splice vaults, manholes and the need for pumping, leak monitoring, leak detection methods and other monitoring technologies. Possible SF6 (hexafluoride gas) duct could be used for cooling of underground cable ducts, grounding.

3.15.5 Installation of Tap Structures/Towers

Installation of the tap structures can be achieved using many different methods. The installation falls into two parts: install foundations and erect structure. The foundations will require excavation and/or piles with a poured in place concrete foundation. The depth and style of foundation will depend on the type of structure that is selected. Variables that will influence the selection will be the structural and environmental (wind, ice) loads that need to be supported as well as the type of soil that the foundation will be installed in. Tap locations typically necessitate 4 foundations of approximately 1 to 2 meters in diameter and may be installed at depths of 5 to 10 meters. The tap towers could be any number of different structural types that will most likely be prefabricated in parts and erected on site. Both the structure and foundation will be determined during the final design phase.

3.15.6 Traction Power Facilities

Traction Power Facility equipment such as switchyard components, switchgear room, control room and traction power transformers will be prepackaged off site. Heavy truck and machinery will be required to carry and install the prepackaged equipment to each respective site.

The following activities are required for traction power station construction / installation.

3.15.6.1 Site Preparation and Construction - Traction Power Facilities

The following site preparation and construction activities will be required:

- Site clearing
- Install building foundation
- Install prefabricated switchgear and control building
- Construct building
- Grounding and bonding

Access to the sites will be via existing local roads (no new access roads are proposed). In addition, the need for additional construction staging areas outside the limits of the substation sites will be assessed during detailed design.

3.15.6.2 Grounding and Bonding - Traction Power Facilities

The grounding and bonding material for the Traction Power Facilities will be delivered to the site by heavy truck. The following activities are required as part of installing the grounding and bonding material:

- Excavate the soil to the required depth (approximately 1m)
- Install ground grids, conductors and rods, as per design
- Connect the grounding system internally and with adjacent existing grounding system, where required
- Install the junction boxes and connect grounding conductors, where required
- Backfill the grounding system, as per design

3.15.7 Gantries

Construction activities associated with installing gantries are anticipated to include the following:

- Site preparation
- Install gantry foundations
- Heavy trucks will transport the gantry structure pieces to the site
- Assembly of the main and strain gantries will be done on site
- Connect 25 kV feeders (routed in underground duct banks) to the main gantry

3.15.8 Install 25kV Aerial Feeder Routes

The following activities are required as part of installing the 25 kV aerial feeders and associated pole line:

- Excavate soil via open cut method to install poles
- Install pole line hardware and crossarms, as per design
- Install feeders
- Connect feeders to gantry

3.15.9 Install Underground 25 kV Feeders/Duct Banks

The following activities are required as part of installing the 25 kV feeders and associated underground duct banks:

- Excavate soil via open cut method to install duct banks
- Excavation under roadways (as required) in order to install duct banks under the road ROW
- Install underground cables (25 kV feeders) within duct banks
- Connect feeders to main gantry
- Backfill/restore road(s), as per design

3.15.10 Bridges and Rail Overpasses

3.15.10.1 Overhead Bridge Structures

OCS attachments to bridge structures (rail under road), will be done via railcar with a raising working platform from track level to install attachments to the bottom of the bridge structure.

With regard to installation of grounding grids/flash plates, this may be done via railcar by raising the working platform from track level to attach the flash plates to the bottom of the overhead structure.

With regard to construction of bridge protection barriers, this will be completed on top of the bridge structure, in the same manner as other bridge related civil construction works. It is noted that temporary road (traffic lanes may be reduced) and/or pedestrian walkway closures may be required during construction of the protection barriers.

3.15.10.2 Overpass Structures –Roadways

Where required, OCS attachments to roadway overpass structures will be done by attaching insulated assemblies via steel brackets to the outside face of the structure.

3.15.10.3 Rail Overpass Structures - Over Watercourses

With regard to rail overpass structures over watercourses, it is anticipated that OCS portal or cantilever structures will be attached along the centerline of the top of pier where possible. Access to the outside face of the pier will be from the bridge deck with materials being brought to the construction site using rail mounted vehicles and then lowered over the side of the bridge to avoid the need for scaffolding built up around the pier from ground level. No in-water works are anticipated to be required.

3.15.10.4 Pedestrian Bridge Replacements

With regard to proposed pedestrian bridge replacements, construction will be completed at track-level and above the tracks in the same manner as other bridge-related civil construction works. It is noted that railroad operations will be affected during work that requires access beyond fouling the tracks (such as erecting bridge elements over and adjacent to the tracks). Also, pedestrian walkway closures will be required during construction of this work.

3.15.10.5 Bridge Replacements

The detailed design and full extent of potential impacts related to bridge replacements will be assessed as part of separate/future EA/TPAP Addendums studies as required. As part of this process, it is recognized that additional impacts beyond Metrolinx's rail ROWs may be identified and will therefore require additional environmental/planning studies to determine the preferred design options and to identify mitigation measures to alleviate these effects. It is currently anticipated that these additional studies will be completed as part of an Addendum to the GO Rail Network Electrification TPAP (once approved), in coordination with affected review agencies, municipalities and other stakeholders as appropriate.

3.15.10.6 Track Lowering

Generally, there are 3 options for track lowering:

- Sledding
- Undercutting
- Excavation

Each option has limitations which may deem them inappropriate for certain site conditions and goals, as outlined below. The extent of the work (in horizontal and vertical scale) is dependent on the difference between the existing and required minimum vertical clearance (MVC) at each site. The required MVC is defined by OCS clearance requirements which, in order to minimize impacts on existing OH bridges, can vary (refer to Section 3.9.4 for further detail).

Sledding

Sledding involves inserting a 'v' shaped plow under the tracks that is pulled by an on-track machine. The sled plows out approximately 300mm-450mm of material from underneath the track onto the adjacent right of way. This is normally done on single track in a typical fill section. This method may not be appropriate for use where there are multiple tracks in a cut section.

Undercutting

Track undercutting requires the use of an on-track undercutter machine. In areas that have wide, clear right-of-way, off-track equipment may be used. Undercutting services are normally obtained from a vendor, but sometimes the machines are purchased if the amount of work is significant. The undercutter head looks like a large chain saw approximately 3m-3.7m long and 1 foot thick (300mm). The machine has a rotating series of buckets located on the field side, or both sides of the track. The buckets empty on to a conveyor belt that can be moved to empty onto a desired location. Initially, the field side shoulder is removed using an excavator. The buckets dig a trench along the field side of the track that is long enough to fit the undercutter head. The head is lowered into the trench parallel to the track and the chain saw action is started. The head is then slowly swung under the track to begin excavating material as the machine progresses at a slow speed. The machine moves along the track as the excavated material is collected by the buckets. The buckets empty onto the conveyor belt. Ideally, there is enough clear right-of way for the conveyor belts to empty onto the existing ground. If there is a right-of way road, the conveyor belt may empty onto waiting dump trucks that match the speed of the machine along the track. If there is no room on the right-of-way, the conveyor belts may be directed onto a waiting work train with hopper cars on an adjacent track. Some elaborate machines come with a series of connected hopper cars connected by conveyor belts.

The undercutter will remove approximately 300mm of material, with some existing material sloughing back into the hole. It is necessary to cut a minimum of 100mm-150mm more than the amount of track lowering, and then surfacing the track on new ballast to the desired elevation. The maximum amount of track lowering at one location should be 200mm-300mm, which would require two passes of the undercutter. In clear main track with no turnouts and ample room for material removal, the undercutter productivity can be as high as approximately 730m per day after setup is completed. Deeper track lowering may be accomplished by multiple passes of the undercutter. This would require approximately 2 passes for every foot of track lowering. In multiple track territory, every track would have to be lowered by each 300mm increment and re-surfaced before starting the second phase of lowering, because the top-of-rail differential should not be more than 300mm-450mm between tracks. The undercutter is then followed by a work train with ballast cars and surfacing equipment. The main advantage of undercutting is that the track does not have to be removed in order to achieve lowering. Some ties will drop out during undercutting which must be replaced. Other than that, the track can usually be surfaced and placed back in-service in a relatively short time. For deeper track lowering, this can be done in incremental steps. One problem with track lowering greater than 1 foot (300mm) is the removal of the existing compacted subgrade beneath tracks that have been in operation for many years. If sub-soil conditions are poor, this may produce an area requiring continual monitoring and re-surfacing until proper compaction is achieved.

Excavation

Excavation consists of removing the existing track and excavating down to new subgrade. The subgrade may be as much as 1m or below the proposed top of rail. In multiple track territory, it may be necessary to install sheeting or another type of track support to prevent collapse of adjacent tracks during excavation. In poor soil conditions, the subgrade would have to be compacted or improved in some manner. A new subballast and ballast layer is then placed and compacted. Track is then installed on top of the ballast layer using new or relay track material. The track is then re-surfaced to final design elevation.

Excavation is typically done on track lowerings greater than 300mm-600mm. The main advantage of excavation is the ability to improve deep subgrades. It is also easier to install drainage and pipe crossings through excavated areas. The major disadvantage of excavation is the need for some type of track support in multiple track territory, which can be expensive. Also, track lowering cannot be done incrementally, and it may require that some tracks be out-of-service for a longer period of time before re-constructed tracks are placed in-service.

3.15.11 GO Stations

Construction activities associated with installing OCS support structures as well as grounding and bonding at passenger stations include the following:

3.15.11.1 OCS Installation

- The preferred method for installation of the OCS structure foundation at station platforms is concrete side bearing cast in place; and
- OCS support structures that may be supported by the platform canopies will be installed as extensions to existing canopy poles which will be designed to support the additional loads of the OCS structure

3.15.11.2 Grounding and Bonding – GO Stations

Grounding and bonding material will be delivered to the site using heavy trucks and machinery. In order to install grounding and bonding, the following activities are required:

- Clear site;
- Excavate the soil to the required depth;
- Install grounding conductors and rods, as per design;
- Connect the grounding system internally and with adjacent existing grounding system, where required;
- Install junction boxes and connect grounding conductors, where required; and
- Backfill the grounding system as per design.

3.15.12 Maintenance Facility Modifications

Construction activities related to the modifying Willowbrook and East Rail maintenance facilities will include the following:

- Install security fence;
- Grounding and bonding of maintenance facility buildings and electrified tracks; and
- OCS installation at maintenance facility

3.15.13 Construction Staging Areas

The locations of construction staging areas were not identified at the conceptual design phase and therefore will need to be identified during detailed design.