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Joanne Richardson
Director – Major Projects and Partnerships
Regulatory Affairs

BY EMAIL AND RESS

December 2, 2020

Ms. Christine E. Long
The Registrar
Ontario Energy Board
Suite 2700, 2300 Yonge Street
P.O. Box 2319
Toronto, ON M4P 1E4

Dear Ms. Long:

EB-2020-0265 – Hydro One Networks Inc. Leave to Construct Application – Hawthorne to Merivale Reconductoring Project – Application and Evidence

Pursuant to Section 92 of the *Ontario Energy Board Act, 1998*, Hydro One Networks Inc. seeks the Ontario Enery Board's ("OEB") approval for an Order or Orders granting leave to reconductor existing transmission circuits M30A and M31A spanning between Hawthorne Transmission station ("TS") and Merivale TS, and perform related transmission station enabling work (the "Hawthorne to Merivale Reconductoring Project", or the "HMR Project", or the "Project") in the Area of Ottawa, Ontario.

Additionally, pursuant to s. 97 of the *Ontario Energy Board Act, 1998,* Hydro One Networks Inc. seeks for an Order granting approval of the forms of the agreement offered or to be offered to affected landowners.

An electronic copy of this Application has been filed through the OEB's Regulatory Electronic Submission System.

Sincerely,

Joanne Richardson

EXHIBIT LIST

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Exh	Tab	Schedule	Attachment	Contents
C				
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Exh	Tab	Schedule	Attachment	Contents
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ONTARIO ENERGY BOARD

In the matter of the *Ontario Energy Board Act, 1998*

And in the matter of an Application by Hydro One Networks Inc. pursuant to s. 92 of the *Ontario Energy Board Act, 1998* for an Order or Orders granting leave to reconductor existing transmission circuits M30A and M31A and perform related transmission station enabling work (the "Hawthorne to Merivale Reconductoring Project", or the "HMR Project", or the "Project") in the Area of Ottawa, Ontario.

And in the matter of an Application by Hydro One Networks Inc. pursuant to s. 97 of the *Ontario Energy Board Act, 1998* for an Order granting approval of the forms of the agreement offered or to be offered to affected landowners.

APPLICATION

1. The Applicant is Hydro One Networks Inc. ("Hydro One"), a subsidiary of Hydro One Inc., herein referred to as "The Applicant". Hydro One is an Ontario corporation with its head office in Toronto and is licensed under Ontario Energy Board ("OEB" or the "Board") Electricity Transmitter Licence No. ET-2003-0035. Hydro One carries on the business, among other things, of owning and operating transmission facilities within Ontario.
2. Hydro One hereby applies to the Board pursuant to Section 92 of the *Ontario Energy Board Act, 1998* ("the Act") for an Order or Orders granting leave to reconductor approximately 11.9 km of double circuit 230 kV transmission line. This will facilitate increased transfers from eastern Ontario supply resources, including generation located in eastern Ontario, west towards the Greater Toronto Area ("GTA"), thereby increasing the efficiency and effectivity of the Ontario grid. Please refer to the Project Area Map for an illustration of the existing transmission

line routes and the existing station locations filed at **Exhibit C, Tab 2, Schedule 1, Attachment 1**.

3. The reconductored dual-bundled circuit 230 kV line will replace approximately 11.9 km of existing 230 kV single circuit transmission lines (known as the M30A and M31A circuits) from Hawthorne Transmission Station ("TS") to Merivale TS. Hydro One is also applying for an Order or Orders granting leave to perform related project work within the transmission stations facilities at both ends of these circuits to accommodate the reconductoring work.
4. The proposed Project will involve the following transmission line work:
   - Reconductor approximately 11.9 km of each phase of the existing single 230 kV lines (M30A and M31A). Each circuit currently consists of three phases with each phase consisting of a single conductor. The HMR Project will reconductor these circuits with a dual-bundled (two conductors per phase) circuit configuration. These circuits will continue to operate at 230 kV line voltage. Each circuit will span on separate towers between Hawthorne TS and Merivale TS. The two circuits will continue to be hosted on the existing tower spans running between the two stations and will remain on the current transmission right-of-way;
   - Reinforce the steel tower arms that will hold the new heavier reconductored dual-bundled phases on both sets of towers for both circuits M30A and M31A. This will involve replacing the current steel arms that carry the single phase 230kV line conductor with stronger steel arms to hold the dual-bundled conductor that will be added on each phase of the 230 kV circuits. Both circuits M30A and M31A will remain connected to the Hawthorne and Merivale transmission stations.
5. The HMR Project will involve performing necessary protection and control work to incorporate the connection of the reconductored dual-bundled circuits.

6. The proposed in-service date for the Project is December 2023, assuming construction commencement in October 2021. In order to achieve the in-service date Hydro One would ask the OEB to provide a decision by May 15, 2021. A Project schedule is provided at **Exhibit B, Tab 11, Schedule 1**.
7. The need for the Project was established by the Independent Electricity System Operator's ("IESO"s) letter (the "Letter") dated December 2, 2015, and is provided at **Exhibit B, Tab 3, Schedule 1, Attachment 1** and together with **Exhibit B, Tab 3, Schedule 1** is referred to as the "**Need Evidence**".
8. Hydro One will rely predominantly on the statutory easement rights it enjoys on Infrastructure Ontario Bill 58 lands, and existing land rights it currently has for the existing M30A and M31A right-of-way to construct, operate and maintain the proposed new transmission facilities. A small number of the existing land rights require updating, and Hydro One has engaged with the impacted landowners where updated land rights are required. Further information on land related matters is found at **Exhibit E, Tab 1, Schedule 1**.
9. The IESO has provided a final System Impact Assessment ("SIA") for the proposed facilities. The SIA concludes that the Project is expected to have no adverse impact on the reliability of the integrated power system. The final SIA is provided in **Exhibit F, Tab 1, Schedule 1**.
10. Hydro One has completed a draft Customer Impact Assessment ("CIA") in accordance with Hydro One's connection procedures. The draft CIA results show that the project will not have any adverse effects on the transmission-connected customers of the area. A copy of the draft CIA is provided in **Exhibit G, Tab 1, Schedule 1**. The final CIA is expected to be available six weeks from filing this Application and will be filed with the OEB immediately thereafter.

11. The cost of the transmission line and related facilities for which Hydro One is seeking approval is approximately $21.3 million, of which $19.7 million is capital and will be added to rate base, and $1.6 million is removals. The details pertaining to these costs are provided at **Exhibit B, Tab 7, Schedule 1**.
12. Project economics, as filed in **Exhibit B, Tab 9, Schedule 1**, estimate there will be a slight increase in transmission rates for the Hydro One construction portion of the Project, to Ontario's transmission ratepayers. The line connection pool rate of Ontario's Uniform Transmission Rates ("UTRs") will remain unchanged, whereas the network connection pool rate is forecast to increase by a 0.26%, or from the current rate of $3.92/kW/month to $3.93/kW/month. For a typical residential customer who is under the Regulated Price Plan, there will be minimal impact on rates.
13. The Application is supported by written evidence which includes details of Hydro One's proposal for the transmission circuits and related station work. The written evidence is prefiled and may be amended from time to time prior to the Board's final decision on this Application.
14. Given the information provided in the prefiled evidence, the Applicant submits that the HMR Project is in the public interest. The Project will facilitate bulk transfers from Eastern Ontario west towards the GTA, including supply from eastern Ontario generation, while providing additional system wide benefits, including improved quality of service and reliability.

15. The Applicant requests that a copy of all documents filed with the Board be served on the Applicant, as follows:

a) Applicant - Hydro One:

Eryn Mackinnon
Sr. Regulatory Coordinator
Hydro One Networks Inc.

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Assistant General Counsel
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PROJECT OVERVIEW

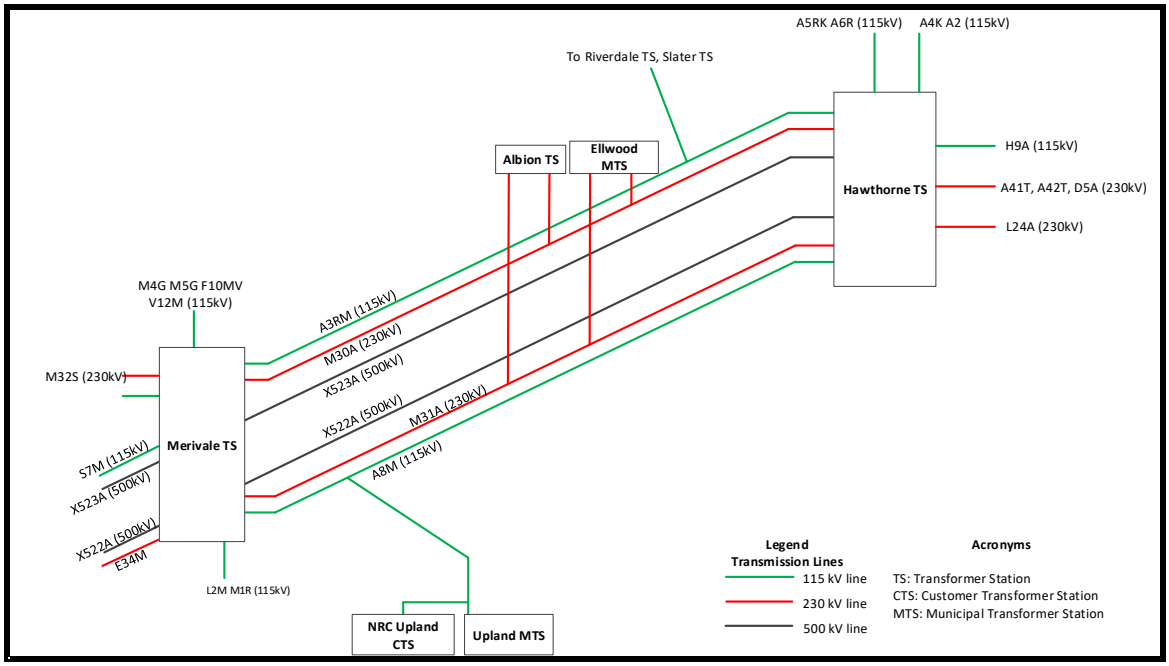
Hydro One's M30A and M31A circuits are both 230kV transmission circuits connecting the two major stations, Hawthorne TS and Merivale TS, in the City of Ottawa. These two circuits are each carried on separate, and adjacent, towers along the Hawthorne TS to Merivale TS corridor route. Each individual tower system that carries one of the 230 kV circuits also shares a 500 kV and a 115 kV circuit, effectively meaning that each set of towers along the route carries three separate circuits, each operating at a different voltage level. The IESO has identified the need for an increased power transfer limit across the two M30A and M31A circuits to address the need to facilitate bulk power flows from eastern Ontario, including eastern Ontario generation, towards the GTA. Currently both M30A and M31A circuits can experience overloading under peak loading conditions, combined with high power transfers flowing west from eastern Ontario into the GTA.

As requested by the IESO, Hydro One's proposed HMR Project will uprate the thermal rating of both circuits M30A and M31A between Hawthorne TS and Merivale TS by replacing the existing single conductor per phase with dual-bundled conductors[1] per phase, over a distance of approximately 11.9 km. At the same time, Hydro One also proposes to upgrade the skywire of circuit M31A only with optical ground wire ("OPGW") between Hawthorne TS and Merivale TS. Performing the upgrade of the skywire at the same time as reconductoring the M30A and M31A circuits will minimize outages to these important Bulk Electric System ("BES") classified transmission lines.

[1] Dual-bundled conductors means two conductors per phase. Currently the in-service 230 kV M30A and M31A circuits each have three conductors (one conductor per phase). Once the M30A and M31A reconductoring project is complete, each circuit will have six conductors (two conductors per phase). It is important to note that the M30A and M31A 230 kV circuits are located on separate, and adjacent towers (on the same right-of-way) and each individual 230 kV circuit shares a tower with one 115 kV circuit and one 500 kV circuit. A visual representation of the before and after circuit and tower configuration can be found at Exhibit C, Tab 1, Schedule 1, Attachment 1.

This Application is seeking OEB approval to reconductor the existing single conductor per phase 230 kV M30A[2] and M31A[3] circuits with a dual-bundled (two conductors per phase) circuit configuration, and the replacement of the existing M31A skywire with OPGW. Figure 1 below schematically depicts the 11.9 km corridor between Hawthorne TS and Merivale TS in which circuits M30A and M31A are installed.

Figure 1: Single Line Diagram - Corridor between Hawthorne TS and Merivale TS.



[2] This circuit has three phases.
[3] Ibid

Figure 2 below, titled 'General Area Map', shows the geographic location of the HMR Project. The area shaded in purple denotes the location of both circuits' route between Hawthorne and Merivale transformer stations.

Figure 2 - General Area Map

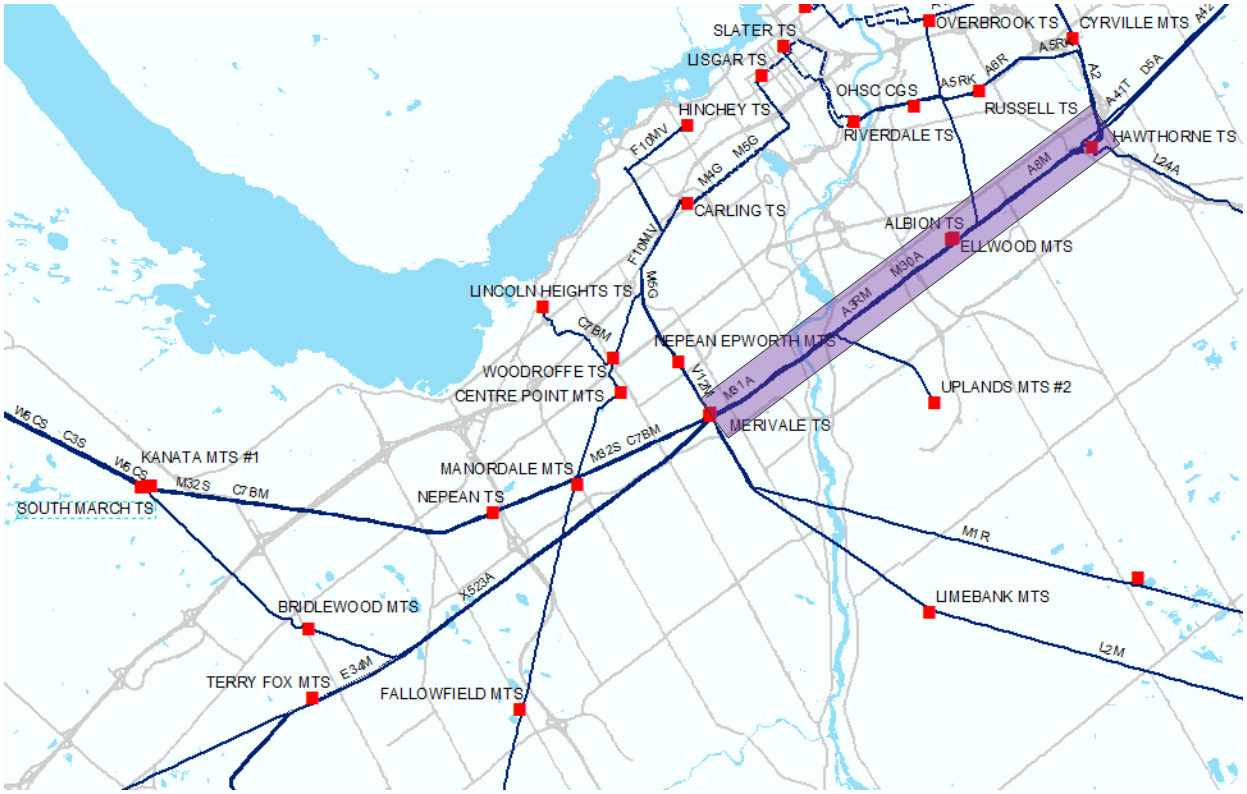


Figure 3 below is a picture that provides a visual depiction of the current configuration of both 230 kV circuits on the two adjacent towers (one 230 kV circuit is carried by one of the two identical towers). The picture illustrates the location where the the 230 kV circuit conductors are strung in relation to the other circuits (a 115 kV and a 500 kV circuit) that also share the same tower. The two 500 kV circuits are on the inside of the right-of-way and do not share the tower arms with another circuit. The 230 kV and 115 kV circuits are on the outside of the right-of-way and are connected next to each other on the same tower arms. The 230 kV circuits are the 'middle' circuit on the tower, with the 115 kV circuit

on one side and the 500 kV circuit on the other. Project work on the 230 kV circuit therefore also impacts the adjacent circuits due to the tower configuration. M30A and M31A circuits are each strung on separate tower structures that are identical and run adjacent to each other along the entire distance of the Hawthorne TS to Merrivale TS corridor route (a common right-of-way). This Application will not impact the current right-of-way corridor width, or the location or heights of the two sets of towers along the corridor.

The proposed reconductoring of the current single 230 kV 1843 kcmil aluminum conductor steel reinforced ("ACSR") would be replaced by a dual-(i.e. two conductors) bundled 1443 kcmil ACSR 230 kV conductor. Given the critical importance of these circuits for westerly bulk power transfer towards the GTA, both circuits cannot be voluntarily placed out-of-service at the same time (i.e. a planned service outage can occur on only one of the two circuits at any one time, as the other line must remain in-service or transmission customers would experience service interuptions). In order to perform the Project work, the other circuits on the same tower (i.e. the 115 kV and the 500 kV circuits) must also be taken out of service for the duration of the circuit reconductoring for safety reasons due to the close proximity of high voltage conductors. Upgrading both the M30A and M31A 230 kV circuits at the same time is not possible, as it would necessitate outages to all six circuits on the right-of-way, impacting supply, resulting in outages to load customers and impacts on eatern Ontario generating stations. Hence, the HMR Project plan means that the 230 kV circuit M30A will be reconductored first and re-energized, and then followed by the reconductoring of the 230 kV M31A.

Figure 3 – Photograph Illustrating the Two Adjacent Towers That Each Support a 115 kV, 230 kV and 500 kV Circuit Between Hawthorne TS and Merivale TS

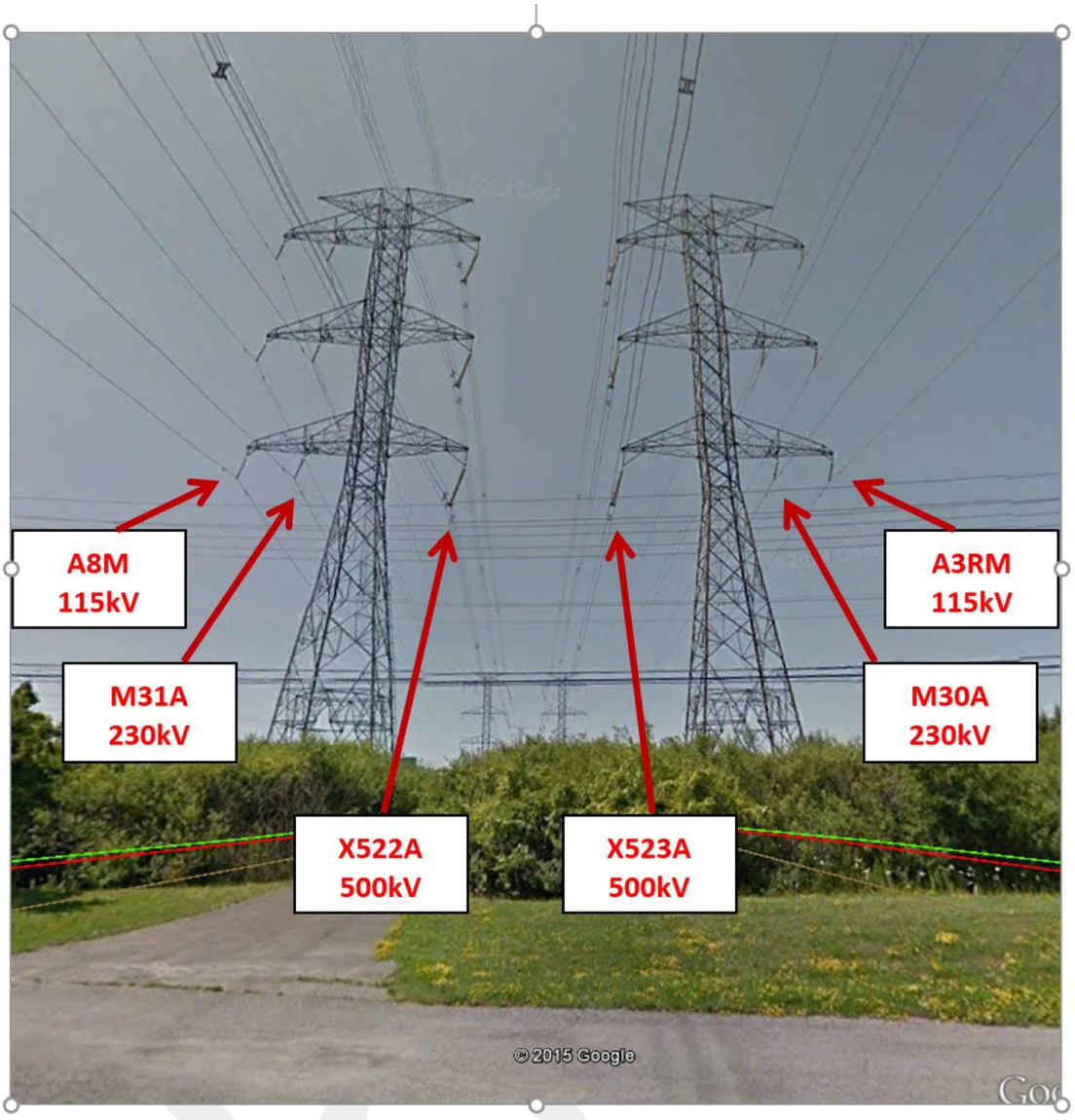


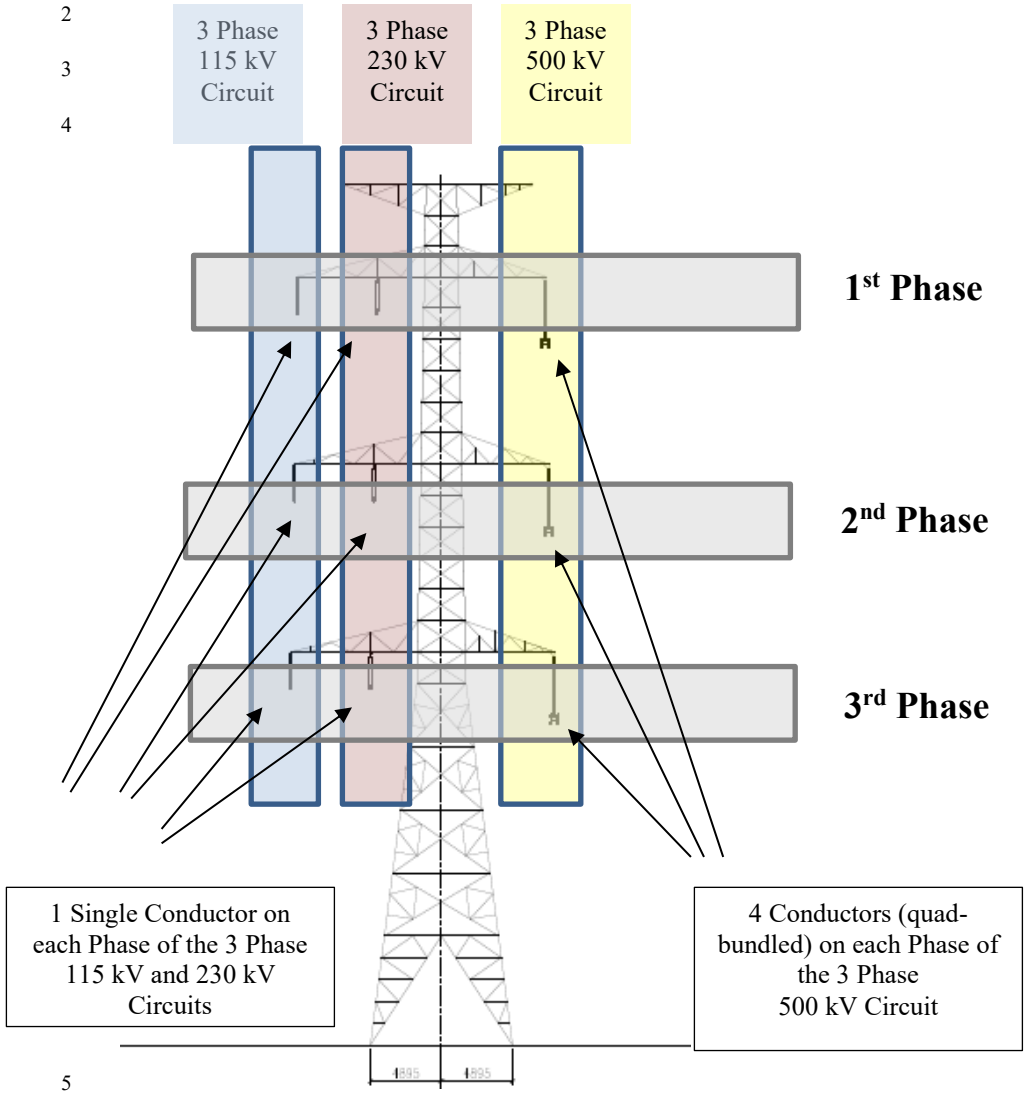
Figure 3 above is illustrating the location and voltage class of each circuit that is carried by the two adjacent tower systems along the Hawthorne TS to Merivale TS right-of-way corridor. One circuit of each voltage level is carried on each of the two adjacent towers, which results in an identical configuration on each of the towers along the entire route.

This configuration was chosen to maximize the use of the right-of-way between Hawthorne TS and Merivale TS, given the number of circuits spanning between the two transmission stations. This physical tower separation between the identical voltage circuit pairs (i.e. one circuit of voltage separated onto different towers prevents the loss of two circuits of the same voltage if there is a fault on one tower). This configuration ensures a continued link along the route at each of the three different voltage classes.

Additionally, this Project will require minor work at Hawthorne TS and Merivale TS which connect both the circuits that will be reconductored. For the reconductoring, the protection relay settings of each line will need to be changed to account for the new circuit impedance resulting from the dual bundle. In addition, the OPGW work will require terminating the fiber at both station to the telecommunication equipment and performing necessary testing to ensure the link's functionality.

Figure 4 below has been provided to assist with the Board's understanding of the description of the Project and the configuration of the circuits and phases carried by the towers.

Figure 4 - Illustrative Example of a Tower[4]* Carrying 3 Different Voltage Circuits



Commentary to Figure 4:

- Each **Circuit** (each with a different voltage) has three phases.
- Each individual **Phase** of one circuit is carried on a separate tower arm, and each phase has either a **single conductor** (as per the 115 kV and 250 kV circuits), or in

[4] The above tower, circuit and phase configuration example reflected in the above illustration is what the current tower configuration is for the two towers carry the 230 kV circuits (M30A and M31A) that the Applicant is requesting leave to reconductor.

the case of the 500kv circuit, each phase has multiple (also known as bundled) conductors on each phase.

This Application is proposing to replace the 230 kV circuit (middle circuit on the Tower configuration in the Figure 4 example shown above) that has three phases of single conductor with three phases that have will two conductors (bundled) per phase.

EVIDENCE IN SUPPORT OF NEED

On February 1, 2019, the IESO provided a letter (the "Letter") to Hydro One, requesting Hydro One to proceed with an M30A and M31A circuit uprate Project to address an existing system capacity need. The letter confirms the need for the Project, stating;

> *"In the past years, the M30/31A circuits have been operating near capacity at the time of summer peak supplying the peak demand of loads in the Ottawa area and carrying transfers from Ontario generating resources located in Eastern Ontario to the rest of the Ontario grid."*

The IESO's Letter, which provides further information of the need for the Project, is provided at **Exhibit B, Tab 3, Schedule 1 Attachment 1.**

The IESO's Letter confirms that the HMR Project will facilitate increased transfers from eastern Ontario supply resources, including generation located in eastern Ontario, towards the GTA, thereby increasing the efficiency and effectivity of the Ontario grid.

After having identified potential solution options, the IESO's Letter concludes that;

> *"Considering the relatively low cost, technical feasibility and short implementation timelines, the conductor uprate option is the preferred solution for reinforcing the M30/31A circuits and increasing the capability of the HxM*[1] *path".*

The Project will meet the IESO-identified capacity need for the Province. The IESO's handoff Letter identified a number of alternatives for addressing the capacity needs on circuits M30A and M31A:

[1] The IESO's Letter defines 'Hawthorne TS to Merivale TS' as the "HxM" path.

> *"A number of reinforcement options were considered for relieving the M30/31A limitations in IESO'S 2014 Interconnections report. One was to build underground cables between the Hawthorne and Merivale stations at a cost of about $300 million. Another option was to build a double circuit 230 kV line from the St. Lawrence area into Ottawa, at a cost of up to $500 million depending on the option chosen. As reported in the 2017 Interconnection report, detailed engineering studies done by Hydro One indicated that the overhead M30/31A circuits are capable of being uprated by replacing the existing conductors with twin conductors at a cost of about $20 million."*

The IESO's letter confirmed that all three options will address the need for additional capacity on the Hawthorne to Merivale path, however the third option is the preferred and most cost effective solution considering the relatively low cost, technical feasibility and short implementation timelines.

The Letter states that another major benefit or 'bonus', for want of a better word, from the HMR Project is the capability to access capacity imports from Quebec. The 2017 Quebec interconnection study[2] identified that 1250-1650 MW of capacity imports from Quebec would be enabled following the reinforcement of the M30A and M31A circuits. Having this non-domestic capacity to participate in Ontario's electricity markets may improve market competition resulting in lower costs for capacity overall. The Letter goes on to state that with an increased M30A and M31A circuit capability, it would also benefit system needs in the future for the Ottawa area.

Further, the IESO stated that an additional source of capacity (i.e. particularly sourced from Quebec generation) east of the GTA can also mitigate the impact of any transmission constraints in the GTA and enhance transmission system resilience located

[2] The link to the 2017 report is: http://www.ieso.ca/sector-participants/ieso-news/2017/05/ontario-quebec-interconnection-capability---a-technical-review

in the Ottawa area. The comparisons of alternatives are discussed in **Exhibit B, Tab 5, Schedule 1**.

Increasing the supply capacity between Hawthorne TS and Merivale TS is the IESO-recommended alternative. Accordingly, Hydro One is seeking approval from the OEB to undertake this solution that will result in increased power flow requirements on the both the M30A and M31A transmission circuits. The proposed HMR Project will provide necessary capacity, reliability and facilitate additional system flows, including eastern Ontario generation. The qualitative benefits of the recommended alternative are discussed in **Exhibit B, Tab 6, Schedule 1**.

ieso
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Powering Tomorrow.

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February 1, 2019

Robert Reinmuller
Director, Transmission System Planning
Hydro One Networks Inc.
483 Bay Street, 13th Floor
Toronto, ON M5G 2P5

Dear Robert:

Upgrading 230 kV Circuits M30/31A between Hawthorne TS and Merivale TS in Ottawa

The purpose of this letter is to request Hydro One Networks Inc. to proceed with the upgrading of 230 kV circuits M30A and M31A (M30/31A) between Hawthorne TS and Merivale TS in the City of Ottawa. These circuits are critical for supplying customers in the western half of the City of Ottawa and providing a transmission path for a portion of the power transfers between Eastern Ontario and the Greater Toronto Area.

Upgrading the M30/31A circuits will allow the load in west Ottawa to be supplied reliably with sufficient capacity to meet forecast demand growth while facilitating bulk power transfers from generation and imports located in Eastern Ontario for use efficiently and effectively across the Ontario grid. Additionally, the proposed upgrade would allow imports from Québec to participate in future capacity auctions in the Ontario Electricity Market. The upgrade will also increase the security of the Ottawa Area electricity supply by providing additional transfer capacity between the Hawthorne and Merivale stations to better mitigate outages to key line or station facilities in the area.

Background

The Hawthorne TS to Merivale TS (HxM) transmission path comprises, two 230 kV circuits and two 115 kV circuits between Hawthorne TS and Merivale TS in the City of Ottawa as shown in Figure 1. This path is also shared with two 500 kV circuits from Lennox TS to Hawthorne TS. Physically, these circuits are carried on two tower lines between the two stations, about 12 km in length. Each tower line carries three circuits at three different voltage levels.

Due to the nature of the power system in Ottawa and Eastern Ontario, the HxM path performs multiple functions with regard to electricity supply in Ottawa and across Eastern Ontario. Hawthorne is the terminus of the 500 kV circuits from Kingston and the delivery point for much of the generation resources and interconnections in the Cornwall and Ottawa areas. As a result, the 230 kV circuits M30/31A and the 115 kV circuits A8M and A3RM on the HxM path connect and supply much of the load demands in west Ottawa, including those in Nepean, Kanata and Downtown Ottawa, from the Hawthorne station located in east Ottawa. As well, the M30/31A

230 kV circuits on the HxM path carry a portion of the bulk power transfers between Eastern Ontario and the Greater Toronto Area. Limitations on the M30/31A circuits will impact the reliability of supply to loads in west Ottawa and utilization of resources in Eastern Ontario for regional or system needs.

In the past years, the M30/31A circuits have been operating near capacity at the time of summer peak supplying the peak demand of loads in the Ottawa area and carrying transfers from Ontario generating resources located in Eastern Ontario to the rest of the Ontario grid. As a result, there has been no capability to receive capacity imports from Québec during the summer peak periods and transactions with Québec can only currently occur in the form of energy imports.

In 2014[1], the IESO conducted a review of Ontario's interconnections with its neighbours, including those with Québec. Subsequently, in 2017[2], the IESO conducted a follow-up technical review focused in more detail on the Ontario-Québec interconnections. Both reviews identified that the main impediment to enabling capacity imports from Québec is the limitation of the HxM path and reinforcement of this path would be necessary to mitigate this restriction. No action was initiated after the 2017 review as the transactions with Québec in the past years were mostly related to energy rather than capacity.

Need and Alternatives

Recently, a demand forecast for the Ottawa Area was updated as part of regional planning for the Ottawa area. With this latest demand forecast and the latest information on Eastern Ontario resources including the new Napanee generating station in Kingston, load flow studies indicate that the M30/31A circuits are inadequate today to supply the demand in west Ottawa and the required bulk power transfers under summer peak conditions. These studies assumed no imports from Québec. Furthermore, the overload will become more severe in the longer term as the demand in west Ottawa is forecast to increase by about 150 MW in the next 10 years.

A number of reinforcement options were considered for relieving the M30/31A limitations in IESO's 2014 Interconnections report. One was to build underground cables between the Hawthorne and Merivale stations at a cost of about $300 million. Another option was to build a double circuit 230 kV line from the St. Lawrence area into Ottawa, at a cost of up to $500 million depending on the option chosen. As reported in the 2017 Interconnection report, detailed engineering studies done by Hydro One indicated that the overhead M30/31A circuits are capable of being uprated by replacing the existing conductors with twin conductors at a cost of about $20 million.

Preferred Solution

All these options will address the need for additional capacity on the HxM path. Considering the relatively low cost, technical feasibility and short implementation timelines, the conductor

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1 Review of Ontario Interties-report prepared for the Minister of Energy by the IESO and OPA in 2014
2 Ontario- Québec Interconnection Capability-report prepared for the Deputy Minister of Energy by the IESO in 2017

uprate option is the preferred solution for reinforcing the M30/31A circuits and increasing the capability of the HxM path.

With the increased M30/31A capability required for addressing the Ottawa area system needs, another major benefit that would be derived from the HxM path uprate is the capability to access capacity imports from Québec. The 2017 Québec interconnection study identified that 1250 -1650 MW[3] of capacity imports from Québec would be enabled following the reinforcement of the M30/31A circuits. Having this non-domestic capacity to participate in Ontario's electricity markets will improve market competition resulting in lower costs for capacity overall. An additional source of capacity east of the GTA can also mitigate the impact of any transmission constraints in the GTA and enhance system resilience in the Ottawa area.

Project Scope and Targeted In-Service Date

This conductor uprating option and its related costs and timelines have been discussed with Hydro One. In consideration that a Class Environmental Assessment, a Leave to Construct approval and some intricate outage scheduling would be required, Hydro One has indicated that a target in-service date of December 2022 is feasible. The IESO supports targeting for this in-service date and will provide assistance, as required, to Hydro One in implementing this project.

If you have any questions, feel free to contact us.

Yours truly,

Bob Chow
Director, Transmission Planning
Independent Electricity System Operator (IESO)

cc: Farooq Qureshi, Hydro One Networks Inc.
Leonard Kula, IESO
Terry Young, IESO
IESO Records

3 The full capability of the HVDC tie at Outaouais is 1250 MW; the additional capacity indicated up to 400 MW would be supplied from other ties with Québec, such as with Beauharnois GS.

Appendix: System Map

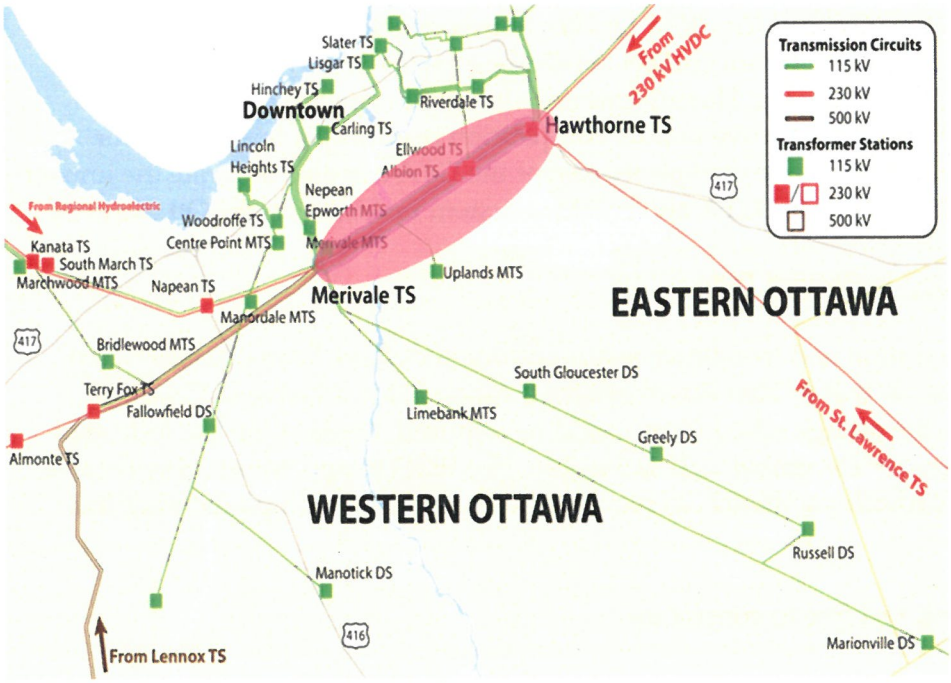


Figure 1 Hawthorne by Merivale Path

PROJECT CLASSIFICATION AND CATEGORIZATION

Project Classification

Per the Board's filing guidelines, rate-regulated projects are classified into three groups based on their purpose.

- Development projects are those which:
  - (i) provide an adequate supply capacity and/or maintain an acceptable or prescribed level of customer or system reliability for load growth or for meeting increased stresses on the system; or
  - (ii) enhance system efficiency such as minimizing congestion on the transmission system and reducing system losses.
- Connection projects are those which provide connection of a load or generation customer or group of customers to the transmission system.
- Sustainment projects are those which maintain the performance of the transmission network at its current standard or replace end-of-life facilities on a "like-for-like" basis.

The HMR Project line and station construction work that will be carried out by Hydro One is classified as development. This Project will remove the current limitation to the transfers of bulk power west from eastern Ontario towards the GTA.

Project Categorization

The Board's filing guidelines require that projects be categorized to distinguish between a project that is a "must-do", which is beyond the control of the applicant ("non-discretionary"), from a project that is at the discretion of the applicant ("discretionary"). Non-discretionary projects may be triggered or determined by such things as:

a) a mandatory requirement to satisfy obligations specified by regulatory organizations including NPCC/NERC or by the Independent Electricity System Operator ("**IESO**");
b) a need to connect new load (of a distributor or large user) or new generation connection;
c) a need to address equipment loading or voltage/short circuit stresses when their rated capacities are exceeded;
d) projects identified in a provincial government-approved plan;
e) projects that are required to achieve provincial government objectives that are prescribed in governmental directives or regulations; and
f) a need to comply with a direction from the Board in the event it is determined that the transmission system's reliability is at risk.

Based upon the above criteria, the HMR Project is non-discretionary. The Project is being undertaken at the request of the IESO.

Categorization and Classification

		Project Need	
		Non-discretionary	Discretionary
Project Class	Development	**X**	

COST/BENEFIT ANALYSIS AND OPTIONS

TRANSMISSION ALTERNATIVES

Prior to selecting the HMR Project, as presented in this Application as the preferred alternative, the IESO and Hydro One considered three alternatives to address the need to transfer more power, including eastern Ontario generation, west from eastern Ontario. Additionally, Hydro One considered a fourth alternative that started with the scope of Alternative 3, and addressed only the size of the conductor that would be used on that circuit, everything else remaining the same. The following describes the alternatives that were considered:

Alternative 1: 230 kV Underground cables between Hawthorne TS and Merivale TS

Under this alternative, approximately 11.9 km of 230 kV underground cables would be installed on the Hawthorne TS to Merivale TS route right-of-way ("ROW"). The new underground cables would require upgrades at the two terminal stations, Hawthorne TS and Merivale TS. Both stations would require expansion and new 230 kV circuit breakers to accommodate the new underground cable circuits. These new underground cable circuits would provide an alternate path to the M30A and M31A circuits that exist along the Hawthorne TS to Merivale TS. For Alternative 1 the cost increase can be expected to be in the magnitude of 13[1] times more when compared to Alternative 3 (the preferred alternative) outlined below.

[1] Based on the cost referenced in the IESO's Handoff Letter of $300 million – Refer to Attachment 1 to Exhibit B, Tab, 3, Schedule 1. ((300-21.3)/21.3 = 13

Alternative 2 – New double circuit 230 kV line between St Lawrence TS and Merivale TS

Under this alternative, a new 230kV double circuit overhead line would be built between St. Lawrence TS (in the vicinity of Cornwall) and Merivale TS. This alternative would equate to a line route distance of approximately 85 km. This alternative could either replace, or be built in addition to, the existing 115 kV circuit, known as L2M, that currently connects the two stations (i.e. between St. Lawrence TS and Merivale TS). For Alternative 2 the cost increase can be expected to be in the magnitude of 22[2] times more when compared to Alternative 3 outlined below.

Alternative 3: Replace the single conductor on each phase of the M30A and M31A circuits with 1443kcmil bundled (dual) conductors

(The Preferred Alternative)

Under this alternative, the existing three single conductors (one per phase) of 230 kV circuits M30A and the three single phase conductors (one per phase) of 230kV M31A circuits would each be replaced with dual-bundled conductors (two conductor per phase). Both circuits would be reconductored between Merivale TS and Hawthorne TS, a distance of approximately 11.9 km for each circuit. The circuit reconductor would necessitate some station work at both Hawthorne TS and Merivale TS, but the work required at these stations would not be nearly as significant as station work that would be required under either Alternative 1 or Alternative 2. This alternative will reduce both circuits' resistance by approximately 40% when compared to the current circuits' status

[2] Based on the cost referenced in the IESO's Handoff Letter of $500 million – Refer to Attachment 1 to Exhibit B, Tab, 3, Schedule 1. (500-21.3)/21.3 = 22

quo. At the same current circuit loading, the reduction in resistance results in a reduction of approximately 40% to current status quo line losses on M30A and M31A.

Alternative 4: Same as Alternative 3, however the new dual-bundled conductor size would be 1780kcmil

This alternative was developed by Hydro One and is identical to Alternative 3 with only one distinct difference. This alternative would use a larger conductor, the 1780 kcmil versus the 1443 kcmil. The larger conductor size alternative would provide a higher thermal rating compared to Alternative 3's conductor thermal rating, but the equipment limitation at the terminal stations would not allow loading the circuit beyond the capability of that proposed in Alternative 3. The incremental cost for the larger conductor size is approximately $4.5 million more than Alternative 3. Hydro One's analysis of this alternative indicated that the larger conductor size would result in further reductions to line losses when compared to Alternative 3, by an additional 10% (approximately), for a combined total line loss reduction of approximately 50% when compared to the status quo). After reviewing the anticipated line losses savings over the life of the asset, Hydro One decided that the incremental increase in cost (approximately $4.5 million) would not be offset by the additional incremental reduction in line losses. In addition, the extra capacity of the circuits over Alternative 3 would also require station upgrades to be completed.

Analysis and Recommendation

All the alternatives listed above would help to address the need and increase the transfer capability and flow west from eastern Ontario. Alternatives 1 and 2 are expected to have a significantly higher cost (as outlined above), when compared to Alternative 3; and both Alternatives 1 and 2 require significant station work compared to Alternative 3, including the addition of new circuit breakers and new station diameters. Alternatives 3 and 4 are

similar in that they both require reconductoring of circuits M30A and M31A. Alternative 4 requires additional tower reinforcement to support the bigger conductor.

Alternative 1 would also require the installation of a new underground 230 kV cable along the existing Hawthorne TS to Merivale TS route ROW. The typical cost of the installation of new underground cables is significantly higher than the above-ground reconductoring alternative proposed by Alternative 3.

Alternative 2 would require the construction of approximately 85 km of new above-ground double circuit 230 kV transmission line, a linear circuit route length more than seven times the preferred route's distance. The cost of Alternative 2 is therefore expected to be significantly higher than the cost of Alternative 3, which is the preferred Project alternative.

Alternatives 1 and 2 were not pursued further, in terms of cost estimation and feasibility, as they were expected to be significantly more costly, as discussed above. Additionally, compared to Alternative 3, both Alternatives 1 and 2 would have significantly broader impact to the environment, landowners and other community stakeholders adjacent to the Alternative 1 and 2 line routes and station facilities.

Alternative 4 does not provide additional incremental benefits that would recover the incremental additional costs.

Alternative 3 has the least community stakeholder, landowner and environmental impacts compared to Alternative's 1 and 2. It is also the least-cost alternative that adequately addresses the need over the medium- and long-term and is therefore the preferred and recommended alternative.

QUANTITATIVE AND QUALITATIVE BENEFITS

QUANTITIVE BENEFITS

The HMR Project has the following quantitative benefits:

Increased Thermal Rating of Circuits M30A and M31A

This investment will increase the thermal rating of circuits M30A and M31A between Hawthorne TS to Merivale TS from 1800A (approximately 648MW) to 3000A (approximately 1080MW). Increasing the rating on these two circuits will increase the transfer capability of the Hawthorne TS to Merivale TS 230 kV transmission path. This increased capability can be utilized to transfer eastern Ontario supply resources, including generation located in eastern Ontario, west towards the GTA. Additionally, a 'bonus' of the Project will enable the potential for more import/export interprovincial flows with Quebec.

Reduction in line losses

By replacing the existing conductors on both the M30A and M31A circuits with dual-bundled 1443 kcmil bundled conductor, the resistance of the circuits will be lowered. Additionally, the losses, compared to the status quo, across the M30A and M31A circuits will be reduced by a factor of approximately 40%.[1]

New Telecommunication Path

Included in this Project is the replacement of the M31A sky-wire (non-OPGW capable) with OPGW. This new OPGW provides a new telecommunication path, which will provide redundancy to the teleprotection system required by NERC and NPCC for the Bulk Electric System and Bulk Power System.

[1] Based on the resistance ratio between the existing 1,843 kcmil conductor and proposed dual-bundled 1,443 kcmil reconductored circuit at the same current flow through the circuit.

QUALITATIVE BENEFITS

The HMR Project has the following qualitative benefits:

Reduced potential for congestion of provincial supply resources.

The M30A and M31A circuits, in their current configuration, limit the utilization of a transmission path that delivers provincial supply resources located in eastern Ontario to supply the GTA. Increasing the transfer capability between Hawthorne TS and Merivale TS along these two circuits (M30A and M31A) will reduce the potential for congestion on this path and the associated economic inefficiency.

Improved operability and reliability of the IESO-controlled Electricity grid in the Ottawa area.

In addition to delivering domestic supply resources, the M30A and M31A conductors associated with the HMR Project are utilized to supply customers in the west of Ottawa, and deliver imports from the High Voltage Direct Current ("HVDC") intertie with Quebec. When the real-time utilization of the circuits approaches the limited capability, operational measures that have the potential to reduce the reliability of supply to Ottawa customers or that reduce the ability for Ontario to rely on imports from Quebec may be required. Increasing the rating of the M30A and M31A circuits will reduce the potential need for such operating measures and the associated reliability impacts across the system.

Reduction in construction outages.

Combining the OPGW work for M31A as part of the HMR Project reduces the number of outages required on the M30A and M31A circuits, which are critical for the system. In addition, combining this scope in the HMR Project results in cost saving, as the same construction team can pull the conductors across the entire circuit span, as well as the OPGW, at the same time. Performing the work as two different projects would require extensive project duplication, including, but not limited to, construction teams mobilizing

to site twice, more outages in the area on these critical transmission circuits, additional planning and cost, and additional disruption to the community in the vicinity of the Project's location.

APPORTIONING PROJECT COSTS AND RISKS

The capital cost of the HMR Project is estimated to be $19.7M, including overheads and capitalized interest, is shown in Table 1 below.

Table 1: Estimated Cost of Line Work

	$000's
Materials	6,520
Labour	4,796
Equipment Rental & Contractor Costs	2,683
Sundry	296
Contingencies	1,797
Overhead[1]	1,716
Capitalized Interest[2]	1,498
Real Estate[3]	387
Total Line Capital Work	**19,693**

1. COST ALLOCATION

Hydro One's cost allocation approach for the HMR Project's work is consistent with the approach set out in section 6.3.5 of the TSC relating to modifications to the transmitter's network facilities. For the HMR Project, the line reconductoring work is required to facilitate bulk power transfers from eastern Ontario to the GTA, including eastern

[1] Overhead costs allocated to the project are for corporate services costs. These costs are charged to capital projects through a standard overhead capitalization rate. As such, they are considered "Indirect overheads".
[2] Capitalized Interest is calculated using the Board's approved interest rate methodology (EB-2016-0160) to the Project's forecast monthly cash flow and carrying forward closing balances from the preceding month.
[3] Real Estate cost for HMR project is to acquire crossing permits to string over railways, roads, and waterways.

Ontario generation and therefore the total Project cost of $19.7M is allocated in its entirety to the Network Facilities cost pool.

2. RISKS AND CONTINGENCIES

As with most projects, there is some risk associated with estimating costs. Hydro One's cost estimate includes an allowance for contingencies in recognition of these risks. Based on past experience, the estimate for this Project work includes allowances in the contingencies to cover the four following potential risks, which are the major contributors to the total contingency suggested for this Project.

- **Outage Constraints** – The risk of securing line outages. Summer and winter period outages may not be available, since the circuits may be operating at full capacity. This may result in schedule delays and additional cost. Additionally, given the criticality of the circuits to the system, a granted/planned outage could be cancelled at short notice.
- **Construction Risk –** The risk of 500 kV circuit hold-off recalls. This risk means that the IESO could ask Hydro One to restore a 500 kV circuit to service even though approval had been granted for taking it out of service to facilitate the reconductoring work on one of the 230 kV circuits. This could happen if the other adjacent 500 kV circuit (being carried on the other adjacent tower along the right-of-way), which will be live and in service, becomes unavailable due to an unplanned outage, etc. In the case of a 500kV circuit recall, the work on the 230 kV circuit must stop and the 500 kV circuit will be restored into service. This scenario would result in additional time delay and likely additional cost to the Project.
- **Approvals and Permits** – there is a risk of delays being encountered in obtaining required approvals, including road crossing and rail crossing permits.
- **Material delivery timelines** – there is risk of delay due to procurement and/or vendor issues.

Cost contingencies that have not been included, due to the unlikelihood or uncertainty of occurrence, include:

- Labour disputes
- Safety or environmental incidents
- Significant changes in costs of materials since the estimate preparation
- Any other unforeseen and potentially significant event/occurrence

3. COSTS OF COMPARABLE PROJECTS

The OEB Filing Requirements for Electricity Transmission Applications, Chapter 4, requires the Applicant to provide information on the cost of comparable projects constructed by the Applicant for baseline comparison.

The Project consists of reconductoring 230 kV circuits M30A and M31A with dual-bundled conductor to increase the capacity of both circuits. The circuits are supported on different towers, along the same right-of-way. In accordance with the filing requirements, Project cost comparisons of the line work for the HMR Project to other transmission line projects completed by Hydro One are provided below. Hydro One has provided three double circuit line comparison projects, one at 230 kV and two at 115 kV.

3.1 LINES PROJECTS

Hydro One has provided three comparable projects for the line work: the D6V/D7V Transmission Line Refurbishment ("D6V/D7V") project, the West Toronto Transmission Enhancement ("WTTE") project, and the Decew TS x Glendale TS Transmission Line Refurbishment ("DxS") project relating to circuits known as D9HS/D10S. These three comparison projects involve reconductoring existing 115 kV or 230 kV circuits. In the case of WTTE and D6V/D7V, the project also involved capacity increases, whereas for the DxS project, the refurbishment replaced the existing conductor with the same-sized

conductor. The HMR Project has significant differences from the majority of Hydro One's line reconductoring projects that have been undertaken in the past, largely due to the following reasons:

- the scope of work involves two circuits on two separate and adjacent sets of towers, compared to the majority of Hydro One's reconductoring projects that reconductor two circuits that are carried on one single set of towers;
- each of the two tower that span between the two connecting stations carries a 230 kV circuit (which will be reconductored) and two other circuits – both operating at different voltages to the 230 kV (i.e. 115 kV and 500 kV);
- generally, the majority of Hydro One's dual circuit transmission line reconductoring projects involve reconductoring that occurs for circuits that share the same tower span. Additionally, these projects generally reconductor a single conductor circuit with the same configuration, instead of a dual-bundled conductor as in the HMR Project's case.
- the presence of a high-voltage 500 kV circuit on the same towers as the 230 kV circuits being reconductored requires additional safety measures to be implemented during the construction process.

These factors all contribute to a comparatively higher complexity for the HMR Project to the 'like' projects Hydro One has selected as being appropriately similar for cost/scope comparability purposes (as shown below in Table 2) and as required per the Board's filing requirements. These additional complexities, timing and safety requirements, add a level of costs above those projects that have been chosen similar in scope. The uniqueness in the scope of the HRM Project makes it difficult to complete a comparable project cost analysis.

Hydro One has provided a side-by-side comparison of the projects it has selected in Table 2 below. The table illustrates that the HMR Project cost per circuit km is approximately $0.8M per km, which is in line with the WTTE project cost per km. Table 2 also reflects the fact that the HMR Project cost per km is expected to be higher than the D6V/D7V and DxS projects on a circuit km basis, but that is primarily a function of the reasons listed above.

Table 2: Costs of Comparable Line Projects

Project	HMR Project	WTTE Project	D6V/D7V Project	DxS Project
Technical	Reconductor of double circuit 230 kV dual-bundled conductor (on two separate towers)	Reconductor of mostly quad 115kV circuit line	Reconductor of double circuit 230 kV line	Reconductor of double circuit 115kV line
Length (km)	11.9	10.0	9.4	9.0
Circuit km length (km)[4]	23.8	40.0	18.8	18.0
Project Surroundings	Mostly urban: residential & commercial Multiple road crossings	Urban	Mostly rural	Mostly urban
In-Service Date	Dec-23	Nov-18	Dec-20	Dec-15
Years for escalation	-	5 yrs, 1 mth	3 yrs	8 yrs
Total Project Cost ($M)[5]	21.3	21.4	8.6	6.3
Less: Bypass ($M)	0.2	-	-	0.2
Less: OPGW termination work ($M)	1.0	-	-	-
Less: OPGW/Skywire ($M) [6]	1.6	0.3	0.3	0.8
Total Project Costs Before escalation ($M)	**18.7**	**21.1**	**8.3**	**5.3**
Add: Escalation Adjustment (2%/year)	-	2.2	0.5	0.9
Total Comparable Project Costs ($M)	**18.7**	**23.3**	**8.8**	**6.2**
Total Cost/Circuit km ($M)	**0.8**	**0.6**	**0.5**	**0.3**

A description of each comparable project is provided below, with commentary highlighting any applicable similarities and/or differences to the HMR Project which drive costs for each:

[4] Circuit km length is the sum of the length of all the circuits in the project.
[5] The HMR Project and the D6V/D7V Project provide forecast cost. The WTTE Project and DxS Project represent actual cost.
[6] Installing OPGW is typically higher cost than the non-OPGW skywire alternative. The construction methodology and skywire material alternative has a cost impact. For the HMR Project, the number of dead-end towers also has an impact on the OPGW cost, as each dead-end tower requires terminating the OPGW at the tower and splicing the fibre.

a) The WTTE Project includes reconductoring of four 115 kV circuits, approximately 10 km long, between Manby TS and Wiltshire TS. For the majority of the distance between the two terminal stations, the four circuits are carried by the same tower span. This Project is located in the west end of Toronto, in a highly urbanized area. The line reconductor project was part of a larger overall project that included transformation capacity upgrades at Runnymede TS. The WTTE Project went in-service in November 2018.

Both the HMR and WTTE projects are similarly situated in urban locations with similar circuit km lengths. Both projects involve work on towers with more than two circuits, requiring more coordination to undertake the construction work, including obtaining approval for outages on critical consistently highly loaded circuits. Both projects involve multiple road crossings and involve increasing the rating of the circuits. Unlike the WTTE project, which involved working around other 115 kV circuits, the HMR Project involves work on a circuit that is carried on a tower which also carries a 500 kV circuit. This requires additional precautions, safety measures and equipment. In addition, and unlike the other projects that are being used for comparison in Table 2, circuits M30A and M31A of the HMR Project are carried on two separate spans of towers for the entire route between Hawthorne TS and Merivale TS. This adds construction time required, as only one circuit can have an outage at a time, so only one circuit can be reconductored at a time. This results in double the setup and mobilization work actions, as each circuit's conductor must be pulled at separate times (i.e. one circuit will be reconductored and restored to service before the second circuit is reconductored, effectively doubling what would usually be a single setup and demobilization). Furthermore, due to the importance of the M30A and M31A circuits to the transmission system only one of these circuits is permitted to be removed from service at any one time. The stringing of two conductors per phase,

compared to the usual single conductor per phase replacement (which the WTTE project and other comparison projects in Table 2 reflect) results in additional overall cost per km.

b) The DxS project, which went into service in December 2015, was a like-for-like conductor replacement for the 115 kV circuits D9HS and D10S. The circuits for this project are on the same double circuit tower span. The DxS project is located mostly in an urban area of St. Catharines and was undertaken to replace end-of-life conductors. The existing conductors were replaced with same-size conductors.

Both the HMR and DxS projects are similarly situated in urban locations with similar circuit km lengths. Both projects require water crossing as well as multiple road crossings. The DxS project involved reconductoring of circuits on the same tower line, which reduces the construction time for each of the circuit, compared to the HMR Project scope of work, where the two circuits are carried by two different, but adjacent, tower spans. For the HMR Project, this increases the construction time and cost, as each circuit of the HMR Project must be pulled individually and at different times, effectively necessitating that one circuit be reconductored and restored to service before the second circuit can be reconductored. This effectively doubles what would usually be single setup and demobilization efforts; and the HMR Project's circuits are carried on 500 kV suitable towers, which require extra precaution, safety measures and equipment. In addition to the 500 kV circuit, the M30A and M31A 230 kV circuits share a tower with a third circuit, rated at 115 kV, further increasing the complexity of the reconductoring project work. Given the HMR Project's twin-bundle reconductor scope, there is a higher material cost per km when compared to the single conductor scope of the DxS project.

c) The D6V/D7V project has been provided as a third comparison. This project consists of refurbishing approximately 9.4 km of double circuit 230 kV line between Guelph North JCT and Fergus JCT. The D6V/D7V project is located mostly in a rural geographical area and is expected to be completed in December 2020.

Both the HMR and D6V/D7V projects involve reconductoring two 230 kV circuits over similar distances. The D6V/D7V project is located primarily in a rural area with minimal road crossings, compared to the highly urbanized HMR Project setting, with multiple road crossings. Both circuits D6V and D7V are carried on a single set of towers with no other circuits on that tower or other towers on that right-of-way, effectively reducing the level of complexity of this undertaking when compared to the HMR Project, which has multiple circuits carried on the same tower span and multiple towers on the same right-of-way. For the D6V/D7V project, this will reduce the construction time required to reconductor both circuits.

The D6V/D7V project has many scope similarities to the DxS project, so the differences to the HMR Project will be also similar to those mentioned in the D6V/D7V project comparison commentary. Examples are the distinction of the the HMR Project circuits being situated on separate towers, requiring dual-bundled conductor replacement compared to a single replacement which results in increases in complexity, safety precautions and ultimately cost per km comparison to the two single tower comparison project's scopes (including the presence in the HMR Project of the high-voltage 500 kV circuit).

CONNECTION PROJECTS REQUIRING NETWORK REINFORCEMENT

The HRM Project is not a connection project, therefore this section is not required.

TRANSMISSION RATE IMPACT

1. ECONOMIC FEASIBILITY

Hydro One's proposed HMR Project will increase the thermal rating of the 230 kV circuits M30A and M31A between Hawthorne TS and Merivale TS by replacing the existing single-conductor per phase configuration with dual 'bundled' conductors on each circuit's three phases. This Project will remove the current capacity limitations on the M30A and M31A between Hawthorne TS and Merivale TS circuits allowing for more flexibility of westerly power flows from eastern Ontario towards the GTA.

The HMR Project itself is not forecast to enable future load connections or load growth of individual customers, and no incremental revenue is associated with this Project. Additionally, there are no incremental operating and maintenance costs as a result of the proposed Project, since it is replacing existing conductors.

A 25-year illustrative discounted cash flow analysis of the network pool work is provided below in Table 1. The results show that based on the estimated initial cost of $21.3 million, of which $19.7 million is capital and $1.6 million is removals, with no incremental revenue or operating and maintenance expenditures, the HMR Project will have a negative net present value of $18.5 million. The resulting revenue requirement shortfall will be recovered via network pool rates.

2. COST RESPONSIBILITY

Network Pool

Hydro One's M30A and M31A 230 kV circuits are network circuits linking the electrical system between two main transformer stations (Hawthorne TS and Merivale TS) located in Ottawa. The circuits are used primarily to transfer bulk power from eastern Ontario to the GTA, including eastern Ontario generation. The Project will address the IESO-

identified capacity need for Ontario[1], facilitating current and future load requirements of the network. This is a system project that is not tied to any particular load increase or customer load application and is intended to relieve the current bulk power transfer limitation. As such, the proposed line upgrade is included in the Network Pool and no customer capital contributions are required, consistent with the provisions of Section 6.3.5 of the Transmission System Code.

3. RATE IMPACT ASSESSMENT

The analysis of the Network Connection pools rate impact has been carried out on the basis of the most recently approved Ontario Transmission Rate Schedules in EB-2020-0180 Decision and Order for the 2020 Uniform Transmission rates. The impact of forgone revenue and any related variance account is not included in this analysis.

Network Pool

Based on the Project's forecast total expenditure of $21.3 million, the revenue requirement shortfall is forecast to have a 0.26% increase from the current rate of $3.92/kW/month to $3.93/kW/month. The detailed analysis illustrating the calculation of the incremental network revenue shortfall and rate impact is provided in Table 2 below.

Impact on Typical Residential Customer

Based on the load forecast, initial capital costs and ongoing maintenance costs, there will be minimal impact on rates. The table below shows this result for a typical residential customer who is under the Regulated Price Plan ("RPP") utilizing the maximum impact by rate pool, regardless of year.

[1] For detailed evidence on this Project's need refer to Exhibit B, Tab 3, Schedule 1 of this Application.

A. Typical monthly bill (Residential R1 in a high density zone at 1,000 kWh per month at Tiered prices)	$181.58 per month
B. Transmission component of monthly bill	$15.31 per month
C. Line Connection Pool share of Transmission component	$2.11 per month
D. Transformation Connection Pool share of Transmission component	$5.07 per month
E. Network Pool share of Transmission component	$8.13 per month
F. Impact on Network Connection Pool Provincial Uniform Rates	0.26%
G. Net impact on typical residential customer bill (E * F)	$0.02 per month or $0.25 per year
H. Percentage increase on typical residential customer bill (G / A)	0.01%[2]

Note: Values rounded to two significant digits.

[2] The actual percentage value, as discussed in Section 3.0 above, is 0.0026% and rounded to two decimal places is 0.00%.

Table 1: NPV Analysis of Project - Page 1 of 2

Date:	3-Nov-20
Project #	

SUMMARY OF CONTRIBUTION CALCULATIONS
Network Pool - Estimated cost

Facility Name:	Hawthorne by Merivale Conductor Upgrade
Description:	Replacing existing conductors of circuits M30A/M31A with a twin-bundle conductor
Customer:	

			In-Service Date	<------- Project year ended - annualized from In-Service Date ------->											
		Month	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15
		Year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
			0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Revenue & Expense Forecast															
Load Forecast (MW)				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Load adjustments (MW)				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tariff Applied ($/kW/Month)				3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
Incremental Revenue - $M				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Removal Costs - $M			(1.6)												
On-going OM&A Costs - $M			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Municipal Tax - $M				(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
Net Revenue/(Costs) before taxes - $M			(1.6)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
Income Taxes			0.4	0.2	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
Operating Cash Flow (after taxes) - $M			(1.2)	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1
		Cumulative PV @ 5.31%													
PV Operating Cash Flow (after taxes) - $M	**(A)**	**1.1**	**(1.2)**	**0.2**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
Capital Expenditures - $M															
Upfront - capital cost before overheads & AFUDC			(16.5)												
- Overheads			(1.9)												
- AFUDC			(1.3)												
Total upfront capital expenditures			**(19.7)**												
On-going capital expenditures				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PV On-going capital expenditures			0.0												
Total capital expenditures - $M			**(19.7)**												
Capital Expenditures - $M															
PV CCA Residual Tax Shield - $M			**0.1**												
PV Working Capital - $M			**0.0**												
PV Capital (after taxes) - $M	**(B)**	**(19.6)**	**(19.6)**												
Cumulative PV Cash Flow (after taxes) - $M	**(A) + (B)**	**(18.5)**	**(20.7)**	**(20.6)**	**(20.3)**	**(20.0)**	**(19.8)**	**(19.6)**	**(19.4)**	**(19.2)**	**(19.1)**	**(19.0)**	**(18.9)**	**(18.8)**	**(18.8)**

Discounted Cash Flow Summary

Economic Study Horizon - Years:		**25**
Discount Rate - %		**5.31%**
		Before Cont $M
PV Incremental Revenue		0.0
PV OM&A Costs		(1.6)
PV Municipal Tax		(0.9)
PV Income Taxes		0.7
PV CCA Tax Shield		3.1
PV Capital - Upfront	(19.7)	
Add: PV **Capital Contribution**	**0.0**	(19.7)
PV Capital - On-going		0.0
PV Working Capital		0.0
PV Surplus / (Shortfall)		**(18.5)**
Profitability Index*		**0.1**

Notes:
* of total cash flow, excluding net capital expenditure & on-going capital & proceeds on disposal / PV of net capital expenditure & on-going capital & proceeds on disposal

Other Assumptions

In-Service Date:	15-Dec-23
Payback Year:	2048
No. of years required for payback:	25

PV

Table 1: NPV Analysis of Project - Page 2 of 2

Date:	3-Nov-20
Project #	

SUMMARY OF CONTRIBUTION CALCULATIONS
Network Pool - Estimated cost

Facility Name:	Hawthorne by Merivale Conductor Upgrade
Description:	Replacing existing conductors of circuits M30A/M31A with a twin-bundle conductor
Customer:	

		<------- Project year ended - annualized from In-Service Date ------->												
Month		Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15	Dec-15
Year		**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**
		13	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*
Revenue & Expense Forecast														
Load Forecast (MW)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Load adjustments (MW)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tariff Applied ($/kW/Month)		3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
Incremental Revenue - $M		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Removal Costs - $M														
On-going OM&A Costs - $M		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Municipal Tax - $M		(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
Net Revenue/(Costs) before taxes - $M		(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
Income Taxes		0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Operating Cash Flow (after taxes) - $M		0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PV Operating Cash Flow (after taxes) - $M	**(A)**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Capital Expenditures - $M														
Upfront - capital cost before overheads & AFUDC														
- Overheads														
- AFUDC														
Total upfront capital expenditures														
On-going capital expenditures		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PV On-going capital expenditures														
Total capital expenditures - $M														
Capital Expenditures - $M														
PV CCA Residual Tax Shield - $M														
PV Working Capital - $M														
PV Capital (after taxes) - $M	**(B)**													
Cumulative PV Cash Flow (after taxes) - $M	**(A) + (B)**	**(18.7)**	**(18.7)**	**(18.6)**	**(18.6)**	**(18.6)**	**(18.5)**	**(18.5)**	**(18.5)**	**(18.5)**	**(18.5)**	**(18.5)**	**(18.5)**	**(18.5)**

Table 2: Network Connection Pool Rate Impact - Page 1 of 2

Revenue Requirement and Network Pool Rate Impact **(Before Capital Contribution)**

Hawthorne by Merivale Conductor Upgrade		Project YE 15-Dec 2024	15-Dec 2025	15-Dec 2026	15-Dec 2027	15-Dec 2028	15-Dec 2029	15-Dec 2030	15-Dec 2031	15-Dec 2032	15-Dec 2033	15-Dec 2034	15-Dec 2035
Calculation of Incremental Revenue Requirement ($ millions)		1	2	3	4	5	6	7	8	9	10	11	12
In-service date	15-Dec-23												
Capital Cost	19.7												
Less: Capital Contribution Required	-												
Net Project Capital Cost	19.7												
Average Rate Base		9.7	19.1	18.7	18.3	18.0	17.6	17.2	16.8	16.4	16.0	15.6	15.3
Incremental OM&A Costs		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grants in Lieu of Municipal tax		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Depreciation		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Interest and Return on Rate Base		0.6	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.0	0.9	0.9
Income Tax Provision		(0.0)	(0.2)	(0.1)	(0.1)	(0.1)	(0.0)	(0.0)	0.0	0.0	0.1	0.1	0.1
REVENUE REQUIREMENT PRE-TAX		**1.0**	**1.4**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Incremental Revenue		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUFFICIENCY/(DEFICIENCY)		**(1.0)**	**(1.4)**	**(1.5)**	**(1.5)**	**(1.5)**	**(1.5)**	**(1.5)**	**(1.5)**	**(1.5)**	**(1.5)**	**(1.5)**	**(1.5)**
	Base Year												
Network Pool Revenue Requirement including sufficiency/(deficiency)	978	979	979	979	979	979	979	979	979	979	979	979	979
Network MW	249	249	249	249	249	249	249	249	249	249	249	249	249
Network Pool Rate ($/kw/month)	3.92	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93
Increase/(Decrease) in Network Pool Rate ($/kw/month), relative to base year		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RATE IMPACT relative to base year		**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**

Assumptions

Incremental OM&A		$15.7126694704142 k per new km of line each year.
Grants in Lieu of Municipal tax	0.34%	Transmission system average
Depreciation	2.00%	Reflects 50 year average service life for towers, conductors and station equipment, excluding land
Interest and Return on Rate Base	5.99%	Includes OEB-approved ROE of 8.52%, 2.75% on ST debt, and 4.42% on LT debt. 40/4/56 equity/ST debt/ LT debt split
Income Tax Provision	26.50%	2018 federal and provincial corporate income tax rate
Capital Cost Allowance	8.00%	100% Class 47 assets except for Land

Table 2: Network Connection Pool Rate Impact - Page 2 of 2

Revenue Requirement and Network Pool Rate Impact **(Before Capital Contribution)**

Hawthorne by Merivale Conductor Upgrade		15-Dec 2036	15-Dec 2037	15-Dec 2038	15-Dec 2039	15-Dec 2040	15-Dec 2041	15-Dec 2042	15-Dec 2043	15-Dec 2044	15-Dec 2045	15-Dec 2046	15-Dec 2047	15-Dec 2048
Calculation of Incremental Revenue Requirement ($ millions)		13	14	15	16	17	18	19	20	21	22	23	24	25
In-service date	15-Dec-23													
Capital Cost	19.7													
Less: Capital Contribution Required	-													
Net Project Capital Cost	19.7													
Average Rate Base		14.9	14.5	14.1	13.7	13.3	12.9	12.5	12.2	11.8	11.4	11.0	10.6	10.2
Incremental OM&A Costs		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grants in Lieu of Municipal tax		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Depreciation		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Interest and Return on Rate Base		0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.6	0.6
Income Tax Provision		0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
REVENUE REQUIREMENT PRE-TAX		**1.5**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**
Incremental Revenue		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUFFICIENCY/(DEFICIENCY)		**(1.5)**	**(1.4)**	**(1.4)**	**(1.4)**	**(1.4)**	**(1.4)**	**(1.4)**	**(1.4)**	**(1.3)**	**(1.3)**	**(1.3)**	**(1.3)**	**(1.3)**
	Base Year													
Network Pool Revenue Requirement including sufficiency/(deficiency)	978	979	979	979	979	979	979	979	979	979	979	979	979	979
Network MW	249	249	249	249	249	249	249	249	249	249	249	249	249	249
Network Pool Rate ($/kw/month)	3.92	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93
Increase/(Decrease) in Network Pool Rate ($/kw/month), relative to base year		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RATE IMPACT relative to base year		**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**	**0.26%**

Table 3: DCF Assumptions

Hydro One Networks -- Transmission Connection Economic Evaluation Model
2020 Parameters and Assumptions

Transmission rates are based on current OEB-approved uniform provincial transmission rates.

		Monthly Rate ($ per kW)	
	Line	**0.97**	
Grants in lieu of Municipal tax (% of up-front capital expenditure, a proxy for property value):		**0.34%**	Based on Transmission system average
Income taxes:			
Basic Federal Tax Rate - % of taxable income:	2018	**15.00%**	Current rate
Ontario corporation income tax - % of taxable income:	2018	**11.50%**	Current rate
Capital Cost Allowance Rate:			
Class 47 costs	2018	**8%**	Current rate
Decision Support defined costs (1)	2018	**0%**	
Decision Support defined costs (2)	2018	**0%**	
Decision Support defined costs (3)	2018	**0%**	
After-tax Discount rate:		**5.31%**	Based on OEB-approved ROE of 8.52% on common equity and 2.75% on short-term debt, 4.42% forecast cost of long-term debt and 40/60 equity/debt split, and current enacted income tax rate of 26.5%

DEFERRAL ACCOUNT REQUESTS

There are no new deferral account requests being made as part of this Application.

PROJECT SCHEDULE

Hawthorne to Merivale Reconductoring Project		
TASK	**START**	**FINISH**
Projected Section 92 Approval	December 2, 2020	May 15, 2021
Lines		
Property Rights Acquisition	May 2021	September 2021
Detailed Engineering	May 2021	September 2021
Long Lead Time Material Ordered	June 2021	October 2021
Construction Start	October 2021	November 2023
Commissioning	September 2022	November 2023
In-Service		December 2023

PHYSICAL DESIGN

1. LINE FACILITIES

The current 230 kV circuits, known as M30A and M31A, located on the same right-of-way between Hawthorne TS and Merivale TS, measure a distance of approximately 11.9 km, and each currently consist of three phases of single conductor. The HMR Project will replace the single 230 kV conductor on each phase of each circuit with two 230 kV conductors on each phase of the three-phase circuits in a bundled configuration (i.e. dual conductors on each phase). Each circuit will continue to operate at 230 kV. The M30A and M31A reconductored circuits will continue to be located where they are currently and will maintain the current right-of-way corridor, tower centre lines, and tower heights, etc. The only change planned for each set of towers is the replacement of the 230 kV tower arms, which current hold the existing M30A and M31A 230 kV conductors. The current tower arms supporting the single circuit 230 kV conductors are not designed for, or capable of, supporting the proposed 1443 kcmil dual-conductor bundled configuration 230 kV conductors. The current 230 kV supporting tower arms will be replaced with stronger arms capable of safely carrying the new dual-conductor bundled 230 kV per phase configuration.

The before and after photos provided below in Figures B and C, along with design drawings (refer to **Exhibit C, Tab 1, Schedule 1, Attachment 1**), illustrate the proposed changes to the appearance of both the M30A and M31A circuits.

Figure A below is provided to illustrate a typical example of a single-conductor circuit that consists of three phases (i.e. one conductor on each phase and three conductors in total).

Figure A shows the existing right-of-way with all the circuits carried by the parallel towers. The red circle in **Figure B** indicates the three phases of the current 230kV M30A circuit. Note that to the left of the circled circuit is the 500 kV circuit and to the right of that circuit are the 115 kV circuits that are carried on the same tower. The HMR Project's location consists of a right-of-way route which accommodates both towers and circuits (i.e. one tower for M30A and a separate and identical tower series accommodating the M31A circuit). For all intents and purposes, both towers and circuits have identical design and configuration.

Figure A: Photograph – Current Right of Way for Towers Carrying M30A and M31A

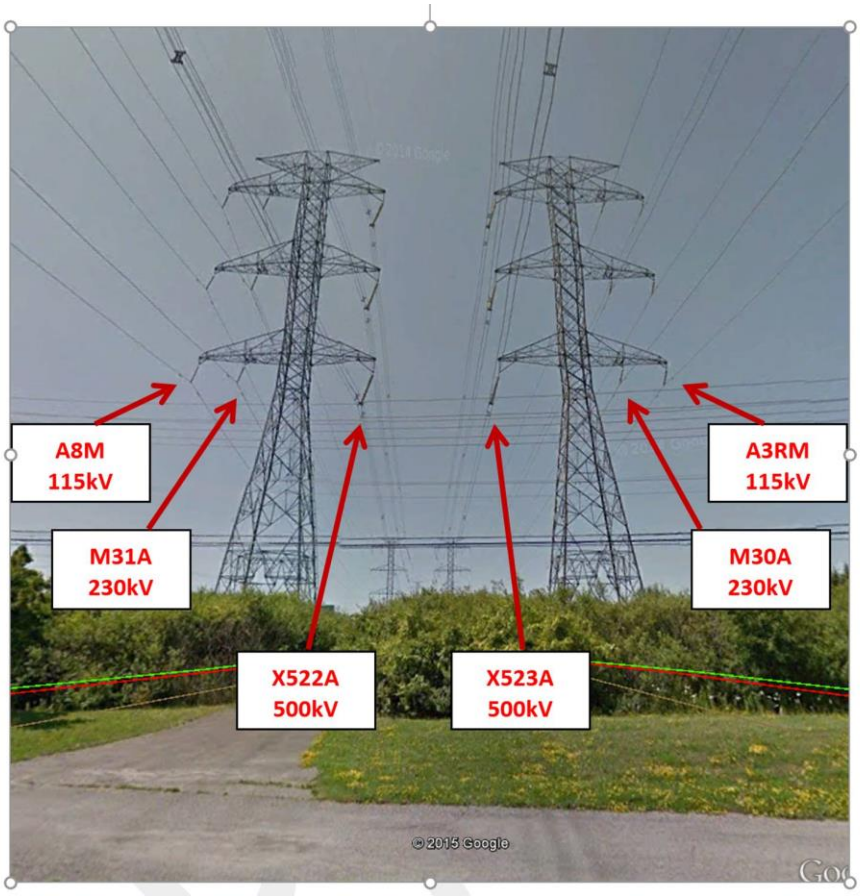
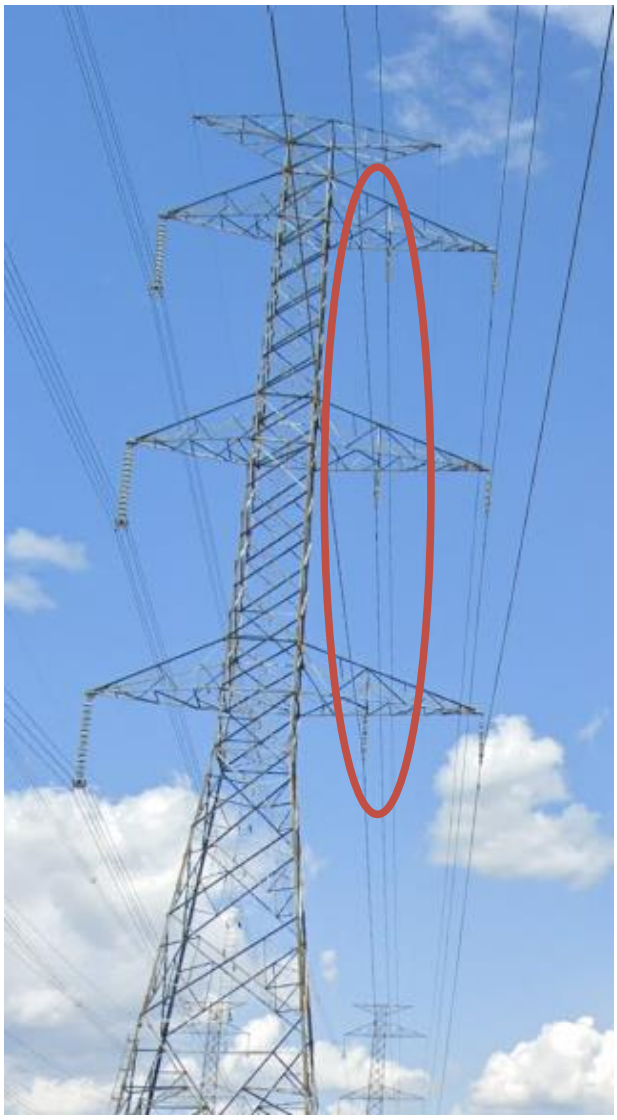


Figure B: Photograph – Current Tower Structure Highlighting the Three-Phase Circuit M30A[1]

(Each phase contains a single conductor)

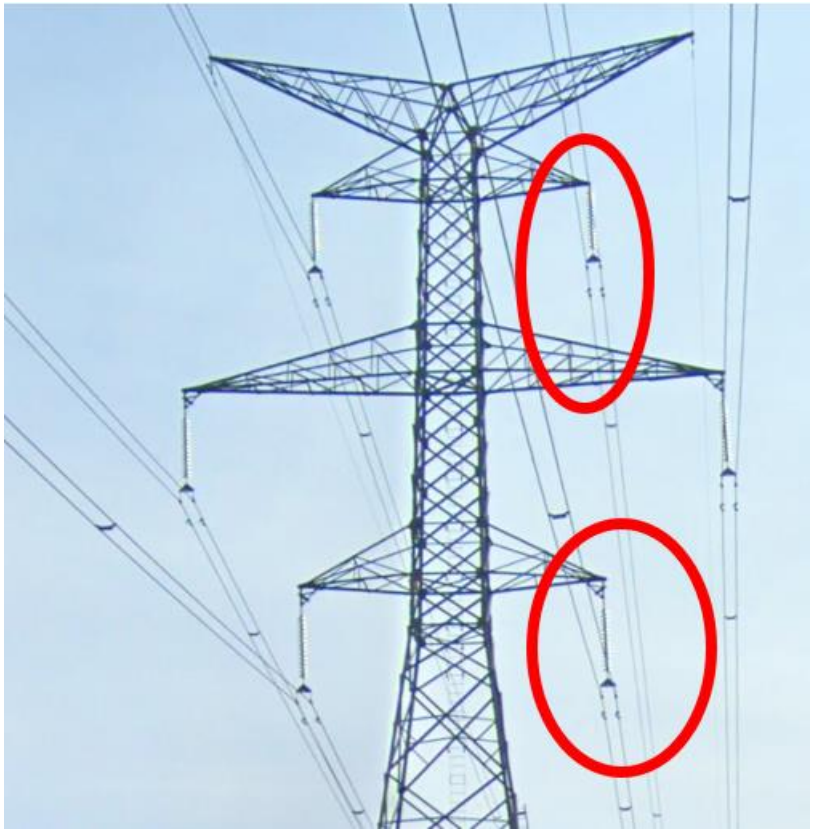


The HMR Project will replace the current single 1843 kcmil conductor 230 kV per phase with a dual-conductor per phase 1443 kcmil 'bundled' 230 kV conductor on each phase.

[1] The tower carrying the other identical 230 kV circuit, known as M31A, is identical to the above tower shown in Figure A which is carrying the M30A circuit (as circled in red).

Figure C[2] below is a photograph provided by the Applicant as a visual illustrative example of a tower carrying a dual-conductor 'bundled' configuration on each single phase. In this photo the circuit configuration has two phases per circuit. Both the M30A and M31A circuits will continue to have three phases per circuit, as shown above in **Figure A**.

Figure C: Photograph – Example of a Double-Conductor per Phase Circuit Configuration with only Two Phases



The right-of-way corridor width on which the towers carrying the circuits are currently situated will not be expanded as a result of this Project.

[2] Figure C is provided for illustrative purposes, it is not the actual tower that will carry the reconductored M30A or M301A dual-bundled conductors per phase. The tower design that will be used can be found at Attachment 1 to this exhibit.

Maps indicating the geographic location of both existing circuits' route are provided at **Exhibit C, Tab 2, Schedule 1, Attachments 1**. A schematic diagram of the proposed line facilities is provided in **Exhibit B, Tab 2, Schedule 1, Figure 1**.

As mentioned, both of the circuit routes will continue along the current right-of-way, and details regarding land matters can be found at **Exhibit E, Tab 1, Schedule 1**.

2. STATION FACILITIES

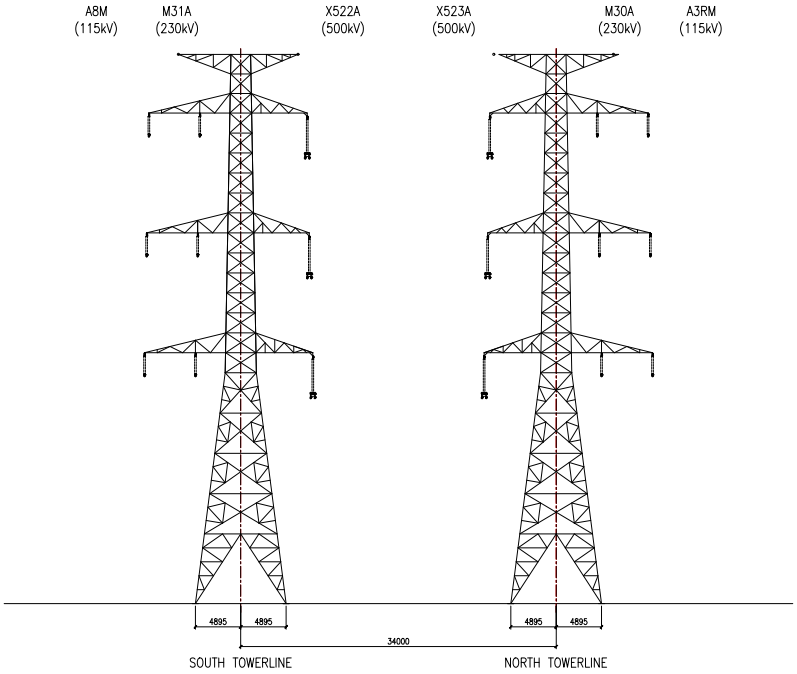
In conjunction with the line facilities work described above the HMR Project will also require the following minor station-related work;

- *Hawthorne TS*

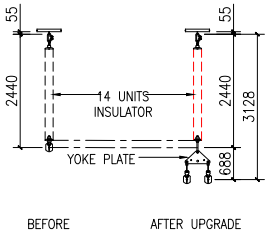
  Project work that will occur at this station consists of modifying the protection relays settings to accommodate for the circuit impedance. In addition, the OPGW skywire will be terminated at the station. This work includes the connection of the OPGW fibre to the telecom equipment at the station and the necessary testing and commissioning.

- *Merivale TS*

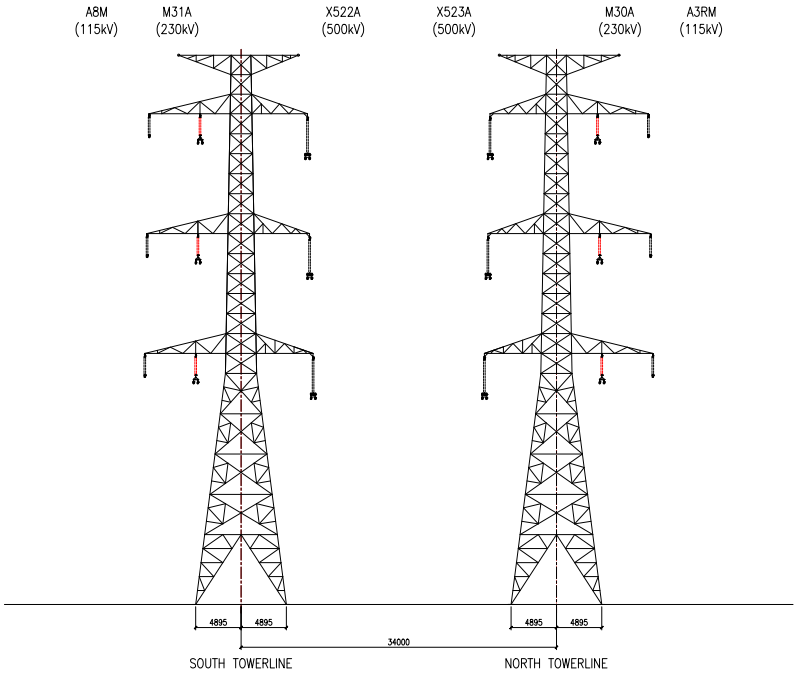
  Project work that will occur at this station will consist of modifying the protection relays settings to accommodate for the circuit impedance. In addition, the OPGW skywire will be terminated at the station. This work includes the connection of the OPGW fibre to the telecom equipment of the station and the necessary testing and commissioning.



BEFORE M30A/M31A UPGRADE



SUSPENSION
ASS'Y DETAIL



AFTER M30A/M31A UPGRADE

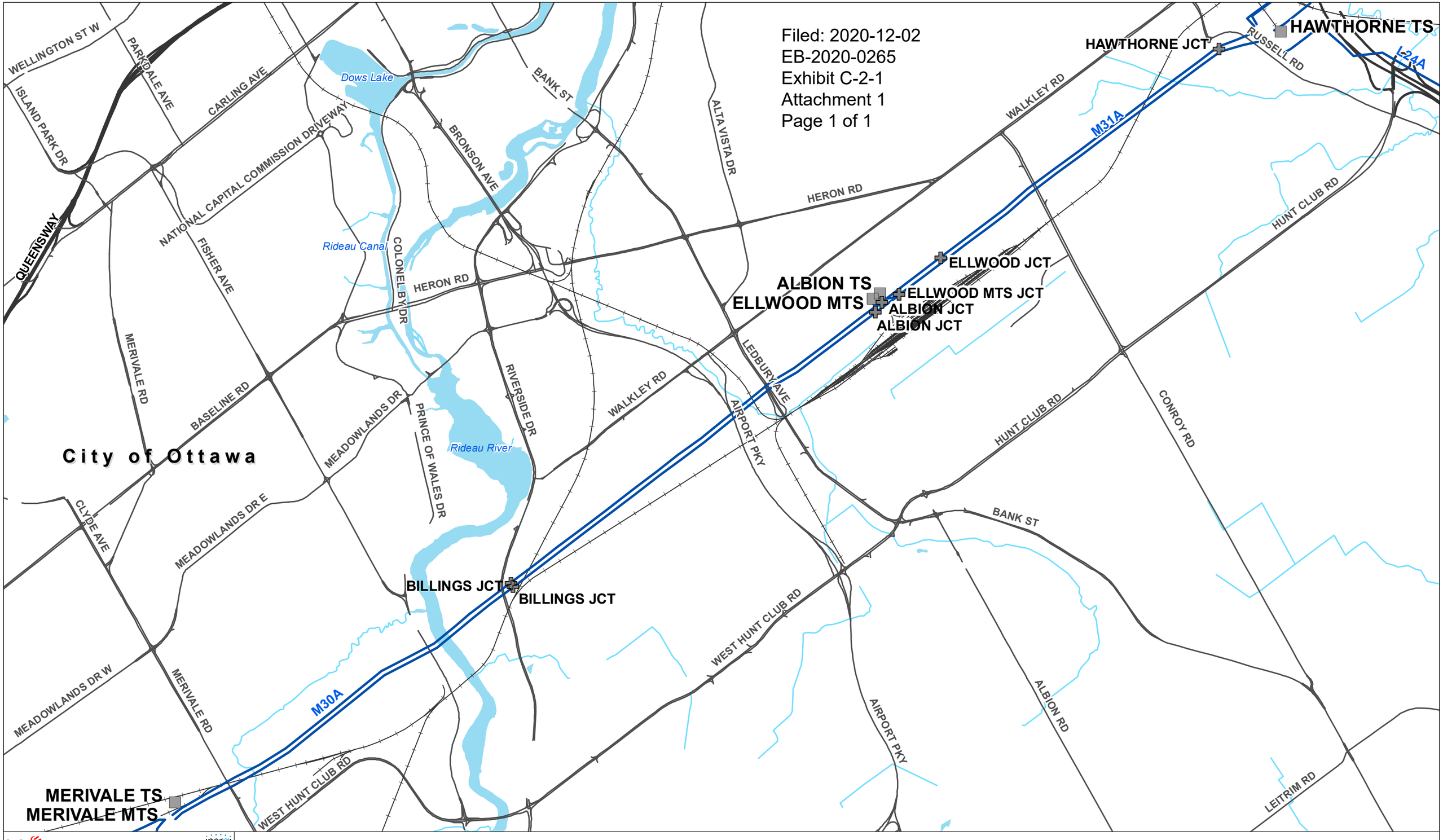
MAPS

A map showing the geographic location of the HMR Project is provided at **Exhibit C, Tab 2, Schedule 1, Attachment 1**. This map is provided with the intention that it is to be used by the Board as the Project's Notice Map.

An illustrative aerial view map showing more detail of the footprint for the Project's line and station work is provided at **Exhibit E, Tab 1, Schedule 1, Attachment 1.**

Further details on land matters for this Project are available at **Exhibit E, Tab 1, Schedule 1.**

Filed: 2020-12-02
EB-2020-0265
Exhibit C-2-1
Attachment 1
Page 1 of 1



hydro one inergi

Produced By: Inergi LP, GISS ervices
Date: Jul 22, 2019
Map19-128_M30A_M31A_HawthorneTS_MerivaleTS

- Transformer Station
- Junction
- 230 kV Transmission Line
- Railway
- Road
- Highway
- Watercourse
- Water

M30A/M31A
Hawthorne TS to Merivale TS

1:30,000

0 500 1,000 m

OPERATIONAL DETAILS

The HMR Project includes the replacement of the current conductors on circuits M30A and M31A. As discussed, each circuit currently consists of one conductor per phase and each circuit has three phases, for a total of three conductors for each circuit. The proposed Project will replace the current conductors along the Hawthorne TS to Merivale TS route with dual-bundled 230 kV conductors (i.e. two conductors per phase, three phases per circuiting, totaling six conductors per circuit). Additionally, this Project will include the replacement of the skywire associated with circuit M31A with OPGW. The two 230 kV circuits are located on different towers along the same right-of-way. In its current configuration each tower carries a 115 kV circuit and a 500 kV circuit in addition to the 230 kV circuit proposed for reconductoring (i.e. M30A is carried on one tower, and M31A is carried on the adjacent tower on the same ROW). No portion of any circuit on either of the towers will be relocated or reconfigured, and as a result there will be no change to the operation of the circuits. The M30A and M31A circuits will continue to be operated at 230 kV. The existing stations in the area, Ellwood MTS and Albion TS, will remain supplied by the 230 kV operated circuits (M30A and M31A). The terminal stations connecting Merivale to the Albion circuits, M30A and M31A, will remain as Hawthorne TS and Merivale TS.

There are two stations connected to the M30A and M31A circuits, and they will remain connected to the same electrical location after the HMR Project is completed. These two stations are:

- Ellwood MTS (owned and operated by Hydro Ottawa Limited ("HOL"))
- Albion TS (owned by Hydro One and supplying HOL)

Hydro One Protection, Control and Telecom ("PC&T") facilities at Merivale TS and Hawthorne TS will continue to protect the reconductored circuits by detecting faults and

isolating faulted elements. Line protection for circuits M30A and M31A will be modified and coordinated for operation with the new dual-bundled conductor (for the reduction of the impedance of each circuit). Operation of the proposed facilities will continue to be in accordance with the procedures administered by Hydro One's Ontario Grid Control Centre ("OGCC") and the IESO.

Hydro One PC&T facilities will continue to protect all elements in the stations and protect the 230 kV transmission lines by detecting faults and isolating faulted elements. Operation of the proposed facilities will continue to be in accordance with the procedures of the OGCC and the IESO.

This section of the transmission system is part of the eastern Ontario Bulk Energy System and is a critical circuit section of the electrical system that allows management of westerly flows towards the GTA.

LAND MATTERS

1. DESCRIPTION OF LAND RIGHTS

The proposed HMR Project for circuits M30A and M31A involves reconductoring the existing single conductor per phase circuit, with a dual-bundled conductors per phase, to increase the ampacity of both circuits along the approximate 11.9 km route between Hydro One's Hawthorne TS and Merivale TS. The Project will be completed within the existing transmission right-of-way ("ROW"). The existing ROW between Hawthorne TS to Merivale TS varies in width from 80.9 metres to 115.8 metres (or historically delineated as the equivalent of 295 feet to 380 feet). The circuits' current ROW width allows for the proposed reconductoring to be completed within the existing ROW constraints. The Project will rely primarily on Hydro One's existing land rights. There will be some new land rights and/or permitting required where appropriate along the route, pertaining to water/rail crossings. The proposed HMR Project will rely on a combination of the following land rights:

- Hydro One-owned property (no new land rights are required);
- Statutory easement right on Infrastructure Ontario Bill 58 lands (no new land rights are required);
- Existing easement rights on federally-owned, municipally-owned and privately-owned properties (no new land rights are required);
- Easement rights on municipally-owned property (new land rights are required);
- Municipal road allowance (no new land rights are required);
- Water and Rail Crossing Agreements/Permits (new rights are required, to be acquired and/or updated).

Temporary land rights may be required for the Project at specific locations along the circuits' existing ROW. It is expected that construction of the Project will not require

extensive temporary land rights, given the ability to utilize the already existing ROW and permanent land rights in close proximity to the Project. Any temporary land rights required have not yet been identified but will be determined in advance of the Project's construction start date. Hydro One will undertake their acquisition at the appropriate time. Temporary land rights required may include, but are not limited to, temporary access roads, temporary laydown areas and material storage areas. A temporary bypass line is required for this Project but does not require additional land rights because it will be sited within the already existing ROW. For illustrative purposes, details of the Project route are shown in **Attachment 1** (Project Route Map) to this Exhibit.

2. DESCRIPTION OF NEW LAND RIGHTS REQUIRED

The Applicant will rely predominantly on statutory easement rights it enjoys on Infrastructure Ontario Bill 58 lands and on existing land rights on federally, municipally and privately-owned property, to construct, operate and maintain the proposed reconductored circuit transmission facilities. New land rights for this Project will be required on a municipally-owned property; a privately-owned rail crossing, and a federally-owned water crossing. On impacted properties necessitating new lands rights, the following land right agreements may be required:

- Agreement to Purchase Limited Interest – Easement;
- Temporary Rights Agreement;
- Damage Claim Agreement;
- Rail Crossing Agreement;
- Water Crossing Agreement.

The Project's ROW crosses a total of approximately 56 properties. The properties impacted by the Project's ROW can be summarized as follows:

- 19 Infrastructure Ontario Bill 58 properties;
- 3 municipally-owned properties;

- 1 federally-owned property;
- 1 privately-owned property;
- 4 railroad crossings;
- 1 federally-owned river crossing;
- Various municipal road allowances and provincial highways.

Of the impacted properties, the following properties necessitate new or updated land rights:

- 1 municipally-owned property;
- 1 rail crossing;
- 1 river crossing.

Details of all impacted properties, properties necessitating new land right and associated ownership information are included in **Attachments 5 and 6** to this Exhibit.

3. EARLY ACCESS TO LAND

The Applicant will be relying on existing land rights to conduct various activities and studies associated with required environment approvals, engineering and design for this Project. Hydro One does not expect to require any early access agreements and does not anticipate the need to apply to the Board under section 98 of the *Ontario Energy Board Act, 1998* for early access in advance of leave to construct approval.

4. LAND ACQUISITION PROCESS

Hydro One requires new land rights on three impacted properties, as identified in **Attachment 6**. Hydro One has engaged with the impacted landowners where new land rights are expected to be required for the HMR Project. Hydro One has previously acquired land rights of this nature from these impacted landowners for similar transmission infrastructure projects. Hydro One will follow its land acquisition process in

a manner similar manner to that which has been employed in the recent past, which allowed Hydro One to acquire the necessary land rights in a timely manner.

Acquisition of Land Rights on Public Roads and Highways

As required, Hydro One intends to locate on public roads and highways. Given its legislated occupation rights under section 41 of the *Electricity Act*, *1998*, Hydro One does not require consent of the owner or any other person having an interest in public streets or highways to locate its proposed project corridor ROW. Hydro One will, however, engage with representatives from the appropriate municipalities having jurisdiction over these public roads and highways to ensure compliance with section 41(9) of the *Electricity Act, 1998*. If necessary, Hydro One will obtain the requisite encroachment and occupancy permits within roadways under the jurisdiction of the Ministry of Transportation.

5. LAND RELATED FORMS

Attachments 2 through 4 to this exhibit contain the land right agreements that Hydro One intends to use to obtain the required land rights for the Project. Listed below are the Hydro One form agreements included in the Application and a statement that indicates whether the individual form agreements have been previously approved by the Board in prior Hydro One leave to construct applications.

- Transfer and Grant of Easement (**Attachment 2**). This form agreement has not been included in previous leave to construct applications.
- Temporary Land Rights Agreement (**Attachment 3**). This form agreement was included and approved by the OEB in previous leave to construct applications.[1]
- Damage Claim Agreement (**Attachment 4**). This form agreement was included and approved by the OEB in previous leave to construct applications.[2]

[1] This form agreement was included in and approved by the OEB in EB-2019-0077 Decision and Order dated October 17, 2019, and EB-2018-0117 Decision and Order dated April 23, 2020.
[2] Ibid.

Where Hydro One requires land rights over the identified rail crossings and river crossing, the form agreement will be provided by the impacted landowner, and therefore the following land right agreements have not been included in this Application as they are not Hydro One's form agreements:

- Rail Crossing Agreement;
- River Crossing Agreement.

RUSSELL RD
HAWTHORNE RD
WALKLEY RD
WALKLEY RD
HAWTHORNE RD
A42T
A41T
HIGHWAY 417
D5A
HAWTHORNE TS
L24A
M31A
HAWTHORNE JCT
RUSSELL RD
M30A
City of Ottawa

hydro one
inergi

Produced By: Inergi LP, GIS Services
Date: Sep 21, 2020
Map19-128_M30A_M31A_HawthorneTS_MerivaleTS_Tiles

- Existing Structures
- Transformer Station
- Junction
- 230 kV Transmission Line

Land Rights
- Easement
- Ownership

- Railway
- Road
- Highway

- Watercourse
- Water

M30A/M31A
Hawthorne TS to Merivale TS

1:5,000
0 100 200 m

hydro one

inergi

Produced By: Inergi LP, GIS Services
Date: Sep 21, 2020
Map19-128_M30A_M31A_HawthorneTS_MerivaleTS_Tiles

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- Existing Structures
- Transformer Station
- Junction
- 230 kV Transmission Line

Land Rights

- Easement
- Ownership

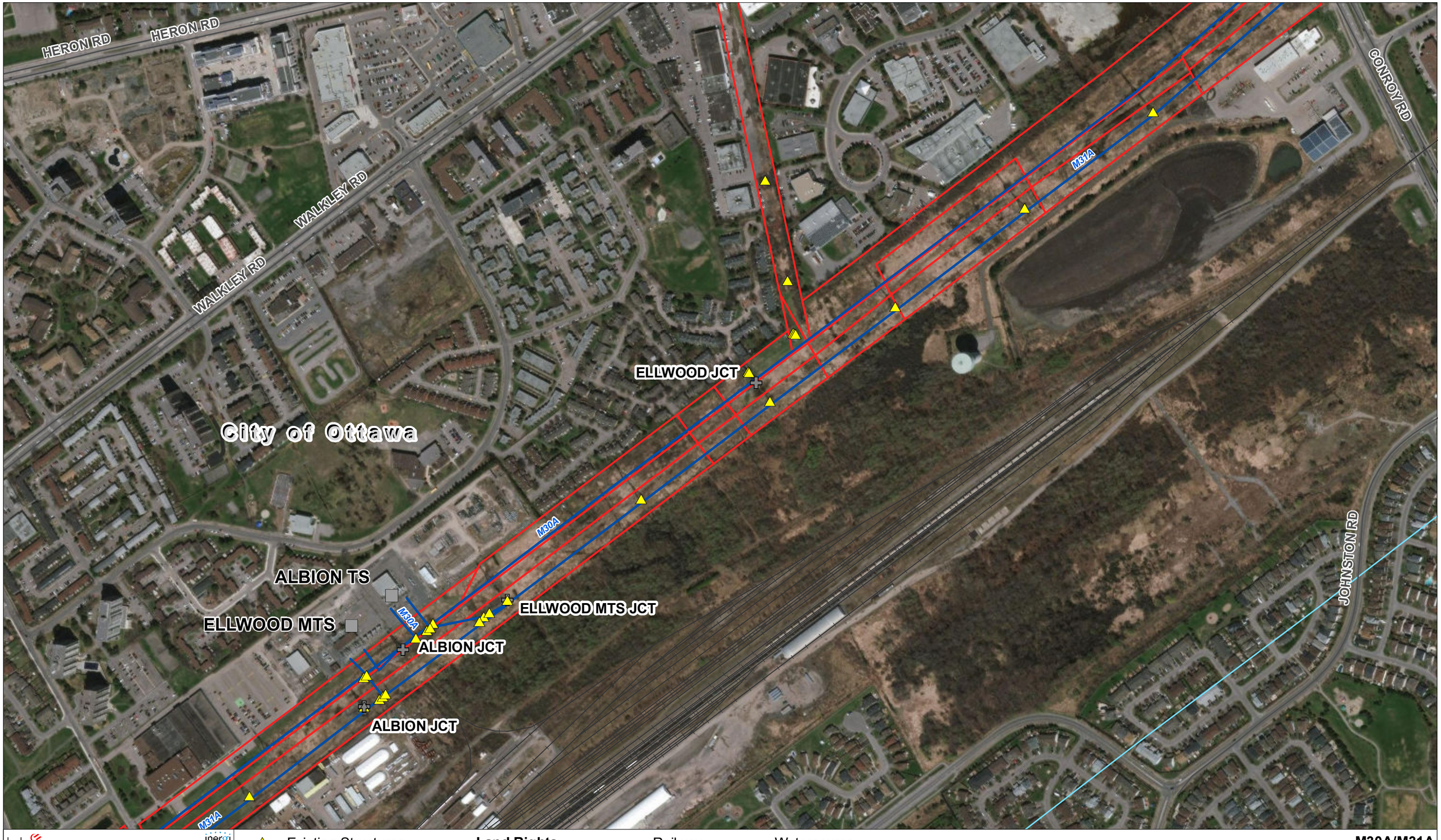
- Railway
- Road
- Highway

- Watercourse
- Water

M30A/M31A
Hawthorne TS to Merivale TS

1:5,000

0 100 200 m



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Date: Sep 21, 2020
Map19-128_M30A_M31A_HawthorneTS_MerivaleTS_Tiles

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- Railway
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Hawthorne TS to Merivale TS

1:5,000

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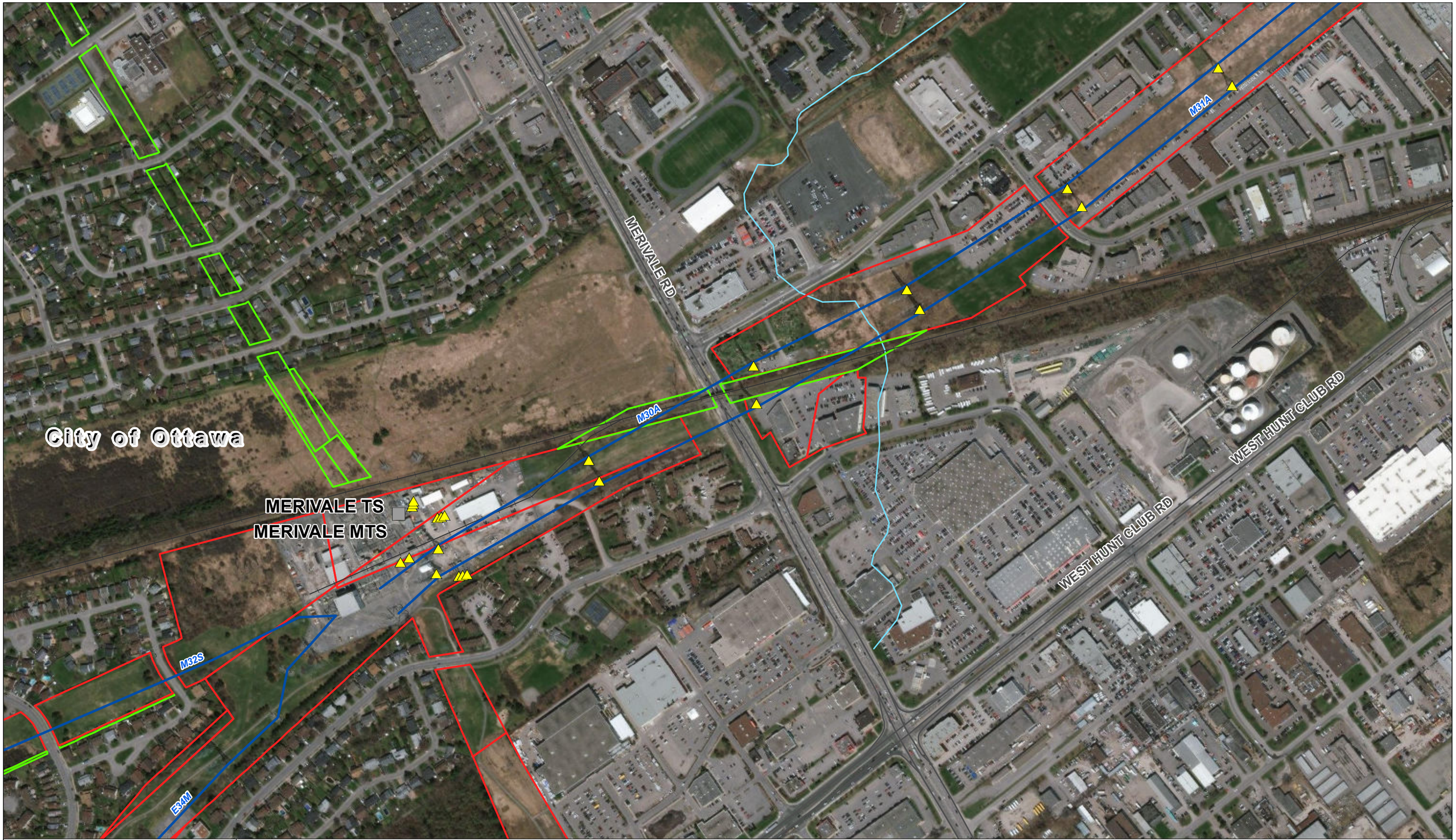

hydro one

inergi

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Map19-128_M30A_M31A_HawthorneTS_MerivaleTS_Tiles

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Land Rights

- Easement
- Ownership

- Railway
- Road
- Highway
- Watercourse
- Water

M30A/M31A
Hawthorne TS to Merivale TS

1:5,000

0 100 200 m

TRANSFER AND GRANT OF EASEMENT

[**INSERT FULL LEGAL NAME OF OWNER**] (the "**Transferor**") is the owner in fee simple and in possession of the Lands described in Schedule A (the "**Lands**").

IN CONSIDERATION of the payment of XXXX Dollars ($XX.XX) paid by Hydro One Networks Inc. (the "**Transferee**") to the Transferor, mutual covenants hereinafter set forth and other good and valuable consideration, the Transferor and Transferee hereto agree as follows:

Hydro One Networks Inc. (the "**Transferee**") has erected, or is about to erect, certain Works (as more particularly described in paragraph 1(a) hereof) in, through, under, over, across, along and upon the Lands.

1. The Transferor hereby grants and conveys to the Transferee, its successors and assigns the rights and easement, free from all encumbrances and restrictions, the following unobstructed and exclusive rights, easements, covenants, agreements and privileges in perpetuity (the "**Rights**") in, through, under, over, across, along and upon that portion of the Lands of the Transferor described herein on Schedule A-1 (the "**Strip**"), for the following purposes:

    (a) To enter and lay down, install, construct, erect, maintain, open, inspect, add to, enlarge, alter, repair and keep in good condition, move, remove, replace, reinstall, reconstruct, relocate, supplement and operate and maintain at all times in, through, under, over, across, along and upon the Strip electrical transmissions systems and telecommunications systems consisting in both instances of a pole structures, steel towers, anchors, guys and braces and all such aboveground or underground lines, wires, cables, telecommunications cables, grounding electrodes, conductors, apparatus, works, accessories, associated material and equipment, and appurtenances pertaining to or required by either such systems (all or any of which are herein individually or collectively called the "**Works**") as in the opinion of the Transferee are necessary or convenient thereto for use as required by Transferee in its undertaking from time to time, or a related business venture. Notwithstanding the foregoing, such part of the Works which form any part of the telecommunications systems shall be installed, if underground, with a depth of cover of not less than one (1) metre and the telecommunications systems may only be used by the Transferee, and its successors and assigns, for telecommunications purposes in connection with the operation of the Transferee's electrical transmission systems or any part thereof located on the Lands or any other lands.

    (b) To enter on and selectively cut or prune, and to clear and keep clear, and remove all trees (subject to compensation for merchantable wood values), branches, bush and shrubs and other obstructions and materials in, over or upon the Strip, and without limitation, to cut and remove all leaning or decayed trees located on the Lands whose proximity to the Works renders them liable to fall and come in contact with the Works or which may in any way interfere with the safe, efficient or serviceable operation of the Works or this easement by the Transferee.

    (c) To conduct all engineering, legal surveys, and make soil tests, soil compaction and environmental studies and audits in, under, on and over the Strip as the Transferee in its discretion considers requisite.

    (d) To erect, install, construct, maintain, repair and keep in good condition, move, remove, replace and use bridges and such gates in all fences which are now or may hereafter be on the Strip as the Transferee may from time to time consider necessary.

(e) Except for fences and permitted paragraph 2(a) installations, to clear the Strip and keep it clear of all buildings, structures, erections, installations, or other obstructions of any nature (hereinafter collectively called the "**obstruction**") whether above or below ground, including removal of any materials and equipment or plants and natural growth, which in the opinion of the Transferee, endanger its Works or any person or property or which may be likely to become a hazard to any Works of the Transferee or to any persons or property or which do or may in any way interfere with the safe, efficient or serviceable operation of the Works or this easement by the Transferee.

(f) To enter on and exit by the Transferor's access routes and to pass and repass at all times in, over, along, upon and across the Strip and so much of the Lands as is reasonably required, for the Transferee, its employees, agents, contractors, subcontractors, workmen and permittees with or without all plant machinery, material, supplies, vehicles and equipment for all purposes necessary or convenient to the exercise and enjoyment of this easement, subject to compensation afterwards for any crop or other physical damage only to the Lands or permitted structures sustained by the Transferor caused by the exercise of this right of entry and passageway.

2. The Transferor agrees that:

(a) It will not interfere with any Works established on or in the Strip and shall not, without the Transferee's consent in writing, erect or cause to be erected or permit in, under or upon the Strip any obstruction or plant or permit any trees, bush, shrubs, plants or natural growth which does or may interfere with the Rights granted herein. The Transferor agrees it shall not, without the Transferee's consent in writing, change or permit the existing configuration, grade or elevation of the Strip to be changed and the Transferor further agrees that no excavation or opening or work which may disturb or interfere with the existing surface of the Strip shall be done or made unless consent therefore in writing has been obtained from the Transferee, provided however, that the Transferor shall not be required to obtain such permission in case of emergency. Notwithstanding the foregoing, in cases where in the reasonable discretion of the Transferee, there is no danger or likelihood of danger to Works of the Transferee or to any persons or property and the safe or serviceable operation of this easement by the Transferee is not interfered with, the Transferor may at its expense and with the prior written approval of the Transferee, construct and maintain roads, lanes, walks, drains, sewers, water pipes, oil and gas pipelines and service cables on or under the Strip (the "**Installation**") or any portion thereof; provided that prior to commencing such Installation, the Transferor shall give to the Transferee a minimum of ten days notice in writing thereof to enable the Transferee to have a representative present to inspect the proposed Installation during the performance of such work, and provided further that the Transferor comply with all instructions given by such representative and that all such work shall be done to the reasonable satisfaction of such representative. In the event of any unauthorised interference aforesaid or contravention of this paragraph, or if any authorised interference, obstruction or Installation is not maintained in accordance with the Transferee's instructions or in the Transferee's reasonable opinion, may subsequently interfere with the Rights granted herein, the Transferee may at the Transferor's expense, forthwith remove, relocate, clear or correct the offending interference, obstruction, Installation or contravention complained of from the Strip, without being liable for any damages caused thereby.

(b) Notwithstanding any rule of law or equity, the Works installed by the Transferee shall at all times remain the property of the Transferee, notwithstanding that such Works are or may become annexed or affixed to the Strip and shall at anytime and from time to time be removable in whole or in part by the Transferee.

(c) No other easement or permission will be transferred or granted and no encumbrances will be created over or in respect to the Strip, prior to the registration of a Transfer of this grant of Rights.

(d) The Transferor will execute such further assurances of the Rights in respect of this grant of easement as may be requisite.

(e) The Rights hereby granted:

(i) shall be of the same force and effect to all intents and purposes as a covenant running with the Strip.

(ii) is declared hereby to be appurtenant to and for the benefit of the Works and undertaking of the Transferee described in paragraph 1(a).

3. There are no representations, covenants, agreements, warranties and conditions in any way relating to the subject matter of this grant of Rights whether expressed or implied collateral or otherwise except those set forth herein.

4. No waiver of a breach or any of the covenants of this grant of Rights shall be construed to be a waiver of any succeeding breach of the same or any other covenant.

5. The burden and benefit of this transfer of Rights shall run with the Strip and the Works and undertaking of the Transferee and shall extend to, be binding upon and enure to the benefit of the parties hereto and their respective heirs, executors, administrators, successors and assigns.

IN WITNESS WHEREOF the parties hereto have executed this Transfer and Grant of Easement.

Signed by the Transferee this day of , 2020.

HYDRO ONE NETWORKS INC.

Per:_____
Name:
Position:

I have authority to bind the Corporation.

Signed by the Transferor this day of , 2020.

[INSERT FULL LEGAL NAME OF TRANSFEROR]

Per:_____
Name:
Position:

Per:_____
Name:
Position:

We/I have authority to bind the Corporation

SCHEDULE "A"

[INSERT LEGAL DESCRIPTION OF LANDS]

SCHEDULE "A-1"

[INSERT LEGAL DESCRIPTION OF THE STRIP]

File: XXXXXX

THIS AGREEMENT made in duplicate the XXXXX day of XXXXXX 201X.

BETWEEN:

(INSERT NAME)

[NTD – ENSURE FULL LEGAL NAMES OF ALL OWNERS INSERTED]
[NTD – IF MORE THAN 1 OWNER THEN AMEND TO "(collectively the "**Owner**")"

(the **"Owner"**)
OF THE FIRST PART

AND:

HYDRO ONE NETWORKS INC.

(**"HONI"**)
OF THE SECOND PART

WHEREAS:

1. The Owner is the registered owner of lands legally described as ***(INSERT LEGAL DESCRIPTION)*** (the "Lands")

2. The Owner is agreeable in allowing HONI to enter onto a portion of the Lands highlighted in yellow as shown on the sketch attached hereto as Schedule "A" (the "Strip"), for the purposes of certain construction activities in conjunction with the XXXXXX (the "Project"), which shall include but are not limited to a temporary material storage yard for the purposes of storage of materials and equipment, including but not limited to construction equipment and machinery, requisite to the construction on the Strip subject to the terms and conditions contained herein (collectively the "Activities").

NOW THEREFORE THIS AGREEMENT WITNESSES THAT in consideration of Two Dollars ($2.00) now paid by HONI to the Owner, and the respective covenants and agreements of the parties hereinafter contained and other valuable consideration, the receipt and sufficiency of which are hereby acknowledged by the parties hereto, the parties hereto agree as follows:

1. The Owner hereby grants to HONI and its respective officers, employees, workers, permittees, servants, agents, contractors and subcontractors, with or without vehicles, supplies, machinery, plant, material and equipment, as of the date this Agreement, (i) the right to commence the Activities on the Strip; and (ii) the right to enter upon and exit from, and to pass and repass at any and all times in, over, along, upon, across, and through the Strip and so much of the Lands as may be reasonably necessary.

2. The permission granted herein shall commence as of the date this Agreement (the "Commencement Date") and shall terminate three (3) years from the Commencement Date (the "Initial Term").

3. The Initial Term may be extended upon 60 days prior written notice from HONI to the Owner for an additional two (2) years on the same terms and conditions contained herein save for this right to extend (the "Extended Term").

4. All agents, representatives, officers, directors, employees and contractors and property of HONI located at any time on the Lands shall be at the sole risk of HONI and the Owner shall not be liable for any loss or damage or injury (including loss of life) to them or it however occurring except and to the extent to which such loss, damage or injury is caused by the negligence or willful misconduct of the Owner.

5. Upon execution of this Agreement by all parties, HONI shall pay to the Owner the amount of XXXXX Dollars ($XXXX), which is compensation for the permission granted herein.

6. HONI shall repair any physical damage to the Lands resulting from the Activities and, shall restore the Lands to its original condition so far as possible and practicable to the satisfaction of the Owner, acting reasonably.

7. HONI agrees that it shall indemnify and save harmless the Owner from and against all claims, demands, costs, damages, expenses and liabilities (collectively the "Costs") whatsoever arising out of HONI's presence on the Lands or of its activities on or in connection with the Lands arising out of the

permission granted herein except to the extent any of such Costs arise out of the negligence or willful misconduct of the Owner.

8. This Agreement does not commit the Owner to enter into any further agreements with HONI in conjunction with the Project.

9. This Agreement shall be governed by and construed in accordance with the laws of the Province of Ontario and the laws of Canada applicable herein. The parties hereto submit themselves to the exclusive jurisdiction of the Courts of the Province of Ontario.

IN WITNESS WHEREOF the Parties have hereunto set their respective hands and seals to this Agreement of Purchase and Sale.

SIGNED, SEALED AND DELIVERED
In the presence of)
)
)
)
)
)
_____) _____ (seal)
Print Name of Witness ***(INSERT NAME)***

)
)
)
)
)
_____) _____ (seal)
Print Name of Witness ***(INSERT NAME)***

IF OWNER IS CORPORATION – USE THE FOLLOWING

[INSERT FULL LEGAL NAME]

Per: _____
Print Name:
Print Title:

Per: _____
Print Name:
Print Title:

We/I have authority to bind the Corporation

HYDRO ONE NETWORKS INC.

Per: _____
Print Name: Tony Seravalle
Title: Manager, Facilities & Real Estate Acquisitions

I have authority to bind the Corporation

SCHEDULE “A”

Damage Claim

THIS MEMORANDUM OF AGREEMENT dated the day of 20XX

Between:

herein called the "Claimant"

-and-

Hydro One Networks Inc.

herein called "HONI"

Witnesseth:

The Claimant agrees to accept ……($) in full payment and satisfaction of all claims or demands for damages of whatsoever kind, nature or extent which may have been done to date by HONI during the construction, completion, operation or maintenance of the works of HONI constructed on Lot(s) …….. , Concession(s) …….. or according to Registered Plan No. …… in the …… of …… of which property the Claimant is the …… and which damages may be approximately summarized and itemized as:

WITNESS

Name:

Address:

HYDRO ONE
HST#

CLAIMANT

Name:

Address:

HYDRO ONE NETWORKS INC.

Per:

Name:

Title:

I have authority to bind the Corporation

RELEASE AND WAIVER

FULL AND FINAL RELEASE

IN CONSIDERATION of the payment or of the promise of payment to the undersigned of the aggregate sum of [INSERT SETTLEMENT AMOUNT] ($), the receipt and sufficiency of which is hereby acknowledged, I/We, the undersigned, on behalf of myself/ourselves, my/our heirs, executors, administrators, successors and assigns (hereinafter the "Releasors"), hereby release and forever discharge HYDRO ONE NETWORKS INC., its officers, directors, employees, servants and agents and its parent, affiliates, subsidiaries, successors and assigns (hereinafter the "Releasees") from any and all actions, causes of action, claims and demands of every kind including damages, costs, interest and loss or injury of every nature and kind, howsoever arising, which the Releasors now have, may have had or may hereafter have arising from or in any way related to [INSERT DESCRIPTION OF THE DAMAGE CAUSED] on lands owned by [INSERT PROPERTY OWNER NAME] and specifically including all damages, loss and injury not now known or anticipated but which may arise or develop in the future, including all of the effects and consequences thereof.

AND FOR THE SAID CONSIDERATION, the Releasors further agree not to make any claim or take any proceedings against any other person or corporation who might claim contribution or indemnity under the provisions of the *Negligence Act* and the amendments thereto from the persons or corporations discharged by this release.

AND FOR THE SAID CONSIDERATION, the Releasors further agree not to disclose, publish or communicate by any means, directly or indirectly, the terms, conditions and details of this settlement to or with any persons other than immediate family and legal counsel.

AND THE RELEASORS hereby confirm and acknowledge that the Releasors have sought or declined to seek independent legal advice before signing this Release, that the terms of this Release are fully understood, and that the said amounts and benefits are being accepted voluntarily, and not under duress, and in full and final compromise, adjustment and settlement of all claims against the Releasees.

IT IS UNDERSTOOD AND AGREED that the said payment or promise of payment is deemed to be no admission whatsoever of liability on the part of the Releasees.

AND IT IS UNDERSTOOD AND AGREED that this Release may be executed in separate counterparts (and may be transmitted by facsimile) each of which shall be deemed to be an original and that such counterparts shall together constitute one and the same instrument, notwithstanding the date of actual execution.

IN WITNESS WHEREOF, the Releasors have hereunto set their respective hands this ..... day of ....., 20XX.

SIGNED, SEALED & DELIVERED
In the presence of:

_____
Witness

_____
Name

SIGNED, SEALED & DELIVERED
In the presence of:

_____
Witness

_____
Name

Initials_____

PIN	LEGAL DESCRIPTION	OWNER(S)
043510149	PT LT 2 CON 6RF GLOUCESTER BEING PARTS 1 & 2, 5R13953, GL56339 (SECONDLY) & OT21958, EXCEPT GL68347 & PT 1, 4R9759; PT LT 3 CON 6RF GLOUCESTER AS IN GL58815, EXCEPT PTS 86 & 87, 5R4833; S/T NS48905; OTTAWA/GLOUCESTER	
043510150	PT LT 2 CON 6RF GLOUCESTER PT 1, 4R9759, BEING REGIONAL RD 26; OTTAWA/GLOUCESTER	
043510405	PT LT 2 CON 6RF GLOUCESTER AS IN GL68347; PT LT 4 CON 6RF GLOUCESTER; PT LT 5 CON 6RF GLOUCESTER AS IN GL71551; PT LT 4 CON 6RF GLOUCESTER PTS 44 & 45 PLAN 5R9458; SECONDLY BEING A FORCED RD THROUGH PT LT 2 CON 6RF GLOUCESTER; PT LT 3 CON 6RF GLOUCESTER; PT LT 4 CON 6RF GLOUCESTER; PT LT 5 CON 6RF GLOUCESTER EXCEPT PART 7 PLAN 4R24959; AKA RUSSELL RD, FROM THE W LIMIT OF THE RDAL BTN LOTS 5 & 6 CON 6RF TO THE S LIMIT OF RIDGE RD CITY OF OTTAWA	
043510218	PT LT 1 CON 6RF GLOUCESTER; PT LT 2 CON 6RF GLOUCESTER PTS 20 & 21, 4R11163; S/T N758079; S/T N480682; OTTAWA/GLOUCESTER	
043510216	PT LT 1 CON 6RF GLOUCESTER; PT LT 2 CON 6RF GLOUCESTER AS IN CT105678 (FIRSTLY), GL36144, GL38741(FIRSTLY), GL56339 (FIRSTLY), GL59049 EXCEPT PTS 20,21,22 4R11163, PTS 16 & 17 4R14092 & GL68347; T/W N758079; T/W N767239; S/T N480682; OTTAWA/GLOUCESTER	
043510217	PT LT 1 CON 6RF GLOUCESTER; PT LT 2 CON 6RF GLOUCESTER PT 22 4R11163 & PTS 16 & 17, 4R14092 ; S/T N758079; S/T N767239; S/T N480682; OTTAWA/GLOUCESTER	
043510186	PT RDAL BTN CONS 5RF & 6RF GLOUCESTER LYING N OF S LIMITOF STEVENAGE DR & S OF N LIMIT OF PT 8,5R251; PT LT 2 CON 5RF GLOUCESTER AS IN N501713; BEING HAWTHORNE RD; GLOUCESTER	
041650766	PART OF LOT 1 CONCESSION 5 RIDEAU FRONT, BEING PART 23 ON PLAN 4R11163, GLOUCESTER. SUBJECT TO RIGHTS AS IN LT1087909.	
041650767	PART OF LOT 1 CONCESSION 5 RIDEAU FRONT, AS IN GL36148, GL38609 AND CT105678 LYING BETWEEN THE EASTERLY LIMIT OF PARTS 3 AND 4 ON PLAN 5R3 9 AND THE WESTERLY LIMIT OF THE ROAD ALLOWANCE BETWEEN CONCESSIONS 5 A ND 6 RIDEAU FRONT, SAVE AND EXCEPT PART 23 ON PLAN 4R11163. SUBJECT TO AN EASEMENT IN FAVOUR OF THE REGIONAL MUNICIPALITY OF OTTAWA-CARLETON, OVER PART 6 ON PLAN 5R439, AS IN CT203525. SUBJECT TO AN EASEMENT IN FAVOUR OF THE CORPORATION OF THE CITY OF OTTAWA, OVER PART 3 ON PLAN 5R13010, AS IN N531874. SUBJECT TO AN EASEMENT IN FAVOUR OF THE CORPORATION OF THE CITY OF OTTAWA, OVER PARTS 1 AND 2 ON PLAN 5R13010, AS IN N531875.	

PIN	LEGAL DESCRIPTION	OWNER(S)
041650668	PT LTS 1 & 2, CON 5RF; PT LT 1, CON 6RF; PT RDAL BTN CONS 5RF&6RF, AS CLOSED BY OT1573; BEING PTS 1-9, 5R-39; S/T CT105677E, OT42772, T/W CT202222 SUBJECT TO AN EASEMENT IN GROSS OVER PART LOT 1, CONCESSION 5 (RIDEAU FRONT), PARTS 1 & 2, PLAN 4R-31818 AS IN OC2092546 TOGETHER WITH AN EASEMENT OVER PART OF LOTS 24 AND 25, CONCESSION 3, OTTAWA FRONT (GLOUCESTER) BEING PART 1 ON PLAN 4R-14193, SAVE AND EXCEPT PARTS 1 TO 22 ON PLAN 4R-16285, AS IN OC2188081 CITY OF OTTAWA	
041650669	PT LT 1, CON 5RF, LYING BTN PT 2, 5R9159 & PTS 3 & 4, 5R-39, AS IN GL36148, GL36740, GL38602, GL38609, & CT105678 ; S/T N379298 OTTAWA/GLOUCESTER	
041650696	THURSTON DR ; PT LTS 1 & 2, CON 5RF , PART 1, 2, 3, & 4 , 5R10073 , PT LT 1, CON 5RF , PART 2 , 5R9159 , PT LT 2, CON 5RF , PTS 1 & 2 , 5R9727 ; S/T CT131357,NS27803 OTTAWA/GLOUCESTER	
041650809	PART OF LOT 1 CONCESSION 5 RIDEAU FRONT LYING WEST OF PART 2 PLAN 5R9159 AND EAST OF THE ROAD ALLOWANCE BETWEEN CONCESION 4 RIDEAU FRONT AND CONCESSION 5 RIDEAU FRONT EXCEPT PART 5 PLAN 5R250 AND PART 2 PLAN 4R14219 AS IN GL36253, GL36740, GL38787, GL46665, CT105678, OTTAWA/GLOUCESTER. SUBJECT TO AN EASEMENT AS IN N379298 IN FAVOUR OF THE CITY OF OTTAWA.	
041650808	PART OF LOT 1 CONCESSION 5 RIDEAU FRONT, PART 2 PLAN 4R14219, OTTAWA.	
041650647	PT LT 1, CON 5RF , PT OF PT 1 & PT 2, 5R1743 & PT 5 & PT OF PT 6, 5R250 ALL LYING S OF PTS 1 & 2, 5R8732 ; OTTAWA/GLOUCESTER	
041650700	PT CONROY RD ; PT RDAL BTN CONS 4RF&5RF , N OF THE WLY EXT OF THE NW ANGLE OF PT 5, 5R10034, S OF THE RDAL BTW JG & RIDEAU FRONT KNOWN AS WALKLEY RD ; PT LT A, CON 5RF , PART	
047410064	PT LTS A & 1, CON 4RF , AS IN GL36048, GL36050, GL36087, GL36253, GL36294, GL36299, GL36585, GL38605, GL38607, GL38712, GL38716, GL38724, GL38787, GL39015, GL43333, GL43424, GL43506, OT12383, OT39560, CT105678, EXCEPT PART 5, 5R10121 ; ; S/T CT224762,N482100 OTTAWA/GLOUCESTER	
047410068	PT RDAL BTN CONS 3RF & 4RF , BEING PART OF ALBION RD LYING BTN THE SLY LIMIT OF THE RDAL BTN JG & RIDEAU FRONT AND THE SLY LIMIT OF LEDBURY AV, PL198 ; OTTAWA/GLOUCESTER	
041540029	LTS 47, 48, 49, 50, 51, 52, 53, 54, 85, 86, 87, 88, 89, 90, 91 & 92, PL 322 ; PT CROSBIE AV, PL 322 , AS CLOSED BY OT12535 LYING E OF GODERICH ST ; OTTAWA/GLOUCESTER	
041540030	PT GODERICH ST, PL 322 , LYING S OF PTS 27 & 28, 5R3233 ; OTTAWA/GLOUCESTER	

PIN	LEGAL DESCRIPTION	OWNER(S)
041540028	LTS 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83 & 84, PL 322 ; PT COCHRANE ST, PL 322 , AS CLOSED BY BYLAW CT217827 LYING S OF PTS 8 & 10, 5R2070 ; PT CROSBIE AV, PL 322 , AS CLOSED BY BYLAW OT12535 LYING W OF GODERICH ST & W OF COCHRANE AV ; OTTAWA/GLOUCESTER	
041540027	PCL 107-3, SEC 4M-35 ; LT 173, PL 4M-35 , EXCEPT PTS 3 & 4, 4R2403 ; LTS 174, 175, 176, 177, 178 & 179, PL 4M-35 ; OTTAWA/GLOUCESTER	
041540050	PT BANFF AV ; PCL STREETS-2, SEC 4M-35 ; PT BANFF AV, PL 4M-35 , (FORMERLY GORDON PLACE) LYING S OF KITCHENER AV ; PCL 180-1, SEC 4M-35 ; LT 180, PL 4M-35 ; OTTAWA/GLOUCESTER	
041540026	COMMENCING AT THE NORTHEAST ANGLE OF THE SAID LOT 107, THENCE WESTERLY ALONG THE NORTHERLY LIMIT OF SAID LOT 107, 83.39 FEET MORE OR LESS TO A POINT DISTANT 16.61 FEET MEASURED FROM THE NORTHWEST ANGLE OF THE SAID LOT 107, THENCE SOUTHERLY IN A STRAIGHT LINE 90 FEET MORE OR LESS TO A POINT IN THE SOUTHERLY LIMIT OF LOT 108 AFORESAID DISTANT 15.8 FEET MEASURED EASTERLY FROM THE SOUTHWEST ANGLE OF LOT 108, THENCE EASTERLY ALONG THE SAID SOUTHERLY LIMIT 87.7 FEET MORE OR LESS TO THE SOUTHEAST ANGLE OF LOT 108 AFORESAID, THENCE NORTHERLY ALONG THE EASTERLY LIMITS OF SAID LOTS 108 AND 107, 90 FEET MORE OR LESS TO THE POINT OF COMMENCEMENT. (SAVE AND EXCEPT PART 1 ON PLAN 4R-315.) ; LTS 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 181 & 182, PL 4M-35 ; PT LT 150, PL 4M-35 , COMMENCING AT THE NORTHEAST ANGLE OF THE SAID LOT 150, THENCE WESTERLY ALONG THE NORTHERLY LIMIT OF THE SAID LOT, 88.07 FEET MORE OR LESS TO A POINT DISTANT 13.93 FEET FROM THE NORTHWEST ANGLE OF THE SAID LOT, THENCE SOUTHERLY IN A STRAIGHT LINE 45 FEET MORE OR LESS TO A POINT IN THE SOUTHERLY LIMIT OF THE SAID LOT DISTANT 13.27 FEET MEASURED EASTERLY ALONG THE SAID SOUTHERLY LIMIT FROM THE SOUTHWEST ANGLE OF THE SAID LOT, THENCE EASTERLY ALONG THE SAID SOUTHERLY LIMIT OF THE SAID LOT, 90.23 FEET MORE OR LESS TO THE SOUTHEAST ANGLE OF THE SAID LOT, THENCE NORTHERLY AND ALONG THE EASTERLY LIMIT OF THE SAID LOT, 45 FEET MORE OR LESS TO THE PLACE OF BEGINNING. (SAVE AND EXCEPT PART 1 ON PLAN 4R-	
041540031	PCL STREETS-2, SEC 4M-35 ; CARDIFF LANE, PL 4M-35 ; OTTAWA/GLOUCESTER	

PIN	LEGAL DESCRIPTION	OWNER(S)
041540055	PCL 107-2, SEC 4M-35 ; PT LTS 107 & 108, PL 4M-35 ; PT LTS 150, 151 & 152, PL 4M-35 ; PT FOREST AV, PL 4M-35 , AS CLOSED BY JUDGE'S ORDER LT12535 ; PT 1, 4R315 ; OTTAWA/GLOUCESTER	
041540054	COMMENCING AT THE NORTHWEST ANGLE OF THE SAID LOT 105, THENCE EASTERLY ALONG THE NORTHERLY LIMIT OF THE SAID LOT 16.52 FEET, THENCE SOUTHERLY IN A STRAIGHT LINE 45 FEET MORE OR LESS TO A POINT IN THE SOUTHERLY LIMIT OF THE SAID LOT, THE SAID POINT BEING DISTANT 16.76 FEET MEASURED EASTERLY ALONG THE SAID SOUTHERLY LIMIT FROM THE SOUTHWEST ANGLE OF THE SAID LOT, THENCE WESTERLY ALONG THE SAID SOUTHERLY LIMIT 16.76 FEET MORE OR LESS TO THE SOUTHWEST ANGLE OF THE SAID LOT, THENCE NORTHERLY ALONG THE WESTERLY LIMIT OF THE SAID LOT, 45 FEET MORE OR LESS TO THE PLACE OF BEGINNING. ; PT LT 106, PL 4M-35 , COMMENCING AT THE NORTHWEST ANGLE OF THE SAID LOT 106, THENCE EASTERLY ALONG THE NORTHERLY LIMIT OF THE SAID LOT 16.76 FEET, THENCE SOUTHERLY IN A STRAIGHT LINE 45 FEET MORE OR LESS TO A POINT IN THE SOUTHERLY LIMIT OF THE SAID LOT, THE SAID POINT BEING DISTANT 16.61 FEET MEASURED EASTERLY ALONG THE SAID SOUTHERLY LIMIT FROM THE SOUTHWEST ANGLE OF THE SAID LOT, THENCE WESTERLY 16.61 FEET ALONG THE SOUTHERLY LIMIT TO THE SOUTHWEST ANGLE, THENCE NORTHERLY ALONG THE WESTERLY LIMIT OF THE SAID LOT 45 FEET MORE OR LESS TO THE PLACE OF BEGINNING. ; PT LT 107, PL 4M-35 , COMMENCING AT THE NORTHWEST ANGLE OF THE SAID LOT 107, THENCE EASTERLY ALONG THE NORTHERLY LIMIT OF THE SAID LOT 16.61 FEET, THENCE SOUTHERLY IN A STRAIGHT LINE 45 FEET MORE OR LESS TO A POINT IN THE SOUTHERLY LIMIT OF THE SAID LOT, THE SAID POINT BEING DISTANT 15.96 FEET MEASURED EASTERLY ALONG THE SAID SOUTHERLY LIMIT FROM THE SOUTHWEST ANGLE OF THE SAID	

PIN	LEGAL DESCRIPTION	OWNER(S)
041540056	NORTHWEST ANGLE OF THE SAID LOT 150, THENCE EASTERLY ALONG THE NORTHERLY LIMIT OF THE SAID LOT 13.93 FEET, THENCE SOUTHERLY IN A STRAIGHT LINE 45 FEET MORE OR LESS TO A POINT IN THE SOUTHERLY LIMIT OF THE SAID LOT, THE SAID POINT BEING DISTANT 13.27 FEET MEASURED EASTERLY ALONG THE SAID SOUTHERLY LIMIT FROM THE SOUTHWEST ANGLE OF THE SAID LOT, THENCE WESTERLY ALONG THE SAID SOUTHERLY LIMIT 13.27 FEET MORE OR LESS TO THE SOUTHWEST ANGLE OF THE SAID LOT, THENCE NORTHERLY ALONG THE WESTERLY LIMIT OF THE SAID LOT 45 FEET MORE OR LESS TO THE PLACE OF BEGINNING. ; PT LT 151, PL 4M-35 , COMMENCING AT THE NORTHWEST ANGLE OF THE SAID LOT 151, THENCE EASTERLY ALONG THE NORTHERLY LIMIT OF THE SAID LOT 13.27 FEET, THENCE SOUTHERLY IN A STRAIGHT LINE 45 FEET MORE OR LESS TO A POINT IN THE SOUTHERLY LIMIT OF THE SAID LOT, THE SAID POINT BEING DISTANT 12.61 FEET MEASURED EASTERLY ALONG THE SAID SOUTHERLY LIMIT FROM THE SOUTHWEST ANGLE OF THE SAID LOT, THENCE WESTERLY ALONG THE SAID SOUTHERLY LIMIT 12.61 FEET MORE OR LESS TO THE SOUTHWEST ANGLE OF THE SAID LOT, THENCE NORTHERLY ALONG THE WESTERLY LIMIT OF THE SAID LOT 45 FEET MORE OR LESS TO THE PLACE OF BEGINNING. ; PT LT 152, PL 4M-35 , COMMENCING AT THE NORTHWEST ANGLE OF THE SAID LOT 152, THENCE EASTERLY ALONG THE NORTHERLY LIMIT OF THE SAID LOT 12.61 FEET, THENCE SOUTHERLY IN A STRAIGHT LINE 50.5 FEET MORE OR LESS TO A POINT IN THE SOUTHERLY LIMIT OF THE SAID LOT, THE SAID POINT BEING DISTANT 11.7 FEET MEASURED EASTERLY ALONG THE SAID SOUTHERLY LIMIT FROM THE SOUTHWEST ANGLE OF	[redacted]
041540161	PART OF BANK ST LYING S OF A LINE CONNECTING THE NW CORNER OF LOT 105, 4M35 & THE NE CORNER OF PART 2, 5R209 & N OF A LINE CONNECTING THE SW CORNER OF PART 10, 5R186 & THE SE CORNER OF PART 5, 5R1852; PART LOTS 1 AND 2, CONCESSION 3, R.F. GLOUCESTER, BEING PART BANK STREET AS WIDENED BY GL30960 BEING A FORCED ROAD; PART LOTS 1, 2 AND 3, CONCESSION 3, R.F, GLOUCESTER, PT LOT 8, PLAN 198; PART BANK STREET WIDENED BY GL30960 AS CLOSED BY BY-LAW 0544844; BEING PARTS 4, 5, 7 AND 8 PLAN 5R1852; PART LOT 3, CONCESSION 3 R.F. GLOUCESTER, BEING PART 1, EXPROP CT152898; PART LOTS 1, 2, 3, CONCESSION 3 R.F. GLOUCESTER, AS IN OT49246; PART LOTS 1 AND 2, CONCESSION 3, R.F. GLOUCESTER; PART LOT 1 PLAN 198; BEING PARTS 1 AND 2 ON 5R186. S/T OT53873. S/T AS IN CT228448 PARTIALLY RELEASED AS IN OC1570748 CITY OF OTTAWA	

PIN	LEGAL DESCRIPTION	OWNER(S)
040650083	PT LT 1, CON 3RF , AS IN GL40458, GL45976, GL36551, EXCEPT PT 2, 5R209 ; S/T OT47129 OTTAWA/GLOUCESTER SUBJECT TO AN EASEMENT IN FAVOUR OF LIQUOR CONTROL BOARD OF ONTARIO OVER PART 37 PLAN 4R17581 AS IN OC61274.	
040650104	PART OF LOT 1, CONCESSION 3, RIDEAU FRONT BEING PART 11 ON PLAN 5R-385 AND PART OF LOT 2, CONCESSION 3, RIDEAU FRONT BEING PART 13 ON PLAN 5R-385 AND PARTS 2 AND 3 ON PLAN 4R-14196, OTTAWA. TOGETHER WITH RIGHTS AS IN CT228448 AND NS77745. SUBJECT TO AN EASEMENT AS IN OC460434.	
040650085	PT LTS 1 & 2, CON 3RF , AS IN GL38579, GL37804, OT4213, OT11087, EXCEPT PTS 11 & 13, 5R385, PTS 1, 5 - 8, 5R8139, PTS 7 & 10, 5R2184 ; OTTAWA/GLOUCESTER	
040650072	PT LTS A, 1 & 2, CON 3RF , PTS 1, 2, 3, 5, 6, 7 & 8, 4R8139, PTS 1, 3, 5 & 7, 4R11928 ; S/T CT131357,CT171861,CT255472,N650512E,NS3635E OTTAWA/GLOUCESTER	
040650086	PT LT 1, CON 3RF , PART 2 , 4R11928 ; S/T NS48906 OTTAWA/GLOUCESTER	
040650087	PT LT 1, CON 3RF , AS IN OT6533, OT4910, GL38600, GL38576, GL36152, GL36079, EXCEPT PT 3, 4R11928 ; S/T CT190860 OTTAWA/GLOUCESTER	
040650089	PT MCCARTHY RD BEING ; PT RDAL BTN CONS 2RF & 3RF , LYING BTN THE SWLY EXT OF THE SELY LIMIT OF SOUTHMORE DR, PL 768 AND THE WLY EXT OF THE SLY LIMIT OF PT 1, 5R42 ; OTTAWA/GLOUCESTER	
040740501	PT LT 1, CON 2RF , AS IN GL37132, GL38715, GL38601, GL36276, OT35269, OT7919, OT6658 LYING E OF PT 31, 5R2314 ; OTTAWA/GLOUCESTER	
040740500	PT LT A, CON 2RF , PT LTS 1 & 2, CON 2RF , PART 27 - 32 , 5R2314 ; T/W NS17003 ; OTTAWA/GLOUCESTER	
040740694	PT LT 1, CON 2RF , AS IN OT35269, GL37132, GL38715 LYING W OF PT 30, 5R2314, EXCEPT PT 1, 5R3588 ; OTTAWA/GLOUCESTER	
040740504	PT LTS 1 & 2, CON 2RF , PART 1, 11, 12, & 14 , 5R3588 ; S/T CT131357,NS27803 OTTAWA/GLOUCESTER	

PIN	LEGAL DESCRIPTION	OWNER(S)
040740619	PART OF RIVERSIDE DR (AKA REGIONAL RD NO 19), FORMERLY BOWESVILLE RD AS FOLLOWS : PT LOTS A & 1, CON 2RF, BEING PT OF A FORCED RD, LYING S OF THE SLY LIMIT OF WALKLEY RD, AND LYING N OF THE DIVISION LINE BTN LTS 1 & 2, CON 2RF EXCEPT PT 10, PL 5R7144 & PT 3, PL 5R3588; PT LOT A, CON 2RF, PT OF PT 1, 5R4777 & AS IN OT46582, CT128351, CT177647, CT130145; PT LT A & 1, CON 2RF, BEING PTS 26, 28 TO 35, 5R315; PT LOT 1, PL 518 , PART 27 , 5R315 ; PT LT 1, CON 2RF , PT BLK A, PL 564 , BEING PART 2, 4R8412 & PART 22, 5R315 EXCEPT PART 1, PL 4R8626 ; PT LTS 1 & 2, CON 2RF , BEING PT 21, 5R315 & AS IN GL2075, GL39274, GL39250, GL39251 & GL39452 ; PT LT 40, PL 564 , PART 20 , 5R315 ; PT LTS 38 & 39, PL 564 , PART 18 & 19 , 5R315 ; PT LT 37, PL 564 , PART 17 , 5R315 ; PT LT 36, PL 564 , PART 16 , 5R315 ; PT LT 1, CON 2RF , PART 5 , 5R2277 , PT 13, 5R315 ; WIDENING STRIP, PL 732 ; PT LT 14, PL 732 , PART 12 , 5R315 ; PT LT 15, PL 732 , PART 11 , 5R315 ; PT LT 16, PL 732 , PART 10 , 5R315 ; PT LT 17, PL 732 , PART 7 , 5R315 ; PT LT 1, PL 732 , PART 6 , 5R315 ; PT LT 2, PL 732 , PART 5 , 5R315 ; PT LT 3, PL 732 , PART 4 , 5R315 ; ROAD WIDENING, PL 710 ; PT LT 11, PL 710 , PART 3 , 5R315 ; PT LT 12, PL 710 , PART 2 , 5R315 ; PT LT 13, PL 710 , PART 1 , 5R315 ; PT LTS 1 & 2, CON 2RF , PART 2 , 5R3588 , PT LTS 1 & 2, CON 2RF , PART 11 & 12 , 5R7144 , S/T INTEREST IF ANY IN OT6888, OT39143 & OT33038 ; S/T GL35603; PT LT A, CON 2(RF), PT 1, 5R4777; OTTAWA/GLOUCESTER	[redacted]

	PIN	LEGAL DESCRIPTION	RIGHTS REQUIRED	OWNER(S)
1	040650104	PART OF LOT 1, CONCESSION 3, RIDEAU FRONT BEING PART 11 ON PLAN 5R-385 AND PART OF LOT 2, CONCESSION 3, RIDEAU FRONT BEING PART 13 ON PLAN 5R-385 AND PARTS 2 AND 3 ON PLAN 4R-14196, OTTAWA. TOGETHER WITH RIGHTS AS IN CT228448 AND NS77745. SUBJECT TO AN EASEMENT AS IN OC460434.	Easement over Municipally-owned property	[redacted]
2	040740500	PT LT A, CON 2RF , PT LTS 1 & 2, CON 2RF , PART 27 - 32 , 5R2314 ; T/W NS17003 ; OTTAWA/GLOUCESTER	Rail Crossing Agreement	
3	040760613	FIRSTLY : PART LOT 33, CONCESSION B, RIDEAU FRONT, NEPEAN, BEING PART OF THE BED OF THE RIDEAU RIVER, PART 7, PLAN 5R-7942 ; SECONDLY : PART LOT 6, PLAN 292745, PARTS 13 AND 15, PLAN 4R-8012 ; THIRDLY : PART LOTS 31 AND 32, CONCESSION B, RIDEAU FRONT, NEPEAN, PART 1, PLAN 5R-12950 AND THE LAND LYING SOUTH OF PART 5, PLAN 4R-1533 SAVE AND EXCEPT PART 1, PLAN 4R-29230, PART 1, PLAN 4R-31107 ; FOURTHLY : PART LOTS 23 AND 24, CONCESSION JUNCTION GORE, GLOUCESTER, PART LOT 25, CONCESSION, JUNCTION GORE, GLOUCESTER, PARTS 1 TO 4, PLAN 5R-13081 AND LAND LYING WEST OF THESE PARTS ; FIFTHLY : PART OF THE BED OF RIDEAU RIVER LYING BETWEEN A LINE EXTENDING FROM THE NORTH EAST ANGLE OF PART 3, PLAN 5R-4307 AND THE SOUTH WEST ANGLE OF PART 3, PLAN 5R-13080 AND NORTH OF THE SOUTHERLY LIMIT OF THE WESTERLY EXTENT OF PLAN 5R-2314, BEING THE RIDEAU RIVER, RIDEAU CANAL AND MOONEY'S BAY SAVE AND EXCEPT PART 1 ON PLAN 4R-23741 ; SIXTHLY : PART LOT 24, CONCESSION JUNCTION GORE, GLOUCESTER, LYING NORTH OF WATER LOT OPPOSITE LOTS 24 AND 25, CONCESSION JUNCTION GORE, GLOUCESTER, AND LYING WEST OF CT116631 AND OT70319 ; SUBJECT TO THE INTEREST, IF ANY, IN NS75692 ; SUBJECT TO THE INTEREST, IF ANY, IN NS17003 SUBJECT TO AN EASEMENT AS IN NS16335 TOGETHER WITH AN EASEMENT OVER PART LOT 31, CONCESSION B, RIDEAU FRONT, NEPEAN, PART 1, PLAN 4R-29230 AS IN OC1903840 TOGETHER WITH AN EASEMENT OVER PART LOT 31, CONCESSION B, RIDEAU FRONT, NEPEAN, PART 1, PLAN 4R-31107 AS IN OC2144942 CITY OF OTTAWA	River Crossing Agreement (federally owned)	

SYSTEM IMPACT ASSESSMENT

Under the Market Rules, any party planning to construct a new or modified connection to the Independent Electricity System Operator ("IESO")-controlled grid must request an IESO System Impact Assessment ("SIA") of these facilities. The IESO has completed a SIA of the proposed facilities under the IESO Connections Assessment and Approval process. Please refer to **Attachment 1** for the IESO's final SIA report.

The IESO assessment addresses the impact of the proposed facilities on system operating voltage, system operating flexibility, and on the ability of other connections to deliver or withdraw power supply from the IESO-controlled grid. The IESO's SIA confirms that Hydro One's proposed transmission facilities will not have a materially adverse impact on the reliability of the integrated power system. Furthermore, the Project will not cause any changes to the current classifications of North American Electric Reliability Corporation's Bulk Electric System elements and Northeast Power Coordinating Council's Bulk Power System elements in the Ottawa transmission zone.

REPORT

System Impact Assessment Report

CONNECTION ASSESSMENT & APPROVAL PROCESS

Final SIA Report

CAA ID: 2016-572
Project: 230 kV circuits M30A & M31A - Conductor Upgrade
Applicant: Hydro One Networks Inc.

Connections & Registrations Department
Independent Electricity System Operator

Date: September 21, 2016

Document Name	System Impact Assessment Report
Issue	Final SIA Report
Reason for Issue	Request for Connection Assessment
Effective Date	September 21, 2016

System Impact Assessment Report

Acknowledgement

The IESO wishes to acknowledge the assistance of Hydro One in completing this assessment.

Disclaimers

IESO

This report has been prepared solely for the purpose of assessing whether the connection applicant's proposed connection with the IESO-controlled grid would have an adverse impact on the reliability of the integrated power system and whether the IESO should issue a notice of conditional approval or disapproval of the proposed connection under Chapter 4, section 6 of the Market Rules.

Conditional approval of the proposed connection is based on information provided to the IESO by the connection applicant and Hydro One at the time the assessment was carried out. The IESO assumes no responsibility for the accuracy or completeness of such information, including the results of studies carried out by Hydro One at the request of the IESO. Furthermore, the conditional approval is subject to further consideration due to changes to this information, or to additional information that may become available after the conditional approval has been granted.

If the connection applicant has engaged a consultant to perform connection assessment studies, the connection applicant acknowledges that the IESO will be relying on such studies in conducting its assessment and that the IESO assumes no responsibility for the accuracy or completeness of such studies including, without limitation, any changes to IESO base case models made by the consultant. The IESO reserves the right to repeat any or all connection studies performed by the consultant if necessary to meet IESO requirements.

Conditional approval of the proposed connection means that there are no significant reliability issues or concerns that would prevent connection of the proposed project to the IESO-controlled grid. However, the conditional approval does not ensure that a project will meet all connection requirements. In addition, further issues or concerns may be identified by the transmitter(s) during the detailed design phase that may require changes to equipment characteristics and/or configuration to ensure compliance with physical or equipment limitations, or with the Transmission System Code, before connection can be made.

This report has not been prepared for any other purpose and should not be used or relied upon by any person for another purpose. This report has been prepared solely for use by the connection applicant and the IESO in accordance with Chapter 4, section 6 of the Market Rules. This report does not in any way constitute an endorsement, agreement, consent or acknowledgment of any kind of the proposed connection for the purposes of obtaining or administering a contract with the IESO for the procurement of electricity supply, generation, demand response, conservation and demand management or ancillary services.

The IESO assumes no responsibility to any third party for any use, which it makes of this report. Any liability which the IESO may have to the connection applicant in respect of this report is governed by Chapter 1, section 13 of the Market Rules. In the event that the IESO provides a draft of this report to the connection applicant, the connection applicant must be aware that the IESO may revise drafts of this report at any time in its sole discretion without notice to the connection applicant. Although the IESO will use its best efforts to advise you of any such changes, it is the responsibility of the connection applicant to ensure that the most recent version of this report is being used.

Hydro One

The results reported in this report are based on the information available to Hydro One, at the time of the study, suitable for a system impact assessment of this transmission system reinforcement proposal.

The short circuit and thermal loading levels have been computed based on the information available at the time of the study. These levels may be higher or lower if the connection information changes as a result of, but not limited to, subsequent design modifications or when more accurate test measurement data is available.

This study does not assess the short circuit or thermal loading impact of the proposed facilities on load and generation customers.

In this report, short circuit adequacy is assessed only for Hydro One circuit breakers. The short circuit results are only for the purpose of assessing the capabilities of existing Hydro One circuit breakers and identifying upgrades required to incorporate the proposed facilities. These results should not be used in the design and engineering of any new or existing facilities. The necessary data will be provided by Hydro One and discussed with any connection applicant upon request.

The ampacity ratings of Hydro One facilities are established based on assumptions used in Hydro One for power system planning studies. The actual ampacity ratings during operations may be determined in real-time and are based on actual system conditions, including ambient temperature, wind speed and facility loading, and may be higher or lower than those stated in this study.

The additional facilities or upgrades which are required to incorporate the proposed facilities have been identified to the extent permitted by a system impact assessment under the current IESO Connection Assessment and Approval process. Additional facility studies may be necessary to confirm constructability and the time required for construction. Further studies at more advanced stages of the project development may identify additional facilities that need to be provided or that require upgrading.

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Executive Summary

Project Description

Hydro One Networks Inc. (the "connection applicant" and the "transmitter") is proposing to re-conductor the 230 kV transmission circuits M30A and M31A from Hawthorne Transformer Station (TS) to Merivale TS (12 km) to achieve an enhanced summertime continuous rating of 2570 A and a long term emergency rating (LTE) of 3400[1] A at an ambient temperature of 35°C, and to replace the low rated line disconnect switches 48-M30A and 48-M31A at Hawthorne TS (the "project").

The proposed re-conductoring will support the load growth expected in the Ottawa transmission zone beyond 2025, as well as provide maximum flexibility for the seasonal Capacity Sharing Agreement[2] between IESO and Hydro Quebec Energy Marketing Inc. (HQEM) signed in May, 2015 (the "Capacity Sharing Agreement"). This re-conductoring will also provide additional capability to support imports from Quebec beyond the level under the Capacity Sharing Agreement.

The proposed in-service date for this project is February 2020.

Notification of Conditional Approval

The IESO determined that the project will not have a material adverse impact on the reliability of the integrated power system. It is therefore recommended that a Notification of Conditional Approval for Connection be issued for the project, excluding the HV disconnect switches at Hawthorne TS which are already covered by the Hydro One blanket expedited system impact assessment (CAA_ID 2010-EX465: for the like-for-like replacement & refurbishment of HV disconnect switches), subject to implementation of the requirements outlined in this report.

Findings

The study confirmed that:

(1) The project will not have a materially adverse impact on the reliability of the integrated power system. The slightly lower impedance of the re-conductored circuits will only marginally change the distribution of power flows on other major transmission circuits in Ottawa and East transmission zones.

(2) The proposed ratings of the re-conductored circuits are expected to be sufficient to support the load growth expected in the Ottawa transmission zone beyond 2025, as well as provide maximum flexibility for the Capacity Sharing Agreement. The proposed ratings of the re-conductored circuits will also support additional imports from Quebec beyond the level under the Capacity Sharing Agreement.

(3) As currently assessed, the project will not cause any changes to the current classifications of North American Electric Reliability Corporation's (NERC) Bulk Electric System (BES) elements and Northeast Power Coordinating Council's (NPCC) Bulk Power System (BPS) elements in the Ottawa transmission zone.

[1] The actual LTE of these transmission circuits will be limited to no less than 3000 A by the terminal station equipment. As such, a rating of 3000 A was assumed for this study.
[2] A backgrounder is available at: http://www.ieso.ca/Documents/Ontario-Quebec-Capacity-Sharing-Agreement-Backgrounder-20151112.pdf

Connection Requirements

(1) The connection applicant must consider the effect of the increased loading on the autotransformers at Merivale TS resulting from this project when developing solutions under the Ottawa Area Integrated Regional Resource Plan[3] (IRRP).

(2) The connection applicant shall satisfy all general requirements listed in section 2 of this report.

Recommendation

It is highly recommended that the connection applicant obtains the IESO's approval for their outage plan to incorporate the project as soon as possible. Transmission circuits M30A and M31A are currently being operated to their thermal capability during summer peak load conditions and, so, long term outages to these circuits will need to be scheduled and coordinated at appropriate times.

– End of Section –

[3] http://www.ieso.ca/Documents/Regional-Planning/Greater_Ottawa/2015-Ottawa-IRRP-Report.pdf

1. Project description

More than half of the City of Ottawa's peak electricity demand comes from western Ottawa, and the majority of this demand is supplied from Hawthorne TS via the Hawthorne TS to Merivale TS transmission circuits. Robust growth was forecasted in the western Ottawa which will increase the flow through the Hawthorne TS to Merivale TS transmission circuits.

In May, 2015 an agreement between IESO and Hydro Québec Energy Marketing (HQEM) was entered into for seasonal capacity sharing (the "Capacity Sharing Agreement"). This agreement started in December 2015 and ends in September 2025, and provides for Ontario delivering up to 500 MW of capacity to Québec in the first four winter periods and in return, Québec delivering up to 500 MW of capacity to Ontario in the summer periods. Since the import through the Quebec intertie at Outaouais also flow through the Hawthorne TS to Merivale TS transmission circuits, the Capacity Sharing Agreement will therefore place an incremental demand on these circuits during the period between 2020 and 2025.

To support the overall capability of the transmission system in the Ottawa transmission zone to supply future load growth and enable the Capacity Sharing Agreement, the connection applicant proposes to re-conductor the 230 kV transmission circuits M30A and M31A from Hawthorne TS to Merivale TS (12 km) to provide the following enhanced ratings:

Table 1: Ratings of existing and re-conductored transmission circuits

230kV Circuits M30A & M31A	Ratings at an ambient temperature of 35°C & a wind speed of 4km/hour	
	Continuous	Long-term emergency
Existing ratings	1350A	1800A
Proposed ratings	2570A	3400[4]A

The next table presents the technical parameters of re-conductored M30A and M31A circuits:

Table 2: Electrical parameters of re-conductored transmission circuits

230 kV Circuits M30A & M31A	Length (km)	Positive Sequence Impedance Vbase=220 kV, Sbase = 100 MVA, Zbase = 484 ohm			Zero Sequence Impedance Vbase=220 kV, Sbase = 100 MVA, Zbase = 484 ohm		
Section		R	X	B	R	X	B
Hawthorne TS to Elwood Jct.	3.999	0.00015	0.00326	0.0085	0.00213	0.00808	0.00252
Elwood Jct. to Albion Jct.	0.169	0.00001	0.00014	0.00036	0.00009	0.00034	0.00011
Albion Jct. to Merivale TS	7.773	0.0003	0.00634	0.01653	0.00413	0.01571	0.00491
Total	11.941	0.00046	0.00974	0.02539	0.00635	0.02414	0.00754

As part of this project the connection applicant will also replace the low rated (currently 1200 A continuous) line disconnect switches 48-M30A and 48-M31A at Hawthorne TS with new disconnect switches rated at 3000 A continuous. This assessment addresses only the re-conductoring of the

[4] Limited to 3000 A by the equipment at the terminal stations.

transmission circuits M30A and M31A since the replacement of disconnect switches is covered by the Hydro One blanket expedited system impact assessment (CAA ID 2010-EX465: for the like-for-like replacement & refurbishment of HV disconnect switches).

Due to the complexity of the work required to incorporate the project it is highly recommended that the connection applicant obtains the IESO's approval for their outage plan as soon as possible. Transmission circuits M30A and M31A are currently being operated to their thermal capability during summer peak load conditions and, so, long term outages to these circuits will need to be scheduled and coordinated at the appropriate time.

The proposed in service date for this project is February 2020.

– End of Section –

2. General requirements

The connection applicant shall satisfy all applicable requirements specified in the Market Rules, the Transmission System Code and Reliability Standards. The following sections highlight some of the general requirements that are applicable to the project.

2.1 Protection Systems

The connection applicant shall ensure that the protection systems are designed to satisfy all the requirements of the Transmission System Code. New protection systems must be coordinated with the existing protection systems.

As currently assessed by the IESO the project is part of the NPCC defined BPS and considered essential to the power system and therefore, must be protected by redundant protection systems in accordance with section 8.2.1a of the TSC. These redundant protections systems must satisfy all requirements of the TSC, and in particular, they must not use common components, common battery banks or common secondary CT or PT windings.

The protection systems installed for the project must only trip the appropriate equipment required to isolate the fault. After the project begins commercial operation, if an improper trip of the 230 kV circuits occurs due to events within the project, the project (or its deficient part) may be required to be disconnected from the IESO-controlled grid until the problem is resolved.

The project shall have the capability to ride through routine switching events and design criteria contingencies in the grid that do not disconnect the project by configuration. Standard fault detection, auxiliary relaying, communication, and rated breaker interrupting times are to be assumed.

Protection modifications that are different from those considered in this SIA must be submitted by the transmitter to the IESO at least six (6) months before any modifications are to be implemented. If those modifications result in adverse reliability impacts, mitigation solutions must be developed.

The connection applicant must provide during the IESO Market Registration process the actual protection operating times in accordance with Market Manual 2: Market Administration, Part 2.20: Performance Validation (sections 4.8 and 4.9).

2.2 IESO Market Registration

The connection applicant must initiate and complete the IESO Market Registration process in a timely manner, at least seven months before energization to the IESO-controlled grid and prior to the commencement of any project related outages, in order to obtain IESO final approval.

“As-built” equipment data and any controls, including any applicable models and data that would be operational, must be provided to the IESO. This includes both PSS/E and DSA software compatible mathematical models representing the new equipment for further IESO, NPCC and NERC analytical studies. The models and data may be shared with other reliability entities in North America as needed to fulfill the IESO’s obligations under the Market Rules, NPCC and NERC rules. The connection applicant may need to contact the software manufacturers directly, in order to have the models included in their packages.

As part of the IESO Market Registration process, the connection applicant and the transmitter must provide evidence to the IESO, as required under Market Manual 2: Market Administration, Part 2.20: Performance Validation (sections 2, 4 and 5.4), confirming that the equipment installed meets the Market Rules requirements and matches or exceeds the performance predicted in this assessment. This evidence shall be either type tests done in a controlled environment or commissioning tests done on-site.

In either case, the testing must be done not only in accordance with widely recognized standards, but also to the satisfaction of the IESO. Until this evidence is provided and found acceptable to the IESO, the Market Registration process will not be considered complete and the connection applicant must accept any restrictions the IESO may impose upon this project's participation in the IESO-administered markets or connection to the IESO-controlled grid. The evidence must be supplied to the IESO within 30 days after completion of commissioning tests. Failure to provide evidence may result in disconnection from the IESO-controlled grid.

If the submitted models and data differ materially from the ones used in this assessment, then further analysis of the project may need to be done by the IESO before final approval to connect is granted.

At the sole discretion of the IESO, performance tests may be required at transmission facilities. The objectives of these tests are to demonstrate that equipment performance meets the IESO requirements, and to confirm models and data are suitable for IESO purposes. The transmitter may also have its own testing requirements. The IESO and the transmitter will coordinate their tests, share measurements and cooperate on analysis to the extent possible.

2.3 Project Status

As per Market Manual 2.10, the connection application will be required to provide a status report of its proposed project with respect to its progress upon request of the IESO. The project status report form can be found on the IESO web site at http://www.ieso.ca/imoweb/pubs/caa/caa_f1399_StatusReport.doc. Failure to comply with project status requirements listed in Market Manual 2.10 will result in the project being withdrawn.

The connection applicant will be required to also provide updates and notifications in order for the IESO to determine if the project is "committed" as per Market Manual 2.10. A committed project is a project that has demonstrated to the IESO a high probability of being placed into service.

This project will be deemed committed by the IESO when the connection applicant, as the transmitter, identifies the project in its Plans for New or Modified Facilities Information Submittal Form for 18-Month Outlook (IESO_FORM_1484), or Plans for Retired, New or Modified Facilities Information Submittal Form (IESO_FORM_1494) provided to the IESO as part of its submission for the IESO 18-Month Outlook and other reliability assessments.

– End of Section –

3. System Impact Assessment

3.1 Preamble

This system impact assessment analyses the project's ability to fulfill its purpose of supporting the load growth expected in the Ottawa transmission zone beyond 2025, as well as providing maximum flexibility for the Capacity Sharing Agreement. In addition, the assessment also looks at the project's ability to support additional import from Quebec beyond the level under the Capacity Sharing Agreement. It includes steady state analysis under extreme load conditions and relay margin calculations.

3.2 Standards and Criteria

This SIA observed the following provisions of the Ontario Resource and Transmission Assessment Criteria (ORTAC[5]):

- Section 3 of the ORTAC identifies the assessment conditions. Accordingly, generation was dispatched as required in order to stress the system so as to identify limitations of the transmission transfer capability.
- Sections 4.2 and 4.3 of the ORTAC set the pre and post-contingency voltage limits on the transmission system. According to these sections, the pre-contingency voltage levels must be between 220 kV and 250 kV and post-contingency voltage levels between 207 kV and 250 kV.
- According to section 4.7.2 of the ORTAC, all line and equipment loading must be within their continuous ratings with all elements in service and within their long-term emergency rating with any one element out of service. Immediately following contingencies, transmission circuits may be loaded up to their short-term emergency ratings where control actions such as re-dispatch, switching, etc. are available to reduce the loading to the long-term emergency ratings. For the BPS it is generally assumed that loading conditions and control actions are available to reduce the loading within the long-term emergency rating in no more than 15 minutes.
- Short circuit levels were calculated according to section 4.8 of the ORTAC, assuming all existing generation facilities in service and voltages at the maximum acceptable levels identified in section 4.2.
- The load security criteria presented in section 7.1 of the ORTAC was applied as follows:
    - Pre-contingency flows with all transmission facilities in service were compared with the continuous equipment ratings and voltages were checked against normal ranges.
    - Flows with one element out of service were compared with the long-term emergency ratings and voltages were checked against applicable emergency ranges. No planned load curtailment or load rejection was used for any post-contingency cases with one element out of service.
    - Flows with two elements out of service were compared with the short-term emergency ratings and voltages were checked against applicable emergency ranges. Planned load curtailment or load rejection of up to 150 MW is a permissible control action to reduce post-contingency equipment loading within the applicable long-term emergency ratings.

[5] For any inconsistency between this report and the ORTAC, the ORTAC provision shall prevail to the extent of the inconsistency.

- According to section 7.3 of the ORTAC, reliance on a special protection system (SPS) was reserved only for exceptional circumstances, examples provided being: infrequent contingencies, temporary conditions, unusual combinations of system demand and outages or to preserve system integrity in the event of severe outages or extreme contingencies.

The relay margins were tested according to Market Manual 7.4: IESO-Controlled Grid Operating Policies[6] Appendix B.3.2:

- Following fault clearance or the loss of an element without a fault, the margin on all instantaneous and timed distance relays that affects the integrity of the *IESO-controlled grid*, including generator loss of excitation and out-of-step relaying at major generating stations, must be at least 20 and 10 percent, respectively.
- The margin on all other relays whose operation would not affect the integrity of the *IESO-controlled Grid*, such as 115 kV or radial 230 kV transmission circuit protections, generator loss of excitation and out-of-step protections on small generating units, those associated with transformer backup protections, must be at least 15 percent on all instantaneous relays and zero percent on all timed relays having a time delay setting less than or equal to 0.4 seconds.
- For those relays having a time delay setting greater than 0.4 seconds, the apparent impedance may enter the timed tripping characteristic, provided that there is a margin of 50 percent on time. For example, the apparent impedance does not remain within the tripping characteristic for a period of time greater than one-half of the relay time delay setting.
- The margin on all system relays, such as change of power relays, must be at least 10 percent.

3.3 Assumptions

The following assumptions were made in this study:

- Load: Ontario load was at the levels contemplated in the IRRP for 2025 (25225 MW). Some of the forecasted load growth in the Merivale TS area was assumed to be supplied from the 230 kV system. This is based on the recent recommendation of a new 230 kV Nepean South station in the Merivale TS area under the Ottawa IRRP.
- Generation: Local hydro-electric generators were assumed to be at their 98% of the time levels. Saunders GS was scheduled to a total output of 800 MW and other hydro-electric generators were scheduled to stress the system. All major Ontario generators, with the exception of one Darlington unit, were assumed to be in service. Since the reference year was 2025, Pickering GS was assumed to have been shut down and the new Clarington TS was assumed in service. Wind generation was assumed to be at minimum levels.
- Imports/Exports: Imports from Quebec were scheduled at higher levels in order to stress the transmission circuits between Hawthorne TS and Merivale TS to identify any potential limitations that might still be present in the Ottawa transmission zone following completion of the project: 1250 MW via the Outaouais HVdc Link, 800 MW from Beauharnois GS, and 250 MW from Masson GS. Transfers across the St. Lawrence interconnection with New York were set at zero.

These assumptions led to a Flow-into Ottawa (FIO) of around 680 MW, as shown in the diagrams presented in Appendix B.

[6] For any inconsistency between this report and the Market Manual, the Market Manual's provision shall prevail to the extent of the inconsistency.

3.4 Redistribution of Flows in the Ottawa zone

Due to the nature of the project: (i) the transmission circuits are very short relative to other major transmission circuits in eastern Ontario, (ii) the fault clearing time of the associated protections is to remain the same and (iii) the transmission circuits are not part of any major Ontario transmission interface defined in eastern Ontario (example: Flow Into Ottawa – FIO), the project is not expected to have any adverse effect on the voltage stability or transient stability of the local area.

The next table shows the project's impact on flows over main 230 kV and 115 kV transmission circuits in the Ottawa transmission zone:

Table 3: Impact of the project on power flows

Name	Existing transmission circuits Power flow at sending end (MW)	Re-conductored transmission circuits Power flow at sending end (MW)	Change	
			(MW)	(%)
230 kV circuits				
M31A	618	637	19	3%
M30A	617	636	20	3%
A42T	626	626	0	0%
A41T	626	626	0	0%
D5A	487	487	0	0%
L24A	513	515	2	0%
M29C	155	159	4	3%
M32S	437	446	9	2%
115 kV circuits				
A3RM	162	152	-10	-6%
A8M	134	122	-12	-9%
H9A	143	143	0	0%
A5RK	147	145	-2	-1%
A6R	112	110	-2	-2%
A4K	163	162	-1	-1%
C7BM	93	94	1	1%
S7M	125	126	1	1%
M4G	111	112	1	1%
F10MV	73	73	0	0%
M5G	105	105	0	0%
V12M	53	53	0	0%
M1R	39	39	0	0%

Additionally, the voltages of the main busbars in the Ottawa transmission zone change only marginally as a result of the project:

Table 4: Impact of the project on local voltage levels

Busbar	Existing transmission circuits	Re-conductored transmission circuits	Voltage Change	
	Busbar voltage (kV)	Busbar voltage (kV)	kV	%
Hawthorne TS 500 kV	543.4	543.7	0.3	0.05%
Hawthorne TS 230 kV	244.0	244.3	0.2	0.09%
Merivale TS 230 kV	242.8	243.5	0.7	0.30%
Hawthorne TS 115 kV	124.2	124.4	0.2	0.16%
Merivale TS 115 kV – T21	125.4	125.7	0.3	0.25%
Merivale TS 115 kV - T22	125.4	125.7	0.3	0.25%

Because of its insignificant impact on the flows and voltages on the Hawthorne TS to Merivale TS corridor, the project is not expected to have any material impact on the transmission system outside the Ottawa transmission zone. No studies were therefore conducted elsewhere on the system.

Table 3 (on previous page) shows a redistribution of power flows on the adjacent 230 kV and 115 kV transmission circuits on the Hawthorne TS to Merivale TS corridor (shaded in the table) resulting in increased flows through the 230 kV transmission circuits and decreased flows through the 115 kV transmission circuits. This redistribution of flows leads to a slight increase of the Merivale TS autotransformers loading:

Table 5: Impact of the project on Merivale TS autotransformers

Unit	Existing transmission circuits Power flow at 230 kV terminals (MVA)	Re-conductored transmission circuits Power flow at 230 kV terminals (MVA)	Change	
			MVA	%
T21	206.7	220.5	13.8	6.7%
T22	199.7	213.0	13.8	6.7%

Potential overloading of Merivale TS autotransformers was previously identified by the IESO in the Ottawa Area IRRP at item 7 (page 4) that states the need for: “Additional 230/115 kV transformer capacity at Merivale TS”. Therefore, there is no further assessment of this issue in this SIA as the Ottawa IRRP Working Group is currently in the process of exploring options to address the need on the Merivale TS autotransformers.

3.5 Steady-State Equipment Loading

In addition to supply the forecasted load growth in the Ottawa transmission zone, the project is also to accommodate their increased loading during higher imports from Quebec. Feasibility studies performed by the IESO (former OPA) in support of the IESO - HQEM MOU identified that under specific conditions, following the loss of the adjacent transmission circuits M30A and A3RM or M31A and A8R the loading of the companion 230 kV transmission circuit may exceed its present long-term emergency rating. In order to confirm that the proposed re-conductoring will be adequate, the following main scenarios were tested:

- The post-contingency loading of the 230 kV transmission circuit M31A following the loss of the 230 kV transmission circuit M30A and the 115 kV transmission circuit A3RM; and
- The post-contingency loading of the 230 kV transmission circuit M30A following the loss of the 230 kV transmission circuit M31A and the 115 kV transmission circuit A8R.

Other contingencies were also tested with the results presented in Appendix A. No deficiencies were identified in the Ottawa transmission zone.

The following table presents the results of the two main scenarios:

Table 6: Results of the main test scenarios

Contingency	Circuit	Section	LTE[7] (A)	Initial flow (A)	Post-contingency flow (A)
M31A & A8R	M30A	Hawthorne TS to Elwood jct.	3000	1506	2871
		Elwood jct. to Albion jct.	3000	1472	2804
		Albion jct. to Merivale TS	3000	1385	2624
	A3RM	Hawthorne TS to Elwood jct.	1760	707	1071
		Elwood jct. to Billings jct.	1760	510	998
		Billings jct. to Merivale jct.	1760	510	998
		Merivale jct. to Merivale TS	1760	485	968
M30A & A3RM	M31A	Hawthorne TS to Elwood jct.	3000	1507	2893
		Elwood jct. to Albion jct.	3000	1474	2826
		Albion jct. to Merivale TS	3000	1383	2646
	A8M	Hawthorne TS to Billings jct.	1760	580	1048
		Billings jct. to Merivale TS	1760	475	933

The existing line disconnect switches 48-M30A and 48-M31A at Hawthorne TS that are rated at only 1200 A continuous will be replaced by the connection applicant as part of this project with new switches rated 3000 A continuous. The line disconnect switches 6-M30A and 6-M31A at Merivale TS are currently rated 3000 A continuous and will remain in place. These line switches may limit the overall circuit rating to 3000 A which, as shown in table 6 above, is sufficient for the projected flows.

Replacement of the Hawthorne TS disconnect switches is covered by the blanket connection assessment CAA ID 2010-EX465 and as such it can be performed at any time.

The proposed ratings of the re-conductored circuits are expected to be sufficient to support the load growth expected in the Ottawa transmission zone beyond 2025, as well as provide maximum flexibility for the Capacity Sharing Agreement. As shown in the results in Table 6, the proposed ratings of the re-conductored circuits will also be sufficient to support additional imports from Quebec beyond the level under the Capacity Sharing Agreement.

[7] The Long Term Emergency rating is used per section 4.7.2 of the ORTAC.

3.6 Fault Level Analysis

A fault level analysis was conducted by the transmitter on behalf of the IESO to identify the impact of the re-conductored circuits on local short circuit levels, and the results are summarized in Table 8. The tests were performed assuming all existing and committed generators in service.

Table 7: Fault level before and after incorporating the project

		Existing transmission circuits				Re-conductored transmission circuits			
		Three phase fault		Line to ground fault		Three phase fault		Line to ground fault	
Station Name	V	Symm	Asymm	Symm	Asymm	Symm	Asymm	Symm	Asymm
Hawthorne TS	kV	kA	kA	kA	kA	kA	kA	kA	kA
	500	12.092	14.988	12.964	16.924	12.121	15.039	12.994	16.975
	230	22.273	27.875	27.875	36.752	22.365	28.023	27.996	36.940
	115	29.340	35.172	37.284	46.720	29.344	35.195	37.292	46.751
Merivale TS	230	18.163	22.632	19.322	24.900	18.967	23.888	20.424	26.383
	115	25.402	30.192	28.082	35.090	25.560	30.626	28.328	35.596
	115	25.402	30.192	28.082	35.090	25.650	30.626	28.328	35.596

Table 9 shows the increase in the fault levels following the incorporation of the project:

Table 8: Fault level increases after project incorporation

Station Name	Voltage (kV)	Three phase fault		Line to ground fault	
		Symmetrical (kA)	Asymmetrical (kA)	Symmetrical (kA)	Asymmetrical (kA)
Hawthorne TS	500	0.029	0.051	0.030	0.051
	230	0.092	0.148	0.121	0.188
	115	0.004	0.023	0.008	0.031
Merivale TS	230	0.804	1.256	1.102	1.483
	115	0.158	0.434	0.246	0.506
	115	0.248	0.434	0.246	0.506

As shown in Table 9, the changes in local short circuit levels as a result of incorporating the project are very small and not expected to have adverse impact on the reliability of the integrated power system.

In Table 8, the highest short circuit level at Hawthorne TS is shown to occur on the 115 kV busbar. This level is within the capabilities of the lowest rated breaker at this station (40 kA symmetric and 49.6 kA asymmetric).

Similarly, the highest short circuit level at Merivale TS is shown to occur on the 230 kV busbar. Since the lowest rated breaker at that station currently has ratings of 63 kA symmetrical and 75.6 kA asymmetrical, the increased short circuit levels following the incorporation of the project would remain well within the rating of the existing breakers.

3.7 Relay Margin Analysis

The relay margin analysis is required to ensure that out of zone tripping does not occur as a result of the addition/modification of power system equipment or modifications to protection settings.

The analysis is performed by simulating planning events in the vicinity of the transmission circuit whose relay margin is being assessed to determine the associated trajectory of the line impedance. To check that the required relay margin is maintained after the simulated fault is cleared, the trajectory of the apparent transmission circuit impedance is compared to the relay characteristic of the transmission circuit(s) that are not expected to trip.

The connection applicant indicated that for this project, the transmission circuit protection equipment for M30A and M31A will be kept as is. In addition, the protection setting criteria will not be changed; that is, Z1 Ground and Z1 Phase will be set 75% and 80% of the transmission circuit positive impedance respectively, and Z2 Ground and Z2 Phase will each be set 125% of the maximum apparent impedance.

As the impedance of re-conductored circuits M30A and M31A will be about 80% of the existing ones, the proposed new settings for Z1 Ground & Z1 Phase at both Hawthorne TS and Merivale TS will be adjusted accordingly based on the setting criteria described above. The existing Zone 2 settings can be retained.

The fault clearing times of M30A and M31A transmission circuit protections will not be changed.

The connection applicant also confirmed that no other protections in the zone require modifications as a result of this project and as such no formal protection impact assessment (PIA) was necessary.

In order to assess the relay margins for the project the following representative planning event was simulated:

- Three phase fault with normal clearing time (local - 83 ms, remote - 95 ms) on M30A (2 cases) at Hawthorne TS and at Merivale TS followed by the loss of the transmission circuit.

As the two parallel transmission circuits are identical a similar fault of the companion transmission circuit M31A is expected to produce the same results.

These faults were simulated assuming the desired imports from Quebec to also confirm that the local system is transiently stable following a recognized contingency.

The analysis did not identify any relay margin violation, an indication that the protection modifications, as proposed by the connection applicant, are acceptable to the IESO.

Appendix C presents the results of the relay margin analysis.

– End of Section –

Appendix A: Analysis Results

Table 9: Equipment loading results

Circuit	Section	LTE (A)	Post-contingency flows (A)							
			X522A	X523A	M30A	M31A	A3RM	A8M	X522A+ M31A	X523A+ M30A
M30A	Hawthorne TS to Elwood jct.	3000	1510	1510	-	2725	1570	1562	2727	-
	Elwood jct. to Albion jct.	3000	1476	1476	-	2658	1537	1529	2660	-
	Albion jct. to Merivale TS	3000	1388	1388	-	2478	1450	1442	2479	-
M31A	Hawthorne TS to Elwood jct.	3000	1511	1511	2725	-	1571	1563	-	2727
	Elwood jct. to Albion jct.	3000	1478	1478	2658	-	1538	1530	-	2660
	Albion jct. to Merivale TS	3000	1386	1386	2478	-	1447	1439	-	2479
A3RM	Hawthorne TS to Elwood jct.	1760	711	711	859	859	-	851	859	859
	Elwood jct. to Billings jct.	1760	509	509	697	697	-	721	698	698
	Billings jct. to Merivale jct.	1760	508	508	697	697	-	720	698	698
	Merivale jct. to Merivale TS	1760	483	483	668	668	-	695	668	668
A8M	Hawthorne TS to Billings jct.	1760	581	581	761	761	774	-	761	761
	Billings jct. to Merivale TS	1760	474	474	644	644	672	-	645	645

All equipment loading is within the applicable ratings.

Table 10: Voltage levels on main busbars

Station	Busbar	Initial	Post contingency voltage (kV)							
			X522A	X523A	M30A	M31A	A3RM	A8M	X522A+ M31A	X523A+ M30A
Hawthorne TS	500 kV	544	527	527	542	542	543	544	515	515
	230 kV	244	242	242	243	243	244	245	242	242
	115 kV	124	123	123	123	123	124	125	123	123
Merivale TS	230 kV	244	241	241	241	241	243	244	241	241
	115 kV - T21	126	124	124	124	124	126	127	124	124
	115 kV - T22	126	124	124	124	124	126	127	124	124

All voltages are within the applicable ranges.

– End of Section –

Appendix B: Diagrams

Hydroelectric Output:

Arnprior GS	0.6MW
Barrett Chute GS	2.3MW
Chats Falls GS	24.5MW
Chenaux GS	35.0MW
Mountain Chute GS	1.7MW
Stewartville GS	9.2MW
Saunders GS	800.0MW

Flow into Ottawa (FIO): 687.3MW

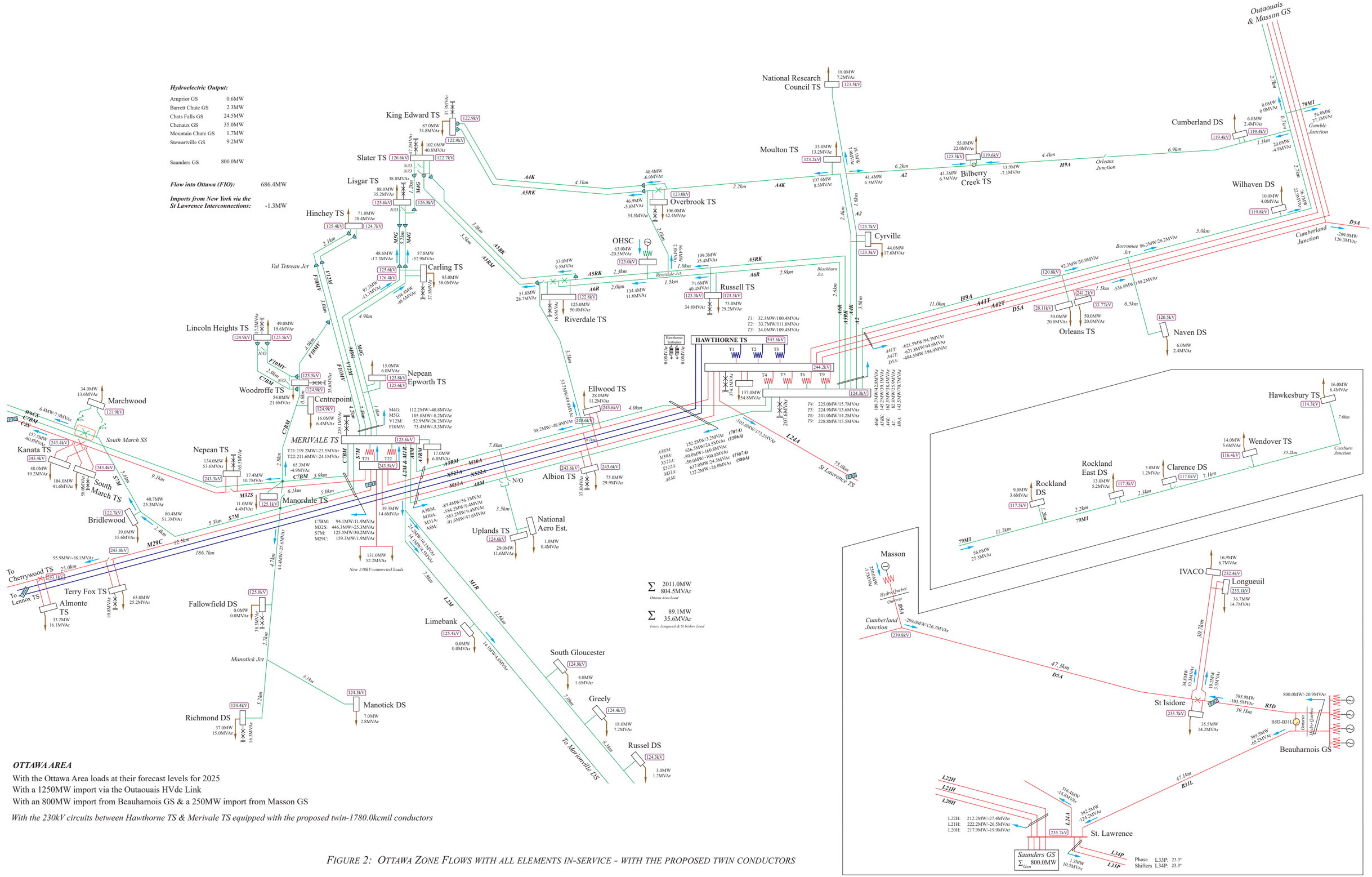
Imports from New York via the St Lawrence Interconnections: -2.0MW

OTTAWA AREA

With the Ottawa Area loads at their forecast levels for 2025
With a 1250MW import via the Outaouais HVdc Link
With an 800MW import from Beauharnois GS & a 250MW import from Masson GS

With the 230kV circuits between Hawthorne TS & Merivale TS equipped with their existing 1843.2kcmil conductors

FIGURE 1: OTTAWA ZONE FLOWS WITH ALL ELEMENTS IN-SERVICE - WITH THE EXISTING CONDUCTORS

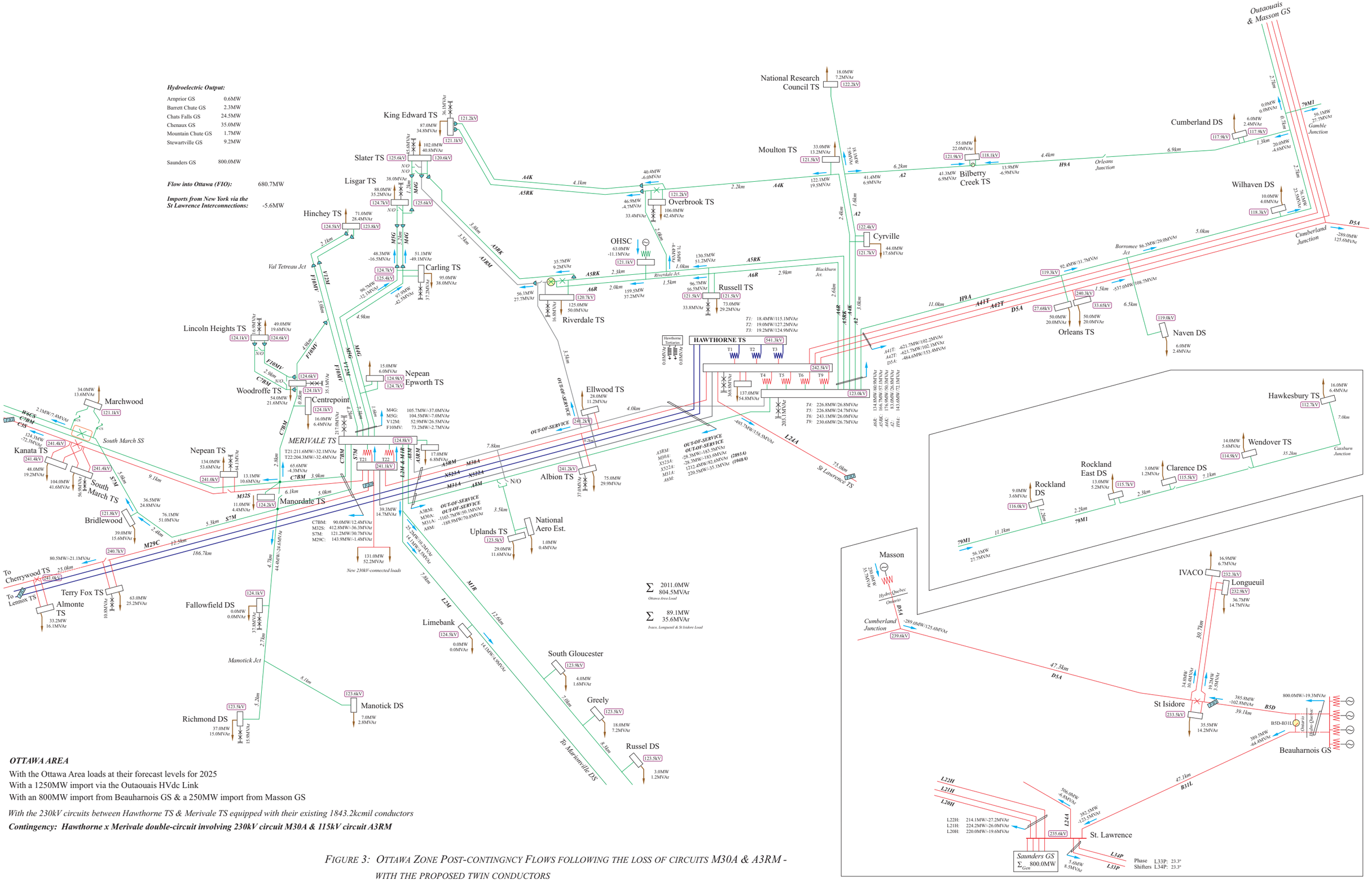


OTTAWA AREA

With the Ottawa Area loads at their forecast levels for 2025
With a 1250MW import via the Outaouais HVdc Link
With an 800MW import from Beauharnois GS & a 250MW import from Masson GS

With the 230kV circuits between Hawthorne TS & Merivale TS equipped with the proposed twin-1780.0kcmil conductors

FIGURE 2: OTTAWA ZONE FLOWS WITH ALL ELEMENTS IN-SERVICE - WITH THE PROPOSED TWIN CONDUCTORS



OTTAWA AREA

With the Ottawa Area loads at their forecast levels for 2025
With a 1250MW import via the Outaouais HVdc Link
With an 800MW import from Beauharnois GS & a 250MW import from Masson GS

With the 230kV circuits between Hawthorne TS & Merivale TS equipped with their existing 1843.2kcmil conductors

Contingency: Hawthorne x Merivale double-circuit involving 230kV circuit M30A & 115kV circuit A3RM

FIGURE 3: OTTAWA ZONE POST-CONTINGNCY FLOWS FOLLOWING THE LOSS OF CIRCUITS M30A & A3RM - WITH THE PROPOSED TWIN CONDUCTORS

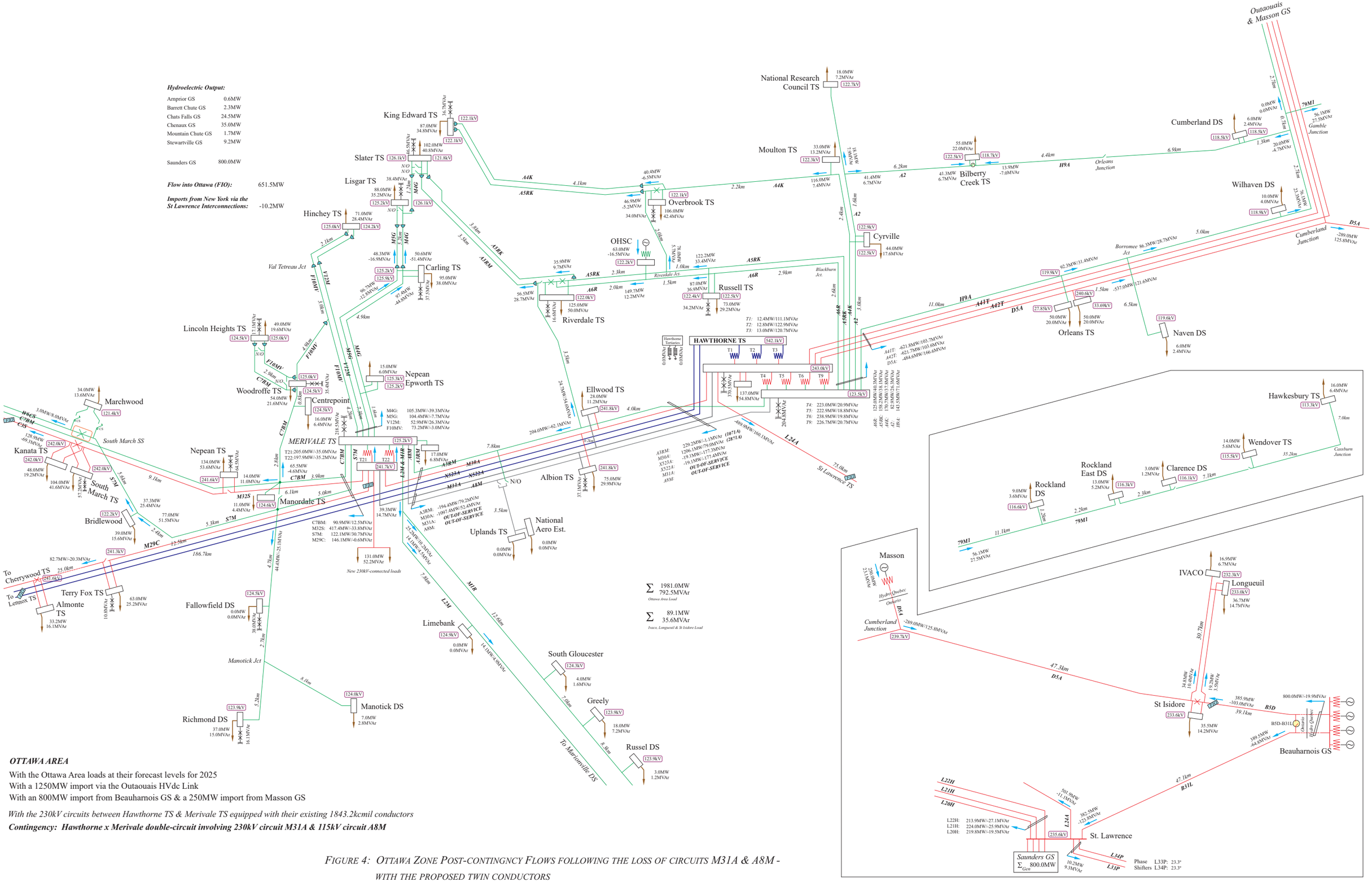


FIGURE 4: OTTAWA ZONE POST-CONTINGNCY FLOWS FOLLOWING THE LOSS OF CIRCUITS M31A & A8M - WITH THE PROPOSED TWIN CONDUCTORS

Appendix C: Relay margin analysis

The following figures show the representative results of the relay margin analysis:

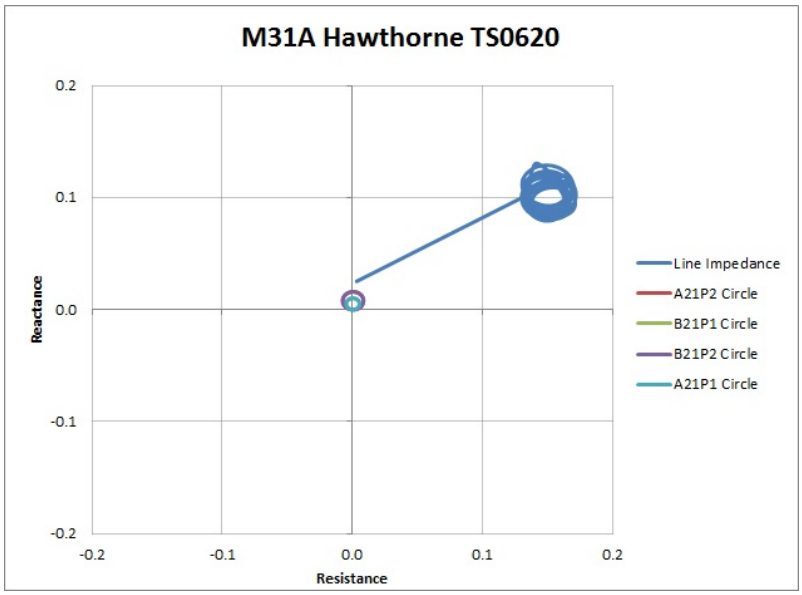


Figure 5: 3 phase fault on M30A at Hawthorne TS

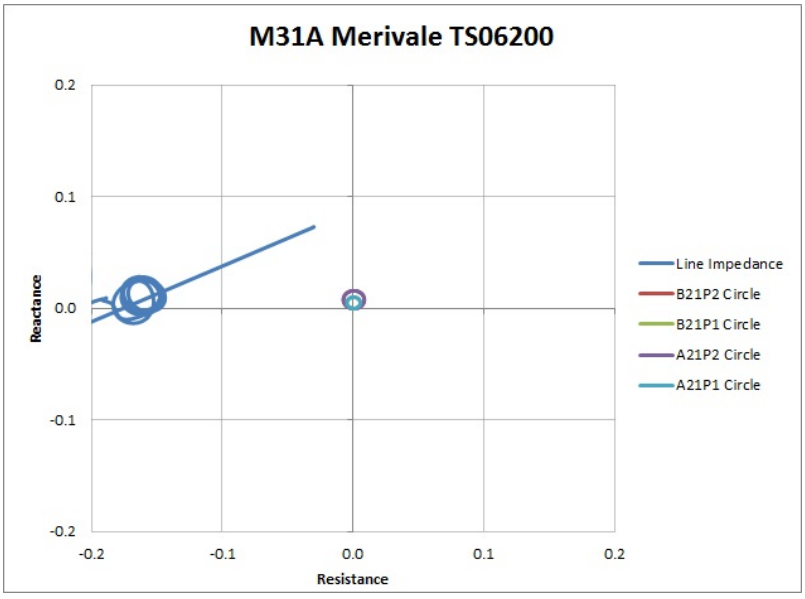


Figure 6: 3 phase fault on M30A at Merivale TS

In both cases the relay margins are sufficiently large indicating that the protection settings are acceptable to the IESO.

-End of Document-

CUSTOMER IMPACT ASSESSMENT

Hydro One has completed a draft Customer Impact Assessment ("CIA") in accordance with its customer connection procedures, and the results confirm that there are no adverse impacts on transmission customers as a result of this Project. Please refer to Attachment 1 for the draft CIA report prepared by Hydro One.

This Application will be updated with the final CIA upon its completion. The final CIA is expected to be finalized and submitted to the OEB within six weeks from the submission of this Application.

Hydro One Networks Inc.
483 Bay Street
Toronto, Ontario
M5G 2P5

CUSTOMER IMPACT ASSESSMENT

M30A/M31A CONDUCTOR UPGRADE

Revision: **Draft**

Date: 27 November 2020

Issued by: System Planning – Central & East
System Planning Division
Hydro One Networks Inc.

Prepared by:

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Approved by:

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Disclaimer

This Customer Impact Assessment was prepared based on preliminary information available about the new M30A/M31A conductor. It is intended to highlight significant impacts, if any, to affected transmission customers early in the project development process and thus allow an opportunity for these parties to bring forward any concerns that they may have, including those needed for the review of the connection and for any possible application for Leave to Construct. Subsequent changes to the required modifications or the implementation plan may affect the impacts of the proposed connection identified in this Customer Impact Assessment. The results of this Customer Impact Assessment and the estimate of the outage requirements are subject to change to accommodate the requirements of the IESO and other regulatory or municipal authority requirements. The fault levels computed as part of this Customer Impact Assessment are meant to assess current conditions in the study horizon and are not intended to be for the purposes of sizing equipment or making other project design decisions. Many other factors beyond the existing fault levels go into project design decisions.

Hydro One Networks Inc. shall not be liable, whether in contract, tort or any other theory of liability, to any person who uses the results of the Customer Impact Assessment under any circumstances whatsoever for any damages arising out of such use unless such liability is created under some other contractual obligation between Hydro One Networks Inc. and such person.

TABLE OF CONTENT

CUSTOMER IMPACT ASSESSMENT

PROPOSED M30A/M31A CONDUCTOR UPGRADE

1.0 INTRODUCTION

1.1 Purpose

This Customer Impact Assessment (CIA) study assesses the potential impact of the proposed Hawthorne TS x Merivale TS 230kV circuits M30A/M31A conductor upgrade on the transmission customers of the Ottawa area. This study is intended to supplement the System Impact Assessment (SIA) CAA ID 2016-572 issued by the IESO. In this report, the IESO concluded that there is no adverse impact of this project on the transmission system.

This is a Draft Customer Impact Assessment for the M30A/M31A conductor upgrade. This draft is issued for comments from transmission connected customers.

1.2 Background

Hydro One's M30A and M31A are 230kV circuits connecting Hawthorne TS and Merivale TS in Ottawa. The circuits have a long term emergency rating of 1800A. The IESO has identified the need for an increased power transfer limit across the two M30A and M31A circuits to address the need to facilitate bulk power flows from Eastern Ontario, including eastern Ontario generation, towards the GTA. Currently both M30A and M31A circuits can experience overloading under peak loading conditions, combined with high power transfers flowing west from Eastern Ontario into the GTA.

This project proposed to replace the existing 1843kcmil conductor of M30A/M31A with a twin-bundle 1443kcmil conductor. This project will increase the long-term emergency rating of the circuits from 1800A to 3000A.

Hydro One will be proceeding with a "Leave to Construct" application under Section 92 of the Ontario Energy Board Act in Fall 2020 to seek the Ontario Energy Board approval for the project. The project is expected to be completed by December 2023.

1.3 Connected Customers

The focus of this study is on transmission customers fed by circuits M30A/M31A. The affected customers are shown below.

Station	Customer
Albion TS	Hydro Ottawa
Ellwood MTS	Hydro Ottawa
Hawthorne TS	Hydro One Distribution Hydro Ottawa
Merivale MTS	Hydro Ottawa

2.0 LOAD FLOW

The SIA completed by IESO found that the conductor upgrade of M30A/M31A has no negative impact on the transmission system. The area voltage is kept within limits and the line loading is within circuit ratings. Please refer to IESO document CAA ID 2016-572.

The CIA also assessed the area voltage after the conductor replacement for M30A/M31A for the base case (with all facilities in service) and for either line out of service. All bus voltages are within criteria and no voltage violations were found for these conditions.

3.0 SHORT- CIRCUIT STUDY

The reconductoring of M30A/M31A has resulted in a small increase in station short circuit levels in the area. The short circuit levels before and after the conductor replacement are given in Appendix B. Hydro One has reviewed the fault level at its stations. Customers are requested to review the results and determine if the new fault levels are within their equipment ratings and whether their station grounding system is adequate.

4.0 CUSTOMER RELIABILITY

This project will improve supply reliability to customers in the Merivale area and those supplied from by Ellwood MTS and Albion TS. The project will eliminate line overloading following contingences under summer peak load conditions and with heavy power transfers from Eastern Ontario to the GTA.

4.1 Preliminary Outage Impact Assessment

Exact outage schedule will be made available during the execution phase of the project and will be established in consultation with load customers in the area. The outage duration, if any, will be minimized and risk managed with proper outage planning and co-ordination.

5.0 CONCLUSION

This report concludes that the conductor replacement of M30A/M31A will not have any adverse effects on the transmission connected customers.

6.0 APPENDIX A

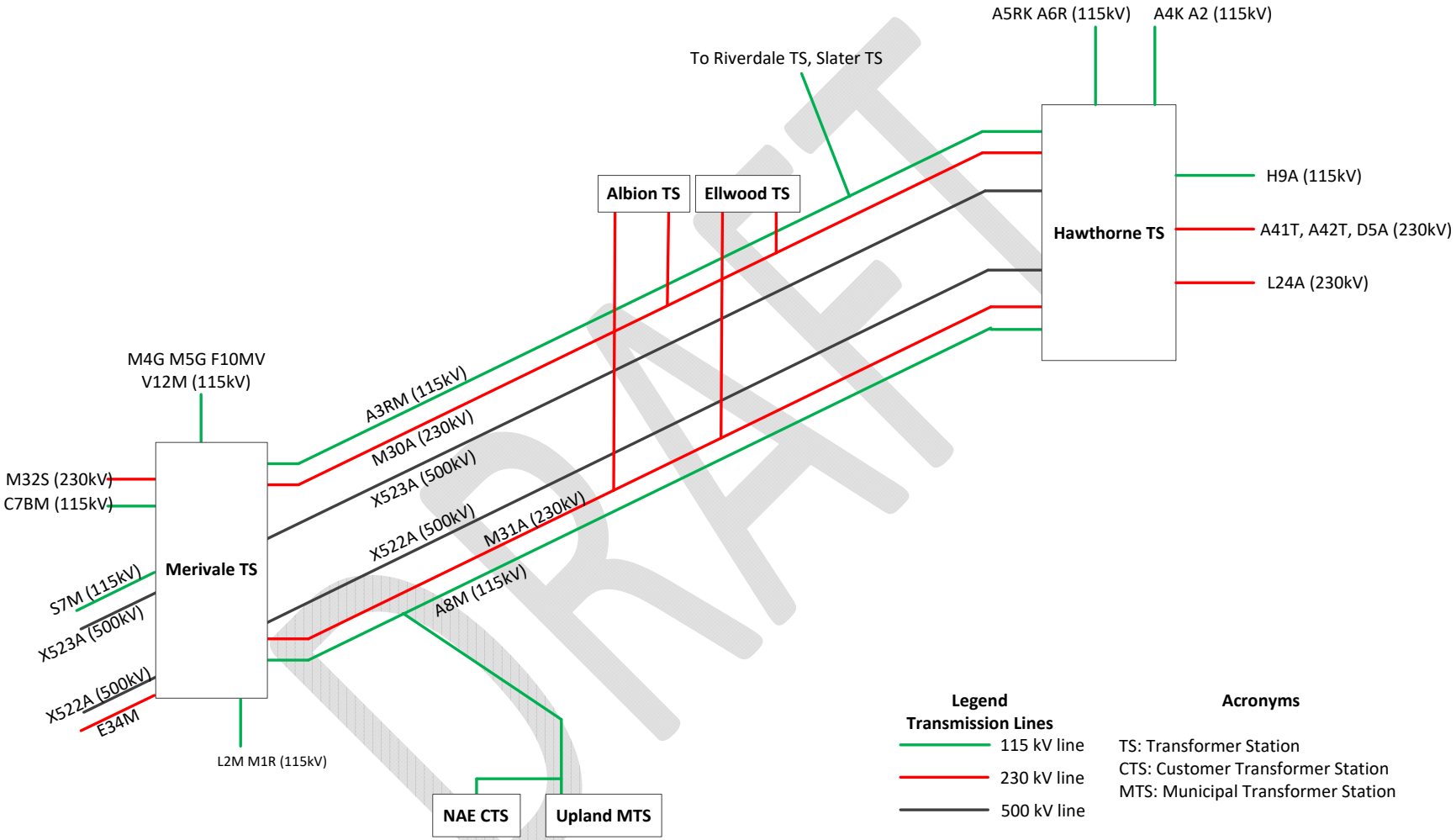

Figure 1. Single line diagram of transmission corridor between Hawthorne TS and Merivale TS.

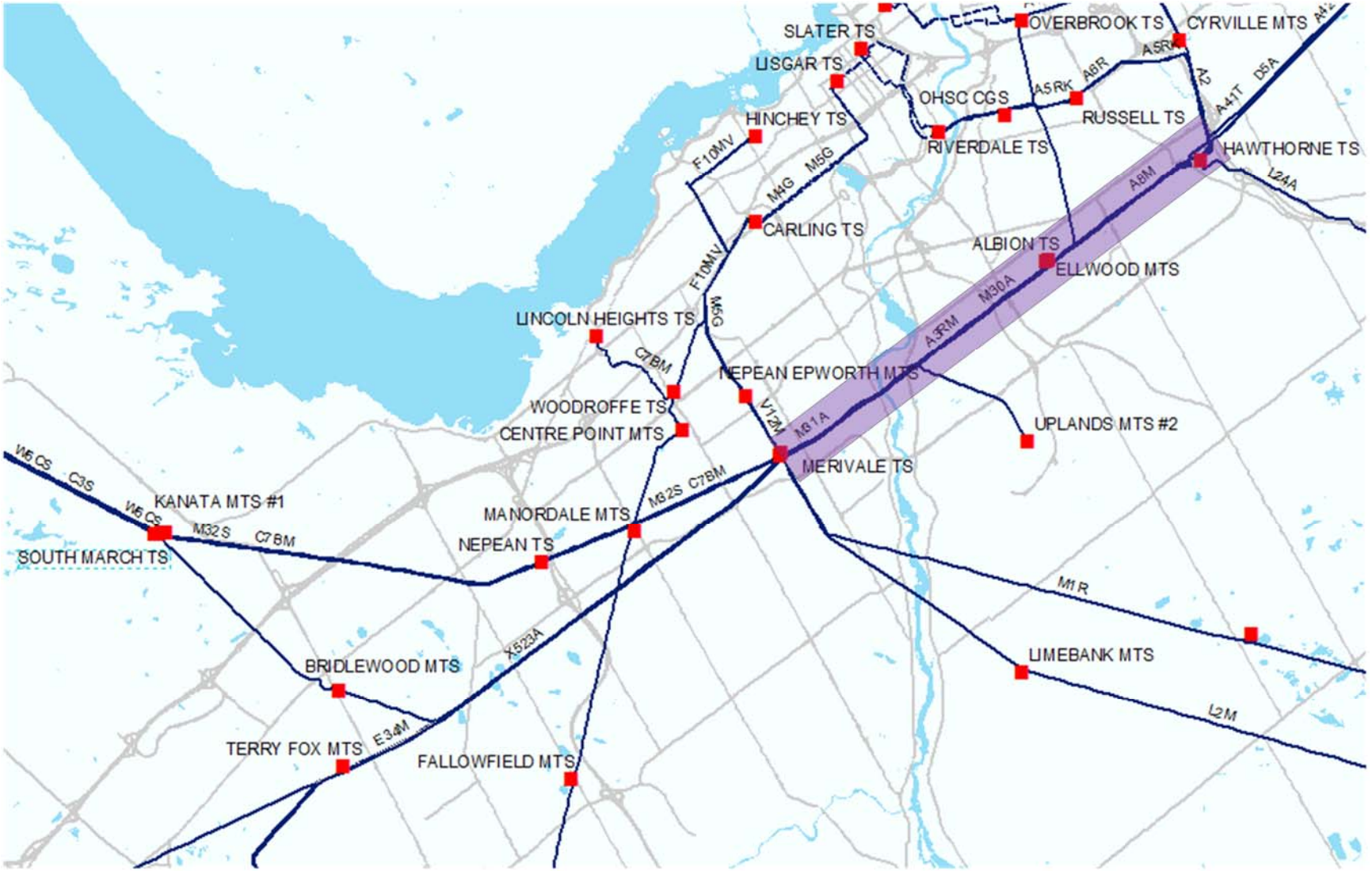

Figure 2. Map of area with transmission corridor between Hawthorne TS and Merivale TS highlighted.

7.0 APPENDIX B

Short circuit level before (pre) and after (post) the M30A/M31A conductor replacement.

		3 Phase sym. (kA)		LG sym. (kA)		Breaker rating (kA)[3]	
Station	Voltage (kV)[1]	PRE	POST	PRE	POST	3 phase (sym)	LG (sym)
ALBION M30A	250	19.3	20.2	20.9	22.2	n/a	n/a
ALBION M31A	250	19.2	20.1	20.8	22.0	n/a	n/a
ALBION TS BQ	13.2	16.4	16.4	8.0	8.0	20.0	20.0
ALBION TS JY	13.2	17.2	17.3	8.2	8.2	20.0	20.0
ELLWOOD M30A	250	19.2	20.1	20.9	22.2		
ELLWOOD M31A	250	19.3	20.2	21.0	22.2		
HAWTHORNE TS	46.0	13.8	13.8	6.7	6.7	17.0	17.0
HAWTHORNE TS	127	30.7	30.5	38.0	37.5	50.0	50.0
HAWTHORNE TS	250	23.4	23.5	29.1	29.3	50.0	50.0
MERIVALE AL	127	26.5	26.6	28.9	29.2	45.4[2]	45.4[2]
MERIVALE TS	250	19.0	19.9	20.0	21.1	63.0	63.0

Note:

1. Voltage shown is the maximum continuous voltage used for short circuit calculation.
2. Asymmetrical interrupting rating provided. Based on 10,000MVA asymmetrical interrupting capability breakers at 127kV.
3. Most limiting breaker rating listed.