NEEDS ASSESSMENT REPORT

Greater Toronto Area West

August 30, 2024

Needs Assessment Report

Greater Toronto Area (GTA) West Region

August 30, 2024

Lead Transmitter:

Hydro One Networks Inc.

Prepared by: GTA West Technical Working Group

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Disclaimer

This Needs Assessment Report was prepared for the purpose of identifying potential needs in the Greater Toronto Area West and to recommend which needs a) do not require further regional coordination and can be directly addressed by developing a preferred plan as part of the Needs Assessment phase and b) require further assessment and regional coordination. The results reported in this Need Assessment are based on the input and information provided by the Technical Working Group (the "TWG") for this region at the time. Updates may be made based on best available information throughout the planning process.

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Executive Summary

REGION	Greater Toronto Area West (GTA West) Region (the "Region")
LEAD	Hydro One Networks Inc. ("Hydro One")

START DATE: May 3, 2024 **END DATE:** August 30, 2024

1. INTRODUCTION

The second Regional Planning cycle for the GTA West Region was completed in February 2022 with the publication of the Regional Infrastructure Plan ("RIP") report (RIP Report). This is the third cycle of Regional Planning for the region.

The purpose of this Needs Assessment ("NA") is to:

a) Identify any new needs and reaffirm needs identified in the previous regional planning cycle; and,
b) Recommend which needs:
   i) require further assessment and regional coordination to develop a preferred plan (and hence, proceed to the next phases of regional planning); and,
   ii) do not require further regional coordination (i.e., can be addressed directly between Hydro One and the impacted Local Distribution Company ("LDC") to develop a preferred plan and/or no regional investment is required at this time and the need may be reviewed during the next regional planning cycle).

The planning horizon for this NA assessment is ten years.

2. REGIONAL ISSUE/TRIGGER

In accordance with the Regional Planning process, the Regional Planning cycle should be triggered at least every five years. Considering these timelines, the 3rd Regional Planning cycle was triggered for the GTA West Region on May 3rd, 2024.

3. SCOPE OF NEEDS ASSESSMENT

The scope of the GTW West Region NA includes:

a) Review and reaffirm needs/plans identified in the previous regional planning cycle RIP (as applicable),
b) Identify any new needs resulting from this assessment,
c) Recommend which needs require further assessment and regional coordination in the next phases of the regional planning cycle to develop a preferred plan; and,
d) Recommend which needs do not require further regional coordination (i.e., can be addressed directly between Hydro One and the impacted LDCs to develop a preferred plan and/or no regional investment is required at this time and the need may be reviewed during the next regional planning cycle).

The TWG may also identify additional needs during the next phases of the planning process, namely Scoping Assessment (SA), Integrated Regional Resource Plan (IRRP), and RIP, based on updated information available at that time.

4. REGIONAL DESCRIPTION AND CONNECTION CONFIGURATION

The GTA West Region includes the area roughly bordered by Highway 27 to the northeast, Highway 427 to the southeast, Regional Road 25 to the west, King Street to the north and Lake Ontario to the south. The Region area comprises the municipalities of Brampton, South Caledon, Halton Hills, Mississauga, Milton, Oakville and portions of Burlington.

5. INPUTS/DATA

The TWG comprises of representatives from LDCs, the Independent Electricity System Operator ("IESO"), and Hydro One and provides input and relevant information for the Region regarding capacity needs, reliability needs, operational issues, and major high-voltage ("HV") transmission assets requiring replacement over the planning horizon. The LDCs also capture input from municipalities in the development of their 10-year summer and winter load forecast.

In accordance with the regional planning process, stakeholder engagement takes place during the IRRP phase.

6. ASSESSMENT METHODOLOGY

The assessment's primary objective is to identify the electrical infrastructure needs in the Region over the 10-year planning horizon. The assessment methodology includes a review of planning information such as load forecast (which factors various demand drivers and consideration of MEPs and/or CEPs where available), conservation and demand management ("CDM") forecast, distributed generation ("DG") forecast, system reliability and operation, and major HV transmission assets requiring replacement.

A technical assessment of needs is undertaken based on:

a) Current and future station capacity and transmission adequacy
b) System reliability needs and operational concerns
c) Major HV transmission equipment requiring replacement with consideration to "right-sizing"
d) Sensitivity analysis to capture uncertainty in the load forecast as well as variability of demand drivers such as electrification.

7. NEEDS

I. Updates on needs identified during the previous regional planning cycle

The following needs discussed in the GTW West second cycle RIP have been addressed or updated:

- R19TH/R21TH overload under specific N-1-1 contingencies at peak load condition: A Key Operation Point ("KOP") procedure has been implemented in Hydro One control room to manage the N-1-1 post contingency thermal overload.
- Erindale T1/T2 DESN load will exceed station LTR by 2028: New forecast suggests the need will trigger in 2030. The TWG recommends this need is addressed with further regional planning coordination in conjunction with other capacity needs in Mississauga.
- Cardiff TS load will exceed station LTR by 2029: New forecast suggests the need will trigger in 2030. The TWG recommends this need is addressed with further regional planning coordination in conjunction with other capacity needs in Mississauga.
- Pleasant T1/T2 DESN capacity will be exceeded in 2027: Transformer replacement with standard LTR will provide sufficient capacity for forecasted loads.
- Erindale T5/T6 DESN load will exceed station LTR by 2031: New load forecast in this NA suggests the need will trigger beyond 2033.
- Lorne Park T2 replacement: Planned in service beyond 2033
- Bramalea T3/T4 replacement: Planned in service beyond 2033
- Tomken T1/T2 replacement: Planned in service beyond 2033
- T38B/T39B loads will exceed 600MW load security criteria in 2030: New load forecast suggests the threshold will be reached in 2029.

The following needs and projects discussed in the GTA West second cycle RIP are currently underway:

- Circuits H29/H30 reconductoring: planned in service in Q2, 2028.
- Palermo TS transformer replacement with larger capacity units: planned in service in Q4, 2027.

II. Newly identified needs in the region

The following are new needs that were identified as part of this assessment:

a) Asset Renewal for Major HV Transmission Equipment

- Halton T3/T4 (27.6kV)
- Pleasant T5/T6 (27.6kV)

b) Station Capacity

- Halton TS (27.6kV)
- Bramalea T1/T2 DESN (27.6kV)
- Cooksville T1/T2 DESN and T3/T4 DESN (all 27.6kV)
- Pleasant T5/T6 DESN (27.6kV)

- Jim Yarrow T1/T2 (27.6kV)
- Goreway T5/T6 DESN (27.6kV).
- Bramalea T3/T4 DESN (44kV)
- Lorne Park T1/T2 DESN (27.6kV)

c) Transmission Line Capacity

- No new transmission Line Capacity need identified

d) System Reliability, Operation and Load Restoration

- Trafalgar 230kV bus over-voltage issue under light load condition as reported by IESO.

e) Transmission System Reinforcement

- Major transmission expansion in Milton area will be needed to accommodate increasing new load connection requests including large transmission-connected data centers. Existing 230kV facilities, especially the radial section of T38B/T39B from Trafalgar TS, do not have sufficient capacity to supply the new demand and may not be simply addressed by reconductoring. In addition, T38B/T39B corridor will exceed the load security limit of 600MW in this NA timeframe

8. SENSITIVITY ANALYSIS

The objective of a sensitivity analysis is to capture uncertainty in the load forecast as well as variability of electric demand drivers to identify any emerging needs and/or advancement or deferment of recommended investments.

The impact of the sensitivity analysis for the high and low growth scenarios identified the following updates to need dates and new station capacity needs. These needs will be assessed again during the next phases of this Regional Planning cycle

No.	Need Identified	Normal Growth Scenario	High Growth Scenario	Low Growth Scenario
Needs update under high and low load growth scenarios				
1	Halton TS LTR	2026	2026	2029
2	Cardiff TS LTR	2030	2028	2032
3	Erindale T1/T2 LTR	2030	2027	2032
4	Bramalea T1/T2 LTR	2031	2030	Beyond 2033
5	Bramalea T3/T4 LTR*	2024	2024	2024
6	Lorne Park LTR*	2031	2030	Beyond 2033
7	Cooksville T1/T2 LTR	2030	2030	Beyond 2033

8	Cooksville T3/T4 LTR	2030	2029	Beyond 2033
9	Pleasant T1/T2 LTR*	2027	2026	Beyond 2033
10	Pleasant T5/T6 LTR	2026	2025	2027
11	Jim Yarrow T1/T2 LTR	2030	2028	Beyond 2033
12	Goreway T5/T6 LTR	2026	2025	2026
Additional capacity needs under high growth scenario				
13	Meadowvale TS LTR	Beyond 2033	2029	
14	Palermo TS LTR	Beyond 2033	2029	
15	Tremaine TS LTR	Beyond 2033	2029	
16	Tomken T1/T2 LTR	Beyond 2033	2031	
* The need can be addressed by transformer renewal with higher LTR specification				

9. RECOMMENDATIONS

The TWG recommendations are as follows:

I. Needs that require further assessment and regional coordination

These needs may have broader regional impacts and require further assessment and coordination during the next phases[1] of the regional planning cycle. A list of these needs are as follows:

a) Integrated transmission reinforcement plan in Milton area to accommodate new transmission and distribution connected loads including large data centers. A reinforcement plan should also help to manage T38B/T39B load security. The TWG recommends further regional coordination to address the capacity constraints. Coordinated efforts from IESO bulk system planning, Hydro One, LDCs and major customers should continue in developing such plan.

b) Accommodation of loads growth beyond LTR at Halton TS with a new 230/27.6kV Halton #2 station

c) Accommodation of load growth beyond LTRs at Bramalea T1/T2, Erindale T1/T2 and Cardiff TS in Mississauga area

d) Accommodation of load growth beyond LTRs at Cooksville T1/T2 and Cooksville T3/T4 in Mississauga area

e) Accommodation of load growth beyond LTRs at Pleasant T5/T6 and Jim Yarrow T1/T2 in Brampton area

f) Accommodation of load growth beyond LTRs at Goreway T5/T6 and Bramalea T1/T2 in Brampton area.

II. Needs that do not require further regional coordination

[1] Non-wires options are further considered (i.e. incremental to CDM and DG that is considered in this NA) as potential options in addressing these needs during the IRRP phase.

These needs are local in nature and do not have a regional impact. They can be addressed by a straightforward transmission and/or distribution wires solution. They do not require investment in any upstream transmission facility or require Leave to Construct (i.e., Section 92) approvals. These needs generally impact a limited number of LDCs and can be addressed directly between Hydro One and the LDC(s) to develop a preferred local plan. A list of these needs are as follows:

a) Accommodation of load growth at Pleasant T1/T2 through transformer renewals with standard LTR specification
b) Accommodation of load growth at Bramalea T3/T4 through transformer renewals with upsized rating
c) Accommodation of load growth at Lorne Park T1/T2 through T2 renewal with standard LTR specification (T1 has sufficient LTR).

List of LDC(s) to be involved in further regional planning phases:

- Alectra Utilities Co.
- Milton Hydro Distribution Inc.
- Halton Hills Hydro Inc.
- Oakville Hydro Electricity Distribution Inc.
- Burlington Hydro Inc.
- Hydro One Networks Inc. (Distribution)

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1. Introduction

The second cycle of the Regional Planning process for the GTA West Region was completed in February 2022 with the publication of the Regional Infrastructure Plan ("RIP") Report [1] - (RIP link). The RIP report included a common discussion of all the options and recommended plans for preferred wire infrastructure investments to address the near- and medium-term needs.

This Needs Assessment initiates the third regional planning cycle for the GTA West Region. The purpose of this Needs Assessment ("NA") is to:

a) Identify any new needs and reaffirm needs identified in the previous regional planning cycle; and,
b) Recommend which needs:
   i) require further assessment and regional coordination to develop a preferred plan (and hence, proceed to the next phases of regional planning); and,
   ii) do not require further regional coordination (i.e., can be addressed directly between Hydro One and the impacted LDC(s) to develop a preferred plan and/or no regional investment is required at this time and the need may be reviewed during the next regional planning cycle).

The planning horizon for this NA assessment is ten years. The flow chart of the Regional Planning Process is shown in Figure 1 below.

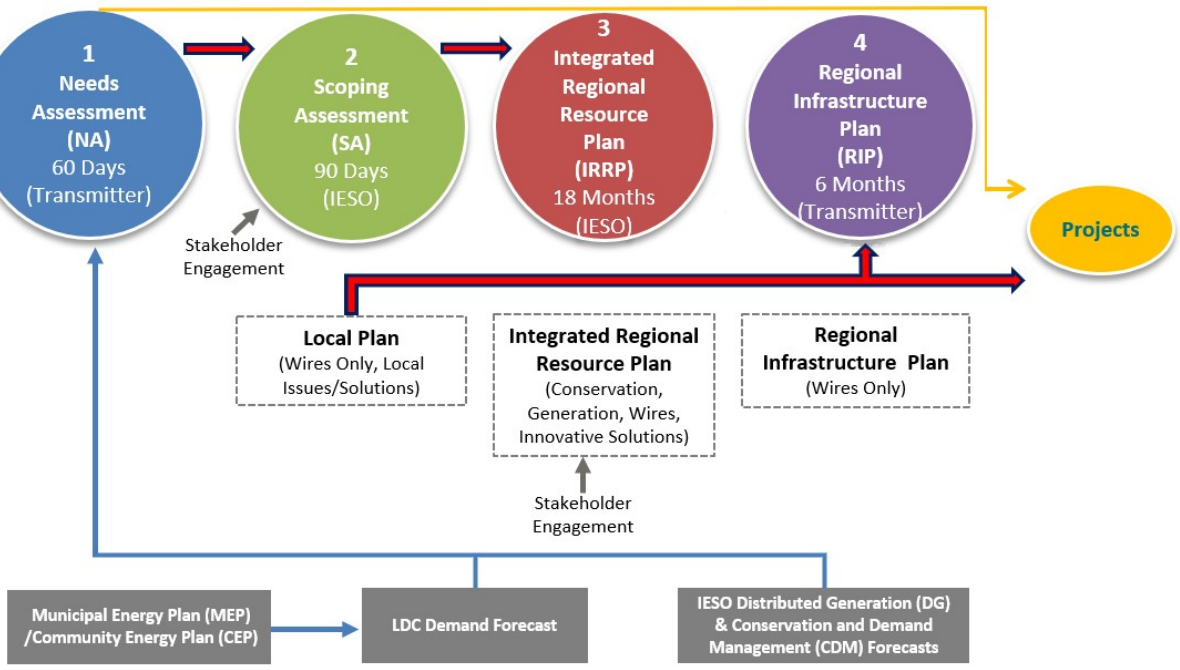

Figure 1: Regional Planning Process

This report was prepared by the GTA West Technical Working Group("TWG"), led by Hydro One Networks Inc. The report presents the results of the assessment based on information provided by the Hydro One, the Local Distribution Companies ("LDC") and the Independent Electricity System Operator ("IESO"). Participants of the TWG are listed below in Table 1.

Table 1: GTA West Region TWG Participants

No.	Name of TWG Participants
1	Hydro One Networks Inc. (Transmission) - (Lead Transmitter)
2	Hydro One Networks Inc. (Distribution)
3	Independent Electricity System Operator
4	Alectra Utilities Co.
5	Burlington Hydro Inc.
6	Milton Hydro Distribution Inc.
7	Halton Hills Hydro Inc.
8	Oakville Hydro Electricity Distribution Inc.

2. Regional Issue/Trigger

In accordance with the Regional Planning process, the Regional Planning cycle should be triggered at least once every five years. As such, the third Regional Planning cycle was triggered for the GTA West Region.

3. Scope of Needs Assessment

The scope of this NA covers the GTA West region and includes:

- Review and update needs and plans identified in the previous cycle RIP,
- Identify any new needs resulting from this assessment,
- Recommend which needs require further assessment and regional coordination in the next phases of the regional planning cycle to develop a preferred plan, and
- Recommend which needs do not require further regional coordination (i.e., can be addressed directly between Hydro One and the impacted LDCs to develop a preferred plan and/or no regional investment is required at this time and the need may be reviewed during the next regional planning cycle).

The TWG may also identify additional needs during the next phases of the planning process, namely Scoping Assessment ("SA"), Integrated Regional Resource Plan ("IRRP"), Local plan (LP) and RIP, based on updated information available at that time.

The planning horizon for this NA assessment is 10 years.

4. Regional Description and Connection Configuration

The GTA West Region includes the area roughly bordered geographically by Highway 27 to the northeast, Highway 427 to the southeast, Regional Road 25 to the west, King Street to the north and Lake Ontario to the south. The GTA West Region area comprises the municipalities of Brampton, South Caledon, Halton Hills, Mississauga, Milton, Oakville and portions of Burlington.

The geographical boundaries of the Region are shown in Figure 2.

Figure 2: Map of GTA West Regional Planning Area

Electrically the GTA West Region is bounded by Richview TS to Manby TS 230 kV circuits on the east, Richview TS to Trafalgar TS to Burlington TS 230 kV circuits on the north and Manby TS to Cooksville TS to Oakville TS 230 kV circuits on the south. The distribution system in this Region is at two voltage levels, 44 kV and 27.6 kV. Local generation in the area include the two gas fired plants, the 1196MVA Goreway CGS in Brampton and the 755MVA TCE CGS in Halton Hills.

The Local Distribution Customers (LDC) in the Region include Burlington Hydro Inc., Alectra Utilities Co., Halton Hills Hydro Inc., Hydro One Networks Inc. (Distribution), Milton Hydro Distribution Inc. and Oakville Hydro Electricity Distribution Inc. The high-voltage system in this Region also provides supply to one customer owned transformer station. An electrical single line diagram for the GTA West Region facilities is shown in Figure 3.

The circuits and stations of the area are summarized in Table 2 below:

Table 2: Transmission Station and Circuits in the GTA West Region

230kV circuits	Transformer Stations	Generation Stations
H29/H30 R14T/R17T R19TH/R21TH T36B/T37B T38B/ T39B V41H/V42H V43 B15C/B16C K21C/K23C, R24C	Bramalea TS Cardiff TS Churchill Meadows TS Claireville TS[1] Cooksville TS Erindale TS CTS-1 Glenorchy MTS Goreway TS Halton TS Halton Hills MTS Jim Yarrow MTS Lorne Park TS Meadowvale TS Oakville TS Palermo TS Pleasant TS Richview TS Tomken TS Trafalgar TS[1] Tremaine TS (Hurontario SS)	Sithe Goreway CGS, 787MW[2]/1196MVA TCE Halton Hills CGS, 526MW[3]/755MVA

1: 500kV Stations with Autotransformers installed

2: At 35°C ambient temperature. Generation capacity will increase by 40MW under IESO's Expedited Long-term RFP

3: At 35°C ambient temperature. Generation capacity will increase by 29MW under IESO's Expedited Long-term RFP

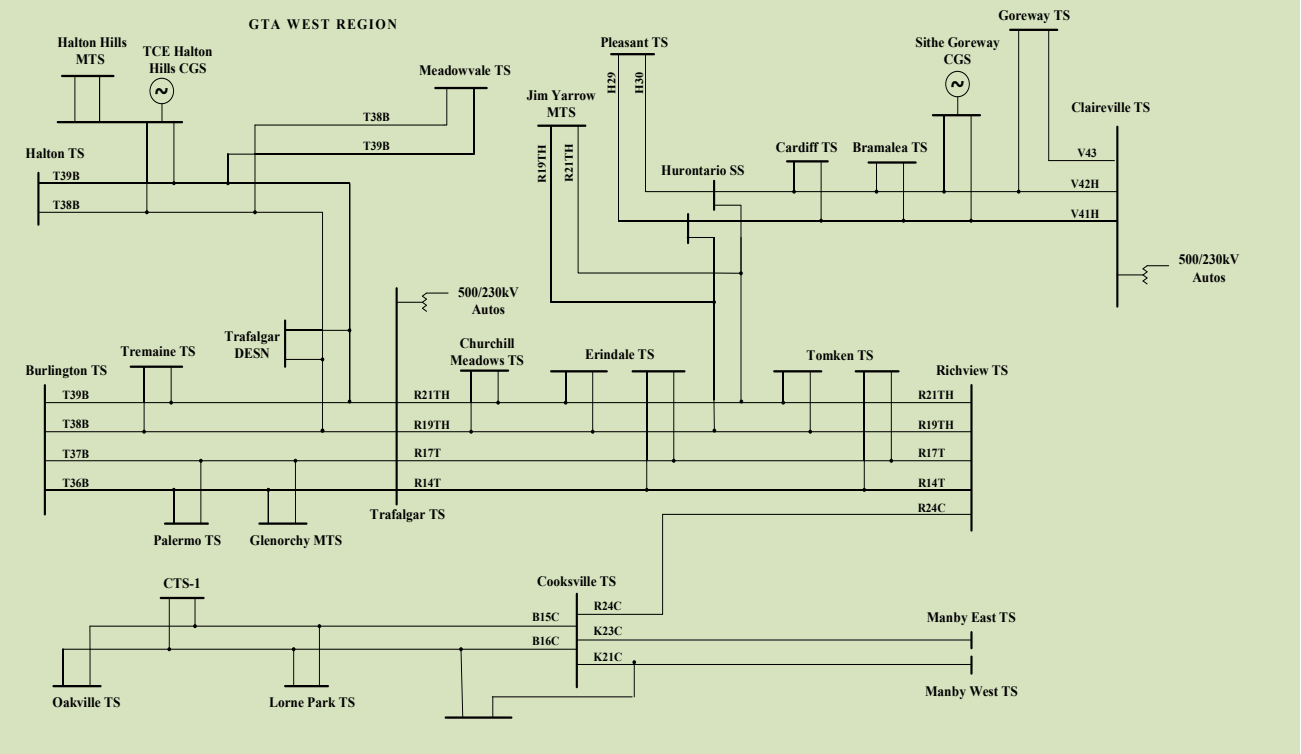

Figure 3: GTA West Transmission Single Line Diagram

5. Inputs and Data

TWG participants, including representatives from LDCs, IESO, and Hydro One provided input for the GTA West NA. With respect to the load forecast information, the OEB Regional Planning Process Advisory Group (RPPAG) recently published a document called "Load Forecast Guideline for Ontario" in Oct. 2022 [2]. The objective of this document is to provide guidance to the TWG in the development of the load forecasts used in the various phases of the regional planning process with a focus on the NA and the IRRP. One of the inputs into the LDC's load forecast that is called for in this guideline is information from Municipal Energy Plans (MEP) and/or Community Energy Plans (CEP). The list of all the Municipalities falling under the geographical boundaries of the region are given in Appendix-E.

The information provided includes the followings:

- GTA West 10-year summer and winter load forecast for all supply stations inclusive of the inputs provided by the municipalities listed in Appendix E
- Known capacity and reliability needs, operating issues, and/or major assets requiring replacement or refurbishment
- Planned transmission and distribution investments that are relevant to Regional Planning for the GTA West
- Captured uncertainty in the load forecast as well as variability of electric demand drivers to identify any emerging needs and/or advancement or deferment of recommended investments.

6. Assessment Methodology

The following methodology and assumptions are made in development of this Needs Assessment:

6.1 Technical Assessments and Study Assumptions

The technical assessment of needs was undertaken based on:

- Current and future station capacity and transmission adequacy
- System reliability and operational considerations
- Asset renewal for major high voltage transmission equipment requiring replacement with consideration to "right-sizing"
- Load forecast data requested from industrial customers in the region
- Summer peak load condition. Three load forecasts were developed, i.e. normal growth scenario, high and low growth scenario. The high and low growth load forecasts are developed to conduct a sensitivity analysis to cover unforeseen developments such as fuel switching, government policies, higher than expected EV charging trend during peak load conditions, etc.

The following assumptions are made in this report:

- The study period for this Needs Assessment is 2024-2033.
- The Region is summer peaking, so this assessment is based on summer peak loads.
- Line capacity adequacy is assessed by using coincident peak loads in the area.
- Station capacity adequacy is assessed by comparing the non-coincident peak load with the station's normal planning supply capacity, assuming a 90% lagging power factor for stations without low-voltage capacitor banks and 95% lagging power factor for stations with low-voltage capacitor banks.
- Normal planning supply capacity for transformer stations is determined by the Hydro One summer 10-Day Limited Time Rating (LTR) of a single transformer at that station.
- Adequacy assessment is conducted as per Ontario Resource Transmission Assessment Criteria (ORTAC) [3].

6.2 Information Gathering Process

6.2.1 Load forecast

The LDCs provided their summer and winter load forecast for all the stations supplying their loads in the GTA West region for the 10-year study period including the inputs from the Municipalities such as MEPs and CEPs. The IESO provided a Conservation and Demand Management ("CDM") and Distributed Generation ("DG") forecast for the Region. The net extreme summer weather load forecasts were produced by reducing the gross load forecasts for each station by the percentage CDM and then by the amount of effective DG capacity provided by the IESO for that station. It is to be noted that as contracts for existing DG resources in the region begin to expire, at which point

the load forecast has a decreasing contribution from local DG resources, and an increase in net demand. This extreme summer weather corrected net load forecast for the individual stations in the Region is given in Appendix A.

6.2.2 Sensitivity analysis

A sensitivity analysis was undertaken by the TWG to capture uncertainty in the load forecast as well as variability of drivers such as electrification. Hence, the NA recommendations are not necessarily linked to sensitivity scenarios; but rather are used to identify any emerging needs for consideration in developing recommendations. The impact of sensitivity analysis for the high and low growth scenarios are provided in section 8 of this report.

6.2.3 Asset renewal needs for major HV equipment

A list is generated for major HV transmission equipment planned or identified to be replaced based on asset condition assessment, relevant for Regional Planning purposes. This includes HV transformers, HV Breakers, HV underground cables and overhead lines. The scope of equipment considered is given in section 7.1.

6.2.4 System reliability and operational issues

Relevant information regarding system reliability and operational issues in the region as feedback is provided by the IESO during the NA phase.

7. Needs

This section describes new needs identified in the Region and updates on previously identified needs since the completion of previous regional planning cycle.

Needs that were identified and discussed in the previous regional planning cycle with associated projects that were recently completed and reaffirmed needs that are underway and are briefly described below with relevant updates:

- Palermo T3/T4 replacement with larger capacity units: project is in progress with planned in service in Q4, 2027.
- Tomken T1/T2 replacement: expected in service date is updated as Q4, 2035.
- Lorne Park T2 replacement: expected in service date is updated as Q4, 2034.
- Bramalea T3/T4 replacement with larger capacity units: expected in service date is updated as Q2, 2040.
- Pleasant T1/T2 capacity need: will plan to replace T1/T2 with standard LTR rating, in service date is to be determined.
- Erindale T5/T6 capacity need: updated load forecast suggests the need is beyond 2033.
- Circuit H29/H30 capacity need: reconductoring to higher capacity is in progress, expected in service date is Q2, 2028.
- R19TH/R21TH post-contingency overload under specific N-1-1 scenarios: operational KOP has been implemented in Hydro One control room.
- T38B/T39B Lantz Junction to Trafalgar DESN (~200m) post-contingency overload: being re-evaluated since more new load connection requests are received, this could be included an integrated transmission reinforcement plan in the area.

All new near and midterm needs that are discussed as a part of this report are summarized in Table 3. Note the planned in-service year for the projects is tentative and is subject to change.

Table 3: Near/Mid-term Needs Identified in Previous RIP and/or this NA

Need Description	Recommended Plan/Update	Previous RIP Report Section	NA Report Section
Asset Renewal Needs			
Halton T3/T4 end-of-life replacement	Planned in service Q4, 2035	N/A	Sec. 7.1
Pleasant T5/T6 End-of-life replacement	Planned in service Q3, 2037	N/A	Se. 7.1

Station Capacity Needs			
Halton TS Forecasted demand will exceeds LTR in 2026.	Plan Halton TS #2 to accommodate new load.	Sec. 6.2	Sec. 7.2.1
Bramalea T1/T2 Forecasted demand will exceed LTR in 2031	Plan Mississauga and Brampton areas to accommodate new load	N/A	Sec.7.2.2
Erindale T1/T2 Forecasted demand will exceed LTR in 2030.	Plan area to accommodate new load	Sec. 6.2, 7.4	Sec. 7.2.4
Cardiff T1/T2 Forecasted demand will exceed LTR in 2030.	Plan area to accommodate new load	Sec. 6.2, 7.4	Sec. 7.2.5
Lorne Park T1/T2 Forecasted demand will exceed LTR in 2031	Replace Lorne Park T2 with standard LTR	N/A	Sec. 7.2.6
Cooksville T1/T2, T3/T4 Forecasted demand will exceed LTR in 2030	Plan area to accommodate new load	N/A	Sec. 7.2.7
Pleasant T5/T6 Forecasted demand will exceed LTR in 2026	Plan area to accommodate new load	N/A	Sec. 7.2.9
Jim Yarrow T1/T2 Forecasted demand will exceed LTR in 2030.	Plan area to accommodate new load	Sec. 7.8.1	Sec. 7.2.10
Goreway T5/T6 Forecasted demand will exceed LTR in 2026.	Plan area to accommodate new load	Sec. 6.2	Sec. 7.2.11
System Reliability, Operation and Load restoration Needs			
T38B/T39B load security and restoration	Consolidate with Milton area transmission reinforcement need and assess further in next phase of regional planning	Sec. 7.6	Sec. 7.4
Trafalgar 230kV high voltage control under light load condition	IESO and Hydro One operations coordinate to assess solutions	N/A	Sec. 7.4
Transmission System Reinforcement Needs			
Milton area reinforcement for load supply and security	Develop an integrated transmission system reinforcement plan in further regional planning phases to address substantial new load connection requests in Milton area	N/A	Sec. 7.5

7.1 Asset Renewal Needs for Major HV Transmission Equipment

In addition to the previously identified asset renewal needs from the second regional planning cycle, Hydro One and TWG has also identified new asset renewal needs for major high voltage transmission equipment that are expected to be replaced over the next 10 years in the Region. The complete list of planned major HV transmission equipment requiring replacement is provided in Table 4. Only Palermo T3/T4 will be put in service in next 10 years according to Hydro One's recent investment planning. Note the in service year is subject to change as the asset renewal planning is a dynamic process.

Asset Replacement needs are determined by asset condition assessment. Asset condition assessment is based on a range of considerations such as:

- Equipment deterioration due to aging infrastructure or other factors
- Technical obsolescence due to outdated design
- Lack of spare parts availability or manufacturer support and/or
- Potential health and safety hazards.

The major high voltage equipment information shared and discussed as part of this process is listed below:

- 230 load serving step down transformers
- 230kV breakers where:
  replacement of six breakers or more than 50% of station breakers, the lesser of the two
- 230kV transmission lines requiring refurbishment where:
  Leave to Construct (i.e., section 92) approval is required for any alternative to like-for-like
- 230kV underground cable requiring replacement where:
  Leave to Construct (i.e., section 92) approval is required for any alternative to like-for-like

The Asset renewal assessment considers the following options for "right sizing" the equipment:

- Maintaining the status quo
- Replacing equipment with similar equipment with *lower* ratings and built to current standards
- Replacing equipment with similar equipment with *lower* ratings and built to current standards by transferring some load to other existing facilities
- Eliminating equipment by transferring all the load to other existing facilities
- Replacing equipment with similar equipment and built to current standards (i.e., "like-for-like" replacement)
- Replacing equipment with higher ratings and built to current standards.

From Hydro One's perspective as a facility owner and operator of its transmission equipment, do nothing is generally not an option for major HV equipment due to safety and reliability risk of equipment failure. This also results in increased maintenance cost and longer duration of customer outages.

In the list of Table 4, Halton T3/T4 and Pleasant T5/T6 transformers are newly identified asset for replacement but the in-service dates will be outside of this NA window based on recent Hydro One investment planning outcome. It is expected that Lorne Park TS capacity will increase once T2 is replaced

with standard LTR specification (sec. 7.2.6). Bramalea T3/T4 may also be replaced with larger capacity to address the capacity issue (sec. 7.2.3).

Table 4: Major HV Transmission Asset Assessed for Replacement in the Region in Next 10 Years

Station/Circuit	Need Description	Planned ISD
Palermo T3/T4	Built in 1969, applied in 1970, replacement with upsized units	2027
Assets planned for replacement post 2033		
Halton T3/T4	Built in 1989, applied in 1990	Beyond 2033
Pleasant T5/T6	Built in 1988, applied in 1991	Beyond 2033
Lorne Park T2	Built in 1974, applied in 1975	Beyond 2033
Tomken T1/T2	Built and applied in 1970	Beyond 2033
Bramalea T3/T4	Built in 1970, applied in 1983	Beyond 2033

7.2 Station Capacity Needs

A Station Capacity assessment was performed over the study period 2024-2033 for the 230kV Transforming stations in the Region using the summer peak load forecasts. Based on the results, the identified station capacity needs are flagged in Table 5. Comparing with the recommendations in RIP 2022 [1], Bramalea T1/T2, Cooksville T1/T2, T3/T4 and Pleasant T5/T6 are newly identified needs in this NA period. Previously identified capacity need of Erindale T5/T6 in [1] has been updated to post 2033.

Table 5: Stations with Capacity Need

TS	LTR (MW)	Load Forecast (MW)									
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Halton T3/T4	195	154.0	179.1	**215.9**	234.4	231.3	250.2	264.2	266.5	268.8	273.5
Bramalea T1/T2	193	134.7	139.5	144.6	149.9	156.4	170.2	182.7	**205.3**	228.8	252.8
Bramalea T3/T4	111	**113.6**	115.1	114.6	119.1	122.7	126.0	126.4	127.3	128.8	130.4
Bramalea T5/T6	169	103.4	103.4	105.0	107.7	111.4	114.9	118.5	118.9	119.8	122.7
Erindale T1/T2	180	166.6	169.2	174.4	180.0	179.8	179.2	**184.5**	193.5	199.2	215.4
Erindale T3/T4	190	156.8	163.0	164.6	166.3	167.3	166.9	166.7	167.3	169.3	181.0
Erindale T5/T6	194	132.9	134.8	135.7	136.2	137.8	139.2	140.6	142.7	145.3	147.9
Cardiff T1/T2	113	109.3	110.8	111.6	111.9	113.3	113.2	**115.6**	118.5	121.8	125.1
Lorne Park T1/T2	144	104.4	105.8	111.2	116.1	122.0	128.2	136.9	**146.1**	152.3	151.8
Cooksville T1/T2	117	50.7	51.4	51.8	51.9	64.1	78.3	**123.9**	152.5	171.4	204.9
Cooksville T3/T4	117	40.2	40.8	41.1	51.2	67.9	87.4	**130.4**	150.3	168.6	202.9
Pleasant T1/T2	155	122.7	131.9	147.1	**156.3**	158.2	158.8	158.9	159.7	161.1	162.8
Pleasant T5/T6	187	181.8	186.2	**191.6**	197.1	203.6	209.2	216.0	223.3	231.9	241.3
Pleasant T7/T8	183	108.0	111.3	115.2	119.3	124.0	128.2	133.1	138.4	144.5	151.1
Jim Yarrow T1/T2	157	134.3	137.6	141.5	145.6	150.4	154.6	**159.6**	165.0	171.3	178.3
Goreway T5/T6	181	177.6	181.9	**187.1**	192.5	198.9	204.4	211.0	218.2	226.6	235.8
Goreway T1/T2	180	74.4	77.3	80.7	84.3	88.4	92.1	96.3	100.8	105.9	111.4

7.2.1 Halton TS

Halton TS (27.6kV) supplies loads from Milton Hydro and Halton Hills Hydro. Milton Hydro forecasts rapid load growth at Halton TS in next three years, while Halton Hills Hydro load forecast remain flat in next 10 years. By end of this assessment cycle, Milton Hydro forecasts nearly 80MW loads beyond Halton TS LTR need to be served from other supplies. As the LTR at Halton TS cannot be increased through standard transformer replacement, a new station Halton TS #2 as previously suggested in [1,6] could be appropriate to address the need. In near term, Milton Hydro plans to use Oakville Hydro's Glenorchy MTS and upsized Palermo TS to meet the increasing demand before Halton TS #2 is available. The TWG recommends that the capacity need at Halton TS be investigated further through the regional planning process in conjunction with Milton area load supply planning (sec. 7.5).

7.2.2 Bramalea T1/T2

Bramalea TS has three DESNs as shown in Table 5, supplying Alectra's loads in Mississauga and Brampton. T1/T2 is the only 27.6kV DESN in Bramalea. The forecasted load at T1/T2 is expected to exceed its LTR in 2031. As Erindale T1/T2 (27.6kV) and Cardiff TS (27.6kV) in Mississauga will have similar capacity need (7.2.4 and 7.2.5 below) in medium term, the TWG acknowledges that a new station might be one option and recommends further regional coordination to address this need.

7.2.3 Bramalea TS T3/T4

Bramalea T3/T4 (44kV) are 83.3MVA CGE units built in 1970. Operating data shows the actual peak load at T3/T4 has slightly exceeded summer LTR and the load will grow at moderate rate near 2%. The issue can be addressed by replacing the transformers with higher rating such as standard 125MVA units. At interim, Alectra may balance the 44kV load with Bramalea T5/T6 DESN that can accommodate extra load. The TWG acknowledges load rebalance and transformer replacement could address the issue.

7.2.4 Erindale TS T1/T2

Erindale TS has three DESNs as shown in Table 5, all supplying Alectra's loads. T1/T2 is the only 27.6kV DESN in Erindale. The forecasted load will exceed T1/T2 LTR in 2030. The TWG acknowledges that a new station might be one option and recommends that further regional coordination takes place to address this need.

7.2.5 Cardiff TS

Cardiff T1/T2 (27.6kV) serves Alectra's loads with two 83.3MVA transformers built in 2004. The LTRs of the transformers are further limited by its MVGIS breakers. Load forecast suggests the station will be overloaded by 2030. Since it is impractical to upsize the transformers and MVGIS still in good condition, the TWG acknowledges that a new station might be one option and recommends that further regional coordination takes place to address this need.

7.2.6 Lorne Park TS

Lorne Park T1/T2 (27.6kV) serves Alectra loads only. The LTR of the station is determined by T2 (built in 1974) that has lower overloading capability than T1 (built in 2008). The forecast shows that Lorne Park TS load will exceed T2 LTR in 2031 and further growth is moderate. The TWG acknowledges that T2 replacement with standard LTR should be one option to address the issue.

7.2.7 Cooksville TS

Cooksville TS (27.6kV) has two DESNs, T1/T2 and T3/T4, supplying Alectra's loads only. All the transformers are 83.3MVA units built in 2013. Alectra forecasts significant load growth at Cooksville after 2028 as shown in Table 5. Lakeview Village, Rangeview, Dixie Mall conversion, Trillium Hospital new building, Water and Wastewater Treatment Plants expansion are examples of the new need to be served. The load growth rates will peak at 60% for T1/T2 DESN and 50% for T3/T4 DESN in 2030. As a result, the LTRs at both DESNs will be exceeded in 2030. Considering the existing transformers are still young and the T1/T2 27.6kV yard was just rebuilt in 2014, the TWG acknowledges that a new station might be one option and recommends that further regional coordination takes place to address this need.

7.2.8 Pleasant TS T1/T2

Pleasant TS has three DESNs. T1/T2 DESN (44kV) supplies loads from Alectra, Hydro One Distribution and Halton Hills Hydro. Combined load forecasts from the three LDCs suggest moderate LTR violation after 2027 as shown in Table 5. T1/T2 are Westinghouse 125MVA units built in 1975 and their LTRs are lower than today's standard (above 180MVA). The TWG recommends this issue is addressed by regular transformer end-of-life renewal with standard LTR specifications.

7.2.9 Pleasant T5/T6

Pleasant T5/T6 (27.6kV) supplies Alectra load only. The DESN is heavily loaded at present. Alectra's load forecast suggests steady annual growth rate near 5% throughout the assessment period and the DESN LTR will be exceeded as early as 2026. As another 27.6kV station adjacent to Pleasant, Jim Yarrow MTS (sec. 7.2.10) also forecasts its LTR will be exceeded during this NA timeframe, the TWG acknowledges that a new station might be one option and recommends that further regional coordination take place to address this need.

7.2.10 Jim Yarrow T1/T2

Jim Yarrow MTS is an Alectra-owned station built in 2004. The load at the MTS is forecasted to grow at approximately 4.4% annually and its LTR will be exceeded in 2030. Since adjacent Pleasant TS is also expected to reach full capacity in this assessment period, the TWG acknowledges that a new station might be one option and recommends that further regional coordination takes place to address this need.

7.2.11 Goreway T5/T6

Goreway TS has two 27.6kV DESNs T1/T2, T5/T6 and one 44kV supply from T4, all supplying Alectra load. The forecasted demand at T5/T6 DESN will exceed LTR in 2026 and keep growing at approximately 4% per year. As Alectra forecasts additional new Brampton loads beyond Bramalea T1/T2 capacity, the TWG acknowledges that a new station in the area may be appropriate and recommends that further regional coordination takes place to address this need. In near term, available capacity from Goreway T1/T2 could be utilized to meet the load growth need in the area.

7.3 Transmission Lines Capacity Needs

All line and equipment loads shall be within their continuous ratings with all elements in service and within their long-term emergency ratings with any one element out of service. Immediately following contingencies, lines 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. A Transmission Lines Capacity Assessment was performed over the study period 2024-2033 for the 230kV Transmission line circuits in the Region by assessing thermal limits of the circuit and the voltage range as per ORTAC to cater this need. Based on the results, there is no new transmission line capacity need other than identified in the second cycle RIP [1].

7.4 System Reliability, Operation and Restoration Needs

The transmission system must be planned to satisfy demand levels up to the extreme weather, median-economic forecast for an extended period with any one transmission element out of service. The system should also meet load security and load restoration criteria as defined in ORTAC [3]. Based on input from the IESO and LDCs, the following operational issues are identified:

- The new load forecast suggests T38B/T39B corridor will exceed load security limit of 600MW [3] in 2029. Table 6 shows load growth of all double-circuit corridors in the Region (assuming the new Halton TS #2 will still tap to T38B/T39B in 2030). The TWG recommends further regional coordination to address the T38B/T39B load security issue. All other double circuits corridors will not have more than 600MW net loads in the assessment window.

- All double-circuit corridor loads will exceed 250MW in this assessment timeframe. The ORTAC [3] requires the amount of load interruption in excess of 250MW must be restored within 30 minutes (and within 4 hours for load loss more than 150MW). The TWG surveyed transmission load interruption performance data from 2014 to 2024 for the Region. The results show that delivery points supplied by the circuits in Table 6 did not log load loss of more than 250MW for longer than 30 minutes, or loss of more than 150MW for longer than 4 hours in the 10 years. Based on past performance data, the TWG would not recommends capital investment for load restoration at this point. Hydro One shall proactively monitor load restoration data and identify opportunities to reduce risk of prolonged load restoration.

Table 6 Double-circuit Corridor Load

Circuits	Loads served by the double circuits (MW)									
	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
T38B/T39B	444.8	492.1	558.6	570.3	588.3	**606.9**	676.2	688.6	703.7	721.2
T36B/T37B	231.6	236.1	241.2	247.5	299.1	283.0	294.5	304.8	314.7	327.6
R14T/R17T	449.9	459.0	466.2	474.7	483.9	483.7	484.2	486.4	491.8	502.7
R19TH/R21TH	456.5	463.2	470.1	476.3	487.4	505.6	510.1	515.4	520.1	526.0
H29/H30	395.0	411.0	431.6	444.1	450.2	454.6	459.2	464.8	471.7	479.3
B15C/B16C	220.1	224.0	230.1	235.8	242.7	249.6	257.9	268.6	277.7	282.1
V41H/V42H	371.7	378.2	383.7	393.8	405.7	421.8	436.9	459.0	482.8	496.6

- IESO reports high voltage at Trafalgar 230kV bus under light load conditions. Hydro One and IESO operation departments are coordinating to assess alternatives including Trafalgar TS Autotransformer tap changer position adjustment.

7.5 Transmission System Reinforcement Needs

Milton area transmission reinforcement:

In addition to the rapid organic load growth forecasted in T38B/T39B corridor, multiple proponents have requested to connect large-scale loads in Milton area, especially in proximity to Milton SS. Majority of the requests are large data centers with combined capacity exceeding 1000MW. It is not feasible for the existing 230kV transmission infrastructure in Milton area to accommodate such sizeable loads. Due to the scale and complexity of such connections, the TWG recommends further regional coordination to address the capacity needs. Coordinated efforts from IESO bulk system planning, Hydro One, LDCs and major customers should continue in developing solutions.

8. Sensitivity Analysis

The objective of a sensitivity analysis is to capture uncertainty in the load forecast as well as variability of electric demand drivers to identify any emerging needs and/or advancement or deferment of recommended investments. The TWG determined that the key electric demand driver in the GTA West region to be considered in this sensitivity analysis is electric vehicle (EV) penetration and unforeseen electrification which would cause the load to increase at a faster rate than shown in the forecast; or the potential delay in some projects which could result in less demand than anticipated.

The TWG reviewed EV scenarios and any unforeseen electrification needs to develop high demand growth forecasts by applying 50% additional growth to the growth rate on the extreme summer corrected Normal Growth net load forecasts. The low growth scenario was obtained by reducing the growth rate by 50%.

The impact of sensitivity analysis for the high and low growth scenario is shown in Table 7. The additional capacity needs identified towards the end of the study period will be assessed again during the next phases of the Regional Planning cycle.

Table 7: Impact of Sensitivity Analysis on Capacity Needs in the Region

No.	Need Identified	Normal Growth Scenario	High Growth Scenario	Low Growth Scenario
Needs update under high and low load growth scenarios				
1	Halton TS LTR	2026	2026	2029
2	Cardiff TS LTR	2030	2028	2032
3	Erinddale T1/T2 LTR	2030	2027	2032
4	Bramalea T1/T2 LTR	2031	2030	Beyond 2033
5	Bramalea T3/T4 LTR*	2024	2024	2024
6	Lorne Park LTR*	2031	2030	Beyond 2033
7	Cooksville T1/T2 LTR	2030	2030	Beyond 2033
8	Cooksville T3/T4 LTR	2030	2029	Beyond 2033
9	Pleasant T1/T2 LTR*	2027	2026	Beyond 2033
10	Pleasant T5/T6 LTR	2026	2025	2027
11	Jim Yarrow T1/T2 LTR	2030	2028	Beyond 2033
12	Goreway T5/T6 LTR	2026	2025	2027
Additional capacity needs under high growth scenario				
13	Meadowvale TS LTR	Beyond 2033	2029	
14	Palermo TS LTR	Beyond 2033	2029	
15	Tremaine TS LTR	Beyond 2033	2029	
16	Tomken T1/T2 LTR	Beyond 2033	2031	
* The need can be addressed by transformer renewal with standard rating specification				

9. Conclusion and Recommendation

The Technical Working Group's recommendations to address the needs identified are as follows:

Table 8: Needs not Requiring Further Regional Coordination

No.	Need	Recommendation
1	Bramalea T3/T4 DESN LTR violation	Replace T3/T4 with higher rating during transformer renewal. Balance T3/T4 load with Bramalea T5/T6 as interim solution.
2	Pleasant T1/T2 DESN moderate LTR violation	Replace T1/T2 with standard LTR.
3	Lorne Park T1/T2 DESN moderate LTR violation	Replace T2 with standard LTR.

Table 9: Needs Requiring Further Regional Coordination

No.	Need
1	Transmission reinforcement at Milton area to accommodate large load connection requests including data centers and manage load security
2	Accommodate Halton TS load growth beyond LTRs
3	Accommodate Mississauga 27.6 kV load growth beyond LTRs at Cardiff T1/T2, Bramalea T1/T2 and Erindale T1/T2
4	Accommodate Mississauga 27.6kV load growth beyond LTRs at Cooksville T1/T2 and T3/T4
5	Accommodate Brampton 27.6 kV load growth beyond LTRs at Pleasant T5/T6 and Jim Yarrow T1/T2
6	Accommodate Brampton 27.6kV load growth beyond LTRs at Goreway T5/T6 and Bramalea T1/T2

List of LDC(s) to be involved in further regional planning activities:

- Alectra Utilities Co.
- Milton Hydro Distribution Inc.
- Halton Hills Hydro Inc.
- Oakville Hydro Electricity Distribution Inc.
- Burlington Hydro Inc.
- Hydro One Networks Inc. (Distribution)

10. References

[1] Hydro One, RIP Report GTA West 2022 (hydroone.com) (issue February 23, 2022)

[2] Ontario Energy Board, Load Forecast Guideline for Ontario (issue October 13, 2022)

[3] Independent Electricity System Operator, Ontario Resource and Transmission Assessment Criteria (issue 5.0 August 22, 2007)

[4] Ontario Energy Board, Transmission System Code (issue July 14, 2000 rev. August 2, 2023)

[5] Ontario Energy Board, Distribution System Code (issue July 14, 2000 rev. March 27, 2024)

[6] Independent Electricity System Operator, IRRP Report GTA West 2021.

Appendix A: Extreme Summer Weather Adjusted Net Load Forecast

Table A.1: GTA West Region – Non-coincident Normal Growth Net Load Forecast

Station	LTR (MW)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Bramalea T1/T2	193	134.7	139.5	144.6	149.9	156.4	170.2	182.7	**193.1**	**193.1**	**193.1**
Bramalea T3/T4	111[1]	**113.6**	115.1	114.6	119.1	122.7	126.0	126.4	127.3	128.8	130.4
Bramalea T5/T6	169	103.4	103.4	105.0	107.7	111.4	114.9	118.5	118.9	119.8	122.7
Bramalea Total	473	351.8	358.0	364.2	376.7	390.6	411.0	427.6	439.4	441.6	446.2
Cardiff	113	109.3	110.8	111.6	111.9	113.3	113.2	**113.2**	**113.2**	**113.2**	**113.2**
Erindale T1/T2	180	166.6	169.2	174.4	180.0	179.8	179.2	**180.3**	**180.3**	**180.3**	**180.3**
Erindale T3/T4	190	156.8	163.0	164.6	166.3	167.3	166.9	166.7	167.3	169.3	181.0
Erindale T5/T6	194	132.9	134.8	135.7	136.2	137.8	139.2	140.6	142.7	145.3	147.9
Erindale Total	564	456.3	467.0	474.8	482.5	484.8	485.2	487.6	490.3	495.0	509.2
Churchill Meadows	168	99.8	101.1	101.9	102.2	103.4	104.9	106.1	107.9	110.0	112.2
Cooksville T1/T2	117	50.7	51.4	51.8	51.9	64.1	78.3	**117.0**	**117.0**	**117.0**	**117.0**
Cooksville T3/T4	117	40.2	40.8	41.1	51.2	67.9	87.4	**116.6**	**116.6**	**116.6**	**116.6**
Cooksville Total	234	90.9	92.2	92.9	103.1	132.0	165.6	233.6	233.7	233.6	233.7
New gross loads to be served in Mississauga								21	71	165	277
CTS-1	75	20.0	21.5	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Glenorchy MTS	153	115.9	120.7	125.5	131.9	138.0	116.8	120.0	126.2	133.3	140.0
Goreway T1/T2	180	74.4	77.3	80.7	84.3	88.4	92.1	96.3	100.8	105.9	111.4
Goreway T5/T6	181	177.6	181.9	**181.3**	**181.3**	**181.3**	**181.3**	**181.3**	**181.3**	**181.3**	**181.3**
Goreway T4	73	26.9	27.0	27.2	27.3	27.6	27.7	27.9	28.3	28.8	29.3
Goreway Total	434	278.9	286.3	289.8	293.1	297.3	301.2	305.7	310.5	315.9	322.0
Halton TS	195	154.0	179.1	**195.2**	**195.2**	**195.1**	**195.1**	**195.1**	**195.1**	**195.1**	**195.1**
New Halton #2 (Gross)	187[2]	0	0	0	0	0	0	70.5	73.3	76.0	81.1
Halton Hills MTS	102	4.0	6.4	6.4	12.7	16.4	22.4	26.0	29.6	33.2	36.9
Jim Yarrow MTS	157	134.3	137.6	141.5	145.6	150.4	154.6	**157.0**	**157.0**	**157.0**	**157.0**
Lorne Park TS	144[1]	104.4	105.8	111.2	116.1	122.0	128.2	136.9	**146.1**	152.3	151.8
Meadowvale	188	125.1	127.5	140.3	141.2	154.5	166.3	170.3	173.8	178.7	182.6
Oakville	172	126.8	128.6	130.2	132.3	134.9	137.3	138.7	142.3	146.9	152.3
Palermo	187[3]	118.0	118.5	119.7	121.0	168.2	173.5	183.1	188.2	**191.8**	198.9
Pleasant T1/T2	155[1]	122.7	131.9	147.1	**156.3**	158.2	158.8	158.9	159.7	161.1	162.8
Pleasant T5/T6	187	181.8	186.2	**187.2**	**187.2**	**187.2**	**187.2**	**187.2**	**187.2**	**187.2**	**187.2**
Pleasant T7/T8	183	108.0	111.3	115.2	119.3	124.0	128.2	133.1	138.4	144.5	151.1
Pleasant Total	525[4]	412.5	429.4	449.5	462.8	469.6	474.3	479.2	485.3	492.9	501.0
New gross loads to be served in Brampton		0	0	0	0	0	0	32	46	124	159
Tomken T1/T2	165	150.8	151.8	152.7	154.3	156.7	157.6	159.0	161.1	164.8	165.3
Tomken T3/T4	192	118.3	118.9	120.5	122.2	126.4	129.2	131.3	133.1	133.4	134.8
Tomken Total	357	269.2	270.6	273.1	276.5	283.2	286.8	290.3	294.2	298.2	300.1
Trafalgar DESN	123	88.7	90.4	92.1	94.5	96.9	99.1	99.7	101.6	103.7	105.9
Tremaine	185	113.4	132.4	157.0	159.7	160.9	162.1	163.9	166.4	170.2	174.9
Total		3166	3277	3392	3474	3624	3710	3917	4032	4229	4379
Note	1. Capacity can be increased by transformer renewal with higher LTR 2. Assumption based on typical station, final LTR will be determined after the station is built 3. Assumption for upsized transformers, final LTR will be determined after transformers are delivered 4. Presently limited to 419 MW by upstream transmission lines H29/H30										

Table A.2 GTA West Region – Coincident Normal Growth Net Load Forecast

Station	LTR (MW)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Bramalea T1/T2	193	109.2	113.0	117.2	121.5	126.8	138.0	148.1	166.5	185.5	193.0
Bramalea T3/T4	111	94.2	95.4	95.0	98.8	101.7	104.4	104.8	105.6	106.8	108.1
Bramalea T5/T6	169	66.9	66.9	67.9	69.7	72.1	74.3	76.7	76.9	77.5	79.4
Bramalea Total	473	270.3	275.4	280.1	289.9	300.6	316.7	329.6	349.0	369.7	380.5
Cardiff	113	101.4	102.8	103.5	103.9	105.1	105.1	107.3	110.0	113.0	116.1
Erindale T1/T2	180	157.6	160.1	165.1	170.3	170.1	169.6	174.6	183.1	188.5	203.8
Erindale T3/T4	190	143.1	148.8	150.2	151.8	152.7	152.3	152.1	152.7	154.6	165.2
Erindale T5/T6	194	122.4	124.1	125.0	125.4	126.9	128.1	129.5	131.4	133.7	136.2
Erindale Total	564	423.2	433.0	440.3	447.5	449.6	450.0	456.2	467.2	476.8	505.2
Churchill Meadows	168	98.5	99.8	100.5	100.8	102.1	103.5	104.7	106.5	108.6	110.7
Cooksville T1/T2	117	47.5	48.2	48.5	48.7	60.1	73.4	116.2	143.0	160.7	192.1
Cooksville T3/T4	117	39.5	40.0	40.3	50.2	66.6	85.8	128.0	147.5	165.5	199.2
Cooksville Total	234	87.0	88.2	88.9	98.9	126.7	159.2	244.2	290.5	326.2	391.3
CTS-1	75	20.0	21.5	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Glenorchy MTS	153	114.6	118.5	122.6	127.6	132.3	111.0	112.9	118.2	124.4	130.3
Goreway T1/T2	180	70.1	72.9	76.1	79.5	83.4	86.8	90.8	95.0	99.8	105.1
Goreway T5/T6	181	176.2	180.5	185.7	191.0	197.3	202.8	209.3	216.4	224.8	233.9
Goreway T4	73	23.0	23.1	23.2	23.3	23.5	23.7	23.9	24.2	24.6	25.0
Goreway Total	434	269.3	276.5	285.0	293.8	304.2	313.3	324.0	335.6	349.2	363.9
Halton TS & #2	195	141.6	164.6	195.3	195.3	195.3	195.3	255.7	257.8	259.8	264.0
Halton Hills MTS	102	4.0	6.3	6.3	12.2	15.7	21.3	24.4	27.7	31.0	34.3
Jim Yarrow MTS	157	128.6	131.7	135.5	139.4	143.9	148.0	152.7	157.9	164.0	170.6
Lorne Park TS	144	85.9	87.1	91.5	95.6	100.4	105.5	112.7	120.2	125.3	124.9
Meadowvale	188	103.3	105.2	115.7	116.5	127.5	137.2	140.5	143.4	147.4	150.6
Oakville	172	114.4	116.0	117.4	119.4	121.7	123.8	125.1	128.4	132.5	137.4
Palermo	187	117.0	117.5	118.7	119.9	166.7	172.0	181.5	186.6	190.2	197.2
Pleasant T1/T2	155	115.6	124.2	138.5	147.2	149.0	149.5	149.6	150.4	151.7	153.3
Pleasant T5/T6	187	180.1	184.5	189.8	195.3	201.7	207.3	214.0	221.3	229.8	239.1
Pleasant T7/T8	183	99.3	102.3	105.9	109.6	114.0	117.9	122.4	127.2	132.8	138.8
Pleasant Total	525	395.0	411.0	434.2	452.1	464.7	474.7	486.0	498.9	514.3	531.3
Tomken T1/T2	165	149.1	150.1	150.9	152.6	155.0	155.8	157.2	159.3	162.9	163.5
Tomken T3/T4	192	107.2	107.7	109.1	110.7	114.5	117.0	118.9	120.5	120.8	122.1
Tomken Total	357	256.3	257.7	260.0	263.2	269.5	272.8	276.1	279.8	283.8	285.6
Trafalgar DESN	123	86.8	88.4	90.1	92.5	94.8	97.0	97.6	99.4	101.5	103.7
Tremaine	185	109.3	127.5	151.2	153.8	155.0	156.1	157.9	160.3	163.9	168.5
Total		2926	3029	3159	3244	3398	3484	3711	3859	4004	4188

Appendix B: Lists of Step-Down Transformer Stations

No.	Transformer Station		Voltage (kV)	Supply Circuits
1	Bramalea TS (Alectra)	T1/T2	230/27.6	V41H/V42H
		T3/T4	230/44	
		T5/T6	230/44	
2	Cardiff TS (Alectra)	T1/T2	230/27.6	V41H/V42H
3	Churchill Meadows TS (Alectra)	T1/T2	230/44	R19TH / R21TH
4	Cooksville TS (Alectra)	T1/T2	230/27.6	B16C/K21C
		T3/T4	230/27.6	
5	Erindale TS (Alectra)	T1/T2	230/27.6	R14T / R17T
		T3/T4	230/44	
		T5/T6	230/44	R19TH / R21TH
6	CTS-1	T1/T2	230/27.6	B15C / B16C
7	Glenorchy MTS (Oakville Hydro)	T1/T2	230/27.6	T36B / T37B
8	Goreway TS (Alectra)	T1/T2	230/27.6	V42H / V43
		T5/T6	230/27.6	
		T4	230/44	V43
9	Jim Yarrow MTS (Alectra)	T1/T2	230/27.6	R19TH / R21TH
10	Halton Hills MTS (Halton Hills Hydro)	T4/T5	230/27.6	T38B/T39B
11	Halton TS (Milton Hydro, Halton Hills Hydro)	T3/T4	230/27.6	T38B/T39B
12	Lorne Park TS (Alectra)	T1/T2	230/27.6	B15C / B16C
13	Meadowvale TS (Alectra)	T1/T2	230/44	T38B / T39B
14	Oakville TS (Alectra, Oakville Hydro)	T5/T6	230/27.6	B15C / B16C
15	Palermo TS (Oakville Hydro, Milton Hydro, Burlington Hydro)	T3/T4	230/27.6	T36B / T37B
16	Pleasant TS (Alectra, HONI, Halton Hills Hydro)	T1/T2	230/44	H29 / H30
		T5/T6	230/27.6	
		T7/T8	230/27.6	
17	Tomken TS (Alectra)	T1/T2	230/44	R14T/R17T
		T3/T4	230/44	R19TH/R21TH
18	Trafalgar DESN (Oakville Hydro)	T1/T2	230/27.6	T38B/T39B
19	Tremaine TS (Milton Hydro, Burlington Hydro)	T1/T2	230/27.6	T38B/T39B

Appendix C: Lists of Transmission Circuits

No.	Connecting Stations	Circuit ID	Voltage (kV)
1	**Hurontario SS***, Pleasant TS	H29/H30	230
2	**Richview TS*, Trafalgar TS*,** Tomken TS, Erindale TS	R14T/R17T	230
3	**Richview TS*, Trafalgar TS*, Hurontario SS*,** Churchill Meadows TS, Erindale TS, Jim Yarrow MTS, Tomken TS	R19TH/R21TH	230
4	**Trafalgar TS*, Burlington TS*,** Palermo TS, Glenorchy MTS,	T36B/T37B	230
5	**Trafalgar TS*, Burlington TS*,** Tremaine TS, Trafalgar DESN, Meadowvale TD, Halton TS, **TCE Halton Hills CGS***, Halton Hills MTS	T38B/ T39B	230
6	**Claireville TS* Hurontario SS***, Cardiff TS, Bramalea TS, **Sithe Goreway CGS*,** Goreway TS	V41H/V42H	230
7	**Cooksville TS*,** Lorne Park TS, CTS-1, Oakville TS	B15C/B16C	230
8	**Manby TS*, Cooksville TS***	K21C/K23C	230
9	**Claireville TS*,** Goreway TS	V43	230
10	**Richview TS*, Cooksville TS***	R24C	230
*: terminal stations, others are stations tapped to the circuits			

Appendix D: List of LDC's

No.	Name of LDC
1	Alectra Utilities Co.
2	Burlington Hydro Inc.
3	Halton Hills Hydro Inc.
4	Milton Hydro Distribution Inc.
5	Oakville Hydro Electricity Distribution Inc.
6	Hydro One Networks Inc. (Distribution)

Appendix E: List of Municipalities in the region

No.	Name of Municipality
1	Brampton
2	Burlington
3	Caledon
4	Halton Hills
5	Milton
6	Mississauga
7	Oakville

Appendix F: Acronyms

Acronym	Description
CDM	Conservation and Demand Management
CEP	Community Energy Plan
CIA	Customer Impact Assessment
CGS	Customer Generating Station
CTS	Customer Transformer Station
DESN	Dual Element Spot Network
DG	Distributed Generation
DS	Distribution Station
GS	Generating Station
HV	High Voltage
IESO	Independent Electricity System Operator
IRRP	Integrated Regional Resource Plan
KOP	Key Operating Point
kV	Kilovolt
LDC	Local Distribution Company
LTE	Long Term Emergency
LP	Local Plan
LTR	Limited Time Rating
LV	Low Voltage
MEP	Municipal Energy Plan
MTS	Municipal Transformer Station
MW	Megawatt
MVA	Mega Volt-Ampere
MVAR	Mega Volt-Ampere Reactive
MVGIS	Medium Voltage Gas Insulated Switchgear
NA	Needs Assessment
OEB	Ontario Energy Board
ORTAC	Ontario Resource and Transmission Assessment Criteria
PF	Power Factor
PPWG	Planning Process Working Group
RIP	Regional Infrastructure Plan
SA	Scoping Assessment
SS	Switching Station
TS	Transformer Station