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NEEDS ASSESSMENT REPORT

GTA North Region

Date: July 14, 2023

Prepared by: GTA North Region Technical Working Group



Disclaimer

This Needs Assessment Report was prepared for the purpose of identifying potential needs in the GTA North Region and to recommend which need: a) does not require further regional coordination and b) identify needs requiring further assessment and/or regional coordination. The results reported in this Needs Assessment are based on the input and information provided by the Technical Working Group (“TWG”) for this region.

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Executive Summary

| | | | |
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| Region | GTA North Region (the “Region”) | | |
| Lead | Hydro One Networks Inc. (“Hydro One”) | | |
| Start Date | March 17, 2023 | End Date | July 14, 2023 |
| 1. INTRODUCTION | | | |
| <p>The second Regional Planning (“RP”) cycle for the GTA North Region was completed in October 2020 with the publication of the Regional Infrastructure Plan (“RIP”) report. This is the third RP cycle for this Region, which begins with the Needs Assessment (“NA”) phase. The purpose of this NA is to:</p> <ol style="list-style-type: none"> a) Identify any new needs and reaffirm needs identified in the previous RP cycle; and b) Recommend which needs: <ol style="list-style-type: none"> i. require further assessment and regional coordination (and hence, proceed to the next phases of RP); and ii. do not require further regional coordination (i.e., can be addressed directly between Hydro One and the impacted Local Distribution Companies (“LDC”) to develop a preferred plan, or no regional investment is required at this time and the need may be reviewed during the next RP cycle. | | | |
| 2. REGIONAL ISSUE/TRIGGER | | | |
| <p>In accordance with the RP process, the RP cycle should be triggered at least once every five years. Considering these timelines, the third Regional Planning cycle was triggered in March 2023 for the GTA North Region.</p> | | | |
| 3. SCOPE OF NEEDS ASSESSMENT | | | |
| <p>The scope of the GTA North Region NA includes:</p> <ol style="list-style-type: none"> a) Reaffirm and update needs/plans identified in the previous RP cycle; b) Identify any new needs resulting from this assessment. c) Recommend which need(s) require further assessment and regional coordination in the next phases of the RP cycle; and d) Recommend which needs 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, or no regional investment is required at this time and the need may be reviewed during the next RP cycle). <p>The Technical Working Group (“TWG”) may also identify additional needs during the next phases of the planning process, namely Scoping Assessment (“SA”), Integrated Regional Resource Plan (“IRR”) and RIP, based on updated information available at that time.</p> <p>The planning horizon for this NA is 10 years.</p> | | | |
| 4. INPUTS/DATA | | | |
| <p>The TWG representatives from LDCs, the Independent Electricity System Operator (“IESO”), and Hydro One provided input and relevant information for the GTA North Region regarding capacity needs, system reliability needs, operational issues, and major high-voltage (“HV”) transmission assets requiring replacement over the planning horizon.</p> <p>The provincial push towards decarbonization as outlined in the IESO’s “Pathways to Decarbonization” report published on December 15, 2022, is expected to impact the electricity demand over the longer term. As a result, the electricity demand, and the need for new infrastructure over the longer term could be higher than previously anticipated or as discussed in this report. The impact of decarbonization will be considered during the next phases of this regional planning cycle.</p> | | | |

5. ASSESSMENT METHODOLOGY

The assessment’s primary objective is to identify the electrical infrastructure needs in the Region over the study period. The assessment methodology includes a review of planning information such as load forecast, conservation, and demand management (“CDM”) forecast, available distributed generation (“DG”) information, system reliability and operation issues, and major HV transmission assets requiring replacement.

A technical assessment of needs was undertaken based on:

- a) Station capacity and transmission adequacy;
- b) System reliability and any operational concerns;
- c) Major HV transmission equipment requiring replacement with consideration to “right-sizing”; and
- d) Sensitivity analysis to capture uncertainty in the load forecast and variability of demand drivers such as electrification.

6. NEEDS

Needs that were identified in the last RP cycle with current need dates are as follows:

- New Markham MTS #5 – need date is 2028
- Uprate 230kV circuits P45/46 from Parkway TS to Markham MTS #4 Jct. – need date is 2028
- New Northern York TS - need date is 2027
- Woodbridge TS: Replace transformer T5 with similar and size equipment as per current standard – need date is 2027
- New Vaughan MTS #5 – need date is 2030
- Claireville TS x Brown Hill TS Transmission circuit capacity need – need date is 2030
- Load Restoration and/or Security needs for 230kV circuits V43/V44, H82V/H83V, and V71P/V75P – Existing need¹

New needs identified in this NA are:

- Kleinburg TS 44kV: Load transfer to Northern York TS – need date is 2027
- New Vaughan MTS #6 – need date is 2027
- New Toubner TS (CTS) – need date is 2027
- New Richmond Hill MTS #3 – need date is 2032
- Load Restoration needs for 230kV circuits P45/P46 – need date is 2027

7. RECOMMENDATIONS

The TWG’s recommendations are as follows:

- a) No further regional coordination is required for the following need and work will be proceeding as planned:
 - Woodbridge TS: Replace transformer T5
 - Toubner TS: Build new station
 - Vaughan MTS #6: Build new station
- b) Further assessment and regional coordination is required in the next phases of the RP cycle to review and/or develop a preferred plan for the follow needs:
 - Kleinburg TS 44kV: Load transfer to Northern York TS
 - Markham MTS #5: Build new station
 - 230kV circuit P45/P46: Uprate circuits between Parkway TS and Markham MTS #4 Jct.
 - Northern York TS: Build new station
 - Vaughan MTS #5: Build new station
 - Richmond Hill MTS #3: Build new station
 - Claireville TS x Brown Hill TS Transmission circuit capacity need and load restoration needs
 - Load Restoration and/or Security needs for 230kV circuits V43/V44, H82V/H83V, P45/P46, and V71P/V75P

1. No action considered was considered necessary in the last regional planning cycle

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1 INTRODUCTION

The second cycle of the Regional Planning (“RP”) process for the GTA North Region was completed in October 2020 with the publication of the Regional Infrastructure Plan (“RIP”) report.

This is the third RP cycle for this Region, which begins with the Needs Assessment (“NA”) phase. The purpose of this Needs Assessment (“NA”) is to identify new needs in the region, reaffirm and update previously identified needs in the last GTA North RP cycle, and recommend which needs require further assessment and regional coordination.

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

Table 1-1: GTA North Region TWG Participants

| Company |
|--------------------------------------------------|
| Alectra Utilities Corporation |
| Hydro One Networks Inc. (Distribution) |
| Independent Electricity System Operator (“IESO”) |
| Newmarket-Tay Power Distribution Ltd |
| Toronto Hydro-Electric System Limited (“THESL”) |
| Hydro One Networks Inc. (Lead Transmitter) |

2 REGIONAL ISSUE/TRIGGER

In accordance with the RP process, the RP cycle should be triggered at least once every five years. Considering these timelines, the third RP cycle was triggered for the GTA North Region.

3 SCOPE OF NEEDS ASSESSMENT

The scope of this NA covers the GTA North Region and includes:

- Reaffirm and update needs/plans identified in the previous RP cycle.
- Identify any new needs resulting from this assessment.
- Recommend which need(s) require further assessment and regional coordination in the next phases of the RP cycle; and
- Recommend which need(s) that 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, or no regional investment is required at this time and the need may be reviewed during the next RP cycle).

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

4 REGIONAL DESCRIPTION AND CONNECTION CONFIGURATION

The GTA North Region is comprised of the Northern York Area, Southern York Area, and the Western Area. Electrical supply to the region is provided from sixteen 230kV step-down transformer stations. The 2022 Summer Peak area load of the region was approximately 2249MW. Please refer to Figure 4-1.

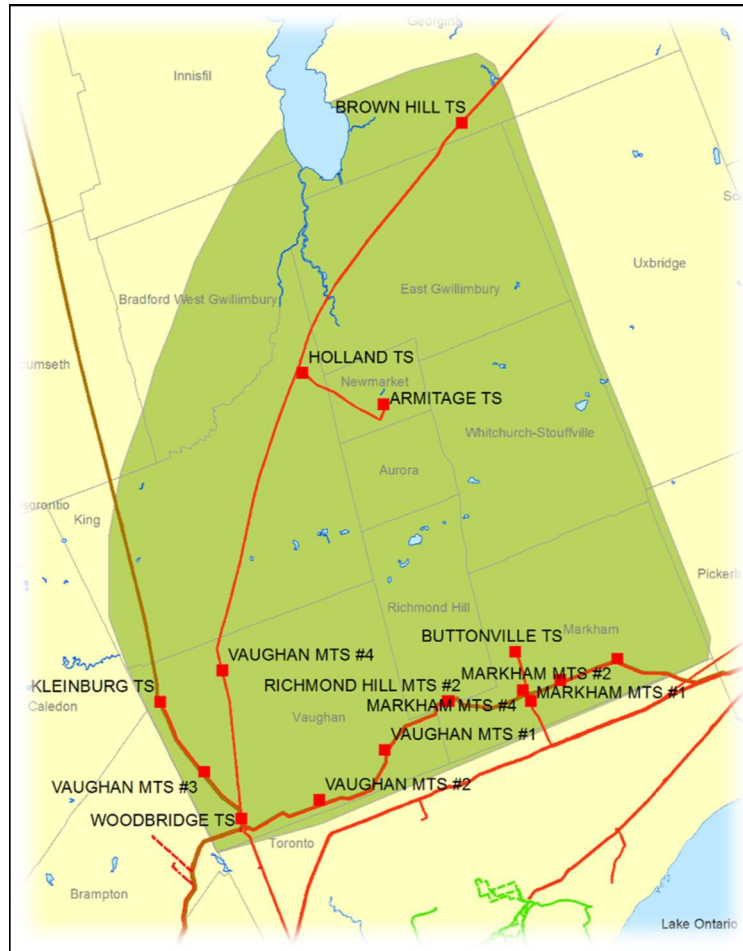


Figure 4-1: GTA North Region Map

Electrical supply to the GTA North Region is primarily provided from three major 500/230 kV autotransformer stations, namely Claireville TS, Parkway TS, and Cherrywood TS, and a 230 kV transmission network supplying the various step-down transformation stations in the region. Local generation in the Region consists of the 393 MW York Energy Centre connected to the 230 kV circuits B88H/B89H in King Township. Please refer to Figure 4-2.

The Northern York Area encompasses the municipalities of Aurora, Newmarket, King, East Gwillimbury, Whitchurch-Stouffville and Georgina, as well as some load in Simcoe County that is supplied from the same electricity infrastructure. It is supplied by Claireville TS, a 500/230 kV autotransformer station, and

three 230 kV transformer stations stepping down the voltage to 44 kV. The York Energy Centre provides a local supply source in Northern York Area. The LDCs supplied in the Northern York Area are Hydro One Distribution, Newmarket-Tay Power Distribution, and Alectra.

The Southern York Area includes the municipalities of Vaughan, Markham, and Richmond Hill. It is supplied by three 500/230 kV autotransformer stations (Claireville TS, Parkway TS, and Cherrywood TS), nine 230 kV transformer stations (includes eight LDC owned stations and one Hydro One owned) stepping down the voltage to 27.6 kV, and one other direct transmission connected load customer. The LDC supplied in the Southern York Area is Alectra.

The Western Area comprises the Western portion of the municipality of Vaughan. Electrical supply to the area is provided through Claireville TS, a 500/230 kV autotransformer station, and a 230 kV tap (namely, the “Kleinburg tap”) that supplies three 230 kV transformer stations (including one LDC owned transformer station) stepping down the voltage to 44 kV and 27.6 kV. The LDCs directly supplied are Alectra and Hydro One Distribution. Embedded LDCs include Alectra and Toronto Hydro.

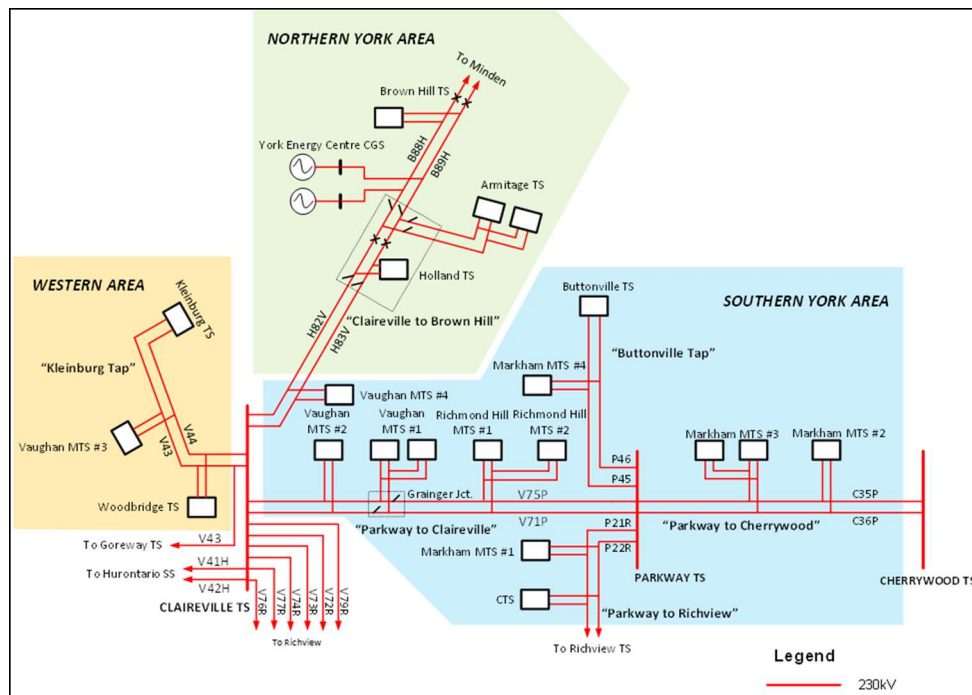


Figure 4-2: GTA North Region– Single Line Diagram

The transformer stations and circuits in the area are listed in Appendix A and Appendix B.

5 INPUTS AND DATA

TWG participants, including representatives from LDCs, IESO, and Hydro One provided information and input for the GTA North Region NA. The information provided includes the following:

- Load Forecast for all supply stations in the GTA North Region.
- Known capacity and system reliability needs, operational issues, and/or major HV transmission equipment requiring replacement over the study period; and
- Planned/foreseen transmission and distribution investments that are relevant to the GTA North RP process.

In December 2022, the IESO published a report¹ on developing an achievable pathway to the decarbonization of the electricity system. As a result, the electricity demand, and the need for new infrastructure over the longer term could be higher than anticipated or discussed in this report. The impact of the decarbonization and resulting electrification will be considered during the next phase of this regional planning cycle.

6 ASSESSMENT METHODOLOGY

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

- Load forecast: The LDCs provided their load forecast for all the stations supplying their loads in the GTA North Region for the 10-year study period. The IESO provided a Conservation and Demand Management (“CDM”) forecast and Distributed Generation (“DG”) contract information for the Toronto Region. The region’s extreme summer non-coincident peak gross load forecast for each station was prepared by applying the growth rates from the LDC load forecast to the actual 2022 summer peak extreme weather corrected loads. The extreme summer weather correction factor was provided by Hydro One. The net extreme weather summer load forecast was produced by reducing the gross load forecast for each station by the percentage CDM from the IESO for that station. The extreme summer weather corrected net non-coincident peak for the individual stations in the GTA North Region are given in Appendix C.
- Relevant information regarding system reliability and operational issues in the region;
- List of major HV transmission equipment planned and/or identified to be replaced based on asset condition assessment, and relevant for RP purposes. The scope of equipment considered is given in Section 7.1.

A technical assessment of needs was undertaken based on:

- Station capacity and transmission adequacy assessment.
- System reliability and operational considerations.

¹ [IESO Report, "Pathways-to-Decarbonization", Dec15, 2022](#)

- Asset renewal for major HV transmission equipment requiring replacement with consideration to “right-sizing”; and
- Sensitivity analysis to capture uncertainty in the load forecast

The following other assumptions are made in this report.

- The study period for this NA is 2023-2032.
- Coincident loads have been assumed equal to non-coincident loads for the purpose of transmission line adequacy assessment.
- 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 having no low-voltage (LV) capacitor banks and 95% lagging power factor for stations having LV 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).

7 ADEQUACY OF EXISTING FACILITIES

This section provides a review of the adequacy of the transmission lines and stations in the GTA North Region. The adequacy is assessed using the latest extreme weather peak summer regional load forecast provided in Appendix C.

7.1 Adequacy of Northern and Southern York Area Facilities

7.1.1 500 and 230 kV Transmission Facilities

All 500 and most 230 kV transmission circuits in the GTA North are classified as part of the Bulk Electricity System (“BES”). The 230 kV circuits also serve local area stations within the region. The Northern and Southern York Areas are comprised of the following 230 kV circuits. Refer to Figure 4-2.

Northern York Area:

- Claireville TS to Holland TS 230 kV circuits: H82V and H83V.
- Holland TS to Brown Hill TS 230 kV circuits: B88H and B89H.

Southern York Area:

- Parkway TS to Cherrywood TS 230 kV circuits: C35P and C36P.
- Parkway TS to Claireville TS 230 kV circuits: V71P and V75P.
- Parkway TS to Buttonville TS (“Buttonville Tap”) 230 kV circuits: P45 and P46².
- Parkway TS to Richview TS 230 kV circuits: P21R and P22R.

Western Area:

- Claireville TS to Kleinburg TS 230 kV circuits: V43 and V44³

The NA review shows that all flows on all transmission lines are within rating during the 2023-2032 study period except for the Claireville x Brown Hill corridor and the Parkway TS to Buttonville TS line. These are discussed below:

- 1) Loading on the Claireville TS to Brown Hill TS 230kV Corridor comprising the double circuit line H82/H3V and B88H/B89H will exceed the thermal limits by summer 2030.

² Radial from Parkway TS

³ Radial from Claireville TS

Table 7-1 Loading on Claireville TS x Brown Hill TS Corridor

| Transformer Station | Limit MW | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | Need Date |
|-----------------------|----------|------|------|------|------|------|------|------|------|------|------|-----------|
| Armitage TS (44kV) | | 285 | 290 | 296 | 301 | 305 | 303 | 305 | 308 | 311 | 313 | |
| Brown Hill TS (44kV) | | 94 | 100 | 118 | 121 | 125 | 124 | 125 | 125 | 126 | 126 | |
| Holland TS (44kV) | | 166 | 173 | 176 | 179 | 169 | 169 | 169 | 169 | 169 | 169 | |
| Northern York Station | | | | | | 66 | 80 | 89 | 99 | 109 | 118 | |
| Vaughan MTS #4 (28kV) | | 101 | 100 | 128 | 149 | 148 | 147 | 146 | 145 | 143 | 142 | |
| Vaughan MTS #5 (28kV) | | | | | | | | | 64 | 132 | 138 | |
| Total | 850 | 646 | 663 | 718 | 750 | 813 | 823 | 834 | 911 | 989 | 1007 | 2030 |

- 2) Loading on the Parkway TS x Markham MTS #4 Jct. section of the 230kV Parkway TS x Buttonville TS double circuit Line P45/P46 will exceed the rating of line by summer 2028

Table 7-2 Loading on the Parkway TS x Markham MTS #4 Jct. Section of 230kV Line P45/P46

| Transformer Station | Limit MW | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | Need Date |
|-----------------------|----------|------|------|------|------|------|------|------|------|------|------|-----------|
| Buttonville TS (28kV) | | 144 | 152 | 154 | 152 | 160 | 149 | 148 | 147 | 146 | 145 | |
| Markham MTS #4(28kV) | | 116 | 117 | 141 | 162 | 191 | 177 | 175 | 174 | 173 | 171 | |
| Markham MTS #5(28kV) | | | | | | | 68 | 136 | 140 | 139 | 138 | |
| Toubner TS (28kV) | | | | | | 32 | 31 | 50 | 52 | 55 | 72 | |
| Total | 420 | 260 | 269 | 294 | 314 | 384 | 425 | 509 | 513 | 513 | 526 | 2028 |

7.1.2 Step down Transformer Station Facilities

There are a total of fifteen Hydro One and LDC owned step-down transformers stations and one direct transmission connected industrial customer owned station in the GTA North Region as given in Table 7-3 Step-Down Transformer Stations in the GTA North Region below:

Table 7-3 Step-Down Transformer Stations in the GTA North Region

| Northern York Area | | |
|-----------------------------|-----------------------------|--------------------------------|
| Armitage TS | Brown Hill TS | Holland TS |
| Southern York Area | | |
| Buttonville TS | Markham MTS #1 ¹ | Markham MTS #2 ¹ |
| Markham MTS #3 ¹ | Markham MTS #4 ¹ | Richmond Hill MTS ¹ |
| Vaughan MTS #1 ¹ | Vaughan MTS #2 ¹ | Vaughan MTS #4 ¹ |
| Industrial Customer | | |
| Western Area | | |
| Kleinburg TS | Vaughan MTS #3 ¹ | Woodbridge TS |

1. Stations owned by Alectra

The loadings on these stations were reviewed. Based on the forecast in Appendix C, additional capacity is required in the Northern York, Markham, and Vaughan areas starting in 2027. The station loading in each area and the associated station capacity and need dates are summarized in Table 7-.

Table 7-4 Adequacy of the Step-Down Transformation Facilities in the GTA North Region

| Area/Supply | LTR-Capacity (MW) | 2023 Summer Forecast (MW) | Need Date |
|-------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------------|-------------------|
| Northern York Area (Armitage TS, Holland TS) | 485 | 452 | 2027 |
| Northern York Area (Brown Hill) | 184 | 94 | - |
| Markham / Richmond Hill transformation Capacity (Buttonville TS, Markham MTS #1, 2, 3, 4, and Richmond Hill MTS #1, 2) ¹ | 957 | 847 | 2028 |
| Vaughan Transformation Capacity (Vaughan MTS #1, 2, 4) | 612 | 551 | 2030 |
| Vaughan Transformation Capacity (Vaughan MTS #3) ² | 153 | 145 | 2027 |
| Kleinburg Area (Kleinburg TS 44kV) | 97 | 102 | Note ³ |
| Woodbridge TS (44kV) | 80 | 85 | Note ⁴ |

1. Two stations required Markham MTS #5 in 2028 and Richmond Hill MTS #3 in 2032
2. Vaughan MTS #6 is a station dedicated for a large customer.
3. Excess load to be transferred to Northern York TS when new station complete in 2027
4. Loads to be managed by Hydro One Distribution

7.2 Asset Renewal Needs

No asset renewal needs have been identified in the GTA North Region over the current study period other than replacement of transformer T5 at Woodbridge TS listed in the 2020 RIP.

7.3 Load Restoration and Load Security Needs

Load Restoration and /or security needs were identified for the V43/V44, H82V/H83V, and V71P/V75P circuits in the 2020 RIP. One new load restoration need has been identified for the P45/P46 circuits. The needs and the recommended plan to address them are summarized below:

1. Load restoration following loss of the Claireville TS x Kleinburg TS 230kV circuits (V43/V44).

Not all loads more than 250 MW and 150 MW can be restored within 30 minutes and 4 hours respectively, as per the ORTAC restoration criteria. The RIP recommended that this need would be addressed as part of the longer-term plan to reinforce the Claireville TS to Kleinburg TS corridor. No further action was proposed at the time. This will be re-visited in the next phase of this RP cycle.

2. Load Restoration following loss of the Claireville TS to Holland TS circuits (H82V/H83V).

All loads exceeding 250 MW cannot be restored within 30 minutes per the ORTAC criteria. Following the loss of H82V/H83V, the normal station service supply to YEC generation is also lost. Holland TS cannot be restored from B88H/B89H until YEC generation is restored. Transferring YEC to an alternate source of station service supply cannot be completed within 30 minutes. The RIP had recommended that the IESO pursue alternative station service configurations at YEC to facilitate faster restoration of load on H82V/H83V, consistent with the load restoration criteria. This will be re-visited in the next phase of this regional planning cycle.

3. Load Security Need for the Parkway TS to Claireville TS 230kV double circuit Line V71P/V75P

The loss of this line can result in an interruption to over the 600MW which is more than what is permitted under the ORTAC criteria. The RIP had recommended that no further action is required. While the load security criteria was not met, Hydro One has installed inline switches at Grainger Jct. – located just outside of Vaughan MTS #1 - which permits quick restoration of the loads. This will be re-visited in the next phase of this regional planning cycle.

4. Load Restoration Need for the Parkway TS to Buttonville TS 230kV double circuit Line P45/P46

The line loading is expected to reach 384MW by summer 2027. Not all loads more than 250 MW and 150 MW can be restored within 30 minutes and 4 hours respectively for a double circuit outage, as per the ORTAC restoration criteria. This is a new need and will be reviewed in the next phase of this regional planning cycle.

8 NEEDS

This section identifies any new needs in the GTA North Region and reaffirms and provides an update on the needs already identified in the previous RIP.

Table 8-1 Near and Medium Terms Needs in the GTA North Region

| No. | Need | Recommended Action Plan | Need Date ¹ |
|------------------------------------|------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------------------|
| Needs as per last RIP ² | | | |
| 1 | Northern York Area: Step-down Transformation Capacity | Build new Northern York Station | 2027 |
| 2 | Woodbridge TS: End-of-life of transformer T5 | Replace the end-of-life transformer with similar type and size equipment as per current standard | 2027 |
| 3 | Markham Area: Step-down Transformation Capacity | Build new Markham #5 MTS and connect to 230kV circuits P45/P46 | 2028 |
| 4 | Increase Capability of 230kV Circuits P45+P46 (supply Buttonville TS, Markham #4 MTS, and future Markham #5 MTS) | Uprate circuits P45/46 from Parkway to Markham MTS #4 Jct. | 2028 |
| 5 | Vaughan Area: Step-down Transformation Capacity | Build new Vaughan MTS #5 | 2030 |
| 6 | Claireville X Brownhill Circuit Upgrade | Uprate circuits- H82/H3V and B88H/B89H | 2030 |
| 7 | Load Restoration and/or Security needs for 230kV circuits V43/V44, H82V/H83V, and V71P/V75P ³ | To be reviewed in next phase of this regional planning cycle | Existing |
| New Needs identified | | | |
| 8 | Kleinburg TS Area | Transfer load to Northern York TS | 2027 |
| 9 | Vaughan Area: Step-down Transformation Capacity | Build new Vaughan MTS #6 and connect to 230kV circuit V43/V44 | 2027 |
| 10 | Markham Area: New Customer Connection | Build New Toubner TS and line tap to 230kV circuits P45/46 | 2027 |
| 11 | Richmond Hill Area: Step-down Transformation Capacity | Build new Richmond Hill #3 MTS | 2032 |
| 12 | Load Restoration for 230kV circuits P45/46 | To be reviewed in next phase of this regional planning cycle | 2027 |

1. Need date based on current forecast

2. Please see Reference 1 in Section 11

3. No action was considered necessary for these needs in the last regional Planning cycle. Needs will be reviewed again in the IRRP and RIP phases of this regional planning cycle.

8.1 Station and Transmission Capacity Needs in the Near and Medium Term

As shown in the Table above, the 2020 RIP had identified three new station capacity needs, one in the Markham area designated as Markham MTS #5, the second in the Vaughan Area, designated as Vaughan MTS #5 and the third in the Northern York Area, designated as Northern York TS. Since then, based on

the current load forecast and customers' request, the need for three additional stations has been identified over the study period - Richmond Hill MTS #3, Vaughan MTS #6 and Toubner TS.

8.1.1 Markham Area - Build Markham MTS #5 and Uprate circuits P45/P46 -2028

Markham MTS #5 was previously identified to provide additional step-down transformation capacity in Markham-Richmond Hill area and planned to be built adjacent to the Buttonville TS and supplied from the same 230kV Parkway TS x Buttonville TS circuits P45/P46 (See Figure 8-1 below). The new station will have 2 x75/125MVA, 230/27.6kV transformers and a 27.6kV switchgear building.

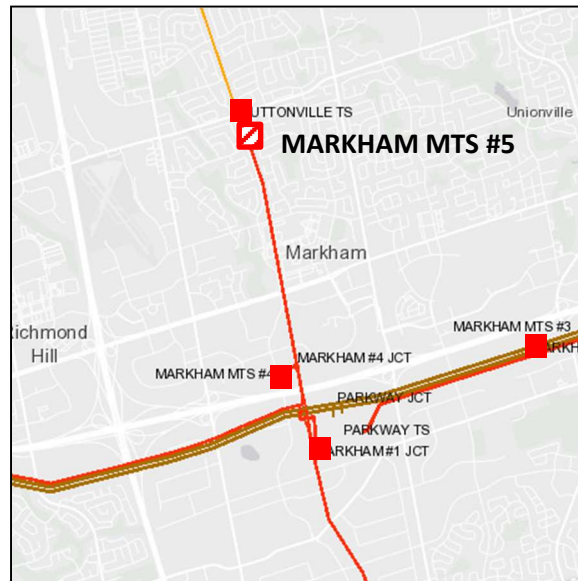


Figure 8-1: Markham MTS #5 Location

The TWG reaffirmed the need to build the new Markham MTS #5 and to uprate the limiting section of the P45/P46 line between Parkway TS and Markham MTS #4 Jct. to provide the needed capacity. The station project need date based on current forecast is summer 2028 (See Table 7-4) and the lines project need date is summer 2028 (see Table 7-2). This will be re-visited in the next phase of this regional planning cycle.

8.1.2 Northern York Region - Build Northern York Area TS and supply from 230kV Line B88H/B89H - 2027

The Northern York Area TS was recommended to be built in the Northern York Region to provide additional step-down transformation capacity in the Bradford, East Gwillimbury, and Newmarket area. This area is currently supplied from Armitage TS and Holland TS and total area load is forecast to exceed the capacity of these existing two stations by summer 2027 as shown in Table 8-2 below.

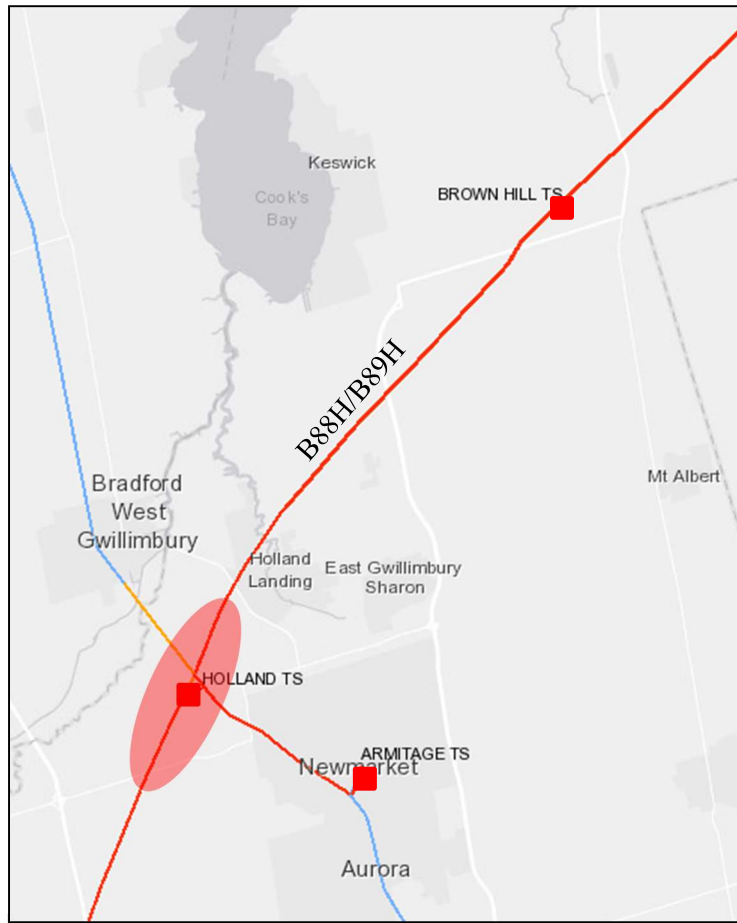


Figure-8-2 Northern York Area TS – Potential Location

Table 8-2: Northern York Area Capacity Need

| Transformer Station | LTR | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|--------------------------------|-----|------|------|------|------|------|------|------|------|------|------|
| Armitage TS (44kV) | 317 | 285 | 290 | 296 | 301 | 305 | 303 | 305 | 308 | 311 | 313 |
| Holland TS (44kV) ¹ | 169 | 166 | 173 | 176 | 179 | 169 | 169 | 169 | 169 | 169 | 169 |
| Northern York Station | 170 | | | | | 66 | 80 | 89 | 99 | 109 | 118 |
| Total | 485 | 451 | 463 | 472 | 480 | 540 | 552 | 564 | 577 | 589 | 600 |

1. Holland load above LTR to be transferred to new Northern York station.

The TWG has reaffirmed the need for building a new station close to these two stations, in the area shown in Figure 8-2. The new station is planned to be supplied from 230kV double circuit line H82V/H83V or B88H/B89H and planned to have 2x75/125MVA, 230/44-27.6kV transformers and 27.6kV and 44kV switchyards. The new station should increase the transformation capacity in Northern York Region by about 170 MW. The station location and timing will be further discussed with the area LDCs in the next phase of the regional planning process.

8.1.3 Vaughan Area – Build Vaughan MTS #5 and supply from 230kV Line H82V/H83V -2030

The Vaughan MTS #5 was previously identified to provide additional step-down transformation capacity in Vaughan area and planned to be built adjacent to the existing Vaughan MTS #4 – see Figure 8-3. The new station is planned to have 2 x75/125MVA, 230/27.6kV transformers, a 27.6kV switchgear building and is planned to be supplied from the 230kV double circuit line H82V/H83V.

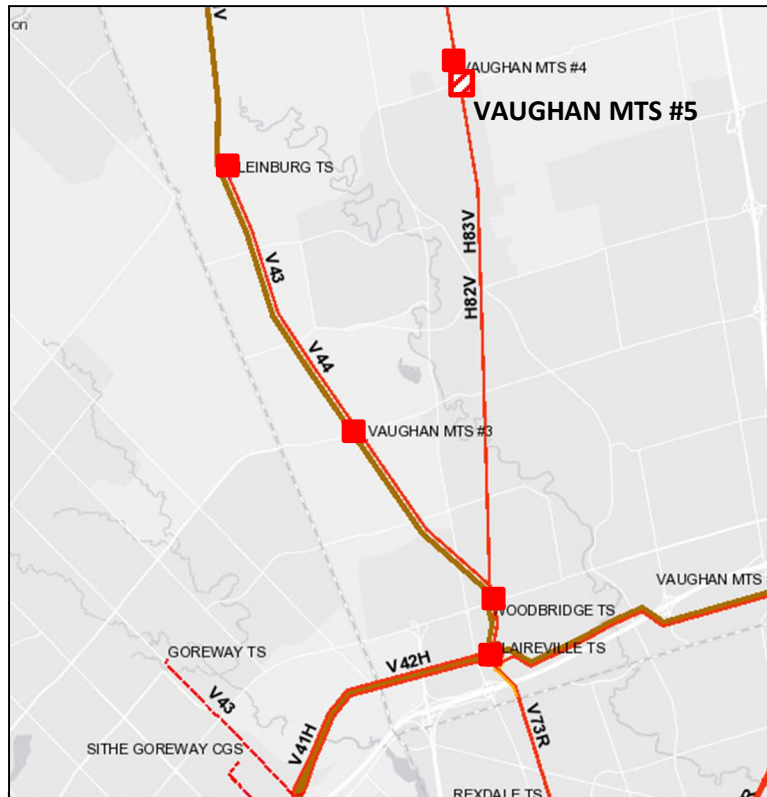


Figure-8-3 Vaughan MTS #5 Location

Table 8-3: Vaughan Area Station Capacity Need

| Transformer Station | LTR | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|-----------------------|-----|------|------|------|------|------|------|------|------|------|------|
| Vaughan MTS #1 (28kV) | 306 | 301 | 297 | 294 | 291 | 288 | 286 | 283 | 281 | 279 | 277 |
| Vaughan MTS #2 (28kV) | 153 | 149 | 148 | 147 | 145 | 144 | 143 | 141 | 141 | 139 | 138 |
| Vaughan MTS #4 (28kV) | 153 | 101 | 100 | 128 | 149 | 148 | 147 | 146 | 145 | 143 | 142 |
| Vaughan MTS #5 (28kV) | | | | | | | | | 64 | 132 | 138 |
| Total | 612 | 551 | 545 | 569 | 585 | 580 | 575 | 570 | 631 | 694 | 696 |

As mentioned in Table 7-1, there isn’t sufficient transmission capacity available on the Claireville to Brown Hill corridor to fully supply Vaughan MTS #5, given that a new station in Northern York is anticipated by 2027. Therefore, a plan to increase transmission supply capability to the area will be required before a plan for the new transformation station in Vaughan can be committed. This will be addressed in the next phase of this regional planning cycle.

8.1.4 Kleinburg TS Area – Transfer Load to Northern York TS

Kleinburg TS 44kV loading is a newly identified need. Kleinburg TS has 2 x 75/125MVA, 230/44-27.6kV transformers with separate 44kV and 27.6kV switchyards. Significant new load is forecast to connect at 44kV in the 2023-2024 period as shown in Table 8-4 below.

Table 8-4 Kleinburg Area Station Capacity Load

| Transformer Station | Limit MW | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|-----------------------------|----------|------|------|------|------|------|------|------|------|------|------|
| Kleinburg TS (28kV) | 91 | 62 | 65 | 81 | 92 | 95 | 95 | 95 | 95 | 95 | 95 |
| Kleinburg TS (44kV) | 97 | 102 | 111 | 124 | 134 | 98 | 98 | 97 | 96 | 95 | 95 |
| Load Transfer to be Managed | | 5 | 14 | 27 | 37 | | | | | | |

To manage loading at Kleinburg TS, Hydro One DX intends to transfer loads in the northern area served by Kleinburg TS to the new Northern York TS planned to be in-service by 2027. The new Northern York TS is planned to be a 230/44-27.6kV station. The TWG will review this in the next phase of the regional planning cycle.

8.1.5 Vaughan Area – Build Vaughan MTS #6 and supply from 230kV Line V43/V44 - 2027

Vaughan MTS #6 is a new identified need. Alectra plans to build a new station to provide dedicated supply to a large customer. The new station will have 2 x 75/125MVA, 230/27.6kV transformers and a 27.6kV switchgear building. Alectra has requested that Hydro One build a short underground line tap to supply the new station from the 230kV Claireville TS x Kleinburg TS double circuit line V43/V44. The planned in-service date for the station is the end of 2027.

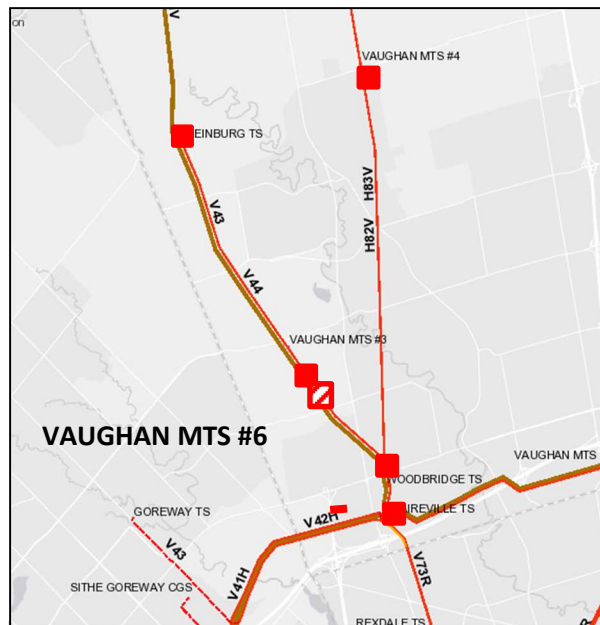


Figure-8-4 Vaughan MTS #6 Location

Table 8-5: Loading on the 230kV Claireville TS x Kleinburg TS line V43/V44

| Transformer Station | Limit MW | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|-----------------------|----------|------|------|------|------|------|------|------|------|------|------|
| Kleinburg TS (28kV) | | 62 | 65 | 81 | 92 | 95 | 95 | 95 | 95 | 95 | 95 |
| Kleinburg TS (44kV) | | 102 | 111 | 124 | 134 | 98 | 98 | 97 | 96 | 95 | 95 |
| Vaughan MTS #3 (28kV) | | 117 | 118 | 118 | 145 | 145 | 145 | 145 | 145 | 145 | 145 |
| Vaughan MTS #6 (28kV) | | | | | | 32 | 31 | 50 | 52 | 68 | 72 |
| Woodbridge TS (28kV) | | 87 | 86 | 79 | 79 | 78 | 78 | 77 | 77 | 76 | 77 |
| Woodbridge TS (44kV) | | 85 | 85 | 86 | 86 | 86 | 87 | 87 | 88 | 90 | 91 |
| Total | 620 | 453 | 465 | 487 | 536 | 534 | 533 | 552 | 553 | 569 | 575 |

Table 8-5 shows the forecast loads connected to the line. As shown, there is adequate capacity to supply the loads over the study period.

Hydro One is currently in initial consultations with Alectra on the connection. Further details will be discussed in the next phase of the regional planning cycle.

8.1.6 Richmond Hill Area – Build Richmond Hill MTS #3 and supply from 230kV Line V71P / V75P - 2032

Richmond Hill MTS #3 is a new identified need. Alectra plans to build a new station to meet forecast loads in the 2030s. The new station will have 2 x 75/125MVA, 230/27.6kV transformers and a 27.6kV switchyard. Alectra has requested Hydro One to connect the new station to the 230kV Claireville TS x Parkway TS double circuit line V71P/V75P. The planned in-service date is summer 2032.

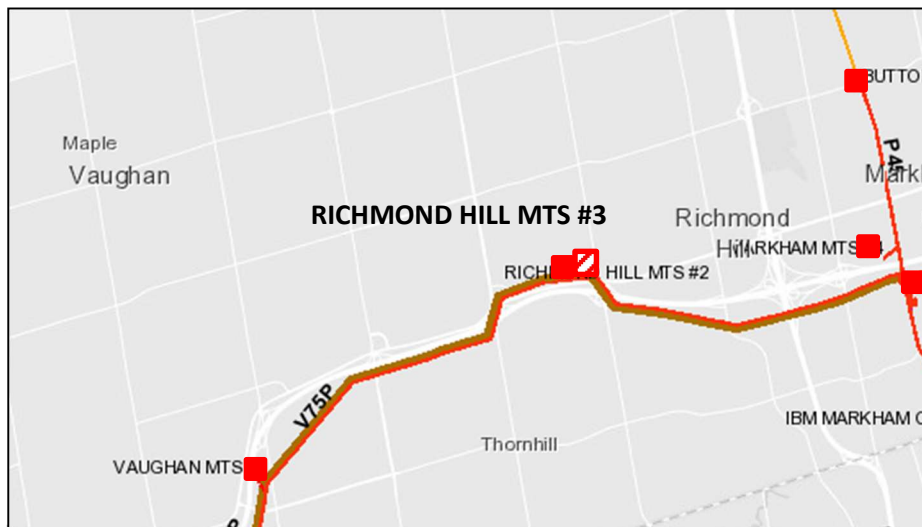


Figure-8-5 Richmond Hill MTS #3 Location

The 2020 RIP report had previously identified load security concerns with the V71P/V75P line as the connected loads exceed the 600 MW limit as per the ORTAC security criteria. However, as discussed in

Section 7.3, no action was recommended as Hydro One had installed sectionalizing switching on the line to restore load quickly in the event of a double circuit outage. The connection of the new station will further increase loading on the line. Alternatives to connect the station and address the load security need on the circuits will be developed and considered in the next phase of this RP cycle.

8.1.7 Toubner TS - 2027

Toubner TS is a new identified need. Hydro One has been requested to build a dedicated step-down transformer station for a direct industrial customer. The station will have 2 x 75/125 MVA, 230/27.6 kV transformers and a 27.6kV switchyard. The new station is in the Hwy. 7 and Hwy. 404 area and will be supplied from a tap for the 230kV line P45/P46 line tapped just north of Parkway TS. There is adequate capacity to supply the new station over the study period. The planned in-service date for the project is 2027.

Hydro One is currently in consultations with the customer to prepare connection estimates for the customer. Further details may be discussed in the current regional planning cycle.

8.1.8 Claireville x Brown Hill Transmission capacity Need- 2030

As described in Section 6.1 loading on the Claireville TS x Brown Hill TS corridor will exceed supply capacity by 2030. Alternatives to address this need will be developed and considered in the next phase of this regional planning cycle.

8.2 Long-Term Capacity Needs

With the provincial focus on decarbonization and the move away from fossil fuels, there will be a greater reliance on electricity. The GTA North region along with the rest of the province is about to embark on period of growth over the longer term driven by electrification, and large-scale development and customer connection projects are expected in several areas within the GTA North Region. The TWG will work with other stakeholders to ensure that all regional needs are met in a timely manner.

8.3 Asset Renewal Needs for Major HV Transmission Equipment – Woodbridge TS

As mentioned in Section 7.2 no asset renewal needs have been identified in the GTA North Region over the current study period other than Woodbridge TS identified in the last RIP.

Woodbridge TS comprises one DESN unit, T3/T5 (75/125 MVA), with two secondary winding voltages at 44 kV and 27.6 kV, each with a summer 10-Day LTR of 80 MW, supplying both Alectra and THESL. The station's 2022 44KV and 27.6kV actual peak loads were 55MW and 78 MW, respectively. Transformer T5 is currently about 51 years old and has been identified to be at its EOL.

The TWG is confirming the previous RIP identified need for the replacement of Woodbridge TS T5 transformer with similar type and size equipment as per current standard. Under this alternative the existing transformer T5 at Woodbridge TS is replaced with a new 75/125 MVA 230/44-27.6 kV transformer. This alternative would address the need and would maintain reliable supply to the customers in the area. The planned in-service date for the work is 2027.

8.4 Load Restoration and Security Needs

Load restoration need have been discussed earlier in Section 7.3, The TWG will consider these needs in the development of new plans to meet load growth and improve reliability of supply in the GTA North Region in the next phase of this regional planning cycle.

9 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 uncertainty can stem from varying factors ranging from changes considered in potential evolution of public policy, electrification (e.g., electrification of transportation or other sectors), Municipal Energy Plans, Community Energy Plans, and Climate Action Plans (for actions that are not firm/committed), non-committed customer connections (both distribution and transmission), DER scenarios (e.g., battery storage), continued operation of off-contract generation.

A high demand growth forecast was developed by assuming that the forecast growth was 50% higher than the extreme summer corrected normal growth net load forecast given in Appendix C. Similarly, a low demand forecast was developed assuming that the growth was half the extreme summer corrected Normal Growth net load forecast.

The impact of sensitivity analysis for the high and low growth scenarios on the capacity needs identified in Table 8-1 is summarized in Table 9-1.

Table 9-1: Impact of Sensitivity Analysis on the Identified Capacity Needs

| No. | Need | Normal Growth Scenario | High Growth Scenario | Low Growth Scenario |
|-----|--------------------------------------|------------------------|----------------------|---------------------|
| 1 | Toubner TS ¹ | 2027 | | |
| 2 | Vaughan MTS #6 ¹ | 2027 | | |
| 3 | Northern York TS | 2027 | 2026 | 2027 |
| 4 | Markham MTS #5 | 2028 | 2027 | 2032 |
| 5 | Vaughan MTS #5 | 2030 | 2030 | 2031 |
| 6 | Richmond Hill MTS #3 | 2032 | 2029 | Beyond 2032 |
| 7 | Uprate circuits P45/P46 ² | 2028 | 2028 | Beyond 2032 |
| 8 | Claireville X Brown Hill Corridor | 2030 | 2027 | Beyond 2032 |

¹Customer requested work with defined in-service date.

²To be done along with the Markham MTS #5 project

Based on current equipment deliverability and construction schedules the earliest in-service dates for projects is summer 2027. The Toubner TS, Vaughan MTS #6 are customer driven projects and need to proceed. The remaining needs listed in Table 9-1 will be addressed in the next phases of this planning cycle

in coordination with the additional identified network capacity and load security/restoration needs and considering a longer-term forecast for the area.

10 RECOMMENDATIONS

The TWG’s recommendations are as follows:

- a) No further regional coordination is required for the following needs and work will be proceeding as planned with all the three projects expected to be in-service by 2027.
 - Woodbridge TS: Replace transformer T5
 - Toubner TS: Build new station.
 - Vaughan MTS #6: Build new station

- b) Further assessment and regional coordination is required in the next phases of the regional planning cycle to review and/or develop a preferred plan for the follow needs:
 - Markham MTS #5: Build new station
 - 230kV circuit P45/P46: Uprate circuits between Parkway TS and Markham MTS #4 Jct.
 - Northern York TS: Build new station
 - Kleinburg TS 44kV: 44kV loads transfer to Northern York TS
 - Vaughan MTS #5: Build new station
 - Richmond Hill MTS #3: Build new station
 - Claireville TS x Brown Hill TS Transmission circuit capacity need
 - Load Restoration and/or Security needs for 230kV circuits V43/V44, H82V/H83V, P45/P46, and V71P/V75P.

11 REFERENCES

- [1]. Hydro One, “GTA North Regional Infrastructure Plan”, October 22, 2020.
[GTA North REGIONAL INFRASTRUCTURE PLAN \(hydroone.com\)](https://www.hydroone.com/en/infrastructure/GTA-North-Regional-Infrastructure-Plan)

- [2]. Hydro One, “Need Assessment Report, GTA North Region”, March 18, 2018.
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- [3]. IESO, “York Region: Integrated Regional Resource Plan”, February 28, 2020.
[York IRRP-20200228.pdf](https://www.ieso.ca/~/media/Files/IRRP/20200228.pdf)

- [4]. IESO, “York Region Scoping Assessment Outcome Report”, August 28, 2018.
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12 APPENDIX A. STATIONS IN THE GTA NORTH REGION

| No. | Station (DESN) | Voltage (kV) | Supply Circuits |
|-----|----------------------------|--------------|-----------------|
| 1 | Armitage TS T1/T2 | 230/44 | B88H/B89H |
| | Armitage TS T3/T4 | 230/44 | B88H/B89H |
| 2 | Brown Hill TS T1/T2 | 230/44 | B88H/B89H |
| 3 | Buttonville TS T3/T4 | 230/27.6 | P45/P46 |
| 4 | CTS | 230/13.8 | P21R/P22R |
| 5 | Holland TS T1/T2, T3/T4 | 230/44 | H82V/H83V |
| 6 | Kleinburg TS T1/T2 27.6 | 230/27.6 | V44/V43 |
| | Kleinburg TS T1/T2 44 | 230/44 | V44/V43 |
| 7 | Markham MTS #1 T1/T2 | 230/27.6 | P21R/P22R |
| 8 | Markham MTS #2 T1/T2 | 230/27.6 | C35P/C36P |
| 9 | Markham MTS #3 T1/T2 | 230/27.6 | C35P/C36P |
| | Markham MTS #3 T3/T4 | 230/27.6 | C35P/C36P |
| 10 | Markham MTS #4 T1/T2 | 230/27.6 | P45/P46 |
| 11 | Richmond Hill MTS #1 T1/T2 | 230/27.6 | V71P/V75P |
| | Richmond Hill MTS #2 T3/T4 | 230/27.6 | V71P/V75P |
| 12 | Vaughan MTS #1 T1/T2 | 230/27.6 | V71P/V75P |
| | Vaughan MTS #1 T3/T4 | 230/27.6 | V71P/V75P |
| 13 | Vaughan MTS #2 T1/T2 | 230/27.6 | V71P/V75P |
| 14 | Vaughan MTS #3 T1/T2 | 230/27.6 | V44/V43 |
| 15 | Vaughan MTS #4 T1/T2 | 230/27.6 | H82V/H83V |
| 16 | Woodbridge TS T3/T5 27.6 | 230/27.6 | V44/V43 |
| | Woodbridge TS T3/T5 44 | 230/44 | V44/V43 |

13 APPENDIX B. TRANSMISSION LINES IN THE GTA NORTH REGION

| Line | Circuit Designations | Voltage (kV) |
|--------------------------------------|----------------------|--------------|
| Claireville TS to Holland TS | H82V/H83V | 230 |
| Holland TS to Brown Hill TS | B88H / B89H | 230 |
| Claireville TS to Kleinburg TS | V43/V44 | 230 |
| Claireville TS to Parkway TS | V71P/V75P | 230 |
| Parkway TS to Markham MTS #1 and CTS | P21R/P22R | 230 |
| Parkway TS to Buttonville TS | P45/P46 | 230 |
| Parkway TS to Cherrywood TS | C35P/C36P | 230 |

14 APPENDIX C: NON-COINCIDENT SUMMER PEAK NET LOAD FORECAST (2023 TO 2032)

| | LTR | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|----------------------------------|-----|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Armitage TS (44kV) | 317 | 285 | 290 | 296 | 301 | 305 | 303 | 305 | 308 | 311 | 313 |
| Brown Hill TS (44kV) | 184 | 94 | 100 | 118 | 121 | 125 | 124 | 125 | 125 | 126 | 126 |
| Buttonville TS (28kV) | 166 | 144 | 152 | 154 | 152 | 160 | 149 | 148 | 147 | 146 | 145 |
| Holland TS (44kV) | 169 | 166 | 173 | 176 | 179 | 169 | 169 | 169 | 169 | 169 | 169 |
| Kleinburg TS (28kV) | 91 | 62 | 65 | 81 | 92 | 95 | 95 | 95 | 95 | 95 | 95 |
| Kleinburg TS (44kV) ¹ | 97 | 102 | 111 | 124 | 134 | 98 | 98 | 97 | 96 | 95 | 95 |
| Markham MTS #1 (28kV) | 81 | 80 | 79 | 78 | 77 | 76 | 76 | 75 | 74 | 74 | 73 |
| Markham MTS #2 (28kV) | 101 | 88 | 98 | 97 | 96 | 106 | 94 | 93 | 93 | 92 | 91 |
| Markham MTS #3 (28kV) | 202 | 171 | 184 | 191 | 189 | 197 | 186 | 184 | 183 | 181 | 180 |
| Markham MTS #4(28kV) | 153 | 116 | 117 | 141 | 162 | 176 | 177 | 175 | 174 | 173 | 171 |
| Markham MTS #5(28kV) | 153 | | | | | | 68 | 136 | 140 | 139 | 138 |
| Northern York Station | 170 | | | | | 66 | 80 | 89 | 99 | 109 | 118 |
| Richmond Hill-1 MTS (28kV) | 153 | 153 | 152 | 150 | 149 | 154 | 146 | 144 | 144 | 142 | 141 |
| Richmond Hill-2 MTS (28kV) | 101 | 95 | 105 | 104 | 104 | 111 | 104 | 104 | 104 | 105 | 105 |
| Richmond Hill-3 MTS (28kV) | 153 | | | | | | | | | | 60 |
| Toubner TS (28kV) | 153 | | | | | 32 | 31 | 50 | 52 | 55 | 72 |
| Vaughan MTS #1 (28kV) | 306 | 301 | 297 | 294 | 291 | 288 | 286 | 283 | 281 | 279 | 277 |
| Vaughan MTS #2 (28kV) | 153 | 149 | 148 | 147 | 145 | 144 | 143 | 141 | 141 | 139 | 138 |
| Vaughan MTS #3 (28kV) | 153 | 117 | 118 | 118 | 145 | 145 | 145 | 145 | 145 | 145 | 145 |
| Vaughan MTS #4 (28kV) | 153 | 101 | 100 | 128 | 149 | 148 | 147 | 146 | 145 | 143 | 142 |
| Vaughan MTS #5 (28kV) | 153 | | | | | | | | 64 | 132 | 138 |
| Vaughan MTS #6 (28kV) | 153 | | | | | 32 | 31 | 50 | 52 | 68 | 72 |
| Woodbridge TS (28kV) | 80 | 87 | 86 | 79 | 79 | 78 | 78 | 77 | 77 | 76 | 77 |
| Woodbridge TS (44kV) | 80 | 85 | 85 | 86 | 86 | 86 | 87 | 87 | 88 | 90 | 91 |
| Grand Total | | 2396 | 2459 | 2559 | 2652 | 2792 | 2814 | 2921 | 2997 | 3084 | 3173 |

1. Kleinburg 44kV load exceeds LTR between 2023 and 2026. Excess load planned to be transferred to Northern York Region when station is built in 2027.

15 APPENDIX D: ACRONYMS

| Acronym | Description |
|---------|-------------------------------------------------------|
| A | Ampere |
| BES | Bulk Electric System |
| BPS | Bulk Power System |
| CDM | Conservation and Demand Management |
| CEP | Community Energy Plan |
| CIA | Customer Impact Assessment |
| CGS | Customer Generating Station |
| CSS | Customer Switching Station |
| CTS | Customer Transformer Station |
| DCF | Discounted Cash Flow |
| DESN | Dual Element Spot Network |
| DG | Distributed Generation |
| DSC | Distribution System Code |
| GS | Generating Station |
| GTA | Greater Toronto Area |
| HV | High Voltage |
| IESO | Independent Electricity System Operator |
| IRRP | Integrated Regional Resource Plan |
| kV | Kilovolt |
| LDC | Local Distribution Company |
| LP | Local Plan |
| LTE | Long Term Emergency |
| LTR | Limited Time Rating |
| LV | Low Voltage |
| MEP | Municipal Energy Plan |
| MTS | Municipal Transformer Station (LDC owned) |
| MW | Megawatt |
| MVA | Mega Volt-Ampere |
| MVAR | Mega Volt-Ampere Reactive |
| NA | Needs Assessment |
| NERC | North American Electric Reliability Corporation |
| NGS | Nuclear Generating Station |
| NPCC | Northeast Power Coordinating Council Inc. |
| NUG | Non-Utility Generator |
| OEB | Ontario Energy Board |
| OPA | Ontario Power Authority |
| ORTAC | Ontario Resource and Transmission Assessment Criteria |
| PEC | Portland Energy Centre |
| PF | Power Factor |
| PPWG | Planning Process Working Group |
| RIP | Regional Infrastructure Plan |
| RP | Regional Planning |
| ROW | Right-of-Way |
| SA | Scoping Assessment |
| SIA | System Impact Assessment |
| SPS | Special Protection Scheme |
| SS | Switching Station |
| STG | Steam Turbine Generator |
| TPS | Traction Power Station |
| TS | Transformer Station |
| TSC | Transmission System Code |
| UFLS | Under Frequency Load Shedding |
| ULTC | Under Load Tap Changer |
| UVLS | Under Voltage Load Rejection Scheme |

