BARRIE / INNISFIL SUB-REGION INTEGRATED REGIONAL RESOURCE PLAN - APPENDICES

Part of the South Georgian Bay/Muskoka Planning Region | December 16, 2016

ieso
Connecting Today. Powering Tomorrow.

Barrie/Innisfil Sub-region IRRP

Appendix A: Demand Forecast

Appendix A: Demand Forecast

A.1 Gross Demand Forecast

Figures A-1 and A-2 show the gross demand forecast in terms of summer peak demand, for both the overall Barrie/Innisfil Sub-region and the individual transformer stations included in the study area. The gross demand forecast reflects existing customer connection requests as well as load projections based on municipal and regional plans for the area. Appendices A.1.1, A.1.2, and A.1.3 describe the LDCs' gross demand forecasting methodologies and assumptions.

The starting points for the forecast were developed by the Working Group. Station summer peak load from 2014 was used as the starting point. Adjustments were made to account for any non-native load in the peak hour (i.e., load transfers). The peak was also adjusted for median weather conditions using Hydro One's 2014 weather correction factor for the Essa zone. All forecasts provided by the LDCs assumed median weather conditions and a power factor of 0.9.[1]

The forecasts for the Barrie/Innisfil IRRP were created prior to the release of the provincial government's Climate Change Action Plan. The plan could have implications for the long-term load growth in the region, particularly the region's classification as summer peaking versus winter peaking (i.e., a change in the time/season of peak demand could occur with a long-term move to electric heat pumps). The magnitude of the region's long-term energy and capacity needs could also vary depending on electric vehicle penetration and operation (i.e., on-peak versus off-peak charging). Potential impacts are not yet well understood at a regional level. As such, future planning cycles will attempt to capture these impacts.

[1] Since Barrie TS and Midhurst TS have low voltage capacitor banks installed the power factor in real time is likely greater than 0.9. The assumed power factor is a conservative assumption used for forecasting and need identification purposes.

Table A-1: Gross Demand Forecast Scenarios 2015-2034 – Barrie/Innisfil Sub-region

Gross Demand Forecast Scenarios (MW)																				
Subsystems	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Reference Scenario	448	466	482	506	531	553	569	587	605	621	638	654	670	686	702	722	736	751	767	782
High Scenario	452	475	496	527	559	587	613	638	662	687	710	734	758	782	806	830	852	875	898	921
Low Scenario	444	456	468	486	505	520	532	543	554	565	575	585	596	606	616	625	634	643	652	661

Table A-2: LDC Gross Station Peak Forecasts (Reference Scenario)

LDC Gross Station Peak Demand Forecasts (MW)																				
Station	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Midhurst TS	182	188	193	198	204	210	216	221	227	232	239	244	249	256	261	269	274	281	286	293
Barrie TS	107	112	116	124	132	140	148	156	163	170	177	184	191	197	203	210	214	219	225	230
Everett TS	63	64	67	69	71	73	75	77	79	81	82	85	87	89	91	94	96	99	101	103
Alliston TS	96	101	107	115	123	129	131	133	136	138	139	141	143	145	147	149	151	153	154	156

A.1.1 PowerStream: Gross Forecast Methodology and Assumptions

PowerStream Inc. ("PowerStream") provides service to more than 365,000 customers across eleven Simcoe County and York sub-region communities including Alliston, Aurora, Barrie, Beeton, Bradford West Gwillimbury, Markham, Penetanguishene, Richmond Hill, Thornton, Tottenham and Vaughan. Collingwood, Stayner, Creemore and Thornbury are serviced through a partnership with the Town of Collingwood in the ownership of Collus PowerStream.

PowerStream's service area in Barrie encompasses the City of Barrie boundaries, excluding the annexed lands. PowerStream's primary distribution voltages in Barrie are 44 kV, 13.8 kV and 4.16 kV.

The City of Barrie is supplied by fourteen 44kV feeders from three Hydro One owned transformer stations. These 44 kV feeders supply 25 PowerStream owned Municipal Substations ("MS") that lower the voltage to PowerStream's primary distribution voltage in each respective region; nine 13.8 kV MS's and sixteen 4.16 kV MS's.

Factors that Affect Electricity Demand

The City of Barrie is located within the Greater Golden Horseshoe - a sub-region that accounts for 70% of Ontario's GDP and that has experienced significant population and employment growth over the past 10 years. According to the Watson "City of Barrie Growth Management Strategy Report", Barrie's population is anticipated to reach 210,000 by 2031. This presents an increase in population from 2006 to 2031 of approximately 76,300.

Over the 25-year forecast period, the City's total number of housing units is forecast to increase from 46,505 in 2006 to 78,705 in 2031, a total increase of 32,300 units. Single detached and semidetached housing are expected to represent approximately 58% of total new construction over the forecast period. Medium and high density households are forecast to comprise the remaining 18% and 24% of the new housing stock, respectively. The percentage of new housing by type is expected to gradually shift towards medium and high density housing units.

Barrie is actively encouraging the growth of the transportation and warehousing/wholesale trade sector, as well as manufacturing, construction, professional and scientific services and health services. Barrie has strong assets that serve a regional service function for Simcoe County. Three notable assets include the Royal Victoria Hospital, Georgian College and the SpringBOARD Innovation Centre.

Simcoe County has experienced increased employment in the areas of Health Care and Social Assistance (2,965 new jobs), Public Administration (2,500 new jobs), and Professional and Technical Services (1,335 new jobs). Barrie was forecast to post a total of 73,500 jobs in 2015 with an annual employment growth of 1.4%, resulting in 90,000 jobs by 2031.

A number of projects are currently under construction in the Barrie area including two large commercial developments, as well as three large mixed residential/commercial developments. Numerous industrial subdivisions are identified for potential development in Barrie, including four subdivisions covering approximately 75 hectares. In addition to the future industrial subdivisions, there are four existing data centers that will be implementing their next phase of development, resulting in a significant increase in load.

Forecast Methodology and Assumptions

The following sections describe PowerStream's load forecast methodology for the reference, high and low scenarios.

Reference Scenario

PowerStream's methodology for developing the base load forecast for Barrie consisted of a number of elements, including past system peak performance, statistical trend analysis, and an end-use analysis using the latest information gathered from meetings with the City of Barrie and Simcoe County. During the meetings information was gathered on projected residential and non-residential developments, population and employment growth. The Hemson Report, Watson Report, and the Places to Grow plan were used in conjunction with the information gathered from meetings with the City of Barrie and Simcoe County.

The forecast was based on a coincident system peak for Barrie with a percentage allocation of loading to each respective high voltage transformer station based on historical loading. This approach ensured that any potential load transfers within the boundaries of PowerStream's service territory encompassing the City of Barrie were accounted for during the summer peak.

The reference scenario assumed a conservative load growth forecast for the four large data centers in Barrie based upon the historical loading at each respective facility.

High & Low Scenario

The low growth scenario assumes lower housing and population numbers, as per the City of Barrie Watson Growth Management Strategy Report low growth scenario. This scenario reflects a slow-down in development of residential and commercial units as a reflection of dampened economic activity.

The high growth scenario assumes housing and population numbers achieving the targets outlined in province's Growth Plan for the Greater Golden Horseshoe, 2006, as amended ("Places to Grow"). This scenario also reflects the original load forecast levels and timeline outlined for each of the respective four data centers located in Barrie.

A.1.2 InnPower: Gross Forecast Methodology and Assumptions

InnPower provides service to the Town of Innisfil, as well as lands annexed by the City of Barrie in 2010. InnPower's distribution loads are supplied via 10 distribution stations which are supplied by five 44 kV feeders and four distribution feeders from Hydro One owned distribution stations (i.e., Cookstown DS and Thornton DS); three feeders originating from Alliston TS, one from Barrie TS, and one from Everett TS. InnPower's distribution voltages include 27.6 kV and 8.32 kV.

InnPower is currently a winter peaking utility. When accounting for diversity with the other LDCs at the substation level, however, the stations supplying InnPower are summer peaking. With anticipated growth from new developments and changing demographics, InnPower expects to transition to a summer peak. As such, InnPower has provided a summer peak forecast in-line with the sub-region's peak demand needs.

Factors that Affect Electricity Demand

Growth in the InnPower service territory is influenced primarily by the province's Places to Grow plan. Growth targets for the Town of Innisfil and portions of the City of Barrie have the largest impact on InnPower's future demand.

The Barrie/Innisfil Boundary Adjustment Act came into effect on January 1, 2010, granting the City of Barrie approximately 2,300 hectares of Innisfil lands for development purposes. These lands were to help fulfill the growth targets put forth in the province's Places to Grow plan. While the lands are now part of the City of Barrie they are still serviced by InnPower.

InnPower has potential industrial and commercial growth from proposed development of sites around Highway 400 and the Innisfil Beach Road area. Five commercial development sites exist today, with the potential for over 100 lots to be developed. There is an on-going environmental assessment for the impact of required water and wastewater facilities around the Highway 400 corridor.

There are additional development plans within the Town of Innisfil, including an all-season resort community planned for the development of Big Bay Point. The development has been approved and includes over 1,600 new customers over a 10-year period. Construction began in 2015.

Forecast Methodology and Assumptions

The following sections describe InnPower's load forecast methodology for the reference, high and low scenarios.

Reference Scenario

InnPower's forecast uses an end-use model where the primary input is new dwelling construction activities. This includes a forecast number of homes to be built in each year, based on the population growth targets, existing and proposed subdivision plans, and historical build rates. The reference scenario is generally in-line with the municipal plans and accounts for the latest schedule – at the time of forecast creation – for the servicing of the Highway 400 development lands.

High & Low Scenario

The high scenario assumes the full population and growth targets outlined in the provincial Places to Grow plan are realized. It also assumes the most optimistic forecast for housing construction. The low scenario reflects the low growth scenario, particularly for the Barrie Annexed lands, from the Watson Report – also reference by PowerStream.

A.1.3 Hydro One Distribution: Gross Forecast Methodology and Assumptions

Hydro One Distribution provides electricity service to counties and townships throughout the province. In the Barrie/Innisfil region, their service territory includes townships surrounding Midhurst, Barrie, Innisfil, Alliston and Bradford, as well as the Honda plant in Alliston.

Table A-3 shows the allocation of Hydro One Distribution's provincial load within the study area.

Table A-3: Allocation of Hydro One Distribution Supply by TS

Share of Hydro One Load			
Station	**% of Overall TS Load**	**% of Hydro One Load in the Study Area**	**% of Hydro One Load in Ontario**
Alliston TS	55%	46%	1.6%
Everett TS	21%	11%	0.4%
Midhurst TS	26%	43%	1.5%

Factors that Affect Electricity Demand

Hydro One's load forecast is an econometric forecast. Main drivers in the development of the forecast are provincial economic and demographic factors, such as Ontario GDP and historical and projected housing starts

Forecast Methodology and Assumptions

The following sections describe Hydro One Distribution's load forecast methodology for the reference, high and low scenarios.

Reference Scenario

Load growth in the area, relative to provincial trends was also taken into account. Moreover, as a main local forecast driver, the proposed Honda expansion over the forecast period and its impact on Hydro One's load were taken into account.

For the reference scenario, Table A-4 and Table A-5 show the provincial GDP and housing starts assumption used to create the forecast.

Table A-4: Ontario GDP Growth Assumption for Hydro One Forecast Development

	2015	2016	2017	2018	2019	2020
GDP Growth	2.8%	2.5%	2.5%	2.3%	2.2%	2.0%

Table A-5: Ontario Housing Starts Assumptions for Hydro One Forecast Development

	2015	2016	2017	2018	2019	2020
Ontario Housing Starts (in thousands)	61.8	61.8	65.5	68.9	72.2	69.2

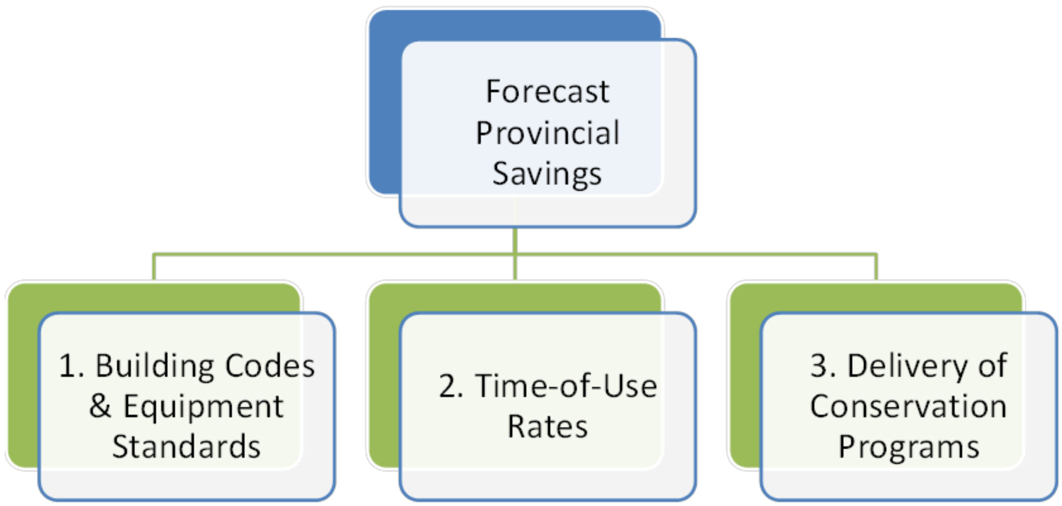
High & Low Scenario

The high and low scenarios were developed using a standard deviation approach. The high and low scenarios represent a standard deviation above and below the reference case, respectively. This approach reflects the inherent variability of load.

A.2 Conservation Forecast in Regional Planning – Barrie/Innisfil IRRP

Conservation savings were separated into the three main categories shown in Figure A-1 below. The impacts of the savings for each category were allocated according to the forecast residential, commercial, and industrial gross demand. This appendix provides additional breakdowns of the conservation savings estimates for the Barrie/Innisfil Sub-region and provides more detail onto how the savings for the three savings categories were developed.

Figure A-1: Conservation Savings Categories



1. *Savings due to Building Codes & Equipment Standards*
2. *Savings due to Time-of-Use Rate structures*
3. *Savings due to the delivery of Conservation Programs*

A.2.1 Estimating Savings from Building Codes and Equipment Standards

Ontario Building codes and equipment standards set minimum efficiency levels through regulations. Under the IESO's current analysis, building codes and equipment standards are forecast to contribute a saving of about 10 TWh by 2032 in Ontario. To estimate the impact on the region, the associated peak demand savings for building codes and equipment standards are estimated and compared with the provincial gross peak demand forecast. From this comparison, annual savings percentages were developed for the purpose of allocating the associated savings to each TS in the sub-region by sector.

Figure A-2: Split of Building Codes & Equipment Standards Savings

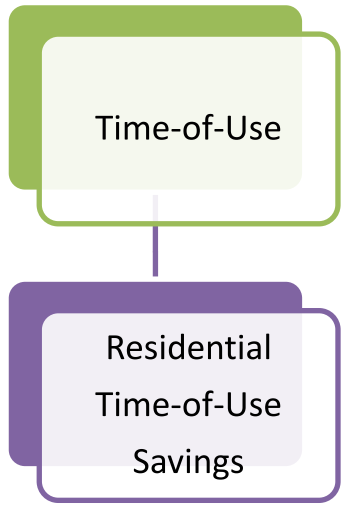
**Savings are projected for Residential & Commercial sectors only*

Annual savings percentages were applied to the forecast sector demand at each TS to develop an estimate of peak demand impacts from codes and standards. By 2032, the residential sector will see about 6.8% peak demand savings through standards, while the commercial sector will see about 6.5% peak demand savings through codes.

A.2.2 Savings from Time-of-Use rates

Almost all residential customers in Ontario have smart meters installed and are on Time-of-Use ("TOU") rates. Small commercial customers, with loads less than 50 kW, are also on TOU rates. Using results from the TOU impact evaluation completed in 2014 and assuming some regional characteristics, an average peak demand reduction of 0.68% was assumed for residential customers who switched to TOU rates. This means a peak reduction of 0.68% across residential customers in the province. This peak reduction factor is assumed to be consistent for residential customers in this sub-region. This percentage impact is assumed to continue, increasing the total forecast peak demand savings as residential sector demand grows. The percentage was applied to the incremental forecast residential load of each TS in the study to estimate the peak reduction. The same impact evaluation found that the peak impact of TOU rates on small commercial customers is minimal. Therefore the commercial sector TOU impact is assumed to be already embedded in the base year and no incremental savings are considered in the forecast.

Figure A-3: Time-of-Use Savings

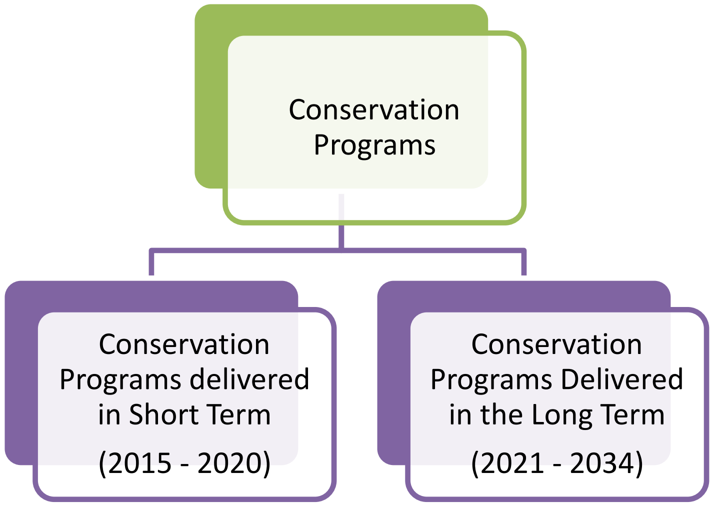


**No incremental savings are assumed for commercial sector*

A.2.3 Savings from the Delivery of Conservation Programs

Conservation programs across the province are forecast to reduce about 20 TWh of energy consumption by 2032. For the short term (2015 – 2020), all LDCs have conservation and demand management ("CDM") plans in place, which includes detailed savings projections from energy efficiency and conservation behind the meter generation. Their plans also indicate how their conservation efforts will integrate with regional planning. As per the Minister's direction for the Conservation First Framework ("CFF"), the IESO is to encourage LDCs to incent measures with persisting savings, peak demand reductions, and those that address local system needs. It is expected that LDCs will meet their CFF conservation targets and provide the estimated benefit that was forecast. The estimated peak impact can be found within the CDM plans; these savings values are used in the demand and conservation forecast for the sub-region. For the long term (2020 – 2034), the achievable potential was estimated in a 2014 study; future programs will be designed to achieve these identified savings. The provincial forecast savings were allocated to the sub-region and transformer stations according to their respective load.

Figure A-4: Timeframes for Conservation Program Savings



Savings from Programs Delivered in the Short Term

CDM plans that were provided by each of the participating LDCs for the CFF contained information that was used to estimate the conservation savings to be considered for short-term program savings. The peak demand savings from Conservation Programs delivered in the short term include all persisting savings till 2034 due to the expected delivery of programs from 2015 – 2020. As a part of the plan, each LDC submitted Cost Effectiveness Calculators that contained estimated energy and demand savings associated with the delivery of programs from 2015 – 2020. The peak demand savings were estimated in the tools for summer demand savings.

For LDCs that only have a portion of their total service territory associated with this IRRP (i.e., PowerStream and Hydro One Distribution), only a portion of their expected savings are estimated to occur in the region. To determine this, the amount of conservation savings in the sub-region is assumed to be proportional to the amount of the LDC's energy within the region, i.e., if 60% of the LDC's energy is served in this region, and then 60% of the expected conservation savings for that LDC are estimated to occur within this sub-region. When the total peak demand savings for the sub-region has been estimated, it is allocated at each TS according to its the relative share of residential, commercial, and industrial gross demand. For savings due to behind-the-meter generation projects, savings are applied directly to the TS to which the project is expected to connect.

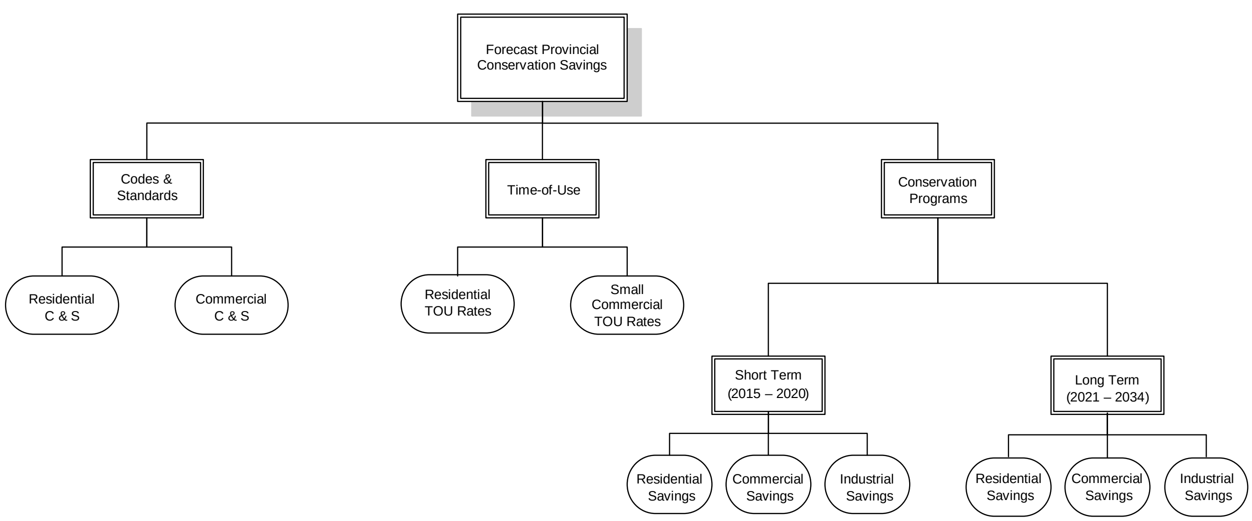
Savings from Programs Delivered in the Long Term

Savings from programs beyond the CFF also were broken down by three sectors, based on the IESO data and analysis. Energy savings were converted to peak reductions using the hourly profile for each sector. These peak reductions were compared with the respective gross peak to derive percentage saving for each year. These percentages were applied to the forecast demand at each TS to develop an estimate of MW peak demand impacts.

In addition to distribution connected customers, planned conservation savings from transmission connected customers were also considered. These customers are eligible for the Industrial Accelerator Program ("IAP") and their peak demand savings were analyzed on a case by case basis. For any transmission connected customers in the study sub-region that have applied for IAP, their expected peak savings were included in the conservation forecast.

As described above, peak demand savings were estimated by sector for each conservation category. They were summed for each TS in the region. The analyses were done under normal weather conditions and can be adjusted to reflect extreme weather conditions. The resulting conservation savings, along with distributed generation resources were applied to the gross demand to determine the net peak demand for further planning analyses.

Figure A-5: Map of Conservation Savings



A.2.4 LDC Load Segmentation Data

In order to generate the CDM forecast, the LDCs provided an allocation of their demand at each station bus for each customer segment. The LDCs' allocation information for 2015 is shown in Table A-6, aggregated to the TS level.

Table A-6: Allocation of Customer Segments at Each TS used for the CDM Forecast

Transformer Station	Sector	% of Total TS Load (2015)
Midhurst TS	Residential	52%
	Commercial	44%
	Industrial	4%
Barrie TS	Residential	51%
	Commercial	42%
	Industrial	7%
Everett TS	Residential	58%
	Commercial	34%
	Industrial	8%
Alliston TS	Residential	34%
	Commercial	20%
	Industrial	46%

A.2.5 Conservation Forecast

The forecast peak demand savings from CDM programs is shown in Table A-7. The savings in Table A-7 are based off the gross forecast accounting for the PowerStream load transfer. Due to the methodology used, there is a slight variance (1 MW over the full study period) of the conservation forecast for the scenarios with and without the load transfer. This comes from the different customer segment allocations at Midhurst TS versus Barrie TS and the difference in savings associated with those segments for the 27 MW of transferred load.

Table A-7: Peak Demand (MW) Savings by TS from 2013 LTEP Conservation Targets

Conservation Forecast (MW)																				
Station	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Midhurst TS	1	2	3	5	7	8	10	12	15	17	20	23	27	30	32	36	40	40	41	41
Barrie TS	0	1	2	3	5	5	6	7	8	10	11	13	15	16	18	20	21	22	22	22
Alliston TS	0	1	1	2	3	3	4	5	5	6	6	7	8	8	9	10	11	11	11	11
Everett TS	0	1	1	2	2	3	3	4	4	4	5	5	5	6	6	7	7	7	7	8
Total	**2**	**5**	**7**	**12**	**16**	**19**	**23**	**28**	**32**	**37**	**42**	**48**	**55**	**60**	**65**	**73**	**79**	**80**	**81**	**82**

A.3 Expected Peak Demand Contribution of Contracted Distributed Generation

The installed capacity of contracted DG is adjusted to reflect the expected power output at the time of local area peak, based on resource-specific peak capacity contribution values. As of June 2015, there was forecast to be approximately 14.6 MW of additional contracted solar generation connected in the Barrie/Innisfil Sub-region in 2015. Based on analysis of historical solar data for sites in the IESO's Essa zone determining the coincidence of production to the zonal peak, a 22% capacity contribution at peak demand was assumed for solar in the Essa zone for the summer months. Based on this factor, the expected peak demand contribution of contracted DG in the Barrie/Innisfil Sub-region is show in Table A-6. There was an additional 250 kW of pending solar projects, and a 1 MW solar project unassigned to a TS for the Barrie area, with potential 2016 in-service dates. These represent an additional potential 0.28 MW reduction in peak for the study area, but were not included in the forecast since their status was not committed (at the time when this forecast was generated) and the capacity saving could not be allocated to the correct TS. However, this potential additional 0.28 MW reduction was accounted for in decision making for the IRRP.

Table A-6: Expected Peak Demand Contribution from Contracted Distributed Generation

Expected Peak Demand Contribution from Contracted Distributed Generation (MW)																				
Station	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Midhurst TS	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Barrie TS	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Alliston TS	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Everett TS	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Total	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2

A.4 Planning Forecast Scenarios

As described in the main report, three planning forecasts were developed for the Barrie/Innisfil IRRP driven by the uncertainties surrounding economic factors influencing residential and commercial growth in the area. The planning forecast takes the gross forecast data provided by the LDCs, accounts for the demand impacts of conservation and DG, outlined in sections A.2 and A.3 respectively, and adjusts for the impact of extreme weather conditions. Extreme weather correction is done using Hydro One's correction factor of 6% between median and extreme weather conditions. Table A-8 shows the planning demand forecasts for the reference, high, and low scenarios respectively. Table A-9 and Table A-10 show the planning demand forecasts for the transformer stations with and without the recommended PowerStream load transfer, respectively.

Table A-8: Peak Demand Planning Forecast for the Barrie/Innisfil Sub-region and the Barrie Sub-area

Planning Demand Forecast Scenarios (MW)																						
Subsystems	**Scenario**	**2014 Historical (Extreme Weather)**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Barrie Innisfil Sub-region	Reference Scenario	455	469	485	501	522	543	563	577	592	606	618	630	642	652	664	676	689	698	713	729	745
	High Scenario	455	474	495	515	544	573	600	623	645	667	687	707	727	746	766	786	804	821	844	868	892
	Low Scenario	455	465	475	486	500	516	529	537	544	552	559	564	569	573	579	584	587	590	598	607	616
Barrie Sub-area (Portion of the Barrie/Innisfil Sub-region)	Reference Scenario	297	302	312	320	331	343	356	366	377	388	396	407	415	422	431	439	449	454	466	477	489
	High Scenario	297	305	317	328	344	361	378	394	410	425	440	454	467	481	495	509	520	531	547	563	579
	Low Scenario	297	300	305	310	318	326	335	342	348	354	360	365	369	372	377	381	384	386	393	400	407

Table A-9: Reference Case Station Peak Demand Planning Forecasts - *Without* Load Transfer

Planning Station Peak Demand Forecasts (MW)																					
Station	**2014 Historical (Median Weather)**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Midhurst TS	177	189	194	198	203	207	212	216	220	224	227	232	235	237	241	245	249	252	258	264	270
Barrie TS	104	113	118	121	129	135	143	150	157	164	169	175	181	186	190	195	201	203	208	214	219
Everett TS	61	66	67	70	71	73	75	76	78	80	82	83	85	86	88	90	93	95	97	99	101
Alliston TS	89	101	106	111	119	127	133	135	137	139	140	141	142	144	145	146	148	149	151	153	154

Table A-10: Reference Case Station Peak Demand Planning Forecast - *With* Load Transfer

Planning Station Peak Demand Forecasts (MW)																					
Station	**2014 Historical (Median Weather)**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Midhurst TS	177	189	194	198	203	207	241	245	248	252	255	259	262	263	267	270	274	277	283	289	295
Barrie TS	104	113	118	121	129	135	115	122	129	136	141	148	154	159	164	169	175	177	182	188	193
Everett TS	61	66	67	70	71	73	75	76	78	80	82	83	85	86	88	90	93	95	97	99	101
Alliston TS	89	101	106	111	119	127	133	135	137	139	140	141	142	144	145	146	148	149	151	153	154

Barrie/Innisfil Sub-region IRRP

Appendix B: Needs Assessment

Appendix B: Needs Assessment

This appendix provides information on the methodology and data used to assess needs and options in the Barrie/Innisfil IRRP.

B.1 Addressing Near-Term/Existing Barrie TS Needs

To address the existing capacity need and the identified end-of-life needs at Barrie TS, different transmission-based solutions were investigated by the Working Group. Based on the assessment of these options along with the system needs, the rebuild and uprating of Barrie TS and E3/4B to 230 kV, with 75/125 MVA transformers was chosen as the preferred option. A description of the alternatives considered by the Working Group is provided below.

B.1.1 Alternatives Considered for the End-of-Life Rebuild of Barrie TS

Rebuild Barrie TS Like-for-Like

Replacing assets like-for-like is standard practice when they reach end-of-life. The existing 115/44 kV transformers at Barrie TS are 55/92 MVA units, which are no longer a Hydro One standard transformer size. To replace the station like-for-like, customized transformers, along with an additional custom spare transformer, would be required. The end-of-life 230/115 kV autotransformer at Essa TS would be replaced with a standard 75/125 MVA unit, and the additional end-of-life 44 kV and 115 kV station equipment at Barrie and Essa TS would be replaced, along with aging conductor and poles along the E3/4B circuits.

The like-for-like replacement option would not result in any incremental capacity being made available at Barrie TS or on the 115 kV supply from Essa TS. With the forecast growth in the south Barrie and Innisfil areas, the like-for-like option means that a significant near-term capacity need would remain in the Barrie TS service area. This option would also limit opportunities for future expansion of the 230 kV to accommodate future capacity increases in the area (i.e., a future TS in south Barrie, or the proposed Metrolinx 230 kV connection) since the 115 kV line cannot meet future capacity needs. This would increase the cost associated with future supply options, which would be needed in the near term since the capacity need in the Barrie area wouldn't be fully addressed by the like-for-like option.

The high level estimated cost of this option is approximately $40 million.

Rebuild Barrie TS to 230 kV Supply

The existing 230/115 kV autotransformers at Essa TS, which are reaching their end-of-life, currently only supply the E3/4B circuits to Barrie TS. With the end-of-life replacement at Barrie TS there is an opportunity to retire the 115 kV switchyard and 230/115 kV autotransformers at Essa TS and supply the rebuilt Barrie TS directly from the 230 kV system.

By converting E3/4B to a 230 kV supply, additional transmission capacity will remain available in the south Barrie and Innisfil area to service the forecast long-term growth in the area. The available capacity on the 230 kV circuits can be used for an additional future TS and for the 230 kV customer connection proposed by Metrolinx.

The transformers at Barrie TS can be replaced with standard 230/44 kV units. Hydro One has two standard transformer sizes which were considered as potential options: 75/125 MVA and 50/83 MVA. The 50/83 MVA units were ruled out since they would result in a decrease in available capacity at Barrie TS and would have required the advancement of additional station capacity in the south Barrie and Innisfil areas. The chosen option of 75/125 MVA units provides an additional 50 MW to meet near- and medium-term needs.

The high level budgetary cost of this option is $80 million.

New DESN at Essa TS & Decommission Barrie TS

The alternative to rebuilding Barrie TS would be to decommission the Barrie TS site and build a new 230/44 kV DESN station at the Essa TS site, with standard 75/125 MVA transformers. From the Essa TS site, 44 kV feeders would utilize the decommissioned E3/4B corridor to re-supply the feeders formerly fed by Barrie TS.

While a new 230/44 kV DESN station at the Essa TS would provide additional capacity in the near term (an additional ~50 MW), it would limit options for future expansion of the 230 kV to accommodate future capacity increases in the area (i.e., future transformer station in south Barrie, or the proposed Metrolinx 230 kV connection).

The high level budgetary cost of this option – not accounting for additional distribution costs to reroute feeders to Essa TS – is $65-70 million.

B.2 Station Capacity Assessment

In order to assess the need for additional TS capacity, planning forecasts were compared to the 10-day limited time rating ("LTR") of the stations in the sub-region. In order to account for the transfer capability between adjacent stations, two groupings of stations were considered:

- **Barrie Sub-area:** Midhurst TS and Barrie TS
- **Barrie/Innisfil Sub-region:** Midhurst TS, Barrie TS, Everett TS, Alliston TS

For each of these station groupings, their combined capacity was compared against their combined planning forecast to determine where new station capacity is most likely to be required. In addition, each station's planning forecast was compared against its LTR.

B.2.1 Reference Case

The needs identified in the Barrie/Innisfil IRRP were based off the reference forecast. Table B-1 shows the reference forecast by area and station, without the recommended PowerStream load transfer. The use of red text indicates transformer capacity at the existing Barrie TS being exceeded until the rebuild is completed in 2020. As stated in the main IRRP document, PowerStream can use their existing emergency load transfer capabilities or other operational measures (e.g., operating with open bus ties) if this load materializes to mitigate risk. Red text along with red shading indicates that the transformer capacity of the station or area is forecast to be exceeded, accounting for the planned Barrie TS rebuild. Cells highlighted in purple indicate to what year needs can be deferred to with the PowerStream load transfer. A revised forecast fully reflecting the transfer is shown in Table B-2.

The need which arises in 2027 at Everett TS can be fully deferred past the end of the study period with the recommended change in CT ratios, allowing the station's full LTR of 117 MVA (or 105 MW) to be utilized.

Table B-1: Reference Planning Station Forecast - *Without* Load Transfer

Transformer Station	Historical Peak (MW) Weather Corrected	Station Peak Planning Forecast (MW)																			
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Midhurst TS	177	189	194	198	203	207	212	216	220	224	227	232	235	237	241	245	249	252	258	264	270
Barrie TS	104	113	118	121	129	135	143	150	157	164	169	175	181	186	190	195	201	203	208	214	219
TOTAL BARRIE AREA	**297***	**302**	**312**	**320**	**331**	**343**	**356**	**366**	**377**	**388**	**397**	**407**	**416**	**423**	**432**	**440**	**450**	**455**	**466**	**478**	**490**
Everett TS	61	66	67	70	71	73	75	76	78	80	82	83	85	86	88	90	93	95	97	99	101
Alliston TS	89	101	106	111	119	127	133	135	137	139	140	141	142	144	145	146	148	149	151	153	154
TOTAL STUDY AREA	**455***	**469**	**485**	**501**	**522**	**543**	**563**	**577**	**592**	**606**	**618**	**631**	**643**	**653**	**665**	**677**	**690**	**699**	**714**	**730**	**746**

* Values were adjusted to extreme weather, other historical values shown are only adjusted to median weather; planning forecast assumes extreme weather conditions.

Table B-2: Reference Planning Station Forecast - *With* Load Transfer

Transformer Station	Historical Peak (MW) Weather Corrected	Station Peak Planning Forecast (MW)																			
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Midhurst TS	177	189	194	198	203	207	241	245	248	252	255	259	262	263	267	270	274	277	283	289	295
Barrie TS	104	113	118	121	129	135	115	122	129	136	141	148	154	159	164	169	175	177	182	188	193
TOTAL BARRIE AREA	**297***	**302**	**312**	**320**	**331**	**343**	**356**	**366**	**377**	**388**	**396**	**407**	**415**	**422**	**431**	**439**	**449**	**454**	**466**	**477**	**489**
Everett TS	61	66	67	70	71	73	75	76	78	80	82	83	85	86	88	90	93	95	97	99	101
Alliston TS	89	101	106	111	119	127	133	135	137	139	140	141	142	144	145	146	148	149	151	153	154
TOTAL STUDY AREA	**455***	**469**	**485**	**501**	**522**	**543**	**563**	**577**	**592**	**606**	**618**	**630**	**642**	**652**	**664**	**676**	**689**	**698**	**713**	**729**	**745**

* Values were adjusted to extreme weather, other historical values shown are only adjusted to median weather; planning forecast assumes extreme weather conditions.

B.2.2 Low Scenario

Under the low scenario, the recommended near-term actions address the sub-region's needs until the end of the study period.

Table B-3: Low Scenario Planning Station Forecast - *With* Load Transfer

Transformer Station	Historical Peak (MW) Weather Corrected	Station Peak Planning Forecast (MW)																			
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Midhurst TS	177	188	190	193	195	197	229	230	231	233	234	235	236	236	237	238	238	238	242	245	249
Barrie TS	104	112	115	118	123	129	106	112	116	121	125	130	133	136	140	143	146	148	151	155	158
TOTAL BARRIE AREA	**297***	**300**	**305**	**310**	**318**	**326**	**335**	**342**	**348**	**354**	**360**	**365**	**369**	**372**	**377**	**381**	**384**	**386**	**393**	**400**	**407**
Everett TS	61	65	67	68	69	70	70	72	73	74	75	76	77	78	79	80	81	82	84	85	87
Alliston TS	89	99	103	107	113	120	123	124	124	124	124	123	123	123	123	122	122	122	122	122	123
TOTAL STUDY AREA	**455***	**465**	**475**	**486**	**500**	**516**	**529**	**537**	**544**	**552**	**559**	**564**	**569**	**573**	**579**	**584**	**587**	**590**	**598**	**607**	**616**

* Values were adjusted to extreme weather, other historical values shown are only adjusted to median weather; planning forecast assumes extreme weather conditions.

B.2.3 High Scenario

Under the high scenario, the recommended near-term actions address the sub-region's needs until the medium term. If load growth is aggressive and aligns with the high growth scenario, the next planning cycle may begin earlier, reflecting the potential need for additional station capacity in Barrie area in the mid-2020s and the typical 5-7 year lead time. The Working Group will continue to monitor load growth, along with CDM and DG uptake. Under the high scenario, capacity needs also arise for Midhurst TS and Alliston TS near the end of the study period.

Table B-4: High Scenario Planning Station Forecast - *With* Load Transfer

Transformer Station	Historical Peak (MW) Weather Corrected	Station Peak Planning Forecast (MW)																			
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Midhurst TS	177	191	197	204	210	216	251	257	262	268	273	278	283	289	294	301	305	311	320	329	338
Barrie TS	104	114	119	124	134	145	127	138	148	158	167	176	184	192	200	208	215	220	227	234	241
TOTAL BARRIE AREA	**297***	**305**	**317**	**328**	**344**	**361**	**378**	**394**	**410**	**425**	**440**	**454**	**467**	**481**	**495**	**509**	**520**	**531**	**547**	**563**	**579**
Everett TS	61	67	69	72	74	76	78	81	83	86	88	91	93	95	98	101	103	106	109	112	115
Alliston TS	89	102	109	116	126	136	144	148	152	156	159	163	166	170	173	177	180	184	188	193	197
TOTAL STUDY AREA	**455***	**474**	**495**	**515**	**544**	**573**	**600**	**623**	**645**	**667**	**687**	**707**	**727**	**746**	**766**	**786**	**804**	**821**	**844**	**868**	**892**

* Values were adjusted to extreme weather, other historical values shown are only adjusted to median weather; planning forecast assumes extreme weather conditions.

B.2.4 LTR Reference Table

The 10-day limited time ratings ("LTR") used for the station capacity analyses are shown in Table B-5. A power factor of 0.9 was used for the conversion to MWs, consistent with the load forecast.

Table B-5: 10-Day Limited Time Ratings for Station Transformers in the Barrie/Innisfil Sub-region

Station/Bus	Existing LTR (MVA)	Existing LTR (MW)	LTR with Recommended Plan (MVA)	LTR with Recommended Plan (MW)
Midhurst TS	337	304	337	304
Barrie TS	115	103	168	151
Everett TS	95	86	117	105
Alliston TS	211	190	211	190

B.3 Essa Bulk Study

B.3.1 Application of Planning Criteria

In accordance with the Ontario Resource and Transmission Assessment Criteria ("ORTAC"), the system must be designed to provide continuous supply to a local area, under specific transmission and generation outage scenarios summarized in Table B-6. Voltage and thermal limitations should be respected under these outage conditions.

Table B-6: ORTAC Criteria - Transmission and Generation Outage Scenarios

Pre-contingency		Contingency[1]	Thermal Rating	Maximum Permissible Load Rejection
All transmission elements in-service	Local generation in-service	N-0	Continuous	None
		N-1	LTE[2]	None
		N-2	LTE[2]	150 MW
	Local generation out-of-service	N-0	Continuous	None
		N-1	LTE[2]	150 MW[3]
		N-2	LTE[2]	>150 MW[3] (600 MW total)

1. N-0 refers to all elements in-service; N-1 refers to one element (a circuit or transformer) out-of-service; N-2 refers to two elements out-of-service (for example, loss of two adjacent circuits on same tower, breaker failure or overlapping transformer outage); N-G refers to local generation not available (for example, out-of-service due to planned maintenance).
2. LTE: Long-term emergency rating (50-hr rating for circuits, 10-day rating for transformers).
3. Only to account for the capacity of the local generating unit out-of-service.

ORTAC Load Security and Restoration

With respect to supply interruptions, ORTAC requires that the transmission system be designed to minimize the impact to customers of major outages, such as a contingency on a double-circuit tower line resulting in the loss of both circuits, in two ways: by limiting the amount of customer load affected; and by restoring power to those affected within a reasonable timeframe.

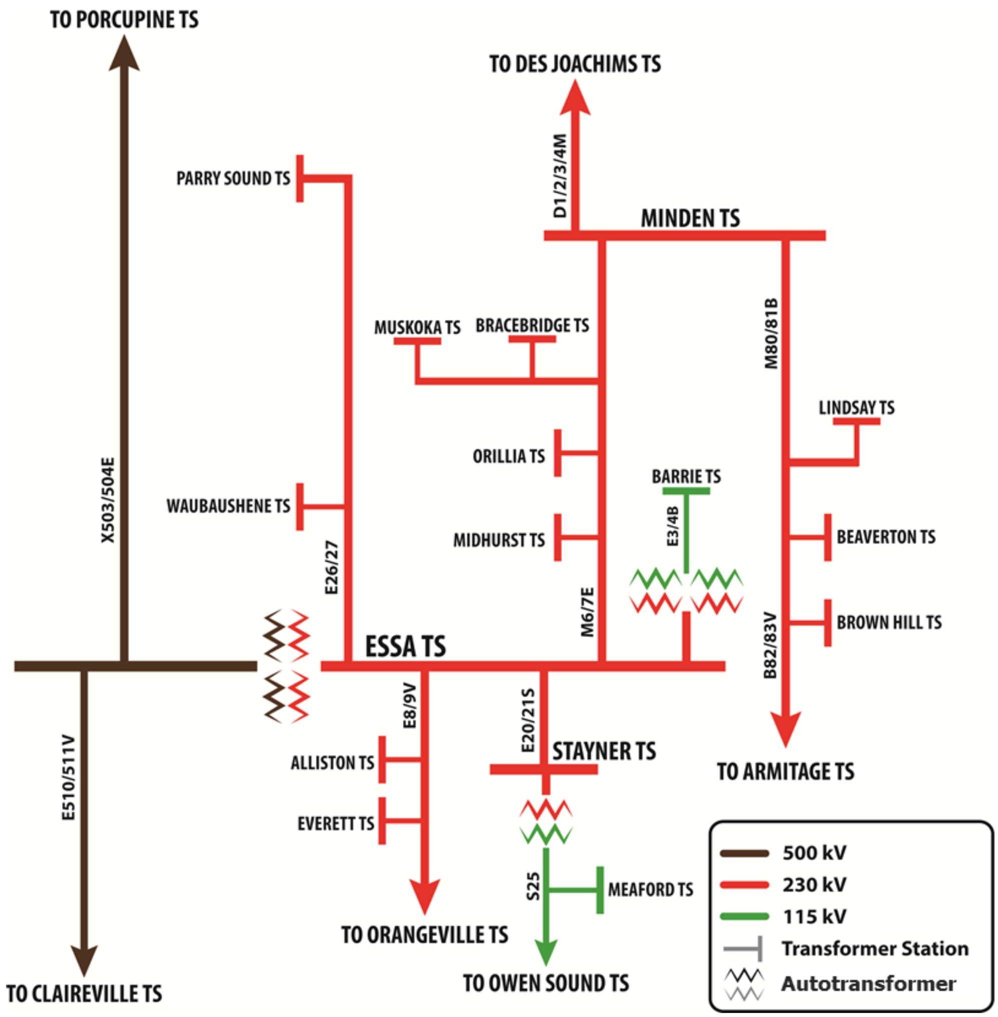
Specifically, ORTAC requires that no more than 600 MW of load be interrupted in the event of a major outage involving two elements. Further, load lost during a major outage is to be restored within the following timeframes:

- All load lost in excess of 250 MW must be restored within 30 minutes;
- All load lost in excess of 150 MW must be restored within four hours; and
- All load lost must be restored within eight hours.

B.3.2 Study Assumptions

Planning criteria were applied to assess supply capacity and reliability needs in the broader sub-region impacting the Essa autotransformers, including the Barrie/Innisfil and Parry Sound-Muskoka Sub-regions.

Figure B-1: Single Line Diagram for the Essa Bulk Study



The scope of the study included the following transmission elements:

- Essa 500/230 kV autotransformers T3 and T4
- Transmission circuits:
  - 500 kV: X503/504E, E510/511V
  - 230 kV: E8/9V, E20/21S, E26/27, M6/7E, M80/81B
  - 115 kV: E3/4B *(to be upgraded to 230 kV within the study period)*

- Transformer stations: Essa, Barrie, Stayner, Everett, Alliston, Waubaushene, Parry Sound, Midhurst, Orillia, Bracebridge, Muskoka, Minden, Lindsay, and Beaverton

The study considers the following contingencies:

- All single and double circuit outages in study scope
- Outages of one or both Essa 500/230 kV autotransformers
- Breaker failure contingencies at Essa, Minden, and in-line at Brown Hill
- Loss of generation at Des Joachims

PSS/E Base Case and Bulk System Conditions

The broader South Georgian Bay/Muskoka area was assessed using PSS/E Power System Simulation software. The PSS/E base case for the planning study was adapted from the 2016 PSS/E base case produced by the IESO.

Demand Forecast

The study was conducted for both winter and summer peak conditions. The IRRP forecasts for the Barrie/Innisfil and Parry Sound–Muskoka Sub-regions were used as the basis of the forecast. For stations not included in the scope of these studies, or for winter peaking information for the Barrie/Innisfil area, the Hydro One Needs Assessment forecast was used as a basis and extrapolated for the last 10 years of the study period.

North South Interface Flow Sensitivity

The Flow South conditions outlined in Table B-7 were tested to examine the impact of the North South interface on the timing of any identified needs.

Table B-7: Flow South Conditions Used to Examine Sensitivity

Base Case	Flow South
Summer Peak – Reference	1200 MW
Winter Peak – Reference	520 MW
Summer Peak – Extreme Flow South	1900 MW
Summer Peak – Flow North	-440 MW

Equipment Ratings

Transmission line and transformer ratings are as per transmitter records, assuming 35°C ratings for summer and 10°C ratings for winter. A wind speed of 4 km/h was respected for both the summer and the winter case.

Barrie/Innisfil Sub-region IRRP

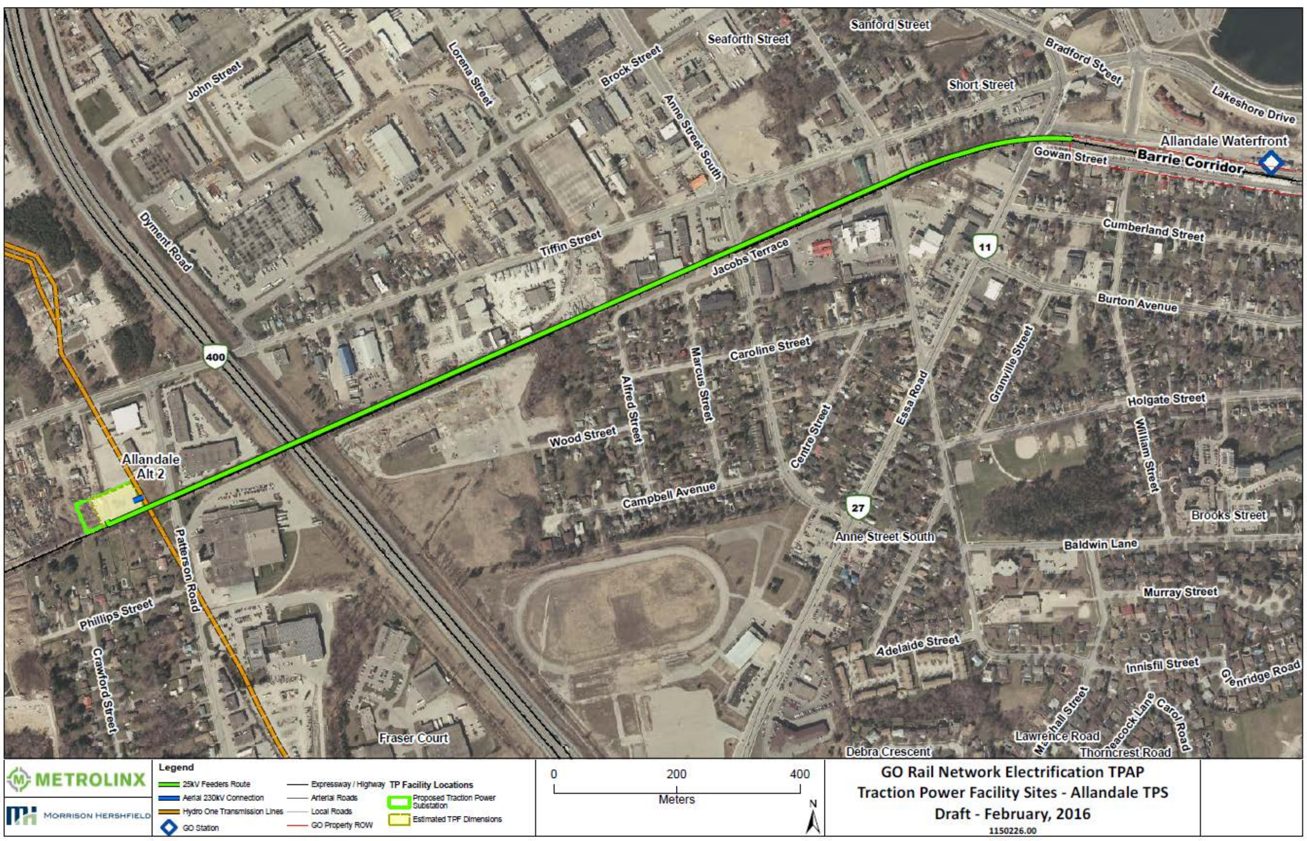
Appendix C: Other Planning Considerations

Appendix C: Other Planning Considerations

C.1 Metrolinx Electrification Plans – Barrie Area

Metrolinx is currently planning to install a traction power station ("TPS") for the Barrie line in the study area. The proposed location for the TPS is south of the existing Barrie TS. The TPS will be supplied by a short line-tap that will connect to the new Essa/Barrie 230 kV double-circuit line. Metrolinx is currently in the feasibility study phase of the project and more information will be available once it is complete. The map Metrolinx is currently using in their public consultation[2] has been included below, Figure C-1.

Figure C-1: Metrolinx Proposed Traction Power Station for the Barrie Line



[2] https://www.metrolinxengage.com/en/content/Barrie/corridor
https://www.metrolinxengage.com/sites/default/files/documents/go_electrification_public_meeting.pdf