ATTACHMENT 33 – ICM BUSINESS CASES POWERSTREAM RZ

Business Case

Project Name

York Region Rapid Transit VIVA Bus Rapid Transit Y2 and H2 Projects

Project ID

101762

Project Duration

2016-2019

Expected In-service date

Various sections will be energized as the project progresses from 2016-2019

Category

System Access

Background

This project addresses the investment need, as a result of mandatory relocation of electrical distribution assets, to support the Bus Rapid Transit ("BRT") as requested by the York Region Rapid Transit ("YRRT") Road Authority, under the *Public Service Work on Highway Act*.

Since 1971, York Region's population has increased nearly seven fold. Growth projections indicate that by 2041, the region will add 630,000 to the existing population of 1.2MM residents. In addition to the population growth, the employment projection for York Region is an increase of 325,000 new jobs, which are expected to drive significant economic activity and increase the resiliency of York Region's economy. Most of the forecasted population growth is expected to occur in the southern municipalities of York Region, i.e., Richmond Hill, Vaughan and Markham.

The existing regional road network consists of more than 4,100 lane kilometers of urban and rural roads that carry more than six billion vehicle kilometers of travel, annually.

In order to meet the transportation needs resulting from the forecasted growth, York Region issued a revised Transportation Master Plan ("TMP") in 2016. The TMP expands on the 2009 Transportation Master Plan. The TMP maps out the transportation requirements to 2041 and specifically shapes the Rapid Transit outlook for York Region.

Building on the 2009 TMP, the 2016 TMP proposes further enhancements to the transportation infrastructure and expands on several Rapid Transit corridors per the VIVA Expansion Plan. It will now include Jane Street, Major Mackenzie Drive and Leslie/Don Mills roads, in addition to Yonge Street, Highway 7 and Davis Drive from the original vivaNext Plan.

The major Rapid Transit Corridors that will be in Alectra Utilities' PowerStream RZ include:

Yonge Street Rapid Transit Corridor

The vivaNext rapidway from Highway 7 to 19th Avenue is currently under construction, with the exception of the historic core of Richmond Hill from Major Mackenzie Drive to Levendale Avenue.

Highway 7 Rapid Transit Corridor

The 2016 TMP proposes the construction of a median rapidway plus six traffic lanes from Helen Street West to Kipling Avenue. The section from Helen Street West to Highway 400 was the first rapidway segment that was Metrolinx funded; it is scheduled to be complete by 2019. The section east of Highway 400 to Bowes Road is under construction and is being coordinated with the opening of Toronto –York Spadina Subway extension in 2017.

Jane Street

Jane Street is part of the Viva Network Expansion Plan with curbside stations being constructed between Highway 7 and Major Mackenzie Drive starting in 2018. Jane Street was identified for widening to six lanes in the 2009 TMP; rapid transit along Jane Street will provide service connection with the Toronto-York Spadina Subway Expansion.

Metrolinx and York Region have been constructing BRT Rapidways along various routes in York Region since 2010. Metrolinx is providing the financial funding for the transportation infrastructure projects. York Region Rapid Transit Corporation ("YRRTC") oversees the construction and day-to-day operation of the BRT Rapidways.

Due to the scope, size and complexity, YRRTC has staged the initiative into several sections and phases as illustrated in project summary in Figure 1.

1) *Highway 7 – Markham, Richmond Hill and Vaughan, Davis Drive –Newmarket (H3.1, H3.2, H3.3, d1 and H2-VMC, 2010-2017)*

2) *Yonge Street – (Y2.1, Y2.2 and Y 3.2, 2010-2018)*

3) *Highway 7 West – Vaughan, West of Commerce, Bathurst and Centre ,(H2 –West and H2 East 2015-2020)*

4) *Highway 7 East – Markham Centre (H3.4, 2016-2020)*

Figure 1 - Project Summary for Funded YRRTC Projects 2010-2017

	Summary of Currently Funded Capital Projects to 2021				
Summary: Project Descriptions	**Highway 7 – Markham, Richmond Hill and Vaughan Davis Drive - Newmarket [H3.1, H3.2, H3.3, D1 and H2-VMC] 2010-2017**	**Yonge Street [Y2.1, Y2,2, Y3.2] 2014-2018**	**Highway 7 West - Vaughan West of Commerce, Bathurst & Centre H2-West and H2-East [Phase 2] 2015-2020**	**Highway 7 East- Markham Centre [H3.4] 2016-2020**	**Facilities & Terminals 2012-2021**
Key Partners	- Metrolinx - York Region and local municipalities - Kiewit-EllisDon - YRRTC/YC2002 – 10 year partnership	- Metrolinx - York Region and local municipalities - RapidLINK Constructors	- Metrolinx - York Region and local municipalities - Infrastructure Ontario - EDCO	- Metrolinx - York Region and local municipalities - Contract award to third party - TBD	- Federal Government - York Region and local municipalities - TYSSE - Individual contracts per facility – PCL, Smart REIT and TBD
Procurement / Legal Arrangements	- Design Build Contract - Metrolinx Master Agreement - Project Charters - Rapid Transit Agreement with York Region - York Region Access and Operating Agreement with Metrolinx - Project Implementation Plan	- Public procurement - Design Build Contract - Metrolinx Master Agreement - Project Charter - Rapid Transit Agreement with York Region - York Region Operating Agreement with Metrolinx - Project Implementation Plan	- Public Procurement / Alternative Finance Procurement [AFP] - Metrolinx Master Agreement - Project Charter - Project Agreement - Rapid Transit Agreement with York Region - Project Implementation Plan - York Region Operating Agreement with Metrolinx	- Public procurement - Contract arrangements tbd - York Region Operating Agreement with Metrolinx	- CSIC - Federal Contribution Agreement[s] - Design Build/ Bid Build Agreements - TBD - Provincial Quick Wins - Tri-party Access and Service Agreements
Governance	- YRRTC Board/Metrolinx Board - Metrolinx Program Executive Group/Senior Staff Working Group - Joint coordination meetings with contractor and project management teams	- YRRTC Board/Metrolinx Board - Metrolinx Program Executive Group/Senior Staff Working Group - Joint coordination meeting with contractor and project management team	- YRRTC Board/Metrolinx Board - Metrolinx Program Executive Group/Senior Staff Working Group - Joint Project Committee - Project Management Team - Works Committee - meetings with contractor and project management teams	- YRRTC Board/Metrolinx Board - Metrolinx Program Executive Group/Senior Staff Working Group - Unionville mobility hub working group	- YRRTC Board - York Region - Federal Management Committee - TYSSE
Delivery Agent	- YRRTC	- YRRTC	- Infrastructure Ontario: Procurement Advisor - YRRTC	- YRRTC	- YRRTC
Project Completion	- Construction complete 2017 - Project and program close out	- Construction complete 2018 - Project and program close out	- Construction complete 2019 - Project and program close out	- Construction complete 2020 - Project and program close out	- Construction complete 2021 - Project and program closeout

In order to accommodate the development of this transportation infrastructure, Alectra Utilities is required to relocate a very significant amount of overhead ("OH") and underground ("UG") plant, including express 27.6kV feeders, that have been identified as posing a conflict to the construction of the rapidway.

Since 2010, the former PowerStream has been relocating OH and UG plant to accommodate road widening and shifting of the boulevard to support the YRRT construction. The following details the work completed to date:

(i) H3.2: Highway 7, East of Bayview Ave to West of Warden Avenue
(ii) H2 VMC: Highway 7, West of Edgeley Blvd to East of Bowes Road in Vaughan
(iii) H2 West: Sections along Highway 7, Helen Street East of Highway 400 in Vaughan
(iv) H2 East: Sections on Centre Street from Highway 7 to Bathurst Street, on Bathurst Street from Centre Street to Highway 7 in Vaughan
(v) Highway 7 from Bathurst Street to Yonge Street in Richmond Hill
(vi) Y2.2: Sections on Yonge Street from 19th Avenue to Levendale Road
(vii) Y2.1: Sections on Yonge Street from Major Mackenzie Drive to Highway 407 in Richmond Hill,

The timelines for the project are dictated by the YRRTC, in conjunction with the contractors: RapidLink and EDCO.

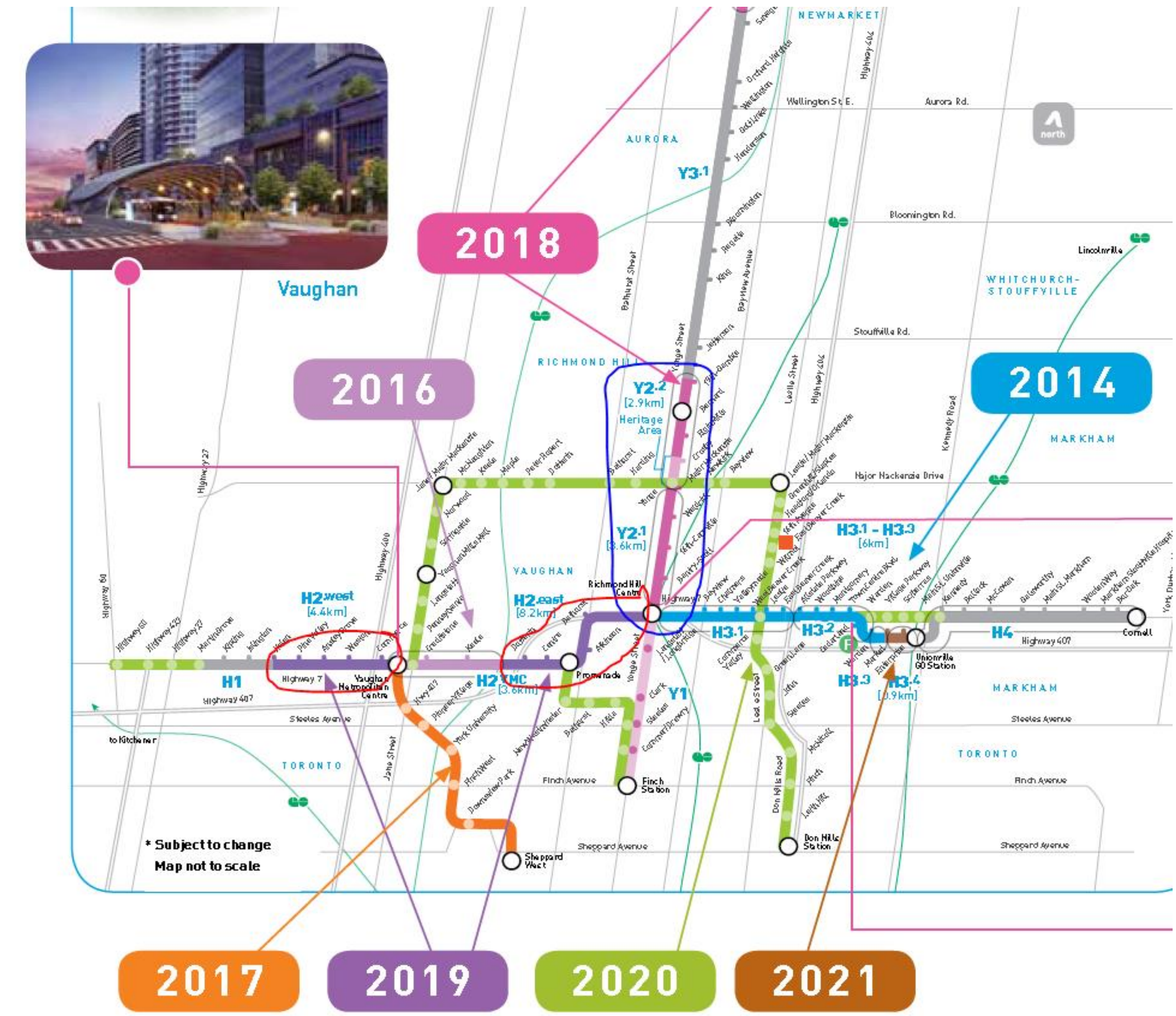
Scope

The current BRT Rapidways phases under construction are Y2 and H2, as illustrated in Figure 2.

The Y2 project is illustrated and outlined in blue. The Y2 consists of two project sections along Yonge Street referred to as Y2.1 (from Highway 7 to Major Mackenzie Drive) and Y2.2 (from Levendale to 19th Avenue) totaling to approximately 6.5km of BRT Rapidway. The contract for this project, valued at approximately $260MM, was awarded by YRRTC to Rapid Link. The Y2 project is structured as a Design-Build initiative.

The H2 project is illustrated and outlined in red. The H2 consists of two project sections H2-West and H2-East totaling approximately 8.5km of BRT Rapidway. The contract for this project, valued at approximately $ 330M, was awarded by YRRTC to EDCO. The H2 project is being done through Alternative Financing and Procurement ("AFP") structure as a Design-Build-Finance project. Figure 2 illustrates the BRT route and the proposed construction schedule.

Figure 2 - BRT Rapidways Project



Y2 and H2 rapidway projects are located on major streets with significant OH as well as UG distribution system plant, including express 27.6kV feeders, which pose a conflict to construction of the rapidways.

Based on known designs and plans, Alectra Utilities has assessed the scope of the required relocation work which involves both OH and UG relocations, as well as Joint-Use Trench ("JUT") to accommodate road widening and shifting of the boulevard. Table 1 and Table 2 provide the high level hydro relocation scope necessary to facilitate the construction of the rapidway.

Table 1- Detailed work for Y2

Y2.1						
Phase/Stage	Description	Work	Length of Underground Alignment	Length of 1000 MCM CU	Length of 350 MCM CU	Number of Switchgear
Stage 4	Yonge St- West Side - Baif Blvd. to Major MacKenzie Dr. W.	Concrete Encased Ductbank Installation, Cable Installation and Final Terminations/Cutovers	1430m	16830m	5610m	4
Stage 5,6	Yonge St- East Side - High Tech Blvd. to 16th Ave.	Final Terminations/Cutovers	1340m	9450m	3150m	0
Stage 7,8	Yonge St- East Side - 16th Ave. to Major MacKenzie Dr. E.	Concrete Encased Ductbank Installation, Cable Installation and Final Terminations/Cutovers	2000m	14370m	4790m	5
Y2.2						
Phase/Stage	Description	Work	Length of Underground Alignment	Length of 1000 MCM CU	Length of 350 MCM CU	Number of Switchgear
Stage 7,8,9	Yonge St- East Side - South of Devonsleigh Blvd. to 19th Ave.	Cable Installation and Final Terminations/Cutovers	775m	4725m	875m	2

Y2.1 has been staged in three sections for construction (stages 4, 5&6, 7&8) as outlined in Table 1.

Y2.2 has been staged in one section for construction (stages 7, 8 and 9), which includes relocation work on Yonge Street East from South of Devonsleigh Boulevard to 19th Avenue.

The Y2.1 and Y2.2 project is being constructed under Design – Build project structure. There are uncertainties regarding the timelines, final road alignment, resource allocation as well as technical challenges as the majority of the work is underground. In light of these uncertainties, the full scope may not be completed by 2018 and work may carry over future years.

Table 2 - Detailed work for Y2

H2-East								
Phase/Stage	**Description**	**Work**	**Number of Poles**	**Number of LIS**	**Length of Underground Alignment**	**Length of 1000 MCM CU**	**Length of 2/0 AL**	**Number of poles where neutral is to be raised**
Phase 3B and 3C	along Bathurst, from Flamingo to North End of Project	Installation of poles including OH equipments, Cable Insallation and Final Terminations/Cutovers, Neutral Raising along	41	3	57m	0m	171m	50
Phase 4	along Centre, from New Westminster to Concord	Installation of poles including OH equipments, Cable Insallation and Final Terminations/Cutovers	4	0	10m	0m	30m	0
Phase 5	along Centre, from Concord to West of Dufferin	Installation of poles including OH equipments, Cable Installation and Final Terminations/Cutovers	22	6	180m	0m	540m	0

H2-West								
Phase/Stage	**Description**	**Work**	**Number of Poles**	**Number of LIS**	**Length of Underground Alignment**	**Length of 1000 MCM CU**	**Length of 2/0 AL**	**Number of Switchgear**
Phase 2	along Hwy 7, from C1 to Aberdeen	Installation of poles including OH equipments,Cable Installation and Final Terminations/Cutovers	6	1	40m	0m	120m	0
Phase 3	along Weston Road	Installation of poles, concrete encased ductbank, and switchgears	8	0	400m	2400m	0m	2
Phase 4 & 5	along Hwy 7, Nova Star to West of Edgeley	Installation of poles, 4-bore shot crossing Hwy 400	29	8	360m	2160m	0m	2
Phase 6	along Hwy 7, C1 to West End of Project	Installation of poles including OH equipments, Cable Installation and Final Terminations/Cutovers	24	0	280m	0m	840m	0m

H2 East has been staged in three stages for construction (Phase 3B & 3C, Phase 4 and Phase 5), as outlined in Table 2.

H2 West has been staged in four stages for construction (Phase 2, Phase 3, Phase 4 & 5 and Phase 6), as outlined in Table 2.

Based on available information on H2 East and H2 West scope, designs, road alignment as well as resource allocations, Alectra Utilities has plans to complete this portion of the project in 2018, in order to not encumber the broader YRRT project.

Options Considered

Alectra Utilities is obligated to relocate its distribution plant to facilitate expansion of the roads and transportation infrastructure. This project is deemed mandatory under *the Public Service Works on Highways Act*.

Budget

Total forecasted gross expenditure for the relocation work for the H2 and Y2 projects is $69.00MM. Once adjusted for contributed capital of $38.20MM, the net expenditure from 2016 to 2019 is $30.81MM.

Table 3 lists the forecasted in-service expenditure from 2016 to 2019, based on the scope of relocation work determined from designs and construction timelines received from YRRT, as well as RapidLink and EDCO.

Table 3 - Capitalized Dollar Based on In Service Date.

Y2					
	2016	**2017**	**2018**	**2019**	**Total Budget**
Gross Capital	$4,892,979.48	$16,000,000.00	$12,700,000.00	$7,300,000.00	$40,892,979.48
Contributed Capital	$2,574,467.02	$8,000,000.00	$6,350,000.00	$3,650,000.00	$20,574,467.02
Net Capital	$2,318,512.46	$8,000,000.00	$6,350,000.00	$3,650,000.00	$20,318,512.46

H2					
	2016	**2017**	**2018**	**2019**	**Total Budget**
Gross	$516,976.05	$11,713,599.47	$12,713,736.20	$3,165,000.00	$28,109,311.72
Contributed	$466,669.37	$7,007,699.47	$7,820,536.20	$2,326,900.00	$17,621,805.04
Net	$50,306.68	$4,705,900.00	$4,893,200.00	$838,100.00	$10,487,506.68

Total YRRT					
	2016	**2017**	**2018**	**2019**	**Total Budget**
Gross	$5,409,955.53	$27,713,599.47	$25,413,736.20	$10,465,000.00	$69,002,291.20
Contributed	$3,041,136.39	$15,007,699.47	$14,170,536.20	$5,976,900.00	$38,196,272.06
Net	$2,368,819.14	$12,705,900.00	$11,243,200.00	$4,488,100.00	$30,806,019.14

Alectra Utilities has been told by YRRT that the scope of the YRRT project for 2018 may increase, which would result in an increase in the cost of the project to Alectra Utilities. Given the present uncertainty of the accelerated schedule and increased scope, Alectra Utilities ICM request for this project relates to the amount for which it is certain will be completed. Alectra Utilities identifies that the variance of this project may be addressed through the ICM true-up mechanism.

Business Case

Project Name

Station Switchgear Replacement – 8th Line MS323

Project ID

102730

Project Duration

Two years:

Phase 1 (2017) - Design and procurement of long-lead material

Phase 1 (2018) - Construction and Commissioning

Expected In-Service Date

December 31, 2018

Category

System Renewal

Background

The 8th Line MS323 is a 44/15 kV municipal transformer station ("MS") located in Bradford. It is one of four municipal stations operated by Alectra Utilities in Bradford. The 8th Line MS323 has a capacity of 10MW and serves approximately 2,700 customers. This station also serves as backup for other stations in the service area.

The most recent asset condition assessment of the low voltage (15kV) switchgear at the 8th Line MS323 has identified a system renewal investment driven by technical obsolescence, poor condition assessment and historical trend of equipment failure.

The switchgear at the MS323 includes four Federal Pioneer SFA17 Sulfur Hexaflouride (SF_6) circuit breakers, which have been determined through operational and functional requirement assessments to be sub-standard. Three of the breakers are configured for feeder protection and the fourth breaker is configured to protect the transformer at the station.

This type of circuit breaker has demonstrated historical failures and is considered obsolete; it is not supported by the manufacturer. Spare parts are not commercially available and must be recovered through the cannibalization of old stock, where possible.

In the most recent annual asset condition assessment, the circuit breakers located at the 8th Line MS323 switchgear lineup were identified as being in the poor condition. Replacement of these circuit breakers is considered a higher priority compared to other poor condition circuit breakers, since the equipment at MS323 is outdoors and more vulnerable to adverse weather conditions. Figure 3 identifies the equipment configuration at MS323.

Figure 3 – Configuration of Outdoor Switchgear at MS323

Scope

A system renewal investment has been identified to address the sub-standard switchgear lineup at 8th Line MS323 with a new 15kV metal-clad switchgear lineup, complete with arc-resistant construction that meets present day standards. The new switchgear will be enclosed in a new prefabricated building.

Scope of the renewal includes ancillary work required to bring the station up to current standards which improves overall reliability and results in cost savings through economies of scale. This additional work includes renewal/implementation of:

- power cables and terminations
- cable duct banks
- a switchgear cell for ancillary equipment
- SorbWeb for transformer oil spill containment
- station service transformer
- communications panel
- relay panel
- AC and DC panels

Similar switchgear replacements have been successfully executed at the following municipal stations:

- Anne St North MS301 in 2016
- Saunders MS302 in 2016

The replacement of these obsolete circuit breakers at 8th Line MS323 will ensure reliability in Bradford. Based on an estimated 0.1 failures per breaker per year and assuming load can be transferred within two hours for a feeder outage and four hours for a station outage, an average of 10,800 Customer Minutes of Interruption ("CMI") per feeder breaker per year and 64,800 CMI per year for the transformer breaker is projected to be avoided. The total for all four circuit breakers is projected to avoid 97,200 CMI per year.

Options Considered

Option 1: *Status Quo*

Under this option, Alectra Utilities will continue to operate the existing switchgear line-up and reactively replace them upon failure.

This option is not recommended, due to the operation risk and significant negative impact on reliability for a large number of customers. Further, failure of the existing equipment would warrant emergency replacement, resulting in non-budgeted funding requirements and could result in lengthy customer interruptions. Reactive replacement of failed equipment is estimated to be more costly than proactive replacement at the station. In addition, interruption impact on customers can be minimized with proactive replacement. As the breakers are no longer supported by the manufacturer, replacement breakers and parts are no longer available.

Option 2: Circuit Breaker Retrofit

Under this option, Alectra Utilities considered the feasibility of retrofitting the existing circuit breakers. In some cases, the switchgear may be retrofitted with new circuit breakers and modified for arc resistant construction. This option was examined with the intent to extend the switchgear life for 15 to 20 years. While the cost for replacing the individual breakers was not estimated, it is expected that doing so would not be cost effective nor would this option provide the benefits of improved safety offered by arc-resistant capability of replacement switchgear.

Option 3: Replace Circuit Breakers at MS323

Under this option, Alectra Utilities will replace the existing 15KV switchgear at 8^{th} Line with a new arc resistant metal clad switchgear.

Recommended Option

The recommended solution is to replace the 15 kV switchgear at 8^{th} Line MS323 with a new 15 kV metal-clad switchgear lineup with arc-resistant construction that meets present day standards and will be housed in a prefabricated building. A new building is required because replacement switchgear would not fit in the existing enclosure. By purchasing the switchgear with a new prefabricated building and replacing the ancillary equipment enclosed in this building, the station outage time is reduced from approximately twelve weeks to four weeks.

It is also recommended that the switchgear replacement be combined with ancillary equipment upgrades required to bring the station up to current standards, improve overall reliability and result in cost savings through economies of scale.

Execution of this project will serve to extend the useful life of this station and improve the overall reliability of supply to Bradford.

Budget

Preliminary engineering and procurement for long-lead material are to proceed in 2017 for an estimated cost of $0.39MM. The estimated cost for completing construction and commissioning of this project in 2018 is $0.93MM.

Table 4: Budget Breakdown by Year

2017	2018	Total Budget
$394,304	$930,153	$1,324,457

Business Case

Project Name

Rear Lot Supply Remediation – Royal Orchard – North (Markham)

Project ID

150047

Project Duration

Phase 1 – 2018

Phase 2 – 2019

Phase 3 - 2020

Expected In-Service Date

December 31, 2018/2019/2020

Category

System Renewal

Background

Alectra Utilities has 37 areas in the PowerStream RZ where customers are supplied by rear lot distribution systems. The electrical system is deteriorating, sub-standard and poses operational, safety, and customer service concerns that must be addressed. If not addressed, the system will continue to deteriorate, and thereby increase the probability of failures and present safety hazards to levels that are neither acceptable nor manageable.

In December 2013, Ontario was hit by an ice storm (the "Ice Storm"), which significantly impacted the PowerStream service territory. During the storm, many trees, including trees in rear lot areas, fell onto power lines and created prolonged power outages to customers. Power restoration in rear lot areas was very difficult due to accessibility issues.

The Ice Storm caused 29,831,573 CMI within the rear lot grids, which accounted for 16.68% of the total system CMI due to the storm.

On a prioritized basis, each year a number of rear lot projects are selected for remediation to address operation and safety concerns, as well as to maintain system reliability and customer service.

Projects are selected annually and are prioritized based on the following factors:

- Asset Condition;
- Imminent Health, Safety and Environmental Issues;
- System Configuration and Capacity;
- Impact to Reliability;
- Criticality of the Circuit;
- Economic and Cost Benefit Analysis; and
- Co-ordination with other Capital and Maintenance Work Programs.

The assets of the rear lot distribution system in the area of Royal Orchard – North (Markham) are at the end-of-life and require remediation. The poles in this rear lot location were inspected in 2013; a majority of the poles are in critical condition. The distribution system was constructed in the 1960s and is over 55 years old.

Table 5 - Demographic Data of Distribution Assets in Royal Orchard - North (Markham)

Location Reference #	Demographic Data							
	Average Pole Age	Number of Poles	Average Transformer Age	Number of Transformers	Number of Customers (Commercial)	Number of Customers (Residential)	Total Number of Customers	Total Number of Services
32B	49	29	51	14	0	164	164	164

Table 6 - Asset Condition Data of Distribution Assets in Royal Orchard – North (Markham)

Location Reference #	Condition Data: 1 (Good) to 10 (Bad)						
	Pole	Transformer	Secondary Run-offs	Primary Runner	Safety Rating for Workers	Safety Rating for Public	Accessibility
32B	9	8	5	8	8	7	9

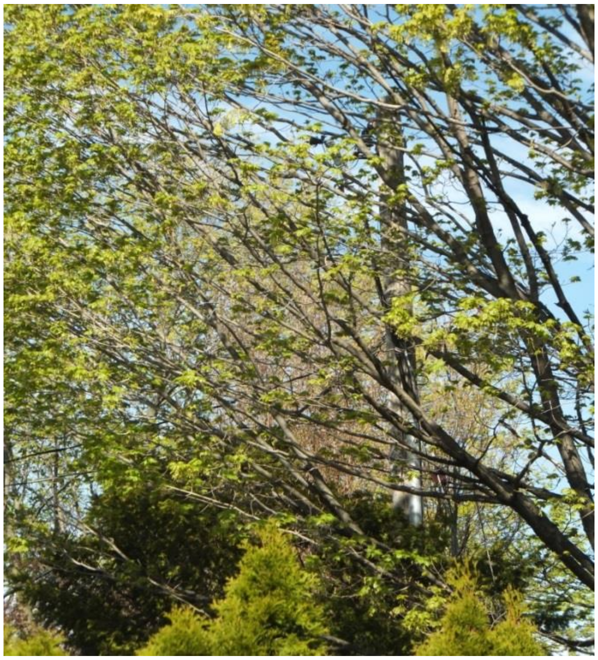
The Royal Orchard Rear Lot area is divided into smaller portions: Royal Orchard – East, Royal Orchard – North, Royal Orchard – South, and Royal Orchard – Baythorn. The Royal Orchard – East portion has already been remediated to front lot underground in 2015 and 2016. The Royal Orchard – Baythorn portion is being remediated with front lot underground in 2017.

The multi-year phased approach to address the remaining rear lot distribution investment need in the area is proposed to be completed over three years from 2018-2020.

Figures 4 and 5 are included to demonstrate the accessibility and vegetation management challenges in the Royal Orchard area.

Figure 4 - Wood Pole in Customer's Backyard

Figure 5 - Wood Pole Surrounded by Trees in Customer's Backyard



Scope

The scope involves converting the Royal Orchard – North (Markham) area from rear lot overhead supply to front lot underground supply including both the primary and secondary system components. There are a total of 164 customers affected by the existing rear lot supply.

Operations Impact

(i) Decreased system reliability:

- Higher outage frequency and longer outage duration will negatively impact system reliability for the customers in the area.

(ii) Difficult accessibility for crew and equipment:

- Due to obstructions such as trees and customer construction, crews encounter difficulty to: gain access; bring in equipment; and create a safe working space in the rear lot. As a result, it is difficult to inspect, maintain, repair and replace equipment. Under emergencies, it is difficult to identify and isolate faulted components and perform switching. Accessibility for service vehicles is often impractical. In some cases, large cranes may be needed to reach over the rear lot from the street. In addition, system security is also at risk because the pole line is out of sight. This increases the risk of equipment being neglected and left to deteriorate.

(iii) Safety risk associated with reduced clearance due to encroachment of power line:

- Over time, growth of vegetation and obstruction due to customer facilities may jeopardize the minimum clearance requirements and restrict crew mobility.

(iv) Difficulty in addressing issues with customer:

- Customers have installed facilities in the backyard that encroach on easements and violate the vertical and horizontal clearance.

(v) Additional cost in tree trimming:

- In comparison to front lot pole line, rear lot pole line requires more frequent tree trimming.

Impact to Customers

The qualitative impacts are outlined below.

(i) Long outage restoration time due to difficult accessibility for PowerStream crews:

- In comparison to front lot distribution systems, rear lot distribution systems experience longer outage durations, as crews are constrained to access the system to restore power during an outage. The crews have to gain access to the backyard to identify, locate, isolate, and repair/replace equipment. In heavily vegetated areas, the crews must also clear or trim the vegetation before they can safely access the distribution system.
- If the replacement of major equipment (e.g., pole, transformer) is necessary, the outage time will extend because the crews need specialized equipment (e.g. large crane) to reach over customer houses to the rear lot where the distribution system is located.

(ii) More frequent outages due to vegetation, animal contact, and lack of access for PowerStream crews:

- When a rear lot supply was first constructed, the area was likely clear of obstruction. Over time, however, trees/bushes have grown near the electrical equipment, and may make contact with the power line. The growth of vegetation also increases the risk of animals (e.g. squirrels) coming into contact with electrical equipment.

(iii) Safety risk associated with close proximity to power line in the backyard:

- The Electrical Safety Code and easement terms specify minimum clearance between customer facilities and power line. There are many cases in which customers do not follow the safety rules and install facilities too close to power line. Examples include: storage facilities; playgrounds; trampolines; swimming pools; patio decks; landscaping; and, house extensions. These encroachments create safety hazards for both customers and crews.

Based on 2 failures per year and assuming each failure affects 168 customers of the rear lot and 100 customers outside of the area for a weighted duration of 3.5 hours per interruption, it is projected that 110,000 CMI can be avoided through a rear lot supply remediation.

Options Considered

Option 1: *Status Quo*

The *status quo* is to do nothing, allowing the rear lot supply system to deteriorate, and respond to the failures on an emergency basis. This option is not acceptable because the assets at rear lot are very poor condition and must be replaced to avoid lengthy outages to customers.

Option 2: Rear Lot Overhead

In this case, the existing rear lot plant is replaced with new overhead plant in the rear lot.

When the replacement project is implemented, the following design parameters were considered:

- Convert from 8.32 kV to 27.6 kV
- Install critical components such as fuse, switch, transformer as close to the accessible street as possible

This option is not acceptable because it does not resolve the major operations and customer reliability concerns related to the distribution assets located at rear lot at this location. In addition, this portion is part of the Royal Orchard area which is divided into smaller portions named Royal Orchard – East, Royal Orchard – North, Royal Orchard – South, and Royal Orchard – Baythorn. Other segments of Royal Orchard – East portion have already been remediated with to front yard distribution in 2015 and 2016. The Royal Orchard – Baythorn portion is presently under remediation to front lot underground distribution in 2017.

Figure 6 - Rear Lot Overhead Sketch

Option 3: Front Lot Overhead

Under this option, the existing rear lot plant is removed and new overhead plant is installed in front lot.

This option is not acceptable because it is not a standard practice to implement front lot overhead for residential supply.

Figure 7 - Front Lot Overhead Sketch

Option 4: Hybrid Design

Under Option 4, the existing rear lot primary conductors, switches and transformers are removed. New underground primary cable and padmount transformers are installed in front lot. To the extent possible, some of the houses can be supplied underground by installing underground secondary conduit and cable from padmount transformers. The rest of the houses will be supplied from secondary bus at rear lot. The existing rear lot pole line and secondary conductors will be replaced with new plant and kept at the rear lot.

This option is not acceptable because it does not resolve the major operations and customer reliability concerns related to the distribution assets located at rear lot in this area. In addition, this portion is part of the Royal Orchard area which is divided into smaller portions named Royal Orchard – East, Royal Orchard – North, Royal Orchard – South, and Royal Orchard – Baythorn. Other segments of Royal Orchard – East portion have already been remediated to front yard distribution in 2015 and 2016. The Royal Orchard – Baythorn portion is presently under remediation to front lot underground distribution in 2017.

Figure 8 - Hybrid Sketch

Option 5: Front Lot Underground

Under this option, the existing rear lot plant is removed and new underground distribution system is installed in front lot.

Figure 9 - Front Lot Underground Sketch

Recommended Option

The recommended solution is to convert the Royal Orchard – North (Markham) area from rear lot overhead supply to front lot underground supply (primary and secondary). This will reduce the number of outages and power restoration time. This project is part of the long-term rear lot supply remediation effort. The project will help avoid a total of two potential rear lot failures and 110,880 potential CMI per year. In addition, this project also eliminates safety hazards associated with ageing and deteriorating rear lot system.

The multi-year project is proposed in phases and will be completed over three years in 2018, 2019, and 2020.

Budget

Table 7 below provides the budget by year.

Table 7 - Budget Allocation

2017	2018	2019	2020	Total Budget $
$ -	$ 1,596,037	$ 2,536,513	$ 701,072	$ 4,833,622

If the project is not approved, Alectra Utilities would not remediate the rear lot location. Since the rear lot assets are at end-of-life and deteriorated, they have a very high probability of failure and will adversely impact reliability. The only option in such cases is replacement on an emergency basis which is more costly than a planned replacement. In addition, due to accessibility, it will be difficult to restore power quickly and customers will experience prolonged outages.

Business Case

Project Name

Cable Replacement – (M49) – Steeles Avenue and Fairway Heights Drive (Markham)

Project ID

150141

Project Duration

One year, 2018

Expected In-Service Date

December 31, 2018

Category

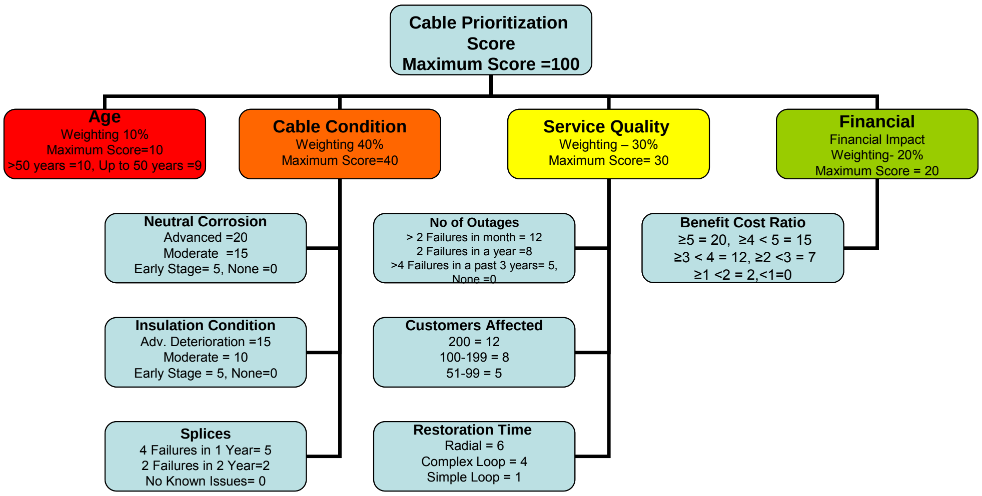
System Renewal

Background

Alectra Utilities has 8,388km of UG primary cable in service in the PowerStream RZ. A portion of the cable population is at end-of-life and requires rehabilitation, in order to maintain system integrity and reliable service to customers. Cable and splice failures are the leading cause of CMI within the PowerStream RZ; in 2016, it contributed to 9.8 minutes of SAIDI out of a total of 52.65 SAIDI minutes.

Alectra Utilities follows a systematic and consistent methodology to managing sub-standard cable that is at high risk of failure. First, Alectra Utilities addressed the sub-standard cable condition issue through a combination of cable injection rehabilitation and cable replacement on a prioritized basis. Cable splices are replaced when the cable is rehabilitated through injection. To supplement the process for prioritizing and determining cable segments for rehabilitation or replacement, Alectra Utilities conducts tan delta cable testing to determine the condition of the cable. Figure 10 illustrates the criteria, weighting and scoring index utilized in the prioritization process.

Figure 10 - Cable Prioritization Method



The underground cable in the (M49) - Steeles Avenue and Fairway Heights Drive (Markham) area is supplied via a John MS 13.8 kV feeder which demonstrates poor reliability performance. There are 117 customers within the project area. The cable is 35 years old and direct buried. Recent cable tests using the tan delta methodology indicate that the cable is sub-standard, at end-of-life and requires remediation. Cable replacement is proposed over cable rehabilitation (i.e., injection) as the cable is rated at 15kV cable and not compatible with the planned voltage conversion to 27.6kV initiative to be completed in 2018.

This project will convert the existing 13.8kV load to 27.6kV supply, thereby facilitating for the planned decommissioning of John MS. This rebuild will also replace 18 sub-standard transformers that are at end-of-life.

John MS provides supply to the area bounded by John Street to the north, Highway 404 in the east, Steeles Avenue to the south, and Bayview Avenue to the West. Most of the 13.8kV load has already been converted to 27.6kV, with the exception of a few remaining pockets. This project area is one of the remaining pockets of 13.8kV load supplied from John MS. When all of the 13.8kV load are converted to 27.6kV, John MS can be decommissioned.

The remaining pockets of the 13.8kV distribution system are supplied via feeders John-F5 and John-F6. The average Feeder Average Interruption Frequency Index (“FAIFI”) in the past three years is 2.937 for John-F5, and 1.745 for John-F6. Performance of both feeders is much worse than the system average interruption frequency index (“SAIFI”) of 1.155. When compared against all 322 feeders in Alectra Utilities service territory in the PowerStream RZ, John-F5 is the ninth worst and John-F6 is the 46th worst ranked feeders, in terms of FAIFI ranking.

As identified in Table 8, the average Feeder Average Interruption Duration Index ("FAIDI") in the past three years is 7.2 hours for John-F5, and 4 hours for John-F6. Outage duration performance for both feeders is much worse than the SAIDI of 1.077 which is identified in Table 9. John-F5 is the 5th worst and John-F6 is the 24th worst among all 322 feeders in the PowerStream RZ in terms of FAIDI.

Table 8 - 3 Year Average Feeder Average Interruption Duration and Frequency Index for Feeders John-F5 and John-F6

Feeder Data 2014-2016				
Feeder	FAIDI		FAIFI	
	FAIDI	Rank	FAIFI	Rank
JOHN-F5	7.202	5	2.937	9
JOHN-F6	4.004	24	1.745	46

Table 9 - 3 Year Average System Average Interruption Duration and Frequency Index for PowerStream RZ

2014-2016 System Average	
SAIDI	SAIFI
1.077	**1.155**

The three subdivisions supplied by the John-F6 feeder include Apricot Street, Fairway Heights and Quail Valley, as identified in Figure 11.

Figure 11 - Three Subdivisions on the John-F6 Feeder

Apricot Street and Fairway Heights are covered under the scope of the Cable Replacement – (M49) - Steeles and Fairway Heights project. Quail Valley is covered under the scope of the Cable Replacement – (M43) – Quail Valley. After these two cable replacement projects are completed, John MS can be decommissioned.

Scope

The scope involves cable replacement in the (M49) - Steeles and Fairway Heights area (Markham) to maintain system reliability and customer service. The total cable quantity for replacement is approximately 3.76km. In addition, Alectra Utilities has planned to convert the supply of the system in the area from 13.8kV to 27.6kV and replace 18 substandard transformers at end-of-life.

Based on previous five year data (2012-2016), on average, there are: 126 cable and splice interruptions per year; affect 37,474 customers; and cause 5,133,208 CMI. The average cable and splice failure impact is 40,740 CMI.

Based on the PowerStream RZ's failure average of 0.5 failures per 1km of cable in the worst areas, it is estimated that on average two failures can be avoided each year and that 81,480 CMIs per year can be avoided by replacing this cable.

In addition to the primary investment driver of addressing sub-standard cable in the area, the second investment driver is to upgrade the service area from the 13.8kV to 27.6kV system which will enable eventual decommissioning of John MS. Once the project is completed, the service areas will be renewed with new underground cable and converted to 27.6kV system leading to lower losses and system reliability.

Options Considered

Option 1: *Status Quo*

The *status quo* is to do nothing, allowing the sub-standard cable to run to failure, and respond to outages under emergency conditions. This option is not acceptable because the cable is at end-of-life, and will continue to further deteriorate. This will give rise to increasing failures that will further negatively impact customer service and reliability in the area.

Option 2: Cable Injection

Cable Injection was used to remediate a portion of this area which was already operating at 27.6kV. The remaining area is not recommended for cable injection because the remaining cable is rated at 15kV and therefore not suitable, when the area is converted from 13.8kV system to 27.6kV system. If the cable is injected now, the injected cables will require replacement in a few years when the area is converted to 27.6kV. The current cable is rated at 15kV class and operated at 13.8kV from John MS 13.8kV feeder. When John MS is decommissioned, the existing 13.8kV load must be converted to 27.6 kV system. The existing 15kV class cables cannot be operated at 27.6kV and therefore must be replaced.

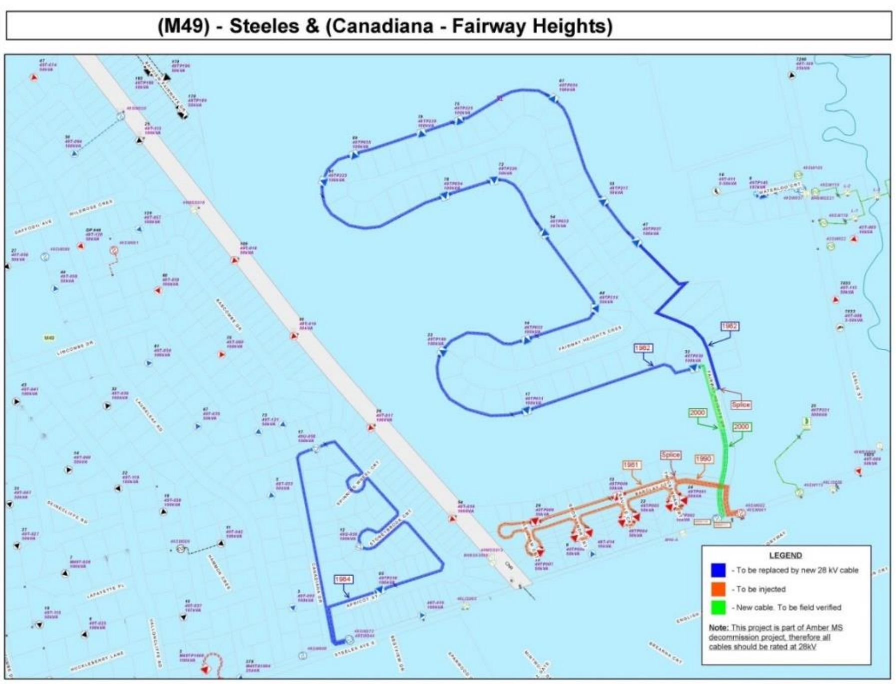
Option 3: Cable Replacement

Carry out cable replacement in the (M49) - Steeles and Fairway Heights area (Markham) to provide system reliability and sustainable customer service. The total cable quantity for replacement is approximately 3.76km . In addition, convert the cable rating from 13.8 kV to 27.6 kV, in order to facilitate system voltage conversion of the area and eventual decommissioning of John MS.

Recommended Option

The recommendation is to carry out cable replacement in the (M49) - Steeles Avenue and Fairway Heights Drive area (Markham) to provide system reliability and sustainable customer service. The project will help avoid 81,480 potential CMI. In addition, converting the cable to 27.6kV system will result in reduced system losses. Figure 12 illustrates the area under consideration for cable replacement.

Figure 12 - (M49) - Steeles Avenue and Fairway Heights Drive Area (Markham)



Budget

The table below provides the project costs.

Table 10 – Budget Allocation

2015	2016	2017	2018	Total Budget $
$ -	$ -	$ -	$ 1,749,769	$ 1,749,769

If the project is not approved, Alectra Utilities will not replace the cable. Since the cable is sub-standard, at end-of-life and deteriorated, it has a very high probability of failure and is expected to adversely impact reliability. In some cases, Alectra Utilities has experienced multiple failures in the same segment and cables have deteriorated to such an extent that they are beyond repair. The only option in such cases is replacement on an emergency or reactive basis, which is more costly than a planned replacement. In addition, since the load is still supplied at 13.8kV from John MS, customers are still impacted by the poor reliability of John MS feeder. Finally, keeping the existing cable will prevent the decommissioning of John MS, which will require continuous maintenance and will result in the continued operation of a substandard and underutilized station.

Business Case

Project Name

Cable Replacement – Steeles Avenue and New Westminster Drive (Vaughan)

Project ID

150142

Project Duration

Three years; 2018, 2019, and 2020

Expected In-Service Date

December 31, 2018/2019/2020

Category

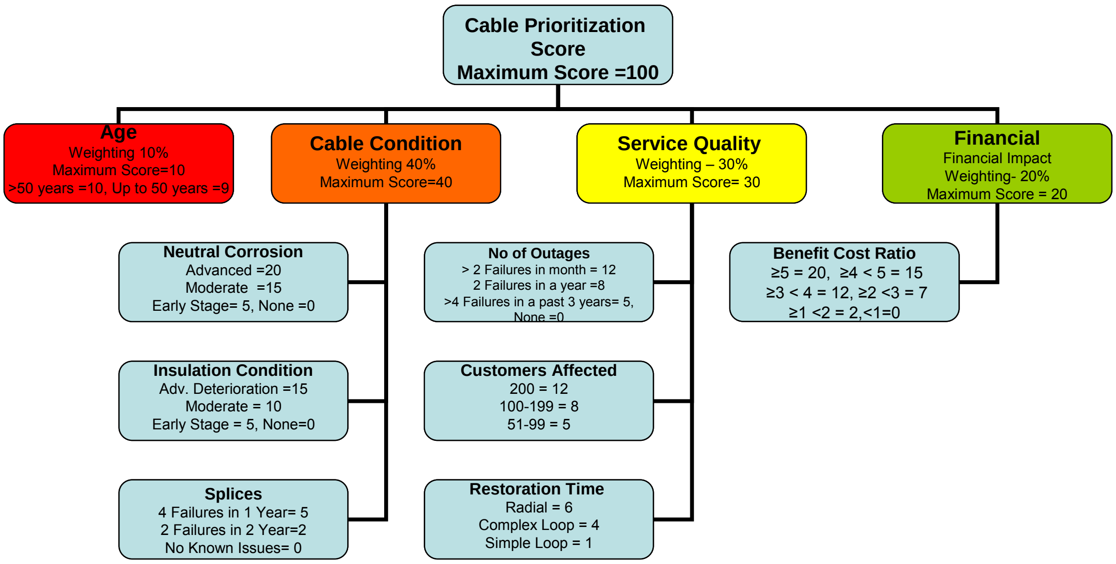
System Renewal

Background

Alectra Utilities has 8,388km of underground primary cable in service in the PowerStream RZ. A portion of the cable population is at end-of-life and requires rehabilitation, in order to maintain system integrity and reliable service to customers. Cable and splice failures are the leading cause of CMI within the PowerStream RZ. In 2016, cable and splice failures contributed to 9.8 minutes of SAIDI out of a total of 52.65 SAIDI minutes.

Alectra Utilities follows a systematic and consistent methodology to managing sub-standard cable of high risk of failure. First, Alectra Utilities addresses the sub-standard cable condition issue through a combination of cable injection rehabilitation and cable replacement on a prioritized basis. Cable splices are replaced when the cable is rehabilitation through injection. To supplement the process for prioritizing and determining cable segments for rehabilitation or replacement, Alectra Utilities conducts tan delta cable testing to determine the condition of the cable. Figure 13 illustrates the criteria, weighting and scoring index utilized in the prioritization process.

Figure 23 - Cable Prioritization Method

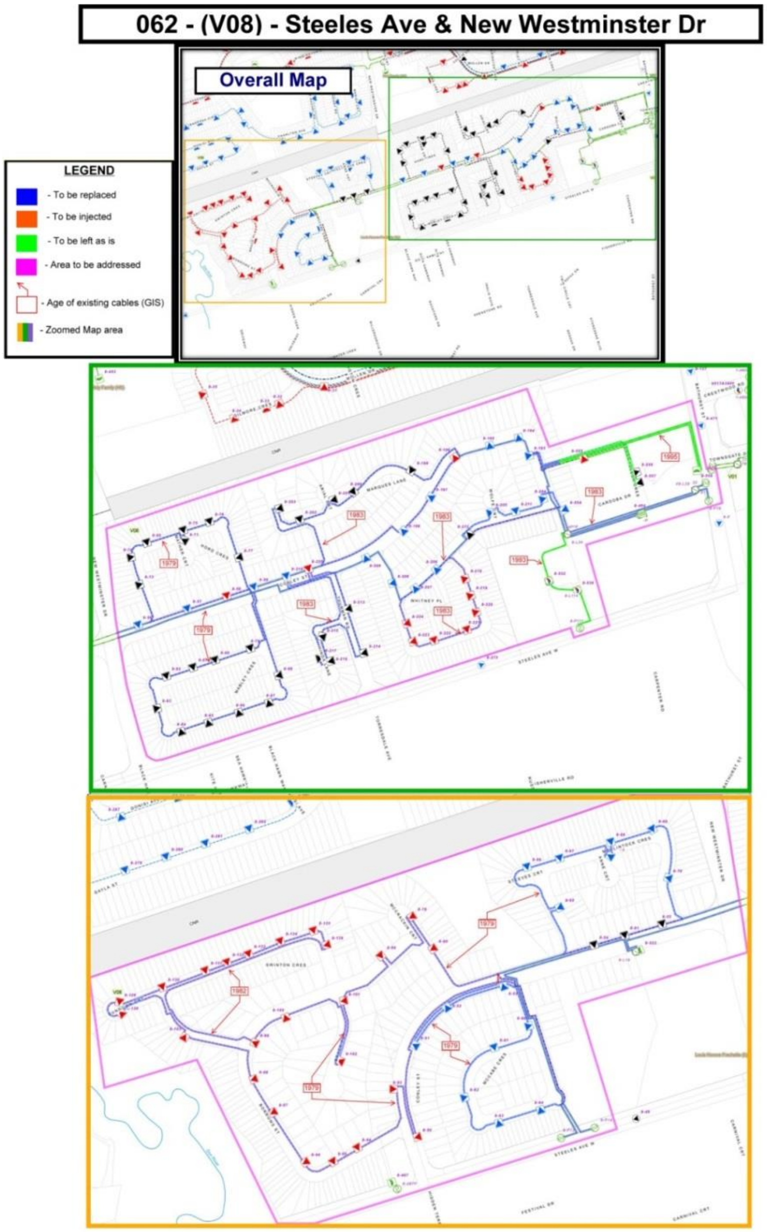


The underground cable in the Steeles Avenue and New Westminster Drive (Vaughan) area supplies 1,090 customers; there have been nine failures in the last four years. Recent tan delta cable tests in the area identify that the cable is at end-of-life and requires replacement. The Cable Replacement – Steeles Avenue and New Westminster Drive (Vaughan) project is proposed to be completed over three phases from 2018- 2020.

Scope

The scope involves cable replacement in the Steeles Avenue and New Westminster Drive area to maintain system reliability and customer service. The total cable quantity for replacement is approximately 16.21km. This quantity is planned for replacement over a three year period from 2018-2020, by phasing the renewal with approximately 5.40km of cable replacement per year. Figure 14 identifies the segment of cable and service area in the Steeles Avenue and New Westminster Drive area of Vaughan.

Figure 14 - (V08) - Steeles & New Westminster Area (Vaughan)



Based on previous five year data (2012-2016), there are on average 126 Cable and Splice Interruptions per year; this impacts 37,474 customers and causes 5,133,208 CMI. On average, each cable and splice failure impact is 40,740 CMI.

Based on the former PowerStream's failure average of 0.5 failures per 1km of cable in the worst areas, it is estimated that on average 2.7 failures can be avoided each year and it is projected that 109,998 CMI's per year can be avoided by replacing this cable.

Options Considered

Option 1: *Status Quo*

The *status quo* is to do nothing, allowing the sub-standard cable to run to failure, and respond to outages under emergency conditions. This option is not acceptable because the cable is at end-of-life; will continue to further deteriorate with increasing failures; and will negatively impact customer service and reliability in the area.

Option 2: Cable Injection

Cable Injection was considered, but the cable is not a candidate for rehabilitation. Cable injection is not recommended in this case because the cable is critically aged. The cable in the (V08) – Steeles Avenue and New Westminster Drive area will be 39, 40, and 41 years old in 2018, 2019, and 2020, respectively, and the cable test results indicate that the cable is at end-of-life and requires intervention.

Option 3: Cable Replacement

The option involves replacing the cable in the Steeles Avenue and New Westminster Drive area to maintain system reliability and customer service. The total cable quantity for replacement is approximately 16.21km. This quantity is planned for replacement from 2018-202, by phasing the renewal with approximately 5.40km of cable replacement per year.

Recommended Option

Option 3 is the recommended solution. Replacing the cable in the Steeles Avenue and New Westminster Drive area of Vaughan, to provide system reliability and maintain sustainable customer service, is part of the long-term cable rehabilitation initiative. The project will help avoid a total of 8 potential cable failures and 325,920 potential CMI.

The renewal is phased and implemented over a period of three years; the project will result in the avoidance of a total of 2.7 potential cable failures and 109,998 CMI.

Budget

The table below provides the budget breakdown by year.

Table 11: Budget Allocation

2017	**2018**	**2019**	**2020**	**Total Budget $**
$ -	$ 2,503,710	$ 2,637,700	$ 2,638,353	**$ 7,779,763**

If the project is not approved, Alectra Utilities would not replace the cable. Since the cable is at end-of-life and deteriorated, it has a very high probability of failure and is expected to adversely impact reliability in the area. In some cases, multiple failures in the same segment of deteriorated cables have already occurred. In these cases, the cables are beyond repair. The only option in such cases is replacement under emergency conditions, which is less economic when compared to planned replacement.

Business Case

Project Name

Planned Circuit Breaker Replacement – Richmond Hill TS#1

Project ID

150154

Project Duration

Two years

Phase 1 (2017) – Replace circuit breakers at Bus A
Phase 2 (2018) – Replace circuit breakers at Bus B

Expected In-Service Date

Phase 1 – December 31, 2018
Phase 2 - December 31, 2018

Category:

System Renewal

Background

Alectra Utilities supplies electricity to the Town of Richmond Hill within the PowerStream RZ from two transformer stations. Richmond TS#1 has a capacity of 150 MW and servers approximately 40,000 customers. It is one of twelve transformer stations owned and operated by Alectra Utilities in the PowerStream RZ. A system renewal investment need was identified through the Asset Condition Assessment process for the replacement of twelve circuit breakers at Richmond Hill TS, due to known technical incompatibility, history of failures and obsolescence.

The former PowerStream had determined that a specific type of 27.6kV 1200 Ampere SF_6 feeder circuit breakers are sub-standard and require replacement. The most recent failure occurred on May 31, 2016 which affected 15,500 customers. It took two hours before service could be restored to all of the customers impacted. Figure 15 illustrates the circuit breaker pole which experienced a catastrophic failure.

Figure 15 - Image of Catastrophic Failure of Richmond Hill TS#1 Circuit Breaker

Alectra Utilities has been assessing the type of circuit breakers, as there has been a history of breaker failures. Kinectrics conducted a breaker pole failure analysis and subsequently a transient recovery voltage ("TRV") assessment, following a previous breaker failure. Kinectrics undertook an assessment and confirmed that the TRV rating for this type of breaker is inadequate for its application at the PowerStream transformer stations. Inadequate TRV rating was identified as a potential contributing cause to the failures.

Subsequently, replacement of the type of circuit breakers was initiated and has been completed at the following locations:

- Vaughan TS#1 in 2009-2010
- Vaughan TS#2 in 2011-2012

In order to mitigate the failure risk associated with this type of breaker, an investment is required to replace all the breakers at Richmond Hill TS#1 and to purchase two additional spare circuit breakers. Alectra Utilities has phased the replacement into two phases. The first six breakers required for the Bus A with the purchase of one spare unit is on plan to be completed by Dec 31, 2017. The Phase 2 plan is to replace the remaining six breakers for the Bus B with an additional spare by December 31, 2018.

Scope

The HKSA model feeder circuit breakers at Richmond Hill TS#1 are to be replaced with HD4 model circuit breakers which have proven to be more electrically and mechanically robust. Once the circuit breakers have been replaced, maintenance costs are projected to be reduced and equipment parts will be readily available. Replacement of these breakers will result in standardization and consequently, reduced requirements for spare equipment. Further, the replacement breakers will be more reliable and pose reduced risk to personnel.

The proposed scope of work for this circuit breaker replacement project includes the following:

- Remove the twelve HKSA feeder circuit breakers at Richmond Hill TS#1;
- Purchase and installation of twelve HD4 circuit breakers;
- Purchase two spare HD4 circuit breakers for contingency application; and
- Retrofit two spare, vacant switchgear cells, one in each bus, to accommodate a HD4 breaker so as to be ready should their use be required in the future.

With the replacement of the remaining six feeder circuit breakers at Richmond Hill TS#1 Bus B in 2018, Alectra Utilities will eliminate the remaining in-service circuit breakers of this type.

Failure of one of the feeder circuit breakers at Richmond Hill TS#1 would initially result in loss of supply to the entire bus, or approximately one half of the station for approximately ten to thirty minutes. Depending on the severity of the failure, it may then take two hours or more to restore load to customers supplied by the feeder of the failed circuit breaker. The replacement of the remaining obsolete circuit breakers will improve reliability for customers served by Richmond Hill TS#1.

Based on an estimated 0.1 failures per breaker per year, a potential CMI avoidance of 59,400 per feeder breaker per year is projected from this renewal investment. Once all six breakers are considered, the potential CMI avoidance total is project at 356,400 CMI per year.

Options Considered

Option 1: *Status Quo*

A failure at this station has significant customer impact. If circuit breaker replacement is not completed, there would be a high likelihood that another failure would occur in the near term.

Failure of an existing circuit breaker would warrant emergency replacement, resulting in non-budgeted funding requirements and would result in additional lengthy customer interruptions. Replacement of failed equipment is expected to be more costly than proactive replacement. Spare parts are not readily available and, over the years, breakers are cannibalised to keep the spares. If the parts are not available, it will further prolong repairs and restoration of the failed feeder. Maintaining the *status quo* is not recommended

Option 2: Replace with HD4 Breakers

Replacement of sub-standard type HKSA breakers with type HD4 breakers to mitigate the failure risk associated with the inadequate TRV rating of HKSA breakers.

Recommended Option

The recommended solution is to replace the Type HKSA feeder circuit breakers with HD4 circuit breakers which have proven to be more electrically and mechanically robust. There breakers have been installed at Vaughan TS#1 and Vaughan TS#2 and have performed satisfactorily. This will complete the replacement of all circuit breakers of this type in the Alectra Utilities transformer stations in York Region. Once the circuit breakers have been replaced, maintenance costs will be reduced and parts will be readily available. Replacement of these breakers will result in standardization and consequently, reduced requirements for spare equipment. The replacement breakers will be more reliable, thereby reducing the likelihood of supply interruption to customers, and reducing the risk to personnel.

Budget

The estimated cost for the first phase of this project, which is to be completed in 2017, is $1.15MM. The estimated cost of work to be executed in 2018 is $1.13MM. The total budget for both phases is $2.28MM.

Table 12 – Budget Allocation

2017	2018	Total Budget
$1,154,914	$1,126,725	$2,281,639

In the event that the OEB does not approve the application, Alectra Utilities will not replace the remaining six breakers on Bus B at Richmond Hill TS. These breakers have proven unreliable and do not meet the TRV ratings imposed on them. There is very high probability of failure of these breakers, which will negatively affect the reliability and customer service. Alectra Utilities will address failures on a reactive basis. Due to the high number of customers supplied from Richmond Hill TS, failures may lead to prolonged outages.

Business Case

Project Name

Rebuild 27.6 kV Pole Line on Warden Ave into 4 Circuits from 16th Ave to Major Mackenzie Drive.

Project ID

100229

Project Duration

2 years – 2 Phases

Phase 1 - Hwy 7 to 16th Ave (2017)

Phase 2 - 16th Ave to Warden to Major Mack Drive (2018)

Expected In-service date

12/31/2017 (Phase 1) and December 12/31/2018 (Phase 2)

Category

System Service

Background

The City of Markham is currently supplied by nine 230/27.6kV transformer stations and 53 feeders operating at 27.6kV. York Region recently issued the growth plans for the region, and projects approximately 613,900 additional residents and 305,100 additional jobs from 2016 to 2041. This growth is expected throughout the York Region.

The City of Markham is working on an Official Planning Amendment, which expands the urban area of the Town of Markham onto both sides of Warden Avenue in order to enable urban growth through to 2031. The north Markham Future Urban Area ("FUA") covers approximately 1,288 hectares (3,183 acres).

Major Mackenzie Drive borders it to the south; the hydro corridor and Woodbine Avenue to the west; the northern City of Markham city limits and Elgin Mills Road to the north; and Robinson Creek to the east.

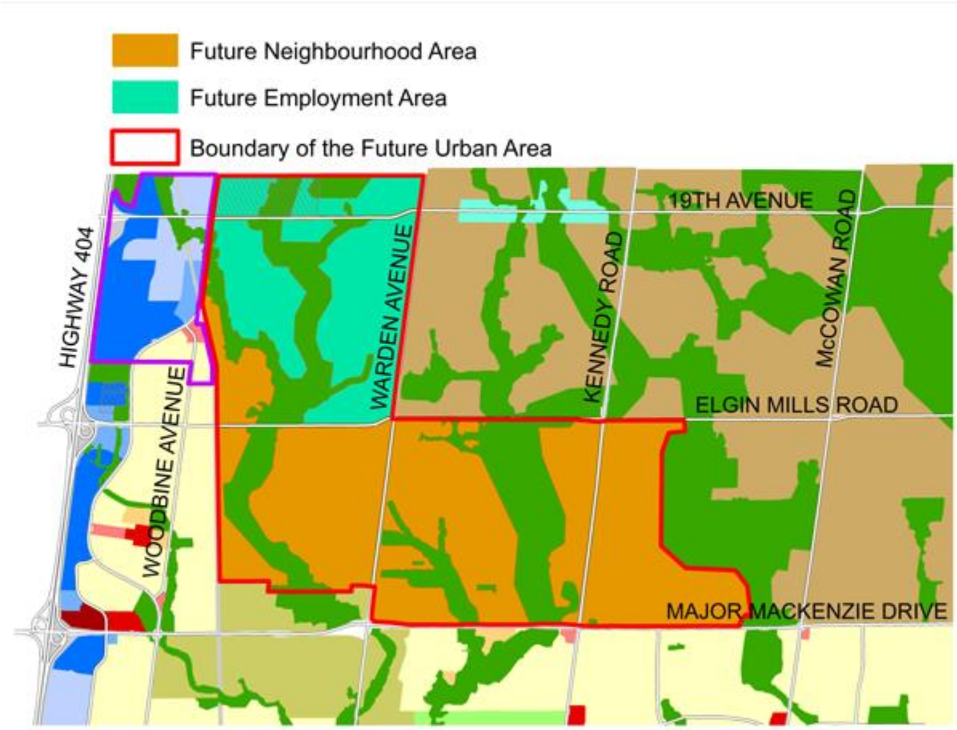
Approximately 675 hectares (1,668 acres) of developable lands are designated for future neighborhoods, located primarily between Major Mackenzie Drive and Elgin Mills Road. Approximately 300 hectares (741 acres) located north of Elgin Mills Road are designated for employment use by the City of Markham for commercial business expansion.

Figure 16 below illustrates the FUA and designated land uses. In total, the FUA is intended to accommodate approximately 12,000 additional residential units, with a population growth of approximately 38,000 persons. Further, the FUA plans and employment zoning projected 19,000 additional jobs for the area. Based on the growth projections outlined above and once the area is developed, Alectra Utilities forecasts approximately 66 MVA of new demand is expected on both sides of Warden Avenue, north of Major Mackenzie Drive.

Based on known developments, approximately 9.5 MVA of commercial growth is expected to be connected by 2018. For the new urban area, the building permits are expected to be issued in 2019.

In order to support the growth in the City of Markham, two new 27.6kV feeders are required to provide necessary capacity for the Highway 404 North Development as well as the FUA expansion.

Figure 16 - Map of City of Markham's Future Urban Area



Scope

The northern portion of the City of Markham is currently supplied by two feeders: 10M2 on Woodbine Avenue; and 12M1 on Warden Avenue, with a total capacity of 40MVA. Of this capacity, 30MVA is currently utilized, leaving a remaining capacity of approximately 10MVA. The peak demand and customer count on 10M2 feeder in 2016 was 340 Amps and 3,290 customers. The peak on 12M1 feeder was 250 Amps, with 4,068 customers connected. Hence, remaining capacity of the feeders is 210 Amps, which is equivalent to 10MVA capacity. This currently available capacity does not meet the expected 75MVA forecasted by the growth development for the area.

Current Large Developments:

The known major developments expected in the area include:

- King Square - a new development on Woodbine Avenue, north of 16th Avenue, which is currently under construction and will add new 4.4MVA demand (approx. 80A) to the system;
- Hyundai Plant – a new automobile plant on Woodbine Avenue, north Elgin Mills Road and will add another 2.2MVA demand to the system; and
- Enbridge - construction of a new 2.8MVA plant on Honda Boulevard.

In addition to the known developments, there are still many vacant lots in the Hwy 404 North development area. Since there is only 10MVA (210 Amp) capacity remaining on the existing feeders and 9.5MVA of known large commercial developments are coming online by the end of 2018, the existing feeders (i.e., 10M2, 12M1) do not have sufficient capacity to supply additional demand in the Hwy 404 North development and FUA (66MVA load). In the event that Alectra Utilities does not proceed with the investment to build two additional feeders in the PowerStream RZ, the existing feeders will be operating over the planning limit.

To facilitate restoration capability, Alectra Utilities utilizes planning criteria for expansion of 27.6kV and 44kV feeders. The planning criteria are used as guidelines for the design of the system, to enable full back up capability during peak loading conditions, to permit switching of load to an adjacent feeder or multiple adjacent feeders. To facilitate this restoration capability, three phase 27.6kV and 44kV feeder loading is planned to a maximum of 400 Amps under normal operating conditions, and 600 Amps under contingency conditions.

Operating feeders at levels beyond the planning criteria during contingency conditions (e.g., single contingency or loss of one feeder) constrains and negatively impacts restoration and ability to reliably supply customers. Alectra Utilities has determined that approximately 9MVA of load demand will be at risk if the additional feeders are not implemented into the area.

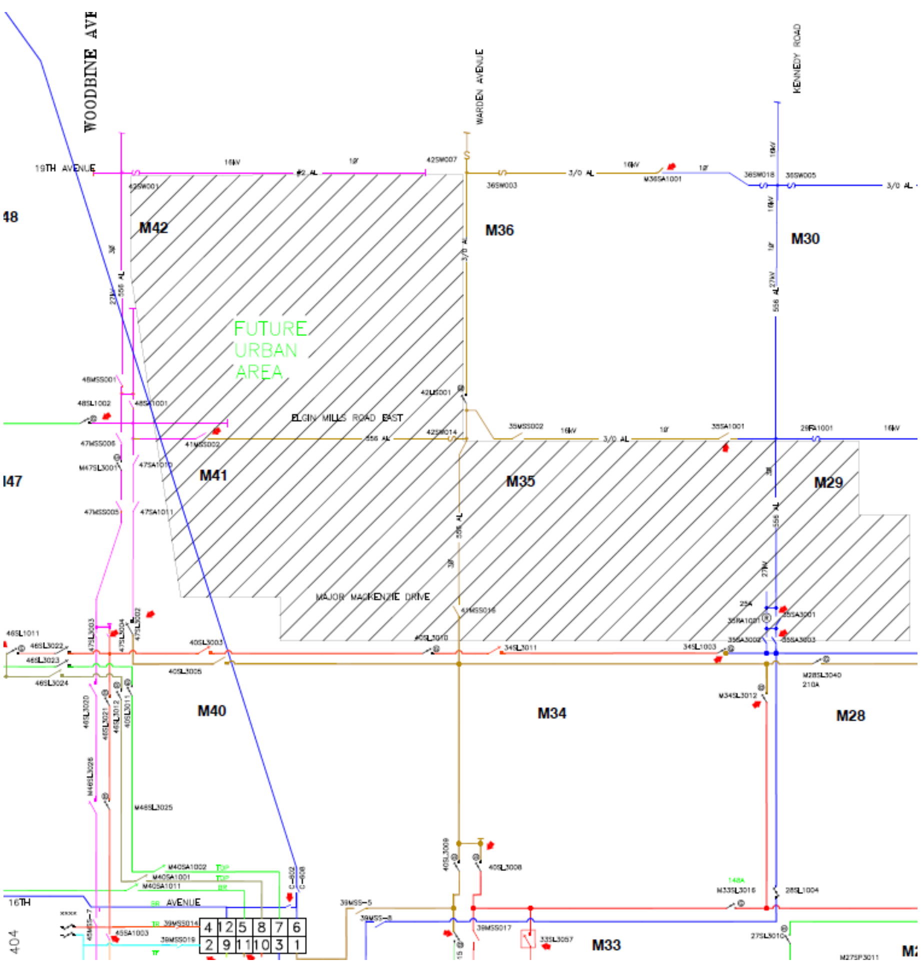
In order to meet this anticipated load growth and as part of Markham TS4 feeder integration plan, Alectra Utilities has planned to implement two feeders, 12M10/12M11 in the Warden Avenue/ Major Mackenzie Drive area, to supply new growth in Markham North.

Options Considered

Option 1: *Status Quo* – Continue to operate with existing feeders.

Under this option, no additional feeders would be built into the area; the growth would be supplied from the existing feeders. Markham North is currently supplied by two feeders (10M2 on Woodbine Avenue and 12M1 on Warden Avenue). The peak demand in 2016 was 340 Amps on 10M2 and 250 Amps on 12M1. Approximately 10MVA of capacity is available on the two feeders. Figure 17 illustrates the existing feeder configuration in the area.

Figure 17 - Existing Feeder Configuration in North Section of the City of Markham



A total of 9.5MVA of new large commercial developments are expected to come online by 2018. There are other vacant lots which have development potential. As the development continues, the 10M2 and 12M1 feeders will continue to be overloaded and will severely impact the load restoration during single contingency events.

Therefore, the existing feeders 10M2 and 12M1 will not have any additional capacity left to supply new loads in the Hwy 404 North development and FUA. In contingency conditions, 9MVA of load will be at risk.

Alectra Utilities is obligated to service future growth within its service territory using good utility practice. Consequently, this option is not recommended

Option 2: Install (string) one feeder in 2018 and the other in 2019 to supply the growth in North Markham

The other option considered was to build (i.e., string) one feeder in 2018 and the second in 2019. This option was rejected due to the higher cost associated with re-mobilizing of construction crews, additional scheduled customer outages required to complete the work, and traffic impacts. Alectra Utilities estimates the cost of stringing the second feeder in 2018 to be $0.1MM, compared with $0.13MM in 2019, when the aforementioned impacts are considered.

Option 3: Build two additional feeders to supply the growth in North Markham

In order support capacity delivery for the new development in the FUA, the proposed project is to add two circuits on Warden Avenue from 16th Avenue to Major Mackenzie Drive. This project will extend feeder 12M10/12M11 to Markham North and increase 40MVA supply capacity and reliability to Hwy 404 North area and the new future urban area north of Major Mackenzie Dr. between Woodbine Avenue and Kennedy Road. This will also: eliminate the contingency capacity constraints; enable Alectra Utilities to service the growth; and provide reliable power to customers.

Recommended Option

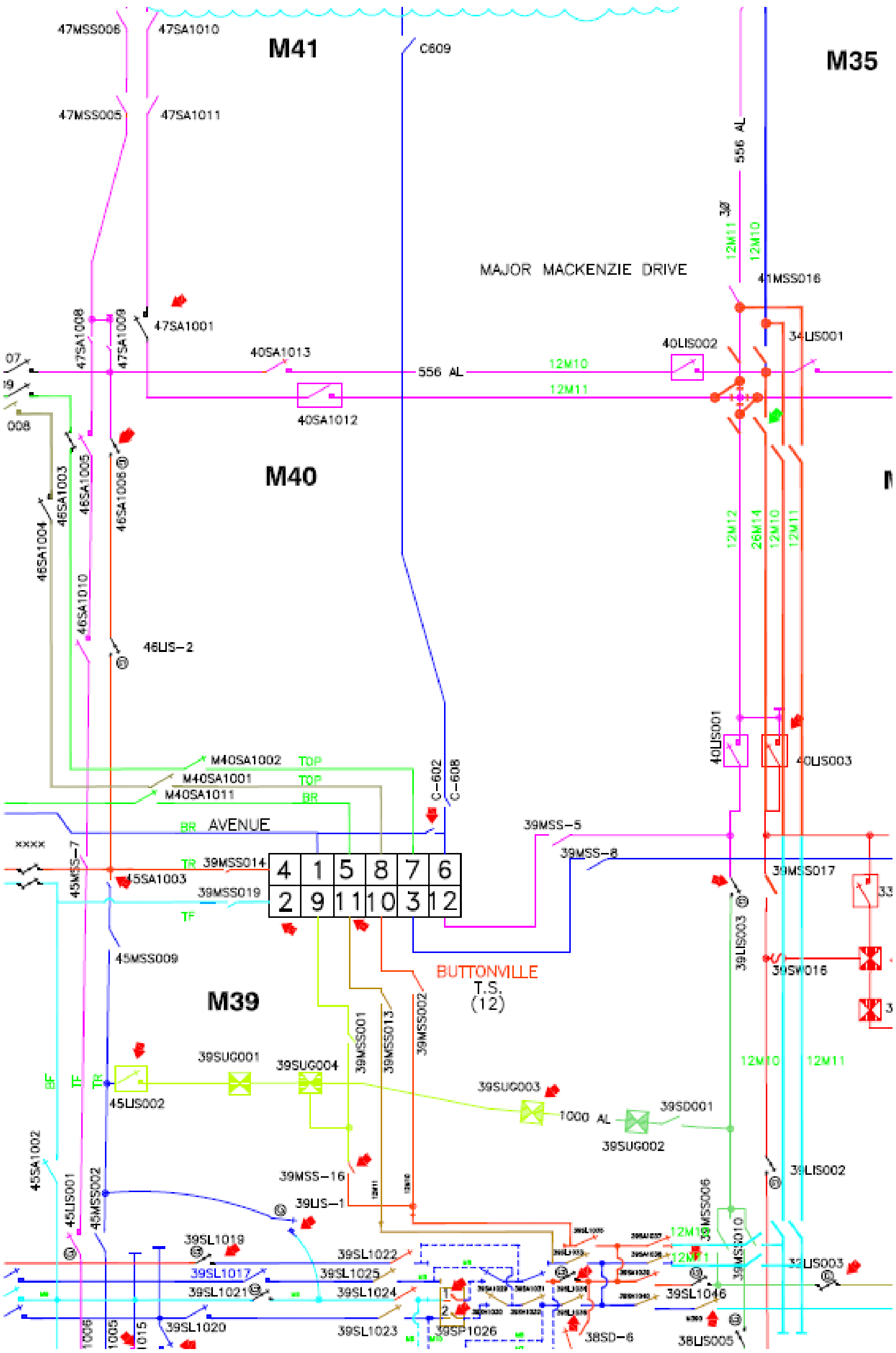
In order to support capacity delivery for the new development in the FUA, it is recommended that two circuits be added on Warden Avenue from 16th Avenue to Major Mackenzie Drive. This project will expand feeders 12M10 and 12M11 to Markham North and increase supply capacity by 40MVA. It will also increase restoration capability, thereby improving reliability to the Hwy 404 North area and new future urban area north of Major Mackenzie Drive between Woodbine Avenue and Kennedy Road.

This project has been divided into two phases:

Phase 1 - in 2017: Rebuild 27.6 kV pole line on Warden Avenue into 4 circuits from Hwy 7 to 16th Avenue

Phase 2 - in 2018: Rebuild 27.6 kV pole line on Warden Ave. into 4 circuits from 16th Ave to Major Mackenzie Drive.

Figure 18 - Proposed Feeder Expansion in the North Section of City of Markham



According to this plan, feeders, 12M10 and 12M11 will provide an additional 100 Amps of supply in 2018 and an additional capacity of 40MVA, to meet the future growth in the new urban area. It will also enable the system to operate within the adapted the contingency conditions criteria. Supply reliability to Markham North customers will increase, due to additional feeders and increased ease of switching between four feeders, in case of outages.

Budget

The table below provides the project costs.

Table 13 - Budget Allocation

2017	2018	Total Budget
$1.01MM	$1.30MM	$2.38MM

In the event that the OEB does not approve the ICM application, Alectra Utilities will continue to supply FUA using existing feeders. Feeders will be loaded beyond the 400 Amps planning guideline to the maximum thermal rating of the feeder. Without additional capacity, the PowerStream RZ will be constrained to add additional customers should the feeder demand meet the maximum thermal limits of the feeder. In such event, the reliability of supply to the customers will be severely impacted. It may result in brown outs/blackouts, in case of feeder level outages during peak conditions, as both the feeders will be at capacity and unable to provide backup to each other.

Business Case

Project Name

Mill Street MS835 Transformer Upgrade – Tottenham

Project ID

101068

Project Duration

Year 1 (2017): Design

Year 2 (2018): Construct

Expected In-service date

12/31/2018

Category

System Service

Background

Tottenham is supplied from Everett TS via a 44kV feeder 138M8, which supplies two municipal substations ("MS"); MS834 (Nolan) in the north and MS835 (Mill) in the south-east. Each substation steps down the voltage from 44kV to 8.32kV and has self-cooled transformers with two active 8.32kV feeders. The 44kV and older 8.32kV distribution system in Tottenham is primarily overhead, while newer residential subdivisions are supplied underground.

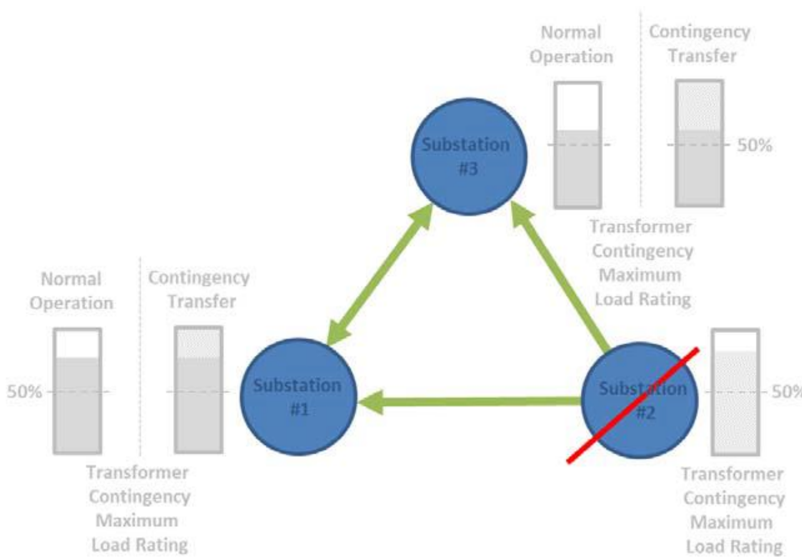
The Nolan MS834 transformer was manufactured in 1985 and has a Health Index ("HI") asset condition score of 78 indicating a good condition. The Mill MS835 transformer was manufactured in 1975 and has an HI asset condition score of 75 indicating a good condition.

Nolan MS834 and Mill MS835 presently supply 2,600 residential customers in Tottenham. Three residential developments (Ballymore, Nordstar, and LRG) are being constructed over the next four years in the Mill St. and Queen St, area of Tottenham.

These three residential developments will result in an increase of 1,300 new residential customers in Tottenham, which represents a 50% increase in the number of customers in Tottenham. Of this increase, 250 customers are expected to be added in 2018.

Alectra Utilities utilizes a triad for MS operation in the PowerStream RZ. The triad configuration ensures that load associated with the loss of the largest transformer element in the substation network can be maintained by adjacent substations, while remaining within the substation's transformer Contingency Maximum Load Rating, thus operating at a respective overloading factor. Three substations are required to fully satisfy the single (N-1) contingency criterion when exceeding 50% of the transformer Contingency Maximum Load Rating, thereby establishing the Triad configuration, as illustrated in Figure 19 below.

Figure 19 - Triad Contingency N-1 Criterion for Three Substation Network



In addition to the required capacity due to growth, municipal stations in Tottenham do not satisfy the triad configuration requirement, with only two 8.32kV substations in the area which are unable to provide backup contingency capacity. In circumstances where the triad configuration cannot be satisfied with a network of individual municipal substations, the use of two transformer units at a single substation should be considered.

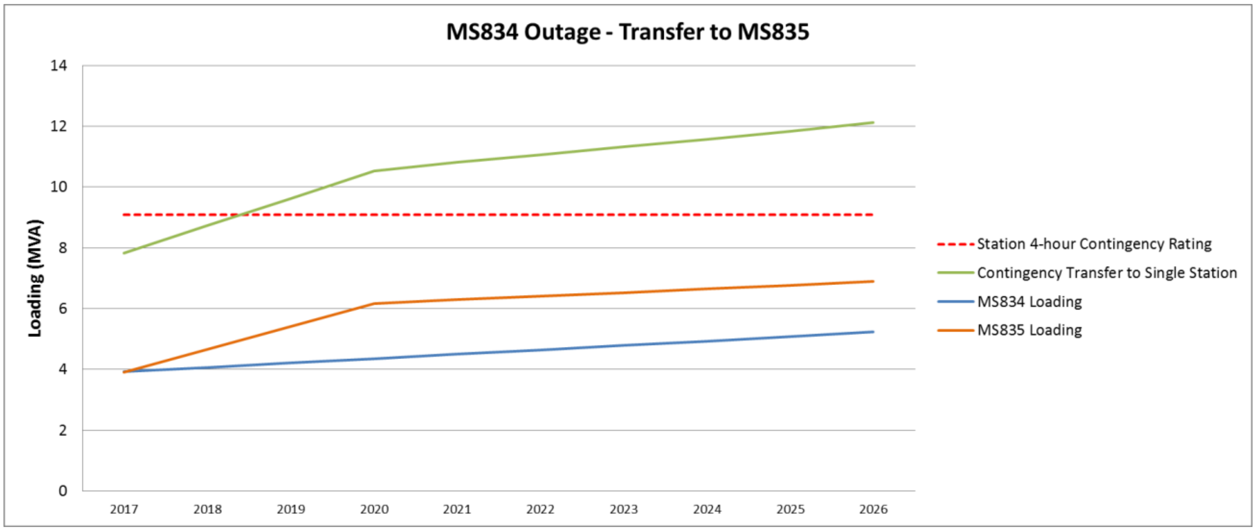
In these circumstances, options should be investigated to ensure that two separate transformer units at one substation provide the required capacity and number of feeders, while also offering the contingency transfer capacity that would not be available with a single transformer unit.

Nolan MS834 has an Oil Natural Air Natural (“ONAN”) rating of 10MVA and a Contingency Maximum Load rating of 15.2MVA, based on a 4-hour contingency loading of 152%, assuming a 0.5% loss of transformer life. Mill MS835 has a lower rated transformer than Nolan MS834, with an ONAN rating of 6MVA and a Contingency Maximum Load rating of only 9.1MVA. Hence, Mill MS835 will not have sufficient capacity to back-up Nolan MS834 in the event of a single contingency once growth is considered.

In circumstances where two transformer units cannot be accommodated by a single substation due to physical constraints, the adjacent substations must have transformers sized to ensure that the loss of the largest transformer element in the substation network can be maintained by adjacent substations while remaining within the substations’ transformer Contingency Maximum Load Rating. This minimum requirement ensures that, under single outage conditions, customers are not impacted.

Under contingency transfer conditions, Mill MS835 will exceed the Contingency Maximum Load rating in 2019, resulting in a major risk that exceeds thermal limits. This will: adversely affect the life of the transformer: and reduce Alectra Utilities’ ability to supply customers in the PowerStream RZ. Figure 20 illustrates Nolan MS834 and Mill MS835 loading against the station 4-hour contingency rating.

Figure 20 - MS834 Outage and Contingency Transfer Capacity



Proposed solutions to meet growth demands and satisfy contingency backup conditions in Tottenham include: a retrofit of single-stage or dual-stage fans to defer new substation construction; construction of additional 8.32kV feeders; use of a self-contained mobile substation for contingency conditions; local generation using a natural gas generator; a grid scale battery storage system; or an upgrade of the existing transformers to the largest transformer element rating in the substation network.

The suggested solution for Tottenham is to upgrade the Mill MS835 transformer from 6MVA to 10MVA, in order to supply the new residential development growth in the area. This will also provide contingency backup transfer capacity for Nolan MS834, which is necessary to minimize negative impact on customers during an outage on Nolan MS834.

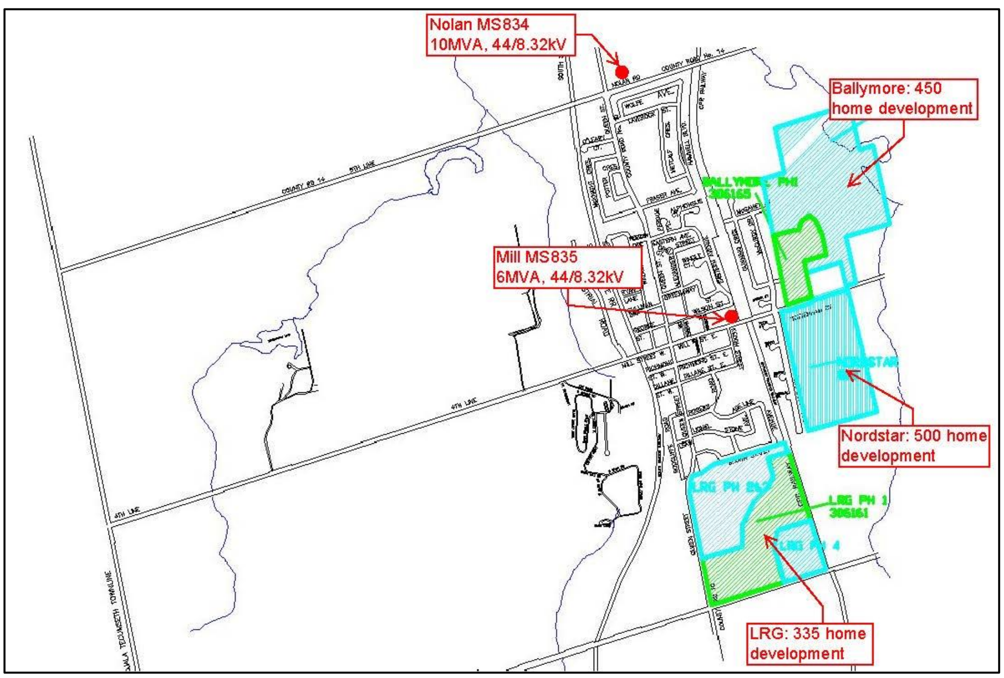
Scope

Tottenham is presently supplied from Everett TS via a 44kV feeder (138M8) which supplies two municipal substations; Nolan MS834 in the north and Mill MS835 in the south-east. Each substation steps down the voltage from 44kV to 8.32kV via self-cooled transformers and each substation has two active 8.32kV feeders.

The 44kV and older 8.32kV distribution system in Tottenham is primarily overhead, while newer residential subdivisions are supplied underground.

Three residential developments are currently under construction in Tottenham: Ballymore (450 homes), Nordstar (500 homes), and LRG (335 homes). These three residential developments will result in 1,300 new residential homes which represents a 50% increase in the number of customers in Tottenham. The developments are currently under construction and will be completed over the next four years in the Mill Street and Queen Street areas of Tottenham, resulting in an additional 3.2MVA of demand by 2020. The new residential demand will be supplied from MS835 Mill utilizing the existing 8.32kV feeder configuration as provided in Figure 21 below.

Figure 21 - Map of Tottenham Residential Developments



Nolan MS834 houses a transformer with ONAN rating of 10MVA and a Contingency Maximum Load rating of 15.2MVA, while Mill MS835 houses a lower rated transformer ONAN rating of 6MVA and a Contingency Maximum Load rating of only 9.1MVA.

Given that Mill MS835 has a lower rated transformer than MS834, Tottenham does not satisfy the minimum triad configuration system planning criteria, which requires that adjacent substations have transformers sized to ensure that the loss of the largest transformer element in the substation network can be maintained by adjacent substations while remaining within the substations' transformer Contingency Maximum Load Rating. This minimum requirement ensures that under single outage conditions customers are not impacted. Table 14 lists the actual and ten year load growth projections for Tottenham.

Since Mill MS835 does not meet the minimum triad configuration, a station service investment is required to upgrade power transformer.

Table 14 - 2017-2026 Tottenham Load Growth Projection

Tottenham 10 Year Load Growth Projection															
Station Information					3.5% 2017-2021 & 3% 2022-2026 Year Projected Peak Load (MVA)										
Station ID	Station Name	ONON Rating (MVA)	Maximum Normal Load (MVA)	Contingency Maximum Load (MVA)	2016 Actual Summer Peak Load	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
MS834 (8.32kV)	Nolan	10	10	15.2*	3.8	3.9	4.1	4.2	4.4	4.5	4.6	4.8	4.9	5.1	5.2
MS835 (8.32kV)	Mill	6	6	9.1*	3.1	3.2	3.3	3.4	3.6	3.7	3.8	3.9	4.0	4.1	4.3
Ballymore Development (Res. Subdiv)						0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Nordstar Development (Res. Subdiv)						0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0
LRG Development (Res. Subdiv)						0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Cumulative Lump-Sum Load						0.7	1.3	2.0	2.6	2.6	2.6	2.6	2.6	2.6	2.6
MS835 Loading Including Potential Known Loads						3.9	4.7	5.4	6.2	6.3	6.4	6.5	6.6	6.8	6.9
Transfer 100% of MS834 load to MS835 during outage		6	6	9.1	6.9	7.8	8.7	9.6	10.5	10.8	11.1	11.3	11.6	11.8	12.1

***Contingency Maximum Load Rating based on 4-hour contingency loading of 152% assuming a 0.5% loss of transformer life (transformers are self-cooled)**

(yellow)	**= ONAN rating exceeded**
(orange)	**= Maximum normal loading exceeded; self-cooled max or single-stage fans in operation**
(red)	**= Contingency maximum load exceeded for 4-hour period resulting in loss of transfomer life**

Both Nolan MS834 and Mill MS835 transformers are self-cooled; therefore the Contingency Maximum Load rating is based on a 4-hour contingency loading of 152% assuming a conservative 0.5% loss of transformer life. It is prudent to prevent the Contingency Maximum Load rating from being exceeded, since it will adversely affect the life of the transformer.

Under contingency transfer conditions, Mill MS835 will exceed the Contingency Maximum Load rating in 2019, resulting in a major risk that exceeds thermal limits and reduces Alectra Utilities' ability to supply customers, as identified in Figure 21, above.

Upon completion of the three residential developments, there will be 1.4 MVA of load at risk in Tottenham, in the event that Nolan MS834 is lost and load is required to be transferred to Mill MS835, thereby exceeding the Contingency Maximum Load rating and adversely affecting the life of the transformer. A sustained outage at Nolan MS834 during the summer peak may result in customer load shedding through rolling blackouts across Tottenham. The 1.4 MVA of load at risk would result in approximately 600 customers affected by rolling blackouts; that is, 15% of Tottenham's residential customers.

Increasing connection capacity, as well as contingency capability in Tottenham, will enable the connection of an additional 1,300 residential units while providing the ability to transfer load from Nolan MS834 in the event of a failure at Mill MS835 and minimizing customer outages.

Options Considered

Option 1: Retrofit of transformer with single-stage or dual-stage fans to defer new substation construction.

In July 2015, an assessment was completed to determine if the existing equipment at Mill MS835 permits a retrofit of single-stage or dual-stage fans, to defer the construction of a new substation by increasing the contingency transfer capacity at Mill MS835. The resulting feasibility report from Brosz & Associates indicated that upgrading the existing transformer with fans is not feasible, due to its previous history of gassing and the lack of the internal design specification availability for the 50 year old transformer.

Option 2: Construction of additional 8.32kV feeders from Nolan MS834

Construction of additional 8.32KV feeders from Nolan MS834 to south-east Tottenham was considered but rejected because contingency transfers to Nolan MS834 would still be limited to 323A; Mill MS835 would continue to be limited to 246A, due to egress cable limits. In addition, this option does not address station back-up under contingency conditions with the Contingency Maximum Load rating being exceeded, with the loss of Nolan MS834.

Option 3: Self-contained mobile substation for contingency conditions

A 10MVA 2-feeder 44kV/8.32kV self-contained mobile substation for contingency conditions was considered an option. Initial cost estimates for a 10MVA unit are approximately $1.5MM. However, the estimate does not include the additional cost for a dual secondary tap configuration (13.8kV/8.32kV or 8.32kV/4.16kV) which would allow the mobile unit to be used in other areas. There are additional costs associated with the mobile unit, including the acquisition of land, civil work, and commissioning. The estimated total cost with land is $2.85MM.

However, the mobile substation is a temporary solution that does not offer a long-term solution for contingency backup capacity in Tottenham, given the forecasted residential developments. Initial discussions with vendors have indicated that most customers use the flatbed trailer mobile unit for durations of 6-8 months, since the solution is only temporary. The mobile unit does not have a proper oil containment system; it lacks a grounding grid; it does not have permanent cable connection; and it requires the transformer fans to be in constant operation. The constant operation of the fans is necessary given that the transformer core winding is reduced to allow for a weight reduction to comply with road transportation road restrictions. Consequently, the result is significant noise from the mobile unit. The mobile unit is therefore ideally suited for a temporary installation, as compared to the long-term contingency backup transfer solution required in Tottenham.

Option 4: Installation of local generation using a 3MW natural gas generator

Installation of local generation in the form of a 3MW natural gas generator was considered as an option to meet local capacity growth. The capital cost is $3,000 per kW of installed generation, totaling $9.00MM for the proposed 3MW generating facility. This option is not recommended due to potential operating costs associated with natural gas prices, as well as environmental and community impacts, due to emissions from the gas generator.

Option 5: Installation of grid scale battery storage system

Installation of a grid scale battery storage system in Tottenham was considered as an option. Alectra Utilities investigated the technical feasibility of a battery storage system. Assessment indicated that a 72.1MWh battery would be required to supply 100% of any individual 24 hour outage, or a 7.4MWh battery if only 90% of the outages are supported. A limitation identified in the report was the battery's ability to charge in a short window during extended outages. Given the current cost of battery storage at approximately $1.8MM for 1MWh, a 7.4MWh system would be $13.3MM and is not economically feasible at this time.

Option 6: Upgrade existing Mill MS835 transformer from 6MVA to 10MVA

Alectra Utilities considered increasing the capacity of Mill MS835 transformer from 6MVA to 10MVA, in order to supply the residential developments in the area and provide contingency backup transfer capacity.

Recommended Option

The recommended option must address the risk of exceeding the Contingency Maximum Loading and respective thermal limits at Mill MS835 during contingency transfer conditions upon loss of Nolan MS834, while satisfying the capacity requirements of the residential developments in Tottenham.

The recommended solution consists of upgrading the Mill MS835 transformer from 6MVA to 10MVA, in order to supply the residential developments in the area and provide contingency backup transfer capacity. The project includes engineering design, purchase of station equipment, approvals, substation construction, equipment installation, and commissioning.

The upgrade entails installation of a new 10MVA 44/8.32kV transformer with a Contingency Maximum Load rating of 15.2MVA. The plan is to re-use the high voltage structure with minor modifications, and the low voltage switchgear and building will be re-used with the requirement of a new bus duct.

Given that the Mill MS835 6MVA transformer has a health index score of 75 indicating a good working condition, the transformer could be used as a spare in other 8.32kV service areas.

Budget

Total budget for the project is $1.23MM. Design and equipment procurement is being undertaken in 2017; with construction expected in 2018, as indicated in Table 15 below.

Table 15 –Budget Breakdown by Year

2017	2018	Total Budget
$361,320	$871,592	$1,232,913

In the event that the OEB does not approve the application, the existing substations in Tottenham would need to be operated beyond their respective ONAN and Contingency Maximum Load ratings. Under the increased loading and if MS834 experienced an outage during the summer peak, the Tottenham area would need to shed customer load through rolling blackouts.

Upgrading MS835 from 6MVA to 10MVA is prudent and the most cost effective option. Further, it directly addresses the needs identified for Tottenham including residential load growth and contingency capacity.

Business Case

Project Name

Build Double Circuit 27.6kV Pole Line on 19th Avenue between Leslie Street and Bayview Avenue

Project ID

101480

Project Duration

1 year

Expected In-service date:

12/31/2018

Category

System Service

Background

The Town of Richmond Hill is supplied by two 230/27.6 kV transformer stations (RH-TS1, RH-TS2) in Richmond Hill and six feeders rated at 27.6kV from Buttonville transformer station ("TS") in the City of Markham. York Region recently issued the growth plans, which project approximately 613,900 new residents and 305,100 new jobs between 2016 and 2041. This growth is distributed throughout York Region.

The North Leslie planning area is bounded by 19th Avenue to the north, Highway 404 to the east, Elgin Mills Road to the south and Bayview Avenue to the west. Presently, there are two (2) 27.6kV circuits (27M8 and 12M6) on Bayview Avenue and one radial feeder (12M7) on Leslie Street.

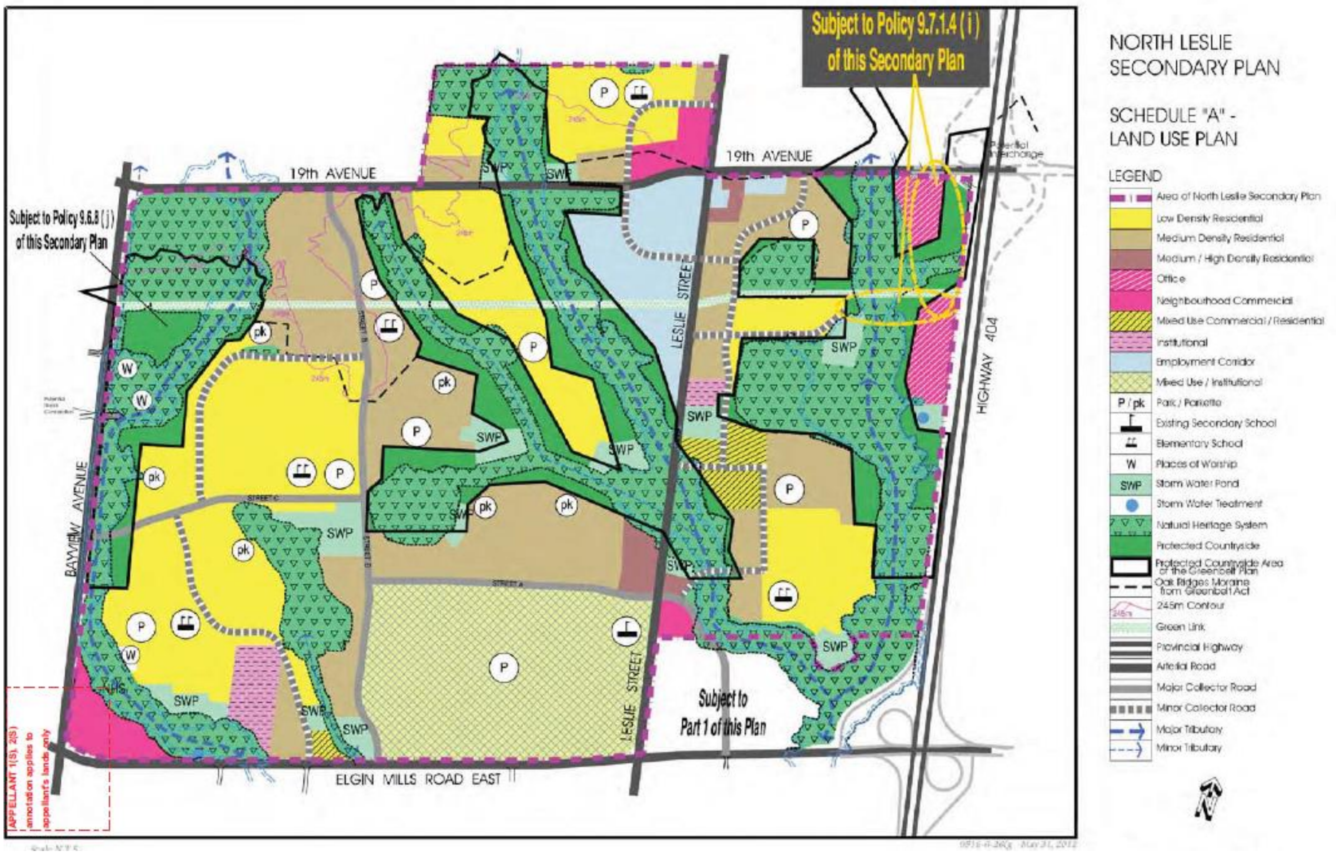
The North Leslie development, as illustrated in Figure 22, is projected to accommodate approximately 6,250 additional housing units with a population of approximately 19,300 people and result in approximately 3,200 jobs.

Based on the planning criteria of demand of 2.5kW per residential unit and 1.5 kW per job, the long term total demand for the area is projected to be an additional 20 MW. In the near term, approximately 500 new homes will require connection to the distribution system in the North Leslie area. The development on 19th Avenue is scheduled to begin in 2018. There is an urgent investment need to install feeders required to connect the additional customers in the area; presently there are no feeders on 19th Avenue.

The primary driver for this investment is to support capacity delivery for the new developments in the North Leslie area. As illustrated in Figure 22, new housing developments along 19th Avenue between Bayview Avenue and Leslie Street are anticipated as outlined in the secondary plan. A system service investment is necessary to support the growing demand in the area, through the construction of a double circuit 27.6kV pole line on 19th Avenue between Leslie Street and Bayview Avenue.

The scope of this project is to extend feeders 12M6 and 27M8 onto 19th Avenue from Leslie Street to Bayview Avenue through the construction of double circuit pole line.

Figure 22 - North Leslie Secondary Plan



Scope

The North Leslie planning area is bounded by 19th Avenue to the North, Highway 404 to the east, Elgin Mills Road to the south and Bayview Avenue to the west. There are two (2) 27.6kV circuits on Bayview Avenue (27M8 and 12M6) and one radial feeder (12M6) on Leslie Street.

Presently, there are no feeders on 19th Avenue between Leslie Street and Bayview Avenue. There are planned residential and commercial developments proposed on the north and south sections of 19th Avenue, which will require connections. The scope of this project is to extend feeders 12M6 and 27M8 onto 19th Avenue from Leslie Street to Bayview Avenue through the construction of double circuit pole line.

Options Considered

Option 1: *Status Quo*

The *status quo* is not to build the additional circuits and to supply load growth from existing facilities.

This will have a material impact on Alectra Utilities' distribution system since there are no feeders on 19th Avenue presently to supply new connections in the North Leslie development area. The *status quo* option will jeopardize Alectra Utilities' obligation to supply new customers along 19th Avenue in the PowerStream RZ.

Further, since there is one radial feeder (12M7) on Leslie Street between Elgin Mills Road and 19th Avenue, any outage on Leslie Street between Elgin Mills Road and 19th Avenue will cause prolonged outages to customers in the North Leslie development area serviced by the radial feeder.

Option 2: Build Two (2) 27.6kV circuits on 19th Avenue from Bayview Avenue to Leslie Street

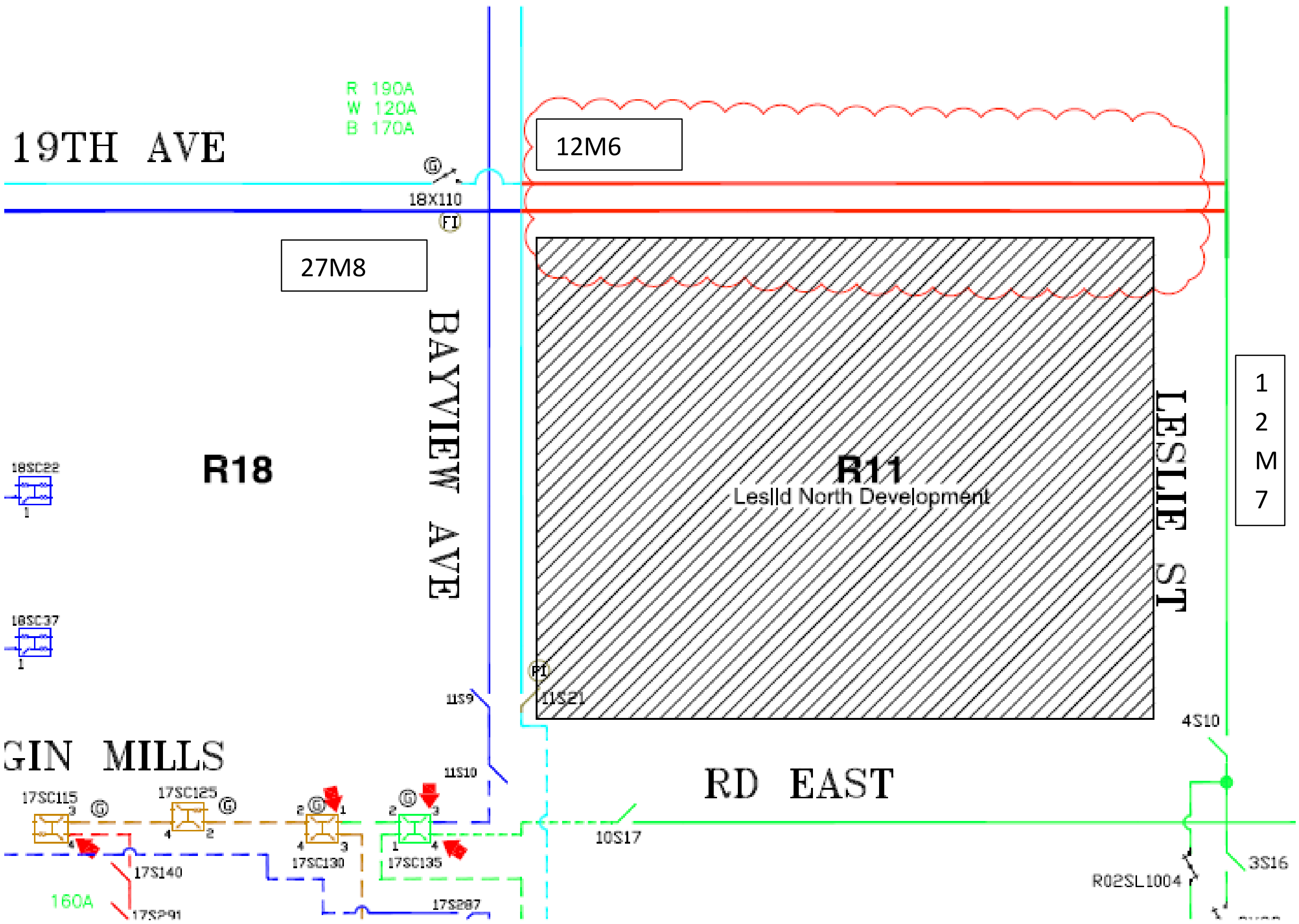
This option will enable Alectra Utilities to connect new developments along 19th Avenue, as well as rectify the radial line constraint of the 12M7 feeder on Leslie Street.

Recommended Option

In order to support capacity delivery for new connections in the North Leslie development area, a system service investment is required to extend the 27.6kV feeders (27M8 and 12M6) on 19th Avenue from Bayview Avenue to Leslie Street, as illustrated in Figure 23. At present, feeder 27M8 has 9MVA available capacity and feeder 12M6 has 2.5MVA available capacity, for a total available capacity of 11.5 MVA. This is sufficient to supply the immediate developments capacity need and provide contingency offload for the radial 12M7 feeder.

This is the most cost effective solution to support the capacity delivery for the new developments, as well as remediate the radial supply concerns on Leslie Street.

Figure 23 - Proposed Pole line between Leslie Street to Bayview Avenue



Alectra Utilities is obligated to service future growth within its service territory. If the pole line is not constructed, Alectra Utilities will be unable to connect new customers along 19th Avenue in the Leslie North area, within the PowerStream RZ.

Budget

The table below provides the project costs.

Table 16 - Budget Breakdown by Year

2018	Total Budget
$1,141,514	$1,141,514

Business Case

Project Name

Double Circuit Existing 23M21 from Bayfield & Livingstone to Little Lake MS306

Project ID

101572

Project Duration

Year 1 (2016): Design Only

Year 2 (2017): Construct Phase 1

Year 3 (2018): Construct Phase 2

Expected in-service date

Q4 2018

Category

System Service

Background

North-East Barrie is bounded by Hanmer Street to the north, Bayfield Street to the west, Blake Street to the south and Penetanguishene Road to the east. Currently, there is only one 44/13.8kV substation in the Barrie North-East area; Little Lake MS306, supplied by the feeder 23M21. The area is also supplied by the 44kV feeder 23M6 along St. Vincent Street, though the majority of the load on feeder 23M6 is south of Highway 400 which is outside of the North-East Barrie area.

Information obtained from the City of Barrie on proposed developments in the Cundles and Duckworth area indicates that an increase in the number of commercial developments will result in new load growth that needs to be serviced. The proposed Cundles and Little Lake Commercial Developments will total 8.8MVA over the next five years.

To meet this growth, a new 20MVA 44/13.8kV four feeder substation (Livingstone MS310), supplied by 44kV feeder 23M21, is expected to be in-service in 2018. Construction of Livingstone MS commenced in 2017 and is on track to be placed in-service in 2018.

Alectra Utilities must ensure compliance with applicable planning limits for contingency scenarios. Currently, feeder 23M21 supplies 7,257 customers (including 6,529 residential customers), and feeder 23M6 supplies 5,757 customers (including 4,709 residential customers). Each feeder provides contingency back-up in the event an adjacent feeder in the area is lost. During the 2016 summer peak, 23M6 feeder exceeded its planning limit of 400A, and would have exceeded its thermal limit of 600 Amps, in the event of an outage on 23M21 feeder. This is prior to factoring in the 8.8MVA in new commercial developments and the new Livingstone MS310. Table 16 identifies the actual 2016 load, as well as the forecasted loading on the 23M28, 23M21 and 23M6 feeders.

Table 16 – North East Barrie Load Growth and 44kV Feeder Contingency Capacity

23M21, 23M28 & 23M6 Load Forecast (3.5% 2017-2021 & 3% 2022-2026)											
	2016 (Actual)	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
23M28 Peak (MVA)	3.0	3.1	3.2	3.3	3.4	3.6	3.7	3.8	3.9	4.0	4.1
Normal Amps	39.4	40.7	42.2	43.6	45.2	46.8	48.2	49.6	51.1	52.6	54.2
23M21 Peak (MVA)	17.1	17.7	18.3	19.0	19.6	20.3	20.9	21.5	22.2	22.9	23.5
Normal Amps	224.4	232.2	240.4	248.8	257.5	266.5	274.5	282.7	291.2	299.9	308.9
23M6 Peak (MVA)	31.1	32.2	33.3	34.5	35.7	36.9	38.0	39.2	40.4	41.6	42.8
Normal Amps	408.1	422.4	437.1	452.4	468.3	484.7	499.2	514.2	529.6	545.5	561.9
Contingency 23M21 to 23M6	632.5	654.6	677.5	701.2	725.8	751.2	773.7	796.9	820.8	845.4	870.8

System planning criteria specifies that 44kV feeders should operate below the 400 Amps planning limit during normal operating conditions, and cannot exceed the 600 Amps thermal limit during contingency conditions.

The proposed solution is to extend the 23M28 feeder along the existing path of the 23M21 feeder, from Bayfield Street and Livingstone Street to Cundles Road and Duckworth Street, and transfer the supply of Little Lake MS306 from the 23M21 feeder to the 23M28 feeder. This would free up capacity on the 23M21 feeder to meet the projected load growth, supply the new Livingstone MS310 and mitigate the existing thermal overloading issue under contingency conditions for the area. Transferring the supply of Little Lake MS306 to the feeder 23M28 and supplying the new Livingstone MS310 from the 23M21 feeder will more evenly distribute load across both feeders. Contingency transfers from the 23M21 feeder will be accommodated by both the existing 23M6 feeder and the new 23M28 feeder.

Scope

Currently there is only one 44/13.8kV substation in the Barrie North-East area; Little Lake MS306, supplied by the 23M21. The area is also supplied by the 44kV 23M6 along St. Vincent Street, though the majority of the load on 23M6 is south of Highway 400, which is outside of the Barrie North-East area. The 23M21 feeder supplies 7,257 customers, of which 6,529 are residential customers, while the 23M6 supplies 5,757 customers of which 4,709 are residential customers.

In response to 8.8MVA growth, a new 20MVA 44/13.8kV four feeder substation (Livingstone MS310), supplied by 44kV feeder 23M2, is expected to be in-service in 2018. Construction of Livingstone MS commenced in 2017.

Each feeder provides contingency back-up in the event that an adjacent feeder in the area is lost. During the 2016 summer peak, 23M6 exceeded its planning limit of 400A, and would have exceeded its thermal limit of 600A in the event of an outage on 23M21. This is prior to factoring in the 8.8MVA in new commercial developments and the new Livingstone MS310. Table 16 identifies the actual 2016 load and forecasted loading on the 23M28, 23M21 and 23M6 feeders.

System planning criteria specifies that 44kV feeders operate below the 400A planning limit during normal operating conditions and do not exceed the 600A thermal limit during contingency conditions.

With limited load transfers available from 23M21 to adjacent 44kV feeder, exceeding the 600A thermal limit of the 23M6 during contingency conditions would result in customer load shedding through rolling blackouts. In the event of an outage on the 23M21 feeder during the summer peak, there will be 3MVA of load at risk in North-East Barrie, resulting in approximately 1,300 customers affected by rolling blackouts.

Increasing 44kV feeder contingency transfer capacity in North-East Barrie and supplying the new Livingstone MS310 on a separate feeder from Little Lake MS306 adds value to customers by enabling the connection of additional load growth, while providing contingency to transfer load from the 23M6 feeder in the event of a failure on the 23M21 feeder, thereby minimizing customer outages.

Options Considered

The following options were considered for North-East Barrie:

Option 1 - *Status Quo*

The first option is to supply the Barrie North-East area loads from the existing two 44 kV feeders; 23M21 and 23M6. In this scenario, both the municipal stations MS310 and MS306 would be supplied from the feeder 23M21. As MS310 and MS306 provide back-up for each other, a failure on the 23M21 feeder would result in both stations sustaining an outage. To ensure reliable supply under a single contingency arrangement, MS306 and MS310 cannot be supplied from the same feeder.

Further, the *status quo* is not recommended because 23M6 has no additional capacity. In 2016, the loading on the 23M26 exceeded the 400A planning limit and the 600A thermal limit would have been exceeded in during contingency transfer from 23M21. This is prior to factoring in the 8.8MVA in new commercial developments and the new Livingstone MS310. The status-quo would not accommodate the future commercial load growth in the area, nor would it provide adequate feeder capacity for load transfers in contingency conditions.

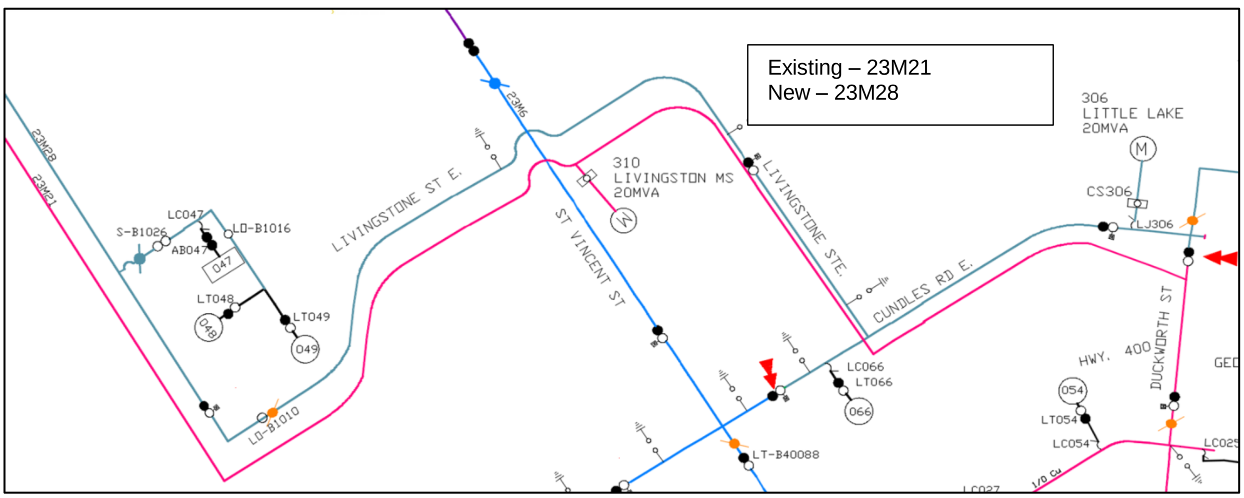
Option 2 - Double circuit the 23M21 from Bayfield Street to Little Lake MS306

Option 2 is to extend feeder 23M28 along the existing path of 23M21 from Bayfield Street and Livingstone Street to Cundles Road and Duckworth Street, and transfer the supply of Little Lake MS306 from 23M21 to 23M28. This would free up capacity on 23M21 to meet the projected load growth, supply the new Livingstone MS310 and mitigate the existing thermal overloading issue under contingency conditions for the area.

Recommended Option

Option 2 is the recommended option. Transferring the supply of Little Lake MS306 to the 23M28 and supplying the new Livingstone MS310 from 23M21 will more evenly distribute load across both feeders. Contingency transfers from the 23M21 feeder will be accommodated by both the existing 23M6 feeder and the new 23M28 feeder. Figure 24 provides the recommended path of 23M28 to supply MS306 Little Lake, as well as the path of feeder 23M21 to supply MS310 Livingston MS.

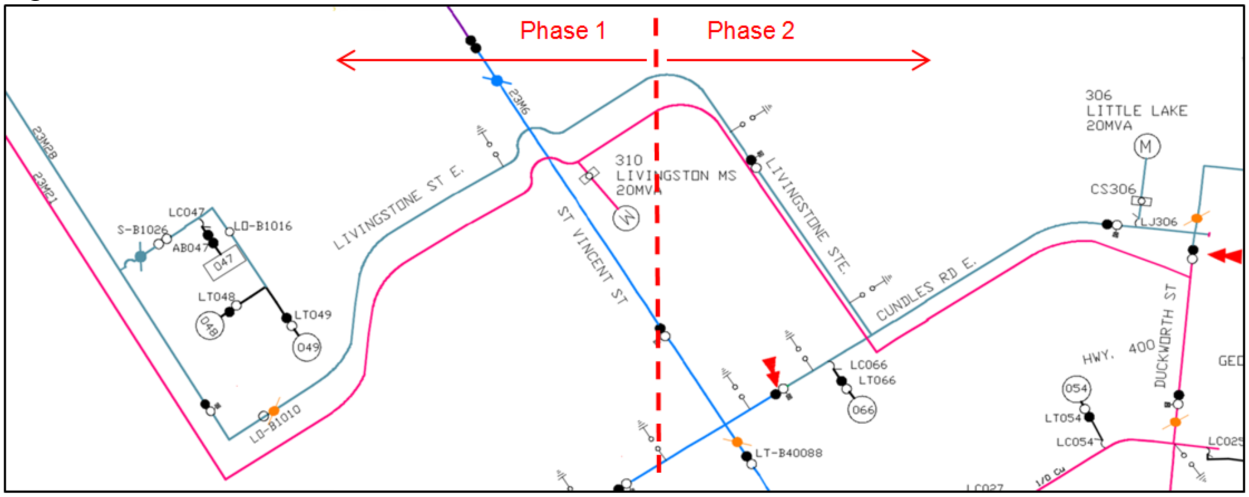
Figure 24 – 23M21 Double Circuit from Bayfield Street to Little Lake MS306



In order to accommodate the two feeders (i.e., double circuiting 23M28, 23M21), the pole line from Bayfield/Livingston along Livingstone Street to Cundles Road, and along Cundles Road to Little Lake MS must be rebuilt. Double circuiting the 23M21 feeder with the 23M28 feeder will be completed by the end of 2018. The project includes engineering design, approvals, construction, and commissioning.

Double circuiting the 23M21 feeder with the 23M28 feeder from Bayfield Street and Livingstone Street to Cundles Road and Duckworth Street will be completed in two phases: Phase 1 (Bayfield Street to St. Vincent, Livingstone MS, inclusive) to be constructed in 2017 to coincide with the construction of Livingstone MS; Phase 2 (east of Livingstone MS to the existing Little Lake MS306) to be constructed in 2018, as per Figure 25 below.

Figure 25 – Phase 1 & Phase 2



Upon completion of the double circuiting the 44kV feeder loading, contingency capacity in 2019 for the North-East Barrie will be within planning and thermal limits, as identified in Table 17. Further, transferring Little Lake MS306 to the 23M28 and supplying the new Livingstone MS310 from 23M21 will distribute load across both feeders. Contingency transfers from 23M21 will be accommodated by both the existing 23M6 and new feeder 23M28.

Table 17 – 44kV Feeder Loading and Contingency Capacity with 23M28 in Service

23M21, 23M28 & 23M6 Load Forecast (3.5% 2017-2021 & 3% 2022-2026)											
	2016 (Actual)	*2017*	*2018*	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
23M28 Peak (MVA)	*3.0*	*3.1*	*3.2*	17.5	18.1	18.7	19.3	19.8	20.4	21.0	21.7
Normal Amps	*39.4*	*40.7*	*42.2*	229.0	237.0	245.3	252.6	260.2	268.0	276.1	284.3
23M21 Peak (MVA)	*17.1*	*17.7*	*18.3*	17.0	17.2	17.4	17.6	17.8	18.0	18.3	18.5
Normal Amps	*224.4*	*232.2*	*240.4*	223.1	225.7	228.5	231.2	234.0	236.8	239.6	242.5
23M6 Peak (MVA)	*31.1*	*32.2*	*33.3*	24.9	25.1	25.4	25.8	26.1	26.4	26.7	27.0
Normal Amps	*408.1*	*422.4*	*437.1*	326.1	330.0	333.9	338.0	342.0	346.1	350.3	354.5
Contingency 23M21 to 23M6	*632.5*	*654.6*	*677.5*	476.1	481.9	485.9	490.0	494.1	498.1	502.1	506.1
Contingency 23M21 to 23M28	*N/A*	*N/A*	*N/A*	302.0	310.9	321.7	331.8	342.1	352.8	363.8	375.2

Double circuiting the existing 23M21 feeder with the 23M28 feeder from Bayfield Street to Duckworth Street and transferring Little Lake MS306 from 23M21 to 23M28 is prudent and directly addresses the needs identified for North-East Barrie, including load growth and 44kV feeder contingency capacity.

Budget

Total budget for the multi-year project is $2,21MM. Investment in 2016 included the project design; Phase 1 construction is underway in 2017 from Bayfield to St. Vincent, Livingstone MS310 inclusive; and Phase 2 in 2018 includes construction from east of Livingstone MS310 to the existing Little Lake MS306, as provided in Table 18 below.

Table 18 – Budget Breakdown by Year

2016	2017	2018	Total Budget
$64,200	$871,864	$1,211,653	$2,147,717