B1.1

Seaton Transformer Station
Business Case

August 17, 2016

PRIVATE INFORMATION

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1.0 Executive Summary

This executive summary will provide an overview of the Seaton Transformer Station (Seaton TS) business case and the recommendation between the "build option" (Veridian to build and own the Seaton TS) **or** the "buy option" (Veridian pays Hydro One to build and own the Seaton TS).

A new major load area (Seaton Community) in north Pickering is the significant driver of development and new residential load customers. Additional commercial development for the employment lands on either side of Highway 407 located at the northern boundary of the community are projected to follow the residential development.

The combined load forecast for the Seaton Community and other developments within the same supply area is such that the only remaining available electrical supply feeder capacity from Hydro One's Whitby Transformer Station is projected to be exhausted by 2020. After this date, there is no more supply available from Veridian's existing distribution system.

Studies were completed to analyze alternative supply options by either finding available unused capacity from the local existing Hydro One transformer stations or through conservation and demand management initiatives. The IESO concluded that the construction of a TS, in close proximity to the Seaton Community, with no feeder construction from the existing Sheppard TS or Malvern TS or Cherrywood TS was the lowest cost option. There was no material capacity made available through conservation and demand management initiatives.

The only resolution remaining to the lack of supply was to add capacity through the construction of a new transformer station (Seaton TS) with a 2019 planned in-service date through either a "Veridian build option" or a "Hydro One buy option".

In the interim until the Seaton TS is in-service, new distribution feeder construction projects towards and into the Seaton Community have been included in Veridian's capital investment plans for 2014 through 2018. The Seaton Community will be supplied through these new feeders with the available remaining capacity from the Hydro One owned Whitby TS.

Load forecast and planning work on the Seaton TS started in 2013 and has been ongoing and continually updated to match the pace of development and connection projections to ensure the appropriate timing for the construction and in-service energization of the Seaton TS. The need for new capacity has been introduced into the IESO's Regional Planning Process.

Three potential sites for the Seaton TS were identified early in the planning process and were included within the Seaton Community master environmental servicing plans. Of the three sites, Site 2 (approximately NE corner of Sideline 22 and Taunton Road) appears to be the most favourable site through the initial evaluation already completed, however this will be confirmed only when the environmental assessment process is finalized in Q2 2017.

For the transformer station, the decision evaluated was between the Veridian build option and the Hydro One buy option. There is significant cost difference between the two options.

The impact to rate payers and the value to shareholders were the two key evaluations completed when considering the economic component of the Veridian-build or the Hydro One buy supply options decision. The result of the financial analysis was that the Veridian-build option for the TS provided the lowest overall cost to rate payers and provided the higher long-term shareholder value through growth in rate base.

Separate applications to the IESO and Hydro One have been completed to initiate the transmission connection process because the Seaton TS would be a new transmission connected facility to the provincial transmission grid. IESO's System Impact Assessment (SIA) was completed with a favourable result in that a Conditional Approval of Connection Proposal to the Seaton TS project was issued in May 2016. Hydro One's Connection Impact Assessment (CIA) has a late August completion date.

The construction of major projects typically has two principal approaches. These are either the Engineering Procurement and Construction (EPC) contract model or the Owner's Engineer contract model. A thorough evaluation of the advantages, disadvantages, risks and benefits of both contract models was completed. It was decided to use the Owner's Engineer approach since it was the contract model that provides for the most control and oversight of the project by the direct management of cost and schedule.

Costello Associates will be engaged to act as Veridian's Owner's Engineer. Veridian will rely heavily on the Owner's Engineer to assist with this project. The main base document of this Seaton TS business case is the Costello Associates Seaton Transformer Station Supply Options Study found in Appendix 1. Based on their industry experience with other LDCs, and our own direct experience with them over the last two and half years, there is high confidence in Costello Associates' competency and capability to be able to fulfill the Owner's Engineer role for Veridian.

It is the recommendation of the Vice President Engineering that Veridian should proceed with the Veridian build option to design, construct and own and operate a new 230kV – 27.6kV 170 MVA municipal transformer station identified as the Seaton TS.

The main benefits of the recommended Veridian build option are summarized as follows:

- Lowest overall cost to rate payers
- Greatest shareholder value
- Greater operating flexibility in day-to-day system operations
- Greater operational control and responsiveness during unplanned events
- Indoor station design requires less maintenance, lower maintenance costs, and improved reliability
- Development of Veridian staff capabilities

The other sections of this report that follow include information in more details and depth expanding on the main points made within this executive summary.

2.0 Overview of Need and Supply Options

2.1 Background

Development in north Pickering has been part of various provincial, regional and municipal plans since the mid 1970's. Generally these plans have included provisions for an airport as well as agricultural, residential and commercial uses. In 2006, the City of Pickering put forward the Central Pickering Development Plan (CPDP) that included plans that projected for approximately 70,000 residents in six (6) new neighbourhoods in the Seaton development area. This area is generally bounded by Whites Road/Sideline 26/North Road to the west, Highway 7 to the north, Brock Road to the east and Taunton Road/Duffins Creek/Canadian Pacific Railway to the south. The more common name for this area is the Seaton Community and it can be better visualized in Figure 1.

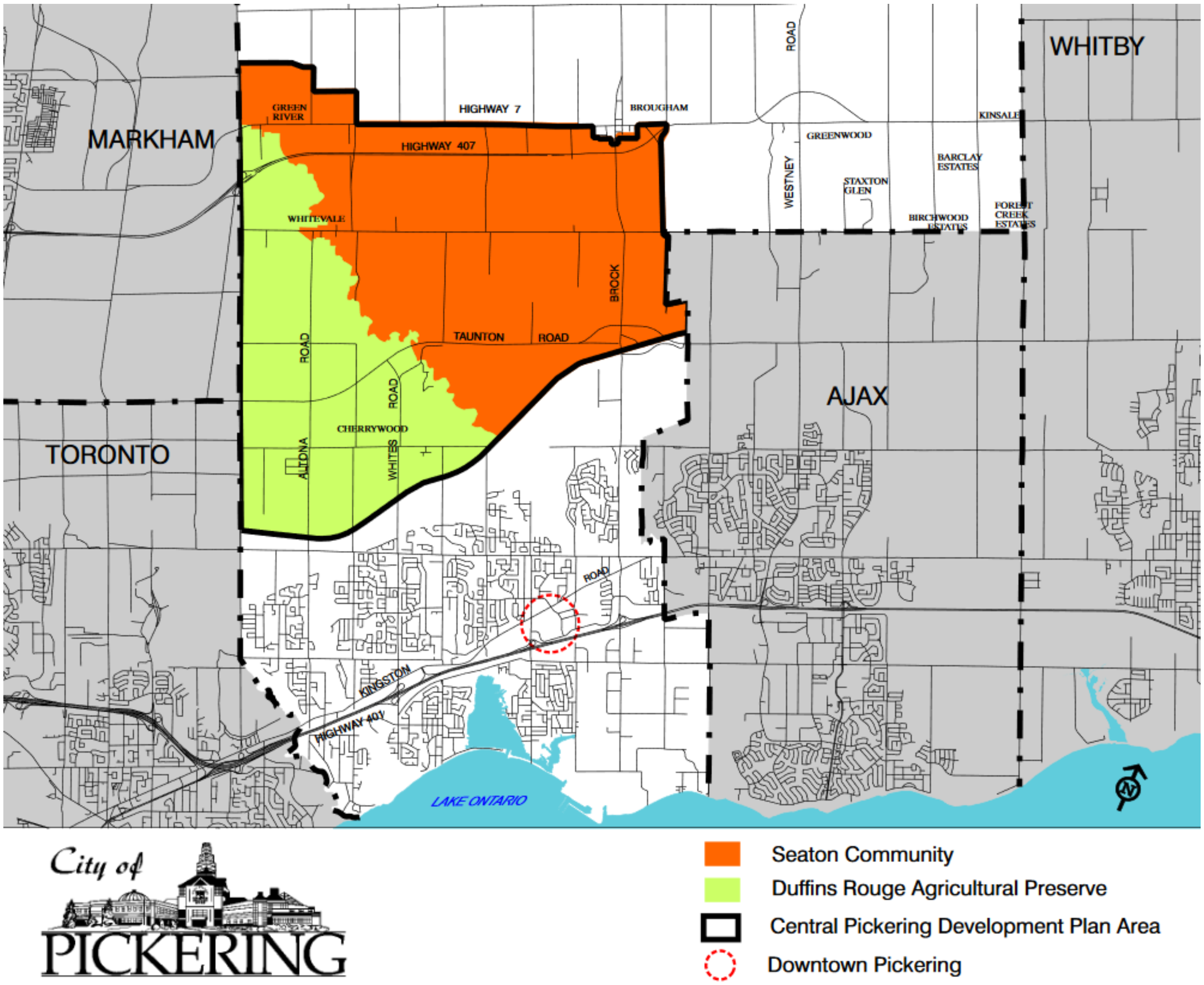

Figure 1 – Seaton Community Area Boundaries

In addition to the 70,000 residents, the CPDP also included a projection of 35,000 people being employed in commercial developments, located primarily in a corridor running along both sides of Highway 407 and Highway 7 in what is known as the Innovation Corridor.

Working with the latest regional, municipal and developer information, analysis of the electrical load needs for the complete Seaton Community development identified that between 155MW and 193MW of electrical capacity is required for this specific area, in addition to current demand outside of the Seaton Community. Further detail on the load forecast for the Seaton Community can be found in *Appendix 1- Costello Associates Seaton Transformer Station Supply Options Study dated August 15, 2016 under Appendix 1- Load Forecast Study & Sensitivity Analysis*.

2.2 Existing Electrical Supply

The City of Pickering and the Town of Ajax are supplied by Hydro One's Cherrywood TS, Malvern TS, Sheppard TS and Whitby TS. At the present time, the only remaining capacity is available from Whitby TS. Whitby TS was the newest transformer station facility constructed to meet the growing supply needs with Phase 1 of the station providing only 44kV feeders. Sufficient land was included at the Whitby TS site to allow a Phase 2 expansion in the future.

Consideration for load growth in north Pickering, north Ajax, as well as in the Town of Whitby resulted in a coordinated plan between Veridian, Whitby Hydro and Hydro One requiring the need to proceed with the Phase 2 expansion of Whitby TS. The expansion, which went in-service in 2008, saw the construction of a second transformer station owned by Hydro One located on the same site, which allocated the 27.6kV portion of the expansion to Veridian and the 44kV expansion to Whitby Hydro. As a result, Veridian had access to six (6) 27.6kV feeders with a planning capacity of 15MW per feeder, for a total of 90MW. Since 2008, this 90MW capacity has been steadily reduced to meet new growth and development supply needs outside of Seaton. It is clear that Veridian would not be able to supply the full electrical capacity requirements of new growth and development with the remaining capacity from Whitby TS alone beyond 2020.

2.3 Existing Distribution Infrastructure

Veridian's current electrical distribution infrastructure in the Seaton Community is mostly of a single phase, rural supply type arrangement supplied at 27.6kV and 8.32kV, with a more substantial three phase backbone along Brock Road and Highway 7. However, being primarily rural in nature and constructed more than 25 years ago, poles are generally undersized with small conductors. Electrical loads are low in this area with only sporadic residential/farm customers. Loads have actually dropped over the years as the Province has acquired lands and demolished structures following departure of previous owners, in preparation for the future Pickering airport. Overall as is, the existing electrical infrastructure is not adequate in size, quantity and capacity to meet the electrical supply needs of the Community in any way.

2.4 Needs Study

Discussions were started with Hydro One in 2011 regarding the future electrical needs in the Seaton Community. The study of this area was furthered with the Regional Planning initiative as mandated by the OEB. In that planning process, needs across the full Region were identified during the initial Needs Screen chaired by the local transmitter (Hydro One) in Q4 2014. Those needs, including the growth of north Pickering, were reviewed and considered for potential actions. These actions included i) do nothing, ii) recommend a transmitter led Regional Infrastructure Plan (RIP), which was a wires only solution, or iii) recommend an Ontario Power Authority (OPA), and now IESO, led Integrated Regional Resource Plan (IRRP). As there was the ability to consider options other than wires only, such as with Conservation and Demand Management (CDM) programs, it was agreed to include the north Pickering needs in an IRRP process. Studies on the CDM programs concluded that there were no material capacity made available through conservation and demand management initiatives to be able to defer the construction of another supply point.

2.5 Integrated Regional Resource Plan (IRRP)

The IRRP process enabled a greater level of analysis to be completed concerning the need in north Pickering. The intent of the analysis being to identify and review all possible scenarios to supply the need in the most economic, practical and prudent manner possible for a long term sustainable result.

The IESO reviewed the other surrounding possible sources of 27.6kV that could supply the load area. The analysis revealed that both the Sheppard TS and Malvern TS in east Toronto (Scarborough) had some limited available capacity that could be potentially used to supply the Seaton Community. However, the IESO determined that their capacity was not economical to use due to the high construction costs related to building significant length feeder supply lines from the TSs through urban areas and then across challenging terrain of the Rouge Valley (and soon to be National Park). Electrically, there were significant, additional electrical losses due to those same long feeder lengths. Regardless of the above, the amount of available capacity between the two TSs was not adequate to fully feed the Seaton Community and as such, it would still be necessary to build the new Seaton TS.

Similarly, the IESO analyzed and discounted building feeders from Cherrywood TS due to feeder construction expense and electrical losses.

In the end, the net present value analysis completed by the IESO concluded that the construction of a TS, in close proximity to the Seaton Community, with no feeder construction from Sheppard or Malvern or Cherrywood, was the lowest cost option. The full IESO analysis can be found in *Appendix 2 – IESO – Transmission and Distribution Options – Pickering Ajax Whitby IRRP.*

3.0 Supply Options Evaluations

3.1 Potential Seaton TS Sites and Locations

The three potential sites are described as follows and found on Figure 2:

Site 1 - Approximately the NE corner of Brock Road and Taunton Road;
Site 2 - Approximately the NE corner of Sideline 22 and Taunton Road; and
Site 3 - The NE corner of Concession Road 3 and Dixie Road (east of existing Hydro One Cherrywood TS).

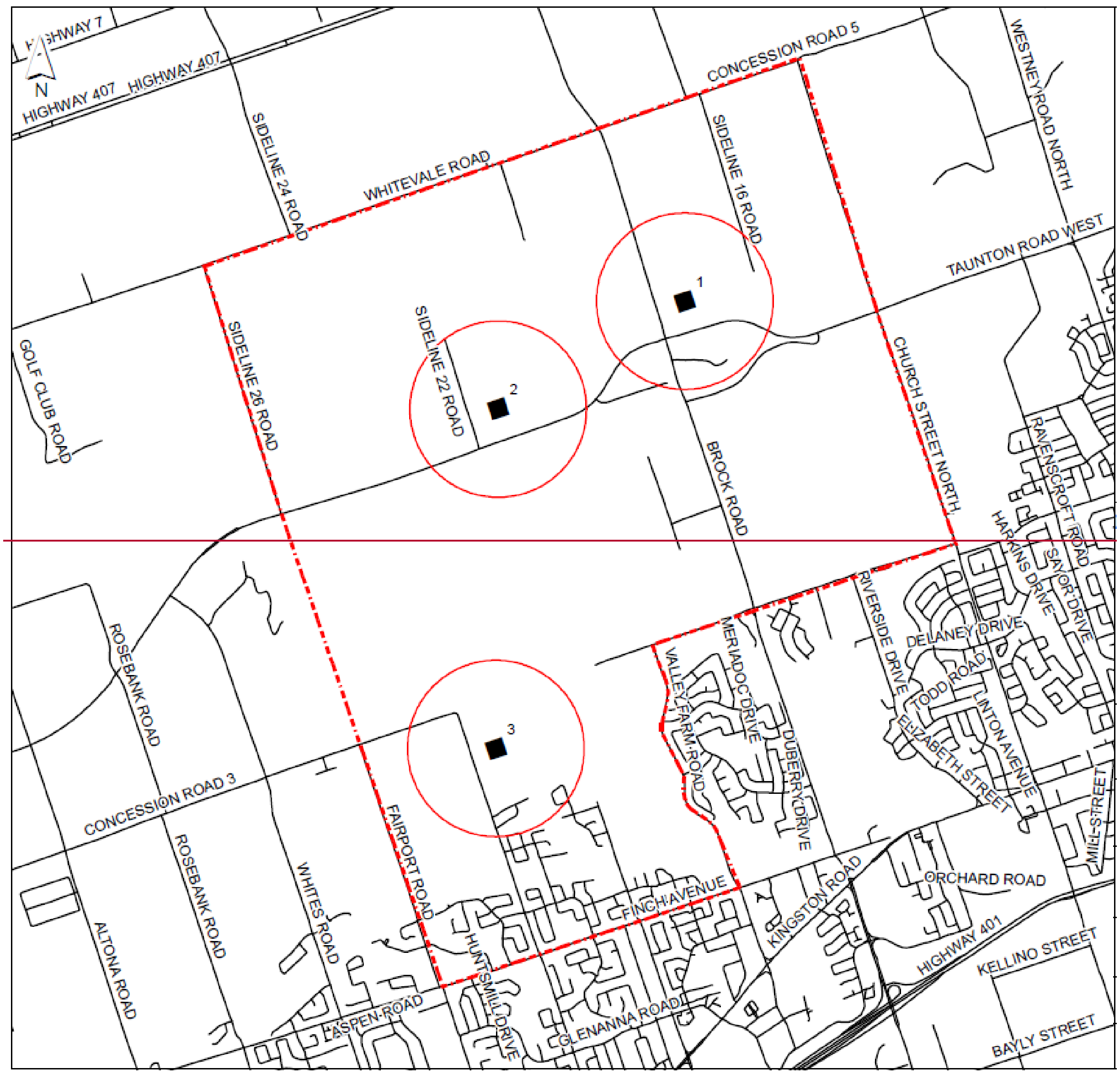

Figure 2 – Location of Potential Seaton Transformer Station Sites

Site 2 appears to be the most favourable site through the initial evaluation already completed, however this will be confirmed when the specific site selection for the transformer station site, balancing technical, environmental and cost factors for all three potential sites **and** the related transmission line rebuild work is finalized in Q2 2017.

3.2 Transformer Station Site Selection

Two primary factors are considered in identifying potential sites for a transformer station i) transmission line availability, and ii) a successful completion of the Environmental Assessment process.

3.3 Transmission Line Availability

The availability of transmission circuits for the supply to the new facility is critical. It is typical to identify potential transformer stations sites to be within close proximity to existing transmission corridors. The closer that a site can be to an existing corridor reduces the amount of work required to extend an existing circuit or build a new circuit which in turn results in an overall savings of time and money.

It is also typical to have two different transmission circuits, rather than just one, available for connection to any TS in order to provide superior reliability of supply. The majority of new TSs are constructed with this arrangement.

Fortunately, the Seaton Community has good availability to a 230kV transmission tower line travelling through the south side of the community. However, these existing towers are currently only built to carry a single transmission circuit and it would be necessary that a section of the tower line be rebuilt to carry two transmission circuits at least as far as the new Seaton TS site. Similarly, Site 3 which is near Hydro One's Cherrywood TS, also requires tower line rebuild work in order to bring two different transmission circuits to that site as well. Estimates from Hydro One have been received for the transmission tower line rebuilds and connection work to all three potential Seaton TS sites and are found in the table below. The highest cost of the transmission tower line rebuild, $9.0M for Site 1, has been included in Veridian's cost for the project for the purpose of this business case and represents the worst case scenario in terms of the external agency approval process required, cost to rebuild and Hydro One's construction time to complete.

Summary of Hydro One 230kV Transmission Line Rebuild Required for Seaton TS Sites		
Sites	**Distance To Rebuild**	**Cost**
Site 1	3.5km	$9.0M
Site 2	1.5km	$7.46M
Site 3	1.0km	$6.6M

The worst case scenario also covers that the transmission tower line rebuild is fully funded by Veridian as a customer specific non-pooled asset and is not cost shared in any way with Hydro One as a network pooled asset. It should be noted that Veridian intends to continue a dialogue with Hydro One on the allocation of costs for the transmission tower line rebuild. Costello Associates advises that it is unclear whether the rebuild relates to "network" or "connection" transmission assets, and that if they are network assets, Veridian may avoid some of these cost responsibilities. It may be necessary to take this decision to the OEB if Hydro One's approach is not reasonable.

To be able to maintain the project schedule in order to meet the 2019 in-service timeline for the TS, Veridian met with Hydro One's Engineering and Project Delivery team on April 14, 2016 and initiated the review of the station design, the 230kV transmission lines design, real estate and environmental needs. There were no initial impediments or delays identified.

3.4 Environmental Assessment (EA)

Once potential station sites for the TS have been identified, those sites, and the related transmission tower line rebuild work, must be evaluated through an Environmental Assessment process. The particular process utilized for a project like this is known as a Class Environmental Assessment. Through an RFP, Veridian engaged the services of WSP Canada (WSP) in February 2015 to complete the EA work related to all three of the potential TS station sites. The EA work related to the transmission right of way (ROW) and the associated tower construction work is being completed in partnership with Hydro One in a joint co-proponent EA process. The final EA process report, known as an Environmental Study Report (ESR) will consist of a combination of the two distinct but associated components (the station site component and the 230kV transmission tower upgrade component). Veridian and Hydro One will be proceeding together as co-proponents and complete the EA process by filing one (1) ESR with the Ministry of the Environment and Climate Change (MOECC) stating that all requirements have been met. Further details for each component are found in the following sub-sections

3.4.1 Veridian Environmental Assessment (Seaton TS Station Site)

WSP's work included, but was not limited to, agency consultations, site investigations and inventories related to significant land features such as wetlands, fish and endangered/threatened species habitats, socio-economics and land use, archaeological and cultural heritage features, noise studies and local points of noise reception. It also included a public information centre in August 2015 with eight registered attendees. There were no significant issues raised or identified through any of the work that would preclude any of the sites from being selected as the preferred site.

Once all data and information gathering was completed, WSP then ranked the sites as measured against a set of specific evaluation criteria. The site specific EA work was substantially complete by March 2016 and documented in a pre-release interim Environmental Study Report (ESR) for all three (3) potential TS sites. This Veridian pre-release interim ESR is being held until Hydro One completes its EA and its own ESR, for the 230kV transmission tower line rebuild.

3.4.2 Hydro One Environmental Assessment (230kV Transmission Tower Line Upgrade)

Work on the Hydro One EA began in Q4 2015 and was to be completed to meet a December 2016 completion date, but is now delayed and is expected to be completed in Q2 2017. To this point, there have been no significant issues raised or identified regarding the physical conditions of tower line right of way (row). However, Hydro One has raised the point that consultations with First Nations may add time and cost to the EA, the impact of which are unknown at this time.

Hydro One's EA process timeline has been included as *Appendix 4 – Public Consultation Schedule for Seaton TS received August 12, 2016*.

3.5 Land Acquisition

Working with the City of Pickering, the three potential TS sites were identified within its Seaton Community Master Environmental Servicing Plan (MESP). These sites had land use designations that were appropriate for a TS facility.

In order to ensure land is available for construction of a TS on any of the three potential sites, Veridian has been in contact with Infrastructure Ontario (IO), the landholder for all three sites, since the completion of the MESP for Seaton identified the potential need for a TS to supply the area. The lands identified where all three potential TS sites are located are considered to be non-developable, and in the case of the two sites near the Seaton development (Sites 1 and 2), also considered to be Natural Heritage Site (NHS) lands. Infrastructure, such as a TS, is a permitted use on these NHS designated lands. One of the three sites would be the location of the TS regardless of the outcome of the Veridian-build or Hydro One-buy business case.

It is extremely unlikely that another use by another agency would be considered by IO for the lands which are under consideration for the Seaton TS. However, to protect Veridian's interest in those sites, IO has accepted Veridian's request to place a legal temporary easement on the lands associated with all three potential TS sites, thereby preventing any other use for these lands. Veridian is currently awaiting IO's legal department to complete the wording for the temporary legal easement agreements. A legal review by Veridian would then follow prior to being signed. These agreements would be registered on title for all three possible sites for the TS. These sites would be held for Veridian until the ultimate TS site is finalized and then Veridian would release the temporary easements on the other two sites. IO will then grant Veridian a permanent easement for the TS site. Timeline of completing the agreements with IO is within Q4 2016.

As of the end of June 2016, IO confirmed that they will use the non-developable land price for calculations related to the land costs for the TS. Currently for the Pickering area that price is $26,000 per acre. The TS site has been sized as 200m x 200m, 40,000 sq metres or 9.9 acres. The cost per year for each of the temporary lease agreements has been estimated by IO to be 7% of the land price or approximately $19,000 per year until the temporary easements are released by Veridian.

The cost of the permanent easement would also be a percentage of the same $26,000/acre land price. Typical cost for hydro ROWs however is known to be a one-time cost of approximately 70% of the appraised land price based on previous experience. This would result in a one-time cost to Veridian of approximately $180,000.

3.6 Transformer Station Connection Options

With the Transmission System Code (TSC) coming into effect, the electricity industry moved to a "user pay" approach that resulted in connecting customers having a choice to either undertake certain contestable work on their own or pay Hydro One to complete the work.

In the case of LDCs who require new transformer station capacity, there are three (3) basic options available:

- LDC pays Hydro One to design, construct, operate and own the new transformer station – the *Hydro One buy option*.
- LDC designs and constructs the new transformer station to Hydro One's technical standards and transfers the ownership and operation to Hydro One upon putting it in-service – the *LDC Turn Over option*
- LDC designs, constructs, owns and operates the new transformer station – the *LDC build option.*

The comparison of the options and comments are found in *Appendix 1- Costello Associates Seaton Transformer Station Supply Options Study dated August 15, 2016, Sections 4.2 and 4.3, Pages 12 – 14*.

As noted in the Appendix comments, there is no case, where the LDC Turn Over option has been selected by an LDC so there is no conclusion as to the success or failure of this option. However, it is expected that even though the initial LDC's construction costs would be lower than Hydro One's, the layering on of Hydro One's engineering, inspection, testing, commissioning and administration costs could most likely result in higher final costs. Schedule delays could also be expected since this is a process that is not well evolved. To this end, it would not be prudent to pursue this untested option so it has been removed from consideration in the evaluation of the connection options. Specifically to the Seaton TS project, the Veridian-build and the Hydro One-buy options are the two remaining that have been evaluated.

4.0 External Approvals/Review Agencies

A number of external approvals will be required to facilitate construction of a TS. Timing requirements for actual approvals to be received will vary along the course of the project and be dependent on the phase of the work involved. Discussion of the more significant approvals required for this project follows.

4.1 Independent System Operator (IESO)

The IESO is responsible for the management of the provincial transmission grid, including the day to day operation of the transmission system as well as medium and long term planning of the provincial power grid.

Veridian completed an application for an IESO System Impact Assessment (SIA) for the proposed new TS on April 20, 2015. Veridian submitted this application to ensure that a Veridian build outcome could be accommodated if selected. It was deemed critical, and of nominal effort and cost to have the review and approval processes started and running in parallel with each other to meet the 2019 in-service timeline of the TS.

The IESO application required a (one) fixed location for the TS in order to complete its technical modelling and review. Veridian was not able to identify the final site for the TS since the EA process to determine the preferred TS site has not yet concluded. To proceed with the application, Veridian identified Site 1 (NE corner of Brock Road/Taunton Road) as the site to be used for the analysis since it represented the worst case, electrically, for the IESO to study, as it was furthest distance from the source of the 230kV (Cherrywood TS).

The IESO completed its System Impact Assessment (SIA) and issued a Conditional Approval of Connection Proposal to the Seaton TS project on May 13, 2016. This Conditional Approval indicates that the IESO concluded that the proposed connection (new Seaton TS at Site 1) will not result in a material adverse impact on the reliability of the integrated power system. With this approval in place Veridian can now initiate the IESO's Market Registration process, to register the facility, in order to be a Market Participant in the transmission market. Upon successful completion of Facility Registration, the IESO will provide Veridian with a final approval that confirms the project (Seaton TS) is fully authorized to connect to the transmission grid. All of which is pending Veridian's Board approval of the business case decision to support the Veridian-build option (Veridian builds, owns, and operates its own TS).

4.2 Hydro One

As owner of the transmission grid that the new Seaton TS would connect to, Veridian will require approvals from Hydro One. Veridian completed the application to Hydro One regarding the new TS at the same time as to the IESO on April 20, 2015. Hydro One assisted the IESO in completion of the IESO's SIA. Hydro One will also complete its own Connection Impact Assessment (CIA) for Veridian's new connection to the transmission system, per the process laid out in the OEB's Transmission System Code. This CIA has a late August completion date. Hydro One will coordinate with Veridian's project team during the detailed design phase, both to ensure coordination between the station and the transmission system, and to ensure that the station meets all of the technical requirements of the Transmission System Code. Hydro One will have oversight over the final commissioning and testing to ensure that the protection systems work as designed. In the commissioning stages, Veridian will work with the IESO and Hydro One Ontario Grid Control Centre (OGCC) to implement any necessary work protection and oversee switching coordination required to bring the TS on-line and into service.

4.3 Ontario Energy Board (OEB)

Pre-approval of the OEB is not required for Veridian to proceed with building its own TS, however if Veridian's Board does approve the business case decision to support the Veridian build option (Veridian builds, owns and operates its own TS), then it will be incumbent on Veridian to be able to demonstrate to the OEB that it is a prudent investment and beneficial to its customers.

5.0 Economic Evaluation

5.1 Financial Comparison of Supply Options

As noted previously, two supply options are under consideration; 1) Veridian-build and operate or 2) Hydro One-buy and operate.

There are 2 key evaluations to be completed when considering the economic component of the supply option decision; 1) Impact on Rate Payers and 2) Value to Shareholders.

From an economic standpoint, the best supply option decision should be the one which is the lowest overall cost to customers over the life of the asset, while creating long term value to shareholders through rate base growth.

A Veridian-built TS provides the lowest overall cost recovery for rate payers and provides higher shareholder value through growth in rate base. The details and support for this conclusion are provided below.

5.2 Station Construction and Capital Costs Comparison

The table below provides a comparison of station construction costs. Full details of these costs is provided in *Appendix 1 – Costello Associates Seaton Transformer Station Supply Options Study dated August 15, 2016, Section 5, Pages 20-22.*

Table 1: Comparison of Station Construction Costs ($ 000's)

	Site 1	Site 2	Site 3
Hydro One			
TS Construction Cost	$ 42,400	$ 37,400	$ 39,500
Metering	$ 250	$ 250	$ 250
Additional Breakers	$ 9,500	$ 9,500	$ 9,500
Hydro One Costs	**$ 52,150**	**$ 47,150**	**$ 49,250**
Required Capital Contribution by Veridian under Hydro One Build Scenario	*$ 35,150*	*$ 30,450*	*$ 32,250*
Veridian			
TS Construction Cost	**$ 37,700**	**$ 34,200**	**$ 36,800**

Hydro One's costs range from $47.15M to $52.15M. Under a Hydro One-buy scenario, Veridian would be required to make a capital contribution to Hydro One, similar to when developers and other Veridian customers make capital contributions to Veridian. The estimated capital contribution would range from $30.45M to $35.15M. This capital contribution would be treated as any other capital investment by Veridian in that it would be included in regulatory rate base and would earn the regulated return and would be recoverable in future rates.

As seen, Veridian's projected construction costs are significantly lower than that of Hydro One.

When evaluating costs the proper comparison is between the Veridian TS construction costs and Veridian's required capital contribution to Hydro One. In the case of each of the sites shown above, the capital outlay by Veridian is lower where Hydro One were to build the station.

Shareholder value though, through rate base growth is higher under the Veridian-build scenario. Along with the station construction costs, total capital costs also include approximately $10M in costs that are common to each scenario. These are for transmission tower line rebuild of $9M and environmental assessment costs of $1M.

Table 2 provides a comparison of total capital costs. The highest capital cost is used for the Veridian-built scenario and the lowest capital cost is used for the Hydro One-buy scenario. To be conservative, the analysis should be conducted using the 'best case' scenario by Hydro One and the 'worst case' scenario by Veridian. This combination results in the highest cost differential and the appropriate base for calculating total costs to rate payers.

Table 2: Comparison - Capital Costs for Veridian ($000's)

		Veridian-built Station		Hydro One TS Station
Construction Costs	$	37,700		
Capital Contribution to Hydro One			$	30,450
Environmental Assessments	$	1,000	$	1,000
Transmission Tower Line Rebuild	$	9,000	$	9,000
Total Capital Costs	**$**	**47,700**	**$**	**40,450**

It should be noted that Veridian intends to continue a dialogue with Hydro One on the allocation of costs for the transmission tower line rebuild. Costello advises that it is unclear whether the rebuild relates to "network" or "connection" transmission assets, and that if they are network assets, Veridian may avoid some of these cost responsibilities. It may be necessary to take this decision to the OEB if Hydro One's approach is not reasonable.

Along with capital costs, incremental operating costs must be considered. Under the Veridian-build scenario, Veridian's overall OM&A costs are forecast to increase by approximately $200K. These additional costs are for maintenance, insurance, taxes and additional training for staff. Under the Hydro One-buy scenario, Veridian would incur no direct additional operating costs.

5.3 Impact to Rate Payers

<u>Net Present Value of total cost recovery over life of asset</u>
Under the Veridian-build scenario, Veridian rate payers would incur costs for the new TS through increased distribution rate charges alone, while under the Hydro One-buy scenario, rate payers would incur costs through increased distribution rate charges <u>and</u> through increased retail transmission charges recovered by Hydro One. Rate payer recoveries of these assets are matched with the estimated useful life of the assets, estimated here at 40 years.

As the cost recoveries for such a long-lived asset continue for many years, the appropriate analysis methodology is that of computing the net present value (NPV) of the multi-year recovery by rate payers under each of the scenarios.

Table 3 below compares the NPV costs of 40 years of ratepayer recoveries.

Table 3: NPV of 40 years of RatePayer Recoveries ($000's)

	Veridian-built Station	Hydro One TS Station
Distribution recoveries	$ 49,352	$ 40,351
Transmission recoveries	$ -	$ 34,775
Total	**$ 49,352**	**$ 75,126**

Note: 6% discount rate used in NPV calculation

In the Hydro One alternative, the most conservative assumptions for cost to Veridian were used. Distribution recoveries were based on the minimum estimated capital contribution by Veridian to Hydro One that would be recovered in distribution rates. Transmission recoveries were based on existing Hydro One transmission rates with an assumption of no annual escalation in transmission rates. Historically Hydro One transmission rates have increased at approximately 3% per year. Using an assumption of a 3% escalation factor, the NPV of transmission recoveries rise to $60.9M and total recoveries under the Hydro One build option rises to approximately $101.25M.

In the Veridian-build alternative, distribution recoveries are based on highest estimates of capital costs.

As seen, over the life of the asset, the lowest overall cost to ratepayers is the Veridian-build option.

<u>Bill impact levels over life of asset</u>
Under distribution rate recoveries initial bill impacts in the first few years are higher than in later years as the distribution rate recoveries decline over time as the asset is depreciated. Similar to the declining interest payments on a mortgage as the principal is paid down over time.

Timing of bill impacts under transmission rate recoveries is different in that they are lower in the initial years and grow as the load on the station grows through the build out of the development.

The key difference, however is that the transmission rates do not decline over time and actually increase over time as the load stays constant or increases and as Hydro One transmission rates are likely to increase over time.

Initial bill impacts under the Veridian-build option for the first full year of cost recovery are significant at approximately 9.3% for residential customers as compared with the initial bill impacts under the Hydro One-buy option at approximately 8.0%. This bill impact assumes the lowest Hydro One cost to build. Under the highest Hydro One cost to build, the initial bill impact is approximately 9.2%.

Under the Veridian-build option, however, cost recovery for the station at each subsequent rebasing period declines at the rate of approximately 2.5% per year. Rate payers would benefit from this first level of reduced recovery at Veridian's next rate rebasing.

Under the Hydro One build option, cost recovery would remain constant or increase each year.

5.4 Shareholder Value

As noted above, the total capital cost of a Veridian-build station is just under $48M and this capital cost would be a direct increase to Veridian's regulated rate base.

Veridian would then be eligible to earn the OEB approved return on the net book value of this asset. Veridian's OEB approved after-tax weighted average cost of capital (WACC) from its 2014 cost of service application was 6.6%. These returns are a direct increase to net income and value to shareholders.

The total after tax return for shareholders for the 40 years that the station would be in service would be approximately $30M. The NPV of the annual after tax returns is $16.42M.

The return would be recovered through distribution rates over the life of the asset.

5.5 Project Financing

Capital requirements for a Veridian built TS would begin in early 2017 with rough estimates of spending of 2017-$6.5M, 2018-$22.1M and 2019-$19.1M, totalling $47.7M.

In late 2014, Veridian established a 5 year $70M credit facility with TD Bank. The facility provides flexibility in timing of draws against the $70M to meet the spending requirements for construction of the new Seaton TS.

The facility is structured as interest with low rates, based on 30, 60 or 90 day BA rates, currently at 1.6%.

The principal on the credit facility is due in December, 2019, at which time, the plan would be to seek a long term fixed rate loan or possibly a bond placement. This would then become part of long-term embedded debt, funded through distribution rates.

This flexible and cost effective financing arrangement is expected to be sufficient to meet the project financing requirements.

6.0 Regulatory Considerations

The regulatory framework governing the construction of a transformer station and the recovery of associated costs from customers is a complex one. Accordingly, Veridian retained the services of Borden Ladner Gervais LLP ('BLG') for the purpose of a legal and regulatory review of the Costello Associates Supply Options Study.

[redacted]

[redacted]

7.0 Project Management

The management and oversight of a project of this size and cost is a significant effort. Sufficient resources must be allocated to and maintained throughout the entire project timeline to ensure a successful end result. The best served approach towards the project management function for a TS was deemed to be the use of outside resources which are experience based in order to leverage successes, and to be aware of, avoid, and learn from difficulties that other LDCs have encountered in constructing similar projects and applying those lessons to this Seaton TS project. This approach also allows a transfer of knowledge to Veridian staff for subsequent projects.

With the Seaton TS being its first transformer station, Veridian does not have this experience or the dedicated resources available to be able to complete the project management on its own.

The construction of a TS is an order of magnitude greater in cost than any of Veridian's previous largest construction projects. It will involve contractors outside of Veridian's normal working relationships, and will require greater project coordination, oversight and reporting efforts than typically required to ensure that this project is completed to meet time and budget cost expectations.

7.1 Contract Models

The construction of major projects typically has two principal approaches. These are either i) an Engineering Procurement and Construction (EPC) contract model, or ii) an Owner's Engineer contract model. A detailed comparison of the two options can be found in *Appendix 1- Costello Associates Seaton Transformer Station Supply Options Study dated August 15, 2016, Section 6.1, Pages 23-25*.

7.1.1 EPC Contract Model

In general, EPC, also known as "turn-key" or "design-build", means that the EPC Contractor hired by the Owner provides the complete engineering, procurement and construction services in totality. The project is largely EPC Contractor managed and therefore the EPC Contractor, and not the Owner, has greater control over the cost and the project schedule. This shifting of cost and schedule risk to the EPC Contractor increases the cost of the project as the EPC Contractor adds the cost of managing the risk into the pricing of the project. The EPC Contractor has direct contracts with all other contractors and suppliers.

7.1.2 Owner's Engineer Contract Model

An Owner's Engineer is an engineer who is hired by the Owner and provides the engineering, procurement and construction management services. Other companies are contracted by the Owner directly to provide all other services and they are usually managed by the Owner's Engineer on the Owner's behalf. The Owner's Engineer is not involved in the design and construction of the project directly, but acts as an advocate and agent for the Owner to apply due diligence. The Owner's Engineer represents the Owner during all phases of the project to confirm that the work is being completed as per the technical specifications as well as complying with all other rules and regulations. With the Owner's Engineer approach, the project is largely Owner-managed and therefore the Owner has greater control over the cost and the project schedule.

The comparison between the EPC and Owner's Engineer contract models are found in the following Table 4 - EPC vs Owner's Engineering Contract Model Comparison.

Table 4 – EPC vs. Owner's Engineering Contract Model Comparison

Item	Engineering, Procurement and Construction (EPC)	Owner's Engineer (OE)
Eligible Contractors	Limited number of firms able to complete a TS project through EPC approach.	Limited number of firms able to act as OE to complete a TS project.
Model History	EPC model has only been used once by an LDC to build a TS since market opening.	Has been the typical approach used by LDCs to build a TS.
Subject Matter Expert	The EPC Contractor is relied on by the Owner as being the expert on the project.	Owner relies on OE as the expert on the project. OE acts as the agent on behalf of the Owner and has the Owner's interests as top priority.
Project Scope (Overall)	The EPC Contractor dictates to the engineer and construction team the project scope. The initial project scope will be the bare minimum to "win" the tender. Any changes through the Owner's review of the design will result in extra costs to the Owner.	The project scope is dictated by the Owner with assistance from the OE. The Owner works with the engineering team to develop the station standards to Owner's standards without influence from the general contractor or the construction team. The Owner designs the station as they want it.
Project Scope (Technical Specifications)	EPC is only as good as the original project specifications presented during bidding process. Changes to specifications/scope of supply after awarding of contract can be expensive, due to EPC Contractor's sole contract with Owner and Owner's inability to obtain multiple quotations from independent contractors/suppliers.	Owner can modify project specifications with minimal effort. Owner, with the assistance of the OE can negotiate independent contracts with suppliers/vendors at any time due to the fact that project is under multiple (independent) contracts and not one all encompassing contract.
Engineering	The engineer reports directly to the EPC Contractor, which may result in engineering compromises in favour of the EPC Contractor with respect to cost.	The engineer reports directly to the Owner and always maintains the interest of the Owner to ensure a successful project.

Item	Engineering, Procurement and Construction (EPC)	Owner's Engineer (OE)
Engineering Design Contract	Responsible for complete engineering design based on Owner's complete and detailed technical specifications.	Responsible to oversee engineering design based on general technical specifications. Develop and issue RFP for Engineering Services to suitable multiple bidders.
Equipment Supply Contracts	Between EPC Contractor & Supplier only.	Between Owner/OE, and Supplier.
On-Site Construction Contracts	Between EPC Contractor & Supplier.	Between Owner/OE, and Contractor(s).
Supplier Selection	Suppliers chosen solely by EPC Contractor with no input from Owner.	Suppliers chosen by mutual agreement of Owner and OE.
Construction Site Management	Construction management of the work site is completely controlled by the EPC Contractor. Any site conflicts which may arise will result in favour of the EPC Contractor, or will result in cost extras to the Owner.	Construction management includes input from Owner and OE, and any site conflicts can be resolved to reassure the Owner of a reasonable settlement for both parties.
Construction Site Safety	Site safety solely the responsibility of the EPC Contractor and subcontractors; in accordance with Contractual Agreements.	Site safety is monitored by OE but site safety is the legal responsibility of Owner and subcontractors; in accordance with Contractual Agreements.
Commissioning	If commissioning is managed by the EPC Contractor, any workmanship and technical deficiencies identified by commissioning may be resolved in favour of the EPC Contractor.	Independent commissioning services ensures that the Owner is receiving comments, review and testing of the Contractor's work with no influence from the Contractor.
Permitting (Environmental, Construction, etc.)	Permitting is the responsibility of the EPC Contractor with the exception of permits that are required by law to be issued in the name of the Owner of the project.	Permits are issued to the Owner directly with OE assisting in filing the necessary paperwork.
Project Schedule	Greater control of the project schedule by the Contractor instead of by the Owner.	Greater control by the Owner on the project schedule through the OE.

Item	Engineering, Procurement and Construction (EPC)	Owner's Engineer (OE)
Reporting	As required to Owner.	As required to Owner.
Project Budget Cost Overruns	The cost risks for the project are borne by the EPC Contractor. Any cost overruns, for equipment and/or services within the EPC Contractor's scope of supply, are at their own cost and cannot be passed onto Owner unless there are change orders supported by justification as to why the costs should be passed onto the Owner, or there are contractual agreements to the contrary.	The cost risks for the project are borne by the Owner. Any cost overruns, for equipment and/or services are at the Owner's cost.
Change Order Mark-up	Multiple layers of cost markups are added on approved project changes.	Mitigation of extra costs through less number of mark-ups and oversight through OE as the subject matter expert based on experience.
Equipment Purchase Mark-up	Administrative markup would be added on approximately $8.0M of major equipment purchases (potential cost of $0.8M- $1.0M added).	Minimal mark-up on equipment purchases. Individual tenders for major equipment directly from the Owner with assistance of the OE. Equipment is then "free-issued" to the contractor for installation.
Project Cost	As noted above, the EPC Contractor bids to "win" the tender with the bare minimum. When changes occur, the engineer will mark up their costs by 15%, the construction team will mark up their costs by 15%, and the general contractor will then assess the costs, and mark up each subcontractor and add their costs. This will result in a change request, typically costing 45-50% of what standard fees may cost for the same work.	By using the OE, the engineering is conducted without influence by the other parties, and change requests will be marked up according to the engineer's raw costs. Change requests can then be capped at 15%, thereby saving 30-35%.

Item	Engineering, Procurement and Construction (EPC)	Owner's Engineer (OE)
Project Budget Cost Savings	The cost savings for the project are retained by the EPC Contractor. Cost savings, for equipment and/or services within the EPC Contractor's scope of supply, are not passed onto Owner unless contractual agreements are to the contrary.	The cost savings for the project are retained by the Owner. Cost savings, for equipment and/or services are retained by the Owner.
Project Day-to-Day Expenses	The day-to-day expenses for the project, within the EPC Contractor's scope of supply are borne by the EPC contractor.	The day-to-day expenses for the project are borne by the Owner but are managed and administered by the OE (up to pre-determined quantities, without Owner's need for intervention). Usually a small fund is established by Owner for day-to-day expenses.
Legal Cost	Legal Costs are low for Owner. Owner negotiates only one detailed supply contract with EPC Contractor. EPC Contractor must negotiate individual contracts with suppliers/vendors. EPC Contractor's legal costs are high due to multiple contracts. In the event legal action is taken, Owner must sue EPC Contractor, who in turn must bring legal action against appropriate suppliers/contractors.	Legal Costs are higher for Owner. Owner negotiates multiple supply contracts directly with suppliers/contractor; with the assistance of OE. In the event legal action is taken, Owner must bring legal action against individual suppliers/contractors.
Administration	Owner's administration costs may be lower with EPC contract through only minimal staff involvement needed to administer/monitor project. Costs are dependent on amount of involvement of Owner based on the number of issues encountered, change orders, project difficulties, etc. Costs and delays may result based on when issues are discovered and how resolved.	Owner's administration costs may be higher with OE contracts. Costs are dependent on the number of issues encountered, change orders, project difficulties. However, OE approach identifies issues sooner which mitigates costs and delays, through earlier discovery and resolution.

7.2 Selected Contract Model Approach

After thorough review, consideration and discussion between Veridian and Costello Associates and others of both contract models, and based on the experiences and direction taken by other LDCs when constructing their TS project, Veridian will utilize the Owner's Engineer approach on the Seaton TS project. It is the contract model that provides for the most control and oversight of the project by the direct management of cost and schedule. With this model, the onus is on the Owner (Veridian), through the Owner's Engineer, to be responsible for more activities through direct involvement in the project rather than the "hands off" approach of the EPC model. Overall, the amount of risk is manageable and deemed to be minimal and acceptable when compared to the advantages. The project management key activities of project planning, cost, time, quality and safety management, contract administration and stakeholder reporting are elaborated on further in Section 7.5.

7.3 Selected Owner's Engineer

Continuing on from Section 7.2, Costello Associates will be engaged to act as Veridian's Owner's Engineer. Veridian does not have the engineering experience or resources needed to monitor the project on its own and would heavily rely on the Owner's Engineer to assist us in performing this task. Costello Associates is currently serving in this capacity with Halton Hills Hydro on their TS project which is nearly parallel in timing to our own. Costello Associates They have had extensive experience in this capacity with other LDCs on their TS projects; Oakville, Festival, Waterloo North, Brant, Niagara Falls. Costello Associates' involvement on nearly every LDC TS constructed since market opening, add to that the experience Veridian has had working closely with their firm over the past 2+ years, makes them an excellent choice for this role. Based on their experience, there is high confidence in Costello Associates' competency to be able to fulfil this same role for Veridian.

7.4 Project Roles, Responsibilities and Reporting Structure

Section 7.2 identified that the Owner's Engineer contract model had been selected for the Seaton TS project. There would be heavy reliance on the Owner's Engineer and their experience to assist Veridian in managing this project.

Section 7.3 identified that under a Veridian-build TS project, Costello Associates would fill the role of Veridian's Owner Engineer/Project Manager.

The main parties, along with their roles, main responsibilities and proposed reporting structure for this project have been identified in Figure 3. On all aspects of the project, the Project Manager would report directly to the Veridian Project Lead. The internal reporting line is from the Project Lead to the Executive Sponsor.

The Executive Sponsor would be responsible for regular stakeholder reporting to the Executive Committee, the Audit and Risk Management Committee and the Board of Directors. These regular reports would encompass status updates on timelines and costs and include any significant quality and safety issues.

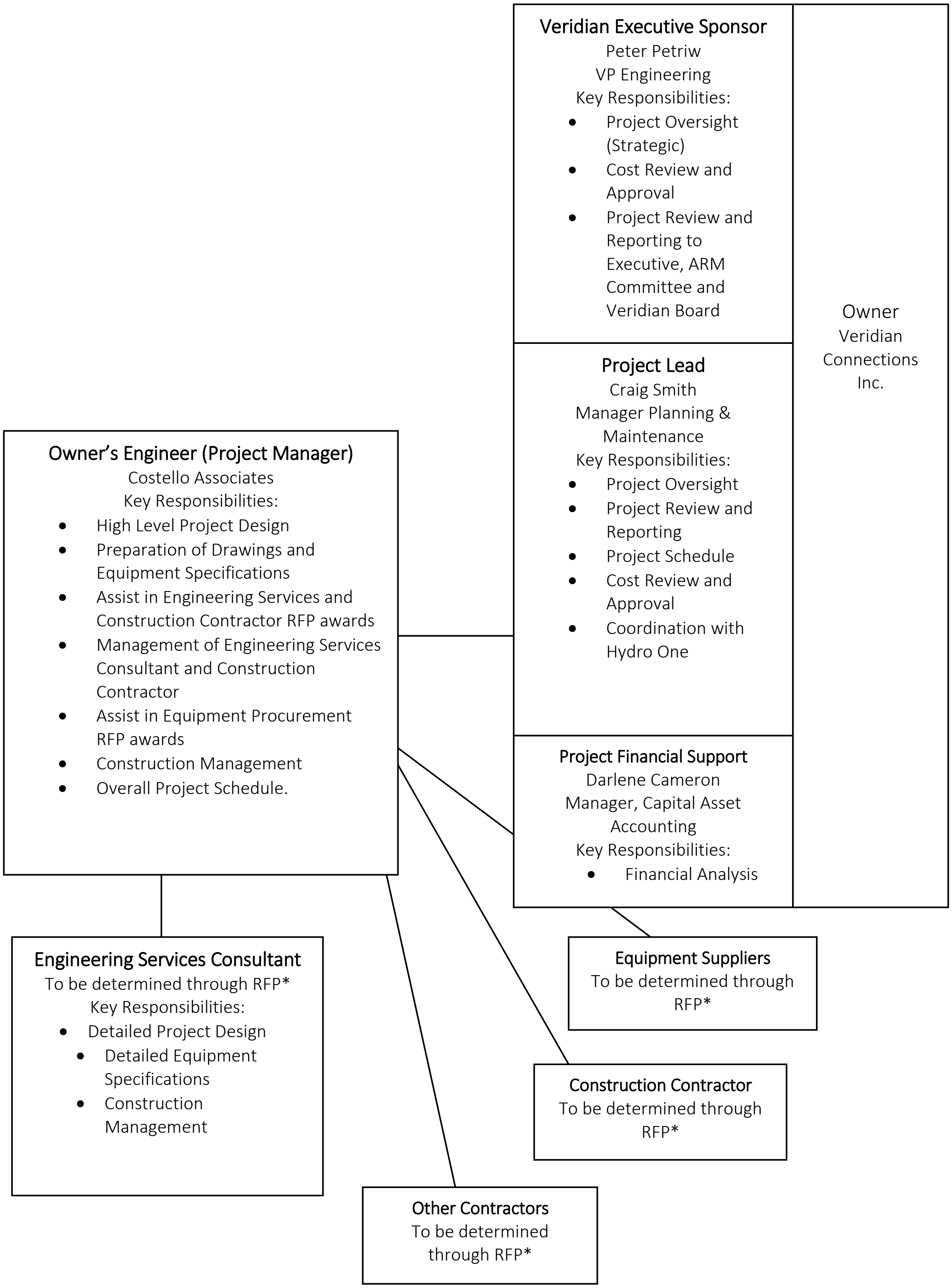

Figure 3 – Project Roles, Responsibilities and Reporting Structure

* - indicates that contract awards will be made by/through Veridian

7.5 Key Areas of Project Management

Project Planning – The project schedule Gantt chart is found in *Appendix 1- Costello Associates Seaton Transformer Station Supply Options Study dated August 15, 2016, Appendix 4***.** The chart was produced by the Project Manager based on their experience and shows the main project sections with individual associated tasks. Each task has been identified with start and finish dates, duration, in an order of operations format showing where each task falls within the overall project schedule. The chart will serve as the roadmap and tracker for project progress and status at any specific point within the total project timeline.

The detailed project schedule would be further reviewed and updated upon selection of the Engineering Services Consultant. At this time there would be identification of any updates required to key risks, resources, the overall plan and critical path and milestones.

The selection of the Engineering Services Consultant is a critical professional services contract for the detailed design, equipment and construction specifications for the TS.

The Engineering Services RFP was prepared between Veridian and Costello Associates, and issued on August 4, 2016. It was deemed critical, and of nominal effort and cost, to have the RFP prepared and issued in order to meet the 2019 in-service timeline of the TS should the Veridian-build outcome be selected. It is clearly stated within the RFP documents that Veridian is under no obligation to award the Engineering Services contract in the event that an alternate decision or direction is taken.

It is vital that the Engineering Services Consultant contract be awarded to an experienced firm whose record shows successful completion of recent transformer station projects for other Ontario-based LDCs similar to the Seaton TS project. The Project Manager will assist in selecting the RFP award as Costello Associates are knowledgeable of all the firms included on the RFP bidders list.

Regular project meetings would review the project plan as a recurring agenda item. The Gantt chart will be updated as necessary through the entire timeline of the project.

Cost Management – The Owner's Engineer approach, as detailed in Section 7.0, allows for greater control to keep costs on budget, minimizing cost overruns, reviewing and approving change requests.

As described in the Project Planning section above, the Engineering Services Consultant would prepare the detailed design and construction specifications which will then be issued through an RFP process resulting in contracts and fixed pricing being put in place once awarded.

The Project Manager would serve as the control portal through which costs for all contracts, including the Engineering Services contract, will be managed. This control translates in that all change requests and cost increases will be first received and scrutinized by the Project Manager and confirmed for validity before being forwarded to Veridian's Project Lead with a recommendation for ultimate approval/denial, and payment in accordance with Veridian's Purchasing Policy.

The Owner's Engineer approach is preferred to minimize the number of mark-ups applied to any change requests that are eventually approved. Under this approach, there is an expectation of significant cost savings on administrative mark-ups for major equipment purchases since Veridian would be dealing directly with the suppliers.

Veridian's Finance department would provide an internal financial resource to ensure accurate and timely financial analysis and reporting for use in project cost management. This resource would work directly with the Project Manager and Project Lead to exchange financial information.

Regular project meetings will review the financial status as a recurring agenda item. Potential cost overruns will be flagged early, along with cost mitigation alternatives, and included in stakeholder reporting. The potential of significant cost overruns will be immediately escalated.

Time Management – The Owner's Engineer/Project Manager approach provides greater control of the project schedule as one of their key responsibilities would be to maintain the Gantt timeline schedule. Delays would be avoided through prompt identification and resolution of issues between parties through the Project Manager. All delays would be brought to the attention of the Veridian Project Lead and by extension to the next level(s).

Regular project meetings would have a status update of project progress reviewed against the project Gantt chart. Potential delays with significant impacts would be identified early, along with mitigation options, and included in regular stakeholder reporting. The potential of significant project delays would be immediately escalated.

Quality Management – Quality assurance and quality control would be completed through the Project Manager's regular project work site inspections to ensure work is being performed of expected quality workmanship and is meeting the technical specifications. Inspections would be documented and forwarded to Veridian for review. Audit check inspections would be carried out with Veridian staff as further assurance of the thoroughness of the quality control being managed. Defects found during inspections will be promptly identified and resolved in a timely manner with the appropriate party through the Project Manager. It is expected that defects would be resolved as part of day-to-day activities and as soon as practical to minimize any delays and costs in maintaining the project schedule and budget.

Safety Management – Work site safety would be the legal responsibility of Veridian and its subcontractors as per contractual agreements. Safety would be a key component built into the construction contractor RFP. Safety performance of the bidders will be one of the evaluation criteria towards the award of the RFP. The successful bidder's safety management program would be thoroughly reviewed and their plans to operate and maintain a safe work site ultimately approved by Veridian.

Work site safety compliance would be monitored by the Project Manager through regular visits. Inspections will be documented and forwarded to Veridian for review. Audit check inspections would be carried out with Veridian staff as further assurance of compliance of safety rules and regulations. Safety and quality assurance and quality control inspections would be attempted to be scheduled together for efficiency for the most part. Specific safety inspections only would be carried out on a weekly basis with hazard identification and elimination and mitigation as per Veridian's Health and Safety policies.

Regular project meetings would review the work site safety inspections as a recurring agenda item.

Contract Administration - Direct interaction with the Project Manager, Project Lead and to the Executive Sponsor would be an ongoing process, involving the dedicated internal financial resource, through frequent reporting, meetings and discussions. Identification of issues, technical, financial, quality, safety or otherwise will be done promptly and resolved in a timely manner.

Stakeholder Reporting – To date, ARM and Board reporting on the development and planning of the TS requirement has been provided quarterly since June 2015.

As noted above, the Executive Sponsor would be responsible for developing an appropriate stakeholder reporting framework which would include the Executive Committee, the Audit and Risk Management Committee and the Board of Directors.

8.0 Operational Impact of Veridian Owned TS

The ownership and operation of a Transmission connected facility would bring both challenges and opportunities to Veridian. These are discussed in *Appendix 1- Costello Associates Seaton Transformer Station Supply Options Study dated August 15, 2016, Sections 6.3 - 6.6, Pages 25 - 27* and summarized here.

8.1 Station and System Reliability

Both Hydro One and LDC transformer stations are built to technically rigorous utility standards which results in both being highly reliable assets.

However, the LDC has less control of the loading of the TS transformers with a Hydro One owned TS. It is the TS owner (Hydro One's) responsibility to monitor the loading and advise the TS LDC users of potential overloads where station ratings may be exceeded. In some cases, this has not occurred and the LDC has only become aware of a problem when Hydro One directs the LDC to transfer load to other transformer stations or initiates rotating blackouts.

The LDC also has less control of the maintenance on the TS equipment with a Hydro One owned TS. In some cases, equipment is maintained on a longer cycle than is the LDC's practice resulting in failures where the LDC's reliability is negatively impacted.

LDC ownership of a TS assigns the responsibility and control of managing load and maintenance practices of the TS to the LDC and hence there is a more direct line with the LDC's own reliability being more under its own control.

8.2 Staff Capabilities

Specialized technical resources – Veridian will be introducing more complicated equipment on a larger scale into its system, by taking on the ownership responsibility of a TS. This will drive the requirement for new and enhanced skill sets and training for Veridian staff to be able to operate and maintain the TS to its expected high performance level. Staff directly impacted would be:

- Stations Department
- Distribution Automation Department
- System Control Centre (SCC) Operators
- Lines Department (to a lesser degree)
- Metering Department (to a lesser degree)

The ownership of a TS necessitates this requirement to have this specialized knowledge in-house within Veridian rather than rely on the current practice where most expertise is outside-sourced. Bringing this additional knowledge on would layer on top of the present initiative to develop in-house staff's knowledge, expertise and capabilities to manage Veridian's existing 53 distribution stations. Having internal Veridian expertise reduces the reliance on outside sources allowing the ability to troubleshoot, repair and restore in a more timely manner using Veridian's own staff.

Veridian will be able to incorporate the operation of a TS into its normal business routine through a combination of contractor assistance combined with progressive additional skills training of its own staff.

The Project Engineer has been hired through Costello Associates as Project Manager. The Project Manager is a component of the Owner's Engineering contract model approach described in Section 7.0 Project Management of this business case.

A future planned new full-time Veridian Stations Engineer position, pending approval, would work with the Project Manager on the Seaton TS as well as on Veridian's own distribution station projects. With a Veridian-build decision, the Stations Engineer would take over responsibility of the Seaton TS maintenance activities after the TS is in-service so it is critical to have this knowledge and expertise developed and remain in-house.

8.3 Operational Control and Responsiveness

Veridian's 24/7/365 System Control Centre (SCC) and its modern SCADA system is a solid foundation with the capacity to monitor and control the TS. Additional training and operational procedures and protocols would build on this foundation. Ownership and control of the TS allow the SCC to have greater control during planned and unplanned events. The need to communicate with Hydro One and the resulting wait time related to supply feeders which is required for Hydro One owned and operated TSs is eliminated. This will result in faster response and shorter restoration times as the majority of activities are within Veridian's sphere of control.

8.4 Spare Equipment and Risk of Failures

There is always a risk of equipment failure. TS equipment failures are typically higher cost, longer in restoration time and costlier than small distribution station equipment failures. Their impacts are magnified by the size and ratings of equipment as well as the number of customers supplied by the TS. This risk is mitigated through redundancy and readily available spare parts and equipment.

Redundancy has been built into the design, features include; two (2) different 230kV transmission circuits as the incoming high voltage supply to the TS and, two (2) sister power transformers and two (2) low voltage 27.6kV busses.

Veridian has chosen to include the cost of a spare power transformer ($4.2M), in addition to the two (2) main power transformers, within the station costs. Main power transformer repair times are long and availability of securing a spare from a supplier or other utility would not be guaranteed so ensuring that a spare is available on-site and ready to install mitigates the risk of most serious of equipment failures. Alternate lower cost options of a pooled spare transformer arrangement are being explored with other LDCs.

Further feeder ties will be made on the extensive feeder network to be constructed outside of the TS station as the feeders enter service. Eventual tie-ins with feeders from Malvern TS, Sheppard TS and Whitby TS will create further feeder back-up and the ability to balance out and shorten any extended length feeders to reduce exposure and the number of customer affected by unplanned events.

Feeders recently built on Taunton Road, through voltage conversion and construction projects, will initially deliver the remaining 27.6kV capacity from Whitby TS to the Seaton Community for the first few years until 2019. These feeders will also serve as the main 27.6kV interconnection between Whitby TS and the Seaton TS, once it is constructed and in-service, for back-up and mutual support.

Planned future capital projects, keeping pace with Seaton Community development, will have the last remaining 5th and 6th available feeders from Whitby TS constructed north on Lakeridge Road and then west on Highway 7 to bring 27.6kV capacity into the Seaton Community from the north as well as build further feeder ties with the Seaton TS feeders advancing from the south eventually meeting within the Seaton Community itself to create a robust distribution system with multiple supply points for reliability.

9.0 Capacity for Distributed Generation Connections

Veridian and other stakeholders require the ability to connect Distributed Generation (DG) projects to the future Seaton TS. This interest has been heightened due to restrictions on DG connectability in the parts of Pickering which are connected to Hydro One's Cherrywood TS.

Currently, no DG projects are able to connect to any Cherrywood TS 44kV supplied Veridian distribution stations due to capacity allocation and equipment rating limitations put in place by Hydro One at Cherrywood TS.

The new Seaton TS will be constructed with DG in mind from the start. The current conceptual design for the station through the use of state-of-the-art feeder relaying and control systems has been planned to be able to accommodate between 40% and 60% of the station capacity in connected DG. This range is typical of the type of station planned and designed by other LDCs in Ontario.

There are a number of station technical factors, including compliance with meeting the OEB's Transmission System Code (TSC) short-circuit current limitations, as well as the type and size of the DG that impacts the ability to connect DG. All these factors will be considered during the detailed station design in order to maximize the amount of DG that can be accommodated and still address the technical factors and comply with the TSC. Provisions in the station design to be able to easily install and activate future mitigation measures, such as current limiting reactors, if and when the short-circuit current levels approach the TSC limit have already been planned to allow more capacity for DG while still meeting the TSC limits. These reactors would only be installed if needed.

For the Seaton TS, the capacity of DG connections could equate to the usage of approximately 11,000 homes.

In perspective, if hypothetically all of the DG connections to the station were microFIT projects (small commercial and/or residential installations up to 10kW), the number of connections could approach 4,000. If hypothetically all the DG connections were to be FIT projects (installations of 10kW or greater), there could be as many as 160 large commercial installations at 250kW each, which is typical of what might be installed on the roof of a big box store. In reality, it is expected that DG connections would be a mix of residential and small-to-medium commercial connections and would be reviewed and allocated on a first come basis through a Connection Impact Assessment.

Further details on the Seaton TS's ability to accept DG can be found in *Appendix 1- Costello Associates Seaton Transformer Station Supply Options Study dated August 15, 2016, Section 6.7, Pages 27 and 28*.

10.0 Summary and Recommendation

<u>Summary</u>

1) The electrical load needs analysis has identified that between 155MW and 193MW of electrical capacity is required for the complete Seaton Community development, in addition to current demand outside of the Seaton Community. Veridian is not able to supply the full electrical capacity requirements of new growth and development with the remaining capacity from Whitby TS alone beyond 2020 without a new supply point (new Seaton TS).

2) A new transformer station, Seaton TS, is required to be in service in 2019. Without this additional supply capacity, new load growth cannot be accommodated. The station shall be a new 230kV -27.6kV 170MVA station which will be adequate to supply the north Pickering area for approximately fifteen (15) years.

3) There are three potential sites for the Seaton TS. Of the three potential sites, Site 2 (approximately the NE corner of Sideline 22 and Taunton Road) appears to be the most favourable site through the initial evaluation already completed. However this will be confirmed only when the EA process has been completed in Q2 2017.

4) The environmental assessment of the three potential station sites was completed by WSP Canada in March 2016. Hydro One is currently completing its environmental assessment of the 230kV transmission tower line upgrade with an expected completion of Q2 2017. Veridian and Hydro One will then proceed together as co-proponents for the completion of the entire environmental assessment to finalize the ultimate site for the Seaton TS.

5) A solid and timely process with Infrastructure Ontario (IO) for securing the lands for a TS has been developed.

6) The IESO, following the completion of its net present value analysis review of alternative supply options, has concluded that the construction of a TS, in close proximity to the Seaton Community, with no feeder construction from the existing Sheppard TS or Malvern TS or Cherrywood TS, is the lowest cost option.

7) An economic analysis has been completed that concludes that, a Veridian built TS provides the lowest overall cost for rate payers and provides higher shareholder value through growth in rate base when compared to the Hydro One buy option. Considering all factors, over the life of the asset, the lowest overall cost to ratepayers is the Veridian-build option.

8) Initial bill impacts under the Veridian-build option for the first full year of cost recovery are significant at approximately 9.3% for residential customers as compared with the initial bill impacts under the Hydro One-buy option at approximately 8.0%. Bill impacts, however decline in subsequent years under the Veridian build option by approximately 2.5% per year whereas they are forecast to stay constant or increase over time under the Hydro One-buy option.

9) The Owner's Engineer approach on the Seaton TS project is the contract model that provides for the most control and oversight of the project by the direct management of cost and schedule by the Owner (Veridian).

10) A robust project management process with sufficient resources allocated and maintained throughout the entire project timeline is absolutely necessary to ensure a safe, on-time, on-budget successful end result.

11) Experience tested consultant and contractors must be used in order to leverage successes, and to be aware of, avoid and learn from difficulties that other LDCs have encountered in constructing their TSs and applying those lessons to this Seaton TS project.

12) Pre-approval of the OEB is not required for Veridian to proceed with building its own TS, however if Veridian's Board does approve the business case decision to support the Veridian-build option (Veridian builds, owns and operates its own TS), then it will be incumbent on Veridian to be able to demonstrate to the OEB that it is a prudent investment and beneficial to its customers.

Recommendation

Management recommends the Veridian-build option of a 230kV – 27.6kV 170 MVA Transformer Station, constructed to be in-service in 2019 to service the Seaton Community for an estimated cost of $47.7M.

VERIDIAN CONNECTIONS
The power to make your community better.

Seaton Transformer Station
Supply Options Study

Prepared by

costello
Utility Consultants

August 15, 2016

PRIVATE INFORMATION

DISCLAIMER

Costello Associates Inc., which operates as Costello Utility Consultants, has prepared this report in accordance with, and subjected to, the terms and conditions of the quotation supplied by Costello Associates Inc. dated June 2013 and accepted by Veridian Connection's Purchase Order.

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1 Executive Summary

Costello Associates has been retained by Veridian Connections Inc. (henceforth, Veridian) to assist with the study of supply options to meet forecasted load growth in the Seaton development area, located in north Pickering. The scope of this work includes the review of Veridian's load forecast study, coordination with Hydro One Networks for the provision of pool-funded station options, development of preliminary project schedules and budgets of self-build options, and to make a recommendation for the supply of new capacity.

The Seaton development area is forecasted to require up to 194 MW of new supply capacity over the next fifteen (15) years. It is estimated there will be up to 1500 new residential lots per year, beginning in 2018. Additional commercial and industrial loads are expected to develop on both sides of Highway 407 following the start of the residential development.

Veridian receives electricity supply from the transmission system in this area from four existing Hydro One Networks transformer stations. Based on current forecasts, the capacity of these stations will be exhausted around mid-2020. New transformer station capacity is required to supply any new load. Veridian has the option of continuing to have Hydro One supply bulk power through a new Hydro One-owned transformer station, or constructing and operating its own transformer station.

There are a number of factors to be considered in this decision. This report has considered the total cost of pool-funded or self-build options, staff capabilities, operational advantages and disadvantages, benefits and risks, and schedules. The cost for Veridian to build this station is substantially less than Hydro One. We believe that there are numerous operational advantages to owning the station, and that existing engineering and operations resources can be trained to properly manage the new station.

In the past fifteen (15) years since the opening of the electricity market, nearly all Ontario local distribution companies (LDCs) that have faced a shortfall of transformer station capacity have elected to build their own station. LDCs have demonstrated that they can build these stations faster, with less cost, to the same or higher technical and reliability levels as Hydro One.

We recommend that Veridian should design and construct its own municipal transformer station through the Owner's Engineer contract model approach.

This is the lowest cost option for Veridian and its customers, provides shareholder value, and provides operating flexibility. Further details are found in subsequent sections in this report.

2 Transformer Stations

2.1 Role of a Transformer Station

The role of a transformer station (TS) within the overall power grid is illustrated in Figure 1. Electricity is generated at nuclear, hydroelectric, fossil fuel, wind, and other facilities throughout Ontario. Bulk power is routed over long distances via the transmission system at high voltages (i.e. 115, 230, and 500 kV). Transformer stations are used to step the voltage down from the transmission system to the distribution voltage level. There are presently over 300 transformer stations owned by both Hydro One and municipal utilities throughout Ontario.

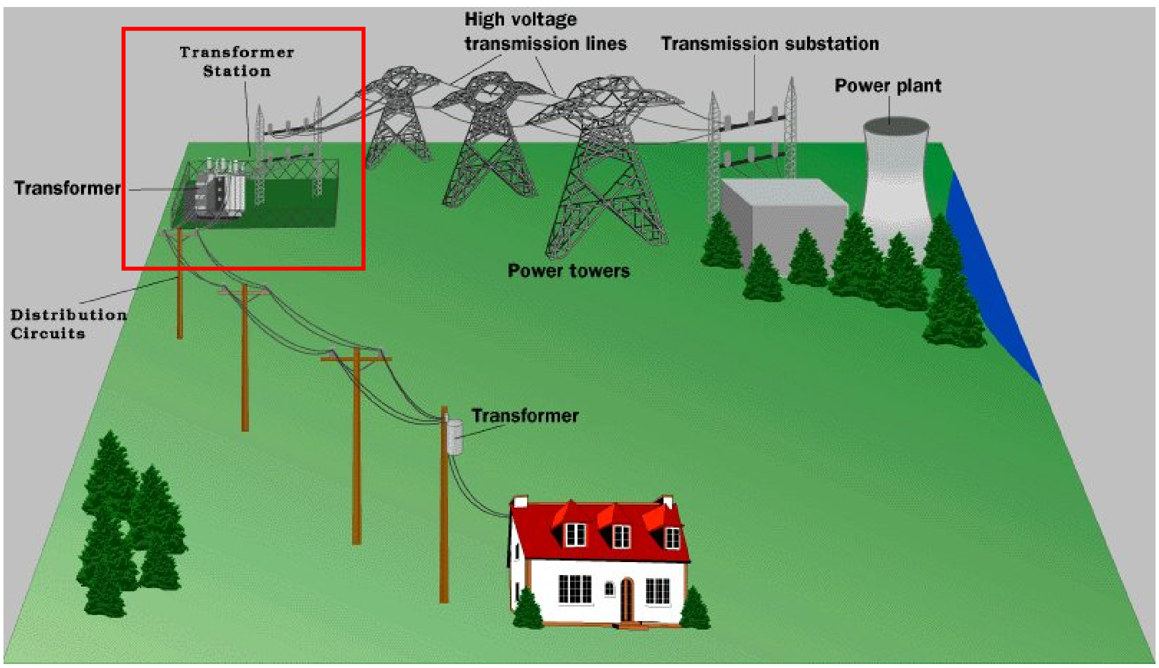

Figure 1 – Role of a Transformer Station

2.2 Transformer Station Ratings

Transformer stations in Ontario are generally designed to have redundancy in critical components, so that the single failure of one device will not result in a loss of supply for distribution customers. Transformer stations are usually supplied by two transmission lines, allowing for constant electricity supply during events such as weather-related momentary outages, and planned maintenance. Stations are equipped with two power transformers, two incoming high voltage switches, two main circuit breakers on the low voltage switchgear, and duplicate protection systems. Figure 2 shows a typical LDC-owned municipal transformer station (MTS).

As part of the redundancy strategy, power transformers are designed to be overloaded for a specified duration in the event of the failure of one incoming transmission circuit or the failure of the other transformer in the same station. The magnitude of the permitted overload is based on the original transformer design, which accounts for the anticipated summer and winter loading throughout the life of the station. This “Limited Time Rating” (LTR) is the maximum loading permitted on a transformer station for safe, reliable operation.

In the event of the loss of one transmission line or power transformer, any station load in excess of the LTR must be removed from the station. This can be done by transferring load to an adjacent facility, or rotational load shedding if alternate supply is not available.

As part of normal utility planning processes, the transmission and distribution utilities review the capacity of the transformer stations to ensure that adequate supply exists. Given that new transformer stations require about two to three years to plan, design, and construct, the decision to build new station capacity must be made well before the electrical load approaches the ratings of the transformer station.

Figure 2 – Typical Municipal Transformer Station

Many other LDCs in the province have reviewed and made decisions to build their own municipal transformer stations. Figure 3 below shows graphically all LDCs that have constructed their own municipal transformer stations in the province of Ontario since market opening.

The list of these LDCs includes:

- Brant/Brantford Hydro;
- Cambridge and North Dumfries Hydro;
- Enwin Utilities (Windsor);
- Festival Hydro (Stratford);
- Grimsby Power/Penwest Utilities;
- Guelph Hydro;
- Hydro One Brampton;
- Hydro Ottawa;
- Kenora Hydro;
- Kitchener Wilmot Hydro;
- Niagara Falls Hydroelectric;
- Niagara on the Lake Hydro;
- Norfolk Power Distribution (Simcoe);
- Oakville Hydro Electricity Distribution;
- Powerstream (Markham, Richmond Hill and Vaughan);
- PUC Distribution (Sault Ste. Marie);
- Toronto Hydro (Scarborough);
- Waterloo North Hydro.

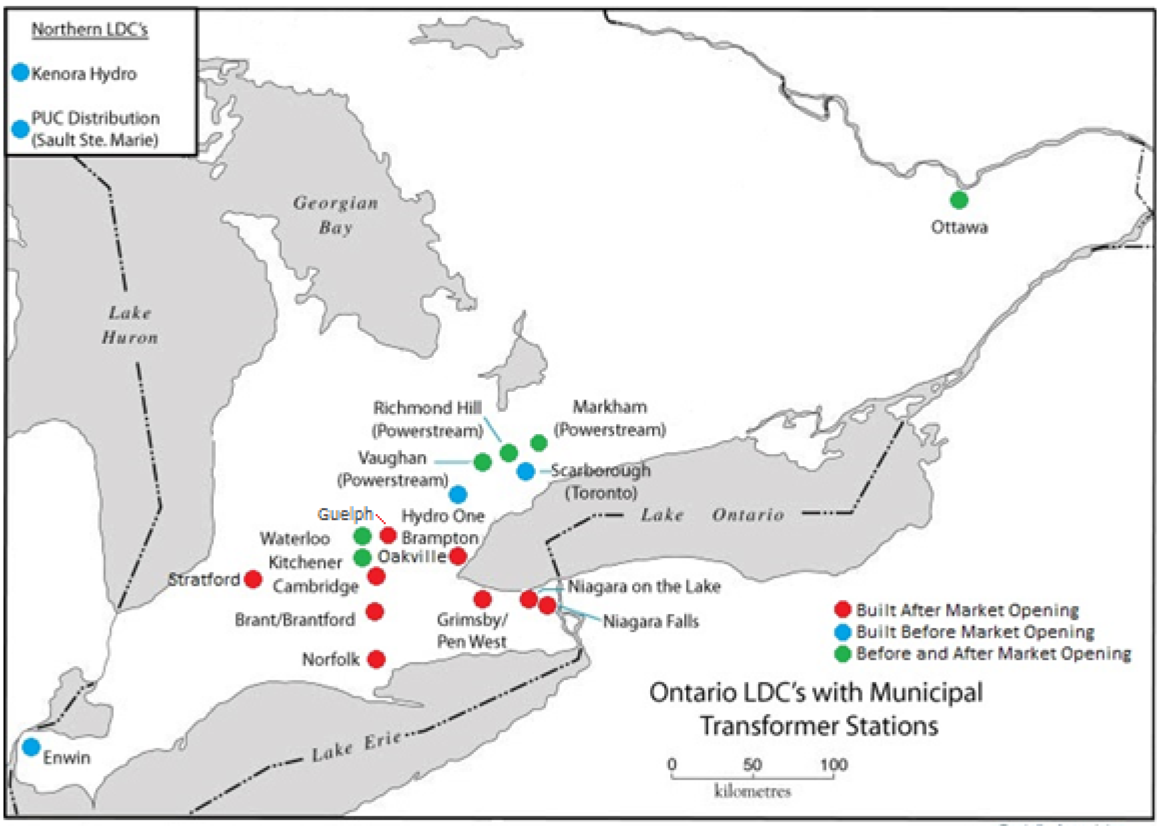

Figure 3 – Ontario LDCs with Municipal Transformer Stations

2.3 Potential Impact of Lack of Capacity

The creation of additional transformer station capacity is a lengthy process. As a minimum, the shortest time frame possible from the decision to move forward to the in-service date is approximately two years. Items in this process contributing the most uncertainty to the timeline are land acquisition, environmental assessment, and transformer delivery.

Accordingly, appropriate lead time ahead of actual need for supply is required in order to be ready when the load begins to materialize. A planning time of two to three years is necessary to accomplish this.

Development of residential and light commercial load may represent only a small percentage of the overall system capacity, and usually can be forecasted and accommodated. Major new industrial or commercial loads can be substantial, and one or two large projects can easily consume available capacity in a short period of time. Utilities must be in a position to have a reasonable amount of available capacity at any given time, so that new load customers can be serviced without delay or risk of the development moving to another municipality.

2.4 2014 Cost of Service Rate Application

Veridian filed its 2014 Cost of Service Rate Application, which made mention of expected customer growth and the need for additional capacity. At the time of filing in October of 2013, Veridian expected 1,700 new customer connections per year beginning in 2015 and continuing past 2018. This anticipated load growth raised discussion of the need for a new transformer station in the Seaton area, targeting an in-service date of 2019, with a total cost of approximately $31.116M.

For the Veridian 2014 Cost of Service Rate Application excerpt, see Appendix 2.

3 Seaton Area Load Growth

3.1 Seaton-Area Development Summary

The Seaton area is a new development. Veridian is obligated to expand the existing electrical service into the Seaton area, of which there are plans to develop. As the local utility serving the area, Veridian Connections has an obligation to provide this new customer base access to the system. Seaton lies within Pickering; it sits north of the Canadian Pacific Railway and stretches just north of Highway 407. Its eastern limit is the 16th Sideline, and its western limit is the Pickering Townline. Two of the three pieces of land under consideration as potential sites for the new transformer station are in close proximity to Taunton Road, and within good reach of the existing 230kV transmission line. One of the sites is particularly close to the existing Cherrywood transformer station.

The City of Pickering put forth an official plan for development, known as the Central Pickering Development Plan (CPDP) in 1975. Historically, the Province had plans for developing the area, which lies near both the Town of Markham and the City of Scarborough. The plan included a new airport as well as a community of up to 200,000 people. The plan was updated in May 2006 to include an agricultural community covering 4,160 hectares, an urban community covering 2,720 hectares housing 75,000 people, and an open space area of 3,200 hectares.

Over time, it became evident that the population of the area was not growing as expected; the government's plans for the new airport were facing opposition, so the plans for both the community and the airport were halted. Some of the land was sold off to private developers. Starting in 1995, however, the Province began to consider the area as a site for development a second time. A portion of the land, however, was sold to farmers and designated to be kept as agricultural land perpetually.

Plans to implement development were put forward beginning in 2002. The City of Pickering conducted a Growth Management Study for the Seaton area, and released the Recommended Structure Plan in 2004.

Veridian projections follow those of the City of Pickering in that the area will see a great deal of growth over the next twenty years. This growth will require additional load capacity over what currently exists in the area. The City of Pickering projects that the Seaton area will begin development in 2015; the population growth is projected to begin in 2018 and the area is expected to see 70,000 residents in six new neighborhoods in the forecasted timeframe of twenty (20) years. This growth also includes 35,000 jobs being created in the area. Together, the residential units and the employment units will require an additional transformer station to service the area.

While the growth will not be immediate, but will rather unfold over the forecast period, Veridian estimates that the Pickering-Seaton area will require anywhere from 155 MW to 194 MW of electrical capacity, in addition to the current electrical demand as the capacity from the only available supply, Whitby TS, will be exhausted in 2020. Figure 4 shows the existing MTSs in proximity to the Seaton area.

Figure 4 – Map of Existing Municipal Transformer Stations in Proximity to the Seaton Area

3.2 Load Forecast

Utility load forecasts can be used for different purposes. Engineering forecasts tend to focus on the capability of the distribution system to provide power to the maximum load that could develop in a given time period. The benefit of this is that should all of the forecasted load actually develop, the infrastructure can accept the new load. In contrast, financial load forecasts are often used for rate-making purposes and may tend to be more conservative. Variations between the actual growth and the forecasted growth can be accommodated in subsequent rate applications. The load forecasts discussed in this report are engineering forecasts, and are based on ensuring that sufficient capacity is available for new growth. Veridian's future rate-making load forecasts may not match the engineering forecasts described below for this reason.

While the existing Pickering area is expected to see some growth over the forecast period, ranging from very little to moderate growth depending on the neighborhood, the bulk of the growth is projected to occur in the new Seaton area. The six neighborhoods in the Seaton area (Lamoureaux, Brock–Taunton, Mount Pleasant, Wilson Meadows, Thompson's Corners and Innovation Corridor) are expected to see high, sustained growth during the forecasted period of twenty (20) years, from 2015-2035; currently there are very few existing units in these areas, numbering in the teens, but the proposed units number in the thousands in five of those six neighborhoods by the end of the forecast. The existing Pickering area's growth is discussed minimally here, as the Seaton growth is the main concern for the demand for new capacity.

The growth of the Seaton area is divided into two categories: residential units (or housing units) and employees. The rationale here is that City of Pickering projects a 70,000 person influx as well as a 35,000 job increase. For every two people in the Seaton area, there will be an employment opportunity. So, the methodology for arriving at the electrical load forecast factors in both the residential growth as well as employees.

More detailed data on the residential and commercial growth in the Seaton area can be found in Appendix 1.

Based on available capacity, Whitby TS feeders could supply the Seaton area with a capacity of 45 MW total. Weighing this available capacity against the predicted demand for the Seaton area, Figure 5 below shows that the demand would exceed the capacity as early as mid-2020, or as late as mid-2021.

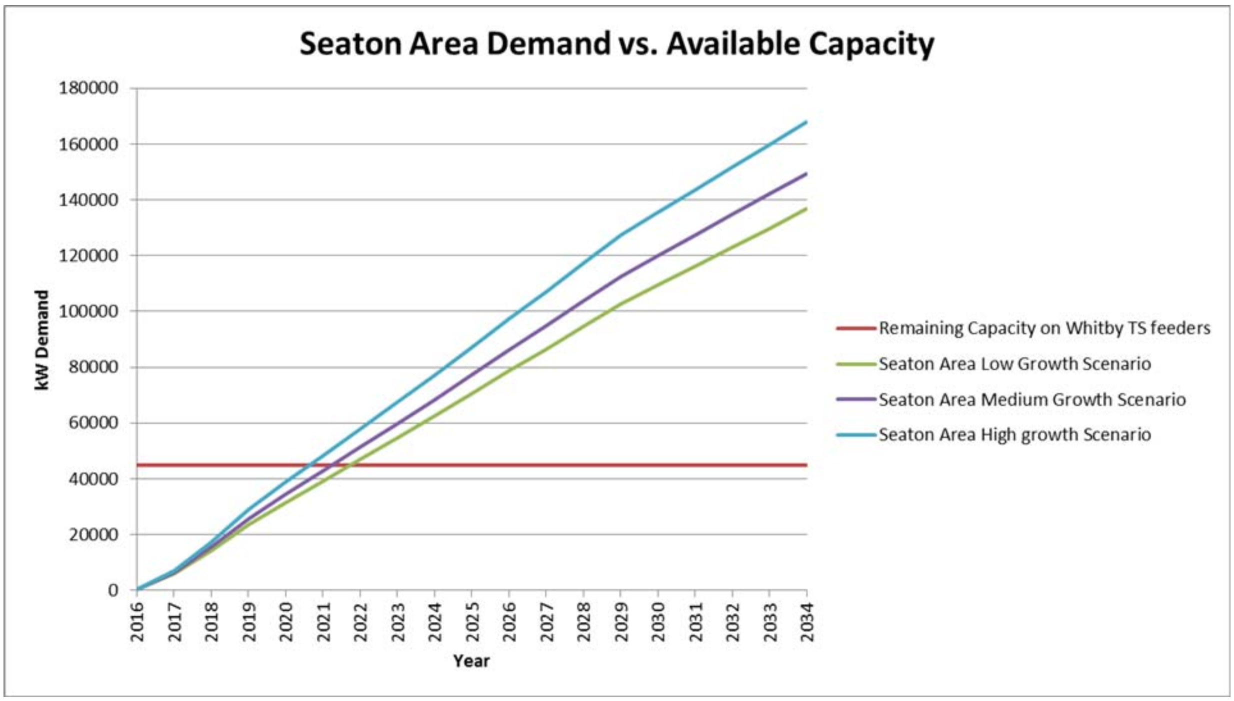

Figure 5 – Seaton Area Demand vs. Available Capacity

3.3 Requirement for Long Range Supply Plan

Veridian Connections had begun regional planning even prior to the regional planning mandate from the OEB, when it started working on the Seaton Master Environmental Servicing Plan (MESP) in 2010. The MESP included discussion of potential transformer stations and the locations under consideration.

As part of the OEB-mandated system planning, Veridian has characterized this project as a System Access endeavor, as it will provide a new customer-base access to the distribution system. System Access investments are modifications (including asset relocation) to a distribution system that the utility is obligated to perform to provide a new customer or group of customers (including a generator customer) with access to electricity services.

Projects/activities in this category of System Access are driven by statutory, regulatory, or other obligations on the part of the utility to provide customers with access to the distribution system. As the utility has the obligation to provide service to the forecasted growth, the new transformer station becomes a non-discretionary project.

The Seaton area is part of the GTA East planning region, which is in Group 1 for the Regional Planning process. GTA East was originally allocated to Group 2, but was accelerated into Group 1. As part of the process, a Needs Screen report was completed in August 2014. The needs identified led to the recommendation for the Pickering/Ajax/Whitby sub-region of the GTA East to conduct a Scoping Assessment, which was led by the Ontario Power Authority (OPA), which is now included in the IESO. This Scoping Assessment report was completed in December 2014; its results suggested a combined wires and non-wires approach to the sub-region. The next step was an Integrated Regional Resource Planning (IRRP) process, which is currently underway.

Any Conservation and Demand Management (CDM) reductions in peak demand would be attributable to existing feeders. Any new development in the Seaton area would be constructed to current energy-efficiency standards and therefore would not be expected to contribute to CDM targets.

Veridian has indicated that the CDM savings that can be attributed to the existing feeders supplying the Seaton Area might be expected to net 965 kW in peak demand reduction. This information is based upon the IESO’s CDM targets for all of Veridian, divided up on a per feeder basis across the system.

This modest reduction in peak demand due to CDM is insignificant in comparison to the rate of growth for the Seaton Area, so there is no material capacity made available through this process.

4 Supply Options

4.1 Historical Practice

Prior to the opening of the electricity market, Ontario Hydro typically constructed new transformer station facilities proactively as demand required. These facilities were provided at no direct cost to the distribution utilities, as station costs were pooled and recovered through regulated transmission charges. Costs for related distribution improvements such as feeder ducts and cables were the responsibility of the LDC. The financial evaluation of projects considered the overall transmission and distribution costs, with each entity responsible for their own portion.

4.2 Transmission System Code – Connection Options

In 2002, as part of the industry changes associated with the passing of the Electricity Act and market opening, the Transmission System Code came into effect and the industry moved to a “user pay” approach. Costs for projects specifically attributable to one or more customers are recovered as part of the regulated connection process. Connecting customers have the choice to undertake certain contestable work or have Hydro One provide services, at the connecting customers’ cost.

In the case of municipal utilities requiring new transformer station capacity, three basic options exist:

1. **Pool-funded Option**: Hydro One designs, constructs, and operates the new station. An economic evaluation is performed by Hydro One, whereby the net present value of the future incremental load revenue is compared to the cost of construction, operation, and maintenance cost of the station. If there is a shortfall in load revenue, the LDC pays the difference up front in the form of a capital contribution to Hydro One.

2. **LDC Build / Turn Over:** The LDC designs and constructs the new station according to Hydro One’s technical standards, and turns the station over to Hydro One prior to energization. Hydro One would reimburse the LDC for “reasonable costs” less the cost to oversee and administer the project. The economic evaluation described in the scenario above is used to calculate cost recovery. This option could be used if the LDC believed it could construct a transformer station exactly the same as Hydro One would, and do it for less cost. To the best of our knowledge, no LDC has exercised this option.

3. **LDC Self-build:** The LDC designs, constructs, owns, and operates the new station. The station asset would become part of the LDC distribution asset base, and the LDC would earn the regulated rate of return for the value of the station. Some or all of the capital cost of the project would be offset by a reduction in transmission charges payable to Hydro One.

4.3 Comparison of Connection Options

	Principle	Pool-funded Option	LDC Build/ Turn Over to Hydro One	LDC Self-Build Option
1	Overall capital cost	✗	◘	✓
2	Risk of load growth – true up payments	✗	◘	✓
3	Increase LDC asset base	✗	✗	✓
4	Control of system capacity	✗	✗	✓
5	Operating flexibility	◘	◘	✓
6	Lower transmission charges	✗	✗	✓
7	Lower upfront capital requirements	✓	◘	✗
8	Burden on resources – project management, engineering, operating expertise	✓	✗	✗

Legend: ✓ = Best ◘ = Better ✗ = Least

Table 1 – Comparison of Connection Options

Additional comments on Table 1:

1. LDCs typically build municipal transformer stations (MTS) for significantly less cost than Hydro One. Historically LDC cost savings were in the range of 20 – 30%, however with recent pricing from Hydro One, the savings are even greater.
2. Should the LDC load not materialize as fast as forecasted, Hydro One could collect additional payments from the connecting customer. If the LDC owned the transformer station, cost is recovered in the distribution rate base, on the book value of the station asset. The amount of load on a municipal transformer station does not affect the recovery of costs and return on equity, but does affect rates.
3. Municipal transformer stations are capitalized and placed in the distribution asset base. This provides an opportunity for the LDC to add significant value to the asset base in a single project. This option delivers the highest increase in shareholder value.
4. The control of system capacity refers to the LDC taking total responsibility for transformer station and distribution system capacity, such that LDC planning ensures that there is sufficient capacity at all times.
5. Operating flexibility refers to day-to-day system operation, for events such as placing hold-offs, storm response, detailed SCADA information, and maintenance coordination. Hydro One stations are controlled from the Ontario Grid Control Centre (OGCC), and major events across the province are prioritized. A relatively small problem in Pickering's service territory may not receive prompt attention from the OGCC if there are larger system issues elsewhere.
6. LDCs that build their own transformer stations avoid the transformation tariff from Hydro One, which is $2.02 / kW in 2016; Hydro One made an application to the OEB (EB-2016-0160) to increase this rate to $2.24 / kW effective January 1, 2017, and to $2.35 / kW for

2018. This is a pass-through cost via retail transmission charges, but does have an impact on the total end cost to local retail customers.

7. Hydro One pool-funded stations require less up front capital from the LDC as opposed to the LDC building the station. Some capital contribution may be necessary depending on the total capital cost of the project and the value of the incremental load revenue over the 25 year economic horizon.

8. The design and construction of a municipal transformer station requires dedicated and experienced resources. Many LDCs do not have internal expertise in stations; their staff may be fully engaged in other activities, or do not wish to take on the responsibility for a project of such magnitude.

9. We are not aware of any connecting customer that has built a transformer station according to Hydro One specifications and turned the station back to Hydro One at time of energization. We expect that although this may seem to be a lower cost alternative compared to Hydro One building the station, Hydro One would impose engineering and administration charges that would be subtracted from the purchase price. There is additional financial risk to Veridian under this option, including the cost for HONI to participate in the inspection, testing, and commissioning of the station. We also expect that there would be some growing pains with the development of this process, possibly resulting in delays and higher costs.

10. LDCs that construct their own MTSs are required to provide compensation to Hydro One if they bypass existing Hydro One facilities. The LDC is required to utilize all available capacity from existing facilities first before placing load on a new MTS.

It is important that the LDC consider factors of the timing/priority of implementing the project; factors relating to customer preferences; factors affecting the final cost of the project, including how to minimize costs; whether technically feasible project design and/or implementation options exist and are considered, and that the least cost option be compared to the cost efficient option.

4.4 Proposed Transformer Station

A new 170 MVA Bermondsey-style transformer station is being proposed as required to meet the anticipated load growth over the next fifteen (15) years. This station is based on typical Hydro One design standards for a completely redundant configuration with two incoming transmission lines, two transformers, and two main 28 kV busses. The station is designed to be able to tolerate the failure of any single major component without dropping load customers.

There are significant differences between stations designed by Hydro One and municipal utilities, mostly in terms of appearance, reliability, and cost. All stations are required by the Transmission System Code to meet minimum technical requirements for reliability and redundancy. Hydro One stations are usually outdoor-style station, with 230 and 28 kV power equipment (busses, switches, and circuit breakers) located in the substation yard. Municipal stations have outdoor 230 kV power equipment, but the 28 kV circuit breakers are usually indoor, gas insulated metalclad switchgear design. The use of indoor switchgear eliminates weather and animal contact risks for the 28 kV busses.

Hydro One’s approach to building new transformer stations for municipal utilities is to provide only the required number of feeder positions for the first few years of planned load growth. In this case, their cost recovery process is based on only including the cost of four of the ultimate twelve feeders in their overall station cost estimate. The additional feeders are required to be completely funded by the municipal utility as load develops. Currently, Hydro One is charging utilities around $1.0M per feeder position. Hydro One also does not include the cost of wholesale metering equipment as part of their overall cost estimate. These costs must be considered when comparing Hydro One station costs to the self-build alternative.

With 28 kV gas insulated switchgear, LDCs typically install all breakers during the initial construction of the TS. It would require a total station outage to be able to add breakers in a progressive manner after the TS is energized and in-service, which is not practical once the station is loaded. Overall, this results in a lower cost in labour savings by eliminating switching the station out and back into service as well as not impacting system security by having the TS out of service during the breaker installation.

Recently built municipal utility stations arguably provide more reliability, are more aesthetically pleasing, and are substantially less expensive than Hydro One stations with the same electrical capacity, and improved long-term performance.

4.5 Potential Seaton TS Sites

As a result of a joint planning exercise with Hydro One, three potential sites are being considered for the construction of the new transformer station known as the Seaton TS. Veridian is in the process of conducting a class environmental assessment for the three sites. This process will select one of the three potential sites, based on environmental, technical, and economic impacts.

The three potential sites in Figure 6 are:

Site 1 – located on the east side of Brock road, just north of Taunton Road (also in Figure 7);
Site 2 – located on the east side of Sideline 22, just north of Taunton Road (also in Figure 8);
Site 3 – located east of the existing Cherrywood TS, northeast corner of Dixie Road and P15C towerline (also in Figure 9).

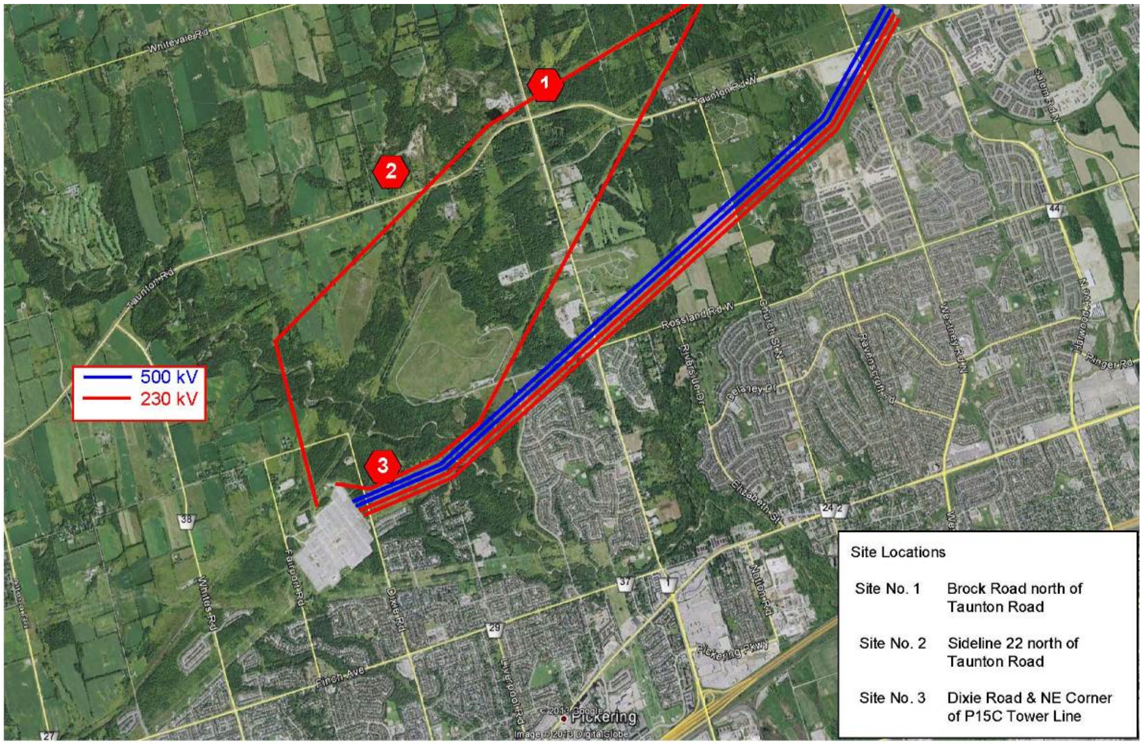

Figure 6 – Potential Seaton TS Station Locations

Figure 7 – Seaton TS Site 1

Figure 8 – Seaton TS Site 2

Figure 9 – Seaton TS Site 3

4.6 Proposed Hydro One Transformer Station

The proposed Hydro One transformer station would also be a 170 MVA Bermondsey-style Dual Element Spot Network (DESN) station, designed ultimately for twelve (12) 28 kV feeders. Hydro One stations are typically of an outdoor design, with outdoor 230 and 28 kV busses and circuit breakers. Protection and control equipment is typically located inside a prefabricated enclosure. 28 kV feeders egress the station via overhead or underground ducts, depending on local circumstances.

Hydro One has provided budget station costs in the range of $33.5M to 38.5M depending on the site selected. More recently, it has only provided a high level cost estimate of $35M +/- 50%.

Hydro One typically provides only four of the twelve (12) feeders at the start of operation. Additional feeders can be constructed in time, as required, and the sole cost of the load customer. The current typical cost of a feeder breaker and cable egress is around $1.0M per feeder.

Hydro One also does not include revenue metering costs in their cost estimates.

4.7 Detailed Design Comparison

The comparison between building an indoor station versus building an outdoor station extend beyond the financial considerations. In receiving cost estimates for the transformer and equipment, it has become clear that the cost differential between the indoor and outdoor options is, in fact, minimal. Given the comparable costs, it is important to look at the other factors.

Indoor stations pose several advantages over outdoor stations: because the equipment is protected from the elements, indoor stations generally require less maintenance, and therefore incur lower maintenance costs. Where weather and animals cannot interfere with the operations of the station equipment, the equipment does not require as much repair. Additionally, service reliability is positively impacted when nature does not obstruct the operation of the transformer station. Lastly, most communities find that an indoor station is much more aesthetically pleasing than an outdoor station.

4.8 Transmission System Rebuild

The transmission system that supplies the Seaton TS area sites #1 and #2 will require rebuilding as part of this project. The area is currently served by a single 230 kV transmission circuit C28C. This circuit would require rebuilding to provide a double circuit 230 kV that extends C10A/C28C from Duffins Junction along the existing right of way to the new station site. This upgrade will be required regardless of whether Hydro One or Veridian builds the new station.

Cost responsibility for this rebuild project is under review by Veridian. Transmission assets that provide capacity to a broad group of load customers or provide an overall benefit to the security of the grid are deemed to be network assets. Costs for building and maintaining network assets are shared by all customers.

Transmission assets that serve specific customers are deemed to be connection assets, and costs for these assets are the responsibility of the customers served.

In this case, it would appear that the rebuilding of this single 230 kV circuit would provide benefit to the overall transmission system. If this is the case, and the OEB agrees, Veridian would not be responsible for some or all of the rebuilding costs.

Veridian has received estimates from Hydro One for the transmission tower rebuilds and connection work to all three potential Seaton TS sites; these estimates are found in Table 2 below.

Sites	Distance to Rebuild	Cost
Site 1	3.5 km	$9.0M
Site 2	1.5 km	$7.46M
Site 3	1 km	$6.6M

Table 2 – Costs Associated with Tower Rebuilds

There is currently a case before the OEB (EB-2013-0421 SECTR project) in Southwestern Ontario where the OEB is determining cost responsibility for necessary transmission upgrades. In addition, EB-2009-0079 in the Woodstock area dealt with a similar situation. These cases may set a precedent for the Seaton project.

Ultimately, the OEB will decide on cost responsibility for the necessary transmission rebuild at Seaton. Hydro One's initial position is that Veridian has cost responsibility for this work. It may be necessary to develop an agreement with Hydro One to allow the TS project to proceed with the understanding that the OEB will ultimately deal with the transmission issues. Again, this transmission issue exists regardless of who builds the station.

5 Cost of Project Alternatives

5.1 Seaton MTS Budget

The total budget amount for the municipal transformer station (MTS) option is $25.6M. A detailed budget is included in Appendix 3. The budget is based on a station design that meets or exceeds the technical requirements of the IESO's market rules, and based on typical Ontario Hydro station designs that have been used for decades. The budget provides funding for the use of modern, high quality, state-of-the-art equipment that has been used by both LDCs and Hydro One in recent station projects. The budget for this station includes $4.4M for contingency.

The estimated cost per feeder for this option is $2.13M. The estimated cost per MW is $167,320. The budget summary is found in Table 3 below.

170 MVA (153 MW) Station with 12 Feeders – Budget Summary		
1	Engineering	$1,800,000
2	Major Equipment	$15,966,000
3	Civil Construction	$5,515,000
4	Electrical Construction	$1,470,000
5	Spare Transformer	$4,915,000
	Sub-Total	**$29,666,000**
	Contingency	$4,449,900
	Total (including capacitors)	**$34,115,900**
	Total (not including capacitors)	**$33,540,900**

Table 3 – Seaton MTS Budget Summary

5.2 Comparison of Station Costs

Site 1 – Brock Road (see Figure 7, Page 16)
Site 2 – Sideline 22 (see Figure 8, Page 17)
Site 3 – Cherrywood (see Figure 9, Page 17)

Each site will require preparation and development before the TS can be built. Each site requires different amounts of grading, filling, clearing, and drainage. These costs will be added to Veridian's self-build option. The base cost of the TS is $33.5M, as noted in Table 3 above. Table 4 below demonstrates the site-specific development costs.

	Site 1	**Site 2**	**Site 3**
Development Cost	$4.2M	$700k	$3.3M
Total Veridian Cost	$37.7M	$34.2M	$36.8M

Table 4 – Site Development Costs

	Site 1	Site 2	Site 3
Hydro One	$52.2M	$47.2M	$49.3M
Veridian	$37.7M	$34.2M	$36.8M
Difference (Hydro One – Veridian)	$14.5M	$13.0M	$12.5M

Table 5 – Direct Costs

	Site 1	Site 2	Site 3
Hydro One	$4.4M	$3.9M	$4.1M
Veridian	$3.1M	$2.9M	$3.1M
Difference (Hydro One – Veridian)	$1.3M	$1.0M	$1.0M

Table 6 – Cost per Feeder

	Site 1	Site 2	Site 3
Hydro One	$341k	$309k	$322k
Veridian	$246k	$224k	$241k
Difference (Hydro One – Veridian)	$95k	$85k	$81k

Table 7 – Cost per MW

Note that when Hydro One provides costs for pool-funded stations, they do not include the cost of revenue metering or the feeder cables to the distribution system. Also, Hydro One only provides typically four feeders as part of the station construction. The remaining feeders must be constructed later at the LDC's cost (typically about $1.0M per feeder).

To compare the Hydro One pool-funded costs to self-build costs, costs of metering and feeders must be added to the Hydro One station costs, as follows:

Hydro One Costs			
Site	1	2	3
Location	Brock	Sideline 22	Cherrywood
TS Cost	$38.4M	$33.4M	$35.5M
Metering	$250k	$250k	$250k
Feeders	$9.5M	$9.5M	$9.5M
Currency Exchange *	$4.0M	$4.0M	$4.0M
Total	$52.2M	$47.2M	$49.3M

Table 8 – Hydro One Costs

Also note that at the time that these cost estimates were created, the USD/CAD dollar exchange rate was approximately 1.1. Since the current exchange rate is about 1.4, the cost of equipment and services that could be sourced from the US has been inflated by a factor of 1.3. This has the potential to add about $4M to the cost of the project. Both Hydro One and Veridian budget costs have been increased by this amount.

Hydro One initially provided site-specific cost estimates ranging from $33.4M to $38.4M. Recently, Hydro One has provided a high-level estimate of $35M +/-50%. We believe that the initial cost estimates are consistent with other similar Hydro One projects, and for the sake of comparison to Veridian's detailed budget estimates, we have elected to use Hydro One's original site-specific cost estimates.

The onus is on the LDC to provide the data, information, and analyses necessary to support the capital-related costs upon which the LDC's rate proposal is based. Filings must enable the OEB to assess whether and how a distributor's Distribution System Plan (DSP) delivers value to customers, including by controlling costs in relation to its proposed investments through appropriate optimization, prioritization, and pacing of capital-related expenditures.

6 Operational Impact of TS Ownership

In evaluating the benefits of transformer station ownership, there are operational impacts to be considered that may place additional burdens on LDCs. There are also certain operational benefits that can be quantified to help support the ownership business case. This section lists the several operational impacts to be considered by Veridian.

6.1 EPC vs. Owner's Engineer Model

There are two general philosophies on how to approach building a municipal transformer station. The first is an engineering, procurement, and construction (EPC) contract with a general contractor, and the second is for the owner, or the owner's agent, to undertake the engineering, major equipment procurement, construction, and station commissioning all as separate items which are tendered and managed by the owner.

EPC tenders the full responsibility for station design, procurement of equipment and materials, and construction, including commissioning, as a single all-inclusive contract. The list of eligible general contractors for this type of work is not large, and this approach has not been common in the industry for projects of this size and type. We are only aware of one LDC-owned transformer station that has been constructed under an EPC arrangement within the last twenty (20) years. All others have followed the Owner's Engineer model as described below.

The Owner's Engineer model can take a couple of variations in form. If in-house resources are available, the owner may choose to manage the project with internal staff. Most often, internal staff resources are not adequate to be dedicated to the project of this magnitude, so the owner may elect to hire the services of an Owner's Engineer to provide direction and oversight directly on behalf of the owner to guarantee a successful outcome to the project.

The Owner's Engineer will advocate for the interests of the owner, and will oversee the project from the time they are brought on, until commissioning of the station. While there are always risks and contingencies associated with building projects, the Owner's Engineer will mitigate risks and reduce opportunities for missteps during the process. It may seem counterintuitive, but the Owner's Engineer model reduces the overall costs of the project by managing all of the aspects internally, eliminating the possibility of contractor markups. It is important to select an Owner's Engineer with experience in similar projects that were successfully completed. It is key that the Owner's Engineer can be trusted by the owner.

In both approaches, the scope of work includes:

- the preparation of conceptual plans;
- site selection review and environmental assessment;
- preparation of an overall project budget;
- preparation of a proposed project schedule;
- preparation of requests for proposals (RFPs) for the detailed engineering services;
- providing general project management during the design phase, equipment specification and procurement, and construction; and
- preparation of RFPs for station commissioning and final start-up.

The following table provides a comparison between the two project management models:

Item	EPC	Owner's Engineer
Detail Required on Specifications	Requires very detailed specifications for every aspect of the station design, construction, and performance prior to tender, to ensure the quality and reliability the owner had hoped for.	Allows a detailed review of all aspects of design, construction, and performance on a progressive basis, as the project proceeds.
Engineering	The engineer reports directly to the contractor, which can result in engineering compromises in favour of the contractor with respect to cost.	The engineer reports directly to the owner and always maintains the interest of the owner to ensure a successful project.
Equipment Procurement	Allows the contractor administrative markup on up to $8.0M of major equipment (estimated $800k-$1.0M).	Individual tenders for major equipment directly from the owner save contractor markup. Equipment is then "free issued" to the contractor for installation.
Construction	Construction management of site and schedule are totally controlled by the contractor. Site conflicts as they arise will result in favour of the contractor, or will result in extras to the cost.	Construction management includes input from the owner's engineer, and site conflicts can be resolved to reassure the owner of a reasonable settlement for both parties.
Commissioning	If commissioning is managed by the contractor, workmanship issues and technical deficiencies identified by commissioning may be resolved in favour of the contractor.	Independent commissioning services ensure that the owner is receiving comments, review, and testing of the contractor's work with no influence from the contractor.
Project Scope	The general contractor dictates to their engineer and construction team the project scope. The initial project scope will be the bare minimum to "win" the tender. Any changes through owner's review of design will result in additional costs to the owner.	The project scope is dictated by the owner. The owner works with the engineering team to develop the station design to their standards, without influence from the general contractor or construction team. This allows the owner to design the station they want.
Project Cost	As noted above, the general contractor bids to win the tender to the bare minimum. When changes occur, the engineer will mark up their costs by 15%, the construction team will mark up their costs by 15%, and the general contractor will then assess the costs, and mark up each subcontractor and add their costs. This will result in a change request, costing an additional 45-50% of what standard fees may cost for the same work.	By using the owner's engineering model, the engineering is conducted without influence by the other parties, and change requests will be marked up according to the engineer's raw costs. Change requests can then be capped at 15%, thus saving 30-35%.

Project Schedule	The general contractor controls the project schedule. Change requests will result in each subcontractor adding additional time to the schedule, thus delaying the project and adding additional costs that are not necessary.	The owner's engineer model allows the owner to have greater influence on the project schedule. With the major equipment (long lead items) and engineering completed prior to tender, the constructor must complete construction according to the owner's schedule.

Table 9 – EPC vs. Owner's Engineer Model

6.2 *Distribution System Plan*

The OEB now requires LDCs to have detailed Distribution System Plans (DSPs) and Asset Management Plans (AMPs) to address capital and maintenance costs associated with maintaining and enhancing the reliability of the distribution system. These plans are now required to be included in the cost of service/rebasing applications.

The DSP requires that an LDC justify its capital expenditures by prioritizing safety and reliability of service while delivering value to customers. Included in an LDC's justifications for spending are: factors affecting the timing and priority of implementing the project; factors affecting the final cost of the project; and how controllable costs have been minimized. Proposed expenditures are categorized into groups indicated by their 'drivers' or 'triggers', namely System Access, System Renewal, System Service, and General Plant. System Access projects such as this, allow the LDC to meet the anticipated load growth.

System planning, including the requirement for new transformer station capacity, should be part of an LDC AMP/DSP. The OEB seems to be particularly interested in how capital investments and maintenance activities impact system reliability and safety. Planning for a new TS requires taking into account all of the cost options and alternatives. This process might include calculating the least cost option, which considers the life cycle cost of all options, and the cost efficient option, which considers the net project benefits and costs over the service life of the project. Since this project is a non-discretionary project that needs to be completed, Veridian's task is to decide on the preferred alternative by figuring out the best possible cost option.

6.3 System Reliability

Hydro One and LDC-owned transformer stations are both built to rigorous utility standards, as specified by the Transmission System Code. It would be difficult to argue that there is a significant difference in the inherent reliability between Hydro One and LDC stations.

There have however been several cases where Hydro One has allowed load growth to exceed the capability of the station ratings. In some cases, LDCs were not aware that the TS was overloaded until Hydro One directed them to move load to other stations (if possible), or initiated rotating blackouts.

The risk of overloading Hydro One TSs is essentially on the downstream customers, as Hydro One will take measures to ensure their transformers are not damaged due to overload. Hydro One recovers their regulated transmission tariff based on the loading of the facility, so it could be argued that there is a financial benefit to operating stations beyond their capability.

LDCs have taken the position that system reliability has been compromised by the age, condition, or loading at existing Hydro One stations, and that by owning their own MTS, the LDC will take the responsibility of ensuring that there is adequate supply capacity for the LDC.

6.4 Staff Capabilities

The operation and maintenance of a transformer station requires specialized technical resources. Transformer stations are significantly more complex than municipal substations, and it is unlikely that existing staff will be considered competent without additional training. In addition, expensive test equipment is required from time to time to perform mandated testing.

LDCs have taken two approaches with these stations. The larger utilities tend to hire and train substation electricians, protection and control (P&C) technologists/engineers, and stations engineers. This may be practical and cost effective if there are multiple transformer stations to be maintained or constructed, or if there are a large number of municipal substations that can be maintained by the same staff. In addition, utilities of this size often have control rooms with modern SCADA systems, and the P&C staff also maintains the SCADA system and associated communication infrastructure.

Smaller utilities usually contract maintenance to qualified contractors. There are several contractors that are well trained and capable of maintaining utility transformer stations. The day to day operation of the transformer station can usually be handled by the utility staff, providing they receive the necessary training prior to energization. Many small LDCs also contract out the continuous monitoring of the station to other LDCs with SCADA (continuous monitoring is a requirement).

Veridian maintains a 24 hour control room, and has a modern SCADA system that will be capable of monitoring and controlling transformer stations. System operators would require some specialized training, and new operational procedures would need to be created for their reference. Veridian also has a protection and control department, with technicians, technologists, and engineers with general backgrounds in P&C. Again, some specialized training would be necessary in order to be self-sufficient, but we expect that Veridian's staff have the necessary foundations to be capable of maintaining transformer stations.

6.5 Operational Control & Responsiveness

The Hydro One transmission system is monitored and controlled from the Ontario Grid Control Centre (OGCC) in Barrie. This includes all transmission interconnects with adjacent power jurisdictions, major generator connections, transmission lines, network stations, and transformer stations.

During normal day to day operations, Hydro One is able to expeditiously interact with LDC customers for operational issues such as hold-offs and routine switching. There are times, however where the OGCC is dealing with major events such as multiple storm fronts in different areas of the province, whereby tasks they consider non-essential are classified as low priority. In these cases, there are often delays in responsiveness which may result in prolonged outages or crews waiting for hold-offs.

LDCs that own transformer stations typically have full SCADA control of the station, and give MTS operation their top priority.

6.6 Spare Equipment and Risk of Failures

Transformer stations are designed with a high level of redundancy, as described in Section 2. This allows for the failure of any single major component without prolonged outages (in some cases, without any outages).

When considering the risks associated with equipment failure, the primary risk is associated with the transformers within the transformer station. These units are high cost and subject to long delivery times as they are not inventoried, but rather, made to order by manufacturers. Some LDCs have elected to purchase a spare transformer at the time of station construction; Veridian has elected to include the cost of a spare transformer in the costing of the business case.

One of the techniques used to manage this risk in virtually all transformer stations in Ontario is the redundancy in the station design. In this format, there are two partner transformers each with the capability of carrying the full station load should a failure occur in the other.

Another recommended strategy for mitigating this risk is the partnering of utilities with transformer stations in their asset bases for the purpose of spares. The group of utilities depicted on the map in Figure 3 presents an opportunity for such partnerships.

6.7 Capacity for Distributed Generation Connections

The current conceptual design for this station (and others like it in Ontario) allows for the connection of distributed generation (DG) through the application of state-of-the-art impedance-based feeder relaying and control systems that are required to allow the implementation of DG. There are a number of factors that impact the ability to connect DG to a transformer station, some of which are short-circuit current limitations as per the Transmission System Code (TSC), voltage regulation, reverse load transfer through the station transformers, and the type of DG (synchronous generation versus inverter-based connections). All of these factors are considered during the detailed design activities with a view to maximize the amount of DG that can be accommodated while still meeting all of the requirements of the TSC.

Inverter-based technologies (photovoltaic and wind) contribute very little to the short-circuit fault conditions, and the only limitation on the amount of this type of generation that can be connected to the system is the station loading and impacts of any reverse power flow. Synchronous generation (energy from waste and natural gas turbine cogeneration) can contribute significantly to the short-circuit faults in the system, and therefore the amount of this type of DG that can be accommodated is much less. For large synchronous generator connections that may make applications, there are a number of options available to curtail the amount of short-circuit contribution from these facilities. A site-specific application is likely the most cost-effective solution for these large units, and a connection impact assessment (CIA) is always required for these facilities so that the impacts on the system can be analyzed and mitigated if required.

A municipal transformer station of the type planned can generally accommodate between 40% and 60% of the station capacity in connected DG. This amount greatly depends on the level of station loading at the time of the connection application, and the level of minimum load on the station so as to avoid reverse power flow through the station. Each individual DG connection will be evaluated against the current station and feeder loadings at the time.

The capacity of DG connections on this station could equate to the usage of approximately 11,000 homes. To put the number of possible DG connections in perspective, Ontario's microFIT program covers connections of up to 10 kW, and the FIT program covers installations of 10 kW or greater. If all of the DG connections to the new station were microFITs (small commercial and/or residential installations), the number of connections could approach 4,000. Similarly, if all the DG connections were to be FIT projects, there could be as many as 160 large commercial installations at 250 kW each, typical of what might go on the roof of a big box store. At the other extreme, a solar farm might be in the 5-10 MW range, which would use up the DG capacity of the station much more quickly: four to eight solar farms would exhaust the capacity. In reality, DG connections of this type would be a mix of residential and small-to-medium commercial connections.

As previously stated, the amount of inverter-based DG that can be accommodated at the station is only limited by the station and feeder loadings at the time. Typically, DG on a system will be a mix of inverter-based and synchronous generation in ratios that cannot be determined at this point. However, the amount of DG that can be connected to the system without impacting short-circuit levels increases with the distance from the station. With respect to short-circuit limitations as per the TSC, the transformer station design can make provision for future mitigation measures that can be activated and installed in the future when the short-circuit levels begin to approach the TSC limit. For large synchronous DG projects, short circuit mitigation would likely be done at the generators' ends, at the generators' cost.

Typical mitigation measures that could be applied at the station would most likely be current-limiting reactors to reduce the short-circuit contribution from the 230 kV system, thus providing more capacity for DG while still meeting the TSC limits. In essence, the current design for the transformer and equipment has already made provisions for the possibility and capacity for DG. There is flexibility within the design to increase the provisions for DG connections. The incremental cost of provision for future mitigation measures is insignificant compared the cost of the station and, depending on the level of DG applications, the full mitigation measures may never be needed. It is planned that the new TS be constructed with DG in mind from the start. The project budget includes the costs of necessary protection and control, and SCADA features that support DG. Given the prevalence of DG, these features are now more or less standard in LDC designs.

6.8 Safety and Environmental Risks of TS Ownership

Transformer stations are designed and constructed in accordance with stringent technical and safety standards. Further, electricity utilities usually exceed the minimum standards with the use of equipment that offers increased safety and reliability protection. Stations are required to be fully tested and commissioned as part of the connection process.

In the final stages of construction, Veridian operations and control room staff will require training on the operation and maintenance of the new station so they will be competent operators by the time the station is energized. Training programs have been developed for similar projects, and Veridian will have access to materials and training staff.

Following the initial energization, it is anticipated that Veridian will initially outsource maintenance activities for the station. Over time, Veridian would provide any necessary specialized training to stations staff to be fully competent.

High tension substations are protected from unauthorized access with security features such as metallic fences, barbed wire, cameras, and motion sensors. Routine visual inspections are required to ensure that the security features remain intact at all times.

The main environmental risk is the inadvertent release of transformer oil into the environment. Modern stations are constructed without the use of PCB oil, but the release of any oil from the site would be unacceptable. It is intended that the new station would be designed with secondary oil containment systems that would contain any oil spills.

7 Project Schedules

Transformer station projects generally require two to three years from the planning stages to energization. Current market demand has pushed transformer deliveries to almost 12-18 months, which impacts the critical path of the project.

Gantt charts for the self-build project are included in Appendix 4.

8 Project Management

Veridian intends to learn from the experiences of other LDCs that have constructed similar projects. In observing the successes and challenges of other transformer construction ventures, Veridian has concluded the importance of hiring a dedicated project manager who will handle all pertinent aspects of the process.

It is the project manager's responsibility to ensure all necessary resources are in place, and to coordinate with Hydro One and the IESO on behalf of the owner. The project manager will oversee the Environmental Assessment (EA), and provide detailed organization of the project. The project manager will issue the Request for Proposal (RFP) for the detailed engineering, and will be involved throughout the life cycle of the project, from conception through project development and execution, to project close-out. The project manager will focus on the project scope, budget, and schedule to deliver a successful project.

9 Conclusions and Recommendations

A) New transformer station capacity is required in 2019. Without additional supply capacity, new load growth cannot be accommodated.

B) Veridian should design, construct, and operate a new 230 kV 170 MVA transformer station. This station would provide supply capacity for the north Pickering area for approximately fifteen (15) years. This is the least cost alternative for rate payers, and provides maximum shareholder value and operating flexibility to Veridian.

C) Veridian should reject Hydro One's offer for a pool-funded station alternative. Hydro One's costs are substantially higher than a self-build alternative.

D) Veridian should continue to press Hydro One, the IESO, and the OEB to provide pool funding for necessary regional transmission upgrades. The transmission lines that service the study area are amongst the oldest in the province, and are in need of replacement.

E) Land options for the new station should be obtained, contingent on approvals from local and provincial authorities.

F) Veridian has asked Costello Utility Consultants to fill the role of the Owner's Engineer, to oversee the construction process, including the handling of the RFP process, finding contractors, supervising the financial aspects, and managing the project.

Appendix 1

Seaton Area Load Forecast Study

&

Sensitivity Analysis

Veridian Connections Inc.

Seaton Area Load Forecast Study

July 2016

costello
Utility Consultants

Project: 15122

TABLE OF CONTENTS

Veridian Connections Inc.

Seaton Area Load Forecast Study

Executive Summary

The Central Pickering Development Plan was developed by the City of Pickering to establish a sustainable urban community in Seaton. This area is bounded by Hwy 7 to the north, 16th Sideline to the east, Canada Pacific Railway to the south, and the Pickering Townline to the west.

Based on the residential development rates and employment projections provided by the City of Pickering, as well as growth rate projections from Hydro One's Needs Assessment Report for the GTA East Region and Metro Toronto – Northern Subregion, electrical load estimates were prepared for the Seaton Development Area and are summarized in Tables 4.4a, b, and c.

The resultant analysis projects electrical loads for the Seaton Area in the range of 155 MW – 194 MW over the course of the next eighteen-to-twenty years.

A review of the existing feeder loadings was carried out to assess remaining capacity and to attempt to predict the future facility needs to supply the area.

This analysis reveals expectations that all remaining Veridian capacity out of Whitby TS will be utilized by 2019.

Based on the analysis above, the existing feeders that can supply the Seaton Area will fall short of the required demand as early as 2017-2018. Residential infill and/or commercial developments elsewhere in Veridian territory may require any remaining capacity to be directed away from the Seaton Area. The potential impacts of this have not been factored into the analysis as this data was not known at the time.

The predicted load growth for the Seaton Area using data sources independent of Veridian's historical feeder loadings has resulted in a predicted load growth for the Seaton Area that is consistent with Veridian's internal analysis.

The impacts of Conservation Demand Management (CDM) targets for Veridian have been factored into the analysis and have been found to be insignificant against the expected rate of electrical growth.

Based on available capacity, Whitby TS feeders could supply the Seaton area with a capacity of 45 MW total. Weighing this available capacity against the predicted demand for the Seaton area, Figure 5.1 below shows that the demand would exceed the capacity as early as mid-2020, or as late as mid-2021.

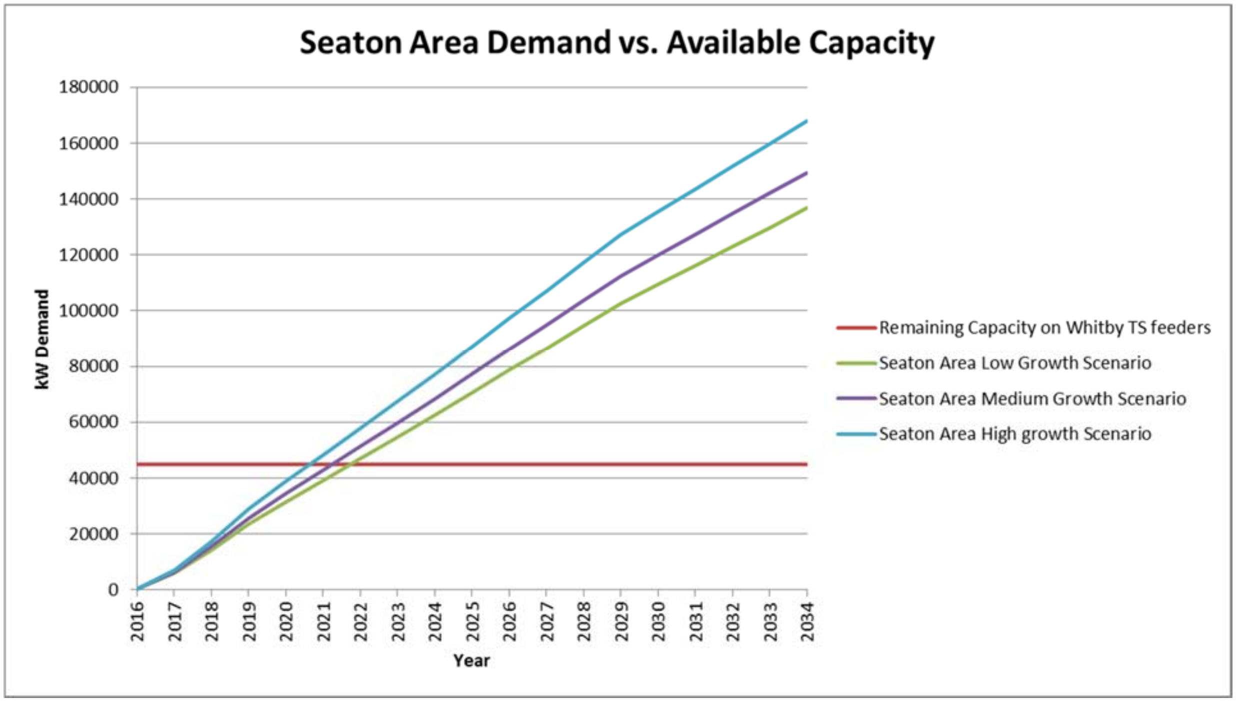
Seaton Area Demand vs. Available Capacity
kW Demand
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
Year
Remaining Capacity on Whitby TS feeders
Seaton Area Low Growth Scenario
Seaton Area Medium Growth Scenario
Seaton Area High growth Scenario

Figure 1

1. Introduction

In February of 2015, Veridian Connections Inc. (henceforth, Veridian) commissioned Costello Associates Inc. to review the proposed Central Pickering Development Plan (May 2006) and to determine a projected long term electrical load growth based on best estimates and current load profiles for the planned development areas.

The analysis and report were also to examine existing feeder loadings versus design capabilities to determine adequacy of current facilities and to offer a high level projection of future capacity requirements.

The report was also required to attach some approximate time frames to the above analysis to the extent that the data would allow.

These draft time frames would provide a starting point for long term capital investment planning activities, which would have to be reviewed on a regular basis to ensure ongoing relevance to actual load growth.

2. Study Methodology

The Central Pickering Development Plan ("CPDP" authored by the City of Pickering and consultations by Planning Alliance Inc.) would serve as the principle reference document for the study as it provides details of the current plans for development of the area.

Electrical load projections were made based on the most current energy consumption research and land use densities proposed in the CPDP to develop a range of potential electrical load growths for each land use type and on a total aggregated basis.

3. Central Pickering Development Plan

- The CPDP covers only the north and west areas of the City of Pickering. The specific area covered in the CPDP is bounded by:

North Limit:	Hwy 7
East Limit:	16th Sideline
South Limit:	Canada Pacific Railway
West Limit:	Pickering Townline

The area north of Highway 7 (adjacent to the 407ETR) was not part of the current Development Plan, but is expected to be predominately a prestige commercial employment area. Electrical loads for this area have been factored in based on a range of kW/employee factors typical for this style of employment developments. Employment levels associated with the predicted population growth were estimated in the CPDP to be approximately 35,000 jobs. This ultimate level of employment was divided even over the 20 years of the planning period.

- Based on the variations in uses and densities of development in each of the major categories of land use, it became necessary to amalgamate the several residential types into an overall Average Residential Unit. This was also the case for the commercial/industrial areas. These areas were combined into an average unit of kW/employee in order to perform a high level analysis and to arrive at the requested long term load forecasts.

- The Central Pickering Development Plan (CDPD) covers a 20 year period of planned development, but is not specific on its goals for the rate of build out. However, developers are currently working on deep services in the area, so the expectation of residential building beginning by 2018 appears to be valid.

  Given the variability in developer driven construction schedules, it becomes difficult to establish a firm capital plan for the electrical infrastructure beyond the five year mark without acknowledging the increased level of sensitivity related to developer driven schedules. A best effort has been made to establish a realistic time table for required capital expenditures, but it must be noted that the real rate of development may end up being very different than predicted in this report.

- During the research for this study, it was confirmed that Veridian does review the feeder loading several times annually and that capital plans are modified to meet the latest situatons driven by the rate and location of development.

4. Estimated Electrical Loading

4.1 Housing Unit Projections (Table 4.1)

- Table 4.1 summarizes the projected population growth in each existing areas of Pickering, as well as the projections for the new Seaton Area. All data was taken from the City of Pickering 20 Year Population Projections dated December 2015.

- Column 1 lists the urban areas of Pickering and gives a total projection for the rural area. Areas numbered 16-21 are the ones being developed under the CPDP (Seaton).

- Columns 2 & 3 indicate the existing and proposed additional units estimated by the City of Pickering. The proposed additional units are to be added over a 20 year period.

- Columns 4 - 11 indicate the projected number of housing units in each area in the specified year.

Table 4.1 Housing Unit Projections

				Number of Residential Units Projected							
	Area	Existing Units	Proposed Additional Units	2014	2015	2016/2017	2018	2019	2020-2024	2025-2029	2030-2034
Existing Pickering Neighbourhoods	1-Rosebank	955	166	961	974	981	993	1005	1055	1105	1121
	2-West Shore	2305	56	2305	2325	2356	2356	2361	2361	2361	2361
	3-Bay Ridges	3268	414	3284	3286	3368	3450	3561	3682	3682	3682
	4-Brock Industrial	4	0	4	4	4	4	4	4	4	4
	5-Rougemount	1041	157	1044	1047	1094	1096	1098	1118	1158	1198
	6-Woodlands	827	306	829	831	841	1078	1080	1080	1080	1133
	7-Dunbarton	880	336	888	920	940	965	1054	1179	1204	1216
	8-City Centre	2266	5923	2266	2266	2266	2396	2626	3685	4585	5544
	9-Village East	1867	209	1867	1869	1871	1873	1875	1895	1915	1936
	10-Highbush	2028	228	2039	2064	2115	2183	2205	2225	2245	2255
	11-Amberlea	4421	27	4423	4428	4433	4436	4439	4442	4445	4448
	12-Liverpool	5976	246	6014	6043	6053	6063	6093	6123	6153	6183
	13-Brock Ridge	2093	254	2093	2128	2207	2312	2347	2407	2467	2527
	14-Rouge Park	258	359	260	311	364	376	417	474	524	574
	15-Duffin Heights	661	2935	873	998	1223	1448	1608	2308	3064	3564
New Seaton Area	16-Lamoureaux	11	5651	11	11	11	1548	3055	4553	5662	5662
	17-Brock - Taunton	13	2405	13	13	13	13	13	513	1513	2418
	18-Mount Plesant	16	7790	16	16	16	16	688	2819	6108	7806
	19-Wilson Meadows	14	3250	14	14	14	14	264	1905	3264	3264
	20-Thompson's Corners	15	2235	15	15	15	15	15	850	1650	2250
	21-Innovation Corridor	12	0	12	12	12	12	12	12	12	12
	Rural Total	1442	592	1454	1466	1482	1498	1531	1591	1645	1680
	Pickering Total	30373	33539	30685	31041	31679	34145	37351	46281	55846	60838
	Column 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11

This information taken from The City of Pickering 20 Year Population Projections, 2013

4.2 Employment Projections and Associated Electrical Load Projections (Table 4.2)

- Table 4.2 summarizes the employment level projections for the Seaton Development area based on the CPDP and then projects the potential electrical loading based on three load density levels on a kW/employee basis.

Low Peak kW / Employee = 3.0kW
Medium Peak kW / Employee = 3.25kW
High Peak kW / Employee = 3.5kW

Table 4.2 Employment Load Forecast

	# of Employees	Minimum Peak kW/Employee	Intermediate Peak kW/Employee	Maximum Peak kW/Employee
2017	0	0.000	0.000	0.000
2018	1944	5832.000	6318.000	6804.000
2019	3888	11664.000	12636.000	13608.000
2020	5832	17496.000	18954.000	20412.000
2021	7776	23328.000	25272.000	27216.000
2022	9720	29160.000	31590.000	34020.000
2023	11664	34992.000	37908.000	40824.000
2024	13608	40824.000	44226.000	47628.000
2025	15552	46656.000	50544.000	54432.000
2026	17496	52488.000	56862.000	61236.000
2027	19440	58320.000	63180.000	68040.000
2028	21384	64152.000	69498.000	74844.000
2029	23328	69984.000	75816.000	81648.000
2030	25272	75816.000	82134.000	88452.000
2031	27216	81648.000	88452.000	95256.000
2032	29160	87480.000	94770.000	102060.000
2033	31104	93312.000	101088.000	108864.000
2034	33048	99144.000	107406.000	115668.000
2035	35000	105000.000	113750.000	122500.000
Column 1	Col 2	Col 3	Col 4	Col 5

Column 1 - Development Plan years
Column 2 - Pickering Development Plans to employ 35,000 by 2035
Column 3 - # of Employees * 3kW, low range for Average Peak kW/Employee from from existing Ontario LDCs
Column 4 - # of Employees * 3.25kW, intermediate range for Average Peak kW/Employee from existing Ontario LDCs
Column 5 - # of Employees * 3.5kW, high range for Average Peak kW/Employee from existing Ontario LDCs

4.3 Estimated Electrical Load Projections Based on New Housing Units and Projected Employment Levels (Tables 4.3a,b,c)

- Based on the projected residential dwelling units for each area (Table 4.1) and the estimated electrical peak demand per housing unit listed below:

  Low Density Residential Peak kW = 2.13kW / unit
  Medium Density Residential Peak kW = 1.67kW / unit
  High Density Residential Peak kW = 1.48kW / unit

  Table 4.3a shows the variance of predicted electrical peaks loads in the existing areas of Pickering

  Table 4.3b shows the variance of predicted peak electrical loads in the Seaton development area due to proposed residential growth.

  Table 4.3c add the predicted peak electrical loads of tables 4.3a and 4.3b together with the predicted peak electrical loads due to employment of Table 4.2.

Table 4.3a Estimated Electrical Load Forecast Existing Areas

Plan Area	Existing Residential (# Units)	Ultimate Residential (# Units)	Proposed Additional Units	Additional Units at High Density (kW)	Additional Units at Medium Density (kW)	Additonal Units at Low Denisty (kW)
1-Rosebank	955	1121	166	245.68	277.22	353.58
2-West Shore	2305	2361	56	82.88	93.52	119.28
3-Bay Ridges	3268	3682	414	612.72	691.38	881.82
4-Brock Industrial	4	4	0	0	0	0
5-Rougemount	1041	1198	157	232.36	262.19	334.41
6-Woodlands	827	1133	306	452.88	511.02	651.78
7-Dunbarton	880	1216	336	497.28	561.12	715.68
8-City Centre	2266	5544	5923	8766.04	9891.41	12615.99
9-Village East	1867	1936	209	309.32	349.03	445.17
10-Highbush	2028	2255	228	337.44	380.76	485.64
11-Amberlea	4421	4448	27	39.96	45.09	57.51
12-Liverpool	5976	6183	246	364.08	410.82	523.98
13-Brock Ridge	2093	2527	254	375.92	424.18	541.02
14-Rouge Park	258	574	359	531.32	599.53	764.67
15-Duffin Heights	661	3564	2935	4343.8	4901.45	6251.55
Rural Total	1442	1680	592	876.16	988.64	1260.96
Totals	30292	39426	12208	18067.84	20387.36	26003.04

Table 4.3b Estimated Electrical Load Forecast for New Seaton Areas

16-Lamoureaux	11	5662	5651	8363.48	9437.17	12036.63
17-Brock - Taunton	13	2418	2405	3559.4	4016.35	5122.65
18-Mount Plesant	16	7806	7790	11529.2	13009.3	16592.7
19-Wilson Meadows	14	3264	3250	4810	5427.5	6922.5
20-Thompson's Corners	15	2250	2235	3307.8	3732.45	4760.55
21-Innovation Corridor	12	12	0	0	0	0
Totals	81	21412	21331	31569.88	35622.77	45435.03

Table 4.3c Totals from above tables

Totals Table 4.3a	30,292	39,426	12,208	18,067.84	20,387.36	26,003.04
Totals Table 4.3b	81	21,412	21,331	31,569.88	35,622.77	45,435.03
Employment Area Totals				105,000	113,750	122,500
Overall Totals	30,373	60,838	33,539	154,637.72	169,760.13	193,938.07
Column 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7

Column 1 - City of Pickering Neighbourhoods, 16-21 are proposed Seaton Neighbourhoods
Column 2 - Existing Residential Units taken from Column 2 in Table 4.1
Column 3 - Total Residential Units after new area completion taken from Column 11 in Table 4.1
Column 4 - Additional Units to be added to each neighbourhood by 2033, taken from Column 3 in Table 4.1
Column 5 - Additional Units * High Density Residential Peak kW (1.48 kW/unit) from the CREEDAC 1997 report
Column 6 - Additional Units * Medium Density Residential Peak kW (1.67 kW/unit) from the CREEDAC 1997 report
Column 7 - Additional Units * Low Density Residential Peak kW (2.13 kW/unit) from the CREEDAC 1997 report
CREEDAC = Canadian Residential Energy End Use Data and Analysis Centre

4.4 Existing Feeder Predicted Load Growth Review

Table 4.4a below reviews current feeder loadings projected out based on a growth rate as determined by the Hydro One Needs Assessment Report, as of August 2014.

Table 4.4b below reviews current feeder loadings projected out based on a growth rate as determined by the statistical analysis of Veridian's historical feeder loads. Based on this analysis, all of the feeders reach their maximum capacities earlier than predicted by Hydro One's project growth loads, in Table 4.4a.

Based on the updated residential growth projections received June 2016, all remaining Whitby TS capacity is expected to be utilized by 2019.

Table 4.4a: Current Electrical Load Forecast (without Seaton Area), Growth Rate as per Hydro One Needs Assessment

Facility Transformer Station/ Feeder	Historical Peak Loading 2009 (MW)	2010 (MW)	2011 (MW)	2012 (MW)	2013 (MW)	2014 (MW)	Average Annual Peak Demand Growth Rate* (%/yr)	Projected Load @ Current Rate of Growth 2016 (MW)	2017 (MW)	2018 (MW)	2019 (MW)	Average Annual Peak Demand Growth Rate* (%/yr)	Projected Load @ Current Rate of Growth 2020 (MW)	2021 (MW)	2022 (MW)	2023 (MW)	2024 (MW)	2025 (MW)	2026 (MW)	2027 (MW)	2028 (MW)	2029 (MW)	2030 (MW)	2031 (MW)	2032 (MW)	2033 (MW)	2034 (MW)
Cherrywood 81M1 (44 kV)	13.88	13.93	16.90	17.48	13.99	15.47	2.80%	15.903	16.348	16.806	17.277	2.40%	17.691	18.116	18.551	18.996	19.452	19.919	20.397	20.886	21.388	21.901	22.427	22.965	23.516	24.080	24.658
81M2 (44 kV)	13.80	15.00	17.52	9.71	16.21	14.03	2.80%	14.423	14.827	15.242	15.669	2.40%	16.045	16.430	16.824	17.228	17.641	18.065	18.498	18.942	19.397	19.862	20.339	20.827	21.327	21.839	22.363
81M3 (44 kV)	12.51	12.51	14.50	20.36	12.52	15.03	2.80%	15.451	15.883	16.328	16.785	2.40%	17.188	17.601	18.023	18.456	18.899	19.352	19.817	20.292	20.779	21.278	21.789	22.312	22.847	23.395	23.957
81M4 (44 kV)	21.72	21.72	11.88	24.67	21.79	18.2	2.80%	18.710	19.233	19.772	20.326	2.40%	20.813	21.313	21.824	22.348	22.885	23.434	23.996	24.572	25.162	25.766	26.384	27.017	27.666	28.330	29.010
81M5 (44 kV)	21.37	21.86	21.36	35.68	22.58	23.38	2.80%	24.035	24.708	25.399	26.111	2.40%	26.737	27.379	28.036	28.709	29.398	30.103	30.826	31.566	32.323	33.099	33.894	34.707	35.540	36.393	37.266
81M6 (44 kV)	25.64	25.78	12.14	30.07	25.92	24.6	2.80%	25.289	25.997	26.725	27.473	2.40%	28.132	28.808	29.499	30.207	30.932	31.674	32.435	33.213	34.010	34.826	35.662	36.518	37.394	38.292	39.211
81M7 (44 kV)	20.27	20.38	42.05	31.65	20.81	26.26	2.80%	26.995	27.751	28.528	29.327	2.40%	30.031	30.752	31.490	32.245	33.019	33.812	34.623	35.454	36.305	37.176	38.069	38.982	39.918	40.876	41.857
81M8 (44 kV)	33.43	33.98	23.52	25.68	33.98	9.78	2.80%	10.054	10.335	10.625	10.922	2.40%	11.184	11.453	11.728	12.009	12.297	12.592	12.895	13.204	13.521	13.846	14.178	14.518	14.867	15.223	15.589
Total Load	162.620	165.160	159.881	195.299	167.800	146.750		150.859	155.083	159.425	163.889		167.823	171.850	175.975	180.198	184.523	188.951	193.486	198.130	202.885	207.754	212.740	217.846	223.075	228.428	233.911
Whitby 40M22 (44 kV)	25.33	25.86	26.27	3.02	26.11	16.52	2.80%	16.983	17.458	17.947	18.449	2.40%	18.892	19.346	19.810	20.285	20.772	21.271	21.781	22.304	22.839	23.387	23.949	24.523	25.112	25.715	26.332
40M23 (44 kV)	31.66	32.23	18.85	41.36	32.97	17.77	2.80%	18.268	18.779	19.305	19.845	2.40%	20.322	20.809	21.309	21.820	22.344	22.880	23.429	23.992	24.567	25.157	25.761	26.379	27.012	27.660	28.324
40M24 (44 kV)	14.12	14.34	26.90	15.97	14.95	22.94	2.80%	23.582	24.243	24.921	25.619	2.40%	26.234	26.864	27.508	28.169	28.845	29.537	30.246	30.972	31.715	32.476	33.256	34.054	34.871	35.708	36.565
40M43 (27.6 kV)	0.00	0.00	0.00	0.00	0.00	0	2.80%	3.000	15.000	15.420	15.852	2.40%	16.232	16.622	17.021	17.429	17.847	18.276	18.714	19.164	19.624	20.094	20.577	21.071	21.576	22.094	22.624
40M44 (27.6 kV)	0.00	0.00	0.00	0.00	0.00	0	2.80%	0.000	2.000	15.000	15.420	2.40%	15.790	16.169	16.557	16.954	17.361	17.778	18.205	18.642	19.089	19.547	20.016	20.497	20.989	21.492	22.008
40M45 (27.6 kV)	0.00	9.42	16.60	4.42	13.00	3.97	2.80%	4.081	4.195	4.313	4.434	2.40%	4.540	4.649	4.761	4.875	4.992	5.112	5.234	5.360	5.489	5.620	5.755	5.893	6.035	6.180	6.328
40M46 (27.6 kV)	0.00	8.55	10.72	8.57	11.00	7.94	2.80%	8.162	8.391	8.626	8.867	2.40%	9.080	9.298	9.521	9.750	9.984	10.223	10.469	10.720	10.977	11.241	11.510	11.787	12.070	12.359	12.656
40M47 (27.6 kV)	0.00	0.00	0.00	0.00	0.00	0	2.80%	15.000	15.420	15.852	16.296	2.40%	16.687	17.087	17.497	17.917	18.347	18.788	19.238	19.700	20.173	20.657	21.153	21.661	22.180	22.713	23.258
40M48 (27.6 kV)	9.23	2.70	3.72	17.37	7.00	15.12	2.80%	15.543	15.979	16.426	16.886	2.40%	17.291	17.706	18.131	18.566	19.012	19.468	19.935	20.414	20.904	21.405	21.919	22.445	22.984	23.536	24.100
Total Load						84.260		104.619	121.465	137.810	141.668		145.068	148.550	152.115	155.766	159.504	163.332	167.252	171.266	175.377	179.586	183.896	188.309	192.829	197.457	202.196
Sheppard 47M2 (27.6 kV)	12.43	12.55	16.02	18.91	15.00	13.70	1.60%	13.917	14.140	14.366	14.596	0.60%	14.684	14.772	14.860	14.949	15.039	15.129	15.220	15.311	15.403	15.496	15.589	15.682	15.776	15.871	15.966
47M4 (27.6 kV)	15.89	16.13	14.42	14.12	16.54	12.52	1.60%	12.722	12.926	13.133	13.343	0.60%	13.423	13.503	13.584	13.666	13.748	13.830	13.913	13.997	14.081	14.165	14.250	14.336	14.422	14.508	14.595
Total Load						26.22		26.640	27.066	27.499	27.939		28.106	28.275	28.445	28.615	28.787	28.960	29.134	29.308	29.484	29.661	29.839	30.018	30.198	30.379	30.562
Malvern 26M35 (27.6 kV)	10.62	10.63	13.43	12.45	13.00	10.49	1.60%	10.654	10.824	10.997	11.173	0.60%	11.240	11.308	11.376	11.444	11.513	11.582	11.651	11.721	11.791	11.862	11.933	12.005	12.077	12.149	12.222

* Values taken from Hydro One Needs Assessment Report

Table 4.4b: Current Electrical Load Forecast (without Seaton Area), Growth Rate as per Veridian Historical Feeder Loadings

Facility Transformer Station/ Feeder	Historical Peak Loading 2009 (MW)	2010 (MW)	2011 (MW)	2012 (MW)	2013 (MW)	2014 (MW)	Average Annual Peak Demand Growth Rate* (%/yr)	Projected Load @ Current Rate of Growth 2016 (MW)	2017 (MW)	2018 (MW)	2019 (MW)	Average Annual Peak Demand Growth Rate* (%/yr)	Projected Load @ Current Rate of Growth 2020 (MW)	2021 (MW)	2022 (MW)	2023 (MW)	2024 (MW)	2025 (MW)	2026 (MW)	2027 (MW)	2028 (MW)	2029 (MW)	2030 (MW)	2031 (MW)	2032 (MW)	2033 (MW)	2034 (MW)
Cherrywood 81M1 (44 kV)	13.88	13.93	16.90	17.48	13.99	15.47	6.20%	16.429	17.448	18.530	19.678	6.20%	20.898	22.194	23.570	25.031	26.583	28.232	29.982	31.841	33.815	35.912	38.138	40.503	43.014	45.681	48.513
81M2 (44 kV)	13.80	15.00	17.52	9.71	16.21	14.03	6.20%	14.900	15.824	16.805	17.847	6.20%	18.953	20.128	21.376	22.701	24.109	25.604	27.191	28.877	30.667	32.569	34.588	36.732	39.010	41.428	43.997
81M3 (44 kV)	12.51	12.51	14.50	20.36	12.52	15.03	6.20%	15.962	16.951	18.002	19.119	6.20%	20.304	21.563	22.900	24.320	25.827	27.429	29.129	30.935	32.853	34.890	37.053	39.351	41.790	44.381	47.133
81M4 (44 kV)	21.72	21.72	11.88	24.67	21.79	18.2	6.20%	19.328	20.527	21.799	23.151	6.20%	24.586	26.111	27.730	29.449	31.275	33.214	35.273	37.460	39.782	42.249	44.868	47.650	50.604	53.742	57.074
81M5 (44 kV)	21.37	21.86	21.36	35.68	22.58	23.38	6.20%	24.830	26.369	28.004	29.740	6.20%	31.584	33.542	35.622	37.830	40.176	42.667	45.312	48.121	51.105	54.273	57.638	61.212	65.007	69.038	73.318
81M6 (44 kV)	25.64	25.78	12.14	30.07	25.92	24.6	6.20%	26.125	27.745	29.465	31.292	6.20%	33.232	35.292	37.481	39.804	42.272	44.893	47.677	50.632	53.772	57.106	60.646	64.406	68.399	72.640	77.144
81M7 (44 kV)	20.27	20.38	42.05	31.65	20.81	26.26	6.20%	27.888	29.617	31.453	33.404	6.20%	35.475	37.674	40.010	42.490	45.125	47.923	50.894	54.049	57.400	60.959	64.738	68.752	73.015	77.542	82.349
81M8 (44 kV)	33.43	33.98	23.52	25.68	33.98	9.78	6.20%	10.386	11.030	11.714	12.440	6.20%	13.212	14.031	14.901	15.825	16.806	17.848	18.954	20.130	21.378	22.703	24.111	25.605	27.193	28.879	30.669
Total Load	162.620	165.160	159.881	195.299	167.800	146.750		155.849	165.511	175.773	186.671		198.244	210.535	223.589	237.451	252.173	267.808	284.412	302.045	320.772	340.660	361.781	384.212	408.033	433.331	460.197
Whitby 40M22 (44 kV)	25.33	25.86	26.27	3.02	26.11	16.52	15.50%	19.081	22.038	25.454	29.399	15.50%	33.956	39.219	45.299	52.320	60.429	69.796	80.614	93.109	107.541	124.210	143.463	165.700	191.383	221.048	255.310
40M23 (44 kV)	31.66	32.23	18.85	41.36	32.97	17.77	15.50%	20.524	23.706	27.380	31.624	15.50%	36.526	42.187	48.726	56.279	65.002	75.077	86.714	100.155	115.679	133.609	154.318	178.238	205.864	237.773	274.628
40M24 (44 kV)	14.12	14.34	26.90	15.97	14.95	22.94	15.50%	26.496	30.603	35.346	40.825	15.50%	47.152	54.461	62.902	72.652	83.913	96.920	111.943	129.294	149.334	172.481	199.216	230.094	265.758	306.951	354.528
40M43 (27.6 kV)	0.00	0.00	0.00	0.00	0.00	0	15.50%	3.000	15.000	17.325	20.010	15.50%	23.112	26.694	30.832	35.611	41.131	47.506	54.869	63.374	73.197	84.542	97.647	112.782	130.263	150.454	173.774
40M44 (27.6 kV)	0.00	0.00	0.00	0.00	0.00	0	15.50%	0.000	2.000	15.000	17.325	15.50%	20.010	23.112	26.694	30.832	35.611	41.131	47.506	54.869	63.374	73.197	84.542	97.647	112.782	130.263	150.454
40M45 (27.6 kV)	0.00	9.42	16.60	4.42	13.00	3.97	15.50%	4.585	5.296	6.117	7.065	15.50%	8.160	9.425	10.886	12.573	14.522	16.773	19.373	22.376	25.844	29.850	34.476	39.820	45.992	53.121	61.355
40M46 (27.6 kV)	0.00	8.55	10.72	8.57	11.00	7.94	15.50%	9.171	10.592	12.234	14.130	15.50%	16.320	18.850	21.772	25.146	29.044	33.546	38.746	44.751	51.688	59.699	68.953	79.640	91.984	106.242	122.710
40M47 (27.6 kV)	0.00	0.00	0.00	0.00	0.00	0	15.50%	15.000	17.325	20.010	23.112	15.50%	26.694	30.832	35.611	41.131	47.506	54.869	63.374	73.197	84.542	97.647	112.782	130.263	150.454	173.774	200.709
40M48 (27.6 kV)	9.23	2.70	3.72	17.37	7.00	15.12	15.50%	17.464	20.170	23.297	26.908	15.50%	31.079	35.896	41.460	47.886	55.308	63.881	73.783	85.219	98.428	113.684	131.305	151.657	175.164	202.315	233.674
Total Load						84.260		115.320	146.730	182.163	210.398		243.010	280.677	324.182	374.430	432.466	499.499	576.921	666.344	769.627	888.919	1026.701	1185.840	1369.645	1581.940	1827.141
Sheppard 47M2 (27.6 kV)	12.43	12.55	16.02	18.91	15.00	13.70	1.60%	13.917	14.140	14.366	14.596	1.60%	14.829	15.067	15.308	15.553	15.802	16.054	16.311	16.572	16.837	17.107	17.381	17.659	17.941	18.228	18.520
47M4 (27.6 kV)	15.89	16.13	14.42	14.12	16.54	12.52	1.60%	12.722	12.926	13.133	13.343	1.60%	13.556	13.773	13.994	14.218	14.445	14.676	14.911	15.149	15.392	15.638	15.888	16.143	16.401	16.663	16.930
Total Load						26.22		26.640	27.066	27.499	27.939		28.386	28.840	29.301	29.770	30.247	30.731	31.222	31.722	32.229	32.745	33.269	33.801	34.342	34.891	35.450
Malvern 26M35 (27.6 kV)	10.62	10.63	13.43	12.45	13.00	10.49	1.60%	10.654	10.824	10.997	11.173	1.60%	11.352	11.534	11.718	11.906	12.096	12.290	12.486	12.686	12.889	13.095	13.305	13.518	13.734	13.954	14.177

*Values taken from Veridian Historical Feeder Loadings

Red	>45MW
Orange	37-45MW
Yellow	27-37MW

4.5 Totalized (Year by Year) Electrical Load Projections for Seaton Area (Table 4.5)

The following three tables summarize the projected loads of the Seaton Area under three different growth rates based on variations in kW per employee, and different residential densities. Table 4.5a summarizes the minimum load growth case while Table 4.5c outlines the maximum load growth case.

Table 4.5a: High Density Residential Peak kW + Low Peak kW/Employee

Area	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
16-Lamoureaux	16.28	16.28	2291.04	4521.4	4965.4	5409.4	5853.4	6297.4	6738.44	7067	7395.56	7724.12	8052.68	8379.76	8379.76	8379.76	8379.76	8379.76	8379.76
17-Brock - Taunton	19.24	19.24	19.24	19.24	167.24	315.24	463.24	611.24	759.24	1055.24	1351.24	1647.24	1943.24	2239.24	2507.12	2775	3042.88	3310.76	3578.64
18-Mount Plesant	23.68	23.68	23.68	1018.24	1648.72	2279.2	2909.68	3540.16	4172.12	5145.96	6119.8	7093.64	8067.48	9039.84	9543.04	10046.24	10549.44	11052.64	11552.88
19-Wilson Meadows	20.72	20.72	20.72	390.72	876.16	1361.6	1847.04	2332.48	2819.4	3221.96	3624.52	4027.08	4429.64	4830.72	4830.72	4830.72	4830.72	4830.72	4830.72
20-Thompson's Corners	22.2	22.2	22.2	22.2	269.36	516.52	763.68	1010.84	1258	1494.8	1731.6	1968.4	2205.2	2442	2619.6	2797.2	2974.8	3152.4	3330
21-Innovation Corridor (Employment Area)	0	5832	11664	17496	23328	29160	34992	40824	46656	52488	58320	64152	69984	75816	81648	87480	93312	99144	105000
Totals	102.12	5934.12	14040.88	23467.8	31254.88	39041.96	46829.04	54616.12	62403.2	70472.96	78542.72	86612.48	94682.24	102747.6	109528.2	116308.9	123089.6	129870.3	136672

Table 4.5b: Medium Density Residential Peak kW + Intermediate Peak kW/Employee

Area	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
16-Lamoureaux	18.37	18.37	2585.16	5101.85	5602.85	6103.85	6604.85	7105.85	7603.51	7974.25	8344.99	8715.73	9086.47	9455.54	9455.54	9455.54	9455.54	9455.54	9455.54
17-Brock - Taunton	21.71	21.71	21.71	21.71	188.71	355.71	522.71	689.71	856.71	1190.71	1524.71	1858.71	2192.71	2526.71	2828.98	3131.25	3433.52	3735.79	4038.06
18-Mount Plesant	26.72	26.72	26.72	1148.96	1860.38	2571.8	3283.22	3994.64	4707.73	5806.59	6905.45	8004.31	9103.17	10200.36	10768.16	11335.96	11903.76	12471.56	13036.02
19-Wilson Meadows	23.38	23.38	23.38	440.88	988.64	1536.4	2084.16	2631.92	3181.35	3635.59	4089.83	4544.07	4998.31	5450.88	5450.88	5450.88	5450.88	5450.88	5450.88
20-Thompson's Corners	25.05	25.05	25.05	25.05	303.94	582.83	861.72	1140.61	1419.5	1686.7	1953.9	2221.1	2488.3	2755.5	2955.9	3156.3	3356.7	3557.1	3757.5
21-Innovation Corridor (Employment Area)	0	6318	12636	18954	25272	31590	37908	44226	50544	56862	63180	69498	75816	82134	88452	94770	101088	107406	113750
Totals	115.23	6433.23	15318.02	25692.45	34216.52	42740.59	51264.66	59788.73	68312.8	77155.84	85998.88	94841.92	103685	112523	119911.5	127299.9	134688.4	142076.9	149488

Table 4.5c: Low Density Residential Peak kW + High Peak kW/Employee

Area	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
16-Lamoureaux	23.43	23.43	3297.24	6507.15	7146.15	7785.15	8424.15	9063.15	9697.89	10170.75	10643.61	11116.47	11589.33	12060.06	12060.06	12060.06	12060.06	12060.06	12060.06
17-Brock - Taunton	27.69	27.69	27.69	27.69	240.69	453.69	666.69	879.69	1092.69	1518.69	1944.69	2370.69	2796.69	3222.69	3608.22	3993.75	4379.28	4764.81	5150.34
18-Mount Plesant	34.08	34.08	34.08	1465.44	2372.82	3280.2	4187.58	5094.96	6004.47	7406.01	8807.55	10209.09	11610.63	13010.04	13734.24	14458.44	15182.64	15906.84	16626.78
19-Wilson Meadows	29.82	29.82	29.82	562.32	1260.96	1959.6	2658.24	3356.88	4057.65	4637.01	5216.37	5795.73	6375.09	6952.32	6952.32	6952.32	6952.32	6952.32	6952.32
20-Thompson's Corners	31.95	31.95	31.95	31.95	387.66	743.37	1099.08	1454.79	1810.5	2151.3	2492.1	2832.9	3173.7	3514.5	3770.1	4025.7	4281.3	4536.9	4792.5
21-Innovation Corridor (Employment Area)	0	6804	13608	20412	27216	34020	40824	47628	54432	61236	68040	74844	81648	88452	95256	102060	108864	115668	122500
Totals	146.97	6950.97	17028.78	29006.55	38624.28	48242.01	57859.74	67477.47	77095.2	87119.76	97144.32	107168.9	117193.4	127211.6	135380.9	143550.3	151719.6	159888.9	168082

Rows 4-8 = Additional Units * High Density Residential Peak kW (1.48 kW/unit) from the CREEDAC 1997 report
Rows 16-20 = Additional Units * Medium Density Residential Peak kW (1.67 kW/unit) from the CREEDAC 1997 report
Rows 28-32 = Additional Units * Low Density Residential Peak kW (2.13 kW/unit) from the CREEDAC 1997 report
CREEDAC = Canadian Residential Energy End Use Data and Analysis Centre

Row 9 = # of Employees * 3kW, low range for Average Peak kW/Employee from existing Ontario LDCs
Row 21 = # of Employees * 3.25kW, intermediate range for Average Peak kW/Employee from existing Ontario LDCs
Row 33 = # of Employees * 3.5kW, high range for Average Peak kW/Employee from existing Ontario LDCs

4.6 Impact of Conservation Demand Management (CDM)

Any CDM reductions in peak demand would be attributable to existing feeders. Any new development in the Seaton area would be constructed to current energy-efficiency standards and therefore would not be expected to contribute to CDM targets.

Veridian has indicated that the CDM savings that can be attributed to the existing feeders supplying the Seaton Area might be expected to net 965 kW in peak demand reduction. This information is based upon the IESO's CDM targets for all of Veridian, divided up on a per feeder basis across the system.

This modest reduction in peak demand due to CDM is insignificant in comparison to the rate of growth for the Seaton Area so there is no material capacity made available through this process.

5.0 Summary of Results

5.1 As of June 2016, it has been realized that the pace of development as originally expected has not materialized. The indication is that the bulk of residential growth will begin in 2018, and will happen largely in 2019. The earlier load growth study began this process in 2016 and therefore changes were made to the forecast period to account for the delay in development.

5.2 Based on the proposed residential growth in the existing developed areas of Pickering, the future additional electrical peak demand could be expected to be in the range of 18 MW to 26 MW (Table 4.3a)

5.3 New electrical peak demand resulting from the proposed Seaton Development area can be expected to be in the range of:

- 31 MW to 45 MW for potential residential load (Table 4.3b)
- 105 MW to 122 MW for employment driven load (Table 4.2)

The above analysis has not taken into account the following:

- Any employment growth, and associated electrical loads, in the existing areas of the City of Pickering;
- Current rate of electrical growth in the exsting areas of the City of Pickering.

According to Veridian information, there are Whitby TS feeders that could supply the Seaton area with a capacity of 45 MW total. Weighing this available capacity against the predicted demand for the Seaton area, Figure 5.1 below shows that the demand would exceed the capacity as early as mid-2019, or as late as mid-2020.

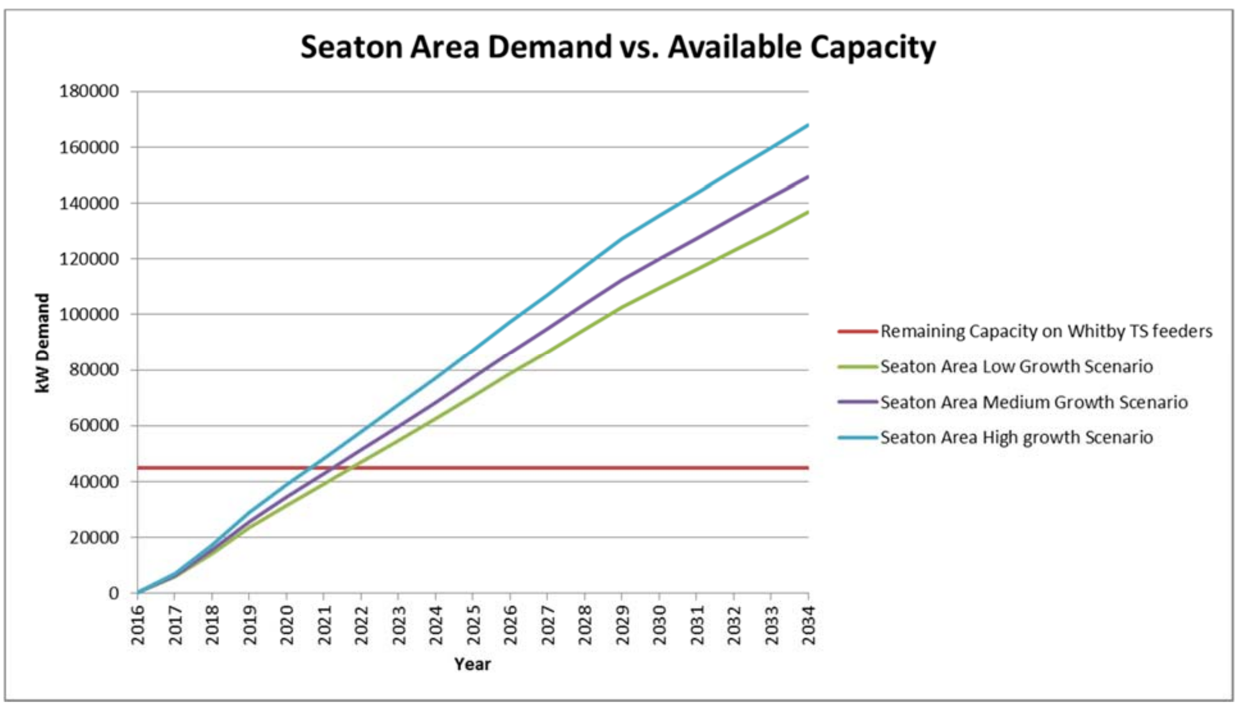

Figure 5.1

6. Conclusions

Based on the analysis above, the existing feeders that can supply the Seaton Area could fall short of the required demand as early as 2017-2018. Residential infill and/or commercial developments elsewhere in Veridian territory may require any remaining capacity to be directed away from the Seaton Area. The potential impacts of this have not been factored into the analysis as this data was not known at the time.

The predicted load growth for the Seaton Area using data sources independent of Veridian's historical feeder loadings has resulted in a predicted load growth for the Seaton Area that is consistent with Veridian's internal analysis.

The impacts of Conservation Demand Management (CDM) targets for Veridian have been factored into the analysis and have been found to be insignificant against the expected rate of electrical growth.

The original study indicated development to begin as early as 2016, whereas all indications currently point to a late 2017, early 2018 start period. This final version of the load study takes this into account, and all of this leads to the conclusion that new transformer station capacity is required to supply the Seaton Area and needs to be in place as early as 2019.

Appendix 2

Veridian Cost of Service Application – Page 33

Excerpt from EB-2013-0174

Full details of the methodology and forecasts by rate class are provided in Exhibit 3, Tab 2.

D – Rate Base and Capital Plan

Distribution System Plan (DSP)

There are a number of major drivers influencing Veridian's Distribution System Plan. Each of these drivers is discussed as follows:

Customer Growth – Veridian expects continued strong customer growth in its Ajax, Pickering, Belleville and Clarington service areas. Additional capacity will be required for the new planned community of Seaton in north Pickering. Development is underway with projected customer connections of 1,700 lots per year starting in 2015 and continuing past the 2018 planning window. Additional capacity and distribution feeder infrastructure will be required. While this new load can be served initially from Veridian's existing Whitby TS facilities, an investment in a Seaton TS will be required and is targeted for an in-service date of 2018. The Seaton TS project is forecast as a multi-year capital investment of approximately $21M.

Road Authority Requirements – As growth and development occurs within Veridian's service area, continued and increased levels of road relocation work requested by various road authorities continues to be a major driver of capital investment. The Ministry of Transportation's Highway #407 extension from its current end point in Pickering through to the Ajax district's eastern service boundary is currently underway with forecasted completion times between 2013 and 2015. A multi-year, project encompassing 13 sub-projects over 2013 and 2014, totaling over $14 million in gross costs and approximately $4 million net of capital contributions is a key component in Veridian's DSP.

Appendix 3

Project Budget

Veridian Connections MTS #1 - 170 MVA Station Preliminary Budget

Design	75/100/125 MVA Power Transformers with 170 MVA Summer LTR - DESN Outdoor 230 kV Air Disconnect Switches Indoor MV-GIS Single Busbar 38 kV 40 kA
Voltage	230 / 28 kV nom.
Installed Capacity	170 MVA
Switchgear Type	38 kV MV-GIS
Main Breaker	2500A x 2, 2500A tie breaker
Feeder Breakers	12 28kV feeders, 2 - 1250A station service
Schedule	Spring 2019
Exchange Rate USD	1.3 *** Difference between 2014 and 2016 exchange rates

	Component	Cost Detail	Exchange Impact		Summary
1)	**Engineering & Design**				
	1.1) Preliminary engineering	$ 50,000			
	1.2) Local Fees and Permits	$ 45,000			
	1.3) Soils & Geotechnical Investigations	$ 75,000			
	1.4) Detailed engineering & Design	$ 850,000			
	1.5) IESO Studies	$ 30,000			
	1.6) Hydro One Connection Costs	$ 750,000			
					$ 1,800,000
2)	**Major equipment**				
	2.1) Transformers	$ 6,600,000	$ 8,580,000		
	2.2) Switchgear	$ 3,000,000			
	2.3) Protection and Control	$ 700,000	$ 910,000		
	2.4) 230 kV Switches	$ 120,000	$ 156,000		
	2.5) Grounding Reactors	$ 200,000			
	2.6) DC System	$ 70,000			
	2.7) Primary Metering	$ 300,000			
	2.8) Capacitor Banks ***	$ 500,000		***	
	2.9) Feeders and ducts	$ 950,000			
	2.10) Other Equipment	$ 1,000,000	$ 1,300,000		
		.			**$ 15,966,000**
3)	**Civil Construction**				
	3.1) Mobilization	$ 75,000			
	3.2) Site Development	$ 1,500,000			
	3.3) Yard Structures	$ 150,000			
	3.4) Switchgear Building	$ 1,800,000			
	3.5) Oil Containment	$ 150,000			
	3.6) Concrete Foundations	$ 80,000			
	3.7) Fence & Stone	$ 110,000			
	3.8) Land	$ 650,000			
	3.9) Other	$ 1,000,000			
					$ 5,515,000
4)	**Electrical**				
	4.1) Grounding	$ 225,000			
	4.2) 230 kV Busswork	$ 200,000			
	4.3) Station Service	$ 200,000			
	4.4) Control Cabling	$ 210,000			
	4.5) Cable Pulling and Termination	$ 80,000			
	4.8) Commissioning	$ 150,000			
	4.9) Bell Canada Construction	$ 30,000			
	4.10) Project bonding	$ 75,000			
	4.11) Other	$ 300,000			
					$ 1,470,000
5)	**Spare Transformer**				
	5.1) Transformer	$ 3,300,000	$ 4,290,000		
	5.2) Pad/Spill Containment	$ 200,000			
	5.3) Instrumentation/Cables	$ 250,000			
	5.4) Engineering	$ 75,000			
	5.5) Installation/Commissioning	$ 100,000			
					$ 4,915,000
	Sub-Total				$ 29,666,000
	Contingency 15%				$ 4,449,900
	Total				**$ 34,115,900**

Note:
*** Capacitor banks not anticipated to be required upon TS entering service, but rather as required as station load increases.

Total (Excluding Capacitor Banks)	**$ 33,540,900**

30-Jun-15

Appendix 4

Project Schedule

Pickering Ajax Whitby IRRP

Appendix B: Transmission and Distribution Options for Meeting Near-Term Forecast Electrical Demand within the Pickering-Ajax-Whitby Sub-region

B.1 Purpose and Introduction

This document reviews the near-term need and timing for additional 27.6 kV transformation and feeder capacity required to serve growth in the Pickering-Ajax-Whitby Sub-region and identifies the technically and economically viable transmission and distribution options for meeting this need. This analysis was carried out as part of the Integrated Regional Resource Plan (“IRRP”) for the Pickering-Ajax-Whitby Sub-region

The study process considered:

- The magnitude and location of growth in electrical demand within the IRRP study area
- The capability of existing transmission and distribution facilities to meet the growth in electrical demand within the area
- The technically feasible transmission and distribution options available for meeting forecast electrical demand
- The relative cost of the transmission and distribution options

The sub-region study area is outlined in the figure below and includes the service territory of Veridian Connections Inc. (“Veridian”) and Whitby Hydro Electric Corporation (“Whitby Hydro”), with some customers in the area served by Hydro One Distribution as an embedded distributor within Veridian and Whitby Hydro facilities.

Figure 1 Pickering Ajax Whitby Study Area

Source: Data provided by Hydro One Networks Inc.

B.2 Area Supply

The main sources of transmission supply to this area are from Cherrywood TS and Whitby TS. These stations step down the voltage from 230 kV to either 44 kV or 27.6 kV distribution level voltages. The Cherrywood TS only steps down voltage to the 44 kV level, while Whitby TS steps voltage down to 27.6 kV and 44 kV levels. Only Veridian uses both voltage levels to supply its service territory, while Whitby Hydro provides distribution service at the 44 kV level. Dedicated feeders from Malvern TS and Sheppard TS also supply the western portion of

Veridian's service territory. These two stations are in the eastern part of another region-Metro Toronto.

B.3 Forecast Growth

Load forecasts used to perform this analysis were provided to the IESO by the three LDCs serving this area, Veridian, Whitby Hydro and Hydro One Distribution. The electrical demand impact of the energy based provincial conservation targets, which are outlined in the December 2013 LTEP, has been included in all planning forecasts. Uptake of DG through the FIT program and other projects has also been included. Additional information on the methodology used to prepare the net demand forecasts used in this study is available in appendix A of the IRRP.

Load growth within the overall study area is forecast to grow at an average annual rate of 2.1% over the 20-year study period, after accounting for the expected impact of provincial conservation targets and distributed generation.

- In the near term, Seaton-a greenfield development that is being planned in North Pickering with residential capacity for up to 70,000 people and 35,000 jobs, is influencing the strong growth rate mentioned above. Veridian plans to supply this community at 27.6 kV by the 2018 time period when significant development is expected to materialize. This area is currently not served by any transmission or distribution infrastructure, and is expected to fully utilize the capacity of a typical 230 / 27.6 kV step-down station over a 20-year time period.
- In the longer-term, growth is expected from the intensification and expansion of existing urban areas in downtown Pickering, Ajax, Whitby and targeted expansion of some areas such as the village of Brooklin in North Whitby. The growth targets for these municipalities are tied in part to the provincial growth targets for the Greater Golden Horseshoe and have been accounted for in the load forecasts provided by the LDCs.
- Given the nature of the near-term growth, 27.6 kV supply will be utilized leaving the remaining 44 kV capacity for serving the rural and industrial developments in the area. There is adequate 44 kV capacity to meet the growth needs of the area until the end of the study period.
- The highlighted area in Figure 2 shows the approximate geographic locations of the Seaton community relative to the local transmission infrastructure.

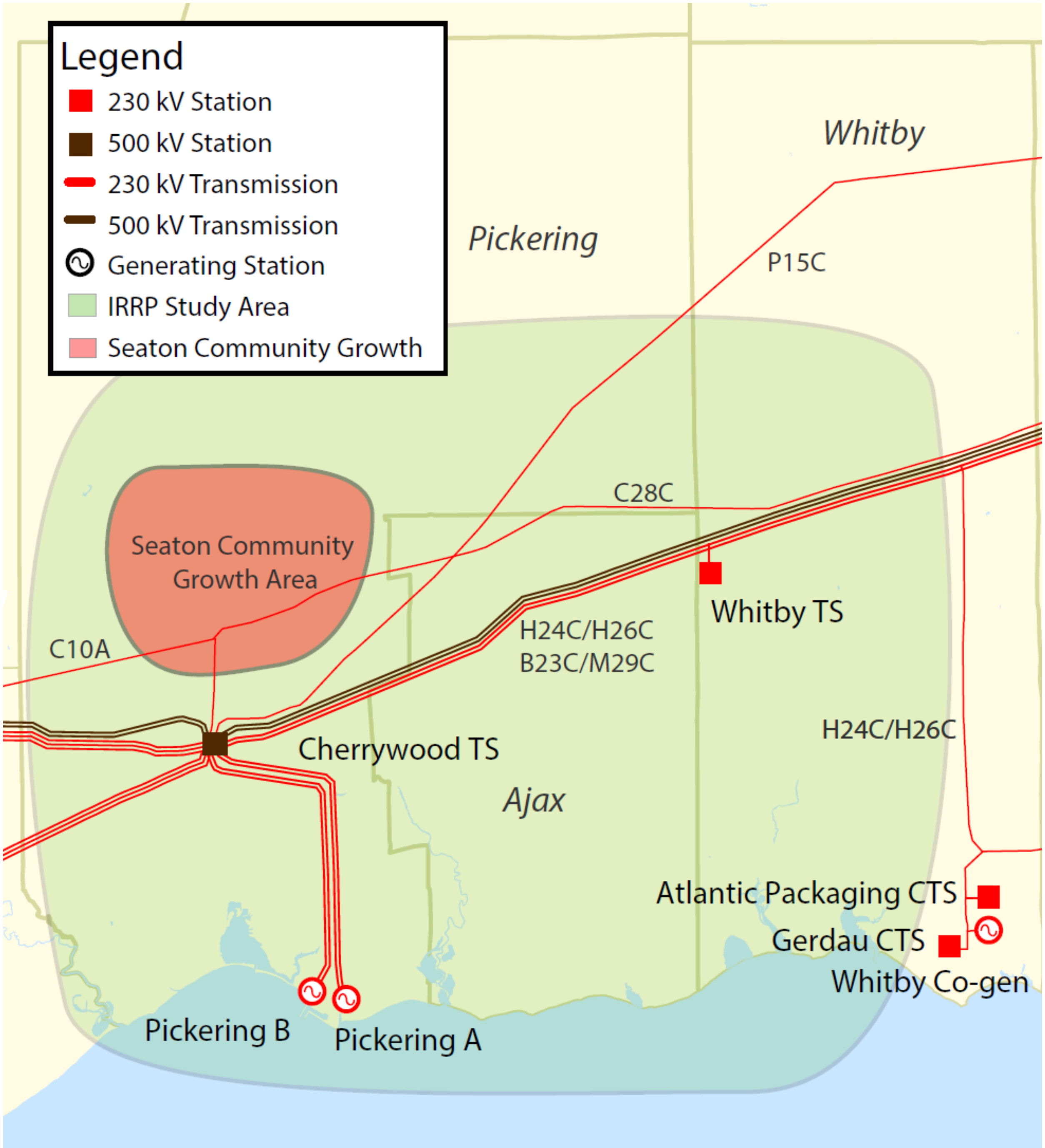

Figure 2 Growth Area

Source: Data provided by Hydro One Networks Inc.

B.4 Near Term Needs

Based on the planning forecast being used in this analysis, the capacity of the 230/27.6 kV transformers serving the sub-region is expected to be exceeded in 2019 (Figure 3). Sufficient 44 kV capacity exists in the study area to supply 44 kV demand until the end of the study period.

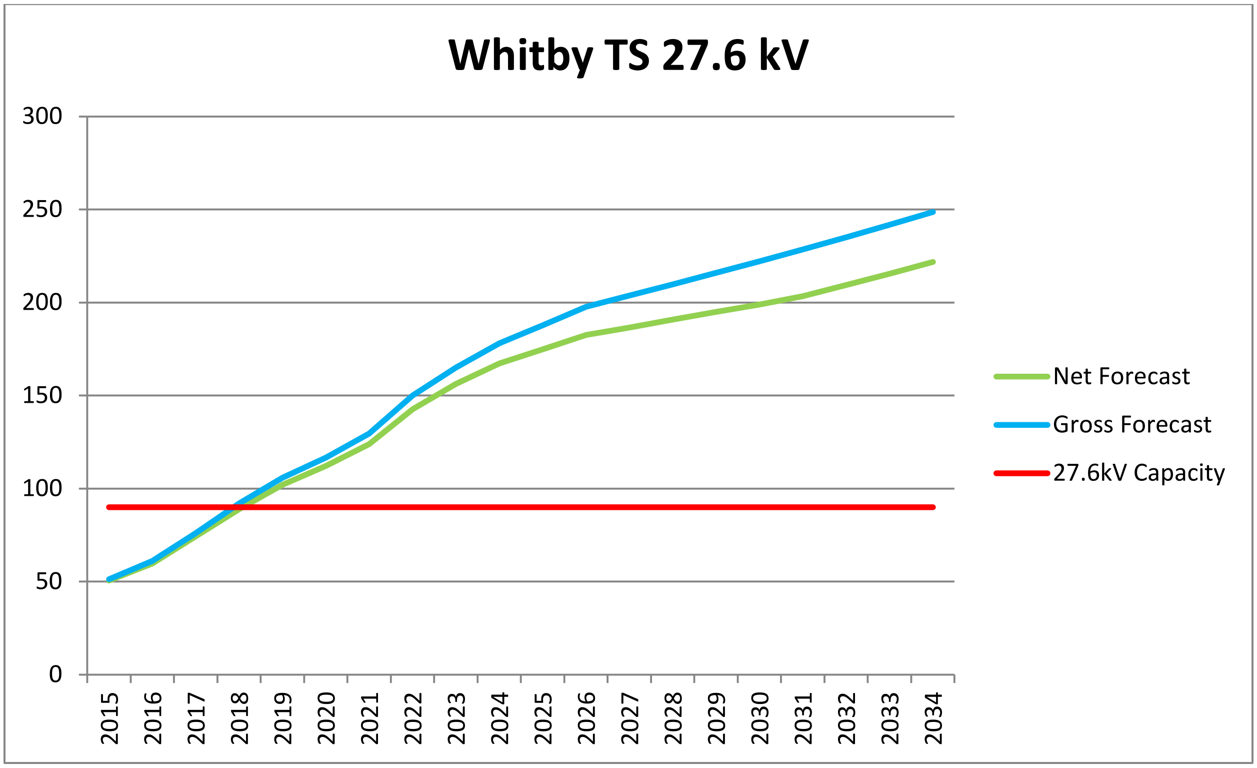

Figure 3 Whitby TS 27.6 kV Capacity

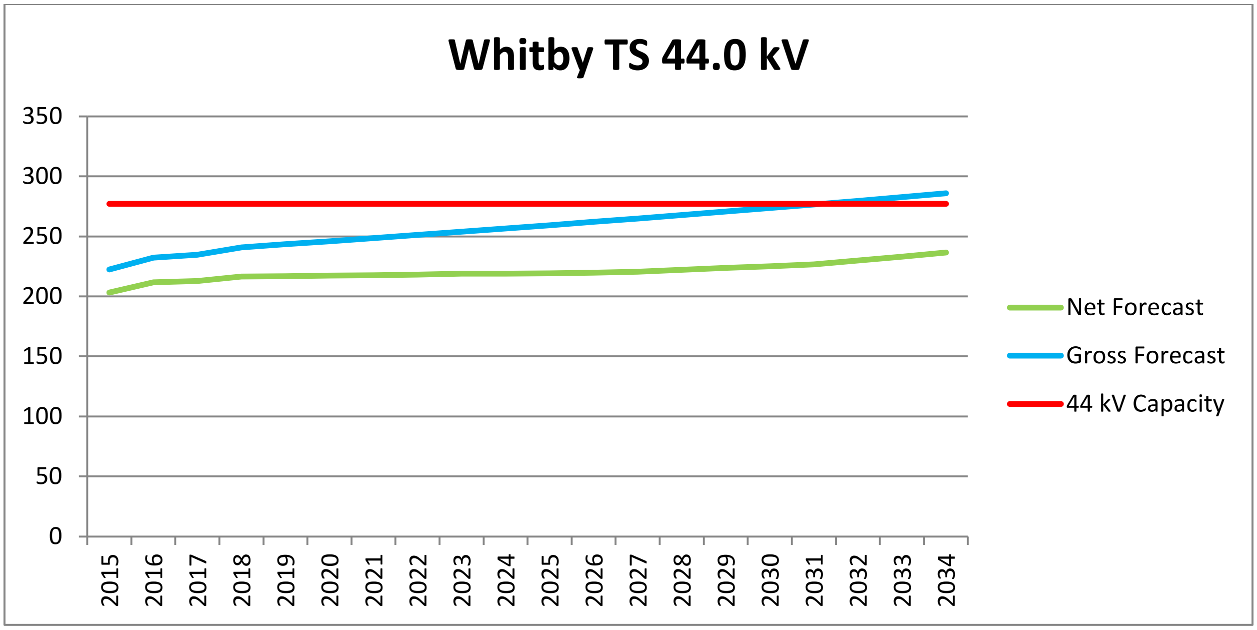

Figure 4 Whitby TS 44 kV Capacity

The 10 year forecast for 27.6 kV demand in the area is shown in the table below, with demand exceeding available capacity highlighted in red:

BY bus LTR (MW)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
90	51	60	74	89	102	112	124	143	156	167

Table 1 Whitby TS 27.6 kV loading and expected growth (MW) to 2024

Incremental 27.6 kV capacity of approximately 12 MW will be needed by 2019 increasing to approximately 132 MW by 2034 at the end of the study period. The majority of this 27.6 kV growth from 2018 onwards is due to the expected demand from the new community of Seaton. This community is forecast by 2034 to have a gross electricity demand of 160 MW, reduced to approximately 142 MW of demand after considering the impacts of conservation and DG.

Given the near-term nature of this need, this report provides a detailed planning analysis of the technically feasible transmission and/or distribution alternatives for meeting the area's 27.6 kV capacity shortfall.

The following sections analyze the technical and economic feasibility of transmission and distribution options in the sub-region. The options include building feeders from an existing step-down transformer station ("TS") having incremental capacity, the incorporation of new step-down stations, and combinations of these options.

B.5 Near-Term Supply Options

Provide additional 27.6 kV supply from existing Transformer Stations

Generally speaking, where technically and economically feasible, distribution transfers can be used on a short- or long-term basis to supply load growth from existing TSs that have available capacity. Currently, no incremental 27.6 kV capacity is available at the existing stations within the sub-region. However, two stations within the adjacent Metro Toronto Region-Sheppard and Malvern TS that already provides supply to Veridian customers are forecast to have incremental 27.6 kV transformation capacity available. Therefore new feeders from these existing stations were investigated as alternatives for providing the needed 27.6 kV capacity to the area.

Sheppard 230/27.6 kV TS:

Sheppard TS is a station in Metro Toronto that is already utilized by Veridian. Current estimates show that approximately 25 MW of 27.6 kV supply capacity is available at this station until the end of the study period. Geographically, this station is approximately 11 km west of the near-term growth area and it is technically feasible to supply the growth area from this station. This station is included in the economic analysis to meet the near-term need for additional 27.6 kV capacity in the study area.

Malvern TS 230/27.6 kV TS:

Malvern TS is a 230/27.6 kV station in Metro Toronto that is already utilized by Veridian. Current estimates show that approximately 60 MW of supply capacity is available at this station until the end of the study period. Geographically, this station is approximately 12 km south west of the near-term growth area and it is technically feasible to supply the growth area from this station. This station is included in the economic analysis to meet the near-term need for 27.6 kV capacity in the study area.

As both these stations only provide a portion (85 MW) of the total incremental 27.6 kV capacity (132 MW) that will be required by 2034, they will be considered as part of a staged wires based solution that can meet the entire capacity need.

Provide additional 27.6 kV supply from a new Transformer Station in the sub-region

New step-down station 230/27.6 kV:

Another option is to provide a new (75/125 MVA) 230/27.6 kV station in the vicinity of the growth area to meet the incremental 27.6 kV demand. Figure 5 shows the locations of the three station sites undergoing an Environmental Assessment. Sites 1 and 2 are the closest to the load centre while Site 3 is the furthest away. This analysis considers building feeders from Site 3 to the approximate load centre which for study purposes is assumed to be at Site 2 as it is closest to the load centre and feeders from other 27.6 kV supply stations, and closest to the transmission supply.

This option is included in the economic analysis to meet the near-term need for 27.6 kV capacity in the sub-region.

Figure 5 shows the relative locations of Sheppard TS and Malvern TS to the new growth area in North Pickering and the prospective sites for a new station within the community of Seaton (outlined in pink).

Figure 5 Locations of Alternative Sources of 27.6 kV Supply

Source: Data provided by Hydro One Networks Inc.

B.6 Transmission and Distribution Infrastructure Alternatives

Eight potential supply alternatives were developed for providing the capacity needed to meet the near-term growth in the area and are summarized in the table below. These alternatives were a combination of the feeder and station options presented in the previous section. The years that assets will need to be in service in order to serve the load for each alternative are also shown in Table 2 below:

Alternatives	Alternative Details and Need Date
1. Use Malvern TS capacity and build Seaton TS-1 or 2	-Build Feeders 1&2 (2019) -Build Feeders 3&4 (2021) -Build Seaton TS (2023)
2. Use Malvern TS capacity and build Seaton TS-3 and associated feeders	-Build Feeders 1&2 (2019) -Build Feeders 3&4 (2021) -Build Seaton TS and Feeders 1&2 (2023) -Build Feeders 3&4 (2026) -Build Feeders 5&6 (2033)
3. Use Sheppard TS capacity and build Seaton TS-1 or 2	-Build Feeders 1&2 (2019) -Build Seaton TS (2021)
4. Use Sheppard TS capacity and build Seaton TS-3 and associated feeders	-Build Feeders 1&2 (2019) -Build Seaton TS and Feeders 1&2 (2021) -Build Feeders 3&4 (2023) -Build Feeders 5&6 (2025) -Build Feeders 7&8 (2032)
5. Use Sheppard TS capacity, then use Malvern TS capacity, then build Seaton TS-1	-Build Feeders 1&2 (2019) -Build Feeders 1&2 (2021)

or 2	-Build Feeders 3&4 (2023) -Build Seaton TS (2026)
6. Use Sheppard TS capacity, then use Malvern TS capacity, then build Seaton TS-3 and associated feeders	-Build Feeders 1&2 (2019) -Build Feeders 1&2 (2021) -Build Feeders 3&4 (2023) -Build Seaton TS and Feeders 1&2 (2026) -Feeders 3&4 (2032)
7. Build Seaton TS- 1 or 2	-Build Seaton TS (2019)
8. Build Seaton TS-3 and associated feeders to load area	-Build Seaton TS and Feeders 1&2 (2019) -Build Feeders 3&4 (2021) -Build Feeders 5&6 (2023) -Build Feeders 7&8 (2026) -Build Feeders 9&10 (2033)

Table 2 Alternatives and need dates

Additional Details:

- A forecast net of conservation and distributed generation has been used in order to determine magnitude and timing of need.
- Two feeders will be built when a capacity need is triggered.
- Feeders are assumed to provide a maximum of 15.5 MW capacity.
- Feeders from Malvern TS will follow transmission right of way until Whites Rd, and then run North on Whites Rd, and East on to Taunton Rd to the load centre.
- Feeder losses were calculated using typical 27.6 kV conductor specifications.
- Planning level feeder construction and station costs were provided by Veridian.

- Planning level transmission line costs were provided by Hydro One Networks Inc.

B.7 Economic Comparison of Alternatives

To compare alternatives based on cost to the ratepayer[1], an economic assessment was performed. The evaluation present valued costs to 2016, considering a 45-year study period – 2019 to 2063 (based on the first replacement decision across all six alternatives; transmission station assets assume a 45-year life). Table 3 and Table 4 summarize the main cost assumptions considered in the evaluation of each alternative (planning level estimates in 2014$ Canadian). All investments were converted to a real annual levelized cost (including on-going annual costs), spread across the asset's assumed life, and only levelized costs falling within the study period were considered. This approach credits value to assets whose life ends beyond the study period (terminal value credit). Table 5 summarizes the net present value results of the six alternatives (in 2016$ Canadian).

The tables below summarize the major economic assumptions used for this analysis:

Cost Breakdown	Malvern TS ($M)	Sheppard TS ($M)
Breaker position at TS	2	2
Feeders to overhead risers	0.4	0.4
Double circuit 28 kV wood pole construction ($0.2M/km) [2]	2.47-2.85	2.26-2.65
Cost adder-off road construction	0.40-0.80	0.40-0.80

[1] Ratepayer Perspective is defined as the viewpoint of the end-use electricity consumer. It includes residential, commercial, and industrial customers within Ontario, and in terms of economics, ratepayer perspective includes costs that flow to bills for their consumption of electricity.

[2] Costs are per pair of feeders-Veridian's deck dated July 2014

Engineering (10% of construction cost)	0.53-0.61	0.51-0.58
Contingency 10%-25%	0.58-1.66	0.56-1.61
Annual Feeder losses	0.36-0.42	0.22-0.25
TOTAL[3] [4] ($M)	**6.37-8.32**	**6.13-8.04**

Table 3 Capital and On-Going Annual Costs for Malvern and Sheppard TS

[3] Total Feeder costs in table above excludes Feeder losses, those are NPV'd separately and added to the feeder costs in the Results section

[4] The total cost shown is dependent on the contingency percentage, off –road construction cost adder and the distances to sites 1 and 2.

Cost Breakdown	Build Seaton TS – Site 1 ($M)	Build Seaton TS – Site 2 ($M)	Build Seaton TS-Site 3 ($M)	Build Feeders to Site 2 from Site 3 ($M) [5]
Feeders to overhead risers	2.40	2.40	2.40	n/a
Double circuit 28 kV wood pole construction ($0.2M/km)	n/a			6.46
Engineering (10% of construction costs)	n/a			0.65
Contingency costs	Included in cost of station			0.71-1.78
Connecting preferred station Site to the transmission system[6]	15	10	8	n/a
Annual	n/a			0.19

[5] Used the same feeder costs as provided by Veridian's consultant excluding off-road construction costs
[6] Transmission connection costs from Sites 1&2 Hydro One December 2015; connection cost for Site 1 from Veridian

feeder losses				
Build 230/28 kV station 170 MVA[7]	25.56			n/a
TOTAL ($M)	**42.96**	**37.96**	**35.96**	**8.01-9.09**

Table 4 Capital and On-Going Annual Costs for Seaton TS Sites

Alternative 1, Malvern TS Feeders 1&2 (2019) + Malvern TS Feeders 3&4 (2021) + Seaton TS 1 or 2 and associated 230 kV line (2023):

This alternative considers building a pair of feeders from Malvern TS to be in service for 2019, followed by the second pair in service for 2021. These four feeders will provide a collective capacity of 60 MW. Additional capacity will be needed in 2023 and will be provided by Seaton TS, built at Sites 1 or 2.

Alternative 2, Malvern TS Feeders 1&2 (2019) + Malvern TS Feeders 3&4 (2021) + Seaton TS 3 and associated 230 kV line and Feeders 1&2 (2023) +Feeders 3&4 (2026) +Feeders 5&6 (2033):

This alternative considers building a pair of feeders from Malvern TS to be in service for 2019, followed by the second pair in service for 2021. These four feeders will provide a collective capacity of 60 MW. Additional capacity will be needed in 2023 and will be provided by Seaton TS, built at Site 3 and the associated 230 kV supply line and 6 feeders to the load centre over the study period with a pair being built every time a capacity need is triggered.

Alternative 3, Sheppard TS Feeders 1&2 (2019) + Seaton TS 1 or 2 and associated 230 kV line (2021)

This alternative considers building a pair of feeders from Sheppard TS to be in service for 2019, providing a total capacity of 25 MW. Additional capacity will be needed in 2021 and will be provided by Seaton TS, to be built at Sites 1 or 2.

[7] Station costs from Veridian-November 2015

Alternative 4, Sheppard TS Feeders 1&2 (2019) + Seaton TS 3 and associated 230 kV line and Feeders 1&2 (2021) +Feeders 3&4 (2023) + Feeders 5&6 (2025) + Feeders 7&8 (2032)

This alternative considers building a pair of feeders from Sheppard to be in service for 2019, providing a total capacity of 25 MW. Additional capacity will be needed in 2021 and will be provided by Seaton TS, built at Site 3 and the associated 230 kV supply line and 8 feeders to the load centre over the study period with a pair being built every time a capacity need is triggered.

Alternative 5, Sheppard TS Feeders 1&2 (2019) + Malvern TS Feeders 1&2 (2021) + Feeders 3&4 (2023) + Seaton TS 1 or 2 and associated 230 kV line (2026)

Alternative 5 considers utilizing the entire surplus 26.6 kV capacity that is available at Sheppard TS and Malvern TS and meeting the remaining capacity need with a new station at either Sites 1 or 2.

Alternative 6, Sheppard TS Feeders 1&2 (2019) + Malvern TS Feeders 1&2 (2021) + Feeders 3&4 (2023) + Seaton TS 3 and associated 230 kV line and Feeders 1&2 (2026) + Feeders 3&4 (2032)

Alternative 6 considers utilizing the entire surplus 26.6 kV capacity that is available at Sheppard TS and Malvern TS and meeting the remaining capacity need with a new station at either Sites 3 and associated feeders to the load centre.

Alternative 7, Seaton TS Site 1 or 2 associated 230 kV supply line (2019)

This alternative considers building a new station near the load centre at Sites 1 or 2 in 2019 when incremental 27.6 kV transformation and distribution capacity is needed in the area.

Alternative 8, Seaton TS at Site 3 and associated 230 kV supply line +Feeders 1&2 (2019)+Feeders 3&4 (2021) + Feeders 5&6 (2023) + Feeders 7&8 (2026) +Feeders 9&10 (2033)

This alternative considers building the new station at Site 3, the associated 230 kV supply line and 10 feeders to the load centre with a pair being built every time a capacity need is triggered. Additionally 8 of these feeders are assumed to be above ground (4 on each side of a road), while the remaining 2 will be underground.

The table below summarizes the total costs for each alternative:

Table 5 Net Present Value Range for Seaton Alternatives

Alternatives	2016 $M
1. Use Malvern TS capacity and then build Seaton TS at Site 1 or 2	93-109
2. Use Malvern TS capacity and build Seaton TS as Site 3 and associated feeders	104-119
3. Use Sheppard TS capacity and then build Seaton TS-1 or 2	73-84
4. Use Sheppard TS capacity and then build Seaton TS-3 and associated feeders	91-102
5. Use Sheppard TS capacity, then use Malvern TS capacity, then build Seaton TS-1 or 2	105-124
6. Use Sheppard TS capacity, then use Malvern TS capacity, then build Seaton TS-3 and associated feeders	113-130
7. Build Seaton TS-1 or 2	60-68
8. Build Seaton TS-3 and associated feeders	94-108

The results in Table 5 demonstrate that the most economic alternative for providing near-term 27.6 kV capacity to the area is to build a new 75 /125 MVA- 230 / 27.6 kV TS at Sites 1 or 2, to be in service for 2019. A new TS near the load centre would result in highest relative reliability given the much shorter feeder distances. Additionally, this option also avoids the approval challenges of building several distribution feeders through a national park-Rouge Valley Urban National Park.

Should Site 3 be selected through the EA process, more detailed technical and economic analysis[8] is required to determine if a new station should be built only versus building feeders from the Malvern or Sheppard stations followed by a new station.

B.8 Conclusion

A new 75 /125 MVA- 230 / 27.6 kV TS at Sites 1 or 2, connected to transmission line C28C[9] to be in service for 2019, is the most cost-effective option to meet the need for additional 27.6 kV capacity in the sub-region.

The analysis was conducted assuming a 2019 in service date. However, given the uncertainty associated with the load forecast, which depends on fully meeting local conservation targets, working group members believe that it is prudent to target a 2018 in service date for the new step-down station. As part of implementation Veridian will monitor growth and adjust the station in-service date accordingly.

[8] Further analysis is recommended due to the similar range of costs of the two alternatives-Station at Site 3 or Building feeders from existing stations followed by a station at Site 3

[9] Currently C28C is a 230 kV single circuit and would need to be modified to 230 kV double circuit for a limited amount of length in order to connect the new station to the power system

Appendix 3 - Public Consultation Schedule for Seaton TS

Item	Existing Schedule Date (Before Veridian Board Meeting)	Revised Schedule (After Veridian Board Meeting)
FN&M Community Notification Letters to be Sent	Week of August 15	September 23, 2016
Letters to Municipal Officials	Week of August 29	October 7, 2016
Agencies, Municipal Planner Notification Letters to be Sent	Week of September 12	Week of October 17, 2016
Property Owner Notification Letters to be Sent		
Newspaper Ad (Updated Notice of Commencement & PIC)		
PIC#1: Updated review of project	Week of September 26	Week of October 31
Send partially completed Draft of the Draft ESR to MOECC, IO and Conservation Authority	Week of January 30, 2017	Week of January 30, 2017
Notification Letters to be sent for PIC #2	Week of January 16, 2017	Week of February 6, 2017
Newspaper Ad for PIC #2		
PIC #2: Present Preferred site for transformer station and associated lines connection	Week of January 30, 2017	Week of February 20, 2017
Send completed Draft of the Draft ESR to MOECC, IO and Conservation Authority	Week of February 20, 2017	Week of February 20, 2017
Notification for the 30- day ESR review and comment period	Week of February 27, 2017	Week of March 13, 2017
30-day ESR Review Period	Week of March 13, 2017- April 20, 2017	April 2- May 2, 2017
Submission of ESR to MOECC	TBD	TBD

Appendix 4

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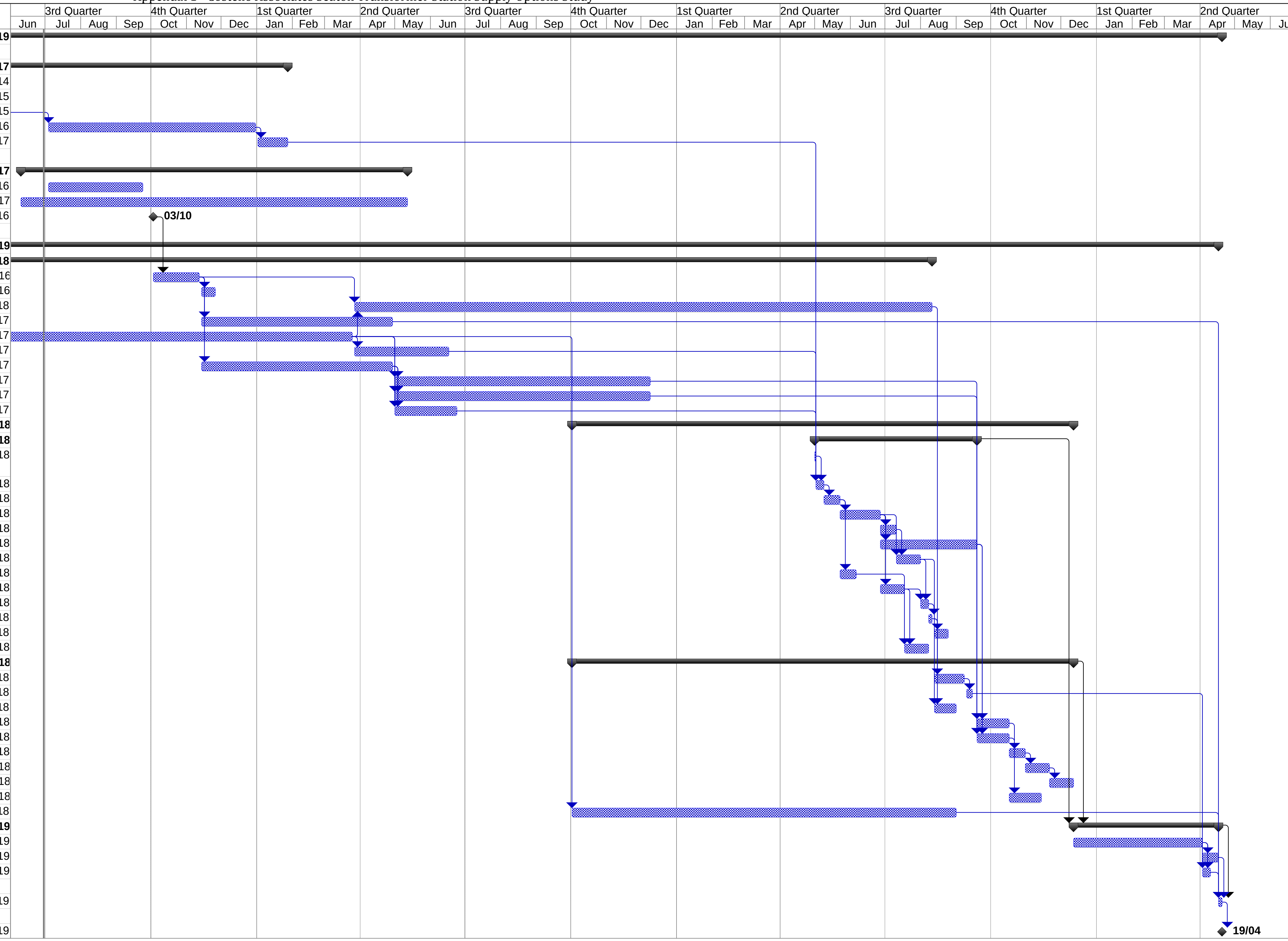
ID		Task Name	Duration	Start	Finish
1		**Veridian Connections Self-build Option**	**1355 days?**	**Mon 10/02/14**	**Fri 19/04/19**
2					
3		**Hydro One Coordination**	**775 days**	**Mon 10/02/14**	**Fri 27/01/17**
4		Request meeting with planners	3 wks	Mon 10/02/14	Fri 28/02/14
5		Make application for new connection	1 wk	Fri 20/02/15	Thu 26/02/15
6		Submit load forecast, historical data	1 wk	Fri 27/02/15	Thu 05/03/15
7		Prepare estimate and CCRA	6.5 mons	Mon 04/07/16	Fri 30/12/16
8		Review and sign CCRA	1 mon	Mon 02/01/17	Fri 27/01/17
9					
10		**LDC Misc. Tasks**	**240 days?**	**Fri 10/06/16**	**Thu 11/05/17**
11		RFP for Engineer/Architect	3 mons	Mon 04/07/16	Fri 23/09/16
12		Coordinate Land Acquisition with IO	12 mons?	Fri 10/06/16	Thu 11/05/17
13		Veridian Board Approval to Proceed with Project	0 days	Mon 03/10/16	Mon 03/10/16
14					
15		**Engineering & Construction**	**857 days**	**Mon 04/01/16**	**Tue 16/04/19**
16		**Engineering**	**680 days**	**Mon 04/01/16**	**Fri 10/08/18**
17		Preliminary Engineering	6 wks	Mon 03/10/16	Fri 11/11/16
18		Prepare detailed budget	2 wks	Mon 14/11/16	Fri 25/11/16
19		Order Transformers	18 mons	Mon 27/03/17	Fri 10/08/18
20		IESO Preliminary Impact Assessment Study	6 mons	Mon 14/11/16	Fri 28/04/17
21		Class EA	16 mons	Mon 04/01/16	Fri 24/03/17
22		Site acquisition	3 mons	Mon 27/03/17	Fri 16/06/17
23		Detailed Engineering	6 mons	Mon 14/11/16	Fri 28/04/17
24		Order Switchgear	8 mons	Mon 01/05/17	Fri 08/12/17
25		Order P&C Panels	8 mons	Mon 01/05/17	Fri 08/12/17
26		Tender Civil/Structural works	2 mons	Mon 01/05/17	Fri 23/06/17
27		**Construction Activities**	**312 days**	**Mon 02/10/17**	**Tue 11/12/18**
28		**Civil**	**101 days**	**Tue 01/05/18**	**Tue 18/09/18**
29		Earliest Start Date for Spring 2019 Energization	1 day	Tue 01/05/18	Tue 01/05/18
30		Mobilize	5 days	Wed 02/05/18	Tue 08/05/18
31		Grading	10 days	Wed 09/05/18	Tue 22/05/18
32		Building foundation	25 days	Wed 23/05/18	Tue 26/06/18
33		Yard foundations	10 days	Wed 27/06/18	Tue 10/07/18
34		Switchgear and Control Building	3 mons	Wed 27/06/18	Tue 18/09/18
35		Oil containment / Tx Piers	3 wks	Wed 11/07/18	Tue 31/07/18
36		Deep Services	2 wks	Wed 23/05/18	Tue 05/06/18
37		Feeder Duct Banks	3 wks	Wed 27/06/18	Tue 17/07/18
38		Grounding - sub-surface	1 wk	Wed 01/08/18	Tue 07/08/18
39		Final Grading	3 days	Wed 08/08/18	Fri 10/08/18
40		Roadways	2 wks	Mon 13/08/18	Fri 24/08/18
41		Fencing	3 wks	Wed 18/07/18	Tue 07/08/18
42		**Electrical**	**312 days**	**Mon 02/10/17**	**Tue 11/12/18**
43		HV Switches & Busswork	4 wks	Mon 13/08/18	Fri 07/09/18
44		Primary Metering	1 wk	Mon 10/09/18	Fri 14/09/18
45		Place, Dress, Fill Transformers	3 wks	Mon 13/08/18	Fri 31/08/18
46		Install Switchgear	4 wks	Wed 19/09/18	Tue 16/10/18
47		Install P&C Panels	4 wks	Wed 19/09/18	Tue 16/10/18
48		Install Scada	2 wks	Wed 17/10/18	Tue 30/10/18
49		Install DC Systems	3 wks	Wed 31/10/18	Tue 20/11/18
50		Grounding	3 wks	Wed 21/11/18	Tue 11/12/18
51		Pull feeder cables & terminate	4 wks	Wed 17/10/18	Tue 13/11/18
52		Hydro One Transmission Line Construction	12 mons	Mon 02/10/17	Fri 31/08/18
53		**Commissioning & Acceptance**	**90 days**	**Wed 12/12/18**	**Tue 16/04/19**
54		Station commissioning 3rd Party	4 mons	Wed 12/12/18	Tue 02/04/19
55		Witness Testing by Hydro One	2 wks	Wed 03/04/19	Tue 16/04/19
56		IESO Metering Verification with MSP	1 wk	Wed 03/04/19	Tue 09/04/19
57					
58		Connection Authorization by IESO	3 days	Wed 17/04/19	Fri 19/04/19
59					
60		Energization	0 days	Fri 19/04/19	Fri 19/04/19



Project: Veridian Connections MTS #1 Self-Build Option

Task	Summary	External MileTask	Inactive Summary	Manual Summary Rollup	Finish-only
Split	Project Summary	Inactive Task	Manual Task	Manual Summary	Progress
Milestone	External Tasks	Inactive Milestone	Duration-only	Start-only	Split