RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2. 2

INTERROGATORY 28:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Page 5 Lines 9-17 discuss outages of rear lot overhead lines. Lines 12-13 state that "Typical outage restoration times for rear lot plant outages are more than twice those of front lot outages".

Does this statement assume overhead in both rear lot and front lot? If not, please explain what is being compared.

RESPONSE:

THESL is revising the cited reference and modifying Figure 1 that follows to clarify the information presented. The changes and modified Figure 1 are provided below with changes noted in red. The changes, however, do not impact the quoted statement. That statement refers to the comparison of the average CAIDI for a sample of rear lot outages, which contain a mix of overhead and underground service, compared to the system average CAIDI, which also represents a mix of overhead and underground service as discussed in Tab 4, Schedule B6, page 7 at lines 17-22. The reasons for this difference are explained throughout Tab 4, Schedule B6 in terms of the difficulties in working on rear lot equipment. In particular, pages 28-29 of Tab 4, Schedule B6 describe some of the extremely long duration outages experienced by customers with rear lot service.

<u>Revised Evidence</u>

If no action is taken, outages, safety risks, and costs resulting from rear lot equipment will likely accelerate to unacceptable levels. In addition to the acceleration in failure rates of the rear lot equipment, studies have shown that underground assets are more

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2. 2

reliable and reduce maintenance costs compared to their overhead counterparts.[1] Typical outage restoration times for rear lot plant outages are more than twice those of front lot outages. Thus, customers supplied via the rear lot may experience outage durations that are much longer than normal. Additionally, the likelihood of an outage occurring on the overhead system is significantly higher. The Figure below compares the frequency of outages per meter of rear lot overhead service with the frequency of outages per meter of rear lot underground service.

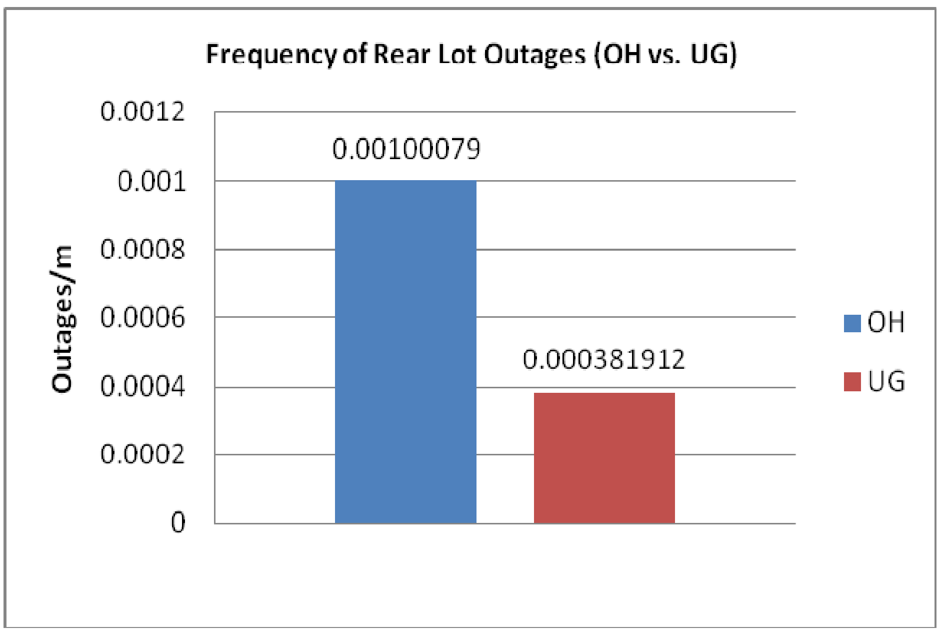

Figure 1 – Outage Frequency for Rear Lot Overhead and Underground Service

[1] Fenrick, S. A. and Lullit Getachew. "Cost and Reliability Comparisons of Underground and Overhead Power Lines". *Utilities Policy*, Volume 20, Issue 1, March 2012, pages 31-37.

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

INTERROGATORY 29:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Line 15 on Page 5 states that "the likelihood of an outage is significantly higher" with rear lot construction and refers to Figure 1 on Page 6. This figure shows Typical outages of overhead construction versus underground construction.

a) What does the Percent of System axis measure?

b) Are the outages in terms of frequency, duration or both?

RESPONSE:

a) and b)

In response to EP interrogatory 28 (Tab 6F, Schedule 7-28), THESL has provided a modified figure to replace Figure 1 on page 6. The questions in these parts are no longer applicable to the modified figure.

c) What is the average frequency and duration of outages for residential overhead distribution in THESL's system?

RESPONSE:

c) Overhead feeders serve a mix of residential and non-residential customers. THESL does not track the frequency and duration of outages by customer class. The average frequency and duration of outages for all customers with overhead service in 2011 was 0.596 frequency and 0.65 hours (duration).

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

d) What is the average frequency and duration of outages for residential U/G distribution in THESL's system? Does this include or exclude the effect of an O/H main feeder outage that supplies the U/G system?

RESPONSE:

d) Underground feeders serve a mix of residential and non-residential customers. THESL does not track the frequency and duration of outages by customer class. The average frequency and duration of outages for all customers with underground service in 2011 was 0.346 frequency and 0.37 hours (duration).

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INTERROGATORY 30:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Lines 11-16 on Page 6 and 1-22 on Page 7 describe the specific reasons for undertaking rear lot conversion. The first category is Operational Constraints on Page 6.

a) Has THESL investigated the use of sectional fibre glass or composite poles that can be more easily carried into backyards and assembled in place? Would this mitigate the safety issue of field crews carrying heavier full length wood poles into backyards and the issue of limited manoeuvring room for full length poles in backyards?

RESPONSE:

a) THESL has investigated the use of sectional composite poles. Crew safety would remain an issue since there would still be restricted access and restricted available space in backyards of customer premises for the crews to assemble and set the poles. Risks due to slips, trips, and falls would still remain due to limited working space and difficult access (e.g., ice, snow and obstructions) compared to that typically afforded in a front lot installation. These potential safety risks are particularly prominent when restoration work is undertaken at night time and in winter months.

b) Has THESL considered using compact backhoes capable of accessing rear lots and digging pole holes in confined areas to set poles? If not why not?

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RESPONSE:

b) THESL has not considered this since many of the safety issues discussed above and in the evidence will necessarily persist as long as rear lot service continues. Furthermore, even compact backhoes may not be able to achieve access due to obstructions on customer property such as landscape, fences, gates, sheds, and pools.

c) Has THESL attempted to develop compact equipment capable of transporting heavy assets such as transformers into backyards? If not why not?

RESPONSE:

c) THESL uses compact equipment such as dollies where practical. Due to varying locations of outages and depending on layout and obstructions at the customer premises, use of this equipment is not possible in all cases.

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INTERROGATORY 31:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Lines 11-16 on Page 6 and 1-22 on Page 7 describe the specific reasons for undertaking rear lot conversion. The second category is asset condition on Page 7.

a) Do THESL's easements give it the right to access backyards to maintain plant and control vegetation that might grow into equipment? If yes, has THESL regularly done this kind of maintenance? If not, why not?

RESPONSE:

a) Yes. THESL does asset maintenance as required and schedules tree trimming as per THESL's tree trimming model.

b) Please provide a copy of the typical easement agreement THESL has with rear lot fed customers (with appropriate redactions to eliminate personal information where necessary).

RESPONSE:

b) Please see a sample of a typical easement agreement THESL has with rear lot fed customers provided as Attachment A to this Schedule (Rear Lot Easement Document).

THIS AGREEMENT made in duplicate this 9th day of November, A.D. 1960.

B E T W E E N:

[redacted]

hereinafter called the "GRANTOR"

OF THE FIRST PART:

- and -

THE HYDRO-ELECTRIC COMMISSION OF THE TOWNSHIP OF NORTH YORK

hereinafter called the "COMMISSION"

OF THE SECOND PART:

WHEREAS the Grantor is the owner in fee simple and in possession of the land described in Schedule "A" hereto.

AND WHEREAS the Commission has erected, or is about to erect a wood pole line, together with the necessary wires, cables, and accessories for the transmission of electrical energy on this land.

NOW THIS INDENTURE WITNESSETH that in consideration of other good and valuable consideration and the sum of TWO AND 00/100 ($2.00) DOLLARS of lawful money of Canada, now paid by the Commission to the Grantor, the receipt whereof is hereby acknowledged, the Grantor HEREBY GRANTS AND CONVEYS to the Commission, its successors and assigns, the free, uninterrupted right and easement in perpetuity:

(a) To enter on and construct, maintain, repair, replace and operate on the lands described in Schedule "A" herein Poles, Transformers and Anchors, with guys and braces and to string wires, cables and accessories thereon (all or any of which works are herein called "the line");

(b) To keep the land for a distance of five feet (5') on each side of the centre line of the pole (herein called the strip) clear of all trees and brush, and to cut or trim from time to time such trees outside the strip as the Commission may consider necessary for the safe and efficient operation of the line;

(c) For the servants, agents, contractors and workmen of the Commission, at all times to pass and repass with any equipment along the strip to examine, repair and renew the line;

2. THE GRANTOR COVENANTS and agrees not to erect on the strip any buildings, structures or other obstructions of any nature whatsoever.

3. THE GRANTOR COVENANTS with the Commission that it has the right to convey the easement over the said land, and that the Commission shall quietly possess and enjoy the said easement, and that it will execute such further assurances of the said easement as may be requisite.

4. All the covenants herein contained shall be construed to be several as well as joint, and wherever the singular is used in this Grant of Easement, the same shall be construed as including the plural where the context or the parties hereto so require.

5. The burden and benefit of this Grant of Easement shall run with the land, and shall extend to, be binding on and enure to the benefit of the parties hereto and their respective successors and assigns.

IN WITNESS WHEREOF the Grantor has hereunto affixed its Corporate Seal under the hands of its proper officers duly authorized in that behalf.

[redacted]

SCHEDULE "A" REFERRED TO IN THE WITHIN GRANT OF EASEMENT BETWEEN [redacted] AND THE HYDRO-ELECTRIC COMMISSION OF THE TOWNSHIP OF NORTH YORK DATED THE 9TH DAY OF NOVEMBER, A.D. 1960.

FIRSTLY:

ALL AND SINGULAR that certain parcel or tract of land and premises situate, lying and being in the Township of North York, in the County of York and Province of Ontario, and being composed of part of Block E as shown on a plan filed in the Registry Office for the Registry Division of the East and West Riding of the County of York as Number 4545. The said parcel is composed of a strip of land 10.00 feet in width lying 5.00 feet in perpendicular width on either side of a centre line and centre line produced, which said centre line may be described as follows:

PREMISING that all bearings used herein are referred to the North Eastern limit of said Block E, assumed to have a bearing of North 38° 00'00" West in accordance with said Registered Plan 4545;

COMMENCING at a point in the interior of said Block E, which may be located by beginning at a point in the South Eastern limit of said Block E, distant 88.00 feet South Westerly therein from the Easterly angle thereof;

THENCE NORTH 38° 00'00" West, parallel to said North Eastern limit of Block E, 21.67 feet to the point of commencement of the ~~lands~~ herein described centre line;

THENCE NORTH 55° 44' 00" East, 88.18 feet more or less to a point in said North Eastern limit of Block E, distant 15.96 feet North Westerly therein from the Easterly angle thereof.

Being the land ~~outlined~~ edged in blue on a print of survey prepared by Marshall, Macklin and Monaghan, O.L.S. dated the 24th day of October, 1960 and hereunto annexed.

SECONDLY:

ALL AND SINGULAR that certain parcel or tract of land and premises situate, lying and being in the Township of North York, in the County of York and Province of Ontario, and being composed of part of Block E as shown on a plan filed in the Registry Office for the Registry Division of the East and West Riding of the County of York as Number 4545. The said parcel is composed of a strip of land 10.00 feet in width lying 5.00 feet in perpendicular width on either side of a centre line and centre line produced, which said centre line may be described as follows:

PREMISING that all bearings used herein are referred to the North Eastern limit of said Block E, assumed to have a bearing of North 38° 00' 00" West in accordance with said Registered Plan 4545;

COMMENCING at a point in the interior of said Block E, which may be located by beginning at a point in the South Eastern limit of said Block E, distant 88.00 feet South Westerly therein from the Easterly angle thereof;

THENCE NORTH 38°00' 00" West, parallel to said North Eastern limit of Block E, 21.67 feet to the point of commencement of the ~~lands~~ herein described centre line;

THENCE SOUTH 55° 44' 00" West, 110.81 feet more or less to the Easterly corner of a concrete block apartment building standing on said Block E in October of 1960.

Being the land ~~outlined~~ edged in red on a print of survey prepared by Marshall, Macklin and Monaghan, O.L.S. dated the 24th day of October, 1960 and hereunto annexed.

DATED 9th November, A.D. 1960.

NORTH YORK 348980

[redacted]

- AND -

THE HYDRO-ELECTRIC COMMISSION OF
THE TOWNSHIP OF NORTH YORK

I certify that the within instrument is duly entered, registered and microfilmed in the Registry Office for the Registry Division of the East and West Riding of the County of York
TOWNSHIP OF NORTH YORK
at 2 o'clock P.m. of the
28 day NOV A.D 1960
348980
Registrar

GRANT OF EASEMENT

220

PARKINSON, GARDINER, ROBERTS,
ANDERSON, CONLIN & FITZPATRICK,
Barristers and Solicitors,
330 Bay Street, Toronto 1, Ont.

81074 - 28 NOV 60

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

INTERROGATORY 32:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Lines 11-16 on Page 6 and 1-22 on Page 7 describe the specific reasons for undertaking rear lot conversion. The third category is Crew Safety Risks.

a) What is the typical size and class of poles used in rear lot construction?

RESPONSE:

a) Poles existing in rear lot vary. THESL typically has poles between 30 feet to 45 feet. THESL does not have extensive class data for rear lot poles. However, sample records indicate there are class 3, 4, and 5 poles in the rear lot distribution.

b) Does THESL perform periodic inspections to identify and treat base rot in poles?

RESPONSE:

b) Yes.

c) Would replacement of wood poles with sectional fibreglass or composite poles eliminate the problem of rot and its attendant safety risks?

RESPONSE:

c) Yes, reports indicate that the problem of rot would likely be eliminated with composite poles. However, composite poles would not eliminate attendant safety risks, which are described in response to EP interrogatory 30 (a) (Tab 6F, Schedule

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

7-30). In addition, potential public safety risks will not be eliminated by using composite poles. Customers may continue to locate recreational equipment or other property such as pools and out buildings near THESL assets.

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INTERROGATORY 33:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Lines 11-16 on Page 6 and 1-22 on Page 7 describe the specific reasons for undertaking rear lot conversion. The fourth category is Public Safety Risks.

a) How does the risk of proximity to energized equipment and conductors in backlot construction compare to the risks of proximity in front lot O/H systems?

RESPONSE:

a) The risk of proximity to energized equipment and conductors in backlot construction is greater than in front lot O/H systems. Although the impact is similar, the probability of contact is greater in the rear lot. This is due to close proximity of existing rear lot assets to houses, pools, out buildings and patios.

b) How much (on a % basis) of the THESL residential supply system is O/H (both front and rear lot) and how much is U/G?

RESPONSE:

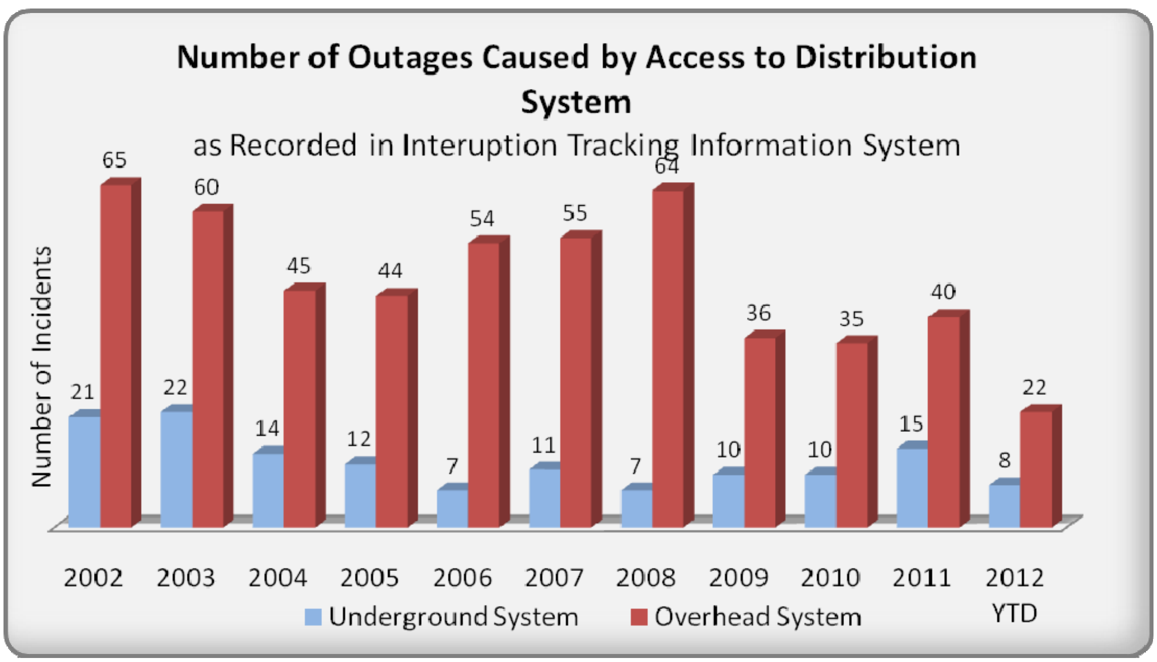
b) THESL currently does not maintain O/H versus U/G based upon customer class (e.g., residential). However THESL's system is comprised of approximately 15,100 kilometres of overhead wires and approximately 10,900 kilometres of underground wires.

c) Please provide a chart showing public electrical contact incidents in the last ten years for rear lot residential systems, for front lot residential systems and for

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

front lot underground systems (including contractor dig ins and overhead contacts).

c) The incidents related to the electrical contact (vehicle contact, dig-in, etc) can be classified in underground or overhead incidents. THESL does not track differentiation between front and rear lots. Below is a graph that summarizes the incidents during the past ten years.



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INTERROGATORY 34:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Lines 11-16 on Page 6 and 1-22 on Page 7 describe the specific reasons for undertaking rear lot conversion. The fifth category is Power Restoration Times.

a) Is the restoration comparison citing two and one half times restoration time for rear lot service compared to front lot derived from the CAIDI averages in lines 18-19? If not, please explain how it was arrived at?

RESPONSE:

a) Yes, it was derived from the CAIDI averages.

b) How was the sample of rear lot outages selected?

RESPONSE:

b) Since THESL does not specifically track outages specific to rear lot, THESL conducted a study whereby outages on feeders supplying rear lot rear lot areas were plotted in order to determine whether the outage actually originated within an area with rear lot service. Data collected in these rear lot areas from outages that occurred during 2010 and early 2011 was used in the analysis.

c) Please provide a chart comparing the durations of all outages on rear lot residential construction to all outages on front lot O/H and on front lot U/G for the past five years.

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

RESPONSE:

c) THESL does not track outages specific to rear lot. The table below provides a summary of the durations of all OH and all UG outages for the past five years:

	2006	2007	2008	2009	2010	2011
OH Outage Durations (minutes)	126,780	112,583	126,151	118,532	107,856	130,019
UG Outage Durations (minutes)	113,125	113,442	125,614	114,127	119,285	117,715

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INTERROGATORY 35:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Starting at Line 24 on Page 7 and continuing through Pages 8 and 9 is as discussion of the options considered in addressing rear lot risks.

a) Option 2 is to rebuild rear lot in kind and is dismissed as infeasible. Please provide the full study that concludes that rebuilding of rear lot systems is infeasible. If such a study was not done, please explain how the option can be dismissed without a full study.

RESPONSE:

a) The justification for considering option 2 infeasible is provided on Tab 4, Schedule B6, page 8, lines 14-20. Furthermore, unacceptable operational constraints (provided in Tab 4, Schedule B6, page 18, lines 5-10 and page 19, lines 1-12) potential public safety (provided in Tab 4, Schedule B6, page 23, lines 4-14, and page 24, lines 1-7), and customer service (provided in Tab 4, Schedule B6, page 29, lines 4-16) issues would still remain should THESL pursue option 2. In addition, the outcome of the business case from the FIM model illustrates a negative NPV of $1.77M for option 2. This can be found in Tab 4, Schedule B6, page 71, Table A2. For all of these reasons, THESL did not conduct a study of this option and believes none is warranted.

b) Page 12 of the Navigant survey at Tab 4, Schedule D3, notes that few other participants in the survey are relocating rear lot lines. Has THESL contacted these other utilities to determine how they are dealing with the issues that make

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

rebuilding rear lot infeasible to THESL? If yes, please provide the responses. If not, why not?

RESPONSE:

b) THESL has not contacted these other utilities. THESL based its decision to pursue option 4 based upon condition of THESL assets, impacts to THESL crews and the public, and the positive NPV outcome of option 4 generated from the FIM model.

c) What is average pole spacing in rear lot construction? What is the range of backyard widths in those areas that have backlot service?

RESPONSE:

c) The average pole spacing in rear lot construction is 30m. The range of backyard widths in those areas that have back lot service is between 10m and 20m. Both of these results were taken from a sample set of rear lot data.

d) Page 8 Line 18-19 refers to the need for large amounts of work to be undertaken by hand. Please describe the type of work that this would involve and explain why it is not feasible to do the work by hand.

RESPONSE:

d) Please refer to Tab 4, Schedule B6, page 19, lines 3-7 which describes the work typically required to replace a single pole in a rear lot. Option 2 is rebuilding the rear lot system. This would require this type of manual work on a much larger scale. THESL has not stated that performing this work manually is infeasible. Rather, the need for large amounts of manual work with its higher potential for injury to THESL

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crews compared to a typical front lot installation is one of the reasons that THESL considers this option infeasible. See response to part (a) and the references provided there for other reasons why the option of rebuilding rear lot service is infeasible.

e) Option 3 is to rebuild as front lot O/H. Has THESL surveyed residential customers on their views about converting backlot overhead to frontlot overhead or are the statements in lines 25-27 based on experience with the Whitebirch job referred to in line 28?

RESPONSE:

e) No. The statements in lines 25-27 are based only on project Whitebirch.

f) If the former, please provide a copy of the survey and feedback received. If the latter, please describe any other conversions similar to Whitebirch in which THESL experienced strong opposition to conversion to front lot overhead.

RESPONSE:

f) As discussed in response to EP interrogatory 22 (a), there are substantial advantages to installing underground rather than overhead infrastructure. As a result, THESL can find no examples where it has proposed converting rear lot service to front lot overhead service.

g) Has THESL ever converted backlot overhead to front lot overhead? If yes, please provide details of the projects undertaken including street names so that they can be viewed.

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

RESPONSE:

g) See response to part (f).

h) What was the ultimate resolution of the Whitebirch conversion dispute?

RESPONSE:

h) Face to face meetings with all residents receiving equipment on the public road allowance resulted in the front lot underground plant being installed and energized.

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INTERROGATORY 36:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Page 8 describes the involvement of City councillors in the opposition to the Whitebirch project.

a) Has THESL consulted with City councillors to determine what parts of front lot overhead construction they and residents object to? If yes, please describe the results of the consultation. If not, why not?

RESPONSE:

a) THESL has received customer and City Councillor feedback on front lot overhead construction. The objections THESL received from City Councillors and residents to front lot overhead construction can be categorized as:

- Decrease in property values
- Negative impact on streetscape aesthetics
- Over-trimming of mature trees for line clearance

b) Does THESL require permits from the City to construct its plant on city road allowance? If yes, please describe the process for obtaining permits.

RESPONSE:

b) Yes. Please see Appendix A to response to EP Interrogatory 22 (Tab 6F, Schedule 7-22) entitled “Municipal Consent Requirements”. Applications are prepared from THESL’s design documents and submitted to the City. The City reviews these applications against their published Municipal Consent Requirements. Any issues are

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

communicated back to THESL for revision to the designs. Once the requirements are deemed met by the City, permits are issued to THESL. Where a proposed above-ground installation or the proposed aesthetic treatment is not satisfactory to the General Manager, an application may be denied.

c) Has THESL been refused permits to construct overhead lines on City road allowance? If yes, please provide examples and explain why the City refused to issue the permits.

RESPONSE:

c) THESL has not been refused permits to construct overhead lines in recent years. However, the Municipal Consent Requirements stipulate in Chapter 5 that, where proposing above ground installations, the following shall be provided with the permit application:

1) Above ground installations must be justified and include an explanation of why this plant cannot be installed underground.
2) Written notification must be provided to all adjacent properties, and all properties that will face or will have a line of sight to the proposed plant. Such notification shall outline the nature of the work and clearly describe the size, appearance and location of the proposed plant. The City Councillor for the respective area must also be notified in writing.
3) The General Manager may require THESL to submit additional information and/or meet with staff and stakeholders during the application review process based on the nature and details of the proposed work. Where a proposed above-ground installation or the proposed aesthetic treatment is not

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satisfactory to the General Manager, a detailed written explanation of the reason for denial of the permit application must provided.

d) Has THESL approached the City to ask if it was willing to bear the extra cost of front lot underground construction? If yes, what was the response? If not, why not?

RESPONSE:

d) THESL has not approached the City to fund any costs associated with underground construction. The City does not fund the cost of installing electricity distribution service for its residents and businesses.

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INTERROGATORY 37:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

In areas of the city that have always been front lot overhead construction, does THESL have any problems with residents objecting to trimming trees to avoid interference with lines? If yes, please describe how THESL has dealt with the objections?

RESPONSE:

Yes, THESL does receive objections from residents regarding tree trimming. THESL communicates with customers through letters, telephone conversations and, if required, THESL will meet customers at their residence. THESL forestry department arborists often engage in customer conversations and provide an overview of tree trimming rationale, process and the overall impact that overgrown trees have on system reliability and public safety. In residential areas with dense tree canopies, THESL has introduced a standard higher pole installation with insulated “tree-proof” cabling.

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INTERROGATORY 38:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Page 9 Lines 11-14 note that Option 3, rebuilding rear lot overhead as front lot overhead, was not evaluated in the business case because in THESL's view it "would ultimately be rejected as a project". If THESL has converted any rear lot overhead to front lot overhead in the past, please explain why it has concluded that such conversions would never be acceptable now?

RESPONSE:

THESL can find no record of ever having converted rear lot service to front lot overhead service. In the initial stages of THESL's rear lot conversion plans for the Whitebirch project, THESL considered converting rear lot infrastructure to an overhead front lot design. However, this idea was met with extreme opposition from the local city councillor, and was ultimately rejected by both the councillor and residents. In addition, results generated by the FIM indicate that the greatest NPV results from converting to a front lot underground design.

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INTERROGATORY 39:

Reference(s): **Tab 4, Sch. B6 Rear Lot Construction**

Notwithstanding THESL's opinion that Option 3 Front Lot Overhead could never be implemented, please prepare the business case evaluation for this option and include the results in Table 1 on Page 10 so that the Board and Intevenors have a complete record of all options for consideration.

RESPONSE:

Please see revised Table 1 to include Option 3 results generated from the FIM model.

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

Business Case Element	Estimated Cost (in Millions)
Option 1: Status Quo (Remediation on a As-Needed Basis) Cost of Ownership of Existing Rear Lot Construction **[COO_E]**	$92.68
Option 2: Like-for-Like Replacement of Existing O/H Rear Lot with New O/H Rear Lot Cost of Ownership of New O/H Rear Lot **[COO_{RL}]**	$87.09
Option 3: Replacement of Existing O/H Rear Lot with New O/H Front Lot Cost of Ownership of New O/H Front Lot **[COO_{OH}]**	$59.94
Option 4: Replacement of Existing O/H Rear Lot with New U/G Front Lot Cost of Ownership of New U/G Front Lot **[COO_{UG}]**	$11.97
Upfront Project Cost (Option 1) **[$COST_E$]**	$0
Upfront Project Cost (Option 2) **[$COST_{RL}$]**	$7.36
Upfront Project Cost (Option 3) **[COSTOH]**	$57.1
Upfront Project Cost (Option 4) **[$COST_{UG}$]**	$66.14
Option 2 versus Option 1 NPV [(COO_E - COO_{RL}) - $COST_{RL}$]	-$1.77
Option 3 versus Option 1 NPV [(COO_E - COO_{OH}) - $COST_{OH}$]	-$24.36
Option 4 versus Option 1 NPV [(COO_E - COO_{UG}) - $COST_{UG}$]	**$14.57**
Non-quantified benefits of Option 4 include: Increased employee and public safety and enhanced property values	

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INTERROGATORY 40:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

The bottom of Table 1 on Page 10 notes that Option 4 will result in "enhanced property values". This is repeated in Line 3 on Page 11 with the statement that "the property values of affected customers are likely to increase".

a) Please explain why increasing property values for a particular set of residential customers should be a consideration for THESL in evaluating its options for rear lot construction.

RESPONSE:

a) Contrary to the premise of the question, the anticipated increases in customer property values was not a consideration for THESL in evaluating the options for replacing rear lot service and THESL did not use the expected increases in property values in the FIM business case analysis for option 4. The evidence mentions this factor because it is a likely positive consequence of replacing rear lot service.

b) Please explain why residential ratepayers served by front lot overhead should pay higher rates resulting from more expensive U/G systems to improve the property values of customers who would benefit from those systems.

RESPONSE:

b) Contrary to the question, rear lot service replacement is being undertaken for reasons of reliability, operational constraints, cost, and safety as fully explained in Tab 4, Schedule B6, pages 16-31. The costs of rear-lot conversion will be collected from all

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customers through the OEB-approved cost allocation and rate design methodologies, a discussion of which is beyond the scope of this application.

c) Please explain why residential customers benefiting from increased property values shouldn't pay for the additional costs of the U/G system that produced the increased value?

RESPONSE:

c) Please see response to part b) above.

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INTERROGATORY 41:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Page 14 Figure 3 shows Customer Hours interrupted due to "rear lot impacts" (line 6-7).

a) Are these "impacts" just outages on rear lot lines or are they something more? If the latter, please explain.

b) What event(s) caused the O/H line to move up so abruptly in 2011?

c) Is the red line on this figure rear lot underground? If yes, please describe the extent of rear lot underground. If not, please explain what it is.

RESPONSE:

a) to c)

THESL is modifying its evidence to withdraw Figure 3 and the referenced sentence. Specifically, Tab 4, Schedule B6, page 14, lines 5-7, the sentence that read "Restoration time is also negatively impacted by these factors (refer to Figure 3 for historical Customer Hours Interrupted due to rear lot impacts)." and Figure 3 are being withdrawn because of errors uncovered in the data underlying Figure 3. As a result, this interrogatory is no longer applicable.

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INTERROGATORY 42:

Reference(s): Tab 4, Sch. B6 Rear Lot Construction

Page 14 Line 16-18 refers to animal and tree contact as a frequent cause of outages on rear lot construction. The Navigant report on Page 9 notes that "Both tree wire and bundled conductor are viewed as a cost-effective reliability improvement measures, designed to improve reliability performance metrics".

a) Has THESL used these types of conductor for rear lot construction to mitigate tree and animal contacts? If yes, please describe the results. If not, why not?

RESPONSE:

a) THESL has used these types of conductors during the construction of rear lot infrastructure, but does not proactively replace existing bare conductor with tree proof conductor in areas with rear lot service. Such a proactive replacement program would create additional exposure for THESL crews to the potential risks associated with repairing and replacing rear lot service, which are discussed in the evidence (Tab 4, Schedule B6, pages 18-23) and in answers to EP interrogatories (Tab 6F, Schedule 7-30 and 7-32).

b) In areas traditionally served by overhead front lot systems, how does THESL manage animal and tree contacts?

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RESPONSE:

b) In areas traditionally served by overhead front lot systems, THESL manages animal and tree contacts by installing animal guards, installing tree proof conductor, and tree trimming.

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INTERROGATORY 43:

Reference(s): **Tab 4, Sch. B6 Rear Lot Construction Appendix A – NPV Calculations and BCE Overview**

Page 67, Section 5.2, describes the Non Asset Risk Procedure, Lines 22-27 describe the method of calculating the NAR for a specific area of study.

a) Lines 22-27 state that outage information used in the eventual NAR calculation is captured at the feeder level. Please confirm that this means that all non asset related outage information for the feeder from its connection at the MS or TS is included and not just that data applying to outages caused by problems on rear lot systems connected to the feeder. If this is not the correct interpretation, please clarify.

RESPONSE:

a) Confirmed. All non-asset-related outage information from the supplying municipal station (MS) to the corresponding 4.16kV rear lot customers, or from the supplying transformer station (TS) to the corresponding 27.6kV rear lot customers, is utilized as part of the non-asset risk calculation within the rear lot business case evaluation (BCE). Note, however, that this data is normalized on a per meter basis, and applied only to the specific rear lot subdivisions in question. In other words, the calculated per-meter NAR is applied to the assets based only on rear lot length being replaced.

b) Please confirm that most U/G serviced subdivisions are actually supplied from feeders which typically run overhead along main roads before connecting to U/G

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cables at the subdivision entry point(s). If this is not the correct understanding, please clarify.

RESPONSE:

b) Not confirmed. Feeders which typically run overhead along main roads supply both O/H and U/G subdivisions. Similarly, feeders which typically run underground along main roads supply both O/H and U/G subdivisions as well.

c) Assuming confirmation of b) above, please describe how the Non Asset Risk procedure in section 5.2 Lines 22-27 is applied to the underground part of the feeder considering that outages on the overhead part of the feeder would necessarily affect the underground part.

RESPONSE:

c) Not applicable as part (b) was not confirmed.

d) If the answer to c) is that the impact of outages on the overhead part of the feeder are normalized over the underground part of it, please explain why the Projected non-asset risk cost of underground front lot in table A3 on page 72 could be $0.

RESPONSE:

d) Not applicable as part (b) was not confirmed.

e) If the answer to c) is that the impact of outages on the overhead part of the feeder are not normalized over the underground part of it, please explain how

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the outage cost to customers due to loss of supply to the underground system are accounted for in the model.

RESPONSE:

e) Not applicable as part (b) was not confirmed.

f) Page 68 lines 2-3 state that "it is assumed that these non asset risks will continue to exist over the entire life cycle of the asset". Please explain how this assumption would account for the reduction in risk that could be achieved by trimming trees, using tree cable, placing animal barriers around live transformer or switch parts, installing lightning arresters to limit lightning damage to equipment and any other mitigation strategies that would reduce non asset related risks.

RESPONSE:

f) The non asset risks would likely decrease assuming the mitigation strategies are successful in actually reducing outages. THESL does not plan to undertake a systematic replacement program for these measures within rear lot areas for the reasons given in response to EP interrogatory 42 (a) (Tab 6F, Schedule 7-42, part a).

g) Please explain why the NPV calculation in the model is done for a 100 year period rather than the expected life of the assets.

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RESPONSE:

g) The cost of ownership (or NPV) calculation is performed over a 100-year period as opposed to the expected life of the assets, as the NPV calculation must be performed over the same time period for all assets being evaluated, such that a comparison can be made between different assets or set of assets and their respective cost of ownership values. The 100-year period is long enough to cover all major asset classes that are evaluated within the Feeder Investment Model (FIM). Assets with an expected life shorter than the 100-year time period are reflected within the cost of ownership calculation as having multiple life cycles – that is, the replacement cost includes the replacement of the asset when it reaches its anticipated end of economic life.

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INTERROGATORY 44:

Reference(s): **Tab 4, Sch. B6 Rear Lot Construction Appendix A – NPV Calculations and BCE Overview**

Tables A1, A2 and A3 on Pages 71 and 72 show the results of the business case evaluation for the three options considered.

a) Please add a fourth table to show the results of the front lot overhead evaluation requested above.

RESPONSE:

a) Table 1 below reflects Option 3 (Replacement of Existing O/H Rear Lot with New O/H Front Lot:

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Table 1 – O/H Front Lot Construction Results

Business Case Element	Estimated Cost (in Millions)
OPTION 1	
Cost of Ownership of Existing Rear Lot Construction (COO_E)	
Projected risk cost of existing rear lot (NPV)	$7.95
Projected non-asset risk cost of existing rear lot (NPV)	$84.05
Maintenance cost of existing rear lot	$0.67
TOTAL (COO_E)	**$92.67**
OPTION 3	
Cost of Ownership of New Standardized Overhead Front Lot Construction (COO_N)	
Projected risk cost of overhead front lot (NPV)	$1.78
Projected non-asset risk cost of overhead front lot (NPV)	$57.49
Maintenance cost of overhead front lot	$0.67
TOTAL (COO_N)	**$59.94**
PROJECT COST	**$57.10**
PROJECT NPV	**-$24.37**

Note that the maintenance costs of Options 1 and 3 are held equal as a simplifying assumption. Actual maintenance costs for Option 1 are expected to be higher due to accessibility constraints in rear lot areas. Incorporating this effect would likely increase the total cost of ownership (COO_E) for option 1.

b) For each option in the BCE, please provide the complete ICM model inputs and outputs used to arrive at the

1. **Projected asset risk cost,**
2. **Projected non asset risk cost, and**
3. **Maintenance cost.**

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RESPONSE:

b) The complete inputs and outputs for each option within the Rear Lot Business Case Evaluation as provided below:

Option 1: Status Quo

Table 1: Input data for Projected Risk Cost of Existing Rear Lot

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
560962	Overhead Switch	0	$29,854
560963	Overhead Switch	0	$39,908
560964	Overhead Switch	0	$39,908
561033	Overhead Switch	0	$2,448
561034	Overhead Switch	0	$6,269
561035	Overhead Switch	0	$6,383
561036	Overhead Switch	0	$2,448
561037	Overhead Switch	0	$2,575
561038	Overhead Switch	0	$2,626
561039	Overhead Switch	0	$2,592
561042	Overhead Switch	0	$2,448
561043	Overhead Switch	0	$2,409
561044	Overhead Switch	0	$2,448
561508	Overhead Switch	0	$28,349
561560	Overhead Switch	0	$6,119
561575	Overhead Switch	0	$2,487
561581	Overhead Switch	0	$2,467
561584	Overhead Switch	0	$7,959
561585	Overhead Switch	0	$6,881

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ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
561587	Overhead Switch	0	$2,448
563676	Overhead Switch	0	$37,977
563688	Overhead Switch	0	$37,974
563733	Overhead Switch	0	$2,720
563734	Overhead Switch	0	$2,750
563756	Overhead Switch	0	$3,230
563757	Overhead Switch	0	$2,325
563794	Overhead Switch	0	$2,467
563796	Overhead Switch	0	$2,592
564249	Overhead Switch	0	$37,721
564265	Overhead Switch	0	$35,677
564268	Overhead Switch	0	$37,110
564270	Overhead Switch	0	$37,128
564271	Overhead Switch	0	$37,110
564272	Overhead Switch	0	$37,110
564273	Overhead Switch	0	$35,657
564276	Overhead Switch	0	$37,292
564331	Overhead Switch	0	$35,661
564332	Overhead Switch	0	$37,126
564333	Overhead Switch	0	$35,657
564361	Overhead Switch	0	$2,409
564362	Overhead Switch	0	$6,352
564365	Overhead Switch	0	$2,592
564369	Overhead Switch	0	$25,254
564373	Overhead Switch	0	$7,186
564376	Overhead Switch	0	$2,504
564379	Overhead Switch	0	$2,806
564381	Overhead Switch	0	$2,720

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ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
564382	Overhead Switch	0	$2,409
564383	Overhead Switch	0	$2,523
564384	Overhead Switch	0	$2,689
564385	Overhead Switch	0	$2,487
564386	Overhead Switch	0	$2,659
564388	Overhead Switch	0	$2,503
564391	Overhead Switch	0	$2,448
564392	Overhead Switch	0	$2,559
564394	Overhead Switch	0	$6,150
564439	Overhead Switch	0	$2,559
564440	Overhead Switch	1	$6,614
564817	Overhead Switch	0	$6,437
564878	Overhead Switch	0	$3,230
564879	Overhead Switch	0	$2,626
564911	Overhead Switch	0	$3,230
565025	Overhead Switch	0	$6,695
565084	Overhead Switch	0	$2,409
1666914	Overhead Switch	0	$2,659
1666915	Overhead Switch	0	$7,513
1666923	Overhead Switch	0	$22,816
1666940	Overhead Switch	0	$9,105
1666944	Overhead Switch	0	$2,540
1666959	Overhead Switch	0	$2,476
1666968	Overhead Switch	0	$2,559
1666993	Overhead Switch	8	$5,415
1666994	Overhead Switch	2	$2,328
1667185	Overhead Switch	0	$2,720
1667212	Overhead Switch	7	$2,116

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ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
1667215	Overhead Switch	0	$9,105
1667236	Overhead Switch	0	$9,105
1667261	Overhead Switch	12	$4,843
1667262	Overhead Switch	7	$2,116
1667263	Overhead Switch	0	$9,105
14074773	Overhead Switch	0	$27,283
14083222	Overhead Switch	7	$2,116
14083223	Overhead Switch	4	$2,469
14083224	Overhead Switch	2	$2,605
14083225	Overhead Switch	6	$2,194
14083629	Overhead Switch	0	$27,283
14083630	Overhead Switch	0	$27,283
14083640	Overhead Switch	0	$2,672
14083644	Overhead Switch	0	$27,806
14083662	Overhead Switch	0	$2,689
14083671	Overhead Switch	0	$2,626
14083672	Overhead Switch	0	$2,592
14083673	Overhead Switch	0	$2,792
14083674	Overhead Switch	0	$2,503
14083676	Overhead Switch	0	$2,409
14083679	Overhead Switch	0	$2,559
14083680	Overhead Switch	0	$2,626
14083687	Overhead Switch	0	$5,749
14083688	Overhead Switch	0	$8,263
14083715	Overhead Switch	0	$2,626
14083716	Overhead Switch	0	$35,166
14083719	Overhead Switch	7	$2,116
14083721	Overhead Switch	0	$2,409

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ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
14083741	Overhead Switch	0	$2,448
28020729	Overhead Switch	0	$28,124
28020739	Overhead Switch	0	$26,909
28020748	Overhead Switch	0	$4,712
28020756	Overhead Switch	0	$5,473
28020757	Overhead Switch	0	$2,649
28021188	Overhead Switch	0	$50,070
28021199	Overhead Switch	0	$2,476
28021200	Overhead Switch	0	$4,712
28021208	Overhead Switch	0	$50,070
28021211	Overhead Switch	0	$22,455
28021641	Overhead Switch	11	$4,838
28021654	Overhead Switch	0	$7,305
28150642	Overhead Switch	0	$2,649
28150715	Overhead Switch	0	$3,119
28830339	Overhead Switch	0	$35,337
30399949	Overhead Switch	18	$1,366
550038	Overhead Transformer	0	$11,526
551173	Overhead Transformer	0	$8,560
551421	Overhead Transformer	0	$11,842
551424	Overhead Transformer	0	$14,878
551426	Overhead Transformer	0	$11,210
551427	Overhead Transformer	0	$14,878
551433	Overhead Transformer	0	$11,526
551435	Overhead Transformer	0	$14,878
551441	Overhead Transformer	0	$14,878
551442	Overhead Transformer	0	$14,878
551445	Overhead Transformer	0	$11,210

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ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
551446	Overhead Transformer	0	$23,599
551752	Overhead Transformer	0	$11,842
552147	Overhead Transformer	0	$11,526
552188	Overhead Transformer	0	$11,842
552189	Overhead Transformer	0	$15,435
552212	Overhead Transformer	0	$11,526
552213	Overhead Transformer	0	$11,842
552214	Overhead Transformer	0	$14,878
555153	Overhead Transformer	0	$15,435
555154	Overhead Transformer	0	$14,878
555171	Overhead Transformer	0	$14,878
555178	Overhead Transformer	0	$15,435
555181	Overhead Transformer	0	$15,435
555251	Overhead Transformer	0	$15,435
555255	Overhead Transformer	0	$15,435
555259	Overhead Transformer	0	$14,878
555327	Overhead Transformer	0	$15,435
555328	Overhead Transformer	0	$15,435
555340	Overhead Transformer	0	$15,435
555422	Overhead Transformer	0	$15,435
555423	Overhead Transformer	0	$24,352
555428	Overhead Transformer	0	$14,878
555429	Overhead Transformer	0	$14,878
555430	Overhead Transformer	0	$11,842
555434	Overhead Transformer	0	$14,878
555435	Overhead Transformer	0	$15,435
555437	Overhead Transformer	0	$11,842
555438	Overhead Transformer	0	$15,435

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ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
555440	Overhead Transformer	0	$24,352
555441	Overhead Transformer	0	$11,526
555445	Overhead Transformer	0	$24,352
555446	Overhead Transformer	0	$15,435
555447	Overhead Transformer	0	$24,352
555452	Overhead Transformer	0	$14,878
555453	Overhead Transformer	0	$11,842
555998	Overhead Transformer	0	$11,526
555999	Overhead Transformer	0	$14,403
556000	Overhead Transformer	0	$10,883
556004	Overhead Transformer	0	$14,878
556010	Overhead Transformer	0	$14,878
556011	Overhead Transformer	0	$11,842
556012	Overhead Transformer	0	$14,878
556013	Overhead Transformer	0	$10,883
556125	Overhead Transformer	0	$11,842
556126	Overhead Transformer	0	$10,224
556128	Overhead Transformer	0	$10,224
556133	Overhead Transformer	0	$15,435
556134	Overhead Transformer	0	$11,842
556136	Overhead Transformer	0	$13,312
556140	Overhead Transformer	0	$10,224
556144	Overhead Transformer	0	$14,878
556175	Overhead Transformer	0	$14,878
556176	Overhead Transformer	0	$11,842
556177	Overhead Transformer	0	$11,526
556179	Overhead Transformer	0	$11,842
556190	Overhead Transformer	0	$14,878

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ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
556207	Overhead Transformer	0	$14,878
556208	Overhead Transformer	0	$15,435
556209	Overhead Transformer	0	$11,842
556212	Overhead Transformer	0	$14,878
556213	Overhead Transformer	0	$14,878
556214	Overhead Transformer	0	$14,878
556215	Overhead Transformer	0	$11,842
556219	Overhead Transformer	0	$14,878
556220	Overhead Transformer	0	$11,842
556221	Overhead Transformer	0	$11,842
556223	Overhead Transformer	0	$11,842
556224	Overhead Transformer	0	$14,878
556225	Overhead Transformer	0	$11,842
556228	Overhead Transformer	0	$20,856
556234	Overhead Transformer	0	$11,526
556242	Overhead Transformer	0	$11,210
556390	Overhead Transformer	0	$13,312
556433	Overhead Transformer	0	$13,312
556441	Overhead Transformer	0	$10,224
556443	Overhead Transformer	0	$9,535
556475	Overhead Transformer	0	$11,526
1756345	Overhead Transformer	0	$10,063
1756346	Overhead Transformer	0	$10,063
1756347	Overhead Transformer	0	$7,528
1756359	Overhead Transformer	0	$12,281
1756360	Overhead Transformer	0	$7,528
1756361	Overhead Transformer	13	$9,343
1756362	Overhead Transformer	0	$13,378

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ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
1756383	Overhead Transformer	0	$13,378
1756389	Overhead Transformer	0	$12,281
1756390	Overhead Transformer	0	$10,063
1756391	Overhead Transformer	0	$9,415
1756392	Overhead Transformer	0	$12,281
1756393	Overhead Transformer	0	$10,063
1756394	Overhead Transformer	0	$10,063
1756395	Overhead Transformer	0	$10,063
1756399	Overhead Transformer	0	$10,063
1756400	Overhead Transformer	0	$9,415
1756402	Overhead Transformer	0	$10,063
1756403	Overhead Transformer	0	$12,281
1756404	Overhead Transformer	0	$10,063
1756405	Overhead Transformer	0	$10,063
1756406	Overhead Transformer	0	$10,063
1756407	Overhead Transformer	0	$10,063
1756408	Overhead Transformer	0	$10,063
1756442	Overhead Transformer	0	$12,281
1756443	Overhead Transformer	0	$12,281
1756456	Overhead Transformer	0	$10,063
1756553	Overhead Transformer	0	$10,063
1756554	Overhead Transformer	0	$13,378
1756555	Overhead Transformer	0	$12,281
1756556	Overhead Transformer	0	$10,063
1756557	Overhead Transformer	0	$12,281
1756558	Overhead Transformer	0	$9,415
1757139	Overhead Transformer	0	$10,063
1757146	Overhead Transformer	0	$11,424

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ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
1757149	Overhead Transformer	14	$8,925
1757186	Overhead Transformer	0	$8,579
1757195	Overhead Transformer	0	$10,063
1757196	Overhead Transformer	0	$8,579
1757197	Overhead Transformer	0	$12,281
1757233	Overhead Transformer	0	$8,579
1757238	Overhead Transformer	0	$7,999
1757239	Overhead Transformer	0	$8,579
1757241	Overhead Transformer	0	$9,415
1757242	Overhead Transformer	0	$10,063
1757243	Overhead Transformer	0	$8,579
1757244	Overhead Transformer	0	$8,579
1757245	Overhead Transformer	0	$10,063
14130033	Overhead Transformer	0	$7,999
14130034	Overhead Transformer	0	$7,999
14130035	Overhead Transformer	0	$8,579
14130040	Overhead Transformer	0	$7,999
14130068	Overhead Transformer	0	$7,413
14130069	Overhead Transformer	0	$8,579
14130070	Overhead Transformer	0	$11,424
14130071	Overhead Transformer	0	$7,999
14130072	Overhead Transformer	0	$7,999
14130073	Overhead Transformer	0	$10,419
14130076	Overhead Transformer	0	$8,579
14130696	Overhead Transformer	0	$11,210
14130711	Overhead Transformer	0	$15,435
14130712	Overhead Transformer	0	$11,842
14130713	Overhead Transformer	0	$14,878

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ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
14130714	Overhead Transformer	0	$11,526
14130715	Overhead Transformer	0	$11,210
14130716	Overhead Transformer	0	$11,842
14130717	Overhead Transformer	0	$11,842
14130718	Overhead Transformer	0	$15,435
14130719	Overhead Transformer	0	$11,842
14130720	Overhead Transformer	0	$15,435
14130721	Overhead Transformer	0	$15,435
14130722	Overhead Transformer	0	$15,435
14130723	Overhead Transformer	0	$15,435
14130724	Overhead Transformer	0	$11,526
14130725	Overhead Transformer	0	$11,526
14130726	Overhead Transformer	0	$11,210
14130727	Overhead Transformer	0	$14,878
14130728	Overhead Transformer	0	$11,526
14130737	Overhead Transformer	0	$15,435
14130752	Overhead Transformer	0	$8,579
14130753	Overhead Transformer	0	$11,424
14130754	Overhead Transformer	0	$8,579
14130784	Overhead Transformer	0	$11,526
14130787	Overhead Transformer	0	$11,526
14130788	Overhead Transformer	0	$15,435
14130789	Overhead Transformer	0	$15,435
14130790	Overhead Transformer	0	$15,435
14130793	Overhead Transformer	0	$11,842
14130800	Overhead Transformer	0	$15,435
14130801	Overhead Transformer	0	$11,842
14130804	Overhead Transformer	0	$8,579

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
14130806	Overhead Transformer	0	$15,435
14131504	Overhead Transformer	0	$39,847
26266383	Overhead Transformer	0	$12,281
28029176	Overhead Transformer	0	$20,271
28029177	Overhead Transformer	0	$11,210
28029178	Overhead Transformer	0	$15,435
28029179	Overhead Transformer	0	$15,435
28029180	Overhead Transformer	0	$11,842
28029181	Overhead Transformer	0	$11,842
28029182	Overhead Transformer	0	$15,435
28029183	Overhead Transformer	0	$15,435
28029184	Overhead Transformer	0	$15,435
28029185	Overhead Transformer	0	$15,435
28029211	Overhead Transformer	0	$74,865
28029212	Overhead Transformer	0	$15,435
28029213	Overhead Transformer	0	$20,542
28029214	Overhead Transformer	0	$20,542
28029215	Overhead Transformer	0	$15,435
28029229	Overhead Transformer	0	$15,435
28029230	Overhead Transformer	0	$15,435
28029232	Overhead Transformer	0	$15,435
28029233	Overhead Transformer	0	$11,842
28029234	Overhead Transformer	0	$20,856
28029235	Overhead Transformer	0	$11,538
28029236	Overhead Transformer	0	$15,435
28029238	Overhead Transformer	0	$74,865
28029273	Overhead Transformer	0	$15,435
28029277	Overhead Transformer	0	$15,435

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
28030012	Overhead Transformer	0	$13,378
28030262	Overhead Transformer	0	$8,449
28033538	Overhead Transformer	0	$20,552
28033539	Overhead Transformer	0	$15,435
28033540	Overhead Transformer	0	$15,435
28033541	Overhead Transformer	0	$11,842
28033738	Overhead Transformer	0	$20,856
28033756	Overhead Transformer	0	$16,923
28142774	Overhead Transformer	0	$13,378
30447149	Overhead Transformer	0	$11,842
225254	Poles	79	$2,751
225257	Poles	28	$11,926
225258	Poles	0	$26,045
233279	Poles	3	$18,617
233283	Poles	9	$19,107
233285	Poles	29	$12,097
233286	Poles	26	$11,672
233294	Poles	26	$11,672
233295	Poles	26	$11,672
233413	Poles	23	$11,216
233416	Poles	26	$11,732
233417	Poles	26	$11,732
233421	Poles	26	$11,732
233422	Poles	49	$7,007
237721	Poles	0	$31,501
237728	Poles	0	$34,127
237735	Poles	56	$2,150
253640	Poles	58	$5,048

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
253641	Poles	57	$5,056
253642	Poles	68	$3,612
253645	Poles	53	$5,830
253662	Poles	30	$11,200
253678	Poles	50	$6,370
253679	Poles	46	$7,568
253680	Poles	50	$6,370
253681	Poles	50	$6,370
254118	Poles	44	$7,336
254121	Poles	59	$5,438
254122	Poles	58	$5,433
254124	Poles	58	$5,433
254131	Poles	33	$11,282
254132	Poles	44	$7,936
254135	Poles	56	$4,924
254141	Poles	38	$8,722
254144	Poles	44	$7,338
254146	Poles	44	$7,335
254149	Poles	46	$8,388
254152	Poles	45	$7,230
254153	Poles	26	$12,419
255475	Poles	56	$1,843
255496	Poles	56	$1,843
255516	Poles	50	$7,582
255517	Poles	56	$2,148
255518	Poles	56	$2,148
258524	Poles	51	$2,060
258528	Poles	51	$2,098

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
258529	Poles	51	$2,060
258530	Poles	15	$10,753
258531	Poles	51	$2,061
258532	Poles	15	$10,753
258556	Poles	51	$2,722
258557	Poles	0	$12,821
258558	Poles	78	$674
258559	Poles	6	$11,787
258563	Poles	78	$674
258854	Poles	78	$1,158
258855	Poles	78	$1,155
258856	Poles	78	$1,169
258857	Poles	78	$1,155
258858	Poles	78	$1,158
258859	Poles	78	$1,158
258860	Poles	78	$1,158
258861	Poles	78	$1,154
258869	Poles	78	$1,158
258870	Poles	78	$1,169
258891	Poles	56	$2,024
258892	Poles	56	$2,003
258894	Poles	56	$2,003
258899	Poles	78	$1,158
258900	Poles	78	$1,154
258901	Poles	78	$1,159
258902	Poles	78	$1,158
258903	Poles	0	$12,868
258904	Poles	78	$1,158

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
258906	Poles	78	$1,159
258907	Poles	56	$2,635
258912	Poles	78	$1,168
258938	Poles	56	$2,628
258945	Poles	1	$12,827
258946	Poles	56	$2,616
258956	Poles	0	$11,983
258997	Poles	0	$12,020
259037	Poles	56	$1,978
259038	Poles	56	$2,001
259045	Poles	22	$9,396
259046	Poles	0	$15,505
259049	Poles	56	$1,824
259050	Poles	56	$1,800
259053	Poles	56	$1,826
259054	Poles	0	$12,733
259055	Poles	56	$1,800
259056	Poles	56	$1,824
259057	Poles	56	$1,800
259071	Poles	0	$26,056
259072	Poles	14	$16,769
259073	Poles	0	$11,285
259142	Poles	51	$3,280
259143	Poles	51	$3,256
259144	Poles	51	$3,283
259147	Poles	51	$3,280
259159	Poles	33	$8,797
259188	Poles	51	$2,018

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
259189	Poles	43	$7,798
259191	Poles	51	$1,991
259192	Poles	51	$1,991
259210	Poles	51	$2,063
259211	Poles	51	$2,063
259217	Poles	51	$2,755
259218	Poles	51	$2,722
259219	Poles	16	$11,328
259220	Poles	51	$2,722
259221	Poles	29	$8,302
259224	Poles	0	$14,500
259225	Poles	13	$11,077
259236	Poles	51	$2,722
259237	Poles	51	$1,903
259238	Poles	51	$1,903
259240	Poles	51	$1,939
259241	Poles	51	$1,927
259246	Poles	9	$10,508
259249	Poles	51	$2,617
259252	Poles	51	$2,566
259253	Poles	51	$2,599
259254	Poles	46	$7,520
259257	Poles	51	$2,593
259267	Poles	3	$18,336
259268	Poles	3	$18,336
259269	Poles	0	$18,579
259270	Poles	3	$18,384
259272	Poles	3	$18,336

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
259275	Poles	3	$18,336
259276	Poles	3	$18,336
259277	Poles	3	$18,336
259280	Poles	2	$19,558
259281	Poles	5	$20,099
259283	Poles	51	$2,013
259285	Poles	51	$1,994
259294	Poles	0	$9,364
259296	Poles	0	$9,469
259297	Poles	0	$13,504
259298	Poles	0	$9,687
259299	Poles	0	$9,980
259302	Poles	0	$10,066
259305	Poles	0	$10,254
259308	Poles	0	$11,691
259309	Poles	3	$19,259
259310	Poles	3	$18,565
259312	Poles	3	$18,384
259313	Poles	3	$18,336
259315	Poles	3	$18,566
259332	Poles	0	$20,258
259343	Poles	51	$1,994
259344	Poles	51	$2,030
259345	Poles	26	$8,451
259346	Poles	51	$1,994
259347	Poles	51	$1,994
259350	Poles	51	$2,030
259830	Poles	78	$1,379

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
259831	Poles	78	$1,367
259833	Poles	78	$1,616
259932	Poles	78	$788
259933	Poles	78	$1,368
259934	Poles	78	$1,317
259935	Poles	78	$788
259936	Poles	4	$15,081
259938	Poles	78	$1,379
259941	Poles	0	$12,242
259946	Poles	78	$1,367
259947	Poles	78	$1,367
259949	Poles	78	$1,366
259950	Poles	78	$1,117
259974	Poles	0	$19,801
259975	Poles	3	$18,336
259976	Poles	0	$20,948
259979	Poles	0	$9,208
259980	Poles	0	$17,666
259982	Poles	0	$5,475
260080	Poles	27	$8,556
260092	Poles	51	$1,994
1204587	Poles	0	$19,826
1204592	Poles	0	$19,826
1204594	Poles	0	$19,826
1204643	Poles	0	$19,826
1204704	Poles	0	$15,772
1204712	Poles	81	$869
1204718	Poles	0	$19,827

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
1204719	Poles	0	$21,298
1204722	Poles	0	$16,300
1206142	Poles	0	$20,047
1206145	Poles	0	$19,826
1206146	Poles	0	$19,826
1206153	Poles	0	$22,551
1206155	Poles	0	$17,066
1206255	Poles	0	$19,826
1206264	Poles	0	$21,304
1206267	Poles	0	$21,304
1206274	Poles	0	$23,256
1206278	Poles	0	$21,773
1206281	Poles	0	$14,977
1206282	Poles	0	$21,997
1206328	Poles	0	$13,981
1206329	Poles	0	$14,568
1206330	Poles	0	$14,571
1206345	Poles	0	$20,047
1206360	Poles	0	$30,595
1206530	Poles	73	$2,937
1206661	Poles	0	$12,280
1206663	Poles	0	$12,984
1206666	Poles	0	$12,280
1206672	Poles	0	$12,459
1206682	Poles	0	$19,620
13418152	Poles	0	$13,039
13418158	Poles	46	$3,067
13418160	Poles	46	$2,903

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
13418161	Poles	46	$2,870
13418162	Poles	46	$3,720
13418166	Poles	0	$23,797
13418167	Poles	0	$22,773
13418191	Poles	46	$2,377
13418192	Poles	46	$2,344
13418320	Poles	0	$17,658
13418416	Poles	0	$16,615
13418417	Poles	0	$21,252
13418418	Poles	0	$24,274
13418454	Poles	24	$10,221
13418455	Poles	46	$3,679
13418456	Poles	46	$2,344
13418457	Poles	46	$3,166
13418459	Poles	46	$2,343
13418460	Poles	46	$3,052
13418474	Poles	0	$22,773
13418485	Poles	46	$2,725
13418486	Poles	46	$2,870
13418487	Poles	46	$3,722
13418489	Poles	46	$2,344
13418490	Poles	46	$2,903
13418491	Poles	46	$2,916
13418492	Poles	46	$2,870
13418493	Poles	46	$2,903
13418494	Poles	46	$2,870
13418495	Poles	46	$3,166
13418496	Poles	46	$3,199

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
13418498	Poles	21	$10,136
13418506	Poles	0	$22,773
13418507	Poles	0	$15,994
13418522	Poles	46	$2,870
13418554	Poles	46	$2,870
13418555	Poles	46	$2,916
13418556	Poles	46	$2,903
13418557	Poles	46	$2,870
13418558	Poles	46	$3,713
13418559	Poles	46	$3,681
13418560	Poles	46	$3,680
13418565	Poles	46	$3,199
13418566	Poles	46	$3,166
13418567	Poles	46	$3,199
13418568	Poles	46	$3,166
13418569	Poles	46	$3,210
13418570	Poles	46	$3,166
13418571	Poles	46	$3,166
13418572	Poles	46	$3,166
13418575	Poles	46	$2,575
13418579	Poles	46	$2,870
13418580	Poles	46	$2,870
13418602	Poles	46	$2,344
13418603	Poles	46	$2,344
13418604	Poles	46	$2,344
13418605	Poles	46	$2,344
13418606	Poles	46	$2,377
13418607	Poles	46	$2,344

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
13418608	Poles	46	$2,344
13418614	Poles	46	$3,083
13418627	Poles	0	$22,784
13418628	Poles	0	$23,804
13418629	Poles	0	$22,773
13418630	Poles	0	$22,773
13418631	Poles	0	$22,773
13418632	Poles	0	$22,773
13418633	Poles	0	$15,994
13418634	Poles	0	$22,774
13418635	Poles	0	$16,322
13418636	Poles	0	$16,469
13418680	Poles	46	$3,136
13418682	Poles	46	$2,870
13418683	Poles	46	$3,713
13418696	Poles	46	$3,166
13418697	Poles	46	$3,211
13418698	Poles	46	$3,166
13418702	Poles	21	$10,136
13418703	Poles	21	$10,136
13418704	Poles	21	$10,136
13418705	Poles	24	$10,219
13420538	Poles	86	$1,464
13420690	Poles	68	$2,207
13420691	Poles	86	$665
13420692	Poles	7	$11,158
13420708	Poles	86	$1,205
13420709	Poles	7	$10,699

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
13420710	Poles	9	$10,594
13420711	Poles	9	$10,563
13420712	Poles	9	$10,562
13420713	Poles	86	$562
13420714	Poles	86	$564
13420715	Poles	86	$573
13420716	Poles	86	$562
13420717	Poles	9	$10,533
13420718	Poles	75	$1,881
13420719	Poles	9	$10,533
13420721	Poles	7	$11,189
13420722	Poles	86	$665
13420723	Poles	86	$661
13420724	Poles	7	$11,189
13420725	Poles	7	$11,188
13420727	Poles	68	$2,207
13420728	Poles	86	$661
13420729	Poles	86	$666
13420730	Poles	86	$564
13420731	Poles	9	$10,562
13420732	Poles	94	$607
13420733	Poles	4	$12,940
13420734	Poles	4	$12,911
13420735	Poles	5	$13,527
13420736	Poles	57	$3,060
13420737	Poles	4	$12,911
13420738	Poles	4	$12,911
13420739	Poles	67	$3,422

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
13420741	Poles	76	$2,946
13420742	Poles	86	$404
13420743	Poles	14	$9,177
13420744	Poles	86	$1,337
13420745	Poles	14	$9,177
13420746	Poles	15	$9,492
13420747	Poles	86	$412
13420748	Poles	14	$9,176
13420750	Poles	14	$9,154
13420815	Poles	0	$21,252
13420868	Poles	86	$1,174
13420873	Poles	86	$365
13420938	Poles	0	$24,545
13420939	Poles	0	$21,252
27412520	Poles	12	$11,503
27412521	Poles	12	$11,502
27413586	Poles	0	$13,351
27413593	Poles	4	$13,319
27417330	Poles	8	$14,185
27417333	Poles	4	$13,178
27417335	Poles	6	$13,700
27418166	Poles	9	$15,026
27418167	Poles	41	$5,215
27418168	Poles	6	$13,998
27418169	Poles	41	$5,251
27418172	Poles	41	$3,105
27418173	Poles	49	$4,675
27418174	Poles	6	$13,711

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
27418175	Poles	8	$14,187
27418176	Poles	6	$13,711
27418181	Poles	14	$11,727
27418183	Poles	41	$6,406
27418185	Poles	50	$4,264
27418438	Poles	8	$14,184
27418440	Poles	36	$6,812
27418445	Poles	86	$1,364
27418448	Poles	56	$4,926
27418450	Poles	57	$4,933
27418451	Poles	58	$5,401
27418452	Poles	58	$4,848
27418453	Poles	56	$4,821
27418454	Poles	59	$5,031
27418458	Poles	14	$12,843
27418654	Poles	41	$3,472
27418655	Poles	41	$3,512
27418656	Poles	41	$3,572
27418657	Poles	41	$4,199
27418658	Poles	41	$4,136
27418659	Poles	41	$4,165
27418665	Poles	41	$6,406
27418666	Poles	41	$6,382
27418667	Poles	41	$6,374
27419239	Poles	41	$6,372
27419240	Poles	41	$6,372
27419242	Poles	41	$6,421
27419243	Poles	41	$3,404

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
27419245	Poles	0	$14,483
27419252	Poles	41	$6,372
27419268	Poles	6	$13,699
27419452	Poles	41	$3,406
27419453	Poles	41	$3,494
27420910	Poles	12	$11,521
27420912	Poles	15	$12,601
27420913	Poles	15	$12,618
27422187	Poles	0	$14,151
27422188	Poles	0	$14,148
27422190	Poles	0	$15,007
27422191	Poles	41	$6,374
27422192	Poles	41	$6,424
27422193	Poles	18	$13,171
27422194	Poles	15	$12,599
27422195	Poles	15	$12,600
27422197	Poles	6	$13,698
27422198	Poles	8	$14,185
27422199	Poles	8	$14,199
27422200	Poles	8	$14,186
27422202	Poles	8	$14,186
27422203	Poles	8	$14,198
27422204	Poles	41	$6,406
27422205	Poles	41	$6,424
27422206	Poles	41	$6,374
27422207	Poles	78	$1,934
27422208	Poles	41	$6,374
27422209	Poles	41	$6,373

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of existing rear lot (NPV)
Total			$7,951,686
27422210	Poles	41	$6,372
27422212	Poles	78	$1,960
27422213	Poles	0	$13,171
27422215	Poles	14	$11,726
27422216	Poles	14	$11,747
27423811	Poles	60	$5,043
27423813	Poles	3	$13,678
27423815	Poles	0	$14,151
27423816	Poles	4	$14,248
27424928	Poles	41	$5,497
27425089	Poles	34	$6,710
27425096	Poles	36	$6,689
27425097	Poles	32	$6,926
27425098	Poles	55	$4,799
27425100	Poles	65	$2,611
27425101	Poles	58	$4,827
27425102	Poles	53	$5,737
27425103	Poles	0	$3,160
27427279	Poles	32	$6,926
30399835	Poles	98	$381

Projected non-asset risk cost of new overhead rear lot (NPV)

Event Cost Total = $39,781,880.85

Duration Cost Total = $44,265,053.41

NAR = $84,046,934.25

Maintenance

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

Tree Trimming = $39,551.97

Wood Pole Inspections = $1,271.66

Discount Rate = 0.0606

Total = ($39,551.97 + $1,271.66) / 0.0606 = $673,657.31

Option 2: Like-for-Like Replacement of Existing O/H Rear Lot with New O/H Rear Lot

Table 2: Input data for Projected Risk Cost of New Overhead Rear Lot

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOS_10030	Overhead Switch	30	$1,967
vOS_10031	Overhead Switch	20	$3,375
vOS_10032	Overhead Switch	19	$1,177
vOS_10033	Overhead Switch	8	$3,402
vOS_10034	Overhead Switch	18	$1,339
vOS_10035	Overhead Switch	12	$31,384
vOS_10036	Overhead Switch	32	$8,223
vOS_10037	Overhead Switch	35	$1,543
vOS_10038	Overhead Switch	18	$1,339
vOS_10039	Overhead Switch	29	$9,438
vOS_10040	Overhead Switch	14	$1,809
vOS_10041	Overhead Switch	12	$31,384
vOS_10042	Overhead Switch	29	$9,438
vOS_10043	Overhead Switch	8	$3,402
vOS_10044	Overhead Switch	18	$18,425
vOS_10045	Overhead Switch	20	$1,138

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOS_10046	Overhead Switch	16	$1,496
vOS_10047	Overhead Switch	20	$1,099
vOS_10048	Overhead Switch	27	$2,221
vOS_10049	Overhead Switch	18	$19,035
vOS_10050	Overhead Switch	17	$1,410
vOS_10051	Overhead Switch	18	$18,606
vOS_10052	Overhead Switch	18	$1,249
vOS_10053	Overhead Switch	19	$16,971
vOS_10054	Overhead Switch	18	$18,425
vOS_10055	Overhead Switch	19	$16,975
vOS_10056	Overhead Switch	18	$18,440
vOS_10057	Overhead Switch	18	$18,425
vOS_10058	Overhead Switch	18	$1,249
vOS_10059	Overhead Switch	19	$1,194
vOS_10060	Overhead Switch	19	$1,193
vOS_10061	Overhead Switch	23	$2,765
vOS_10062	Overhead Switch	17	$1,379
vOS_10063	Overhead Switch	19	$16,991
vOS_10064	Overhead Switch	18	$18,443
vOS_10065	Overhead Switch	17	$1,349
vOS_10066	Overhead Switch	19	$1,213
vOS_10067	Overhead Switch	24	$2,716
vOS_10068	Overhead Switch	19	$16,971
vOS_10069	Overhead Switch	19	$1,177
vOS_10070	Overhead Switch	21	$3,256
vOS_10071	Overhead Switch	19	$3,583
vOS_10072	Overhead Switch	19	$1,177

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOS_10073	Overhead Switch	19	$16,680
vOS_10074	Overhead Switch	17	$1,410
vOS_10075	Overhead Switch	29	$9,617
vOS_10076	Overhead Switch	21	$1,078
vOS_10077	Overhead Switch	14	$5,175
vOS_10078	Overhead Switch	17	$1,349
vOS_10079	Overhead Switch	14	$5,175
vOS_10080	Overhead Switch	27	$2,221
vOS_10081	Overhead Switch	18	$1,249
vOS_10082	Overhead Switch	19	$1,230
vOS_10083	Overhead Switch	20	$1,099
vOS_10084	Overhead Switch	18	$1,316
vOS_10085	Overhead Switch	18	$1,281
vOS_10086	Overhead Switch	30	$9,121
vOS_10087	Overhead Switch	17	$1,362
vOS_10088	Overhead Switch	18	$1,283
vOS_10089	Overhead Switch	20	$1,099
vOS_10090	Overhead Switch	18	$1,249
vOS_10091	Overhead Switch	16	$4,334
vOS_10092	Overhead Switch	31	$8,597
vOS_10093	Overhead Switch	31	$8,597
vOS_10094	Overhead Switch	18	$1,316
vOS_10095	Overhead Switch	20	$1,137
vOS_10096	Overhead Switch	17	$19,267
vOS_10097	Overhead Switch	20	$1,138
vOS_10098	Overhead Switch	17	$1,379
vOS_10099	Overhead Switch	20	$1,099

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOS_10100	Overhead Switch	17	$1,363
vOS_10101	Overhead Switch	20	$1,099
vOS_10102	Overhead Switch	31	$8,597
vOS_10103	Overhead Switch	31	$1,820
vOS_10104	Overhead Switch	19	$1,193
vOS_10105	Overhead Switch	18	$1,316
vOS_10106	Overhead Switch	16	$1,482
vOS_10107	Overhead Switch	20	$1,138
vOS_10108	Overhead Switch	18	$1,265
vOS_10109	Overhead Switch	26	$11,169
vOS_10110	Overhead Switch	16	$21,222
vOS_10111	Overhead Switch	26	$2,340
vOS_10112	Overhead Switch	20	$1,138
vOS_10113	Overhead Switch	20	$1,138
vOS_10114	Overhead Switch	25	$2,453
vOS_10115	Overhead Switch	18	$1,316
vOS_10116	Overhead Switch	18	$1,283
vOS_10117	Overhead Switch	20	$1,138
vOS_10118	Overhead Switch	16	$21,222
vOS_10119	Overhead Switch	20	$1,099
vOS_10120	Overhead Switch	20	$1,099
vOS_10121	Overhead Switch	20	$1,099
vOS_10122	Overhead Switch	37	$6,569
vOS_10123	Overhead Switch	26	$2,422
vOS_10124	Overhead Switch	18	$1,283
vOS_10125	Overhead Switch	20	$1,157
vOS_10126	Overhead Switch	27	$2,310

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOS_10127	Overhead Switch	14	$5,175
vOS_10128	Overhead Switch	20	$1,099
vOS_10129	Overhead Switch	20	$1,099
vOS_10130	Overhead Switch	14	$5,175
vOS_10131	Overhead Switch	17	$1,410
vOS_10132	Overhead Switch	22	$1,015
vOS_10133	Overhead Switch	13	$1,921
vOS_10134	Overhead Switch	13	$1,921
vOS_10135	Overhead Switch	17	$19,289
vOS_10136	Overhead Switch	18	$1,283
vOS_10137	Overhead Switch	18	$1,316
vOS_10138	Overhead Switch	20	$1,157
vOS_10139	Overhead Switch	13	$1,921
vOS_10140	Overhead Switch	25	$2,507
vOS_10141	Overhead Switch	17	$1,440
vOS_10142	Overhead Switch	17	$19,291
vOS_10143	Overhead Switch	29	$9,663
vOS_10144	Overhead Switch	22	$2,952
vOS_10145	Overhead Switch	19	$1,177
vOS_10146	Overhead Switch	20	$1,157
vOS_10147	Overhead Switch	17	$4,029
vOS_10148	Overhead Switch	28	$2,189
vOS_10149	Overhead Switch	20	$1,138
vOT_15578	Overhead Transformer	28	$5,010
vOT_15579	Overhead Transformer	27	$7,016
vOT_15580	Overhead Transformer	32	$3,256
vOT_15581	Overhead Transformer	28	$5,010

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOT_15582	Overhead Transformer	28	$5,010
vOT_15583	Overhead Transformer	28	$5,010
vOT_15584	Overhead Transformer	27	$7,025
vOT_15585	Overhead Transformer	30	$3,538
vOT_15586	Overhead Transformer	28	$5,010
vOT_15587	Overhead Transformer	28	$5,010
vOT_15588	Overhead Transformer	26	$7,406
vOT_15589	Overhead Transformer	34	$2,950
vOT_15590	Overhead Transformer	30	$3,538
vOT_15591	Overhead Transformer	28	$5,010
vOT_15592	Overhead Transformer	28	$5,010
vOT_15593	Overhead Transformer	28	$5,010
vOT_15594	Overhead Transformer	15	$40,417
vOT_15595	Overhead Transformer	28	$5,010
vOT_15596	Overhead Transformer	35	$2,819
vOT_15597	Overhead Transformer	28	$5,010
vOT_15598	Overhead Transformer	28	$5,010
vOT_15599	Overhead Transformer	27	$7,016
vOT_15600	Overhead Transformer	28	$5,010
vOT_15601	Overhead Transformer	28	$5,010
vOT_15602	Overhead Transformer	27	$6,847
vOT_15603	Overhead Transformer	28	$5,010
vOT_15604	Overhead Transformer	28	$5,010
vOT_15605	Overhead Transformer	30	$3,538
vOT_15606	Overhead Transformer	26	$7,406
vOT_15607	Overhead Transformer	28	$6,548
vOT_15608	Overhead Transformer	28	$5,010

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOT_15609	Overhead Transformer	30	$3,538
vOT_15610	Overhead Transformer	15	$40,417
vOT_15611	Overhead Transformer	30	$4,483
vOT_15612	Overhead Transformer	30	$4,483
vOT_15613	Overhead Transformer	32	$3,244
vOT_15614	Overhead Transformer	30	$3,538
vOT_15615	Overhead Transformer	30	$3,538
vOT_15616	Overhead Transformer	30	$3,538
vOT_15617	Overhead Transformer	34	$2,950
vOT_15618	Overhead Transformer	30	$4,483
vOT_15619	Overhead Transformer	30	$3,538
vOT_15620	Overhead Transformer	30	$3,538
vOT_15621	Overhead Transformer	30	$4,483
vOT_15622	Overhead Transformer	28	$5,010
vOT_15623	Overhead Transformer	30	$4,483
vOT_15624	Overhead Transformer	30	$3,538
vOT_15625	Overhead Transformer	30	$4,483
vOT_15626	Overhead Transformer	30	$4,483
vOT_15627	Overhead Transformer	30	$4,483
vOT_15628	Overhead Transformer	30	$4,483
vOT_15629	Overhead Transformer	30	$3,538
vOT_15630	Overhead Transformer	34	$2,950
vOT_15631	Overhead Transformer	28	$5,010
vOT_15632	Overhead Transformer	30	$3,538
vOT_15633	Overhead Transformer	32	$3,244
vOT_15634	Overhead Transformer	30	$4,483
vOT_15635	Overhead Transformer	30	$4,483

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOT_15636	Overhead Transformer	30	$4,483
vOT_15637	Overhead Transformer	30	$3,538
vOT_15638	Overhead Transformer	26	$7,406
vOT_15639	Overhead Transformer	32	$3,244
vOT_15640	Overhead Transformer	32	$3,244
vOT_15641	Overhead Transformer	30	$3,538
vOT_15642	Overhead Transformer	30	$3,538
vOT_15643	Overhead Transformer	30	$4,483
vOT_15644	Overhead Transformer	28	$5,010
vOT_15645	Overhead Transformer	30	$4,483
vOT_15646	Overhead Transformer	30	$3,538
vOT_15647	Overhead Transformer	28	$5,010
vOT_15648	Overhead Transformer	30	$3,538
vOT_15649	Overhead Transformer	32	$3,244
vOT_15650	Overhead Transformer	30	$4,483
vOT_15651	Overhead Transformer	30	$3,538
vOT_15652	Overhead Transformer	30	$3,538
vOT_15653	Overhead Transformer	28	$5,010
vOT_15654	Overhead Transformer	30	$3,538
vOT_15655	Overhead Transformer	30	$3,538
vOT_15656	Overhead Transformer	34	$2,950
vOT_15657	Overhead Transformer	30	$4,483
vOT_15658	Overhead Transformer	30	$3,538
vOT_15659	Overhead Transformer	30	$4,483
vOT_15660	Overhead Transformer	30	$3,538
vOT_15661	Overhead Transformer	28	$5,010
vOT_15662	Overhead Transformer	28	$5,010

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOT_15663	Overhead Transformer	30	$3,538
vOT_15664	Overhead Transformer	30	$3,538
vOT_15665	Overhead Transformer	30	$4,483
vOT_15666	Overhead Transformer	30	$3,538
vOT_15667	Overhead Transformer	30	$3,538
vOT_15668	Overhead Transformer	28	$5,010
vOT_15669	Overhead Transformer	32	$3,244
vOT_15670	Overhead Transformer	30	$4,483
vOT_15671	Overhead Transformer	30	$4,483
vOT_15672	Overhead Transformer	28	$5,010
vOT_15673	Overhead Transformer	30	$4,483
vOT_15674	Overhead Transformer	30	$3,538
vOT_15675	Overhead Transformer	30	$3,538
vOT_15676	Overhead Transformer	32	$3,244
vOT_15677	Overhead Transformer	30	$3,538
vOT_15678	Overhead Transformer	30	$3,538
vOT_15679	Overhead Transformer	32	$3,244
vOT_15680	Overhead Transformer	28	$5,010
vOT_15681	Overhead Transformer	32	$3,244
vOT_15682	Overhead Transformer	28	$5,010
vOT_15683	Overhead Transformer	30	$3,538
vOT_15684	Overhead Transformer	28	$5,010
vOT_15685	Overhead Transformer	28	$5,010
vOT_15686	Overhead Transformer	32	$3,244
vOT_15687	Overhead Transformer	30	$4,483
vOT_15688	Overhead Transformer	28	$5,010
vOT_15689	Overhead Transformer	28	$5,010

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOT_15690	Overhead Transformer	30	$3,538
vOT_15691	Overhead Transformer	32	$3,244
vOT_15692	Overhead Transformer	30	$3,538
vOT_15693	Overhead Transformer	30	$3,538
vOT_15694	Overhead Transformer	34	$2,950
vOT_15695	Overhead Transformer	32	$3,244
vOT_15696	Overhead Transformer	28	$5,010
vOT_15697	Overhead Transformer	32	$3,244
vOT_15698	Overhead Transformer	25	$15,005
vOT_15699	Overhead Transformer	30	$3,538
vOT_15700	Overhead Transformer	28	$5,010
vOT_15701	Overhead Transformer	30	$3,538
vOT_15702	Overhead Transformer	32	$3,244
vOT_15703	Overhead Transformer	34	$2,950
vOT_15704	Overhead Transformer	30	$3,538
vOT_15705	Overhead Transformer	28	$5,010
vOT_15706	Overhead Transformer	30	$3,538
vOT_15707	Overhead Transformer	30	$4,483
vOT_15708	Overhead Transformer	28	$5,010
vOT_15709	Overhead Transformer	32	$3,244
vOT_15710	Overhead Transformer	30	$3,538
vOT_15711	Overhead Transformer	30	$4,483
vOT_15712	Overhead Transformer	28	$5,010
vOT_15713	Overhead Transformer	34	$2,950
vOT_15714	Overhead Transformer	30	$3,538
vOT_15715	Overhead Transformer	32	$3,244
vOT_15716	Overhead Transformer	34	$2,950

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOT_15717	Overhead Transformer	32	$3,244
vOT_15718	Overhead Transformer	28	$5,010
vOT_15719	Overhead Transformer	28	$5,010
vOT_15720	Overhead Transformer	32	$3,244
vOT_15721	Overhead Transformer	30	$3,538
vOT_15722	Overhead Transformer	28	$5,010
vOT_15723	Overhead Transformer	30	$3,538
vOT_15724	Overhead Transformer	32	$3,244
vOT_15725	Overhead Transformer	34	$2,950
vOT_15726	Overhead Transformer	34	$2,950
vOT_15727	Overhead Transformer	30	$4,483
vOT_15728	Overhead Transformer	30	$4,483
vOT_15729	Overhead Transformer	30	$4,483
vOT_15730	Overhead Transformer	32	$3,244
vOT_15731	Overhead Transformer	30	$4,483
vOT_15732	Overhead Transformer	30	$4,483
vOT_15733	Overhead Transformer	30	$4,483
vOT_15734	Overhead Transformer	30	$3,538
vOT_15735	Overhead Transformer	30	$4,483
vOT_15736	Overhead Transformer	30	$3,538
vOT_15737	Overhead Transformer	30	$4,483
vOT_15738	Overhead Transformer	32	$3,244
vOT_15739	Overhead Transformer	28	$5,010
vOT_15740	Overhead Transformer	32	$3,244
vOT_15741	Overhead Transformer	30	$3,538
vOT_15742	Overhead Transformer	32	$3,244
vOT_15743	Overhead Transformer	30	$4,483

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOT_15744	Overhead Transformer	32	$3,244
vOT_15745	Overhead Transformer	30	$4,483
vOT_15746	Overhead Transformer	30	$3,538
vOT_15747	Overhead Transformer	30	$3,538
vOT_15748	Overhead Transformer	30	$3,538
vOT_15749	Overhead Transformer	30	$3,538
vOT_15750	Overhead Transformer	32	$3,244
vOT_15751	Overhead Transformer	30	$3,538
vOT_15752	Overhead Transformer	30	$3,538
vOT_15753	Overhead Transformer	32	$3,244
vOT_15754	Overhead Transformer	30	$4,483
vOT_15755	Overhead Transformer	30	$3,538
vOT_15756	Overhead Transformer	30	$3,538
vOT_15757	Overhead Transformer	30	$3,538
vOT_15758	Overhead Transformer	30	$3,538
vOT_15759	Overhead Transformer	30	$3,538
vOT_15760	Overhead Transformer	28	$5,010
vOT_15761	Overhead Transformer	28	$5,010
vOT_15762	Overhead Transformer	30	$4,483
vOT_15763	Overhead Transformer	28	$5,010
vOT_15764	Overhead Transformer	28	$5,010
vOT_15765	Overhead Transformer	30	$4,483
vOT_15766	Overhead Transformer	28	$5,010
vOT_15767	Overhead Transformer	28	$5,010
vOT_15768	Overhead Transformer	28	$5,010
vOT_15769	Overhead Transformer	28	$5,010
vOT_15770	Overhead Transformer	32	$3,244

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vOT_15771	Overhead Transformer	30	$3,538
vOT_15772	Overhead Transformer	28	$5,010
vOT_15773	Overhead Transformer	28	$5,010
vOT_15774	Overhead Transformer	30	$3,538
vOT_15775	Overhead Transformer	30	$3,538
vOT_15776	Overhead Transformer	30	$4,483
vOT_15777	Overhead Transformer	28	$5,010
vOT_15778	Overhead Transformer	30	$3,538
vOT_15779	Overhead Transformer	30	$4,483
vOT_15780	Overhead Transformer	28	$5,010
vOT_15781	Overhead Transformer	28	$5,010
vOT_15782	Overhead Transformer	30	$4,483
vOT_15783	Overhead Transformer	30	$4,483
vOT_15784	Overhead Transformer	28	$5,010
vOT_15785	Overhead Transformer	28	$5,010
vOT_15786	Overhead Transformer	28	$5,010
vOT_15787	Overhead Transformer	30	$4,483
vOT_15788	Overhead Transformer	30	$3,538
vOT_15789	Overhead Transformer	30	$3,538
vOT_15790	Overhead Transformer	28	$5,010
vOT_15791	Overhead Transformer	32	$3,244
vOT_15792	Overhead Transformer	32	$3,244
vOT_15793	Overhead Transformer	30	$4,483
vOT_15794	Overhead Transformer	30	$3,538
vPO_37552	Poles	51	$2,438
vPO_37553	Poles	82	$1,350
vPO_37554	Poles	67	$1,723

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37555	Poles	65	$1,708
vPO_37556	Poles	65	$1,708
vPO_37557	Poles	51	$2,435
vPO_37558	Poles	67	$1,624
vPO_37559	Poles	76	$1,694
vPO_37560	Poles	76	$1,190
vPO_37561	Poles	99	$605
vPO_37562	Poles	77	$1,270
vPO_37563	Poles	67	$1,720
vPO_37564	Poles	51	$2,435
vPO_37565	Poles	71	$1,648
vPO_37566	Poles	99	$487
vPO_37567	Poles	99	$606
vPO_37568	Poles	74	$1,620
vPO_37569	Poles	67	$1,720
vPO_37570	Poles	76	$1,191
vPO_37571	Poles	99	$275
vPO_37572	Poles	99	$275
vPO_37573	Poles	75	$1,862
vPO_37574	Poles	51	$2,435
vPO_37575	Poles	99	$280
vPO_37576	Poles	99	$483
vPO_37577	Poles	80	$1,295
vPO_37578	Poles	99	$349
vPO_37579	Poles	99	$609
vPO_37580	Poles	99	$605
vPO_37581	Poles	99	$276

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37582	Poles	54	$2,503
vPO_37583	Poles	67	$1,719
vPO_37584	Poles	99	$240
vPO_37585	Poles	99	$609
vPO_37586	Poles	78	$1,267
vPO_37587	Poles	63	$1,692
vPO_37588	Poles	63	$1,688
vPO_37589	Poles	50	$2,398
vPO_37590	Poles	99	$605
vPO_37591	Poles	78	$1,267
vPO_37592	Poles	99	$605
vPO_37593	Poles	78	$1,267
vPO_37594	Poles	99	$605
vPO_37595	Poles	99	$605
vPO_37596	Poles	67	$1,726
vPO_37597	Poles	51	$2,435
vPO_37598	Poles	78	$1,267
vPO_37599	Poles	99	$280
vPO_37600	Poles	99	$189
vPO_37601	Poles	67	$1,720
vPO_37602	Poles	67	$1,719
vPO_37603	Poles	65	$1,705
vPO_37604	Poles	53	$2,470
vPO_37605	Poles	53	$2,474
vPO_37606	Poles	52	$2,452
vPO_37607	Poles	76	$1,311
vPO_37608	Poles	99	$280

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37609	Poles	99	$609
vPO_37610	Poles	99	$352
vPO_37611	Poles	73	$1,661
vPO_37612	Poles	99	$353
vPO_37613	Poles	65	$1,705
vPO_37614	Poles	80	$1,273
vPO_37615	Poles	99	$606
vPO_37616	Poles	75	$1,186
vPO_37617	Poles	51	$2,438
vPO_37618	Poles	73	$1,664
vPO_37619	Poles	76	$1,194
vPO_37620	Poles	75	$1,190
vPO_37621	Poles	67	$1,719
vPO_37622	Poles	76	$1,191
vPO_37623	Poles	99	$605
vPO_37624	Poles	99	$605
vPO_37625	Poles	65	$1,704
vPO_37626	Poles	54	$2,505
vPO_37627	Poles	54	$2,505
vPO_37628	Poles	74	$1,620
vPO_37629	Poles	79	$1,197
vPO_37630	Poles	75	$1,186
vPO_37631	Poles	99	$606
vPO_37632	Poles	72	$1,612
vPO_37633	Poles	99	$609
vPO_37634	Poles	99	$606
vPO_37635	Poles	99	$605

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37636	Poles	67	$1,723
vPO_37637	Poles	53	$2,474
vPO_37638	Poles	99	$606
vPO_37639	Poles	99	$609
vPO_37640	Poles	63	$2,414
vPO_37641	Poles	99	$307
vPO_37642	Poles	99	$247
vPO_37643	Poles	55	$3,155
vPO_37644	Poles	99	$229
vPO_37645	Poles	62	$2,338
vPO_37646	Poles	99	$299
vPO_37647	Poles	57	$2,690
vPO_37648	Poles	99	$299
vPO_37649	Poles	99	$211
vPO_37650	Poles	99	$189
vPO_37651	Poles	99	$207
vPO_37652	Poles	99	$284
vPO_37653	Poles	99	$373
vPO_37654	Poles	99	$376
vPO_37655	Poles	58	$3,023
vPO_37656	Poles	99	$207
vPO_37657	Poles	58	$2,699
vPO_37658	Poles	57	$2,690
vPO_37659	Poles	60	$3,395
vPO_37660	Poles	94	$879
vPO_37661	Poles	99	$284
vPO_37662	Poles	99	$201

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37663	Poles	99	$307
vPO_37664	Poles	59	$2,840
vPO_37665	Poles	99	$299
vPO_37666	Poles	57	$2,690
vPO_37667	Poles	63	$2,419
vPO_37668	Poles	94	$886
vPO_37669	Poles	99	$373
vPO_37670	Poles	57	$2,690
vPO_37671	Poles	99	$197
vPO_37672	Poles	99	$193
vPO_37673	Poles	99	$201
vPO_37674	Poles	99	$197
vPO_37675	Poles	57	$2,695
vPO_37676	Poles	99	$303
vPO_37677	Poles	99	$229
vPO_37678	Poles	46	$5,284
vPO_37679	Poles	70	$1,831
vPO_37680	Poles	62	$2,367
vPO_37681	Poles	99	$303
vPO_37682	Poles	60	$2,824
vPO_37683	Poles	56	$2,974
vPO_37684	Poles	84	$1,051
vPO_37685	Poles	99	$197
vPO_37686	Poles	99	$197
vPO_37687	Poles	99	$376
vPO_37688	Poles	99	$225
vPO_37689	Poles	99	$197

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37690	Poles	99	$201
vPO_37691	Poles	57	$2,690
vPO_37692	Poles	59	$2,943
vPO_37693	Poles	99	$198
vPO_37694	Poles	99	$208
vPO_37695	Poles	70	$1,833
vPO_37696	Poles	57	$2,690
vPO_37697	Poles	62	$2,489
vPO_37698	Poles	99	$197
vPO_37699	Poles	99	$189
vPO_37700	Poles	99	$207
vPO_37701	Poles	57	$2,690
vPO_37702	Poles	99	$193
vPO_37703	Poles	58	$2,699
vPO_37704	Poles	57	$2,695
vPO_37705	Poles	99	$189
vPO_37706	Poles	59	$2,746
vPO_37707	Poles	99	$303
vPO_37708	Poles	99	$198
vPO_37709	Poles	99	$211
vPO_37710	Poles	99	$339
vPO_37711	Poles	99	$197
vPO_37712	Poles	96	$862
vPO_37713	Poles	99	$208
vPO_37714	Poles	99	$280
vPO_37715	Poles	99	$189
vPO_37716	Poles	63	$2,554

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37717	Poles	99	$303
vPO_37718	Poles	99	$202
vPO_37719	Poles	57	$2,690
vPO_37720	Poles	99	$303
vPO_37721	Poles	99	$225
vPO_37722	Poles	99	$358
vPO_37723	Poles	99	$299
vPO_37724	Poles	57	$2,838
vPO_37725	Poles	99	$303
vPO_37726	Poles	57	$2,695
vPO_37727	Poles	99	$413
vPO_37728	Poles	99	$189
vPO_37729	Poles	61	$3,115
vPO_37730	Poles	99	$189
vPO_37731	Poles	99	$299
vPO_37732	Poles	63	$2,506
vPO_37733	Poles	99	$303
vPO_37734	Poles	99	$299
vPO_37735	Poles	99	$208
vPO_37736	Poles	67	$1,720
vPO_37737	Poles	99	$281
vPO_37738	Poles	30	$6,623
vPO_37739	Poles	30	$6,624
vPO_37740	Poles	30	$7,609
vPO_37741	Poles	29	$7,348
vPO_37742	Poles	30	$6,623
vPO_37743	Poles	99	$284

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37744	Poles	30	$6,623
vPO_37745	Poles	30	$6,623
vPO_37746	Poles	30	$6,623
vPO_37747	Poles	30	$6,658
vPO_37748	Poles	30	$6,658
vPO_37749	Poles	21	$13,726
vPO_37750	Poles	31	$7,120
vPO_37751	Poles	29	$7,385
vPO_37752	Poles	30	$7,586
vPO_37753	Poles	29	$7,387
vPO_37754	Poles	31	$6,879
vPO_37755	Poles	31	$7,094
vPO_37756	Poles	31	$6,879
vPO_37757	Poles	31	$6,873
vPO_37758	Poles	28	$7,111
vPO_37759	Poles	30	$6,623
vPO_37760	Poles	29	$7,386
vPO_37761	Poles	30	$6,623
vPO_37762	Poles	30	$6,814
vPO_37763	Poles	30	$6,623
vPO_37764	Poles	99	$288
vPO_37765	Poles	99	$289
vPO_37766	Poles	99	$299
vPO_37767	Poles	99	$421
vPO_37768	Poles	99	$197
vPO_37769	Poles	99	$244
vPO_37770	Poles	99	$417

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37771	Poles	27	$8,162
vPO_37772	Poles	99	$299
vPO_37773	Poles	99	$243
vPO_37774	Poles	99	$289
vPO_37775	Poles	99	$262
vPO_37776	Poles	99	$262
vPO_37777	Poles	99	$174
vPO_37778	Poles	99	$197
vPO_37779	Poles	27	$7,863
vPO_37780	Poles	99	$197
vPO_37781	Poles	28	$8,991
vPO_37782	Poles	90	$872
vPO_37783	Poles	99	$170
vPO_37784	Poles	27	$8,163
vPO_37785	Poles	99	$367
vPO_37786	Poles	99	$197
vPO_37787	Poles	99	$417
vPO_37788	Poles	99	$288
vPO_37789	Poles	99	$262
vPO_37790	Poles	99	$293
vPO_37791	Poles	99	$363
vPO_37792	Poles	99	$363
vPO_37793	Poles	99	$293
vPO_37794	Poles	99	$243
vPO_37795	Poles	99	$170
vPO_37796	Poles	99	$170
vPO_37797	Poles	28	$8,454

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37798	Poles	27	$8,162
vPO_37799	Poles	99	$303
vPO_37800	Poles	28	$8,373
vPO_37801	Poles	99	$243
vPO_37802	Poles	99	$174
vPO_37803	Poles	99	$262
vPO_37804	Poles	99	$299
vPO_37805	Poles	27	$8,163
vPO_37806	Poles	99	$197
vPO_37807	Poles	99	$197
vPO_37808	Poles	99	$290
vPO_37809	Poles	99	$243
vPO_37810	Poles	27	$8,173
vPO_37811	Poles	99	$289
vPO_37812	Poles	99	$170
vPO_37813	Poles	28	$8,366
vPO_37814	Poles	99	$225
vPO_37815	Poles	99	$262
vPO_37816	Poles	99	$266
vPO_37817	Poles	99	$243
vPO_37818	Poles	99	$417
vPO_37819	Poles	99	$262
vPO_37820	Poles	99	$152
vPO_37821	Poles	99	$170
vPO_37822	Poles	99	$247
vPO_37823	Poles	99	$170
vPO_37824	Poles	99	$299

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37825	Poles	75	$1,211
vPO_37826	Poles	99	$299
vPO_37827	Poles	93	$924
vPO_37828	Poles	99	$362
vPO_37829	Poles	75	$1,211
vPO_37830	Poles	27	$8,162
vPO_37831	Poles	99	$156
vPO_37832	Poles	99	$197
vPO_37833	Poles	83	$1,160
vPO_37834	Poles	99	$262
vPO_37835	Poles	99	$299
vPO_37836	Poles	99	$201
vPO_37837	Poles	99	$197
vPO_37838	Poles	99	$367
vPO_37839	Poles	99	$243
vPO_37840	Poles	99	$362
vPO_37841	Poles	99	$421
vPO_37842	Poles	27	$7,863
vPO_37843	Poles	78	$1,218
vPO_37844	Poles	27	$8,162
vPO_37845	Poles	99	$299
vPO_37846	Poles	99	$298
vPO_37847	Poles	99	$247
vPO_37848	Poles	99	$247
vPO_37849	Poles	75	$1,211
vPO_37850	Poles	27	$7,863
vPO_37851	Poles	99	$197

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37852	Poles	99	$299
vPO_37853	Poles	99	$289
vPO_37854	Poles	99	$262
vPO_37855	Poles	99	$262
vPO_37856	Poles	99	$201
vPO_37857	Poles	99	$243
vPO_37858	Poles	27	$8,162
vPO_37859	Poles	99	$299
vPO_37860	Poles	27	$8,162
vPO_37861	Poles	99	$189
vPO_37862	Poles	78	$1,218
vPO_37863	Poles	99	$266
vPO_37864	Poles	27	$8,163
vPO_37865	Poles	99	$289
vPO_37866	Poles	99	$197
vPO_37867	Poles	99	$152
vPO_37868	Poles	99	$262
vPO_37869	Poles	99	$262
vPO_37870	Poles	99	$266
vPO_37871	Poles	99	$264
vPO_37872	Poles	99	$303
vPO_37873	Poles	28	$8,390
vPO_37874	Poles	99	$289
vPO_37875	Poles	99	$290
vPO_37876	Poles	28	$8,441
vPO_37877	Poles	99	$299
vPO_37878	Poles	99	$243

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37879	Poles	99	$243
vPO_37880	Poles	99	$303
vPO_37881	Poles	99	$417
vPO_37882	Poles	99	$293
vPO_37883	Poles	99	$289
vPO_37884	Poles	99	$362
vPO_37885	Poles	28	$8,326
vPO_37886	Poles	75	$1,211
vPO_37887	Poles	27	$8,162
vPO_37888	Poles	99	$266
vPO_37889	Poles	99	$418
vPO_37890	Poles	99	$299
vPO_37891	Poles	99	$262
vPO_37892	Poles	28	$8,712
vPO_37893	Poles	88	$1,083
vPO_37894	Poles	66	$2,179
vPO_37895	Poles	89	$1,075
vPO_37896	Poles	88	$1,083
vPO_37897	Poles	88	$1,083
vPO_37898	Poles	89	$1,075
vPO_37899	Poles	91	$1,096
vPO_37900	Poles	88	$1,083
vPO_37901	Poles	72	$2,003
vPO_37902	Poles	88	$1,083
vPO_37903	Poles	69	$1,932
vPO_37904	Poles	89	$1,075
vPO_37905	Poles	28	$9,132

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37906	Poles	99	$220
vPO_37907	Poles	99	$347
vPO_37908	Poles	99	$220
vPO_37909	Poles	99	$344
vPO_37910	Poles	99	$220
vPO_37911	Poles	99	$216
vPO_37912	Poles	99	$217
vPO_37913	Poles	99	$344
vPO_37914	Poles	99	$344
vPO_37915	Poles	99	$216
vPO_37916	Poles	99	$248
vPO_37917	Poles	99	$217
vPO_37918	Poles	99	$344
vPO_37919	Poles	63	$1,990
vPO_37920	Poles	99	$347
vPO_37921	Poles	99	$344
vPO_37922	Poles	99	$347
vPO_37923	Poles	99	$245
vPO_37924	Poles	99	$344
vPO_37925	Poles	99	$344
vPO_37926	Poles	99	$344
vPO_37927	Poles	99	$245
vPO_37928	Poles	99	$344
vPO_37929	Poles	68	$1,939
vPO_37930	Poles	99	$347
vPO_37931	Poles	99	$344
vPO_37932	Poles	99	$216

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37933	Poles	99	$344
vPO_37934	Poles	99	$248
vPO_37935	Poles	99	$344
vPO_37936	Poles	99	$344
vPO_37937	Poles	64	$1,884
vPO_37938	Poles	99	$344
vPO_37939	Poles	99	$347
vPO_37940	Poles	99	$244
vPO_37941	Poles	99	$344
vPO_37942	Poles	99	$344
vPO_37943	Poles	99	$344
vPO_37944	Poles	93	$817
vPO_37945	Poles	90	$930
vPO_37946	Poles	31	$6,231
vPO_37947	Poles	99	$307
vPO_37948	Poles	31	$6,198
vPO_37949	Poles	31	$6,198
vPO_37950	Poles	31	$6,280
vPO_37951	Poles	92	$917
vPO_37952	Poles	87	$1,138
vPO_37953	Poles	99	$271
vPO_37954	Poles	92	$917
vPO_37955	Poles	91	$936
vPO_37956	Poles	99	$271
vPO_37957	Poles	84	$1,167
vPO_37958	Poles	91	$936
vPO_37959	Poles	91	$1,009

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of new overhead rear lot (NPV)
Total			$2,372,329
vPO_37960	Poles	90	$939
vPO_37961	Poles	92	$918
vPO_37962	Poles	91	$936
vPO_37963	Poles	91	$936
vPO_37964	Poles	96	$986
vPO_37965	Poles	74	$1,647
vPO_37966	Poles	90	$935
vPO_37967	Poles	92	$917
vPO_37968	Poles	91	$1,009
vPO_37969	Poles	92	$1,067
vPO_37970	Poles	91	$1,010
vPO_37971	Poles	99	$225
vPO_37972	Poles	79	$1,574
vPO_37973	Poles	85	$1,132
vPO_37974	Poles	91	$1,014
vPO_37975	Poles	99	$703
vPO_37976	Poles	99	$225
vPO_37977	Poles	74	$1,660
vPO_37978	Poles	26	$11,726
vPO_37979	Poles	99	$271
vPO_37980	Poles	27	$12,586
vPO_37981	Poles	86	$1,053

Projected non-asset risk cost of overhead front lot (NPV)

Event Cost Total = $39,781,880.85

Duration Cost Total = $44,265,053.41

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

NAR = $84,046,934.25

Maintenance

Tree Trimming = $39,551.97

Wood Pole Inspections = $1,271.66

Discount Rate = 0.0606

Total = ($39,551.97 + $1,271.66) / 0.0606 = $673,657.31

Option 3: Replacement of Existing O/H Rear Lot with New O/H Front Lot

Table 3: Input data for Projected Risk Cost of Overhead Front Lot

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOS_10000	Overhead Switch	21	$283
vOS_10001	Overhead Switch	21	$283
vOS_10002	Overhead Switch	43	$283
vOS_10003	Overhead Switch	27	$283
vOS_10004	Overhead Switch	19	$283
vOS_10005	Overhead Switch	20	$283
vOS_10006	Overhead Switch	42	$283
vOS_10007	Overhead Switch	15	$284
vOS_10008	Overhead Switch	21	$283
vOS_10009	Overhead Switch	34	$283
vOS_10010	Overhead Switch	21	$283
vOS_10011	Overhead Switch	17	$283
vOS_10012	Overhead Switch	22	$283
vOS_10013	Overhead Switch	14	$283

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOS_10014	Overhead Switch	14	$283
vOS_10015	Overhead Switch	27	$285
vOS_10016	Overhead Switch	19	$283
vOS_10017	Overhead Switch	18	$283
vOS_10018	Overhead Switch	20	$283
vOS_10019	Overhead Switch	14	$283
vOS_10020	Overhead Switch	39	$283
vOS_10021	Overhead Switch	17	$283
vOS_10022	Overhead Switch	17	$289
vOS_10023	Overhead Switch	46	$283
vOS_10024	Overhead Switch	34	$283
vOS_10025	Overhead Switch	20	$283
vOS_10026	Overhead Switch	20	$283
vOS_10027	Overhead Switch	26	$283
vOS_10028	Overhead Switch	29	$283
vOS_10029	Overhead Switch	32	$283
vOS_9910	Overhead Switch	30	$283
vOS_9911	Overhead Switch	30	$283
vOS_9912	Overhead Switch	20	$283
vOS_9913	Overhead Switch	8	$285
vOS_9914	Overhead Switch	18	$283
vOS_9915	Overhead Switch	14	$292
vOS_9916	Overhead Switch	38	$283
vOS_9917	Overhead Switch	35	$283
vOS_9918	Overhead Switch	18	$283
vOS_9919	Overhead Switch	35	$284
vOS_9920	Overhead Switch	20	$283

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOS_9921	Overhead Switch	23	$285
vOS_9922	Overhead Switch	60	$283
vOS_9923	Overhead Switch	8	$285
vOS_9924	Overhead Switch	28	$284
vOS_9925	Overhead Switch	32	$283
vOS_9926	Overhead Switch	17	$283
vOS_9927	Overhead Switch	21	$283
vOS_9928	Overhead Switch	43	$283
vOS_9929	Overhead Switch	27	$285
vOS_9930	Overhead Switch	17	$283
vOS_9931	Overhead Switch	28	$284
vOS_9932	Overhead Switch	29	$283
vOS_9933	Overhead Switch	30	$284
vOS_9934	Overhead Switch	28	$284
vOS_9935	Overhead Switch	18	$288
vOS_9936	Overhead Switch	28	$284
vOS_9937	Overhead Switch	28	$284
vOS_9938	Overhead Switch	29	$283
vOS_9939	Overhead Switch	20	$283
vOS_9940	Overhead Switch	20	$283
vOS_9941	Overhead Switch	25	$283
vOS_9942	Overhead Switch	18	$283
vOS_9943	Overhead Switch	30	$284
vOS_9944	Overhead Switch	28	$284
vOS_9945	Overhead Switch	18	$283
vOS_9946	Overhead Switch	19	$283
vOS_9947	Overhead Switch	36	$283

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOS_9948	Overhead Switch	30	$284
vOS_9949	Overhead Switch	20	$283
vOS_9950	Overhead Switch	31	$283
vOS_9951	Overhead Switch	20	$283
vOS_9952	Overhead Switch	20	$283
vOS_9953	Overhead Switch	24	$285
vOS_9954	Overhead Switch	17	$283
vOS_9955	Overhead Switch	35	$284
vOS_9956	Overhead Switch	21	$283
vOS_9957	Overhead Switch	15	$284
vOS_9958	Overhead Switch	18	$283
vOS_9959	Overhead Switch	15	$284
vOS_9960	Overhead Switch	28	$283
vOS_9961	Overhead Switch	19	$283
vOS_9962	Overhead Switch	19	$283
vOS_9963	Overhead Switch	21	$283
vOS_9964	Overhead Switch	18	$283
vOS_9965	Overhead Switch	29	$283
vOS_9966	Overhead Switch	48	$283
vOS_9967	Overhead Switch	18	$283
vOS_9968	Overhead Switch	19	$283
vOS_9969	Overhead Switch	21	$283
vOS_9970	Overhead Switch	19	$283
vOS_9971	Overhead Switch	24	$283
vOS_9972	Overhead Switch	30	$284
vOS_9973	Overhead Switch	30	$284
vOS_9974	Overhead Switch	18	$283

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOS_9975	Overhead Switch	32	$283
vOS_9976	Overhead Switch	17	$289
vOS_9977	Overhead Switch	20	$283
vOS_9978	Overhead Switch	18	$283
vOS_9979	Overhead Switch	21	$283
vOS_9980	Overhead Switch	27	$283
vOS_9981	Overhead Switch	34	$283
vOS_9982	Overhead Switch	30	$284
vOS_9983	Overhead Switch	52	$283
vOS_9984	Overhead Switch	20	$283
vOS_9985	Overhead Switch	18	$283
vOS_9986	Overhead Switch	17	$283
vOS_9987	Overhead Switch	20	$283
vOS_9988	Overhead Switch	29	$283
vOS_9989	Overhead Switch	41	$283
vOS_9990	Overhead Switch	25	$285
vOS_9991	Overhead Switch	41	$283
vOS_9992	Overhead Switch	20	$283
vOS_9993	Overhead Switch	20	$283
vOS_9994	Overhead Switch	40	$283
vOS_9995	Overhead Switch	18	$283
vOS_9996	Overhead Switch	19	$283
vOS_9997	Overhead Switch	20	$283
vOS_9998	Overhead Switch	25	$285
vOS_9999	Overhead Switch	21	$283
vOT_15332	Overhead Transformer	40	$2,948
vOT_15333	Overhead Transformer	22	$9,263

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOT_15334	Overhead Transformer	27	$3,989
vOT_15335	Overhead Transformer	23	$6,476
vOT_15336	Overhead Transformer	23	$6,476
vOT_15337	Overhead Transformer	23	$6,476
vOT_15338	Overhead Transformer	37	$4,341
vOT_15339	Overhead Transformer	26	$4,404
vOT_15340	Overhead Transformer	23	$6,476
vOT_15341	Overhead Transformer	23	$6,476
vOT_15342	Overhead Transformer	23	$8,804
vOT_15343	Overhead Transformer	30	$3,527
vOT_15344	Overhead Transformer	26	$4,404
vOT_15345	Overhead Transformer	23	$6,476
vOT_15346	Overhead Transformer	23	$6,476
vOT_15347	Overhead Transformer	40	$2,948
vOT_15348	Overhead Transformer	20	$27,525
vOT_15349	Overhead Transformer	23	$6,476
vOT_15350	Overhead Transformer	31	$3,326
vOT_15351	Overhead Transformer	23	$6,476
vOT_15352	Overhead Transformer	40	$2,948
vOT_15353	Overhead Transformer	37	$4,333
vOT_15354	Overhead Transformer	40	$2,948
vOT_15355	Overhead Transformer	23	$6,476
vOT_15356	Overhead Transformer	25	$7,955
vOT_15357	Overhead Transformer	23	$6,476
vOT_15358	Overhead Transformer	23	$6,476
vOT_15359	Overhead Transformer	26	$4,404
vOT_15360	Overhead Transformer	23	$8,804

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOT_15361	Overhead Transformer	26	$7,491
vOT_15362	Overhead Transformer	40	$2,948
vOT_15363	Overhead Transformer	26	$4,404
vOT_15364	Overhead Transformer	12	$53,592
vOT_15365	Overhead Transformer	25	$5,741
vOT_15366	Overhead Transformer	25	$5,741
vOT_15367	Overhead Transformer	48	$1,650
vOT_15368	Overhead Transformer	26	$4,404
vOT_15369	Overhead Transformer	26	$4,404
vOT_15370	Overhead Transformer	26	$4,404
vOT_15371	Overhead Transformer	53	$1,396
vOT_15372	Overhead Transformer	25	$5,741
vOT_15373	Overhead Transformer	26	$4,404
vOT_15374	Overhead Transformer	26	$4,404
vOT_15375	Overhead Transformer	25	$5,741
vOT_15376	Overhead Transformer	23	$6,476
vOT_15377	Overhead Transformer	25	$5,741
vOT_15378	Overhead Transformer	26	$4,404
vOT_15379	Overhead Transformer	25	$5,741
vOT_15380	Overhead Transformer	25	$5,741
vOT_15381	Overhead Transformer	25	$5,741
vOT_15382	Overhead Transformer	44	$2,515
vOT_15383	Overhead Transformer	26	$4,404
vOT_15384	Overhead Transformer	30	$3,527
vOT_15385	Overhead Transformer	23	$6,476
vOT_15386	Overhead Transformer	26	$4,404
vOT_15387	Overhead Transformer	28	$3,971

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOT_15388	Overhead Transformer	44	$2,515
vOT_15389	Overhead Transformer	25	$5,741
vOT_15390	Overhead Transformer	25	$5,741
vOT_15391	Overhead Transformer	26	$4,404
vOT_15392	Overhead Transformer	40	$3,893
vOT_15393	Overhead Transformer	28	$3,971
vOT_15394	Overhead Transformer	28	$3,971
vOT_15395	Overhead Transformer	26	$4,404
vOT_15396	Overhead Transformer	26	$4,404
vOT_15397	Overhead Transformer	25	$5,741
vOT_15398	Overhead Transformer	23	$6,476
vOT_15399	Overhead Transformer	25	$5,741
vOT_15400	Overhead Transformer	26	$4,404
vOT_15401	Overhead Transformer	23	$6,476
vOT_15402	Overhead Transformer	26	$4,404
vOT_15403	Overhead Transformer	28	$3,971
vOT_15404	Overhead Transformer	25	$5,741
vOT_15405	Overhead Transformer	26	$4,404
vOT_15406	Overhead Transformer	26	$4,404
vOT_15407	Overhead Transformer	23	$6,476
vOT_15408	Overhead Transformer	26	$4,404
vOT_15409	Overhead Transformer	26	$4,404
vOT_15410	Overhead Transformer	30	$3,527
vOT_15411	Overhead Transformer	25	$5,741
vOT_15412	Overhead Transformer	26	$4,404
vOT_15413	Overhead Transformer	25	$5,741
vOT_15414	Overhead Transformer	26	$4,404

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOT_15415	Overhead Transformer	23	$6,476
vOT_15416	Overhead Transformer	23	$6,476
vOT_15417	Overhead Transformer	26	$4,404
vOT_15418	Overhead Transformer	26	$4,404
vOT_15419	Overhead Transformer	25	$5,741
vOT_15420	Overhead Transformer	26	$4,404
vOT_15421	Overhead Transformer	26	$4,404
vOT_15422	Overhead Transformer	23	$6,476
vOT_15423	Overhead Transformer	28	$3,971
vOT_15424	Overhead Transformer	25	$5,741
vOT_15425	Overhead Transformer	25	$5,741
vOT_15426	Overhead Transformer	23	$6,476
vOT_15427	Overhead Transformer	25	$5,741
vOT_15428	Overhead Transformer	26	$4,404
vOT_15429	Overhead Transformer	26	$4,404
vOT_15430	Overhead Transformer	28	$3,971
vOT_15431	Overhead Transformer	26	$4,404
vOT_15432	Overhead Transformer	26	$4,404
vOT_15433	Overhead Transformer	48	$1,650
vOT_15434	Overhead Transformer	23	$6,476
vOT_15435	Overhead Transformer	28	$3,971
vOT_15436	Overhead Transformer	23	$6,476
vOT_15437	Overhead Transformer	26	$4,404
vOT_15438	Overhead Transformer	23	$6,476
vOT_15439	Overhead Transformer	23	$6,476
vOT_15440	Overhead Transformer	28	$3,971
vOT_15441	Overhead Transformer	25	$5,741

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOT_15442	Overhead Transformer	23	$6,476
vOT_15443	Overhead Transformer	23	$6,476
vOT_15444	Overhead Transformer	26	$4,404
vOT_15445	Overhead Transformer	28	$3,971
vOT_15446	Overhead Transformer	44	$1,902
vOT_15447	Overhead Transformer	26	$4,404
vOT_15448	Overhead Transformer	30	$3,527
vOT_15449	Overhead Transformer	48	$1,650
vOT_15450	Overhead Transformer	40	$2,948
vOT_15451	Overhead Transformer	48	$1,650
vOT_15452	Overhead Transformer	36	$8,738
vOT_15453	Overhead Transformer	26	$4,404
vOT_15454	Overhead Transformer	23	$6,476
vOT_15455	Overhead Transformer	44	$1,902
vOT_15456	Overhead Transformer	48	$1,650
vOT_15457	Overhead Transformer	30	$3,527
vOT_15458	Overhead Transformer	26	$4,404
vOT_15459	Overhead Transformer	23	$6,476
vOT_15460	Overhead Transformer	44	$1,902
vOT_15461	Overhead Transformer	25	$5,741
vOT_15462	Overhead Transformer	23	$6,476
vOT_15463	Overhead Transformer	28	$3,971
vOT_15464	Overhead Transformer	26	$4,404
vOT_15465	Overhead Transformer	44	$2,515
vOT_15466	Overhead Transformer	23	$6,476
vOT_15467	Overhead Transformer	30	$3,527
vOT_15468	Overhead Transformer	44	$1,902

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOT_15469	Overhead Transformer	28	$3,971
vOT_15470	Overhead Transformer	30	$3,527
vOT_15471	Overhead Transformer	28	$3,971
vOT_15472	Overhead Transformer	23	$6,476
vOT_15473	Overhead Transformer	23	$6,476
vOT_15474	Overhead Transformer	28	$3,971
vOT_15475	Overhead Transformer	44	$1,902
vOT_15476	Overhead Transformer	23	$6,476
vOT_15477	Overhead Transformer	26	$4,404
vOT_15478	Overhead Transformer	48	$1,650
vOT_15479	Overhead Transformer	53	$1,396
vOT_15480	Overhead Transformer	30	$3,527
vOT_15481	Overhead Transformer	25	$5,741
vOT_15482	Overhead Transformer	29	$8,334
vOT_15483	Overhead Transformer	25	$5,741
vOT_15484	Overhead Transformer	48	$1,650
vOT_15485	Overhead Transformer	44	$2,515
vOT_15486	Overhead Transformer	25	$5,741
vOT_15487	Overhead Transformer	25	$5,741
vOT_15488	Overhead Transformer	44	$1,902
vOT_15489	Overhead Transformer	25	$5,741
vOT_15490	Overhead Transformer	26	$4,404
vOT_15491	Overhead Transformer	25	$5,741
vOT_15492	Overhead Transformer	28	$3,971
vOT_15493	Overhead Transformer	23	$6,476
vOT_15494	Overhead Transformer	28	$3,971
vOT_15495	Overhead Transformer	26	$4,404

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOT_15496	Overhead Transformer	28	$3,971
vOT_15497	Overhead Transformer	25	$5,741
vOT_15498	Overhead Transformer	28	$3,971
vOT_15499	Overhead Transformer	25	$5,741
vOT_15500	Overhead Transformer	26	$4,404
vOT_15501	Overhead Transformer	26	$4,404
vOT_15502	Overhead Transformer	26	$4,404
vOT_15503	Overhead Transformer	44	$1,902
vOT_15504	Overhead Transformer	28	$3,971
vOT_15505	Overhead Transformer	26	$4,404
vOT_15506	Overhead Transformer	44	$1,902
vOT_15507	Overhead Transformer	28	$3,971
vOT_15508	Overhead Transformer	25	$5,741
vOT_15509	Overhead Transformer	26	$4,404
vOT_15510	Overhead Transformer	26	$4,404
vOT_15511	Overhead Transformer	26	$4,404
vOT_15512	Overhead Transformer	26	$4,404
vOT_15513	Overhead Transformer	26	$4,404
vOT_15514	Overhead Transformer	23	$6,476
vOT_15515	Overhead Transformer	23	$6,476
vOT_15516	Overhead Transformer	25	$5,741
vOT_15517	Overhead Transformer	23	$6,476
vOT_15518	Overhead Transformer	27	$9,344
vOT_15519	Overhead Transformer	25	$5,741
vOT_15520	Overhead Transformer	27	$9,344
vOT_15521	Overhead Transformer	23	$6,476
vOT_15522	Overhead Transformer	23	$6,476

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vOT_15523	Overhead Transformer	27	$9,344
vOT_15524	Overhead Transformer	28	$3,971
vOT_15525	Overhead Transformer	26	$4,404
vOT_15526	Overhead Transformer	23	$6,476
vOT_15527	Overhead Transformer	23	$6,476
vOT_15528	Overhead Transformer	26	$4,404
vOT_15529	Overhead Transformer	44	$1,902
vOT_15530	Overhead Transformer	25	$5,741
vOT_15531	Overhead Transformer	23	$6,476
vOT_15532	Overhead Transformer	26	$4,404
vOT_15533	Overhead Transformer	25	$5,741
vOT_15534	Overhead Transformer	23	$6,476
vOT_15535	Overhead Transformer	24	$6,605
vOT_15536	Overhead Transformer	25	$5,741
vOT_15537	Overhead Transformer	25	$5,741
vOT_15538	Overhead Transformer	23	$6,476
vOT_15539	Overhead Transformer	0	$7,768
vOT_15540	Overhead Transformer	27	$9,247
vOT_15541	Overhead Transformer	25	$5,741
vOT_15542	Overhead Transformer	26	$4,404
vOT_15543	Overhead Transformer	26	$4,404
vOT_15544	Overhead Transformer	23	$6,476
vOT_15545	Overhead Transformer	28	$3,971
vOT_15546	Overhead Transformer	28	$3,971
vOT_15547	Overhead Transformer	25	$5,741
vOT_15548	Overhead Transformer	26	$4,404
vPO_37059	Poles	40	$3,715

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37060	Poles	99	$838
vPO_37061	Poles	95	$855
vPO_37062	Poles	92	$854
vPO_37063	Poles	92	$854
vPO_37064	Poles	40	$3,712
vPO_37065	Poles	86	$995
vPO_37066	Poles	97	$1,016
vPO_37067	Poles	95	$765
vPO_37068	Poles	85	$995
vPO_37069	Poles	65	$1,770
vPO_37070	Poles	95	$851
vPO_37071	Poles	72	$1,299
vPO_37072	Poles	91	$1,001
vPO_37073	Poles	99	$219
vPO_37074	Poles	86	$996
vPO_37075	Poles	95	$983
vPO_37076	Poles	95	$852
vPO_37077	Poles	65	$1,637
vPO_37078	Poles	99	$407
vPO_37079	Poles	99	$407
vPO_37080	Poles	97	$1,103
vPO_37081	Poles	72	$1,299
vPO_37082	Poles	99	$412
vPO_37083	Poles	99	$215
vPO_37084	Poles	67	$1,819
vPO_37085	Poles	99	$540
vPO_37086	Poles	85	$998

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37087	Poles	85	$995
vPO_37088	Poles	99	$407
vPO_37089	Poles	77	$1,315
vPO_37090	Poles	95	$851
vPO_37091	Poles	99	$98
vPO_37092	Poles	85	$998
vPO_37093	Poles	97	$802
vPO_37094	Poles	90	$848
vPO_37095	Poles	89	$848
vPO_37096	Poles	70	$1,290
vPO_37097	Poles	85	$995
vPO_37098	Poles	65	$1,767
vPO_37099	Poles	85	$995
vPO_37100	Poles	97	$802
vPO_37101	Poles	85	$995
vPO_37102	Poles	99	$273
vPO_37103	Poles	95	$856
vPO_37104	Poles	72	$1,299
vPO_37105	Poles	65	$1,767
vPO_37106	Poles	99	$412
vPO_37107	Poles	99	$251
vPO_37108	Poles	95	$851
vPO_37109	Poles	95	$851
vPO_37110	Poles	92	$850
vPO_37111	Poles	74	$1,308
vPO_37112	Poles	41	$3,791
vPO_37113	Poles	40	$3,745

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37114	Poles	64	$1,839
vPO_37115	Poles	99	$412
vPO_37116	Poles	85	$998
vPO_37117	Poles	99	$543
vPO_37118	Poles	95	$851
vPO_37119	Poles	94	$1,006
vPO_37120	Poles	99	$544
vPO_37121	Poles	92	$850
vPO_37122	Poles	99	$802
vPO_37123	Poles	88	$998
vPO_37124	Poles	63	$1,627
vPO_37125	Poles	72	$1,303
vPO_37126	Poles	94	$1,007
vPO_37127	Poles	65	$1,640
vPO_37128	Poles	63	$1,630
vPO_37129	Poles	95	$851
vPO_37130	Poles	65	$1,637
vPO_37131	Poles	85	$995
vPO_37132	Poles	85	$995
vPO_37133	Poles	92	$849
vPO_37134	Poles	77	$1,316
vPO_37135	Poles	77	$1,316
vPO_37136	Poles	95	$983
vPO_37137	Poles	98	$766
vPO_37138	Poles	63	$1,627
vPO_37139	Poles	88	$998
vPO_37140	Poles	93	$982

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37141	Poles	85	$998
vPO_37142	Poles	88	$998
vPO_37143	Poles	85	$995
vPO_37144	Poles	95	$855
vPO_37145	Poles	74	$1,312
vPO_37146	Poles	99	$273
vPO_37147	Poles	85	$998
vPO_37148	Poles	77	$1,626
vPO_37149	Poles	99	$153
vPO_37150	Poles	99	$122
vPO_37151	Poles	67	$2,197
vPO_37152	Poles	99	$321
vPO_37153	Poles	76	$1,587
vPO_37154	Poles	99	$449
vPO_37155	Poles	70	$1,855
vPO_37156	Poles	99	$449
vPO_37157	Poles	99	$288
vPO_37158	Poles	99	$251
vPO_37159	Poles	99	$284
vPO_37160	Poles	99	$420
vPO_37161	Poles	99	$582
vPO_37162	Poles	99	$585
vPO_37163	Poles	71	$2,032
vPO_37164	Poles	99	$284
vPO_37165	Poles	71	$1,858
vPO_37166	Poles	70	$1,855
vPO_37167	Poles	73	$2,316

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37168	Poles	78	$1,282
vPO_37169	Poles	99	$420
vPO_37170	Poles	99	$270
vPO_37171	Poles	99	$153
vPO_37172	Poles	74	$1,856
vPO_37173	Poles	99	$450
vPO_37174	Poles	70	$1,855
vPO_37175	Poles	77	$1,630
vPO_37176	Poles	79	$1,260
vPO_37177	Poles	99	$582
vPO_37178	Poles	70	$1,855
vPO_37179	Poles	99	$266
vPO_37180	Poles	99	$255
vPO_37181	Poles	99	$269
vPO_37182	Poles	99	$266
vPO_37183	Poles	70	$1,859
vPO_37184	Poles	99	$149
vPO_37185	Poles	99	$321
vPO_37186	Poles	55	$3,807
vPO_37187	Poles	87	$1,210
vPO_37188	Poles	75	$1,603
vPO_37189	Poles	99	$149
vPO_37190	Poles	73	$1,920
vPO_37191	Poles	69	$2,009
vPO_37192	Poles	69	$1,529
vPO_37193	Poles	99	$266
vPO_37194	Poles	99	$266

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37195	Poles	99	$585
vPO_37196	Poles	99	$317
vPO_37197	Poles	99	$266
vPO_37198	Poles	99	$270
vPO_37199	Poles	70	$1,855
vPO_37200	Poles	72	$2,022
vPO_37201	Poles	99	$77
vPO_37202	Poles	99	$285
vPO_37203	Poles	87	$1,213
vPO_37204	Poles	70	$1,855
vPO_37205	Poles	76	$1,685
vPO_37206	Poles	99	$266
vPO_37207	Poles	99	$251
vPO_37208	Poles	99	$284
vPO_37209	Poles	70	$1,855
vPO_37210	Poles	99	$255
vPO_37211	Poles	71	$1,858
vPO_37212	Poles	70	$1,859
vPO_37213	Poles	99	$251
vPO_37214	Poles	72	$1,881
vPO_37215	Poles	99	$453
vPO_37216	Poles	99	$267
vPO_37217	Poles	99	$288
vPO_37218	Poles	99	$483
vPO_37219	Poles	99	$266
vPO_37220	Poles	80	$1,253
vPO_37221	Poles	99	$285

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37222	Poles	99	$416
vPO_37223	Poles	99	$251
vPO_37224	Poles	78	$1,698
vPO_37225	Poles	99	$149
vPO_37226	Poles	99	$271
vPO_37227	Poles	70	$1,855
vPO_37228	Poles	99	$149
vPO_37229	Poles	99	$317
vPO_37230	Poles	99	$176
vPO_37231	Poles	99	$450
vPO_37232	Poles	70	$1,933
vPO_37233	Poles	99	$453
vPO_37234	Poles	70	$1,859
vPO_37235	Poles	99	$202
vPO_37236	Poles	99	$251
vPO_37237	Poles	75	$2,130
vPO_37238	Poles	99	$251
vPO_37239	Poles	99	$449
vPO_37240	Poles	78	$1,672
vPO_37241	Poles	99	$149
vPO_37242	Poles	99	$449
vPO_37243	Poles	99	$285
vPO_37244	Poles	99	$417
vPO_37245	Poles	35	$5,076
vPO_37246	Poles	35	$5,078
vPO_37247	Poles	36	$5,809
vPO_37248	Poles	35	$5,635

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37249	Poles	35	$5,076
vPO_37250	Poles	99	$420
vPO_37251	Poles	35	$5,076
vPO_37252	Poles	35	$5,076
vPO_37253	Poles	35	$5,076
vPO_37254	Poles	36	$5,101
vPO_37255	Poles	36	$5,101
vPO_37256	Poles	25	$10,909
vPO_37257	Poles	37	$5,403
vPO_37258	Poles	25	$9,267
vPO_37259	Poles	36	$5,790
vPO_37260	Poles	25	$9,268
vPO_37261	Poles	37	$5,246
vPO_37262	Poles	37	$5,385
vPO_37263	Poles	37	$5,246
vPO_37264	Poles	37	$5,244
vPO_37265	Poles	24	$8,890
vPO_37266	Poles	35	$5,076
vPO_37267	Poles	35	$5,660
vPO_37268	Poles	35	$5,076
vPO_37269	Poles	36	$5,202
vPO_37270	Poles	35	$5,076
vPO_37271	Poles	99	$431
vPO_37272	Poles	99	$121
vPO_37273	Poles	99	$449
vPO_37274	Poles	99	$187
vPO_37275	Poles	99	$266

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37276	Poles	99	$350
vPO_37277	Poles	99	$183
vPO_37278	Poles	33	$6,309
vPO_37279	Poles	99	$449
vPO_37280	Poles	99	$99
vPO_37281	Poles	99	$121
vPO_37282	Poles	99	$383
vPO_37283	Poles	99	$383
vPO_37284	Poles	99	$68
vPO_37285	Poles	99	$266
vPO_37286	Poles	32	$6,104
vPO_37287	Poles	99	$265
vPO_37288	Poles	34	$6,848
vPO_37289	Poles	99	$541
vPO_37290	Poles	99	$64
vPO_37291	Poles	33	$6,311
vPO_37292	Poles	99	$568
vPO_37293	Poles	99	$265
vPO_37294	Poles	99	$183
vPO_37295	Poles	99	$430
vPO_37296	Poles	99	$383
vPO_37297	Poles	99	$125
vPO_37298	Poles	99	$564
vPO_37299	Poles	99	$565
vPO_37300	Poles	99	$125
vPO_37301	Poles	99	$99
vPO_37302	Poles	99	$64

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37303	Poles	99	$64
vPO_37304	Poles	34	$6,508
vPO_37305	Poles	33	$6,310
vPO_37306	Poles	99	$453
vPO_37307	Poles	33	$6,455
vPO_37308	Poles	99	$99
vPO_37309	Poles	99	$68
vPO_37310	Poles	99	$383
vPO_37311	Poles	99	$449
vPO_37312	Poles	33	$6,311
vPO_37313	Poles	99	$265
vPO_37314	Poles	99	$265
vPO_37315	Poles	99	$122
vPO_37316	Poles	99	$99
vPO_37317	Poles	33	$6,317
vPO_37318	Poles	99	$121
vPO_37319	Poles	99	$64
vPO_37320	Poles	33	$6,450
vPO_37321	Poles	99	$317
vPO_37322	Poles	99	$383
vPO_37323	Poles	99	$387
vPO_37324	Poles	99	$99
vPO_37325	Poles	99	$183
vPO_37326	Poles	99	$383
vPO_37327	Poles	99	$185
vPO_37328	Poles	99	$64
vPO_37329	Poles	99	$103

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37330	Poles	99	$64
vPO_37331	Poles	99	$449
vPO_37332	Poles	99	$578
vPO_37333	Poles	99	$449
vPO_37334	Poles	99	$563
vPO_37335	Poles	99	$564
vPO_37336	Poles	58	$1,955
vPO_37337	Poles	33	$6,310
vPO_37338	Poles	99	$189
vPO_37339	Poles	99	$265
vPO_37340	Poles	99	$682
vPO_37341	Poles	99	$383
vPO_37342	Poles	99	$449
vPO_37343	Poles	99	$270
vPO_37344	Poles	99	$265
vPO_37345	Poles	99	$568
vPO_37346	Poles	99	$99
vPO_37347	Poles	99	$564
vPO_37348	Poles	99	$187
vPO_37349	Poles	32	$6,104
vPO_37350	Poles	99	$578
vPO_37351	Poles	33	$6,309
vPO_37352	Poles	99	$449
vPO_37353	Poles	99	$448
vPO_37354	Poles	99	$103
vPO_37355	Poles	99	$103
vPO_37356	Poles	99	$578

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37357	Poles	32	$6,104
vPO_37358	Poles	99	$265
vPO_37359	Poles	99	$450
vPO_37360	Poles	99	$121
vPO_37361	Poles	99	$383
vPO_37362	Poles	99	$383
vPO_37363	Poles	99	$270
vPO_37364	Poles	99	$99
vPO_37365	Poles	33	$6,309
vPO_37366	Poles	99	$450
vPO_37367	Poles	33	$6,310
vPO_37368	Poles	99	$252
vPO_37369	Poles	60	$1,977
vPO_37370	Poles	99	$387
vPO_37371	Poles	33	$6,311
vPO_37372	Poles	99	$121
vPO_37373	Poles	99	$265
vPO_37374	Poles	99	$185
vPO_37375	Poles	99	$383
vPO_37376	Poles	99	$383
vPO_37377	Poles	99	$387
vPO_37378	Poles	99	$110
vPO_37379	Poles	99	$453
vPO_37380	Poles	33	$6,464
vPO_37381	Poles	99	$121
vPO_37382	Poles	99	$122
vPO_37383	Poles	34	$6,500

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37384	Poles	99	$449
vPO_37385	Poles	99	$99
vPO_37386	Poles	99	$99
vPO_37387	Poles	99	$453
vPO_37388	Poles	99	$183
vPO_37389	Poles	99	$125
vPO_37390	Poles	99	$121
vPO_37391	Poles	99	$564
vPO_37392	Poles	33	$6,417
vPO_37393	Poles	99	$578
vPO_37394	Poles	33	$6,310
vPO_37395	Poles	99	$387
vPO_37396	Poles	99	$183
vPO_37397	Poles	99	$449
vPO_37398	Poles	99	$383
vPO_37399	Poles	33	$6,733
vPO_37400	Poles	99	$673
vPO_37401	Poles	83	$1,409
vPO_37402	Poles	99	$669
vPO_37403	Poles	99	$673
vPO_37404	Poles	99	$673
vPO_37405	Poles	99	$669
vPO_37406	Poles	99	$678
vPO_37407	Poles	99	$673
vPO_37408	Poles	90	$1,310
vPO_37409	Poles	99	$673
vPO_37410	Poles	84	$1,281

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37411	Poles	99	$669
vPO_37412	Poles	34	$7,048
vPO_37413	Poles	99	$304
vPO_37414	Poles	99	$534
vPO_37415	Poles	99	$304
vPO_37416	Poles	99	$530
vPO_37417	Poles	99	$304
vPO_37418	Poles	99	$300
vPO_37419	Poles	99	$301
vPO_37420	Poles	99	$530
vPO_37421	Poles	99	$530
vPO_37422	Poles	99	$300
vPO_37423	Poles	99	$355
vPO_37424	Poles	99	$301
vPO_37425	Poles	99	$530
vPO_37426	Poles	53	$2,749
vPO_37427	Poles	99	$534
vPO_37428	Poles	99	$530
vPO_37429	Poles	99	$534
vPO_37430	Poles	99	$351
vPO_37431	Poles	99	$530
vPO_37432	Poles	99	$531
vPO_37433	Poles	99	$530
vPO_37434	Poles	99	$351
vPO_37435	Poles	99	$530
vPO_37436	Poles	57	$2,682
vPO_37437	Poles	99	$534

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37438	Poles	99	$530
vPO_37439	Poles	99	$300
vPO_37440	Poles	99	$530
vPO_37441	Poles	99	$354
vPO_37442	Poles	99	$530
vPO_37443	Poles	99	$531
vPO_37444	Poles	54	$2,582
vPO_37445	Poles	99	$531
vPO_37446	Poles	99	$534
vPO_37447	Poles	99	$351
vPO_37448	Poles	99	$530
vPO_37449	Poles	99	$531
vPO_37450	Poles	99	$530
vPO_37451	Poles	99	$503
vPO_37452	Poles	99	$560
vPO_37453	Poles	37	$4,746
vPO_37454	Poles	99	$130
vPO_37455	Poles	37	$4,724
vPO_37456	Poles	37	$4,724
vPO_37457	Poles	38	$4,779
vPO_37458	Poles	99	$559
vPO_37459	Poles	99	$670
vPO_37460	Poles	99	$112
vPO_37461	Poles	99	$559
vPO_37462	Poles	99	$569
vPO_37463	Poles	99	$112
vPO_37464	Poles	99	$684

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of overhead front lot (NPV)
Total			$1,782,939
vPO_37465	Poles	99	$569
vPO_37466	Poles	99	$605
vPO_37467	Poles	99	$572
vPO_37468	Poles	99	$560
vPO_37469	Poles	99	$569
vPO_37470	Poles	99	$569
vPO_37471	Poles	99	$567
vPO_37472	Poles	92	$1,070
vPO_37473	Poles	99	$568
vPO_37474	Poles	99	$559
vPO_37475	Poles	99	$605
vPO_37476	Poles	99	$632
vPO_37477	Poles	99	$605
vPO_37478	Poles	99	$90
vPO_37479	Poles	99	$888
vPO_37480	Poles	99	$666
vPO_37481	Poles	99	$609
vPO_37482	Poles	99	$321
vPO_37483	Poles	99	$90
vPO_37484	Poles	91	$1,079
vPO_37485	Poles	31	$9,082
vPO_37486	Poles	99	$399
vPO_37487	Poles	32	$9,693
vPO_37488	Poles	99	$659

Projected non-asset risk cost of overhead front lot (NPV)

Event Cost Total = $39,781,880.85

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

Duration Cost Total = $17,706,021.36

NAR = $57,487,902.21

Maintenance

Tree Trimming = $39,551.97

Wood Pole Inspections = $1,271.66

Discount Rate = 0.0606

Total = ($39,551.97 + $1,271.66) / 0.0606 = $673,657.31

Option 4: Replacement of Existing O/H Rear Lot with New U/G Front Lot

Table 4: Input data for Projected Risk Cost of Underground Front Lot

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37453	Underground Cable	99	$10,102
vUC_37454	Underground Cable	99	$8,905
vUC_37455	Underground Cable	99	$108
vUC_37456	Underground Cable	99	$9,246
vUC_37457	Underground Cable	99	$9,187
vUC_37458	Underground Cable	99	$9,014
vUC_37459	Underground Cable	99	$9,722
vUC_37460	Underground Cable	99	$50
vUC_37461	Underground Cable	99	$61
vUC_37462	Underground Cable	99	$10,150
vUC_37463	Underground Cable	99	$8,928
vUC_37464	Underground Cable	99	$10,168

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37465	Underground Cable	99	$9,484
vUC_37466	Underground Cable	99	$10,398
vUC_37467	Underground Cable	99	$79
vUC_37468	Underground Cable	99	$9,480
vUC_37469	Underground Cable	99	$9,224
vUC_37470	Underground Cable	99	$9,075
vUC_37471	Underground Cable	99	$79
vUC_37472	Underground Cable	99	$9,260
vUC_37473	Underground Cable	78	$621
vUC_37474	Underground Cable	87	$349
vUC_37475	Underground Cable	80	$543
vUC_37476	Underground Cable	76	$698
vUC_37477	Underground Cable	80	$526
vUC_37478	Underground Cable	81	$21,394
vUC_37479	Underground Cable	84	$18,829
vUC_37480	Underground Cable	80	$23,972
vUC_37481	Underground Cable	77	$639
vUC_37482	Underground Cable	77	$635
vUC_37483	Underground Cable	86	$373
vUC_37484	Underground Cable	80	$523
vUC_37485	Underground Cable	79	$563
vUC_37486	Underground Cable	78	$627
vUC_37487	Underground Cable	81	$21,685
vUC_37488	Underground Cable	86	$370
vUC_37489	Underground Cable	81	$505
vUC_37490	Underground Cable	76	$688
vUC_37491	Underground Cable	77	$673

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37492	Underground Cable	99	$79
vUC_37493	Underground Cable	91	$299
vUC_37494	Underground Cable	99	$50
vUC_37495	Underground Cable	74	$801
vUC_37496	Underground Cable	79	$554
vUC_37497	Underground Cable	76	$717
vUC_37498	Underground Cable	76	$713
vUC_37499	Underground Cable	73	$932
vUC_37500	Underground Cable	79	$567
vUC_37501	Underground Cable	79	$569
vUC_37502	Underground Cable	78	$27,102
vUC_37503	Underground Cable	80	$23,364
vUC_37504	Underground Cable	77	$636
vUC_37505	Underground Cable	85	$17,993
vUC_37506	Underground Cable	80	$23,128
vUC_37507	Underground Cable	80	$23,827
vUC_37508	Underground Cable	82	$20,326
vUC_37509	Underground Cable	74	$785
vUC_37510	Underground Cable	76	$719
vUC_37511	Underground Cable	73	$927
vUC_37512	Underground Cable	92	$14,163
vUC_37513	Underground Cable	86	$380
vUC_37514	Underground Cable	96	$231
vUC_37515	Underground Cable	73	$858
vUC_37516	Underground Cable	84	$422
vUC_37517	Underground Cable	77	$641
vUC_37518	Underground Cable	80	$529

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37519	Underground Cable	84	$422
vUC_37520	Underground Cable	74	$848
vUC_37521	Underground Cable	75	$779
vUC_37522	Underground Cable	74	$834
vUC_37523	Underground Cable	81	$507
vUC_37524	Underground Cable	78	$610
vUC_37525	Underground Cable	82	$473
vUC_37526	Underground Cable	86	$386
vUC_37527	Underground Cable	75	$767
vUC_37528	Underground Cable	72	$949
vUC_37529	Underground Cable	75	$760
vUC_37530	Underground Cable	78	$617
vUC_37531	Underground Cable	80	$23,141
vUC_37532	Underground Cable	74	$19,383
vUC_37533	Underground Cable	76	$17,491
vUC_37534	Underground Cable	73	$28,701
vUC_37535	Underground Cable	74	$24,588
vUC_37536	Underground Cable	69	$28,886
vUC_37537	Underground Cable	78	$614
vUC_37538	Underground Cable	80	$17,471
vUC_37539	Underground Cable	76	$21,679
vUC_37540	Underground Cable	99	$10,185
vUC_37541	Underground Cable	99	$9,233
vUC_37542	Underground Cable	90	$14,741
vUC_37543	Underground Cable	99	$10,441
vUC_37544	Underground Cable	82	$20,427
vUC_37545	Underground Cable	83	$444

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37546	Underground Cable	73	$861
vUC_37547	Underground Cable	81	$499
vUC_37548	Underground Cable	81	$21,712
vUC_37549	Underground Cable	79	$25,369
vUC_37550	Underground Cable	99	$128
vUC_37551	Underground Cable	82	$474
vUC_37552	Underground Cable	99	$71
vUC_37553	Underground Cable	97	$225
vUC_37554	Underground Cable	91	$291
vUC_37555	Underground Cable	84	$416
vUC_37556	Underground Cable	97	$220
vUC_37557	Underground Cable	85	$391
vUC_37558	Underground Cable	91	$14,463
vUC_37559	Underground Cable	79	$554
vUC_37560	Underground Cable	81	$507
vUC_37561	Underground Cable	80	$529
vUC_37562	Underground Cable	81	$510
vUC_37563	Underground Cable	73	$871
vUC_37564	Underground Cable	79	$552
vUC_37565	Underground Cable	79	$25,469
vUC_37566	Underground Cable	82	$479
vUC_37567	Underground Cable	79	$556
vUC_37568	Underground Cable	99	$137
vUC_37569	Underground Cable	75	$758
vUC_37570	Underground Cable	76	$690
vUC_37571	Underground Cable	99	$208
vUC_37572	Underground Cable	75	$733

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37573	Underground Cable	79	$24,898
vUC_37574	Underground Cable	80	$24,503
vUC_37575	Underground Cable	83	$19,923
vUC_37576	Underground Cable	82	$466
vUC_37577	Underground Cable	86	$373
vUC_37578	Underground Cable	79	$26,658
vUC_37579	Underground Cable	83	$449
vUC_37580	Underground Cable	81	$493
vUC_37581	Underground Cable	89	$324
vUC_37582	Underground Cable	73	$877
vUC_37583	Underground Cable	75	$756
vUC_37584	Underground Cable	88	$15,774
vUC_37585	Underground Cable	99	$11,197
vUC_37586	Underground Cable	80	$521
vUC_37587	Underground Cable	78	$605
vUC_37588	Underground Cable	73	$889
vUC_37589	Underground Cable	75	$751
vUC_37590	Underground Cable	74	$830
vUC_37591	Underground Cable	90	$308
vUC_37592	Underground Cable	81	$504
vUC_37593	Underground Cable	77	$652
vUC_37594	Underground Cable	83	$456
vUC_37595	Underground Cable	85	$407
vUC_37596	Underground Cable	76	$704
vUC_37597	Underground Cable	76	$715
vUC_37598	Underground Cable	78	$619
vUC_37599	Underground Cable	77	$657

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37600	Underground Cable	82	$20,822
vUC_37601	Underground Cable	80	$23,405
vUC_37602	Underground Cable	80	$23,405
vUC_37603	Underground Cable	79	$24,748
vUC_37604	Underground Cable	78	$27,456
vUC_37605	Underground Cable	79	$583
vUC_37606	Underground Cable	79	$24,857
vUC_37607	Underground Cable	86	$384
vUC_37608	Underground Cable	79	$565
vUC_37609	Underground Cable	90	$15,019
vUC_37610	Underground Cable	99	$26
vUC_37611	Underground Cable	77	$668
vUC_37612	Underground Cable	82	$21,018
vUC_37613	Underground Cable	86	$376
vUC_37614	Underground Cable	86	$17,166
vUC_37615	Underground Cable	86	$385
vUC_37616	Underground Cable	81	$486
vUC_37617	Underground Cable	83	$452
vUC_37618	Underground Cable	86	$17,184
vUC_37619	Underground Cable	78	$28,172
vUC_37620	Underground Cable	76	$714
vUC_37621	Underground Cable	79	$26,349
vUC_37622	Underground Cable	79	$24,136
vUC_37623	Underground Cable	99	$22
vUC_37624	Underground Cable	80	$23,069
vUC_37625	Underground Cable	80	$23,496
vUC_37626	Underground Cable	74	$797

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37627	Underground Cable	75	$765
vUC_37628	Underground Cable	73	$868
vUC_37629	Underground Cable	79	$25,529
vUC_37630	Underground Cable	78	$27,576
vUC_37631	Underground Cable	78	$28,152
vUC_37632	Underground Cable	76	$682
vUC_37633	Underground Cable	81	$22,243
vUC_37634	Underground Cable	80	$23,209
vUC_37635	Underground Cable	74	$847
vUC_37636	Underground Cable	84	$415
vUC_37637	Underground Cable	81	$499
vUC_37638	Underground Cable	78	$609
vUC_37639	Underground Cable	76	$697
vUC_37640	Underground Cable	78	$594
vUC_37641	Underground Cable	78	$614
vUC_37642	Underground Cable	78	$608
vUC_37643	Underground Cable	71	$23,292
vUC_37644	Underground Cable	73	$19,902
vUC_37645	Underground Cable	74	$25,051
vUC_37646	Underground Cable	99	$9,802
vUC_37647	Underground Cable	97	$10,875
vUC_37648	Underground Cable	95	$11,778
vUC_37649	Underground Cable	70	$26,822
vUC_37650	Underground Cable	79	$583
vUC_37651	Underground Cable	77	$30,444
vUC_37652	Underground Cable	77	$664
vUC_37653	Underground Cable	78	$28,744

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37654	Underground Cable	79	$25,964
vUC_37655	Underground Cable	85	$407
vUC_37656	Underground Cable	82	$475
vUC_37657	Underground Cable	75	$730
vUC_37658	Underground Cable	80	$24,476
vUC_37659	Underground Cable	72	$1,026
vUC_37660	Underground Cable	81	$502
vUC_37661	Underground Cable	85	$393
vUC_37662	Underground Cable	89	$331
vUC_37663	Underground Cable	99	$21
vUC_37664	Underground Cable	90	$313
vUC_37665	Underground Cable	84	$430
vUC_37666	Underground Cable	80	$525
vUC_37667	Underground Cable	91	$294
vUC_37668	Underground Cable	76	$706
vUC_37669	Underground Cable	93	$268
vUC_37670	Underground Cable	80	$534
vUC_37671	Underground Cable	99	$148
vUC_37672	Underground Cable	84	$418
vUC_37673	Underground Cable	79	$553
vUC_37674	Underground Cable	74	$806
vUC_37675	Underground Cable	76	$686
vUC_37676	Underground Cable	99	$76
vUC_37677	Underground Cable	80	$516
vUC_37678	Underground Cable	80	$24,594
vUC_37679	Underground Cable	99	$44
vUC_37680	Underground Cable	84	$411

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37681	Underground Cable	78	$597
vUC_37682	Underground Cable	86	$378
vUC_37683	Underground Cable	70	$1,235
vUC_37684	Underground Cable	83	$446
vUC_37685	Underground Cable	79	$568
vUC_37686	Underground Cable	99	$73
vUC_37687	Underground Cable	85	$395
vUC_37688	Underground Cable	75	$746
vUC_37689	Underground Cable	75	$739
vUC_37690	Underground Cable	75	$731
vUC_37691	Underground Cable	77	$672
vUC_37692	Underground Cable	79	$579
vUC_37693	Underground Cable	77	$632
vUC_37694	Underground Cable	81	$21,707
vUC_37695	Underground Cable	79	$25,292
vUC_37696	Underground Cable	89	$15,083
vUC_37697	Underground Cable	80	$540
vUC_37698	Underground Cable	77	$637
vUC_37699	Underground Cable	78	$586
vUC_37700	Underground Cable	85	$399
vUC_37701	Underground Cable	83	$19,692
vUC_37702	Underground Cable	73	$900
vUC_37703	Underground Cable	82	$20,346
vUC_37704	Underground Cable	76	$717
vUC_37705	Underground Cable	75	$775
vUC_37706	Underground Cable	80	$535
vUC_37707	Underground Cable	99	$10,579

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37708	Underground Cable	77	$637
vUC_37709	Underground Cable	72	$958
vUC_37710	Underground Cable	86	$384
vUC_37711	Underground Cable	81	$21,767
vUC_37712	Underground Cable	89	$318
vUC_37713	Underground Cable	82	$474
vUC_37714	Underground Cable	79	$573
vUC_37715	Underground Cable	77	$647
vUC_37716	Underground Cable	76	$679
vUC_37717	Underground Cable	76	$679
vUC_37718	Underground Cable	73	$865
vUC_37719	Underground Cable	78	$27,288
vUC_37720	Underground Cable	78	$602
vUC_37721	Underground Cable	77	$31,020
vUC_37722	Underground Cable	79	$585
vUC_37723	Underground Cable	82	$21,077
vUC_37724	Underground Cable	82	$20,959
vUC_37725	Underground Cable	76	$713
vUC_37726	Underground Cable	81	$22,425
vUC_37727	Underground Cable	80	$519
vUC_37728	Underground Cable	82	$458
vUC_37729	Underground Cable	84	$413
vUC_37730	Underground Cable	79	$25,093
vUC_37731	Underground Cable	99	$10,473
vUC_37732	Underground Cable	79	$24,947
vUC_37733	Underground Cable	79	$24,843
vUC_37734	Underground Cable	80	$23,096

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37735	Underground Cable	87	$16,388
vUC_37736	Underground Cable	77	$640
vUC_37737	Underground Cable	86	$386
vUC_37738	Underground Cable	83	$19,056
vUC_37739	Underground Cable	83	$19,308
vUC_37740	Underground Cable	77	$626
vUC_37741	Underground Cable	75	$761
vUC_37742	Underground Cable	80	$23,977
vUC_37743	Underground Cable	77	$648
vUC_37744	Underground Cable	82	$20,003
vUC_37745	Underground Cable	83	$19,753
vUC_37746	Underground Cable	99	$56
vUC_37747	Underground Cable	81	$22,102
vUC_37748	Underground Cable	81	$21,080
vUC_37749	Underground Cable	71	$1,104
vUC_37750	Underground Cable	76	$698
vUC_37751	Underground Cable	77	$32,244
vUC_37752	Underground Cable	91	$14,595
vUC_37753	Underground Cable	76	$715
vUC_37754	Underground Cable	76	$709
vUC_37755	Underground Cable	79	$24,617
vUC_37756	Underground Cable	75	$756
vUC_37757	Underground Cable	74	$827
vUC_37758	Underground Cable	82	$479
vUC_37759	Underground Cable	79	$24,907
vUC_37760	Underground Cable	83	$19,415
vUC_37761	Underground Cable	73	$919

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37762	Underground Cable	80	$536
vUC_37763	Underground Cable	79	$551
vUC_37764	Underground Cable	80	$22,524
vUC_37765	Underground Cable	75	$783
vUC_37766	Underground Cable	81	$22,565
vUC_37767	Underground Cable	79	$24,108
vUC_37768	Underground Cable	76	$687
vUC_37769	Underground Cable	82	$20,196
vUC_37770	Underground Cable	83	$19,453
vUC_37771	Underground Cable	80	$23,082
vUC_37772	Underground Cable	75	$23,138
vUC_37773	Underground Cable	75	$22,789
vUC_37774	Underground Cable	81	$505
vUC_37775	Underground Cable	72	$22,875
vUC_37776	Underground Cable	77	$20,898
vUC_37777	Underground Cable	73	$21,055
vUC_37778	Underground Cable	78	$594
vUC_37779	Underground Cable	83	$19,549
vUC_37780	Underground Cable	91	$11,761
vUC_37781	Underground Cable	99	$124
vUC_37782	Underground Cable	99	$117
vUC_37783	Underground Cable	78	$29,469
vUC_37784	Underground Cable	83	$19,487
vUC_37785	Underground Cable	76	$37,244
vUC_37786	Underground Cable	99	$186
vUC_37787	Underground Cable	79	$25,070
vUC_37788	Underground Cable	85	$395

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37789	Underground Cable	79	$25,161
vUC_37790	Underground Cable	89	$329
vUC_37791	Underground Cable	99	$206
vUC_37792	Underground Cable	83	$449
vUC_37793	Underground Cable	99	$56
vUC_37794	Underground Cable	76	$697
vUC_37795	Underground Cable	78	$27,234
vUC_37796	Underground Cable	80	$23,659
vUC_37797	Underground Cable	88	$343
vUC_37798	Underground Cable	76	$719
vUC_37799	Underground Cable	76	$695
vUC_37800	Underground Cable	76	$711
vUC_37801	Underground Cable	82	$20,291
vUC_37802	Underground Cable	99	$41
vUC_37803	Underground Cable	76	$724
vUC_37804	Underground Cable	79	$554
vUC_37805	Underground Cable	82	$470
vUC_37806	Underground Cable	79	$585
vUC_37807	Underground Cable	75	$759
vUC_37808	Underground Cable	83	$436
vUC_37809	Underground Cable	80	$23,845
vUC_37810	Underground Cable	83	$19,846
vUC_37811	Underground Cable	99	$9,531
vUC_37812	Underground Cable	80	$23,836
vUC_37813	Underground Cable	78	$612
vUC_37814	Underground Cable	81	$493
vUC_37815	Underground Cable	99	$70

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37816	Underground Cable	75	$782
vUC_37817	Underground Cable	83	$452
vUC_37818	Underground Cable	72	$958
vUC_37819	Underground Cable	79	$580
vUC_37820	Underground Cable	86	$370
vUC_37821	Underground Cable	77	$662
vUC_37822	Underground Cable	76	$679
vUC_37823	Underground Cable	79	$25,564
vUC_37824	Underground Cable	83	$438
vUC_37825	Underground Cable	79	$565
vUC_37826	Underground Cable	85	$407
vUC_37827	Underground Cable	81	$506
vUC_37828	Underground Cable	76	$711
vUC_37829	Underground Cable	80	$527
vUC_37830	Underground Cable	73	$891
vUC_37831	Underground Cable	77	$644
vUC_37832	Underground Cable	80	$541
vUC_37833	Underground Cable	75	$732
vUC_37834	Underground Cable	75	$775
vUC_37835	Underground Cable	79	$555
vUC_37836	Underground Cable	75	$732
vUC_37837	Underground Cable	78	$28,644
vUC_37838	Underground Cable	79	$571
vUC_37839	Underground Cable	77	$31,020
vUC_37840	Underground Cable	77	$638
vUC_37841	Underground Cable	75	$744
vUC_37842	Underground Cable	82	$21,077

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37843	Underground Cable	79	$25,310
vUC_37844	Underground Cable	78	$27,365
vUC_37845	Underground Cable	77	$636
vUC_37846	Underground Cable	78	$609
vUC_37847	Underground Cable	74	$849
vUC_37848	Underground Cable	77	$665
vUC_37849	Underground Cable	81	$21,417
vUC_37850	Underground Cable	99	$151
vUC_37851	Underground Cable	99	$67
vUC_37852	Underground Cable	81	$21,471
vUC_37853	Underground Cable	99	$10,386
vUC_37854	Underground Cable	83	$19,892
vUC_37855	Underground Cable	99	$65
vUC_37856	Underground Cable	96	$12,959
vUC_37857	Underground Cable	81	$498
vUC_37858	Underground Cable	83	$433
vUC_37859	Underground Cable	78	$601
vUC_37860	Underground Cable	99	$148
vUC_37861	Underground Cable	77	$654
vUC_37862	Underground Cable	75	$726
vUC_37863	Underground Cable	74	$815
vUC_37864	Underground Cable	99	$133
vUC_37865	Underground Cable	72	$963
vUC_37866	Underground Cable	82	$21,104
vUC_37867	Underground Cable	78	$28,086
vUC_37868	Underground Cable	82	$20,003
vUC_37869	Underground Cable	79	$24,381

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37870	Underground Cable	79	$25,397
vUC_37871	Underground Cable	99	$118
vUC_37872	Underground Cable	99	$63
vUC_37873	Underground Cable	80	$517
vUC_37874	Underground Cable	78	$619
vUC_37875	Underground Cable	84	$18,767
vUC_37876	Underground Cable	81	$21,852
vUC_37877	Underground Cable	77	$658
vUC_37878	Underground Cable	77	$657
vUC_37879	Underground Cable	81	$21,706
vUC_37880	Underground Cable	81	$21,443
vUC_37881	Underground Cable	82	$473
vUC_37882	Underground Cable	74	$819
vUC_37883	Underground Cable	78	$603
vUC_37884	Underground Cable	76	$714
vUC_37885	Underground Cable	72	$953
vUC_37886	Underground Cable	84	$412
vUC_37887	Underground Cable	74	$807
vUC_37888	Underground Cable	81	$494
vUC_37889	Underground Cable	82	$479
vUC_37890	Underground Cable	78	$613
vUC_37891	Underground Cable	75	$750
vUC_37892	Underground Cable	80	$23,196
vUC_37893	Underground Cable	80	$523
vUC_37894	Underground Cable	75	$23,913
vUC_37895	Underground Cable	77	$20,370
vUC_37896	Underground Cable	76	$21,637

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37897	Underground Cable	77	$16,530
vUC_37898	Underground Cable	71	$24,815
vUC_37899	Underground Cable	71	$23,646
vUC_37900	Underground Cable	70	$26,517
vUC_37901	Underground Cable	76	$694
vUC_37902	Underground Cable	75	$766
vUC_37903	Underground Cable	99	$11,025
vUC_37904	Underground Cable	89	$15,242
vUC_37905	Underground Cable	99	$9,483
vUC_37906	Underground Cable	95	$13,197
vUC_37907	Underground Cable	99	$33
vUC_37908	Underground Cable	89	$330
vUC_37909	Underground Cable	76	$692
vUC_37910	Underground Cable	99	$42
vUC_37911	Underground Cable	82	$20,645
vUC_37912	Underground Cable	81	$21,403
vUC_37913	Underground Cable	73	$71,860
vUC_37914	Underground Cable	78	$27,356
vUC_37915	Underground Cable	79	$573
vUC_37916	Underground Cable	79	$552
vUC_37917	Underground Cable	83	$447
vUC_37918	Underground Cable	83	$438
vUC_37919	Underground Cable	99	$46
vUC_37920	Underground Cable	91	$299
vUC_37921	Underground Cable	83	$438
vUC_37922	Underground Cable	99	$138
vUC_37923	Underground Cable	82	$477

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37924	Underground Cable	99	$76
vUC_37925	Underground Cable	78	$603
vUC_37926	Underground Cable	79	$571
vUC_37927	Underground Cable	77	$633
vUC_37928	Underground Cable	99	$12,019
vUC_37929	Underground Cable	79	$558
vUC_37930	Underground Cable	77	$659
vUC_37931	Underground Cable	80	$520
vUC_37932	Underground Cable	78	$616
vUC_37933	Underground Cable	81	$513
vUC_37934	Underground Cable	73	$854
vUC_37935	Underground Cable	75	$767
vUC_37936	Underground Cable	99	$95
vUC_37937	Underground Cable	84	$420
vUC_37938	Underground Cable	74	$798
vUC_37939	Underground Cable	76	$683
vUC_37940	Underground Cable	75	$753
vUC_37941	Underground Cable	75	$750
vUC_37942	Underground Cable	80	$517
vUC_37943	Underground Cable	77	$660
vUC_37944	Underground Cable	80	$522
vUC_37945	Underground Cable	77	$30,122
vUC_37946	Underground Cable	80	$23,881
vUC_37947	Underground Cable	80	$23,963
vUC_37948	Underground Cable	82	$20,191
vUC_37949	Underground Cable	77	$670
vUC_37950	Underground Cable	74	$826

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37951	Underground Cable	97	$12,713
vUC_37952	Underground Cable	82	$20,949
vUC_37953	Underground Cable	80	$535
vUC_37954	Underground Cable	74	$804
vUC_37955	Underground Cable	80	$23,291
vUC_37956	Underground Cable	76	$711
vUC_37957	Underground Cable	72	$982
vUC_37958	Underground Cable	85	$390
vUC_37959	Underground Cable	78	$601
vUC_37960	Underground Cable	99	$99
vUC_37961	Underground Cable	76	$704
vUC_37962	Underground Cable	85	$393
vUC_37963	Underground Cable	82	$474
vUC_37964	Underground Cable	80	$528
vUC_37965	Underground Cable	79	$577
vUC_37966	Underground Cable	81	$511
vUC_37967	Underground Cable	74	$802
vUC_37968	Underground Cable	76	$710
vUC_37969	Underground Cable	78	$612
vUC_37970	Underground Cable	79	$583
vUC_37971	Underground Cable	86	$17,025
vUC_37972	Underground Cable	88	$347
vUC_37973	Underground Cable	76	$704
vUC_37974	Underground Cable	76	$689
vUC_37975	Underground Cable	79	$581
vUC_37976	Underground Cable	87	$362
vUC_37977	Underground Cable	99	$11,043

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_37978	Underground Cable	76	$709
vUC_37979	Underground Cable	75	$737
vUC_37980	Underground Cable	77	$672
vUC_37981	Underground Cable	75	$742
vUC_37982	Underground Cable	80	$532
vUC_37983	Underground Cable	82	$476
vUC_37984	Underground Cable	79	$25,310
vUC_37985	Underground Cable	78	$28,122
vUC_37986	Underground Cable	75	$727
vUC_37987	Underground Cable	99	$10,749
vUC_37988	Underground Cable	81	$21,767
vUC_37989	Underground Cable	84	$413
vUC_37990	Underground Cable	83	$456
vUC_37991	Underground Cable	83	$435
vUC_37992	Underground Cable	81	$22,515
vUC_37993	Underground Cable	83	$433
vUC_37994	Underground Cable	77	$634
vUC_37995	Underground Cable	80	$23,141
vUC_37996	Underground Cable	83	$19,053
vUC_37997	Underground Cable	76	$680
vUC_37998	Underground Cable	76	$695
vUC_37999	Underground Cable	75	$746
vUC_38000	Underground Cable	79	$25,383
vUC_38001	Underground Cable	74	$817
vUC_38002	Underground Cable	76	$697
vUC_38003	Underground Cable	81	$508
vUC_38004	Underground Cable	75	$763

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38005	Underground Cable	77	$669
vUC_38006	Underground Cable	75	$774
vUC_38007	Underground Cable	76	$706
vUC_38008	Underground Cable	83	$438
vUC_38009	Underground Cable	78	$27,839
vUC_38010	Underground Cable	78	$604
vUC_38011	Underground Cable	83	$19,773
vUC_38012	Underground Cable	71	$23,345
vUC_38013	Underground Cable	77	$20,664
vUC_38014	Underground Cable	71	$23,519
vUC_38015	Underground Cable	80	$17,278
vUC_38016	Underground Cable	85	$13,025
vUC_38017	Underground Cable	75	$18,603
vUC_38018	Underground Cable	77	$20,017
vUC_38019	Underground Cable	75	$752
vUC_38020	Underground Cable	74	$24,670
vUC_38021	Underground Cable	80	$24,539
vUC_38022	Underground Cable	73	$27,587
vUC_38023	Underground Cable	84	$410
vUC_38024	Underground Cable	79	$25,061
vUC_38025	Underground Cable	83	$19,737
vUC_38026	Underground Cable	84	$18,443
vUC_38027	Underground Cable	89	$323
vUC_38028	Underground Cable	99	$8,789
vUC_38029	Underground Cable	81	$22,316
vUC_38030	Underground Cable	75	$739
vUC_38031	Underground Cable	83	$439

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38032	Underground Cable	81	$495
vUC_38033	Underground Cable	78	$27,179
vUC_38034	Underground Cable	82	$20,305
vUC_38035	Underground Cable	85	$407
vUC_38036	Underground Cable	89	$324
vUC_38037	Underground Cable	77	$32,389
vUC_38038	Underground Cable	99	$10,707
vUC_38039	Underground Cable	99	$10,663
vUC_38040	Underground Cable	80	$518
vUC_38041	Underground Cable	84	$426
vUC_38042	Underground Cable	79	$568
vUC_38043	Underground Cable	87	$358
vUC_38044	Underground Cable	81	$497
vUC_38045	Underground Cable	76	$700
vUC_38046	Underground Cable	99	$44
vUC_38047	Underground Cable	87	$366
vUC_38048	Underground Cable	82	$479
vUC_38049	Underground Cable	81	$507
vUC_38050	Underground Cable	75	$765
vUC_38051	Underground Cable	78	$616
vUC_38052	Underground Cable	77	$664
vUC_38053	Underground Cable	75	$749
vUC_38054	Underground Cable	79	$25,192
vUC_38055	Underground Cable	81	$507
vUC_38056	Underground Cable	83	$441
vUC_38057	Underground Cable	69	$29,630
vUC_38058	Underground Cable	77	$627

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38059	Underground Cable	75	$754
vUC_38060	Underground Cable	99	$83
vUC_38061	Underground Cable	73	$21,421
vUC_38062	Underground Cable	76	$682
vUC_38063	Underground Cable	74	$828
vUC_38064	Underground Cable	99	$30
vUC_38065	Underground Cable	76	$35,304
vUC_38066	Underground Cable	74	$19,883
vUC_38067	Underground Cable	99	$97
vUC_38068	Underground Cable	74	$847
vUC_38069	Underground Cable	99	$80
vUC_38070	Underground Cable	95	$247
vUC_38071	Underground Cable	78	$586
vUC_38072	Underground Cable	99	$63
vUC_38073	Underground Cable	79	$25,614
vUC_38074	Underground Cable	79	$24,739
vUC_38075	Underground Cable	79	$25,419
vUC_38076	Underground Cable	79	$25,224
vUC_38077	Underground Cable	87	$353
vUC_38078	Underground Cable	86	$379
vUC_38079	Underground Cable	76	$685
vUC_38080	Underground Cable	82	$20,936
vUC_38081	Underground Cable	79	$580
vUC_38082	Underground Cable	83	$441
vUC_38083	Underground Cable	84	$415
vUC_38084	Underground Cable	79	$560
vUC_38085	Underground Cable	78	$603

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38086	Underground Cable	79	$24,979
vUC_38087	Underground Cable	74	$823
vUC_38088	Underground Cable	79	$554
vUC_38089	Underground Cable	75	$736
vUC_38090	Underground Cable	78	$610
vUC_38091	Underground Cable	79	$569
vUC_38092	Underground Cable	79	$25,714
vUC_38093	Underground Cable	88	$15,774
vUC_38094	Underground Cable	79	$24,979
vUC_38095	Underground Cable	79	$548
vUC_38096	Underground Cable	80	$545
vUC_38097	Underground Cable	99	$10,846
vUC_38098	Underground Cable	85	$395
vUC_38099	Underground Cable	77	$669
vUC_38100	Underground Cable	95	$248
vUC_38101	Underground Cable	76	$697
vUC_38102	Underground Cable	76	$699
vUC_38103	Underground Cable	78	$592
vUC_38104	Underground Cable	78	$606
vUC_38105	Underground Cable	76	$36,474
vUC_38106	Underground Cable	76	$715
vUC_38107	Underground Cable	82	$472
vUC_38108	Underground Cable	82	$21,018
vUC_38109	Underground Cable	77	$31,464
vUC_38110	Underground Cable	80	$24,498
vUC_38111	Underground Cable	82	$20,936
vUC_38112	Underground Cable	79	$568

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38113	Underground Cable	77	$653
vUC_38114	Underground Cable	80	$23,164
vUC_38115	Underground Cable	80	$23,695
vUC_38116	Underground Cable	87	$353
vUC_38117	Underground Cable	99	$9,253
vUC_38118	Underground Cable	78	$586
vUC_38119	Underground Cable	80	$537
vUC_38120	Underground Cable	86	$380
vUC_38121	Underground Cable	78	$611
vUC_38122	Underground Cable	84	$419
vUC_38123	Underground Cable	77	$639
vUC_38124	Underground Cable	76	$695
vUC_38125	Underground Cable	77	$645
vUC_38126	Underground Cable	77	$640
vUC_38127	Underground Cable	99	$9,914
vUC_38128	Underground Cable	91	$14,632
vUC_38129	Underground Cable	89	$324
vUC_38130	Underground Cable	72	$999
vUC_38131	Underground Cable	99	$80
vUC_38132	Underground Cable	77	$670
vUC_38133	Underground Cable	76	$712
vUC_38134	Underground Cable	76	$695
vUC_38135	Underground Cable	75	$781
vUC_38136	Underground Cable	76	$682
vUC_38137	Underground Cable	85	$17,649
vUC_38138	Underground Cable	89	$316
vUC_38139	Underground Cable	81	$501

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38140	Underground Cable	74	$833
vUC_38141	Underground Cable	81	$22,570
vUC_38142	Underground Cable	79	$583
vUC_38143	Underground Cable	85	$398
vUC_38144	Underground Cable	76	$717
vUC_38145	Underground Cable	81	$495
vUC_38146	Underground Cable	75	$776
vUC_38147	Underground Cable	76	$692
vUC_38148	Underground Cable	81	$21,449
vUC_38149	Underground Cable	82	$479
vUC_38150	Underground Cable	75	$24,143
vUC_38151	Underground Cable	76	$21,486
vUC_38152	Underground Cable	71	$23,968
vUC_38153	Underground Cable	71	$24,356
vUC_38154	Underground Cable	73	$27,275
vUC_38155	Underground Cable	75	$22,789
vUC_38156	Underground Cable	69	$28,756
vUC_38157	Underground Cable	75	$18,603
vUC_38158	Underground Cable	76	$21,082
vUC_38159	Underground Cable	72	$22,838
vUC_38160	Underground Cable	75	$18,270
vUC_38161	Underground Cable	77	$647
vUC_38162	Underground Cable	78	$615
vUC_38163	Underground Cable	91	$288
vUC_38164	Underground Cable	80	$22,878
vUC_38165	Underground Cable	99	$112
vUC_38166	Underground Cable	85	$17,393

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38167	Underground Cable	82	$460
vUC_38168	Underground Cable	89	$15,260
vUC_38169	Underground Cable	85	$18,075
vUC_38170	Underground Cable	78	$602
vUC_38171	Underground Cable	82	$20,813
vUC_38172	Underground Cable	85	$18,106
vUC_38173	Underground Cable	99	$10,000
vUC_38174	Underground Cable	99	$84
vUC_38175	Underground Cable	83	$450
vUC_38176	Underground Cable	74	$836
vUC_38177	Underground Cable	72	$941
vUC_38178	Underground Cable	83	$452
vUC_38179	Underground Cable	85	$401
vUC_38180	Underground Cable	74	$819
vUC_38181	Underground Cable	75	$727
vUC_38182	Underground Cable	99	$76
vUC_38183	Underground Cable	99	$102
vUC_38184	Underground Cable	83	$446
vUC_38185	Underground Cable	88	$338
vUC_38186	Underground Cable	76	$683
vUC_38187	Underground Cable	79	$579
vUC_38188	Underground Cable	79	$574
vUC_38189	Underground Cable	77	$652
vUC_38190	Underground Cable	80	$544
vUC_38191	Underground Cable	81	$500
vUC_38192	Underground Cable	87	$357
vUC_38193	Underground Cable	93	$13,880

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38194	Underground Cable	82	$21,240
vUC_38195	Underground Cable	74	$24,702
vUC_38196	Underground Cable	83	$439
vUC_38197	Underground Cable	77	$636
vUC_38198	Underground Cable	78	$621
vUC_38199	Underground Cable	74	$19,837
vUC_38200	Underground Cable	80	$23,291
vUC_38201	Underground Cable	80	$547
vUC_38202	Underground Cable	80	$519
vUC_38203	Underground Cable	81	$497
vUC_38204	Underground Cable	84	$417
vUC_38205	Underground Cable	77	$641
vUC_38206	Underground Cable	73	$876
vUC_38207	Underground Cable	80	$537
vUC_38208	Underground Cable	80	$24,539
vUC_38209	Underground Cable	80	$24,421
vUC_38210	Underground Cable	78	$28,254
vUC_38211	Underground Cable	80	$23,582
vUC_38212	Underground Cable	79	$25,705
vUC_38213	Underground Cable	80	$24,013
vUC_38214	Underground Cable	99	$26
vUC_38215	Underground Cable	75	$775
vUC_38216	Underground Cable	82	$20,455
vUC_38217	Underground Cable	99	$11,442
vUC_38218	Underground Cable	99	$9,819
vUC_38219	Underground Cable	99	$116
vUC_38220	Underground Cable	80	$538

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38221	Underground Cable	88	$336
vUC_38222	Underground Cable	93	$267
vUC_38223	Underground Cable	88	$334
vUC_38224	Underground Cable	76	$714
vUC_38225	Underground Cable	83	$450
vUC_38226	Underground Cable	82	$473
vUC_38227	Underground Cable	75	$731
vUC_38228	Underground Cable	78	$599
vUC_38229	Underground Cable	79	$581
vUC_38230	Underground Cable	79	$562
vUC_38231	Underground Cable	80	$523
vUC_38232	Underground Cable	84	$414
vUC_38233	Underground Cable	85	$405
vUC_38234	Underground Cable	77	$650
vUC_38235	Underground Cable	77	$629
vUC_38236	Underground Cable	93	$265
vUC_38237	Underground Cable	77	$638
vUC_38238	Underground Cable	79	$575
vUC_38239	Underground Cable	81	$509
vUC_38240	Underground Cable	99	$10,985
vUC_38241	Underground Cable	83	$19,283
vUC_38242	Underground Cable	80	$23,818
vUC_38243	Underground Cable	77	$671
vUC_38244	Underground Cable	77	$668
vUC_38245	Underground Cable	75	$781
vUC_38246	Underground Cable	75	$783
vUC_38247	Underground Cable	72	$976

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38248	Underground Cable	79	$563
vUC_38249	Underground Cable	84	$410
vUC_38250	Underground Cable	84	$418
vUC_38251	Underground Cable	78	$27,084
vUC_38252	Underground Cable	75	$739
vUC_38253	Underground Cable	78	$27,766
vUC_38254	Underground Cable	87	$352
vUC_38255	Underground Cable	90	$302
vUC_38256	Underground Cable	78	$28,234
vUC_38257	Underground Cable	99	$71
vUC_38258	Underground Cable	78	$26,723
vUC_38259	Underground Cable	82	$20,630
vUC_38260	Underground Cable	76	$696
vUC_38261	Underground Cable	75	$743
vUC_38262	Underground Cable	88	$347
vUC_38263	Underground Cable	78	$611
vUC_38264	Underground Cable	75	$781
vUC_38265	Underground Cable	79	$571
vUC_38266	Underground Cable	77	$641
vUC_38267	Underground Cable	81	$502
vUC_38268	Underground Cable	82	$475
vUC_38269	Underground Cable	87	$366
vUC_38270	Underground Cable	80	$22,751
vUC_38271	Underground Cable	78	$618
vUC_38272	Underground Cable	77	$20,678
vUC_38273	Underground Cable	76	$22,408
vUC_38274	Underground Cable	71	$23,720

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38275	Underground Cable	75	$18,371
vUC_38276	Underground Cable	76	$17,257
vUC_38277	Underground Cable	73	$20,161
vUC_38278	Underground Cable	89	$15,319
vUC_38279	Underground Cable	72	$21,459
vUC_38280	Underground Cable	77	$16,989
vUC_38281	Underground Cable	87	$13,599
vUC_38282	Underground Cable	77	$638
vUC_38283	Underground Cable	78	$27,008
vUC_38284	Underground Cable	99	$9,465
vUC_38285	Underground Cable	99	$9,330
vUC_38286	Underground Cable	99	$147
vUC_38287	Underground Cable	99	$170
vUC_38288	Underground Cable	81	$504
vUC_38289	Underground Cable	79	$24,689
vUC_38290	Underground Cable	80	$22,956
vUC_38291	Underground Cable	81	$22,288
vUC_38292	Underground Cable	78	$27,138
vUC_38293	Underground Cable	77	$656
vUC_38294	Underground Cable	78	$614
vUC_38295	Underground Cable	85	$388
vUC_38296	Underground Cable	83	$444
vUC_38297	Underground Cable	87	$366
vUC_38298	Underground Cable	76	$685
vUC_38299	Underground Cable	79	$567
vUC_38300	Underground Cable	89	$323
vUC_38301	Underground Cable	81	$495

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38302	Underground Cable	77	$637
vUC_38303	Underground Cable	77	$640
vUC_38304	Underground Cable	79	$26,667
vUC_38305	Underground Cable	99	$122
vUC_38306	Underground Cable	69	$29,307
vUC_38307	Underground Cable	79	$570
vUC_38308	Underground Cable	80	$529
vUC_38309	Underground Cable	93	$272
vUC_38310	Underground Cable	80	$525
vUC_38311	Underground Cable	91	$288
vUC_38312	Underground Cable	99	$90
vUC_38313	Underground Cable	99	$80
vUC_38314	Underground Cable	77	$668
vUC_38315	Underground Cable	82	$461
vUC_38316	Underground Cable	81	$497
vUC_38317	Underground Cable	75	$726
vUC_38318	Underground Cable	82	$20,500
vUC_38319	Underground Cable	95	$250
vUC_38320	Underground Cable	80	$519
vUC_38321	Underground Cable	75	$739
vUC_38322	Underground Cable	76	$702
vUC_38323	Underground Cable	74	$834
vUC_38324	Underground Cable	80	$517
vUC_38325	Underground Cable	80	$523
vUC_38326	Underground Cable	92	$14,122
vUC_38327	Underground Cable	93	$268
vUC_38328	Underground Cable	91	$299

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38329	Underground Cable	99	$99
vUC_38330	Underground Cable	78	$614
vUC_38331	Underground Cable	74	$849
vUC_38332	Underground Cable	82	$21,131
vUC_38333	Underground Cable	81	$487
vUC_38334	Underground Cable	77	$657
vUC_38335	Underground Cable	79	$583
vUC_38336	Underground Cable	76	$691
vUC_38337	Underground Cable	83	$438
vUC_38338	Underground Cable	76	$681
vUC_38339	Underground Cable	75	$782
vUC_38340	Underground Cable	74	$798
vUC_38341	Underground Cable	77	$656
vUC_38342	Underground Cable	75	$762
vUC_38343	Underground Cable	82	$459
vUC_38344	Underground Cable	81	$21,803
vUC_38345	Underground Cable	83	$442
vUC_38346	Underground Cable	83	$448
vUC_38347	Underground Cable	77	$631
vUC_38348	Underground Cable	79	$584
vUC_38349	Underground Cable	77	$31,464
vUC_38350	Underground Cable	81	$22,098
vUC_38351	Underground Cable	83	$453
vUC_38352	Underground Cable	92	$282
vUC_38353	Underground Cable	84	$430
vUC_38354	Underground Cable	99	$11,102
vUC_38355	Underground Cable	83	$19,919

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38356	Underground Cable	80	$23,527
vUC_38357	Underground Cable	77	$672
vUC_38358	Underground Cable	80	$24,480
vUC_38359	Underground Cable	79	$581
vUC_38360	Underground Cable	86	$17,103
vUC_38361	Underground Cable	84	$409
vUC_38362	Underground Cable	76	$708
vUC_38363	Underground Cable	99	$197
vUC_38364	Underground Cable	99	$72
vUC_38365	Underground Cable	99	$175
vUC_38366	Underground Cable	80	$23,586
vUC_38367	Underground Cable	77	$664
vUC_38368	Underground Cable	74	$830
vUC_38369	Underground Cable	83	$441
vUC_38370	Underground Cable	75	$784
vUC_38371	Underground Cable	78	$596
vUC_38372	Underground Cable	79	$567
vUC_38373	Underground Cable	75	$740
vUC_38374	Underground Cable	77	$30,344
vUC_38375	Underground Cable	80	$545
vUC_38376	Underground Cable	78	$608
vUC_38377	Underground Cable	79	$565
vUC_38378	Underground Cable	85	$405
vUC_38379	Underground Cable	75	$727
vUC_38380	Underground Cable	72	$986
vUC_38381	Underground Cable	77	$630
vUC_38382	Underground Cable	77	$653

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38383	Underground Cable	79	$24,753
vUC_38384	Underground Cable	83	$432
vUC_38385	Underground Cable	96	$235
vUC_38386	Underground Cable	76	$710
vUC_38387	Underground Cable	77	$670
vUC_38388	Underground Cable	79	$570
vUC_38389	Underground Cable	75	$770
vUC_38390	Underground Cable	78	$27,229
vUC_38391	Underground Cable	75	$765
vUC_38392	Underground Cable	79	$24,634
vUC_38393	Underground Cable	85	$13,058
vUC_38394	Underground Cable	75	$18,041
vUC_38395	Underground Cable	78	$16,270
vUC_38396	Underground Cable	75	$23,170
vUC_38397	Underground Cable	73	$20,764
vUC_38398	Underground Cable	79	$576
vUC_38399	Underground Cable	80	$14,913
vUC_38400	Underground Cable	70	$26,406
vUC_38401	Underground Cable	77	$20,499
vUC_38402	Underground Cable	76	$722
vUC_38403	Underground Cable	75	$759
vUC_38404	Underground Cable	75	$22,482
vUC_38405	Underground Cable	87	$16,365
vUC_38406	Underground Cable	83	$433
vUC_38407	Underground Cable	81	$491
vUC_38408	Underground Cable	78	$610
vUC_38409	Underground Cable	87	$355

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUC_38410	Underground Cable	81	$21,694
vUC_38411	Underground Cable	79	$25,587
vUC_38412	Underground Cable	99	$11,979
vUC_38413	Underground Cable	77	$663
vUC_38414	Underground Cable	85	$17,929
vUC_38415	Underground Cable	77	$30,675
vUC_38416	Underground Cable	83	$19,269
vUC_38417	Underground Cable	79	$25,605
vUC_38418	Underground Cable	78	$28,308
vUC_38419	Underground Cable	99	$10,466
vUC_38420	Underground Cable	99	$129
vUC_38421	Underground Cable	79	$566
vUC_38422	Underground Cable	77	$646
vUC_38423	Underground Cable	75	$741
vUC_38424	Underground Cable	99	$106
vUC_38425	Underground Cable	93	$271
vUC_38426	Underground Cable	85	$408
vUC_38427	Underground Cable	75	$726
vUC_38428	Underground Cable	77	$635
vUC_38429	Underground Cable	76	$714
vUC_38430	Underground Cable	78	$616
vUC_38431	Underground Cable	76	$691
vUC_38432	Underground Cable	79	$553
vUC_38433	Underground Cable	81	$507
vUC_38434	Underground Cable	89	$15,301
vUS_4261	Underground Switch	76	$5,040
vUS_4262	Underground Switch	38	$16,552

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUS_4263	Underground Switch	83	$4,340
vUS_4264	Underground Switch	22	$38,953
vUS_4265	Underground Switch	62	$7,145
vUS_4266	Underground Switch	23	$37,715
vUS_4267	Underground Switch	61	$7,317
vUS_4268	Underground Switch	99	$1,409
vUS_4269	Underground Switch	62	$7,145
vUS_4270	Underground Switch	54	$8,834
vUS_4271	Underground Switch	41	$14,587
vUS_4272	Underground Switch	23	$37,715
vUS_4273	Underground Switch	54	$8,834
vUS_4274	Underground Switch	22	$38,953
vUS_4275	Underground Switch	26	$30,428
vUS_4276	Underground Switch	92	$3,661
vUS_4277	Underground Switch	51	$9,759
vUS_4278	Underground Switch	99	$2,956
vUS_4279	Underground Switch	61	$7,317
vUS_4280	Underground Switch	17	$59,100
vUS_4281	Underground Switch	56	$8,346
vUS_4282	Underground Switch	21	$41,906
vUS_4283	Underground Switch	71	$5,610
vUS_4284	Underground Switch	28	$27,784
vUS_4285	Underground Switch	26	$30,428
vUS_4286	Underground Switch	27	$29,709
vUS_4287	Underground Switch	25	$32,931
vUS_4288	Underground Switch	26	$30,428
vUS_4289	Underground Switch	71	$5,610

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUS_4290	Underground Switch	80	$4,655
vUS_4291	Underground Switch	80	$4,629
vUS_4292	Underground Switch	46	$11,844
vUS_4293	Underground Switch	58	$7,842
vUS_4294	Underground Switch	26	$30,677
vUS_4295	Underground Switch	25	$33,094
vUS_4296	Underground Switch	61	$7,317
vUS_4297	Underground Switch	76	$4,989
vUS_4298	Underground Switch	47	$11,450
vUS_4299	Underground Switch	28	$27,784
vUS_4300	Underground Switch	83	$4,340
vUS_4301	Underground Switch	39	$15,644
vUS_4302	Underground Switch	36	$18,101
vUS_4303	Underground Switch	83	$4,340
vUS_4304	Underground Switch	36	$18,051
vUS_4305	Underground Switch	56	$8,346
vUS_4306	Underground Switch	54	$9,061
vUS_4307	Underground Switch	99	$2,588
vUS_4308	Underground Switch	26	$30,769
vUS_4309	Underground Switch	61	$7,317
vUS_4310	Underground Switch	26	$30,769
vUS_4311	Underground Switch	61	$7,317
vUS_4312	Underground Switch	71	$5,610
vUS_4313	Underground Switch	74	$5,290
vUS_4314	Underground Switch	99	$2,956
vUS_4315	Underground Switch	64	$6,772
vUS_4316	Underground Switch	67	$6,180

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUS_4317	Underground Switch	24	$35,028
vUS_4318	Underground Switch	60	$7,551
vUS_4319	Underground Switch	67	$6,203
vUS_4320	Underground Switch	99	$2,956
vUS_4321	Underground Switch	71	$5,610
vUS_4322	Underground Switch	31	$23,572
vUS_4323	Underground Switch	44	$12,547
vUS_4324	Underground Switch	44	$12,547
vUS_4325	Underground Switch	64	$6,772
vUS_4326	Underground Switch	93	$3,633
vUS_4327	Underground Switch	25	$31,960
vUS_4328	Underground Switch	92	$3,661
vUS_4329	Underground Switch	58	$7,842
vUS_4330	Underground Switch	99	$2,956
vUS_4331	Underground Switch	60	$7,572
vUS_4332	Underground Switch	99	$2,956
vUS_4333	Underground Switch	44	$12,547
vUS_4334	Underground Switch	92	$3,661
vUS_4335	Underground Switch	80	$4,629
vUS_4336	Underground Switch	64	$6,772
vUS_4337	Underground Switch	52	$9,524
vUS_4338	Underground Switch	92	$3,661
vUS_4339	Underground Switch	69	$5,898
vUS_4340	Underground Switch	22	$39,806
vUS_4341	Underground Switch	24	$35,573
vUS_4342	Underground Switch	56	$8,346
vUS_4343	Underground Switch	92	$3,661

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUS_4344	Underground Switch	92	$3,661
vUS_4345	Underground Switch	53	$9,304
vUS_4346	Underground Switch	64	$6,772
vUS_4347	Underground Switch	67	$6,203
vUS_4348	Underground Switch	92	$3,661
vUS_4349	Underground Switch	24	$35,573
vUS_4350	Underground Switch	99	$2,956
vUS_4351	Underground Switch	99	$2,956
vUS_4352	Underground Switch	99	$2,956
vUS_4353	Underground Switch	74	$5,290
vUS_4354	Underground Switch	54	$9,042
vUS_4355	Underground Switch	67	$6,203
vUS_4356	Underground Switch	87	$3,991
vUS_4357	Underground Switch	57	$8,086
vUS_4358	Underground Switch	26	$30,769
vUS_4359	Underground Switch	99	$2,956
vUS_4360	Underground Switch	99	$2,956
vUS_4361	Underground Switch	26	$30,769
vUS_4362	Underground Switch	56	$8,346
vUS_4363	Underground Switch	99	$1,538
vUS_4364	Underground Switch	38	$16,253
vUS_4365	Underground Switch	38	$16,253
vUS_4366	Underground Switch	22	$39,514
vUS_4367	Underground Switch	67	$6,203
vUS_4368	Underground Switch	64	$6,772
vUS_4369	Underground Switch	87	$3,991
vUS_4370	Underground Switch	38	$16,253

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUS_4371	Underground Switch	51	$9,759
vUS_4372	Underground Switch	54	$8,834
vUS_4373	Underground Switch	22	$39,636
vUS_4374	Underground Switch	28	$27,256
vUS_4375	Underground Switch	43	$13,315
vUS_4376	Underground Switch	83	$4,340
vUS_4377	Underground Switch	87	$3,991
vUS_4378	Underground Switch	32	$21,363
vUS_4379	Underground Switch	62	$7,036
vUS_4380	Underground Switch	92	$3,661
vUT_4013	Underground Transformer	10	$24,061
vUT_4014	Underground Transformer	9	$31,070
vUT_4015	Underground Transformer	22	$6,519
vUT_4016	Underground Transformer	9	$29,445
vUT_4017	Underground Transformer	9	$29,554
vUT_4018	Underground Transformer	11	$25,621
vUT_4019	Underground Transformer	11	$25,621
vUT_4020	Underground Transformer	17	$13,582
vUT_4021	Underground Transformer	9	$29,445
vUT_4022	Underground Transformer	9	$31,551
vUT_4023	Underground Transformer	14	$34,866
vUT_4024	Underground Transformer	7	$23,114
vUT_4025	Underground Transformer	9	$29,445
vUT_4026	Underground Transformer	17	$13,582
vUT_4027	Underground Transformer	17	$14,032
vUT_4028	Underground Transformer	62	$2,138
vUT_4029	Underground Transformer	99	$2,302

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUT_4030	Underground Transformer	17	$13,582
vUT_4031	Underground Transformer	7	$23,189
vUT_4032	Underground Transformer	17	$13,582
vUT_4033	Underground Transformer	9	$29,445
vUT_4034	Underground Transformer	9	$31,070
vUT_4035	Underground Transformer	62	$2,138
vUT_4036	Underground Transformer	9	$29,445
vUT_4037	Underground Transformer	10	$34,314
vUT_4038	Underground Transformer	17	$13,582
vUT_4039	Underground Transformer	27	$8,257
vUT_4040	Underground Transformer	26	$7,862
vUT_4041	Underground Transformer	34	$10,275
vUT_4042	Underground Transformer	10	$34,314
vUT_4043	Underground Transformer	62	$2,138
vUT_4044	Underground Transformer	9	$29,445
vUT_4045	Underground Transformer	15	$59,115
vUT_4046	Underground Transformer	32	$5,694
vUT_4047	Underground Transformer	22	$9,939
vUT_4048	Underground Transformer	9	$17,592
vUT_4049	Underground Transformer	25	$5,498
vUT_4050	Underground Transformer	20	$7,266
vUT_4051	Underground Transformer	21	$6,954
vUT_4052	Underground Transformer	9	$17,592
vUT_4053	Underground Transformer	21	$10,280
vUT_4054	Underground Transformer	18	$8,127
vUT_4055	Underground Transformer	34	$3,470
vUT_4056	Underground Transformer	25	$8,424

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUT_4057	Underground Transformer	29	$6,552
vUT_4058	Underground Transformer	24	$8,827
vUT_4059	Underground Transformer	28	$4,590
vUT_4060	Underground Transformer	25	$7,996
vUT_4061	Underground Transformer	22	$9,939
vUT_4062	Underground Transformer	22	$9,939
vUT_4063	Underground Transformer	11	$24,003
vUT_4064	Underground Transformer	21	$6,622
vUT_4065	Underground Transformer	18	$8,391
vUT_4066	Underground Transformer	24	$8,827
vUT_4067	Underground Transformer	28	$4,590
vUT_4068	Underground Transformer	27	$4,804
vUT_4069	Underground Transformer	21	$10,280
vUT_4070	Underground Transformer	31	$6,000
vUT_4071	Underground Transformer	22	$9,939
vUT_4072	Underground Transformer	26	$5,063
vUT_4073	Underground Transformer	15	$32,093
vUT_4074	Underground Transformer	27	$4,804
vUT_4075	Underground Transformer	27	$4,804
vUT_4076	Underground Transformer	48	$1,922
vUT_4077	Underground Transformer	21	$6,622
vUT_4078	Underground Transformer	15	$16,137
vUT_4079	Underground Transformer	25	$7,996
vUT_4080	Underground Transformer	10	$24,219
vUT_4081	Underground Transformer	12	$12,911
vUT_4082	Underground Transformer	23	$9,394
vUT_4083	Underground Transformer	28	$4,590

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUT_4084	Underground Transformer	36	$3,124
vUT_4085	Underground Transformer	25	$7,996
vUT_4086	Underground Transformer	14	$10,994
vUT_4087	Underground Transformer	14	$10,994
vUT_4088	Underground Transformer	25	$7,996
vUT_4089	Underground Transformer	12	$12,911
vUT_4090	Underground Transformer	21	$6,622
vUT_4091	Underground Transformer	39	$2,775
vUT_4092	Underground Transformer	25	$7,996
vUT_4093	Underground Transformer	28	$4,590
vUT_4094	Underground Transformer	25	$7,996
vUT_4095	Underground Transformer	28	$4,590
vUT_4096	Underground Transformer	10	$24,219
vUT_4097	Underground Transformer	27	$7,546
vUT_4098	Underground Transformer	20	$7,266
vUT_4099	Underground Transformer	20	$7,266
vUT_4100	Underground Transformer	29	$6,552
vUT_4101	Underground Transformer	20	$7,266
vUT_4102	Underground Transformer	20	$7,266
vUT_4103	Underground Transformer	27	$7,546
vUT_4104	Underground Transformer	25	$5,276
vUT_4105	Underground Transformer	23	$9,394
vUT_4106	Underground Transformer	24	$8,827
vUT_4107	Underground Transformer	15	$16,137
vUT_4108	Underground Transformer	29	$6,552
vUT_4109	Underground Transformer	19	$7,704
vUT_4110	Underground Transformer	28	$4,590

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUT_4111	Underground Transformer	19	$7,704
vUT_4112	Underground Transformer	25	$5,276
vUT_4113	Underground Transformer	25	$5,276
vUT_4114	Underground Transformer	23	$5,882
vUT_4115	Underground Transformer	27	$7,546
vUT_4116	Underground Transformer	19	$7,990
vUT_4117	Underground Transformer	29	$6,552
vUT_4118	Underground Transformer	21	$6,954
vUT_4119	Underground Transformer	27	$7,546
vUT_4120	Underground Transformer	27	$7,546
vUT_4121	Underground Transformer	27	$4,804
vUT_4122	Underground Transformer	36	$4,735
vUT_4123	Underground Transformer	25	$8,424
vUT_4124	Underground Transformer	12	$20,016
vUT_4125	Underground Transformer	21	$6,768
vUT_4126	Underground Transformer	10	$15,881
vUT_4127	Underground Transformer	21	$6,781
vUT_4128	Underground Transformer	34	$3,470
vUT_4129	Underground Transformer	16	$9,458
vUT_4130	Underground Transformer	30	$4,043
vUT_4131	Underground Transformer	28	$7,045
vUT_4132	Underground Transformer	21	$6,781
vUT_4133	Underground Transformer	17	$47,571
vUT_4134	Underground Transformer	9	$19,707
vUT_4135	Underground Transformer	10	$24,958
vUT_4136	Underground Transformer	21	$6,781
vUT_4137	Underground Transformer	30	$4,043

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUT_4138	Underground Transformer	21	$6,781
vUT_4139	Underground Transformer	23	$5,897
vUT_4140	Underground Transformer	12	$20,016
vUT_4141	Underground Transformer	9	$19,707
vUT_4142	Underground Transformer	25	$8,184
vUT_4143	Underground Transformer	27	$7,546
vUT_4144	Underground Transformer	23	$5,882
vUT_4145	Underground Transformer	34	$3,470
vUT_4146	Underground Transformer	25	$8,202
vUT_4147	Underground Transformer	27	$7,546
vUT_4148	Underground Transformer	23	$5,897
vUT_4149	Underground Transformer	9	$19,707
vUT_4150	Underground Transformer	10	$15,881
vUT_4151	Underground Transformer	10	$15,881
vUT_4152	Underground Transformer	27	$4,804
vUT_4153	Underground Transformer	25	$8,424
vUT_4154	Underground Transformer	27	$7,546
vUT_4155	Underground Transformer	27	$4,804
vUT_4156	Underground Transformer	23	$5,897
vUT_4157	Underground Transformer	22	$9,755
vUT_4158	Underground Transformer	25	$5,498
vUT_4159	Underground Transformer	8	$21,454
vUT_4160	Underground Transformer	8	$21,454
vUT_4161	Underground Transformer	19	$7,853
vUT_4162	Underground Transformer	24	$8,827
vUT_4163	Underground Transformer	36	$4,735
vUT_4164	Underground Transformer	16	$14,359

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUT_4165	Underground Transformer	8	$21,454
vUT_4166	Underground Transformer	9	$27,318
vUT_4167	Underground Transformer	36	$4,735
vUT_4168	Underground Transformer	36	$4,735
vUT_4169	Underground Transformer	8	$21,454
vUT_4170	Underground Transformer	36	$4,735
vUT_4171	Underground Transformer	34	$3,470
vUT_4172	Underground Transformer	28	$7,065
vUT_4173	Underground Transformer	19	$7,693
vUT_4174	Underground Transformer	28	$7,065
vUT_4175	Underground Transformer	19	$7,693
vUT_4176	Underground Transformer	34	$3,470
vUT_4177	Underground Transformer	19	$7,693
vUT_4178	Underground Transformer	23	$9,379
vUT_4179	Underground Transformer	25	$5,276
vUT_4180	Underground Transformer	23	$9,379
vUT_4181	Underground Transformer	25	$5,276
vUT_4182	Underground Transformer	25	$5,276
vUT_4183	Underground Transformer	20	$7,105
vUT_4184	Underground Transformer	9	$19,078
vUT_4185	Underground Transformer	29	$4,324
vUT_4186	Underground Transformer	29	$4,324
vUT_4187	Underground Transformer	34	$3,470
vUT_4188	Underground Transformer	9	$19,078
vUT_4189	Underground Transformer	24	$8,618
vUT_4190	Underground Transformer	9	$19,078
vUT_4191	Underground Transformer	9	$19,078

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUT_4192	Underground Transformer	20	$7,105
vUT_4193	Underground Transformer	9	$19,078
vUT_4194	Underground Transformer	34	$3,470
vUT_4195	Underground Transformer	24	$8,827
vUT_4196	Underground Transformer	23	$9,212
vUT_4197	Underground Transformer	16	$14,800
vUT_4198	Underground Transformer	23	$9,212
vUT_4199	Underground Transformer	19	$11,824
vUT_4200	Underground Transformer	16	$14,800
vUT_4201	Underground Transformer	19	$11,824
vUT_4202	Underground Transformer	29	$6,552
vUT_4203	Underground Transformer	10	$24,860
vUT_4204	Underground Transformer	19	$11,824
vUT_4205	Underground Transformer	29	$4,324
vUT_4206	Underground Transformer	29	$4,324
vUT_4207	Underground Transformer	23	$9,212
vUT_4208	Underground Transformer	24	$8,827
vUT_4209	Underground Transformer	25	$5,498
vUT_4210	Underground Transformer	13	$11,878
vUT_4211	Underground Transformer	24	$8,827
vUT_4212	Underground Transformer	16	$14,800
vUT_4213	Underground Transformer	13	$11,878
vUT_4214	Underground Transformer	16	$14,800
vUT_4215	Underground Transformer	10	$24,860
vUT_4216	Underground Transformer	19	$11,824
vUT_4217	Underground Transformer	10	$24,860
vUT_4218	Underground Transformer	16	$14,800

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

ID	Asset Type	Years to Optimal Intervention	Projected risk cost of underground front lot (NPV)
Total			$11,551,746
vUT_4219	Underground Transformer	16	$14,800
vUT_4220	Underground Transformer	19	$11,824
vUT_4221	Underground Transformer	28	$7,065
vUT_4222	Underground Transformer	28	$7,065
vUT_4223	Underground Transformer	29	$4,324
vUT_4224	Underground Transformer	22	$6,441
vUT_4225	Underground Transformer	33	$5,399
vUT_4226	Underground Transformer	22	$6,441
vUT_4227	Underground Transformer	29	$4,324
vUT_4228	Underground Transformer	26	$7,763
vUT_4229	Underground Transformer	22	$6,441

<u>Projected non-asset risk cost of underground front lot (NPV)</u>

Event Cost Total = $0

Duration Cost Total = $0

NAR = $0

<u>Maintenance</u>

Submersible Transformer Vaults = $6,294.98

Cable Chambers = $1,701.49

Submersible Switches = $17,709.56

Discount Rate = 0.0606

Total = ($6,294.98 + $1,701.49 + $17,709.56) / 0.0606 = $424,191.99

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c) Please also include an explanation of the assumptions the inputs are based on, and show the calculations for

1. **how the input numbers were arrived at, and**
2. **how each of the output numbers in Tables A1, A2 and A3 and the expected A4 for overhead front lot construction are arrived at.**

RESPONSE:

c) The definitions for each of the inputs are as follows:

i. **Total Cost of Ownership:** The cost of ownership is calculated for each "state" of assets within this business case. Option 1 refers to the Existing State of Assets in their existing Rear Lot overhead configuration, while Options 2, 3 and 4 present the New State of assets as per new Rear Lot Overhead infrastructure (Option 2), new Front Lot Overhead infrastructure (Option 3) or new Front Lot Underground infrastructure (Option 4) respectively. The cost of ownership (or NPV) calculation is performed over a 100-year period, as the calculation must be performed over the same time period for all assets being evaluated, such that a comparison can be made between different assets or set of assets and their respective cost of ownership values. The 100-year period is long enough to cover all major asset classes that are evaluated within the Feeder Investment Model (FIM). Assets with an expected life shorter than the 100-year time period will be reflected within the cost of ownership calculation as having multiple life cycles – the replacement cost is therefore considered to account for the replacement of the asset as necessary of the 100 years. Total Cost of Ownership ultimately includes three components:

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- Projected Risk Cost which represents the asset cost of ownership,
- Non-Asset Projected Risk Cost which represents the non-asset-related risks associated with the evaluated state of assets
- Maintenance Costs associated with the evaluated state of assets

As each "state" of assets is not expected to change, it is assumed that non-asset projected risk costs and maintenance costs will remain constant across the life cycles of the associated assets.

ii. **Projected Risk Cost:** The projected risk cost for each option represents the net present value of the 'cost of ownership' for the asset itself. In order to calculate the 'cost of ownership' of a single asset, the estimated annualized risk is plotted along with its 'Equivalent Annual Cost' (EAC), as shown in Figure 1. Note that the EAC is the minimum life cycle cost of the asset, including both capital cost as well as future risk. The EAC defines the cost that is incurred every year, for the ownership of the asset, in a specific design for all future years. For the existing asset, only the risk is taken into account since the replacement cost is a sunk cost. As such, the asset follows its risk cost curve until it reaches its optimal replacement timing, at which point it should be replaced and thus, begins to follow the EAC line. The net present value of these costs from the current age onwards, over a 100-year period, represents the asset-related 'Cost of Ownership' of an asset in a particular design. The cost of ownership is represented by the region shaded blue in Figure 1.

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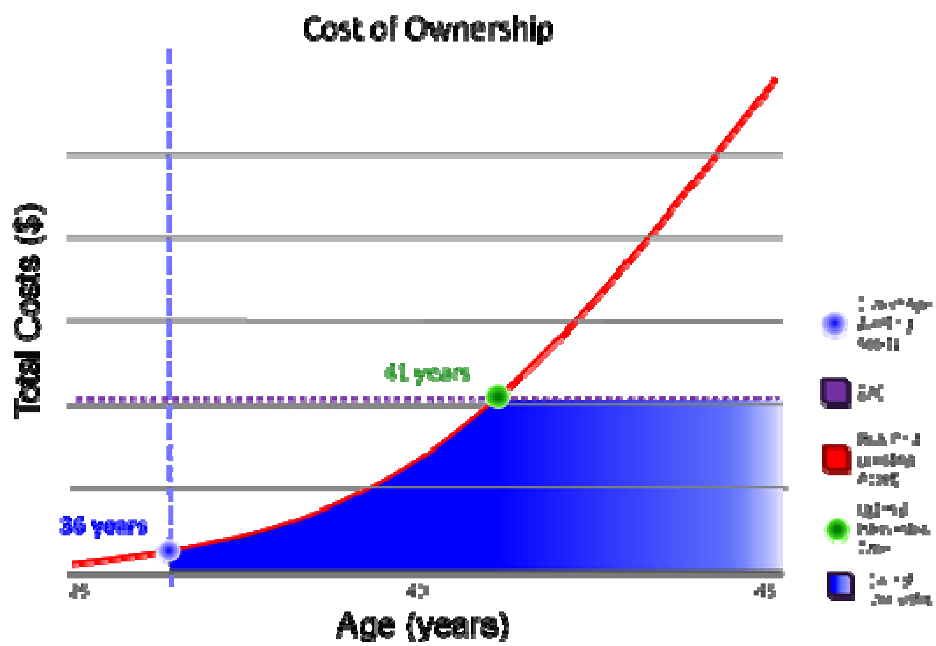

Figure 1 – Cost of Ownership Calculation (Example)

iii. **Projected Non-Asset Risk Cost:** The projected non-asset risk cost for each option represents the net present value of the non-asset risks associated with the "state" of assets that exist in each option evaluated. The Projected Non-Asset Risk Cost can be calculated as follows:

- **NAR = ((SAIFI$_{\text{EFFECT}}$)(EVENTS)(LOAD) + (SAIDI$_{\text{EFFECT}}$)(EVENTS)(LOAD)(AVG$_{\text{DUR}}$))/DISCOUNT$_{\text{RATE}}$**

  Where:

  - SAIFI$_{\text{EFEECT}}$ ($30) represents the cost associated with this first period of the interruption.
  - SAIDI$_{\text{EFEECT}}$ ($15) represents the cost associated with this second period of the interruption.

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- EVENTS represents the total quantity of non-asset-related events for the assets that are being evaluated. Note that this total quantity is based upon the length of feeder that is being exposed to these non-asset-related events.
- LOAD represents the peak load in kVA that will be interrupted due to the outage event.
- AVG_{DUR} represents the average duration of non-asset-related events as reported along the feeder.
- $DISCOUNT_{RATE}$ represents THESL's corporate discount rate of 6.06%.

iv. **Maintenance:** Maintenance costs are calculated for both rear-lot overhead plant as well as underground plant within this business case evaluation. For rear-lot overhead plant, the costs for tree trimming and pole inspections are considered as per the formula below:

- **$MC = (TT_{COST} + INSPECT_{COST}) / DISCOUNT_{RATE}$**

  Where:
  - TT_{COST} represents the cost associated with tree trimming.
  - $INSPECT_{COST}$ represents the cost associated with pole inspections.
  - $DISCOUNT_{RATE}$ represents THESL's corporate discount rate of 6.06%.

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INTERROGATORY 45:

Reference(s): Tab 4, Sch. B8 Scadamate R1 switches

Page 14 presents the cost of a Scadamate R2 Switch and concludes that retrofitting R1 versions of the switch with R2 components will not provide sufficient cost savings given the small difference in cost between the retrofit and a new R2 switch.

a) Does THESL consider the problem with the R1 version of the switch to be a design or manufacturing defect?

RESPONSE:

a) THESL considers the problem with the R1 version of the SCADA-Mate switch to be a design defect.

b) Does THESL accept the manufacturer's conclusion on Page 22 that pressure washing from the ground was responsible for moisture accumulation in the mechanism that ultimately causes corrosion and failure of the switch?

RESPONSE:

b) Although THESL accepts that moisture accumulation within the motor operator was likely the largest contributing factor to the failure, in THESL's view it has not been established that this moisture was a result of the pressure washing program.

c) Why does THESL pressure wash from the ground rather from an aerial device?

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RESPONSE:

c) THESL typically pressure washes from aerial devices and not from the ground, as is incorrectly indicated in the manufacturer's report. The author of the manufacturer's report was not aware of THESL pressuring washing procedures and assumed that the pressure washing was done from the ground because the motor operator is located below the base of the switch.

d) Were all R1 switches in the system pressure washed from the ground at some point in their installed lifetime? If not, has THESL had any of those evaluated to determine if they have similar corrosion damage and may not need replacement?

RESPONSE:

d) No. As explained in part (c) THESL used aerial devices for pressure washing.

e) Is the manufacturer contributing to the cost of replacing the R1 switches? If yes, please quantify the contribution. If not, please explain why there will be no contribution.

RESPONSE:

e) As stated in the response to OEB Staff interrogatory 42 (b) (Tab F6, Schedule 1-42, part b), "No compensation has been established at this time".

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INTERROGATORY 46:

Reference(s): **Tab 4, Sch. B8 Scadamate R1 switches**

Table 1 on Page 30 shows the avoided estimated risk cost for the project as $45.86 M. Please provide the complete ICM model inputs and outputs used to arrive at this conclusion including the assumptions the inputs are based on and an explanation of how the model calculates the avoided estimated risk cost.

RESPONSE:

Avoided estimated risk cost ($54.76M for SCADAMATE R1 Project) is calculated using the various costs and benefits associated with executing the project in 2012 as opposed to 2015. Please note that the Avoided Estimated Risk Cost and the Project Net Cost in the table below has been revised to correct an error in the evidence. In calculating the present value of the 2015 figure, THESL inadvertently applied both an annual discount rate to the years 2013, 2014 and 2015 and an overall rate to the 2015 figure. This response also corrects Table 1 on page 30 of Tab 4, Schedule B8.

At the time of the project execution, some SCADAMATE R1 switches may be before their optimal intervention time which will have sacrificed economic life. Also some SCADAMATE R1 switches may be after their optimal intervention time which will have incurred excess risk. Additionally, there may be benefits associated with the project considering multiple asset replacements together as a part of the linear project. However, in this instance, the benefits would not be applicable as the project consists of pre-determined switches being replaced all over the system. Therefore, the total Project Net Cost is directly proportional to the total costs including sacrificed life and excess risk.

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The table below lists all the SCADAMATE R1 switches that need to be replaced and the breakdown of the Project Net Cost per switch in years 2012 to 2015. For calculating avoided estimated risk cost, the Project Net Cost in 2012 is subtracted from the Present Value of the Project Net Cost in 2015.

The Optimal Intervention Timing column in the table shows how many years from now (2012) the switch could be optimally replaced. An optimal intervention timing value of '0' years means that 2012 is the optimal year for the particular switch to be replaced and therefore it will incur '$0' Cost of deviating from the optimal strategy of asset replacement. As opposed to replacing the switch in 2012, if the switch replacement project is delayed to later years, the cost increases significantly.

Note that there are certain switches in which the Optimal Intervention Timing value is not at zero years, but have still been included as part of the SCADAMATE R1 segment. This is due to the fact that the driver of replacing these switches is due primarily to both the associated asset risks, as well as to potential impacts on essential customers such as pumping stations and hospitals that are connected using these switches.

Avoided Estimated Risk Cost	=		$54,762,047		
		COST OF DEVIATING FROM OPTIMAL STRATEGY (REPLACEMENT)			
Location	Optimal Intervention Timing	2012	PV (2013)	PV (2014)	PV (2015)
Project Net Cost		$283,933	$18,348,930	$36,607,173	$55,045,980
OSC40880	0	$0	$96,203	$192,709	$289,325
OSC33911	0	$0	$22,940	$46,986	$72,027
OSC65977	0	$0	$133,533	$265,491	$395,742

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Avoided Estimated Risk Cost	=		$54,762,047		
		COST OF DEVIATING FROM OPTIMAL STRATEGY (REPLACEMENT)			
Location	Optimal Intervention Timing	2012	PV (2013)	PV (2014)	PV (2015)
Project Net Cost		$283,933	$18,348,930	$36,607,173	$55,045,980
OSC69882	0	$0	$133,533	$265,491	$395,742
OSC9416	0	$0	$38,145	$76,622	$115,333
OSC38192	0	$0	$297,985	$588,702	$872,160
OSC5813	0	$0	$244,667	$483,404	$716,216
OSC3206	0	$0	$103,545	$206,562	$308,899
OSC2938	0	$0	$134,626	$269,514	$404,408
OSC85939	0	$0	$91,746	$183,800	$275,975
OSC52727	0	$0	$423,841	$838,532	$1,243,991
OSC54003	0	$0	$36,410	$73,607	$111,472
OSC38413	0	$0	$302,003	$596,635	$883,909
OSC62574	0	$0	$16,761	$37,532	$62,246
OSC63584	0	$0	$1,069	$3,248	$6,478
OSC4133	0	$0	$4,190,149	$8,546,891	$13,056,183
OSC67950	0	$0	$18,762	$39,168	$61,093
OSC71749	0	$0	$18,874	$38,340	$58,321
OSC55255	0	$0	$28,199	$58,106	$89,571
OSC85025	0	$0	$15,024	$29,963	$44,792
OSC58792	1	$1,160	$0	$730	$2,364
OSC5742	0	$0	$475,173	$941,785	$1,399,608
OSC5839	0	$0	$25,256	$50,959	$77,029
OSC39293	0	$0	$123,141	$244,263	$363,290
OSC26527	0	$0	$91,716	$181,987	$270,750
S175	0	$0	$391,653	$776,304	$1,153,764
OSC84468	0	$0	$24,209	$51,743	$82,429
OSC41616	0	$0	$206,211	$406,916	$602,162

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Avoided Estimated Risk Cost	=	$54,762,047			
		COST OF DEVIATING FROM OPTIMAL STRATEGY (REPLACEMENT)			
Location	Optimal Intervention Timing	2012	PV (2013)	PV (2014)	PV (2015)
Project Net Cost		$283,933	$18,348,930	$36,607,173	$55,045,980
OSC91960	0	$0	$28,716	$74,366	$138,814
OSC4665	0	$0	$9,038	$20,014	$32,827
OSC453	0	$0	$128,540	$255,861	$381,814
OSC3723	0	$0	$416,076	$821,911	$1,217,528
OSC47348	0	$0	$83,274	$168,252	$254,680
OSC4367	0	$0	$31,724	$65,101	$99,978
OSC52633	0	$0	$12,740	$26,479	$41,132
OSC26044	0	$0	$127,449	$252,310	$374,540
OSC55748	0	$0	$127,092	$252,699	$376,694
OSC15961	0	$0	$13,971	$30,347	$49,002
OSC6674	0	$0	$48,254	$95,847	$142,734
OSC85412	0	$0	$57,921	$119,260	$183,749
OSC7147	0	$0	$135,115	$269,441	$402,788
OSC27716	0	$0	$76,285	$152,264	$227,817
OSC8616	0	$0	$84,264	$229,054	$444,780
OSC40834	0	$0	$99,517	$198,539	$296,920
OSC89248	1	$699	$0	$399	$1,312
OSC70655	0	$0	$489	$2,188	$5,067
OSC5722	0	$0	$154,820	$305,962	$453,419
OSC1019	0	$0	$16,774	$36,209	$58,166
OSC50296	2	$2,325	$899	$0	$57
OSC81817	0	$0	$43,584	$89,443	$137,373
OSC87281	0	$0	$8,397	$18,011	$28,759
OSC93009	10	$48,692	$40,328	$32,688	$25,810
OSC38185	0	$0	$39,614	$79,559	$119,737

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Avoided Estimated Risk Cost	=	$54,762,047			
		COST OF DEVIATING FROM OPTIMAL STRATEGY (REPLACEMENT)			
Location	Optimal Intervention Timing	2012	PV (2013)	PV (2014)	PV (2015)
Project Net Cost		$283,933	$18,348,930	$36,607,173	$55,045,980
OSC7699	0	$0	$41,515	$82,991	$124,351
OSC28922	0	$0	$217,836	$431,908	$642,097
OSC66704	0	$0	$14,406	$29,872	$46,306
OSC1256	11	$15,542	$12,640	$10,098	$7,893
OSC36717	8	$32,644	$25,578	$19,375	$14,040
OSC63516	0	$0	$181,438	$358,053	$529,883
OSC11208	0	$0	$67,473	$133,939	$199,348
OSC75064	0	$0	$51,391	$102,065	$151,976
OSC957	0	$0	$426,177	$844,708	$1,255,387
OSC57370	0	$0	$43,296	$85,680	$127,139
OSC2160	0	$0	$2,696	$6,686	$11,899
OSC1563	0	$0	$35,944	$73,326	$111,993
OSC50833	0	$0	$63,622	$126,047	$187,246
OSC70606	0	$0	$29,131	$60,004	$92,469
OSC68048	0	$0	$18,889	$39,127	$60,597
OSC60779	0	$0	$95,231	$190,003	$284,173
OSC47319	0	$0	$29,529	$84,797	$170,154
OSC3400	0	$0	$221,136	$439,465	$654,790
OSC7003	0	$0	$36,942	$76,405	$118,192
OSC41954	0	$0	$45,690	$107,753	$186,921
OSC25127	0	$0	$21,720	$44,900	$69,414
OSC30940	0	$0	$221,256	$437,170	$647,743
OSC11099	0	$0	$15,352	$32,130	$50,226
OSC30494	0	$0	$1,259,870	$2,485,019	$3,675,836
OSC66380	0	$0	$154,761	$308,567	$461,206

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Avoided Estimated Risk Cost	=		$54,762,047		
		COST OF DEVIATING FROM OPTIMAL STRATEGY (REPLACEMENT)			
Location	Optimal Intervention Timing	2012	PV (2013)	PV (2014)	PV (2015)
Project Net Cost		$283,933	$18,348,930	$36,607,173	$55,045,980
OSC863	0	$0	$27,609	$56,445	$86,382
OSC42017	0	$0	$24,876	$51,331	$79,231
OSC63339	0	$0	$91,565	$181,688	$270,307
OSC66329	0	$0	$131,386	$260,602	$387,568
OSC92350	0	$0	$2,380	$5,264	$8,609
OSC48880	0	$0	$102,618	$202,858	$300,712
OSC57194	3	$2,837	$1,480	$544	$0
OSC70474	0	$0	$77,724	$154,643	$230,670
OSC55277	0	$0	$161,888	$321,805	$479,598
OSC41917	0	$0	$33,486	$69,330	$107,350
OSC7171	0	$0	$23,609	$48,601	$74,850
OSC97424	0	$0	$44,975	$98,374	$160,076
OSC8681	0	$0	$40,364	$83,349	$128,751
OSC51687	0	$0	$359,050	$709,295	$1,050,752
OSC64242	0	$0	$255,440	$510,971	$766,137
OSC829	0	$0	$8,011	$17,488	$28,343
OSC16303	0	$0	$277,668	$549,432	$815,228
OSC42077	0	$0	$16,761	$37,532	$62,246
S244	0	$0	$4,009	$9,451	$16,249
OSC84659	0	$0	$136,375	$273,011	$409,647
OSC56394	7	$3,904	$3,011	$2,207	$1,509
OSC33856	2	$2,579	$859	$0	$779
OSC99632	0	$0	$7,550	$18,745	$33,511
OSC5999	0	$0	$74,999	$148,554	$220,635
OSC648	1	$2,064	$0	$2,005	$6,038

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Avoided Estimated Risk Cost	=		$54,762,047		
		COST OF DEVIATING FROM OPTIMAL STRATEGY (REPLACEMENT)			
Location	Optimal Intervention Timing	2012	PV (2013)	PV (2014)	PV (2015)
Project Net Cost		$283,933	$18,348,930	$36,607,173	$55,045,980
OSC34189	0	$0	$146,742	$291,724	$434,806
OSC11625	0	$0	$4,657	$10,061	$16,153
OSC22629	0	$0	$212,302	$419,486	$621,553
OSC29927	0	$0	$139,650	$275,999	$409,043
OSC59905	0	$0	$168,426	$335,782	$501,839
OSC28943	0	$0	$111,296	$222,000	$331,952
OSC45715	0	$0	$21,720	$44,900	$69,414
OSC48803	24	$50,801	$45,816	$41,160	$36,823
OSC36939	0	$0	$18,874	$38,340	$58,321
OSC72267	0	$0	$22,178	$45,833	$70,838
OSC10238	0	$0	$184,478	$365,809	$543,889
OSC7256	0	$0	$46,011	$93,188	$141,374
OSC17629	0	$0	$23,932	$48,684	$74,158
OSC4127	0	$0	$10,426	$22,023	$34,704
OSC10293	0	$0	$17,827	$36,836	$56,923
OSC7414	8	$36,707	$28,947	$22,080	$16,126
OSC56295	0	$0	$138,568	$275,490	$410,632
OSC56542	0	$0	$48,254	$95,847	$142,734
OSC658	0	$0	$38,043	$78,657	$121,643
OSC77275	0	$0	$15,867	$32,963	$51,183
OSC29264	0	$0	$37,234	$76,301	$117,029
OSC8977	0	$0	$33,554	$66,557	$98,983
OSC36646	0	$0	$2,217	$5,419	$9,555
OSC43407	0	$0	$17,731	$37,054	$57,850
OSC91394	0	$0	$171,004	$337,925	$500,759

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Avoided Estimated Risk Cost	=		$54,762,047		
		COST OF DEVIATING FROM OPTIMAL STRATEGY (REPLACEMENT)			
Location	Optimal Intervention Timing	2012	PV (2013)	PV (2014)	PV (2015)
Project Net Cost		$283,933	$18,348,930	$36,607,173	$55,045,980
OSC67394	0	$0	$56,050	$111,299	$165,701
OSC52383	0	$0	$14,640	$31,422	$50,235
OSC8250	0	$0	$4,712	$12,509	$23,322
OSC80158	0	$0	$18,889	$39,127	$60,597
OSC1518	0	$0	$216,789	$429,834	$639,015
OSC97120	8	$36,013	$27,985	$20,944	$14,914
OSC15450	0	$0	$27,909	$55,673	$83,247
OSC94501	0	$0	$23,853	$49,098	$75,607
OSC38300	0	$0	$12,520	$27,311	$44,253
OSC99384	0	$0	$23,118	$46,878	$71,192
OSC35496	0	$0	$18,136	$37,589	$58,249
OSC21136	0	$0	$125,781	$249,496	$371,065
OSC4311	9	$47,965	$38,975	$30,821	$23,557
OSC22666	0	$0	$29,469	$60,517	$92,997
OSC264	0	$0	$120,573	$238,707	$354,364
OSC42204	0	$0	$46,871	$93,351	$139,379
OSC9989	0	$0	$47,333	$94,269	$140,745
OSC57969	0	$0	$80,670	$159,774	$237,278
OSC2437	0	$0	$80,091	$159,344	$237,670
OSC35169	0	$0	$254,503	$502,829	$744,984
OSC58853	0	$0	$352,179	$701,687	$1,048,088
OSC24013	0	$0	$37,220	$76,273	$116,985
OSL11400	0	$0	$108,159	$216,312	$324,272
OSC45246	0	$0	$165,284	$326,189	$482,751

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INTERROGATORY 47:

Reference(s): **Tab 4, Sch. B11 Automatic Transfer Switches and Reverse Power Breakers**
Tab 4, Sch. D1 Kinetrics Asset Condition Assessment Audit

Figure 2 on Page 10 of the first reference shows asset condition for ATS units.

a) 5% of units are in poor condition in 2010 and none are in very poor condition. By 2011, 10% of units are in very poor condition. This would appear to mean that at least 5% of the Fair condition units in 2010 moved to the very poor condition by 2011. Please confirm that this is the proper interpretation of the graph.

RESPONSE:

a) Yes.

b) Is this kind of rapid deterioration typical of ATS units? If so, why were there none identified as very poor in 2010?

RESPONSE:

b) Increasingly rapid deterioration is characteristic of equipment at end-of-life. Of the ATS units examined in the 2010 assessment, none were identified as requiring immediate replacement (within one year) (See Tab 4, Schedule B11, page 9).

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c) Figure 13-2 on Page 49 of the second reference shows 2012 Very Good, Good and Fair ATS units greater than those for 2011. Please explain how an asset can climb back up the asset condition chart.

RESPONSE:

c) The apparent improvement in figure 13-2 of the ACA is largely due to "Poor" and "Very Poor" units being removed from service. Between the 2011 and 2012 ACAs about 10% of the worst ATS units were removed from service, resulting in a proportionate increase in the percentage of "Very Good", "Good" and "Fair" ATS units.

d) If the answer to c) above is that maintenance can restore a unit to better condition, does THESL plan to increase maintenance to reverse the deteriorating trend for ATS units?

RESPONSE:

d) Theoretically an asset can climb back up the asset condition chart if restorative maintenance work is performed that corrects deficiencies and reverses degradation. In this case, however, with a lack of usable spare parts and with increasing deterioration, the maintenance program currently undertaken by THESL is unable to effectively extend the life of the ATS units.

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INTERROGATORY 48:

Reference(s): **Tab 4, Sch. B15 Stations Control and Communications Segment**

Page 2 discusses the SONET fibre optic communication system. Lines 15-20 describe consequences for HONI 115 kV transmission feeders and HONI 230 kV transmission in Scarborough if the SONET system fails.

a) It appears that HONI relies on THESL's SONET system for control of some of its transmission assets. Please explain.

RESPONSE:

a) HONI leases SONET fibre optic lines from THESL for inter-station communication purposes.

b) Does HONI contribute to the cost of owning and operating THESL's SONET system? If yes, please describe the cost sharing. If not, please explain why HONI should not contribute if it derives benefits from the system.

RESPONSE:

b) HONI and THESL have a commercial agreement under which HONI pays to lease the lines from THESL.

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INTERROGATORY 49:

Reference(s): **Tab 4, Sch. D3 Navigant Independent Survey and Review of Distribution Design Standards**

Page 4 states City of Toronto is "fifth largest metropolitan area in terms of population in North America".

a) Please describe the boundaries of the "metropolitan area" considered.

RESPONSE:

a) Navigant did not directly investigate or map the boundaries of the metropolitan area of the City of Toronto.

b) What is the population of that metropolitan area?

RESPONSE:

b) Navigant did not conduct primary research to determine the population of the metropolitan area of the City of Toronto.

c) Please identify the four larger metropolitan areas referred to along with their population numbers and total load.

RESPONSE:

c) Navigant did not research the amount of load served by the four larger cities, nor was it necessary to do so in the context of preparing the referenced report.

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Notwithstanding this response, Navigant understand the larger cities include New York City, Mexico City, Los Angeles, and Chicago.

d) How was "total load" measured?

RESPONSE:

d) Navigant did not measure the total load for these larger four cities, nor was it necessary to do so in the context of preparing the referenced report.

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

INTERROGATORY 50:

Reference(s): **Tab 4, Sch. D3 Navigant Independent Survey and Review of Distribution Design Standards**

Page 10 states that "for example, concrete poles should be located on main travelled roadways where guying rights are more difficult to obtain. THESL also generally uses concrete poles on its distribution for similar reasons". Please explain how concrete poles alleviate the need for guying rights?

RESPONSE:

Use of concrete poles does not eliminate the need for guying rights in all instances or locations. However, in some locations where span angles are low, or where overhead line tension is low, concrete poles can be used without supplemental guying. In contrast, use of wood poles, which are less rigid than concrete poles, often require supplemental guying for non-tangent overhead distribution line sections.

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

INTERROGATORY 51:

Reference(s): Tab 4, Sch. D3 Navigant Independent Survey and Review of Distribution Design Standards

Page 11 states that "THESL continues to install many submersible transformers to comply with City requirements; whereas other utilities are seeking to minimize or eliminate their use due to maintenance and harsh operating environments".

a) Please describe City requirements pertaining to submersible transformers and provide documentation for the requirements.

RESPONSE:

a) The City does not have specific requirements for the installation of submersible transformers. However, the City does have requirements for the installation of pad-mounted transformers and other above-ground plant. Through its "Municipal Consent Requirements for the Installation of Plant Within City of Toronto Streets" document (included as Appendix A to Tab 6F, Schedule 7-22), the City requires justification for proposed above-ground plant (such as pad-mounted transformers) including an explanation of the reason why this plant cannot be installed below-ground (like a submersible transformer). Any above-grade installations within the street must also conform to "Vibrant Streets," Toronto's coordinated street furniture program. [1]

[1] http://www.toronto.ca/involved/projects/streetfurniture/pdf/vibrant_streets.pdf

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

b) What is THESL's experience for the cost difference between maintaining submersible vs. padmounted transformers expressed in dollar terms per unit maintained?

RESPONSE:

b) THESL's maintenance program for submersible and pad-mounted transformers involves regular inspections and vault cleaning. The cost of inspecting a submersible transformer vault is $87 per unit. An estimated 100 transformer vaults are washed every year, at an estimated cost of $1000 per unit. The cost of inspecting pad-mounted transformers is $97 per unit.

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES ON ISSUE 2.2

INTERROGATORY 52:

Reference(s): **Tab 4, Sch. D3 Navigant Independent Survey and Review of Distribution Design Standards**

Page 30 references THESL standard design practices. Please provide copies of the following:

1. SDP#002 Rev 3 Overhead Distribution
2. SDP#002Rev2 New Underground Residential Subdivisions
3. SDP#003Rev1 New Underground Services
4. SDP#005 Underground Cable Installations
5. SDP#006Rev 2 Underground Residential Rebuilds
6. SDP#007Rev1 Underground Rebuilds Industrial/Commercial Areas
7. SDP#008 Rear Lot Conversions

RESPONSE:

Please see the following Appendices:

- Appendix A: SDP#001 Rev3 – Overhead Distribution
- Appendix B: SDP#002 Rev3 – New Underground Residential Subdivisions
- Appendix C: SDP#003 Rev1 – New Underground Services
- Appendix D: SDP#005 – Underground Cable Installations
- Appendix E: SDP#005 – Underground Cable Installations – Amendment
- Appendix F: SDP#006 Rev2 – Underground Residential Rebuilds
- Appendix G: SDP#006 Rev2 – Underground Residential Rebuilds – Amendment

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- Appendix H: SDP#007 Rev1 – Underground Rebuilds Industrial/Commercial Areas
- Appendix I: SDP#007 Rev1 – Underground Rebuilds Industrial/Commercial Areas – Amendment
- Appendix J: SDP#008 – Rear Lot Conversions
- Appendix K: SDP#008 – Rear Lot Conversions – Amendment

Standard Design Practice

OVERHEAD DISTRIBUTION

SDP #001 Rev. 3

Prepared by: Standard Design Practice Team

Approved by: Les Koch
Manager, Standards & Policy Planning

Issue Date: Oct. 10, 2007

SDP #001 - Overhead Distribution

Revision History			
Rev. #	**Date**	**Description**	**Approved by:**
00	19-Sept-03	- Original Issue	R. Sironi
01	8-Nov-04	- Revised drawing guidelines to align with field recommendations and GEAR requirements. - Added requirement to ensure all equipment is equipped with appropriate grounding provisions. - Revised "Switch" section to include DA strategy recommendations and additional notifications.	R. Sironi
02	9-June-05	- Added cover sheet, contents page and revision history table. - Added new requirements resulting from Ontario Regulation 22/04. - Revised sample drawings. - Removed the nomenclature standards from the document, as they will form Section 21 in the Construction Standards. - General revisions based on stakeholder feedback and alignment with current processes.	J. Petras
03	10-Oct-07	- Revised to reflect new street light process. - Revised Switch section to include reference to SP #005 "Installation of SCADA Switches and Planning Guideline". - Added requirement for designers to consult with Bell when relocating poles with Bell attachments. - Added new Sections: Section 1.2.7.1 - 600V Delta to 600/347V Wye Conversion Section 1.2.11 - Unmetered Connections Section 1.2.12 – Customer Communications & Public Affairs. - Added Customer & Councillor Notification Letters - Revised Equipment numbering section (formerly Nomenclature) to reflect the current standards. - Added reference to the "Distribution Grid Operations Project Review Form". - Revised sample drawings to show new symbology. - General revisions based on stakeholder feedback and alignment with current processes and practice documents.	L. Koch

SDP #001 - Overhead Distribution

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Toronto Hydro- Electric System Ltd. Standard Design Practice		SDP # 001 Rev. 3	
SUBJECT	**OVERHEAD DISTRIBUTION**	**DATE ISSUED**	Sept. 19, 2003
		REVIEW DATE	Oct. 10, 2009
		SUPERCEDES SDP #	SDP #001 Rev. 2
		DATE REVISED	Oct. 10, 2007
Issued by: Don Pernerowski – for Standards & Policy Planning **Approved by: Les Koch**			

Section 1 - Practice:

The purpose of this document is to provide a guideline for the design of projects involving overhead construction on the 27.6kV and 13.8kV distribution systems. The document provides the necessary framework to ensure project designs are aligned with business strategies and completed design packages are delivered in a consistent fashion.

Four key issues are addressed in the document:

1. Design Checklist: identifies the activities, which should be considered during the design phase.
2. Design Considerations: supplements the Construction Standards by identifying key design components and strategies for new projects.
3. Drawing Guidelines: identifies key information to be shown on project drawings.
4. Project Deliverables: identifies the documents & drawings required when signing-off on a design file.

This document can be used as a guideline for O/H distribution projects involving Voltage Conversions, Primary Line Rebuilds, Secondary Line Rebuilds, Pole Replacements, Tree-proof Primary Cable Installations and Long-span Construction.

1.1 Design Checklist

Many issues need to be considered in the design of O/H distribution projects. To ensure a comprehensive design package is delivered, designers must be cognizant of all issues during the design. To assist designers in this area, “O/H Distribution Design Project Checklist” (Appendix “A”) has been developed and should be used as a guide to ensure all aspects of the design stage are successfully completed.

1.2 Design Considerations

1.2.1 General

- Designers shall ensure project designs satisfy the requirements of Section 7 of Ontario Regulation 22/04 “Electrical Distribution Safety” under the Electricity Act, 1998.
- Designers shall employ “Safety by Design” concept in project designs (i.e. ensure adequate clearances are available from adjacent structures, conductors, trees etc.; accessibility to manual operated switches etc.).
- Designers shall endorse the use of only certified construction standards and specifications in the assembly of the project drawings. The use of authorized legacy standards should be limited to the maintaining of lines where certified construction standards would be problematic. Any new construction specifying the use of legacy standards will require a certificate of approval prepared by a Professional Engineer.
- In accordance with Bill 208, all known “Designated Substances” that may be encountered in the project shall be identified on the drawing. Examples of “Designated Substances” and their applications may include:
  Asbestos - cables and ducts
  Lead - PILC and AILC cables, meter backer boards, listing tape and older station batteries
  Mercury - mercury vapor lamps and street light relays

Vinyl Chloride - 4" PVC ducts and PVC jacketed cables
Arsenic - arsenical lead sheathed cables
Ethylene Oxide - polyethylene insulated cables
Silica - current limiting fuses and lightning arresters (4kV),
and other substances and applications that may be added from time to time.

- Installations along Hydro One corridor lands should be avoided whenever possible. If necessary, consult System Reliability Planning.
- When preparing scope packages & project designs, both Planners and Designers shall consider the requirements of Distribution Grid Operations. These requirements are identified in a "Distribution Grid Operations Project Review Form" that can be obtained by contacting a Control Room Operations Supervisor.
- Avoid installations that may not be accessible to vehicles year round (i.e. ravines, parks, along highways etc.).
- Avoid installations that occupy and/or cross CN/CP Rail right of ways.
  When encroaching or crossing a CN/CP Rail right of way is necessary, special permits as well as easements need to be obtained from CN/CP. A signed release of Liability in respect to entering railway premises is also required. The requirements are set forth in the following documents:
  CANADIAN TRANSPORT COMMISSION GENERAL ORDER NO. E-11 "Regulations Respecting Standards for Wire Crossings and Proximities"
  http://www.tc.gc.ca/acts-regulations/GENERAL/r/rsa/regulations/020/rsa022/rsa22.html
  CANADIAN STANDARDS ASSOCIATION CSA C22.3 No.7 Underground Systems (latest version)
- Long-span construction may be considered for new installations and in situations where a substantial number of poles in an O/H line require replacement.
- To limit system exposure in the event of a major failure, the number of main feeders of the same voltage class on a pole line should be limited to two. System Reliability Planning must approve exceptions.
- In areas of heavy tree growth, consideration should be given to the installation of Tree-proof primary cable.
- Load control equipment (i.e. relays, control wires etc.) for water heaters is no longer required on secondary bus installations (refer to Standard Practice SP #001 "Ownership Transfer of Water Heater Assets").
- For plant relocations due to city initiated road widening, refer to Standard Practice SP #007 "Road Widening".
- For projects involving pole replacements, verify existing pole ownership. If poles are determined to be Bell owned or having Bell attachments, consult Standard Practice SP #009 "Joint Use Bell Poles/Attachments" to determine each parties responsibilities including cost sharing. It is strongly recommended that a joint field visit with Bell be coordinated to inspect the site and review the placement of new poles and equipment.
- If it is determined that poles are TTC or Hydro One owned, initiate preliminary discussions and coordinate joint field visits.
- Identify if foreign attachments (i.e. THSLI, Bell, Rogers, Hydro One, TTC etc.) along the proposed construction route will be affected and if so, contact Standards & Policy Planning to obtain the current attachment transfer process and the necessary forms to be completed.
- Review the Wood Pole Inspection Program for co-ordination of pole replacements. Consult the Asset Registry in Ellipse or Component Reliability Planning. During the

design stages, requests for stakeouts, locates and spot testing of wood poles can be arranged through Distribution Projects – East (see Appendix “D” for request form).

- Customers on life support should be clearly noted on applicable plans.

1.2.2 Poles

- Cedar poles shall be used on all O/H distribution projects unless existing area by-laws require us to deviate from this practice.
- The following table provides a guideline for pole selection:

Selection Criteria for Wood Poles		
Area Type	**Conditions**	**Min. Pole Height Requirements**
Residential	Guying, services	30’
	Single Circuit Primary (1Ø or 3Ø), Secondary, Streetlights, Telecom etc.	40’
	Single Circuit Primary (1Ø), Secondary, Streetlights, Telecom + transformer(s).	40’
	Single Circuit Primary (3Ø Halo Framing), Secondary, Streetlights, Telecom + transformer(s).	45’
Industrial/Commercial	Multiple Primaries, Secondary, Transformers, U/G Terminations, Switches etc.	50’
Arterial Roadways	Same conditions as above	50’ or 55’

- Existing cedar poles shall be maintained where they are determined to be sound (through the Pole Inspection Programs, site inspections) and meet the minimum pole height requirements indicated above. If however, an existing wood pole requires the installation of new equipment such as transformers, switches, u/g cables etc. designers should consider replacing the pole unless it is perfectly sound.
- In the former Toronto service area, the City has in past limited pole heights to a 45’ maximum. For new construction involving double 13.8kV circuits (armless construction) and transformers or when 4.16kV underbuild must be maintained on a conversion project, 50’ or 55’ poles may be required. Designers should attempt to obtain permission from the City through the permit process in the early stages of design where poles in excess of 45’ are required in the former Toronto area.
- When spot replacing or replacing a short stretch of wood or concrete poles, replacement poles to be consistent with existing streetscape.
- The maximum allowable span between poles shall be 38m (125’) with the exception being Long-span construction.
- Locate poles as close as possible to lot lines and maintain the following clearances:
  - 1.0m from driveways
  - Horizontal clearances from foreign utilities shall be in accordance with Appendix “O” of the City of Toronto’s Municipal Consent Requirements and Construction Standard 31-0100.
- Poles shall be framed in the standard armless vertical or triangular (Halo)** configurations (**preferred method for Tree-proof primary installations).

- When replacing poles having 3rd Party attachments, field consultation meetings shall be coordinated with the 3rd Parties to review new pole placements and/or copies of the plan drawings should be submitted to 3rd Parties for their comment.
- Where projects involve the upgrading of a string of Bell owned poles, ownership change of the poles should be considered. Both parties must agree upon any ownership changes.
- Where replacing poles, Designers should replace existing anchors where they are to be used for dead-end poles and any that are completely buried in the ground.
- Ensure the appropriate guying is identified as required. For guying types and application refer to Construction Standard 07-3000.
- Anchoring requirements (i.e. anchor type, anchor lead length) shall be noted on the drawings for new/existing poles.
- Joint anchoring for 3rd Party attachments should be avoided where practicable. Each party will be responsible for installing and maintaining their own anchoring system.
- Power Installed Screw Anchors (PISA) are preferred in locations identified as being clear of underground foreign utilities such as electrical, gas, water or communication lines. Expansion anchors shall be used when proposed anchor locations are in close proximity to underground foreign utilities.
- If replacing a new pole adjacent to an existing pole and anchor, it is recommended that the existing anchor not be re-used and a new anchor be installed.
- For Long-span construction:
  - Locate poles approx. 60m apart (max. span 73m).
  - Anchor leads of 4.5m shall be obtained on secondary dead-ends (minimum 3.65m).
  - Down guys shall be minimum 3/8” (9.5mm) guy steel.
  - Power installed anchors shall utilize a double helix and ¾” (19mm) anchor rod.
  - “Dig by Hand” or vacuum excavation type anchors shall utilize a 20” x 20” plate anchor and ¾” (19mm) anchor rod.

1.2.3 Transformers

- All O/H distribution transformers are single-phase units (3-1Ø units banked to obtain 3Ø secondary voltage).
- The standard sizes are 50kVA, 100kVA and 167kVA (100kVA is the preferred rating).
- The transformer secondary voltages are 120/240V, 120/208V (open wye) and 347/600V.
- For industrial/commercial areas transformers should be located as close to the centre of the electrical load as possible.
- For Long-span construction install transformers at approximately every second or third pole based on the anticipated loading.
- Transformers shall be installed a minimum of 3.0m (10’) from any doors, windows, ventilation inlet or outlets and any combustible surface or material on a building.
- When installing three phase transformer banks, ensure load restrictions on the pole are not exceeded. Refer to Construction Standards Section 09.
- In conversion or rebuild areas, efforts shall be made to replace “kicker bank” transformers to the current standards (primarily in former North York area).

1.2.3.1 Transformer Loading

- For new residential installations, efforts shall be made to maximize the number of services per transformer. Spacing of transformers shall be determined based on the anticipated loading and the available kVA ratings.
- The following table can be used as a guideline in determining the size of transformer required for new residential customers. The values in the tables were obtained from the Ontario Hydro – Overhead Distribution Standards (1992 edition) and former MEA Design Guidelines for transformer loading. The values from the table are consistent with a number of the former utility practices.

Unit Value Per Customer				
Type of Heating or Customer	House Size			
	100 m ² 1100 ft ²	200 m ² 2150 ft ²	300 m ² 3200 ft ²	400 m ² 4300 ft ²
	Unit Value			
Non-electric heat (includes central air)	1.5	2.5	3.5	4.5
Electric heat	4.0	5.0	6.0	7.0

Transformer Size (kVA)	
Total Unit Value	**Transformer Size (kVA)**
10 – 24	50kVA
25 – 50	100kVA
51 – 88	167kVA

- For house sizes not listed in the previous table, interpolate between columns to get the correct unit value.
- Based on the type of home, multiply the unit value from the “Unit Value Per Customer” table above by the appropriate factor as follows:
  - Detached home – use multiplier of 1
  - Semi-detached home – use multiplier of 0.9
  - Town or row house – use multiplier of 0.8

  Example:

  If you have 10 detached non-electric heat homes of which; the house size of 5 are 250m² and the remaining 5 are 200 m² and 10 semi-detached non-electric heat homes of which all are 150 m², the size of transformer required would be:
  (250m²) 5 x 3.0 units = 15 units
  (200m²) 5 x 2.5 units = 12.5 units
  (150m²) 10 x 2.0 units x 0.9 = 18 units
  Total unit value = 45.5 units (from the “Transformer Size” table you would select a 100kVA unit).

- When upgrading or converting existing transformers, their respective peak loads can be obtained from Transformer Load Management (TLM) available in G/NetViewer. If TLM is not yet available for the area, use the "Load and Supply Information System" software located on the Intranet at http://thehub.torontohydro.com/apps/lsis/.
  Both data sources will provide the transformers estimated maximum summer and winter load based on the connected customers.
- Upon determination of the estimated loading, utilize the following loading guide for selecting the transformer size:

Transformer Loading Guide	
Transformer Size	Existing Load
50kVA	< 37.5kVA
100kVA	>/= 37.5kVA </= 75kVA
167kVA	> 75kVA up to 125kVA
Split bus and add additional transformer	> 125kVA

Note: Loading guide allows for future load growth.

1.2.4 Grounding

- The following are the minimum requirements for ground rod installations:
  13.8kV system – Three ground rods per kilometre
  27.6kV system – Six ground rods per kilometre
  Due to the density of distribution equipment within the city, this minimum ground rod density is usually exceeded.
- For grounding requirements of concrete and steel poles refer to Construction Standards Section 18.
- Ground rods must be installed and bonded to the system neutral at poles supporting distribution equipment such as transformers, switches and surge arresters. A ground electrode plate may be installed in lieu of a ground rod at the base of the pole where soil or other surface conditions (such as foreign utility clearances) make the installation of the ground rod impractical.
- Steel cross-arms and other metallic supporting structures must be bonded to the system neutral.
- All electrical equipment associated with the project shall be equipped with the appropriate grounding provisions as required to facilitate future Work Protection requests.
- Any unused or abandoned lines shall be disconnected and grounded in accordance with Section 11 of Ontario Regulation 22/04 and Construction Standard 8-1000 Sht. 3/3.
- Designer shall notify Component Reliability Planning of any unused or abandoned lines that shall be maintained. Notification shall include the design project # and drawing number(s).

1.2.5 Primary Conductors

- The standard primary conductors used for overhead distribution shall be as per the following table:

Primary Conductors			
Operating Voltage	Main Feeder		Main Feeder Taps
	556kcmil (ASC)	336kcmil (ASC)	#3/0 AWG (ACSR)
27.6kV	X		X
13.8kV		X	X

- For the system neutral, use a #3/0 ACSR except for the first kilometre from 27.6kV stations where 336kcmil Al conductor is to be used.

1.2.5.1 Tree-Proof Primary Cable Installations

- Tree-proof primary cable is an alternative to bare primary conductors for heavily treed areas. Feeder Reliability Planning shall identify those projects requiring tree-proof cable installation and note the requirement in the project scope package.
- Long-span construction should not be used with tree-proof cable installations.
- The standard tree-proof cables used for O/H distribution shall be in accordance with the following table:

Tree-Proof Primary Cables				
Operating Voltage	Main Feeder		Main Feeder Taps	
	556kcmil (25kV Tree-proof)	336kcmil (15kV Tree-proof)	#3/0 ACSR (25kV Tree-proof)	#3/0 ACSR (15kVTree-proof)
27.6kV	x		x	
13.8kV		x		x

- For the system neutral, use a #3/0 ACSR except for the first kilometre from 27.6kV stations where 336kcmil Al conductor is to be used.
- In consultation with the Field Supervisor or Crew Leader, designers shall determine stringing lengths for projects involving main feeder sized tree-proof cable considering the angles and/or bends and the pulling tensions along the installation route.
- Lightning arrestors shall be installed at deadends and transitions from tree-proof to bare conductors. Refer to Construction Standards Section 5.

1.2.6 Secondary Bus Conductors

- The standard type of conductor used for secondary bus operating up to 600V shall be aluminium.
- The common secondary bus voltages supplied are 120/240V, 120/208V and 347/600V.

- All existing open secondary bus shall be replaced with factory assembled multiplexed secondary bus whenever possible. Field-lashed neutral supported bus may be necessary for longer spans.
- The standard secondary bus cables to be used shall be in accordance with the following table:

Overhead Conductors – Secondary Bus		
Application	Multiplexed (Neutral Supported)	Field-Lashed
120/240V	#3/0 AWG Triplex *2-#3/0 ASC Main* *1-#3/0 ACSR Neutral*	#3/0 AWG ASC *2-#3/0 ASC Main* *1-#3/0 ACSR Neutral*
	266.8kcmil Triplex *2-266.8kcmil ASC Main* *1-#3/0 ACSR Neutral*	266.8kcmil ASC *2-266.8kcmil ASC Main* *1-#3/0 ACSR Neutral*
120/208V	#3/0 AWG Quad *3-#3/0 ASC Main* *1-#3/0 ACSR Neutral*	#3/0 AWG ASC *3-#3/0 ASC Main* *1-#3/0 ACSR Neutral*
	266.8kcmil Quad *3-266.8kcmil ASC Main* *1-#3/0 ACSR Neutral*	266.8kcmil ASC *3-266.8kcmil ASC Main* *1-#3/0 ACSR Neutral*
347/600V	#3/0 AWG Quad(colour coded) *3-#3/0 ASC Main* *1-#3/0 ACSR Neutral*	#3/0 AWG ASC *3-#3/0 ASC Main* *1-#3/0 ACSR Neutral*

- For Long-span construction, field lashed secondary bus shall be utilized with the capacity limited to the current carrying capacity of the #3/0 AWG ASC bus. The secondary bus will consist of 1-3/8" guy steel, 2-#3/0 AWG ASC mains and 1-#3/0 AWG ASC neutral.
- For ampacity ratings on multiplexed and field-lashed secondary bus, refer to Construction Standards 08-2110 and 08-2210 respectively.

1.2.7 Service Conductors

- The standard type of conductor used for services operating up to 600V shall be aluminium.
- The standard service conductors are factory assembled on a bare ACSR neutral messenger.
- All existing open wire services shall be replaced with the appropriately sized service conductor.
- New services shall be properly shown on the project drawings attached either at the pole or mid span. Designers should note that material requirements for connections at the pole or mid-span are different and therefore should consult Construction Standards Section 11 for the appropriate standard.

- The standard service conductors shall be in accordance with the following table:

Overhead Conductor – Services		
Service Size	Application	Conductor Size
Up to 200 Amp	120/240V	#2 AWG ASC Quad 2-#2 ASC Main 1-#4 ACSR Neutral 1-#8 ASC Water Heater Control (not used)
400 Amp	120/240V	4/0 AWG ASC Quad 2-#4/0 ASC Main 1-#2/0 ACSR Neutral 1-#4 ASC Water Heater Control (not used)
Up to 200 Amp	120/208V or *****120/208V (open WYE)	#1/0 AWG ASC Pentaplex 3-#1/0 ASC Main 1-#1/0 ACSR Neutral 1-#4 ASC Water Heater Control (not used)
400 Amp	120/208V or ******120/208V (open WYE)	"Double up" on #1/0 AWG ASC Pentaplex
Up to 100 Amp	347/600V	#4 AWG ASC Quad (colour coded) 3-#4 ASC Main 1-#4 ACSR Neutral
100 Amp to 200 Amp	347/600V	#1/0 AWG ASC Quad (colour coded) 3-#1/0 ASC Main 1-#1/0 ACSR Neutral
400 Amp	347/600V (temporary service for construction sites)	266.8kcmil Quad *3-266.8kcmil ASC Main* *1-#3/0 ACSR Neutral*

Note:

***** For 120/208V (open WYE) services up to 200 Amp, utilize only two of the #1/0 ASC main conductors and tie the third one back.

****** For 120/208V (open WYE) 400 Amp services, service cables shall be supplied directly off the transformer secondary bushings and not off the secondary bus.

- After selection of the appropriate conductor size to meet the service rating, the electrical design must also satisfy voltage drop guidelines.
- Toronto Hydro maintains service voltage at the Customer's service entrance within the guidelines of C.S.A. Standard CAN3-C235-83 (latest edition), which allows variations from nominal voltage as identified in the following table:

Nominal Voltage	**Voltage Variation Limits**			
	Extreme Conditions			
		Normal Conditions		
	A	B	C	D
Single Phase 120/240	106/212	110/220	125/250	127/254

Nominal Voltage	Voltage Variation Limits			
	Extreme Conditions			
		Normal Conditions		
	A	B	C	D
Two Phase (3 Wire - Open WYE)				
120/208	110/190	112/194	125/216	127/220
Three Phase (4 Wire)				
120/208	110/190	112/194	125/216	127/220
347/600	306/530	318/550	360/625	367/635

- The maximum allowable voltage drop on the secondary bus and service conductors shall not exceed column "B" in the above table.
- Although a water heater control wire is included in the service quad, it shall only be used for maintenance purposes.
- Existing flat rate water heater controlled customers within the project limits are to remain on a flat rate charge until such a time as an exit strategy has been developed for the flat rate customers (refer to Standard Practice SP #001 "Ownership Transfer of Water Heater Assets" for the re-wiring details).
- For Long-span construction applications the following should be considered:
  - There is an approx. 1.0m sag in a 60m span of long-span secondary bus.
  - The maximum number of services off mid-span is to be 8.
  - Services to homes are to have a minimum clearance of 5.5m over the travelled portion of the roadway.
  - Services are to be tapped off at right angles and adjacent to each other, if possible to avoid "kinking" the secondary bus.
  - Where there is an unbalance in the number of services on a secondary bus span, anchoring will be required on adjacent poles as follows:
  - Unbalance of (1) service – ok
  - Unbalance of (2) services – requires key anchoring (refer to Construction Standard Drawing #07-2600).
  - Unbalance of (3 to 4) services – requires proper side guy and anchoring An unbalance of (4) mid span services is the maximum permissible.

1.2.7.1 600V Delta to 600/347V Wye Conversion

- Existing 600V ungrounded (Delta) 3 phase, 3 wire services shall be changed to 3 phase, 4 wire (WYE) grounded services as part of the 4.16kV to 13.8kV or 27.6kV conversion. This will involve the installation of a fourth (neutral) wire between THESL supply transformation and the customer's service entrance switch to meet ESA inspection requirements for a suitable ground return path on wye configured transformer supplies.
- Meters shall normally be upgraded to 3 phase, 4 wire metering system.
- Refer to Standard Practice SP #002 "Voltage Conversion from 600V Delta to 347/600V Wye" for specific conversion requirements.

1.2.8 Fusing

- All three phase laterals and sub-laterals off main feeders are to be fused using the appropriately sized SMD20 disconnect switch and power fuse.
- If work is being carried out at a riser pole or lateral in which porcelain SMD20 switches are installed, the project design should include the replacement of these switches with new polymer SMD20 switches.
- The standard ratings for switch cutouts and power fuses shall be in accordance with the following table:

Fusing for Overhead Laterals				
Operating Voltage	Laterals		Sub-Laterals	
	Cut-out Voltage Rating	Fuse Rating	Cut-out Voltage Rating	Fuse Rating
27.6kV	25kV	140K	25kV	100K
13.8kV	15kV	140K	15kV	100K

- The above ratings would apply for single-phase laterals as well.
- Sub-sub laterals should be fused at 40K.

1.2.9 Switches

- Automated switches are generally located at strategic locations along the feeder to provide for inter-feeder ties or feeder sectionalizing to meet current or future requirements. Installations would typically be outside the core area and identified in the scope package by Feeder Reliability Planning.
- Switches may be either manual or remote operation. Remote switch locations shall be identified in accordance with Standard Practice SP #005 “Installation of SCADA Switches and Planning Guideline”.
- Where new automated switches are being proposed, designers shall forward the following information to the Distribution Automation Section:
  - Designers Name
  - Switch ID #
  - Location
  - Switch Type
  - Estimated installation date
  - Copy of the project schematic
- Feeder Reliability Planning shall review the locations of existing in-line switches within the project limits and include their removal in the scope package if they provide no operational advantage.

1.2.10 Street Lighting

- THESI-St. Ltg. own the street lighting system in the City of Toronto and shall be responsible for coordinating changes to the street lighting system.
- THESL designers shall include streetlight transfers and upgrades (i.e. replacement of brackets or luminaires or bulbs) on their plan drawings.

- For street lighting work that involves new street light installations or relay to 24hr conversion, THESI-St. Ltg. will be responsible for preparing their own street light plan drawings. The streetlight drawing number(s) shall be referenced on the title sheet of the THESL project drawings.
- For the “THESL Design Process for Capital Projects Involving Street Lighting” refer to Appendix “F”.
- All requests made to THESI-St. Ltg. for information should include suitable timelines to respond.
- All streetlight transfers and upgrades will require ESA inspection. THESI-St. Ltg. will be responsible for coordinating these inspections with ESA after the work has been completed.
- Designers shall indicate on the drawings any changes to street light energy billing based on the proposed design. Refer to Drawing Guidelines section for template.
- Designers shall be responsible for ensuring that any changes to the street light energy consumptions are reported to THESI-St. Ltg. in a timely fashion. Upon notification that project has been completed, designer shall complete and forward a “Street Light Change Form” (see Appendix “G”) to THESI-St. Ltg. Refer to Standard Practice SP #022 - Street Light Energy Billing.

1.2.11 Unmetered Connections

- In cases where an unmetered service is connected to a street light circuit, efforts shall be made to relocate the service connection from the street light circuit to the overhead secondary bus.

1.2.12 Customer Communications & Public Relations

- Prior to issuing the project for construction, Designers shall arrange to send project notification letters (see attached Appendix E1 or E2) to property owners within the limits of the project in accordance with Section 3.6.4 of the Municipal Consent Requirements. A copy of the letter along with the City Councillor Notification of Project letter (see attached Appendix E3), map of the project area and a list of addresses affected by the rebuild shall be submitted to Communications & Public Affairs for forwarding to the City Councillor and neighbourhood associations. To identify the Local Councillor for the project area click on the following link: http://app.toronto.ca/im/council/councillors.jsp
- Upon completion of the design, the Designer shall forward the project drawings in pdf format to Communications & Public Affairs. The drawing package should only include the Title Sheet and Plan drawings.

1.3 Drawing Guidelines

In addition to the alignment of project designs with business strategies, it is also necessary that framework be established that will support the delivery of consistent project drawings. The following guidelines will provide the necessary information that will assist in achieving this objective.

The guideline will consist of the following three key elements:

1. Drawing Structure

2. Equipment Numbering
3. Symbology

1.3.1 Drawing Structure

- Drawing sheet sizes shall be a maximum size of Imperial D (22” X 34”). Field staff have, in past requested the use of ½ size prints for use as reference in the field. To ensure text is legible in a ½ size format, utilize a sufficient sized font for the text.
- Templates for the standard sheet sizes are in ProjectWise and are to be used when creating a new drawing. See ProjectWise User Manual for details.
- Drawing numbers, title blocks and page borders are to be generated using ProjectWise. Title block information will be filled in automatically as the ProjectWise attribute tables are filled in. Drawing numbers are generated using ProjectWise – Do not modify the drawing numbers from the standard format in any way. See ProjectWise User Manual for details.
- Sufficient white space shall be reserved to the left of each Title Block for placement of the “As-Constructed” stamp.
- Every drawing must be created using a separate file.
- All attribute data fields in ProjectWise must be filled in as part of assigning a new drawing number. See ProjectWise User Manual for details.
- All drawings must be stored in ProjectWise in Vaults named after the project number. See ProjectWise User Manual for details.
- ProjectWise workflow must be updated as the drawing moves from the 1) Proposed to 2) Approval then on to 3) Issued. A new version should be created at this state, if modification is requested, as all drawings that have reached this state are assumed to be signed and therefore legal copies. The Records Section will perform the final state change to Archived when they receive the “As Constructed” mark-up. See ProjectWise User Manual for details.
- Designers shall utilize the White Space Management Guidelines when preparing the project drawings.
- Drawing type grouping selection through Projectwise and drawing titles shall be consistent with the following table:

Project Drawings	
Drawing Type Grouping from ProjectWise	**Project Drawing Title**
Title Sheet	Title Sheet
Primary Schematic	Primary Schematic
Overhead	Plan
Recovery	Primary & Secondary Removal
Existing Feeder or Reference Drawing	Existing Feeder or Reference Drawing

- Plans must be prepared in accordance with the Municipal Consent Requirements. The following is the link to the document: http://www.toronto.ca/engineering/mcr/index.htm#mcr

- A sample set of project drawings is included in this document for reference.

1.3.1.1 Title Sheet

- The title sheet shall include the project name, key map with north arrow, Drawing Index, General Notes, Legend, Install column, Street Light Energy Billing table (if design includes street light work), Cut Repair Table and a note indicating compliance with Ontario Regulation 22/04.
- For the General Notes, consult the General Notes library for the standard notes applicable to overhead construction projects. Include any specific notes relevant to the project. Ensure to include all known “Designated Substances” that may be encountered in the project and be sure to include a note indicating that minimum horizontal clearances from foreign utilities shall be maintained in accordance with Appendix “O” of the City of Toronto’s Municipal Consent Requirements (*Note- the City clearance requirements are consistent with Toronto Hydro Construction Standard 31-0100).*
- General Notes shall also include a note requiring field crews to re-label existing equipment locations where identified on the drawing and to complete the necessary “Equipment Changeout Record” forms and “Nomenclature Labelling Reports”.
- The key map shall encompass the entire limits of the project and be “blocked-off” in sections. Each section shall be numbered according to the ProjectWise drawing number and sheet number.
- The install column shall provide an equipment legend, W.O. # and Work Breakdown Structure description for each task and quantities being installed.
- A street light “Energy Billing” table similar to below shall be placed on the title page whenever the design includes street light work.

ENERGY BILLING		
CHANGES	QUANTITY	TYPE
ADD		
DELETE		
NO CHANGE		

- For projects that involve street lighting and where the street lighting plan is to be prepared by THESI, the THESI designer’s name and the street light project number shall be indicated on the Title Sheet.
- In accordance with Ontario Regulation 22/04, the following note shall be placed in the top right corner of the title sheet where the assembly of the drawings utilizes only certified construction standards, technical specifications or authorized legacy standards in cases where maintaining a portion of line with current standards would be problematic:

THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS AND APPROVED EQUIPMENT AND MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF ONTARIO REGULATION 22/04.

- The Cut Repair table shall totalize all the cut repairs on the project that will be completed by the City. This information will be used for comparison against the City invoices for the actual repair work. The table shall be similar to the following:

Approx. Cut Repairs			
Roadways	---------------	________	m^2 +/-
Concrete Sidewalk	---------------	________	m^2 +/-
Curb	---------------	________	m^2 +/-
Other	---------------	________	m^2 +/-

- Any new construction involving the use of legacy standards will require a certificate of approval be prepared by a Professional Engineer identifying the standard and placed on the drawing.

1.3.1.2 Primary Schematic

- The purpose of this drawing is to provide an overall view of the proposed project.
- This drawing can be separated from the rest of the project drawings and used by the Control Centre. For this reason, the repetition of certain information (i.e. key map, legend etc) is required.
- The entire limits of the project shall be shown on one drawing, where possible.
- Sufficiently sized text should be used to ensure drawing is legible in a ½ size format.
- The drawing shall be "Not to Scale" and indicate the following:
  - be semi-geographic, showing all relevant civil (i.e. poles etc.) and electrical (i.e. primary conductors, switches, transformers, etc.) components to facilitate ones "orientation".
  - include a legend of proposed and existing plant.
  - include a key map similar to the Title sheet (reduced size) without the "blocked-off" sections and numbering.
  - north arrow shall be shown pointing up or to the right.
  - identify customers on life support and include contact person & telephone #.
  - proposed and existing equipment numbering.
  - proposed connections to the existing plant either solidly connected or via fuse disconnects or switches.
  - the feeder designations involved.
  - overhead plant that may be retained temporarily for some reason or the other, for example part of 4kV system to supply a customer(s).
  - indicate clearly the voltage rating(s) of the system and conductor size.
- Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######, FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.3 Plan

- The Plan shall show the area of the proposed construction and shall be clipped from G/NetViewer and exported into a Microstation file.Designers shall follow the "White Space Management Guidelines" when creating the plan drawings.
- If the area of proposed construction requires more than one plan drawing, divide the area evenly from sheet to sheet using match lines. Maximize the use of drawing white space to minimize the number of plan drawings.
- Plans must be prepared in accordance with the Municipal Consent Requirements. The following is the link to the document: http://www.toronto.ca/engineering/mcr/index.htm#mcr
  In efforts to avoid any unnecessary delays in obtaining permits, It is extremely important that all information requested in Appendix Q "Minimum Permit and Construction Drawing Standards for Short and Full Stream Drawings" of the Municipal Consent Requirements be shown on the Plan.
- Plan shall show the proposed overhead plant. However, where new and/or existing underground laterals or risers are a requirement of the project they shall be shown with the appropriate symbology and equipment numbering at the pole location and referenced to an associated drawing.
- Existing conductors that are to be maintained within the project area shall be shown on the Plan.
- The drawings shall indicate the pole "call-up" information in the sequence listed below while considering White Space Management Guidelines. For equipment numbering of poles, transformers and switches refer to the Equipment Numbering section.
- Pole "call-up" information and order shall be in accordance with the following:

P1234	Pole Location Number
45'	Pole Height
OT12345	Transformer Location Number
100kVA	Transformer kVA
Rø	Transformer Phase Designation
OT12345-F	Transformer Cut-out Number
15A	Transformer Cut-out Fuse Size
OS12345	Switch Location Number
140K	Fusing
05-376D	Construction Standard Number(s) *(if the "Standards" table is not used).*
2.8m A/L	Anchor Lead Length

- When re-numbering of existing equipment is necessary in accordance with the Equipment Numbering section, the old equipment number shall be shown in brackets beside its new number in the pole "call-up".
- Tie dimensions for new poles shall be shown in accordance with the Municipal Consent Requirements.
- Cable designations and tap phasing shall be clearly shown.
- New ground rod locations, anchors and span guys shall be shown on the Plan.

- Include a "Transformer Service Changes" table on each plan drawing to indicate service changes from one transformer to another. The table shall consist of three columns: i) Address of Services, ii) From Transformer #, iii) To Transformer #. At the bottom of the table, indicate the transformer #'s that are to be deleted.
- Existing & new U/G secondary services shall be shown on the Plan and referenced to an associated underground drawing number.
- Secondary/primary breakers and dead ends are to be shown geographically correct.
- Street light requirements (i.e. transfers, upgrades etc.) shall be indicated on the plan drawings.
- As an alternative to listing the applicable Construction Standards with the pole call-up information, the Standards may be summarized in a table format. The preference for identifying the Standards on the plan sheets should be discussed with the Construction DRP.
- Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######, FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.4 Primary & Secondary Removal

- This drawing will have a similar format to the primary schematic showing electrical plant to be removed in conjunction with the project.
- A remove column shall be included on the drawing showing an equipment legend, the recovery W.O. #, a description for each task and the quantities to be recovered.
- For primary and secondary conductors being removed, list the locations from pole# to pole#.
- Where practicable, the entire limits of the project shall be shown on one sheet.
- The drawing shall be "Not to Scale" and include following recovered items:
  - poles
  - overhead primary conductors
  - secondary bus conductors
  - switches, fuses
  - transformers
  - laterals/risers
  - guys and anchors
  - services
  - street lights as applicable.
- Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######, FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.5 Reference Sheet

- This drawing shall be used to indicate existing electrical plant in the project area.

1.3.2 Equipment Numbering

- New equipment numbering standards have been developed and are included in Section 21 of the Construction Standards.
- Location numbers for new equipment (with the exception of poles, tap boxes, vault or transformer switches and elbows) can be obtained through the "New Location Number Request Application" program accessible by clicking on the following link: http://assetmgmt.torontohydro.com/nomenclature/
- For each new number requested through the "New Location Number Request Application", Designers should receive a "Nomenclature Labeling Report" which shall be included in the design folder for completion by the field crews.
- Designers must be identified in the Requestors list to access the program. If you are unable to access the program, contact the Supervisor of Asset Data Management-Capacity Planning to get on the list.
- In addition to the numbering of new equipment, some existing equipment within the limits of a project may require re-numbering as well. In general, the following guidelines shall apply for new projects:

  New Installations

  - All new equipment identified in Construction Standard 21-1000 shall be numbered to the new Standard.
  - For poles, the new Standard shall apply when:
    i. installing new pole lines;
    ii. replacing the majority of poles along an entire street or city block (the few remaining poles would be included in the re-numbering).
  - For spot pole replacements or when not renumbering an entire street or block, use the legacy numbering standards for the area with the new numbering materials.

  Re-Numbering of Existing Equipment

  - **The re-numbering of existing equipment shall only apply in the respective operating districts where GEAR is functional. GEAR is currently functional in the former York and Etobicoke operating districts only, through Belfield Control. GEAR should be functional in the other operating districts in the near future. Designer should contact System Operations to determine the status of GEAR in your project area.**
  - If the limits of the project are within the GEAR functioning areas, the following re-numbering standards shall be applied:
    - All existing switchable devices (i.e. transformers, switches, elbows) within the limits of the project shall be re-numbered to the new standard.
    - Existing cable chambers within the limits of a project shall not be re-numbered.
    - Existing vaults within the limits of the project may be re-numbered provided the entire string or loop of vaults/pads can be re-numbered.
    - Existing poles within the limits of a project may be re-numbered to the new standard provided an entire street is completed; for example a side street where all the poles on the street are within the project scope.

- On the project drawings, both the new location number and former number (in brackets) will be shown.
- Location numbers for the re-numbering of existing equipment can also be obtained through the “New Location Number Request Application” program.

1.3.3 Symbology

The new symbology shall now be used for all new projects. The symbols can be viewed by clicking on the following link:
http://thehub.torontohydro.com/gear/Users/SymbologyPage/SymbologyPage.html
Cell libraries have been developed and can be obtained through IT.

1.4 Project Deliverables

Projects that are initiated through the Investment Plan are typically designed approx. one year in advance of construction. To ensure a seamless process between the design and construction phase, designers must be cognizant of the outstanding pre-construction requirements (i.e. cut permits, notifications etc.). To assist in this area, a Project Design Deliverables checklist (Appendix “B”) has been developed and can be used by designers to ensure all required documentation is included and/or noted in the Design folder when signed-off. Upon construction approval, the Design folder will be returned to the designer for final assembly and for execution of the remaining items (such as permits, notification letters etc.).

Customer Connections & Maintenance projects are primarily customer initiated. Project designs are completed and forwarded directly to construction to meet customer in-service dates. For these projects to proceed, the customer must meet all Toronto Hydro financial and legal requirements.

Section 2 - Rationale:

To ensure O/H distribution designs are aligned with business strategies and project design packages are delivered in a consistent fashion.

Section 3 - References:

- Toronto Hydro Construction Standards “Conditions of Service”
- Toronto Hydro Technical Specification for Civil Construction Work #CV-CON-01
- Toronto Hydro “Conditions of Service”
- City of Toronto Municipal Consent Requirements
- Field Consultation Meeting – Terms of Reference
- Job Planning Process (Latest Version)
- White Space Management Guidelines
- New Design Process
- As-Constructed Map Products Process (Latest Version)
- “Foreign Attachment Transfer Process”, Notification & Summary Forms (obtain from Standards & Policy Planning)
- Standard Practice SP #001 “Ownership Transfer of Water Heater Assets”
- Standard Practice SP #002 “Voltage Conversion from 600V Delta to 347/600V Wye”

- Standard Practice SP #005 “Installation of SCADA Switches and Planning Guideline”
- Standard Practice SP #006 “Customer Isolation”
- Standard Practice SP #007 “Road Widening”
- Standard Practice SP #009 “Joint Use Bell Poles/Attachments”
- Ontario Regulation 22/04
- Distribution Grid Operations Project Review Form
- Electrical Safety Authority Technical Guidelines for Sections 6, 7 & 8.
- Ontario Electrical Safety Code

APPENDIX “A”

O/H DISTRIBUTION DESIGN PROJECT CHECKLIST

(Distribution Projects - Design)

Project Name: ______________________________

This checklist is intended to act as a guideline for the various activities involved in the design phase of an O/H distribution project. In addition, it includes those activities required in finalizing the project design package prior to issuing to construction. It should be kept in your working design file. Activities listed may not necessarily be in sequential order and may not apply to all O/H distribution projects. The activities listed can be used as a reference in updating your departmental “Design Work Completion Report – Distribution”.

Item #	Design Activities	Date Completed (or) N/A
1	Review project scope package from System Reliability Planning.	
2	Assemble record maps and pertinent drawings.	
3	Define limits of the project design in G/NetViewer and submit redline file to ProjectWise in accordance with the New Design Process.	
4	Receive Microstation file of the design area from Design/Records and ensure the project drawings in both .dgn and .pdf format are deposited into the appropriate “set” within ProjectWise in accordance with the New Design Process.	
5	Submit drawings of the proposed construction area to THESI-St. Ltg.	
6	Coordinate preliminary design meeting with System Reliability Planning, Operational Performance Measurement, Dist. Proj. - Construction, Distribution Grid Operations and other key stakeholders to review the project proposal (as required).	
7	Arrange Field Staff Consultation meeting (as per T of R) with area Construction Supervisor to: 1) Review the project. 2) Address construction issues 3) Identify the safety hazards associated with the project and measures to eliminate and/or control during construction phase.	
8	Prepare preliminary design concept and review with Design Supervisor.	
9	Forward “Design Scope Revision Request” form to System Reliability Planning for proposed revisions to original project scope (as required).	
10	Initiate project drawings through Project Wise.	
11	Prepare drawings using the Microstation files.	
12	Identify pole ownership and/or foreign pole attachments along the proposed route. Initiate preliminary correspondence with external parties. Field consultation meetings with Bell should be coordinated when determining the placement of new poles.	
13	Consult wood pole inspection program for coordination of pole replacements. If information is not available, initiate request to have the poles tested by completing the request form in Appendix “D”.	
14	Consult with CCM on future development within the project area.	
15	Conduct load checks on transformers requiring upgrade or conversion.	
16	Prepare preliminary design utilizing only certified construction standards and technical specifications.	
17	Obtain new equipment numbers and Nomenclature Labeling Reports through the “New Location Number Request Application”.	

Item #	Design Activities	Date Completed (or) N/A
18	Include note on drawing indicating compliance with Section 7 of Ontario Regulation 22/04.	
19	Receive input from THESI-St.Ltg. regarding street light requirements/changes and incorporate into the Plan drawing as required.	
20	Submit preliminary Plans to Bell and solicit their comments on new pole placements where Bell is the pole owner or where they have attachments on THESL poles (This step only required if there was no previous field consultation meeting with Bell).	
21	Review design with Supervisor and sign drawings.	
22	Prepare estimate and material requirements in Ellipse.	
23	Review “Attachment Transfer Process” and prepare “Joint Use/Foreign Utilities Project Summary” forms for 3rd Parties attached to THESL poles as required.	
24	Submit completed “Joint Use/Foreign Utilities Project Summary” forms to Policy & External Relations.	
25	Prepare and send out “Customer Notification of Project” letters (Appendix “E1” or “E2”) to all homeowners within the limits of the project.	
26	Prepare and forward “City Councillor Notification of Project” letter (Appendix “E3”) along with a copy of the “Customer Notification of Project” letter, map of the project area and a list of addresses affected by the project to Communications and Public Affairs.	
27	Obtain the necessary external preliminary approvals as required.	
28	Initiate request for easements/agreements with Legal Dept.	
29	Arrange meeting with Construction Supervisor to review final design, validation of MU/LUs and obtain sign-off.	
30	Forward to Communications & Public Affairs a set of project drawings in pdf format (Title sheet and Plan drawings only).	
31	Make necessary changes to estimate and finalize MU/LUs.	
32	Include “Steps and Conditions Chart” template for completion by Construction Supervisor/Crew Leader identifying the safety hazards and control measures to be used during the construction phase.	
33	Obtain sign-off/authorization from Design Supervisor on project estimate	
34	Advise Distribution Automation Dept. of projects involving the installation of any new automated switches.	
35	Prepare “Installed Units Summary” (WBS2) form.	
36	Prepare “Equipment Changeout Record” forms (as required).	
37	Complete “Prior to Construction” deliverables upon budget approval for construction.	
38	Confirm installation dates with Distribution Automation Dept. for projects involving installation of new automated switches.	
39	Obtain final sign-off/approval from Design Supervisor on project drawings.	
40	Obtain P.Eng. approval if using legacy standards for new construction.	
41	Update status of project drawings in Project Wise from “Approved” state to “Issued”.	
42	Prepare project package in Ellipse.	
43	Arrange pre-construction site meeting with construction, THESI-St.Ltg., 3rd Parties and all other authorities.	
44	Notify Design/Records when project design has been approved for construction for entering into GEAR.	
45	Upon completion of construction, Operational Performance Measurement shall forward copies of “As-Constructed” drawings to the Designer, Records & Mapping and where applicable THESI-St.Ltg.	
46	Prepare billing summaries and invoices for Bell when the project involves the replacement of Bell owned poles.	

Item #	Design Activities	Date Completed (or) N/A
47	Complete Street Light Change Form (Appendix G) where applicable and submit to THESI – St. Ltg.	
48	Maintain approved project drawings and the “as-constructed” drawings in the department central filing system for a period of one year following the annual audit required under Ontario Regulation 22/04.	
49	Participate in Post Construction meeting, as required.	

O/H DISTRIBUTION DESIGN PROJECT CHECKLIST

(Customer Connections & Maintenance)

Project Name: ____________________

This checklist is intended to act as a guideline for the various activities involved in the design phase of an O/H distribution project. In addition, it includes those activities required in finalizing the project design package prior to issuing to construction. It should be kept in your working design file. Activities listed may not necessarily be in sequential order and may not apply to all O/H distribution projects. The activities listed can be used as a reference in updating your departmental Project Tracking.
(Policy & External Relations are responsible for the NPV calculations and Offer to Connects for projects involving customers of Class 3C, 4 & 5)

Item #	Design Activities	Date Completed (or) N/A
1	Receive Customer initiated project/initial contact with Customer by phone.	
2	Prepare and forward letter to customer outlining our requirements and the design costs.	
3	Receive Customer project details, construction schedule and drawings.	
4	For projects involving Customer Class 3C, 4 & 5 provide project details and contacts to Policy & External Relations.	
5	Receive Customer design deposit. For projects involving Customer Class 3C, 4 & 5, Policy & External Relations will submit design deposit request and receive payment from the Customer.	
6	Submit Project Notification Form (PNF) to Operational Performance Measurement.	
7	Coordinate preliminary conceptual schematic meeting with Customer to review our requirements.	
8	Initiate project & TRIM files and obtain design work order number.	
9	Assemble record maps and pertinent drawings.	
10	Define limits of the project design in G/NetViewer and submit redline file to ProjectWise in accordance with the New Design Process.	
11	Receive Microstation file of the design area from Design/Records and ensure the project drawings in both .dgn and .pdf format are deposited into the appropriate “set” within ProjectWise in accordance with the New Design Process.	
12	Submit drawings of the proposed construction area to THESI-St. Ltg.	
13	Coordinate preliminary design meeting with System Reliability Planning, Operational Performance Measurement, Dist. Proj. - Construction, Distribution Grid Operations and other key stakeholders to review the project proposal (as required).	
14	Forward completed “Feeder Request Form” to System Reliability Planning for approval.	
15	Receive approved “Transmittal and Feeder Request Form” from System Reliability Planning.	
16	Arrange Field Staff Consultation meeting (as per T of R) with area Construction Supervisor to: 1) Review the project. 2) Address construction issues. 3) Identify the safety hazards associated with the project and measures to eliminate and/or control during construction phase.	
17	Prepare preliminary design concept and review with Design Supervisor.	

Item #	Design Activities	Date Completed (or) N/A
18	Initiate project drawings through Project Wise.	
19	Prepare base maps using the Microstation files.	
20	Identify pole ownership and/or foreign pole attachments along the proposed route. Initiate preliminary correspondence with external parties. Field consultation meetings with Bell should be coordinated when determining the placement of new poles.	
21	Consult wood pole inspection program for coordination of pole replacements. If information is not available, initiate request to have the poles tested by completing the request form in Appendix "D".	
22	Prepare preliminary design utilizing only certified construction standards and technical specifications.	
23	Obtain new equipment numbers and Nomenclature Labeling Reports through the "New Location Number Request Application".	
24	Include note on drawing indicating compliance with Section 7 of Ontario Regulation 22/04.	
25	Receive input from THESI-St.Ltg. regarding street light requirements/changes and incorporate into the Plan drawing as required.	
26	Submit preliminary Plans to Bell and solicit their comments on new pole placements where Bell is the pole owner or where they have attachments on THESL poles (This step only required if there was no previous field consultation meeting with Bell).	
27	Review design with Supervisor and sign drawings.	
28	Prepare estimate and material requirements in Ellipse.	
29	Design Supervisor to authorize project estimate in Ellipse.	
30	Review "Attachment Transfer Process" and prepare "Joint Use/Foreign Utilities Project Summary" forms for 3rd Parties attached to THESL poles being replaced (as required).	
31	Submit completed "Joint Use/Foreign Utilities Project Summary" forms to Policy & External Relations.	
32	Prepare and send out "Customer Notification of Project" letter (Appendix "E1") to all property owners within the limits of the project.	
33	Prepare and forward "City Councillor Notification of Project" letter (Appendix "E3") along with a copy of the "Customer Notification of Project" letter, map of the project area and a list of addresses affected by the project to Communications and Public Affairs.	
34	Prepare NPV calculation for expansion costs (for projects involving Customer Class 3C, 4 & 5 calculation shall be performed by Policy & External Relations)	
35	Prepare and submit the Standard form and Contract to the Customer (for projects involving Customer Class 3C, 4 & 5, Policy & External Relations shall provide the Legal Dept. with information required to prepare the "Offer to Connect")	
36	Policy & External Relations shall obtain the final draft "Offer to Connect" from Legal Dept. for approval and return to Legal Dept. for submission to the Customer.	
37	Prepare "Alternate Bid" if "Offer to Connect" is declined and forward to Legal Dept. for comment.	
38	Receive signed Contract from Customer (Policy & External Relations receives signed "Offer to Connect" from the Customer).	
39	Received signed "Alternate Bid" from Customer.	
40	Send out "Supply Agreement" where applicable.	
41	Send out "Connection Agreement" where applicable.	
42	Receive signed "Supply Agreement" from Customer.	

Item #	Design Activities	Date Completed (or) N/A
43	Receive signed “Connection Agreement” from Customer.	
44	Receive “Letter of Credit” from Customer (by Policy & External Relations).	
45	Receive full payment from Customer (by Policy & External Relations).	
46	Obtain the necessary external approvals/permits as required.	
47	Arrange meeting with Construction Supervisor to review final design, validation of MU/LUs and obtain sign-off.	
48	Make necessary changes to estimate and finalize MU/LUs.	
49	Include “Steps and Conditions Chart” template for completion by Construction Supervisor/Crew Leader identifying the safety hazards and control measures to be used during the construction phase.	
50	Obtain sign-off/authorization from Design Supervisor on project estimate.	
51	Obtain final drawing Approval from Supervisor and stamp drawings "Approved for Construction".	
52	Forward to Communications & Public Affairs a set of project drawings in pdf format (Title sheet and Plan drawings only).	
53	Order prints for construction.	
54	Update status of project drawings in Project Wise from “Approved” state to “Issued”.	
55	Prepare “Installed Units Summary” (WBS2) form.	
56	Prepare “Equipment Changeout Record” forms (as required).	
57	Prepare project package in Ellipse.	
58	Prepare Work Order and Job Cards.	
59	Prepare Construction folder.	
60	Design Supervisor to sign-off on Construction folder.	
61	Submit “Notice of Project” to Ministry of Labour.	
62	Forward Construction folder to Project Management.	
63	Distribute approved project drawings to internal parties as per the “Drawing Distribution Chart”; see attached Appendix “C”.	
64	Obtain P.Eng. approval if using legacy standards for new construction.	
65	Arrange pre-construction site meeting with construction, THESI-St.Ltg., 3rd Parties and other authorities.	
66	Update as-constructed units and prepare final billing.	
67	Notify Legal Dept. and Policy & External Relations upon project completion.	
68	Upon completion of construction, Operational Performance Measurement shall forward copies of “As-Constructed” drawings to the Designer, Records & Mapping and where applicable THESI-St.Ltg.	
69	Prepare billing summaries and invoices for Bell when the project involves the replacement of Bell owned poles.	
70	Complete Street Light Change Form (Appendix G) where applicable and submit to THESI – St. Ltg.	
71	Maintain approved project drawings and the “as-constructed” drawings in the department central filing system for a period of one year following the annual audit required under Ontario Regulation 22/04.	
72	Purge project folder and submit to TRIM System for archiving.	
73	Close all remaining material requirements with Demand Management.	
74	Participate in Post Construction meeting, as required.	

APPENDIX "B"
PROJECT DESIGN DELIVERABLES

Project Name: ______________________ IP Project No.: ______________

Design / Construction Project No.: ______________________

Construction Estimate $ ______________________ Estimate # ______________

Legend: **X** - *Items are Mandatory*

✓ - *Additional items to be included if applicable to the project*

Item #	Deliverables	Customer Connections & Maintenance	Distribution Projects: Design Completion	Distribution Projects: Prior to Construction
1	Project documents filed in appropriate folder	X	X	X
2	Completed "Installed Units Summary" (Work Breakdown Structure II form)	X	X	X
3	Drawings – 1 full size set. Each drawing to include the following note above the title block "DESIGN COMPLETE - SUBJECT TO FINAL APPROVAL".		X	
4	Remove the note "DESIGN COMPLETE-SUBJECT TO FINAL APPROVAL" from the drawings.			X
5	Approved Project drawings – full and ½ size sets (see attached Appendix "C")	X		X
6	"Requirement Summary" from Ellipse (Job Estimating - MSQ655) of the resource, vehicle and material requirements.	X	X	X
7	"Equipment Changeout Record" forms for key assets to be installed & recovered.	X	X	X
8	Nomenclature Labeling Reports	X	X	X
9	Construction Estimate break down (e.g. material, labour, O/H, U/G Civil etc.) through Ellipse	X	X	X
10	Preliminary Civil Contract Unit Price package.		X	
11	'Notice of Project' – The Occupational Health & Safety Act – with any necessary sketch(es)/drawing(s) attached – **for projects with Hydro portion over $50,000.00**	X (1 Completed copy)	X (1 Completed copy)	X (1 Completed copy per trade)
12	'Steps & Conditions' chart	✓ (1 copy)	X (1 copy)	X (8 copies)
13	Action Log and Minutes from Field Consultation Meeting	X	X	
14	Customer & City Councillor Notification of Project letters issued.	X	X	
15	Job Cards	X		
16	Cover Sheet	X		
17	Completed "Joint Use/Foreign Utilities Project Summary" forms (available through Policy & External Relations).	✓	✓	✓
18	City Cut Permit and other approvals.	X		X
19	Include existing Feeder Prints/Concession Maps, showing the proposed mark-ups as required by the area Control Centre.	✓	✓	
20	For 'Unit Price' contract, include UNIT PRICE SHEET with estimated price	✓	✓	X
21	Notification to Component Reliability Planning of any unused or abandoned lines within the limits of the project that have been disconnected and grounded in accordance with Ontario Regulation 22/04. Provide W.O # and drawing #.	✓		✓
22	Attach Easement Agreements / Letters of Understanding.	✓		✓

Additional Comments: ______________________________

____

Design Supervisor: ______________ Ext. ________ Date: ________

Designer: ______________ Ext. ________ Date: ________

Issue for Construction - Drawing Distribution Chart

10-Oct-07

Department	Location & Contact	CIVIL DRAWINGS		CIVIL/ELECT DRAWINGS		ELECT DRAWINGS		ST.LTG. DRAWINGS (if prepared by THESI)	
		Full	Half	Full	Half	Full	Half	Full	Half
	MANDATORY								
System Reliability Planning	**Tony Nguyen** 500 Commissioner St.		1		1		1		
Records	**Robert McNabney** 500 Commissioner St.		1		1		1		
Operation Performance Management	500 Commissioner St.		1				1		1
Cable Locates	**Robert Gregoris**		1		1				
Operations	**Hilton Meade** Control Centre 5800 Yonge St.				1	1			
Field Supervisor	Drawings	2	4	2	4	2	4	2	1
Unit Price Civil	Drawings Cost Summary Sheets	4	2	4	2			*4	*2
QA/QC Inspection	**Biagio Cerami** – East **John Egan** – West	4	2	4	2	4	2	*4	*2
Originating Dept.	Dept File Copy (1) Design Supervisor (1)		2		2		2		*2
	ONLY WHEN REQUIRED - "Need to be identified by Design Technician"								
Stations	**Ed Solsky** 500 Commissioners St		1		1	1			
CROMS Mtce	**Joe Waite** Control Centre 5800 Yonge St.		1		1	1			
Operations	**Charlene Mueller** Control Centre 5800 Yonge St.				1	1			
Customer Accounts	**Grace Chau** 5800 Yonge St				1				
	TOTAL DRAWINGS	10	16	10	18	10	11	10	8

*** Note - Other 3rd Party (i.e. Rogers, Bell etc.) drawing requirements for projects involving Joint-use trenching.**

REQUEST FOR PERMITS, LOCATES, STAKEOUTS AND POLE TESTING

PLEASE SUBMIT REQUESTS TO : DISTRIBUTION PROJECTS EAST - **BEN SERGI / COLIN COCHRANE**

REQUEST INFORMATION (Please Print)

CHECK ONE: **PERMITS & LOCATES** ☐ **LOCATES ONLY** ☐

PERMIT TYPE: **(check one)** **FULL STREAM** ☐ **SHORT STREAM** ☐

COMMENTS (PERMIT NUMBER, PERMIT STATUS, ETC.)

DATE REQUESTED: DATE REQUIRED: RUSH ☐ EMERGENCY ☐

REQUESTED BY: DEPARTMENT NAME:

PHONE # DEPARTMENT #

PROJECT NAME: PROJECT ADDRESS:

PROJECT # WO#

PROJECT START DATE: O/H CONST. SUPERVISOR EXT. #

NOTE: **APPROVED PROJECT DRAWINGS MUST ACCOMPANY THIS FORM**

OPTIONAL LOCATIONS LIST ATTACHED: Y/N ☐

SPECIFIC POLES TO BE TESTED: Y/N ☐

POLE # POLE #

POLE # POLE #

COMMENTS:

JOB COMPLETION INFORMATION: (To be completed by C.S. Linestakers only)

☐ **PERMIT/S** ☐ **LOCATES** ☐ **STAKE OUT INFO.**

PERMIT NUMBERS

COMPLETED BY & Ext. # DATE COMPLETED:

toronto hydro
electric system

Date:

To our valued customer:

RE: Hydro Construction – IMPORTANT NOTICE

We are planning to rebuild the overhead electrical system on your street. The existing system is nearing the end of its life expectancy and if left unattended, it could hamper our ability to maintain a reliable level of service to you and your neighbours.

The proposed work may involve installation of new poles and equipment within the public road allowance in front of or adjacent to your property.

Entry to your house will not be required. If you have any doubts about someone claiming to be "from Hydro", ask to see the person's Toronto Hydro Identification card that includes the employee's name and colour photograph.

We expect the work to get underway by _____, 200_. Our construction personnel are instructed to take extra care and precautions in order to minimize disruptions on both public and private property. During the course of our work, you may experience some power interruptions. They will be necessary to switch from the old to the new supply arrangements. We will endeavour to keep the interruptions to a minimum and to give you prior notice.

We thank you in advance for your co-operation and understanding in this matter. Should you require additional information, please call the **Project REBUILD** hotline at 416-542-3366, or email us at rebuild@torontohydro.com.

Sincerely,
TORONTO HYDRO

p.c. Toronto Hydro - Communications & Public Affairs

APPENDIX "E2"
CUSTOMER NOTIFICATION OF ROTTED POLE REPLACEMENT

Date:

To our valued customer:

RE: Hydro Construction – IMPORTANT NOTICE

We are planning to replace some deteriorated poles in your area. These poles may need to be relocated in the process.

Between now and the time of construction, you may see our design staff in your area. Entry to your house will not be required. If you have any doubts about someone claiming to be "from Hydro", ask to see the person's Toronto Hydro Identification card that includes the employee's name and colour photograph.

In some cases, new poles will be installed in advance followed by the transferring of pole hardware and removal of the old poles. This staging is intended to maximize the number of poles installed and removed when the ground is not frozen.

We expect the work to get underway by _____, 200_. Our construction personnel are instructed to take extra care and precautions in order to minimize disruptions on both public and private property. During the course of our work, you may experience some power interruptions. They will be necessary during the transferring of equipment to the new poles. We will endeavour to keep the interruptions to a minimum and to give you prior notice.

We thank you in advance for your co-operation and understanding in this matter. Should you require additional information, please call the **Project REBUILD** hotline at 416-542-3366, or email us at rebuild@torontohydro.com.

Sincerely,
TORONTO HYDRO

p.c. Toronto Hydro - Communications & Public Affairs

Internal Note: **This notification is to be sent to customers in the vicinity of the pole change including those that may be affected if a power outage is necessary during the change out.**

APPENDIX “E3”
CITY COUNCILLOR NOTIFICATION OF PROJECT

Date:

Toronto City Hall
100 Queen Street West
2nd floor, Suite ____
Toronto, Ontario, M5H 2N2

Attn: City Councillor

Re: Project Name

For your information, please find attached a copy of our first notification letter that will be delivered to the property owners concerning the above project. Also enclosed is the map of the area and a full listing of the addresses that will be affected by this important hydro upgrade.

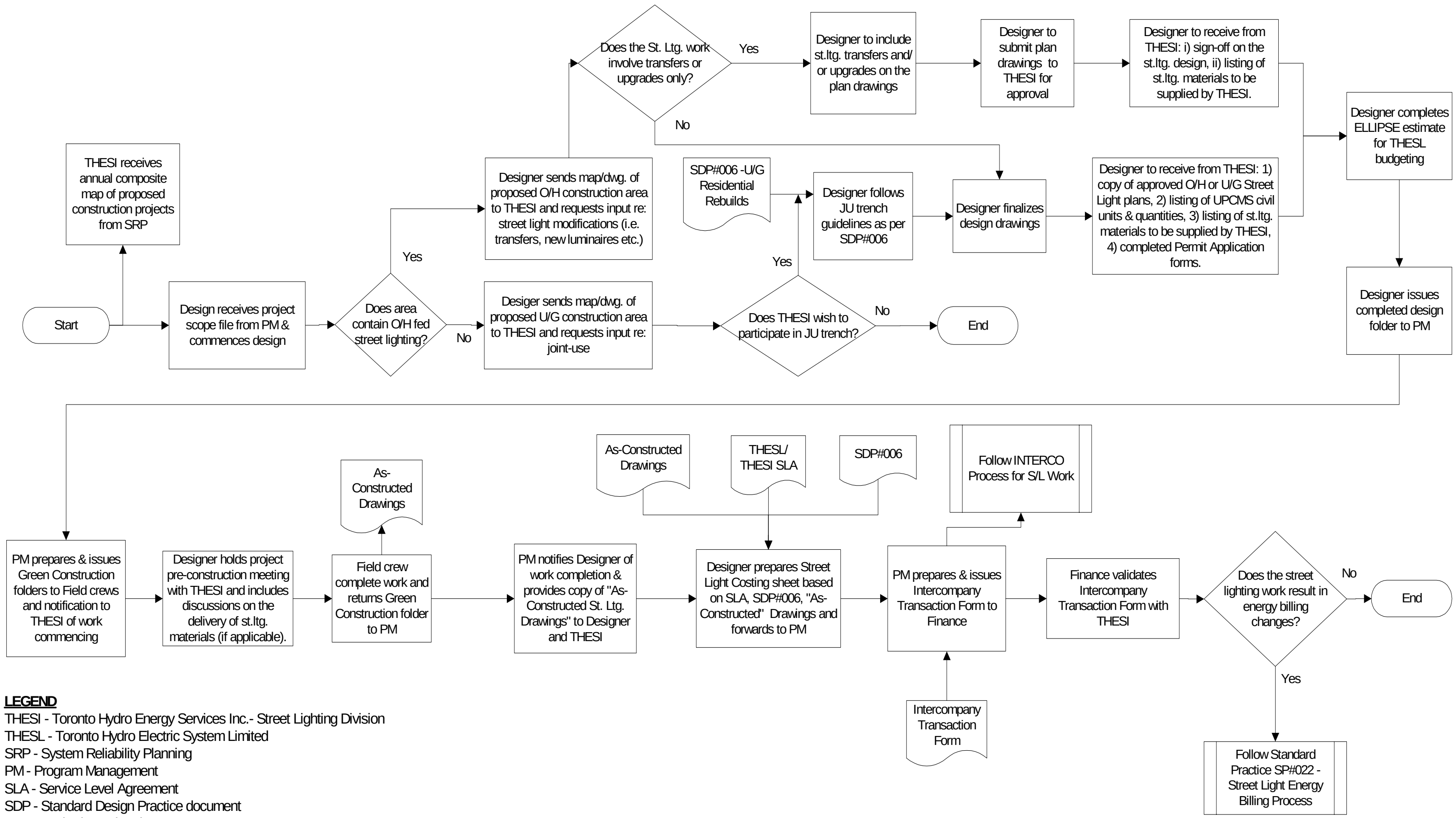
If you have any questions or concerns regarding the project, please feel free to contact me at 416-542-3366, or e-mail me at rebuild@torontohydro.com.

Sincerely,

Toronto Hydro
Communications & Public Affairs

p.c. Design Technician

APPENDIX “F”
THESL DESIGN PROCESS FOR CAPITAL PROJECTS INVOLVING STREET LIGHTING



LEGEND

THESI - Toronto Hydro Energy Services Inc.- Street Lighting Division
THESL - Toronto Hydro Electric System Limited
SRP - System Reliability Planning
PM - Program Management
SLA - Service Level Agreement
SDP - Standard Design Practice document
SP - Standard Practice document
JU - Joint-use

NOTES:

1. THESI will prepare plan drawings for all underground street light work and for overhead street light work that involves the adding of lights and/or conversions to existing lighting systems (i.e. relay to 24hr control). THESL designers shall include street light transfers and/or upgrades (such as replacing brackets or luminaires or bulbs) on their plan drawings.
2. THESL will submit completed permit applications to the City on behalf of THESI.
3. THESL designer will calculate THESI chargeable costs based on THESL/THESI SLA , As-Constructed drawings and Standard Design Practice SDP#006.
4. Underground utility locates and stakeouts will be obtained by THESL's contractor.
5. All street light material (except those include in the UPCMS) will be supplied byTHESI.
6. Contact for all THESI information and requests is Andrew Herczeg (tel.# 416-640-9830).

toronto hydro
electric system

STREET LIGHT CHANGE FORM

THESL Designers to complete and submit to Toronto Hydro Energy Services Inc. - Street Lighting Division. Each project shall be entered on a separate form.

PROJECT NAME: ____________________

PROJECT #: ____________________

PROJECT DRAWING #'s: ____________________

FORMER CITY DISTRICT (i.e. TORONTO, ETOBICOKE etc.): ____________________

PROJECT COMPLETION DATE: ____________________

STREET LIGHT CHANGES			
ADD	DELETE	SIZE (WATTS)	LUMINAIRE TYPE (i.e. HPS, Metal Halide etc.)

Submitted by / Ext. #: ____________________

Department: ____________________

Date: ____________________

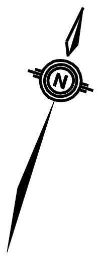
THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARS. SPECIFICATIONS AND APPROVED EQUIPMENT AND MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF THE ONTARIO REGULATION 22/04.

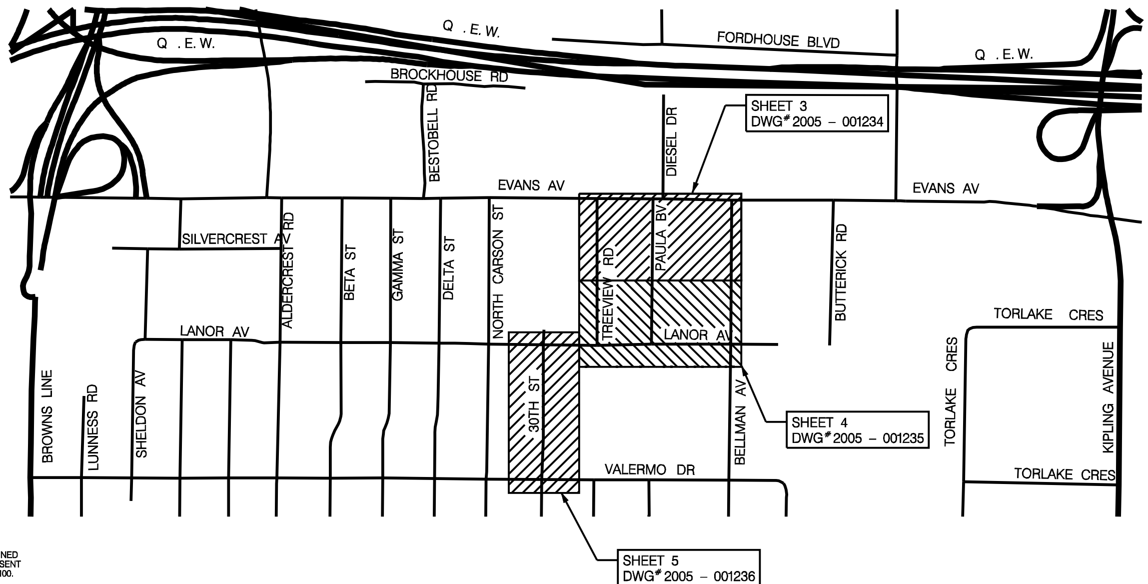
TORONTO HYDRO

OVERHEAD INSTALLATION

W5275 EVANS/VALERMO DA F1/F2 (PART 1)

OVERHEAD V/C





KEY MAP

INSTALL:

W.O. #43298 – POLES, ANCHORS, FRAMING, GROUND RODS

23 – 45' W.C. POLE

2 – 55' W.C. POLE

4 STRUT GUY

1 STANDARD GUY C/W ANCHOR

S/G — 2 SPAN GUY ONLY

GR — 14 GROUND RODS

W.O. #43287 – PRIMARY AND SECONDARY CONDUCTORS

27.6 /16kV /3/0 TREE — 9 – SPANS OF #3/0 ACSR AL 27.6KV 3–PH PRIMARY TREE PROOF CONDUCTOR 945m +/-

16kV /3/0 TREE — 16 – SPANS OF #3/0 AWG ACSR AL 27.6KV 1–PH PRIMARY TREE PROOF CONDUCTOR 560m +/-

120/240V / 3 – 2 — 33 – SPANS OF #3/0 PRESPUN 120/240V SECONDARY CONDUCTOR 1155m +/-

REPLACE OPEN WIRE SERVICE
7 – #2 QUAD SERVICE WIRES 173m +/-

120/240V /3–2

W.O. #43291 – SWITCH INSTALLATION

3 – 1–PH 25kV SMD20 DISCONNECT SWITCH FUSED @ 140k

W.O. #43292 – TRANSFORMERS

1 – 3 POLEMOUNT 1–PH 100KVA 27600 GRD. Y /16000 – 120 /240V STD. TRANSFORMERS

4 – 1 POLEMOUNT 1–PH 50KVA 27600 GRD. Y /16000 – 120 /240V STD. TRANSFORMERS

4 – 1 POLEMOUNT 1–PH 100KVA 27600 GRD. Y /16000 – 120 /240V STD. TRANSFORMERS

W.O. #43311 – STREET LIGHT TRANSFER

14 – LUMINAIRES C/W LAMPS & PHOTO CONTROLS TO NEW POLES

GENERAL NOTES

BY TORONTO HYDRO

GENERAL

1. WHERE NECESSARY, LOWER SECONDARY TO MAINTAIN SUFFICIENT CLEARANCE BETWEEN PRIMARY AND SECONDARY CONDUCTORS.
2. INCREASE OR MAINTAIN EXISTING CLEARANCE OVER TRAVELLED PORTION OF ROADWAY (MINIMUM 5.5m CLEARANCE).
3. RE–SAG PRIMARY AND SECONDARY CONDUCTORS WHERE NECESSARY.
4. USE EXISTING ANCHORS AND GUYS UNLESS OTHERWISE SPECIFIED AND ADJUST ANY SLACK GUYS.
5. PLUMB POLES AS REQUIRED.
6. TRIM TREES ALONG ROUTE AS REQUIRED.
7. MINIMUM HORIZONATAL CLEARANCES FROM FOREIGN UTILITIES SHALL BE MAINTAINED IN ACCORDANCE WITH APPENDIX O OF THE CITY OF TORONTO'S MUNICIPAL CONSENT REQUIREMENTS. FOR CLEARANCES, REFER TO TORONTO HYDRO'S STANDARD 31–0100.
8. NEW POLES AND EQUIPMENT ARE TO BE NUMBERED AS PER CONSTRUCTION STANDARD SECTION 21. EXISTING POLE AND EQUIPMENT LOCATIONS ARE TO BE RELABELED AS INDICATED. BOTH THE NEW LOCATION NUMBER AND FORMER NUMBER (IN BRACKETS) ARE SHOWN AT EACH POLE/EQUIPMENT LOCATIONS (i.e. P1234(123)).
9. UNLESS OTHERISE NOTED, OWNERSHIP OF POLES REMAINS UNCHANGED.
10. CONDUCTOR LENGTHS GIVEN IN INSTALL TABLE ARE TOTAL LENGTHS NOT ROUTE METERS.
11. UTILITY LOCATES TO BE OBTAINED PRIOR TO POLE AND ANCHOR INSTALLATIONS.
12. NOTIFY CITY INSPECTOR, MR. TIWARI BUDHU @ 416–936–0481, 48 HOURS PRIOR START OF WORK.
13. AS PER THE REQUIREMENTS OF BILL 208, THE FOLLOWING "DESIGNATED SUBSTANCES" MAY BE ENCOUNTERED ON THE PROJECT:
    VINYL CHLORIDE – 4" PVC DUCTS AND PVC JACKETED CABLES
    ETHYLENE OXIDE – POLYETHYLENE INSULATED CABLES
    SILICA – CURRENT LIMITING FUSES AND LIGHTNING ARRESTERS (4kV)
14. IN INSTANCES WHERE AN ISOLATED AND UNDERGROUNDED LINE IS IN CLOSE PROXIMITY OF, AND FOLLOWS THE SAME GENERAL ROUTE OF AN ENERGIZED OVERHEAD LINE, IT IS POSSIBLE FOR THE ISOLATED LINE TO BE CHARGED BY INDUCTION. EXERCISE DUE CAUTION.
15. NEW POLES ARE TO BE INSTALLED ON THE FIELD SIDE OF SECONDARY BUS UNLESS NOTED OTHERWISE.

PRIMARY AND SECONDARY

16. EXISTING OVERHEAD PRIMARY CONDUCTORS SHALL BE REUSED AND RE–INSULATED WHERE NOTED ON THE DRAWING. IF THE CONDUCTOR IS COVERED, 350mm OF THE COVERING MUST BE REMOVED WHERE AMPACT STRIPPUPS, CONNECTIORS AND DEAD ENDS ARE INSTALLED.
17. ALL SERVICES SHALL BE RECONNECTED TO THEIR ORIGINAL SUPPLY TRANSFORMER UNLESS OTHERWISE INDICATED IN THE SERVICE CHANGES CHART.
18. CHANGE ALL OPEN WIRE SECONDARY SERVICES TO SERVICE CABLE.

STREET LIGHTING

19. MOUNT STREET LIGHTS TO CONFORM TO EXISTING LIGHTING.
20. INSTALL LIGHTS TO FACE DIRECTION INDICATED.
21. MAKE STREET LIGHT CONNECTIONS TO SECONDARY BUS.

APPROX. CUT REPAIRS

ROADWAYS	+/-	0	sq m
CONCRETE	+/-	0	sq m
SIDEWALK	+/-	0	m
OTHER	+/-	0	sq m

ENERGY BILLING

CHANGES	QUANTITY	TYPE
ADD	—	—
DELETE	—	—
NO CHANGE	X	X

DRAWINGS FOR P0098765

SHEET	DWG No.	DESCRIPTION	SHEET	DWG No.	DESCRIPTION
1	2005 – 001232	TITLE SHEET	2	2005 – 001233	PRIMARY SCHEMATIC
3	2005 – 001234	PLAN	4	2004 – 001235	PLAN
5	2005 – 001236	PLAN	6	2004 – 001237	PRIMARY & SECONDARY REMOVAL

SAMPLE DRAWINGS FOR
SDP #001

TORONTO HYDRO (West)
ETOBICOKE DISTRICT

toronto hydro

(ESTIMATE #5678)

L. WONG	N /A	
W5275	N /A	
P0010756	L. WONG	
P0098765	J. MELLOR	
N /A	D. GEORGE	

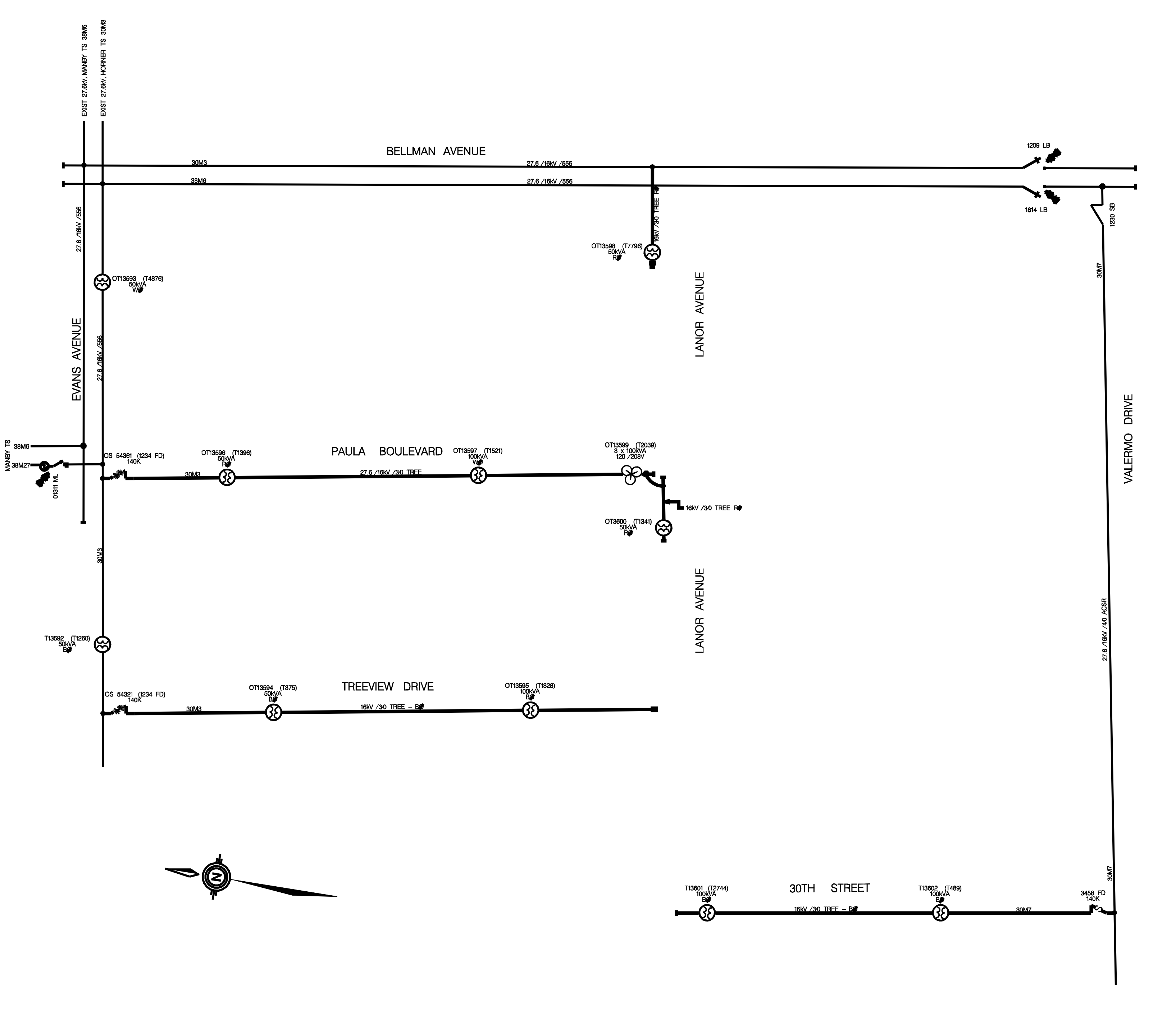
W5275 EVANS /VALERMO DA F1/F2

OVERHEAD V/C

TITLE SHEET

2005 – 001232 | 1

REFER TO TITLE PAGE DRAWING #2005–001232
FOR ACCOMPANYING PROJECT DRAWING



LEGEND

SYMBOL	DESCRIPTION
	PROPOSED
	PRIMARY CABLE: 3–3Ø 28kV TREE CABLE
	PRIMARY CABLE: 1–3Ø 28kV TREE CABLE
	TRANSFORMER — 1 – PHASE
	TRANSFORMER — 3 – PHASE
	FUSED CUTOUT
	EXISTING
	OVERHEAD PRIMARY
	LOADBREAK SWITCH
	NORMALLY OPEN
	SCADA SWITCH
	SOLID BLADE SWITCH

SAMPLE DRAWINGS FOR
SDP #001

TORONTO HYDRO (West)
ETOBICOKE DISTRICT

toronto hydro

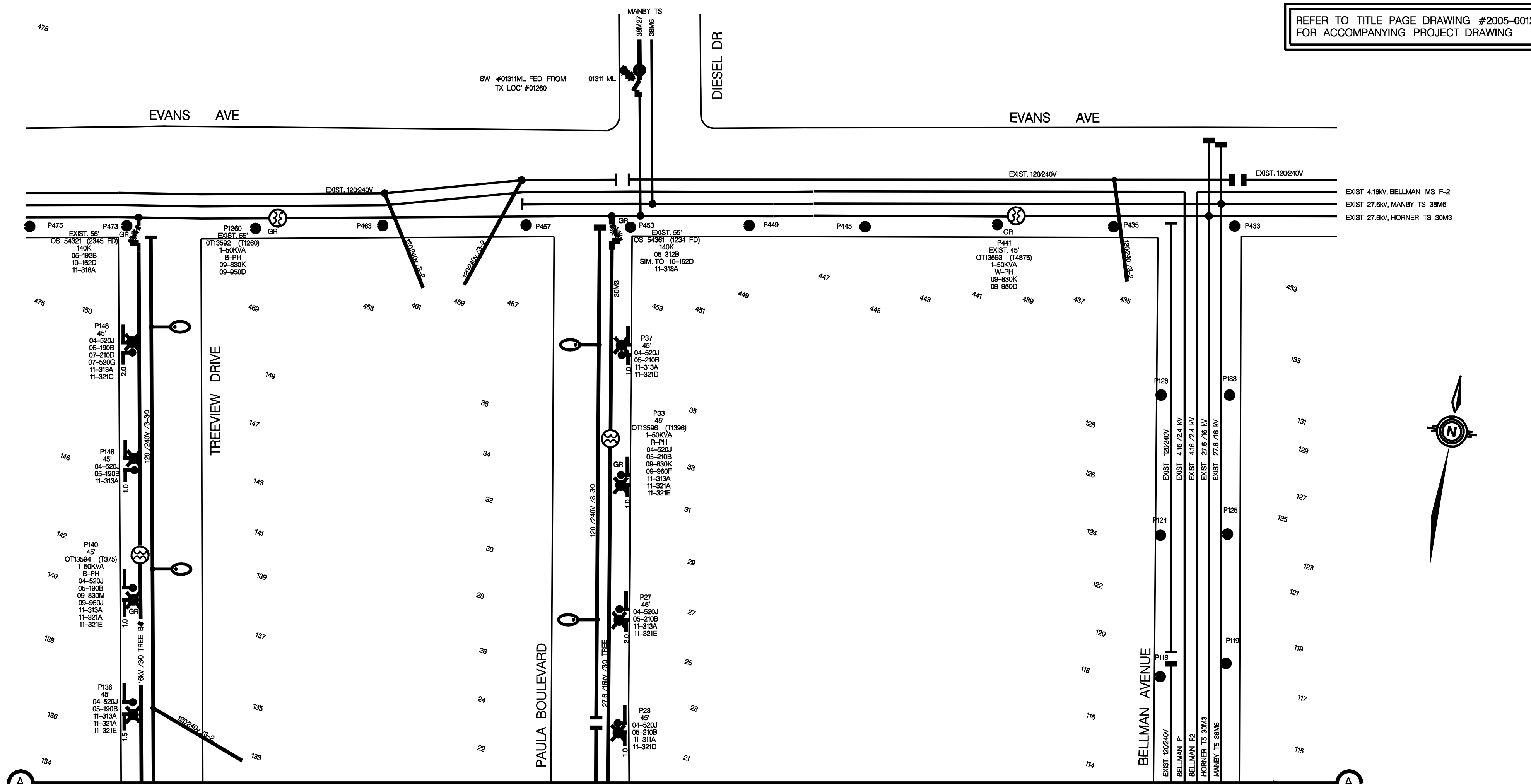
(ESTIMATE #5678)

L. WONG	N /A	
W5275	N /A	
P0010756	L. WONG	
P0098765	J. MELLOR	
NTS	D. GEORGE	

W5275 EVANS /VALERMO DA F1/F2
OVERHEAD V/C
PRIMARY SCHEMATIC

2005 – 001233 | 2

REFER TO TITLE PAGE DRAWING #2005-001232
FOR ACCOMPANYING PROJECT DRAWING



MATCH LINE A – A, SEE SHEET #4, DRAWING #2005 – 001235

TRANSFORMER SERVICE CHANGES		
ADDRESS OF SERVICE	FROM TRANSFORMER #	TO TRANSFORMER #
130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140 TREEVIEW DRIVE 141, 142, 143, 146, 147, 149 TREEVIEW DRIVE	T375	T13594
457, 459, 461, 463, 469, 475, 477, 478, 479 EVANS AVENUE 150 TREEVIEW DRIVE	T1260	T13592
453 EVANS AVENUE 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36 PAULA BOULEVARD	T1396	T13596
435, 437, 439, 441, 443, 445, 447, 449, 451 EVANS AVENUE	T4876	T13593
THE FOLLOWING IS A LIST OF TRANSFORMER NUMBERS TO BE DELETED: T375 , T1260, T1396, T4876.		

toronto hydro

TORONTO HYDRO (West)
ETOBICOKE DISTRICT

(ESTIMATE #5678)

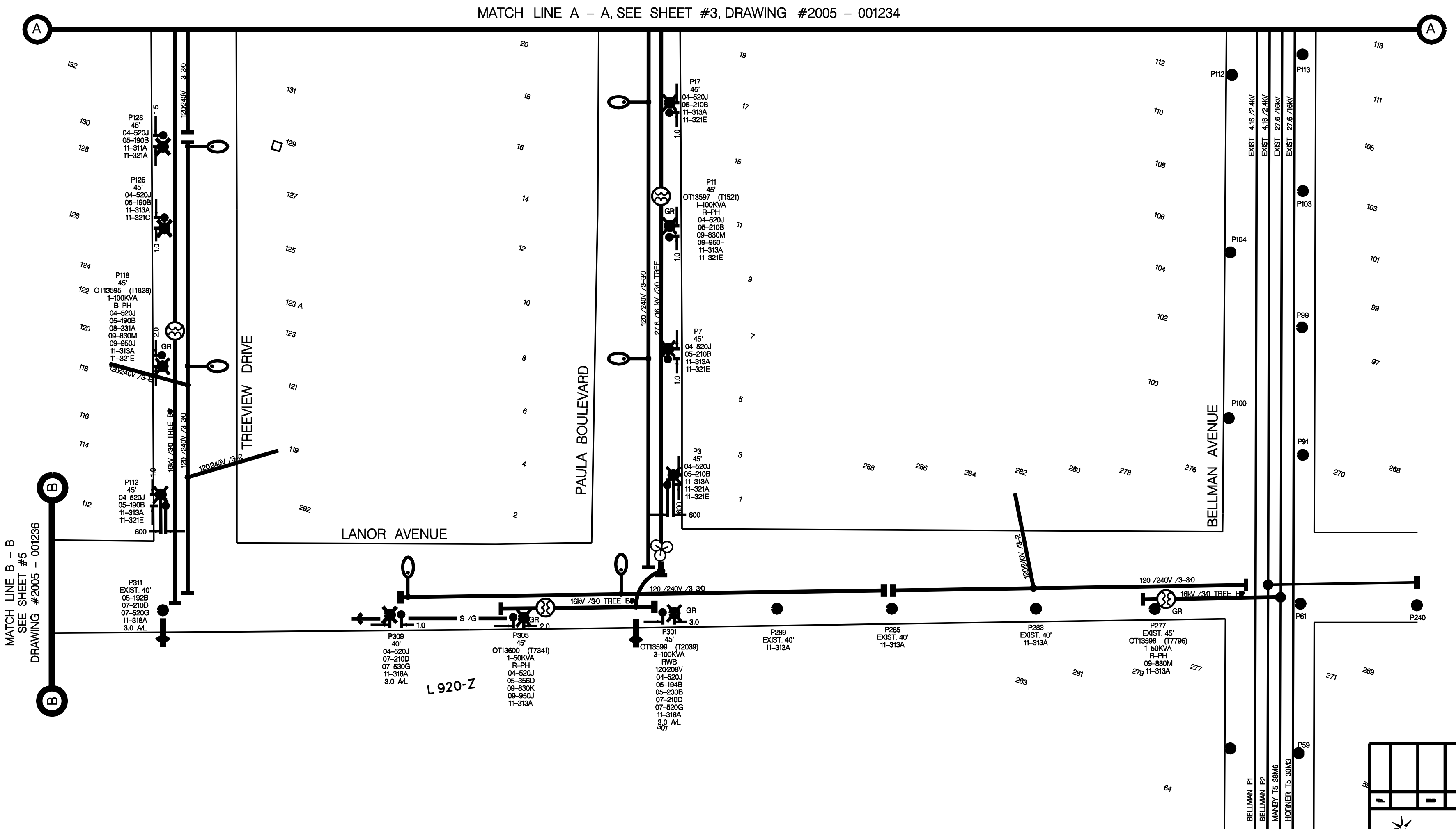
L. WONG	N /A	
W5275	N /A	
P0010756	L. WONG	
P0098765	J. MELLOR	
N /A	D. GEORGE	

W5275 EVANS /VALERMO DA F1/F2

OVERHEAD V/C
PLAN

2005 – 001234 | 3

REFER TO TITLE PAGE DRAWING #2005–001232
FOR ACCOMPANYING PROJECT DRAWING



TRANSFORMER SERVICE CHANGES		
ADDRESS OF SERVICE	FROM TRANSFORMER #	TO TRANSFORMER #
300 VALERMO DRIVE	T1341	T13600
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17 PAULA BOULEVARD 18, 19, 20, 21, 22 PAULA BOULEVARD	T1521	T13597
276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 288 LANOR AVENUE	T1796	T13598
292 LANOR AVENUE 112, 114, 116, 188, 119, 120, 121, 122, 123, 124, 125 TREEVIEW DRIVE 126, 127, 128, 129 TREEVIEW DRIVE	T1828	T13595
301 LANOR AVENUE	T2039	T13599
THE FOLLOWING IS A LIST OF TRANSFORMER NUMBERS TO BE DELETED: T1341, T1521, T7796, T1828, T2039.		

TORONTO HYDRO (West)
ETOBICOKE DISTRICT

toronto hydro

(ESTIMATE #5678)

L. WONG	N /A	
W5275	N /A	
P0010756	L. WONG	
P0098765	J. MELLOR	
N /A	D. GEORGE	

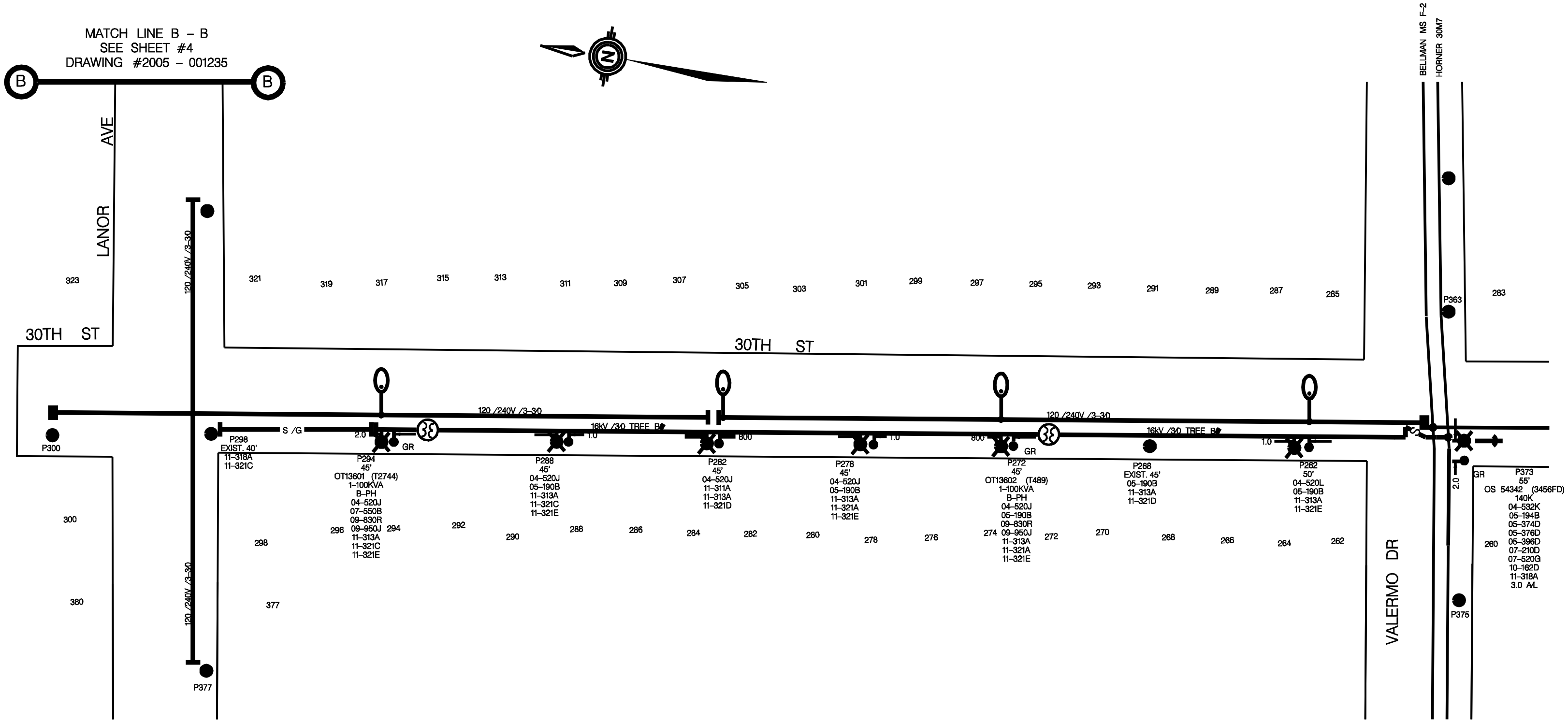
W5275 EVANS /VALERMO DA F1/F2

OVERHEAD V/C
PLAN

2005 – 001235 | 4

REFER TO TITLE PAGE DRAWING #2005–001232
FOR ACCOMPANYING PROJECT DRAWING

MATCH LINE B – B
SEE SHEET #4
DRAWING #2005 – 001235



SAMPLE DRAWINGS FOR
SDP #001

TRANSFORMER SERVICE CHANGES

ADDRESS OF SERVICE	FROM TRANSFORMER #	TO TRANSFORMER #
256, 258, 260, 262, 264, 266, 268, 270, 272, 274, 276, 278, 279, 281 30TH STREET 283, 285, 287, 289, 291, 293, 295, 297, 299, 301, 303 30TH STREET	T489	T13602
377, 380 LANOR AVENUE	T2744	T13601

THE FOLLOWING IS A LIST OF TRANSFORMER NUMBERS TO BE DELETED:
T489, T2744.

TORONTO HYDRO (West)
ETOBICOKE DISTRICT

toronto hydro

(ESTIMATE #5678)

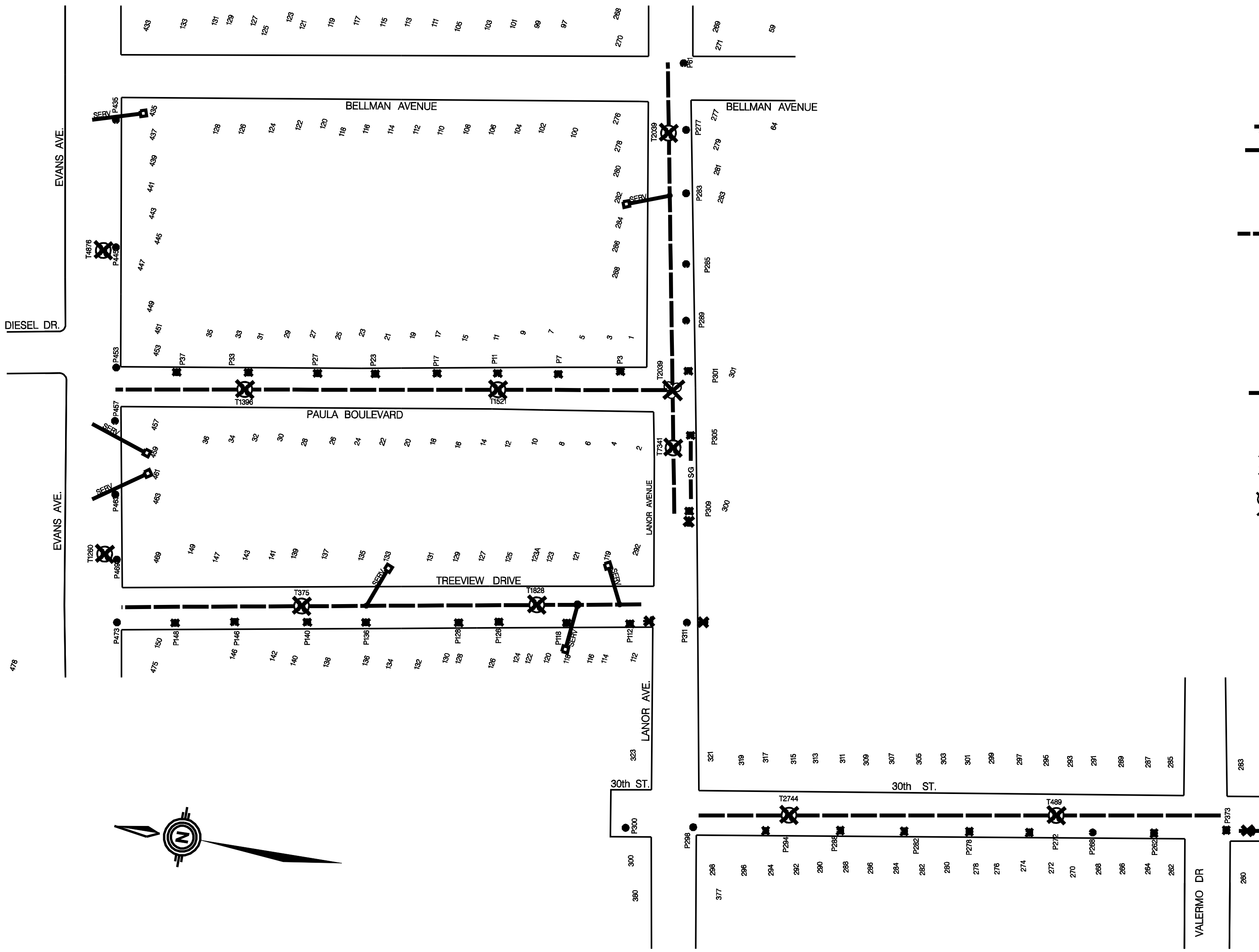
L. WONG	N /A	
W5275	N /A	
P0010756	L. WONG	
P0098765	J. MELLOR	
N /A	D. GEORGE	

W5275 EVANS /VALERMO DA F1/F2

OVERHEAD V/C
PLAN

2005 – 001236 | 5

REFER TO TITLE PAGE DRAWING #2005-001232
FOR ACCOMPANYING PROJECT DRAWING



REMOVALS:

W.O. #43298 – REMOVALS

POLES:

2 – 30' W.C. POLES

24 – 40' W.C. POLES

ANCHORS AND GUYS:

2 – GUYS AND ANCHORS

2 – STRUT GUYS AND ANCHORS

1 – SPAN GUY

LINE:

9 – SPANS OF 3ϕ 4.16kV #4 CU PRIMARY
P453 EVANS AVE. TO P301 LANOR AVE.

23 – SPANS OF 1ϕ 4.16kV #4 CU PRIMARY
P473 EVANS AVE. TO P112 TREEVIEW DR.
P309 LANOR AVE. TO P61 BELLMAN AVE.
P298 30th ST. TO P373 VALERMO DR.

32 – SPANS OF OPEN WIRE 120/240V SECONDARY
P453 EVANS AVE. TO P301 LANOR AVE.
P473 EVANS AVE. TO P112 TREEVIEW DR.
P309 LANOR AVE. TO P61 BELLMAN AVE.
P298 30th ST. TO P373 VALERMO DR.

33 – SPANS OF 120V STREETLIGHT SECONDARY

P453 EVANS AVE. TO P301 LANOR AVE,
P473 EVANS AVE. TO P311 LANOR AVE.
P309 LANOR AVE. TO P61 BELLMAN AVE.
P298 30th ST. TO P373 VALERMO DR.
7 – SPANS OF OPENWIRE 120/240V SERVICES

SERV

TRANSFORMERS

2 – 25KVA 2.4kV – 120/240V TRANSFORMERS
2 – 37KVA 2.4\kV – 120/240V TRANSFORMERS
4 – 75KVA 2.4kV – 120/240V TRANSFORMERS
2 – 100KVA 2.4kV – 120/240V TRANSFORMERS

3 – 75KVA 2.4kV – 120/240V TRANSFORMER

SAMPLE DRAWINGS FOR
SDP #001

TORONTO HYDRO (West)
ETOBICOKE DISTRICT

toronto hydro

(ESTIMATE #5678)

L. WONG	N /A	
W5275	N /A	
P0010756	L. WONG	
P0098765	J. MELLOR	
N /A	D. GEORGE	

W5275 EVANS /VALERMO DA F1/F2

OVERHEAD V/C
REMOVAL PRIMARY & SECONDARY

2005 – 001237 | 6

Standard Design Practice

NEW UNDERGROUND RESIDENTIAL SUBDIVISIONS

SDP #002 Rev. 3

Prepared by: Standard Design Practice Team

Originally Approved by: Romano Sironi, Manager, Strategy & Policy — Issue Date: March 1, 2004
Rev. 1 Approved by: Romano Sironi, Manager, Strategy & Policy — Issue Date: November 8, 2004
Rev. 2 Approved by: John Petras, Manager, Standards & Materials — Issue Date: June 9, 2005
Rev. 3 Approved by: Mary Byrne, Manager, Standards & Policy Planning — Issue Date: July 10, 2012

SDP #002 – NEW UNDERGROUND RESIDENTIAL SUBDIVISIONS

Revision History			
Rev. #	**Date**	**Description**	**Approved by:**
00	1-Mar-04	- Original Issue	R. Sironi
01	8-Nov-04	- Revised clearance requirements for padmount transformers from combustible surfaces. - Revised nomenclature section indicating implementation schedule to be developed by Work Practice Harmonization.	R. Sironi
02	9-June-05	- Added cover sheet, contents page and revision history table. - Added new requirements resulting from Ontario Regulation 22/04. - Revised 120/240 V & 120/208V (open Wye) 400 Amp secondary bus and service cable requirements to indicate triplex cable. - Revised drawing guidelines. - Removed the nomenclature standards from the document, as they will form Section 21 in the Construction Standards. - General revisions based on stakeholder feedback and alignment with current processes.	J. Petras
03	10-July-12	- Added section numbering to bullets throughout document. - Added Y drive path for location of the Design Project Checklist (section 1.1 Design Checklist). - Revised clauses to include Job Planning Process and *Occupational Health and Safety Act* (section 1.2.1 General). - Updated asbestos items (section 1.2.1 General). - Added clause to consider the requirements of Distribution Grid Operations (section 1.2.1 General). - Updated supply arrangement clauses (section 1.2.1 General). - Updated civil structure requirements (section 1.2.1 General). - Deleted reference to using submersible vaults instead of tap boxes (section 1.2.1 General). - Added clause to refer to SDP #004 - Major Civil Projects, Section 1.2.4 - Special Permits and Approvals for instruction (section 1.2.1 General). - Added clause to refer to the City map “Asbestos Locations”, (section 1.2.1 General). - Revised clause regarding the use of legacy construction standards, (section 1.2.1 General) - Added city DIPS requirements (section 1.2.2.1.1 and 1.2.2.1.2 General). - Deleted clause s referencing the MCR and horizontal clearances (section 1.2.2.1 General). - Added color of ducts for direct buried service ducts (section 1.2.2.2.1 Ducts). - Added color of ducts for any direct buried ducts (section 1.2.2.2.2 Ducts). - Added clause regarding the backfilling of excavations (section 1.2.2.2.3 Ducts). - Added clause to use re-bar for new concrete encased ducts (section 1.2.2.2.4 Ducts). - Revised clause to reflect the minimum number of ducts to be installed at road crossings (section 1.2.2.2.6 Ducts). - Added clause to use cable-pulling software (section 1.2.2.2.10 Ducts). - Added clause to slope ducts towards underground structures (section 1.2.2.2.11 Ducts). - Revised clause to where to place G.I. bends (section 1.2.2.2.12 Ducts). - Added clause regarding third party ducts (section 1.2.2.2.13 Ducts). - Deleted clauses regarding UPCMS costing and street lighting ducts (section 1.2.2.2. Ducts). - Added clause regarding the location of vaults and pad foundations (section 1.2.2.3.3 Vaults/Foundations).	M. Byrne

SDP #002 – NEW UNDERGROUND RESIDENTIAL SUBDIVISIONS

Revision History (continued)			
Rev. #	**Date**	**Description**	**Approved by:**
03 cont'd	10-July-12	- Added clause to use "petro-plug" in submersible transformer vaults (section 1.2.2.3.5 Vaults/Foundations). - Revised the type of tap box to be used (section 1.2.2.3.6 Vaults/Foundations). - Added clause to use submersible vault drains (section 1.2.2.3.7 Vaults/Foundations). - Added clause regarding the clearance requirements of pad-mounted transformers to buildings (section 1.2.2.3.10 Vaults/Foundations). - Updated tap box information (section 1.2.2.4.2 Tap (Splice) Boxes) - Added clause to equipment number the secondary connections and primary slices (section 1.2.2.4.6 Tap (Splice) Boxes) - Deleted clauses referring to joint use costs (section 1.2.2.5 Joint Use Trench). - Revised clause to reflect joint trench to follow the City DIPS requirements (section 1.2.2.5.1 Joint Use Trench). - Added clauses regarding foreign utilities that use the joint trench (sections 1.2.2.5.2, 1.2.2.5.3, 1.2.2.5.5, and 1.2.2.5.6 Joint Use Trench). - Added clause to the number of transformer connections (section 1.2.3.4 Transformers). - Revised availability of pad-mounted transformer designs (section 1.2.3.9 transformers). - Added clause to avoid placing pad-mounted transformers near major intersections (section 1.2.3.11 Transformers). - Revised ampacity ratings (section 1.2.4 Primary Cables) - Revised maximum secondary bus cable ratings (section 1.2.5.3 Secondary Bus Cables). - Added clause to avoid making service and unmetered connections at transformer's bushings (section 1.2.6.5 Service Cables). - Deleted sections 1.2.7 Secondary Design Criteria, and section 1.2.7.1 General. - Added clause to the number of connections that can be made at the transformer's secondary bushings (section 1.2.7.1 Transformer Loading). - Updated the number of service connections (section 1.2.8.2 and 1.2.8.3 Secondary Bus Loading). - Updated the appendix voltage drop tables, and the examples (section 1.2.9.6 Secondary Voltage Drop). - Revised clause to refer to the construction standards for selecting the type of fuses (section 1.2.10.1 Fusing). - Added new section (section 1.2.11 Switchgear). - Added and updated clauses throughout section (section 1.2.12 Street Lighting). - Revised clause regarding unmetered connections (section 1.2.13.1 Unmetered Connections). - Updated the Drawing Guidelines sections (sections 1.3, 1.3.1, 1.3.1.1, 1.3.1.2, 1.3.1.3, 1.3.1.4, 1.3.1.5, 1.3.1.6, and 1.3.1.7). - Updated the link to view the symbols and cell libraries (section 1.3.3 Symbology). - Revised clause to indicate where to view the "project design deliverables" checklist and the "project distribution list" (section 1.4 Project Deliverables). - Updated the references (section 3 References). - Removed Appendices: New Underground Subdivision Design Project Checklist, Project Design Deliverables, Street Light Change Form, Issue for Construction – Drawing Distribution Chart.	M. Byrne

SDP team members for SDP#002 Rev 3:
Ian Maikawa (RC 2400), John Hecimovic (RC 2400), James Daniel (RC 2400), Tarek Turk (RC 2400), Alan Hung (RC 3160), Garbis Kerestecioglu (RC 3160), Stephen Plant (RC 3620), Debbie Girard (RC 3110), Domenic Zurzolo (RC 4330), Bob Payne (RC 3720), Frank Yu (RC 2400), Ben Sheng (RC 2200)

SDP #002 – NEW UNDERGROUND RESIDENTIAL SUBDIVISIONS

CONTENTS

Section 1 - Practice:

The purpose of this document is to provide a guideline for the design of projects involving new underground residential subdivision projects. The document provides the necessary framework to ensure project designs are aligned with business strategies and completed design packages are delivered in a consistent fashion.

Four key issues addressed in this document:

a) Design Checklist: identifies the activities, which should be considered during the design phase.
b) Design Considerations: supplements the Construction Standards by identifying key design components and strategies for new projects.
c) Drawing Guidelines: identifies key information to be shown on project drawings.
d) Project Deliverables: identifies the documents and drawings required when signing-off on a design file.

This document can be used as a guideline for new underground residential subdivisions involving Customer Class 3B and 3C.

1.1 Design Checklist

Many issues need to be considered in the design of projects involving new underground residential subdivision projects. To ensure a comprehensive design package is delivered, Designers must be cognizant of all issues during the design. To assist Designers in this area, “U/G Subdivision Design Project Checklist” has been developed and should be used as a guide to ensure all aspects of the design stage are successfully completed.

The **Design Project Checklist** can be viewed on the Y drive;
Y:\THESL\Asset Mgmt\AM Common\PAS\Standard Design Practice\Design Project Checklist

1.2 Design Considerations

1.2.1 General

1.2.1.1 Designers shall ensure project designs satisfy the requirements of Section 7 of Ontario Regulation 22/04 “Electrical Distribution Safety” under the Electricity Act, 1998.

1.2.1.2 Designers shall employ the “Job Planning Process” and the “Safety by Design” concept in project designs.

1.2.1.3 Designers shall endorse the use of only certified construction standards and specifications in the assembly of the project drawings. The use of authorized legacy construction standards should be limited to the maintaining of lines where certified construction standards would be problematic. The use of legacy construction standards will require a certificate of approval prepared by a Professional Engineer from the Standards & Materials section.

1.2.1.4 In accordance with the *Occupational Health and Safety Act*, all known "Designated Substances" that may be encountered in the project shall be identified on the drawing. Examples of "Designated Substances" and their applications may include:
Asbestos – AILC cables, ducts, pavement asphalt, listing tape, barrier boards and meter backer boards
Lead - PILC and AILC cables, and older station batteries
Mercury - mercury vapor lamps and street light relays
Vinyl Chloride - 4" PVC ducts and PVC jacketed cables
Arsenic - arsenical lead sheathed cables
Ethylene Oxide - polyethylene insulated cables
Silica - current limiting fuses and lightning arresters (4 kV)
and other substances and applications that may be added from time to time.

1.2.1.5 When preparing scope packages and project designs, both Planners and Designers shall consider the requirements of Distribution Grid Operations. These requirements are identified in a "Distribution Grid Operations Project Review Form" that can be obtained by contacting a Control Room Operations Supervisor.

1.2.1.6 All new subdivisions shall utilize an underground loop design.

1.2.1.7 The preferred distribution voltage systems shall be 27.6 kV and 13.8 kV. Installations on the 4.16 kV system are to be limited to 300 kVA new load.

1.2.1.8 Subdivisions may be supplied from either the overhead or underground distribution systems.

Supply from the overhead system:

- Both ends supplying the distribution loop shall be fused and should not terminate within the same switching device or at the same structure.
- In the horseshoe area (former Scarborough, North York, Etobicoke districts), the distribution loop can be supplied from the same feeder or two different feeders off the same station bus. When using the same feeder, ends of the loop are to be connected at two different switch locations.
- Open point is to be located at a transformer in the middle of the distribution loop.

Supply from the underground system:

- Both ends supplying the distribution loop shall be fused and should not terminate within the same switching device or at the same structure.
- In the horseshoe area, the distribution loop can be supplied from the same feeder or two different feeders off the same station bus. When using the same feeder, ends of the loop are to be connected at two different switch locations.
- Open point is to be located at a transformer in the middle of the distribution loop.
- In the core area, two different feeders from the same station bus must supply the main distribution loop. Refer to the "13.8 kV Underground Residential Distribution (URD)/Open Loop System" schematic, Figure 10 in the Toronto Hydro Distribution System Planning Guidelines document located at Y:\THESL\Asset Mgmt\AM Common\System Reliability Planning\Planning Guide.

1.2.1.9 The standard civil design for new subdivisions will utilize underground structures consisting of concrete encased and direct buried (secondary services on private property) ducts, pre-cast vaults or pads and tap boxes. This design will minimize the need for future excavations within the road allowance should distribution or secondary cables require repair or replacement.

1.2.1.10 The use of cable chambers in new subdivision designs to contain primary, secondary or service cables should be avoided. Separate tap boxes shall be used for primary cable splicing and secondary bus/service connections.

1.2.1.11 The electrical design will utilize a secondary bus system that eliminates the need for multiple service cable ducts installed from each transformer location.

1.2.1.12 Customer service cable connections will be made to the secondary bus system inside the tap boxes which should ideally be located at lot lines.

1.2.1.13 For new installations which cross over or may be in close proximity to gas pipelines, CN/CP tracks, Hydro One corridors etc. consult SDP #004 **-** Major Civil Projects, Section 1.2.4 - Special Permits and Approvals for instruction.

1.2.1.14 Opportunities for Joint-use trenching initiatives shall be discussed with foreign utilities in the early stages of design. Refer to Section 1.2.2.5 – Joint-Use Trench.

1.2.1.15 Refer to the City map “Asbestos Locations” to determine if the asphalt in the proposed construction area requires asbestos testing. Streets that are **GREEN** do not require testing. Streets that are **RED** do not require testing as these will be treated as being contaminated with Asbestos. Only streets indicated in **PURPLE** on the City map need to be tested. Driveway aprons do not require testing. Conduct one test per road crossing. Boulevard pole locations do not require testing. If test results are positive or you are working in a **RED** area, adhere to Type II Asbestos Handling Procedures for Removal and Disposal of any Contaminated Asphalt.

1.2.2 Civil

1.2.2.1 General

1.2.2.1.1 The standard locations for Toronto Hydro underground structures (ducts, submersible vaults, and tap boxes) from the street line shall follow the requirements that are specified in the City of Toronto-Development Infrastructure Policy & Standards (DIPS), “Policy and Standards For Public Local Residential Streets and Private Streets” document. The information in the Tables 1, 2, and 3 is from Appendix A1 of the above document.

Table 1 - Right of Way width 16.5 m and Roadway width 8.0 m

*Right of Way width **16.5 m** and Roadway width **8.0 m***				
Sidewalk	**Boulevard Width**			
	3.20 m		**5.30 m**	
	Centre line of joint trench from street line	Centre line of tap box from street line	Centre line of joint trench from street line	Centre line of vault/tap box from street line
both sides – adjacent to curb **(DIPS- 3A)**	1.05 m	2.25 m	1.05 m	2.7 m
one side – adjacent to curb **(DIPS-3B)**	1.05 m	2.25 m	1.05 m	2.7 m

Table 2 - Right of Way width 18.5 m and Roadway width 8.5 m

*Right of Way width **18.5 m** and Roadway width **8.5 m***				
Sidewalk	**Boulevard Width**			
	4.70 m		**5.30 m**	
	Centre line of joint trench from street line	Centre line of tap box from street line	Centre line of joint trench from street line	Centre line of vault/tap box from street line
both sides – adjacent to curb **(DIPS-2A)**	1.05 m	2.25 m	1.05 m	2.7 m
both sides – away from curb **(DIPS-2B)**	1.05 m	2.45 m	1.05 m	2.7 m

Table 3 - Right of Way width 20.0 m and Roadway width 8.5 m

*Right of Way width **20.0 m** and Roadway width **8.5 m***				
Sidewalk	**Boulevard Width**			
	5.50 m		**6.00 m**	
	Centre line of joint trench from street line	Centre line of tap box from street line	Centre line of joint trench from street line	Centre line of vault/tap box from street line
both sides – adjacent to curb **(DIPS-1A)**	1.05 m	2.5 m	1.05 m	2.7 m
both sides – away from curb **(DIPS-1B)**	1.05 m	2.45 m	1.05 m	2.7 m

1.2.2.1.2 Designers are to refer to the latest City of Toronto-Development Infrastructure Policy & Standards (DIPS), "Policy and Standards For Public Local Residential Streets and Private Streets" document for excavation clearances between hydro services and foreign utilities. The City of Toronto document (refer to Appendix A1, which accompanies cross-sectional drawings of the streets) can be viewed at http://www.toronto.ca/wes/techservices/involved/transportation/future_streets/index.htm

1.2.2.1.3 The minimum cover over the electrical ducts in an open trench installation shall be in accordance with Toronto Hydro Distribution Construction Standard 31-0300.

1.2.2.1.4 The edge of transformer pads, vaults and tap boxes shall also maintain a minimum horizontal clearance of 1.0m from the paved portion of driveways.

1.2.2.2 Ducts

1.2.2.2.1 For open trench installations, all primary and secondary cable ducts located in the public road allowance or on private property of Class 3B customers as referenced in the Conditions of Service shall be concrete encased 100mm dia. PVC constructed as per Toronto Hydro Distribution Construction Standards, Section 31 and Technical Specification for Civil Construction Work Spec # CV-CON-01. Service cable ducts located in private property shall be direct buried 100mm dia. PVC, supplied and installed by the Developer. Direct buried service ducts shall be RED PVC (in accordance with CSA Standard 22.3 No. 7.94 "Underground Systems") and shall run from the customer meter base to the lot line. The Developer will connect these service cable ducts to Toronto Hydro's lateral service ducts that veer off from the main trench. Service cable ducts from the customer meter base shall be installed in parallel with the lot line and perpendicular to the street line or main trench.

1.2.2.2.2 Any direct buried hydro ducts being installed must be red in colour.

1.2.2.2.3 Excavations shall be backfilled in accordance with Section 5.1.17 of Toronto Hydro Technical Specification for Civil Construction Work Spec # CV-CON-01 and the City's Municipal Consent Requirements.

1.2.2.2.4 For new concrete encased ducts being installed in poor soil conditions or where there is a high water table, re-bar shall be used to reinforce the structure in accordance with Toronto Hydro Distribution Construction Standard 31-1120.

1.2.2.2.5 When preparing UPCMS costs sheets, Designers shall consider the additional unit requirements for duct descents from the normal depth leading to submersible vaults and below secondary tap boxes for primary ducts.

1.2.2.2.6 Each primary cable, neutral cable, secondary bus and service cable are to be installed in separate ducts.

1.2.2.2.7 For road crossings, it is recommended that a minimum of 6 ducts (3W2H) be installed. If additional capacity is required, ducts should be added in multiples of 3 (i.e. 3W3H, 3W4H). Spare duct(s) are to be terminated 1.0m from back of curb in accordance with Toronto Hydro Distribution Construction Standard 31-1160. Terminating of these ducts shall be noted in the General Notes and Details.

1.2.2.2.8 Road crossing ducts shall be installed in a common trench with new vault drains where practicable.

1.2.2.2.9 The project drawings shall identify the number of Toronto Hydro required ducts in the main trench and any spare duct requirements.

1.2.2.2.10 Primary cable ducts are to run concurrently from vault to vault and run below the secondary tap boxes. Cable pulling calculations shall be performed to ensure maximum pulling tensions on the primary, secondary bus and service cables are not exceeded.

1.2.2.2.11 The duct route shall be designed with a minimum number of bends both horizontal and vertical to keep cable-pulling tensions within allowable limits. Cable pulling software shall be used when necessary to ensure pulling tensions on the cables are within acceptable limits for both pulling directions. When determining pulling tensions, Designers shall consider the maximum cable size that will be installed in the new duct structure.

1.2.2.2.12 Where field conditions permit, attempts shall be made to slope the ducts toward underground structures (such as vaults, pads etc.) in efforts to minimize the accumulation of water in the ducts.

1.2.2.2.13 Galvanized iron (GI) or rigid PVC bends may be required when terminating ducts at riser poles in accordance with Toronto Hydro Distribution Construction Standard 31-1220. To protect against accidental damage, bends should be placed on the side of the pole that is opposite to oncoming traffic, where practicable.

1.2.2.2.14 Third Party ducts would typically be direct buried and installed in accordance with Toronto Hydro Distribution Construction Standard 31-1390.

1.2.2.3 Vaults/Foundations

1.2.2.3.1 Submersible transformer vaults are a requirement of the City for new Class 3C residential subdivisions. For transformation requirements on private property (Class 3B customers), pad-mounted transformers shall be considered.

1.2.2.3.2 Pad-mounted transformers shall be utilized in new residential subdivisions unless current City requirements in the area insist on the use of submersible transformers.

1.2.2.3.3 In determining possible new locations, transformer vaults and padmount foundations should be located as close as possible to lot lines, while meeting all the clearance requirements. In selecting locations, Designers should also attempt to anticipate customer acceptance. In townhouse areas, end of unit blocks tend to be more acceptable than the typical small front yards. Consideration should also be given to avoiding children's play areas, minimizing exposure to traffic and maintaining minimum clearances as per the Ontario Electrical Safety Code.

1.2.2.3.4 Submersible transformer vaults shall be equipped with a "Petro-plug" interceptor and drained to the storm sewer using a 100 mm Diameter

Nominal (DN, PVC pipe with a minimum slope to sewer of 2.5%. The Developer will be responsible for installing the drain from the sewer to a location approx. 650 mm from the vault. The invert at the end of the duct should be approx. 2.0 m min. below the top of curb. The entire length of pipe to be installed on a bedding of 75 mm select granular 'A' material. Refer to section 5.6.4 of the Civil Specification No. CV-CON-01 for additional requirements.

1.2.2.3.5 The "Petro-plug" interceptor shall be installed in the drain opening inside the submersible transformer vault. A minimum of 310 mm of straight section of sewer drainpipe from the transformer vault wall is required to facilitate the Petro-plug installation, refer to Toronto Hydro Distribution Construction Standard 31-5100.

1.2.2.3.6 Type C tap boxes as per Toronto Hydro Distribution Construction Standard 31-3135 shall be used for multiple primary cable splicing.

1.2.2.3.7 Submersible vault drains shall be installed in a common trench with road crossing ducts.

1.2.2.3.8 Where no sewers are available, pad-mounted transformers shall be utilized.

1.2.2.3.9 Upon completion of vault installations, it is vital that vaults be protected (i.e. plywood, fencing etc.) from damage during subdivision construction. This requirement should be noted on the project drawings and the unit price cost sheets.

1.2.2.3.10 Pad-mounted transformer locations must meet minimum clearance requirements from any combustible surface or material on a building, window, and door inlet or outlet vents in accordance with Section 26-242 of the Ontario Electrical Safety Code. For the minimum clearance requirements refer to Toronto Hydro Distribution Construction Standards 03-5100, and 31-4070.

1.2.2.4 Tap (Splice) Boxes

1.2.2.4.1 Tap boxes shall be used for secondary connections and primary splices. Primary cables shall not occupy the same tap boxes used for secondary bus and/or service cables.

1.2.2.4.2 The available tap box sizes and their applications are indicated in Table 4.

Table 4 - Tap (Splice) Box Sizes

Tap (Splice) Box Sizes									
Item #	Type	Construction Standard	Item ID#	Size (Inside Dimensions)			Available Knockouts	Cover Type	Installation Type
				Length	Width	Height			
1	A	31-3120	3530037	900 mm	600 mm	900 mm	20	Plastic	Grass
2	A	31-3120	3530038	900 mm	600 mm	900 mm	20	Polymer Concrete	Asphalt/ Concrete
3	B	31-3125	9656478	1200 mm	900 mm	900 mm	28	Plastic	Grass Only
4	B	31-3125	9662429	1200 mm	900 mm	900 mm	28	Polymer Concrete	Asphalt/ Concrete
5	C	31-3135	9662865	1500 mm	900 mm	1050 mm	44	Plastic	Grass

a) Type A tap box can be used to make secondary bus and service cable connections. It should be noted that their application is limited to 3 – 6 way maximum Homac terminal bus for connecting line 1, line 2, and neutral cables.

b) Type B tap box can be used for **either** one 1/0, 28 kV primary cable splice where the cable length exceeds the maximum pulling tension, **or** utilized for secondary bus and service cable connections. Tap box Type B is limited to one single-phase primary cable splice **or** to the use of 3 – 8 way maximum Homac terminal bus for connecting line 1, line 2, and neutral cables.

c) Type C tap box can be used only for primary cable splices where cable lengths exceed the maximum pulling tensions. Tap box Type C can accommodate a maximum of three 1/0, 28 kV primary cables**.**

1.2.2.4.3 The preferred tap box locations are at lot lines in the sod boulevard. Alternatively, Type A and B can be installed in asphalt or concrete boulevards. Installations in sidewalks should be avoided where possible.

1.2.2.4.4 Avoid installing tap boxes in low-lying areas where they may be susceptible to flooding.

1.2.2.4.5 Upon completion of tap box installations, it is vital that they be protected (i.e. plywood, fencing etc.) from damage during subdivision construction. This requirement should be noted on the project drawings and the unit price cost sheets.

1.2.2.4.6 Tap boxes used for both secondary connections and primary splices shall be numbered in accordance with the “Equipment Numbering” in the Drawing Guidelines Section.

1.2.2.5 Joint Use Trench

1.2.2.5.1 Toronto Hydro shall participate in joint use trench with foreign utilities as specified in the City of Toronto-Development Infrastructure Policy & Standards (DIPS), “Policy and Standards For Public Local Residential Streets and Private Streets” document.

1.2.2.5.2 Joint-use trench participation shall be limited to the scope of the project. Foreign utilities that occupy a common trench shall negotiate the cost directly with Toronto Hydro's civil contractor. Foreign utilities will be responsible to develop their own drawings and submit permits outside the joint trench where required.

1.2.2.5.3 Foreign utility trench participants shall engage Toronto Hydro at the beginning of the project to obtain the drawings for the proposed installation of Toronto Hydro's new infrastructure.

1.2.2.5.4 Foreign utilities that occupy a common trench shall be placed on top and offset to the field/house side of the concrete encased electrical cable ducts. The natural gas pipeline shall be located at the step portion of the trench.

1.2.2.5.5 Foreign utilities shall be responsible for providing an on-site inspector who shall report directly to the civil contractor as required, to interpret the work plans and specifications.

1.2.2.5.6 Toronto Hydro's civil contractor and the foreign utilities shall attend the pre-construction meeting to review the proposed plans.

1.2.3 Transformers

1.2.3.1 For underground loop designs, pad-mounted transformers shall be utilized unless current City requirements in the area insist on the use of submersible transformers. Transformer type should be confirmed with the appropriate City of Toronto district office during early design.

1.2.3.2 The transformer secondary voltages are 120/240 V.

1.2.3.3 The available 1ø transformer sizes are indicated in Table 5.

Table 5 - 1ø Transformers

1ø Submersible Transformers (120/240 V Secondary)			
Distribution System	50 kVA	100 kVA	167 kVA
13.8 kV	X	X	X
27.6 kV	X	X	X

1ø Pad-mounted Transformers (120/240 V Secondary)		
Distribution System	100 kVA	167 kVA
13.8 kV	X	X
27.6 kV	X	X

1.2.3.4 For the 27.6 kV system the number of new transformers installed on a 1ø distribution loop (fused at 140K) shall be limited to 8 units on each side of the open point for a total of 16 units on the entire 1ø distribution loop. For 1ø sub-distribution loops (fused at 100K), the number of transformers shall be limited to 5 units on each side of the open point for a total number of 10 units on the entire sub-distribution loop.

1.2.3.5 There are areas within the former Toronto district, which are supplied by feeders from a three-wire station bus. For new projects in these areas, 3-Ø Delta/Y pad-mounted transformers will be required. The secondary voltage will be 120/208 V (open wye).

1.2.3.6 The available 3-Ø Delta-Y transformer sizes are indicated in Table 6.

Table 6 - Three-Phase Pad-mounted Transformers

Three-Phase Pad-mounted Transformers (120/208 V Secondary)			
Distribution System	150 kVA	300 kVA	500 kVA
13.8 kV	X	X	X

1.2.3.7 Transformers should be located as close as possible to lot lines.

1.2.3.8 All new 3Ø and 1Ø pad-mounted transformers rated 27.6/16 kV, 13.8/8 kV contain internal current limiting fuses and pressure relief devices.

1.2.3.9 3Ø pad-mounted transformers rated 4.16 kV are available in both live-front and dead-front designs. 1Ø pad-mounted transformers rated 2.4 kV are available in a dead-front design. Both designs have pressure relief and current limiting fuses however the live-front designs utilize external current limiting fuse protection. The live-front units may be required in the core area due to the higher system fault levels as the separable components (i.e. elbows, inserts) used in the dead-front designs are not rated to withstand the higher system fault levels.

1.2.3.10 For clearance requirements refer to Toronto Hydro Distribution Construction Standard 03-5100.

1.2.3.11 Placement of pad-mounted transformers should be clear of any major intersections. This would be for reasons of safety and to minimize any financial impacts in the event of future intersection improvements.

1.2.3.12 To assist in the sectionalizing of any future underground primary cable faults, 300 Amp current reset faulted circuit indicators are to be installed on both the incoming and outgoing primary cables at each transformer location. Refer to Toronto Hydro Distribution Construction Standards, Section 20.

1.2.4 Primary Cables

1.2.4.1 Primary cables shall be installed in concrete encased ducts.

1.2.4.2 The standard primary distribution cable sizes are indicated in Table 7.

Table 7 - Primary Distribution Cables

Primary Distribution Cables			
Distribution System	Cable Type	***Ampacity Rating (max)	MVA Rating (max)
13.8 kV	*1/C 1/0 Al 15 kV TRXLPE **1/C 1/0 Al 28 kV TRXLPE CN	170 Amps	4.1 MVA
27.6 kV	1/C 1/0 Al 28 kV TRXLPE CN	150 Amps	7.2 MVA

Note:

***** *1/C 1/0 Al 15 kV TRXLPE cable is only to be used on the 13.8 kV distribution system in the downtown core area where there is no possibility of future 27.6 kV system expansion.*

****** *1/C 1/0 Al 28 kV TRXLPE CN cable is to be used on the 13.8 kV distribution system in the horseshoe and bordering core areas where there is the possibility of future 27.6 kV system expansion.*

**** For the conditions under which the above Ampacity ratings apply, consult the following Toronto Hydro Distribution Construction Standards:*

- *13.8 kV XLPE Al cable – Construction Standard 16-1060*
- *27.6 kV XLPE Al cable – Construction standard 16-1140*

1.2.4.3 A #2 str. Cu. PVC insulated white neutral shall be installed and run concurrently with the 1/0 Al 15 kV TRXLPE cable. A separate neutral conductor is not required when using 1/0 Al 28 kV TRXLPE CN as this cable has a full sized concentric neutral.

1.2.4.4 The above MVA ratings indicate the maximum permissible load for a 3Ø distribution circuit.

1.2.5 Secondary Bus Cables

1.2.5.1 The recommended cable type to be used for 120/240 V and 120/208 V (open Wye) secondary bus shall be aluminium. Copper cable shall be used for 120/208 V secondary bus.

1.2.5.2 The typical secondary bus voltage supplied shall be 120/240 V. Where load is being supplied from a three-wire (Delta) primary bus, 120/208 V (open Wye) shall be utilized.

1.2.5.3 Table 8 represents the standard secondary bus size to be used.

Table 8 - Secondary Bus Cables

Secondary Bus Cables		
Application	**Max. Bus Loading**	**Cable Type**
120/240 V or 120/208 V (open Wye)	343 Amps	3-1/C 500 kcmil Al. 600V XLPE PVCJ Triplex (Black, Black, White)
120/208 V (open Wye)	430 Amps	3–1/C 500 kcmil Cu. (Red, Black, Blue) and 1–1/C 300 kcmil Cu. (white) 600V XLPE PVCJ Quad
120/208 V	430 Amps	3–1/C 500 kcmil Cu. (Red, Black, Blue) and 1–1/C 300 kcmil Cu. (white) 600V XLPE PVCJ Quad

1.2.6 Service Cables

1.2.6.1 The recommended cable type to be used for 120/240 V and 120/208 V (open Wye) services and unmetered connections operating up to 120/240 V shall be aluminum.

1.2.6.2 Service cable selection is in accordance with the Ontario Electrical Safety Code, Section 8-104, 5(a), which requires that conductor ampacity be at least 80% of the continuous rating of the main switch.

1.2.6.3 Standard service cable sizes including those for unmetered connections are indicated in Table 9.

Table 9 - Secondary Service Cables

Secondary Service Cables		
Service Size	Application	Cable Type
100, 200 Amp, Dual Meter Bases	120/240 V or 120/208 V (open WYE)	3 – 1/C #4/0 Al 600 V XLPE PVCJ Triplex (Black, Black, White)
	120/208 V	4 – 1/C #4/0 Al. 600 V XLPE PVCJ Quad (Red, Black, Blue, White)
400 Amp	120/240 V or 120/208 V (open Wye)	3 -1/C 500 kcmil Al. 600 V XLPE PVCJ Triplex (Black, Black, White)
	120/208 V	3–1/C 500 kcmil Cu. (Red, Black, Blue) and 1–1/C 300 kcmil Cu. (white) 600 V XLPE PVCJ Quad
Unmetered Connections	120 V	2 - 1/C #2 Al. 600 V XLPE PVCJ Duplex (Black, White) with 1 – 1/C #6 Sol. Cu. Ground (SKU # 007150276)

1.2.6.4 For secondary service sizes greater than 400 Amps, consult Toronto Hydro Distribution Construction Standards, Section 15.

1.2.6.5 Terminating of service cables and unmetered supply cables at the transformer secondary bushings should be avoided.

1.2.7 Transformer Loading

1.2.7.1 The typical number of secondary bus connections made at the transformer secondary bushings shall be four. These connections are to be made "back to back" and directly to the transformer secondary bushings. If more than four bus connections are required, the secondary terminal cluster shall be used, refer to Toronto Hydro Distribution Construction Standard 16-6000.

1.2.7.2 The following table can be used as a guideline in determining the size of transformer required. The values in the tables were obtained from the Ontario Hydro – Overhead Distribution Standards (1992 edition) and former MEA Design Guidelines for transformer loading. The values from Tables 10 and 11 are consistent with a number of the former utility practices.

Table 10 - Unit Value Per Customer

Unit Value Per Customer				
Type of Heating or Customer	House Size			
	100 m ² 1100 ft ²	200 m ² 2150 ft ²	300 m ² 3200 ft ²	400 m ² 4300 ft ²
	Unit Value			
Non-electric heat (includes central air)	1.5	2.5	3.5	4.5
Electric heat	4.0	5.0	6.0	7.0

Table 11 - Transformer Size (kVA)

Transformer Size (kVA)	
Total Unit Value	Transformer Size (kVA)
10 – 24	50 kVA
25 – 50	100 kVA
51 – 88	167 kVA

1.2.7.3 For house sizes not listed in Table 10, interpolate between columns to get the correct unit value.

1.2.7.4 Based on the type of home, multiply the unit value from the "Unit Value Per Customer" table above by the appropriate factor as follows:
- Detached home – use multiplier of 1
- Semi-detached home – use multiplier of 0.9
- Town or row house – use multiplier of 0.8

1.2.7.5 Examples:

i) if you have 14 detached non-electric heat homes of which; the house size of 7 are 250 m² and the remaining 7 are 300 m², the size of transformer required would be:
(250 m²) 7 x 3.0 units = 21 units
(300 m²) 7 x 3.5 units = 24.5 units
Total unit value = 45.5 units (from the "Transformer Size" table you would select a 100 kVA unit).

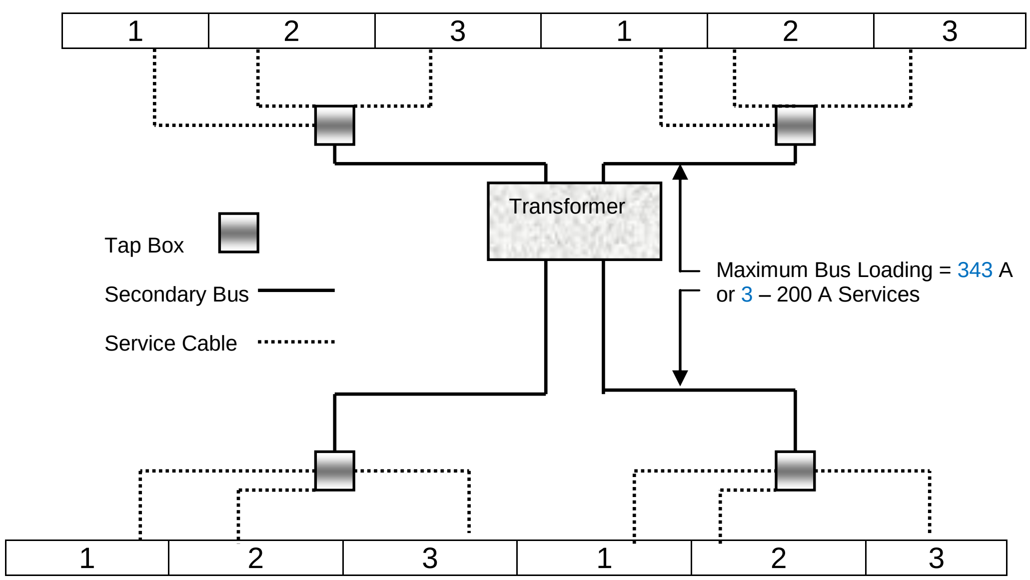
ii) if you have 16 semi-detached non-electric heat homes of which all are 150 m², the size of the transformer required would be:
(150 m²) 16 x 2.0 x 0.9 = 28 units
Total unit value = 28 units (from the "Transformer Size" table you would select a 100 kVA unit).

1.2.8 Secondary Bus Loading

1.2.8.1 The secondary bus sizes are based on a coincident load factor of 62.5% applied to 80% of the service rating. For example: the coincident bus peak load demand for a 200 A and 400 A service = (200+ 400) x 0.8 x 0.625 = 300 A. Note: the coincident bus peak demand must not exceed the maximum ampacity of the bus (i.e. 500 kcmil Al bus = 343 A).

1.2.8.2 Diagram 1 illustrates a typical secondary bus layout for 200 A services:

Diagram 1 Typical Secondary Bus Layout for 200 A Services



Maximum # of 200 A Services = Maximum Bus Rating / 62.5% Coincident Load Factor applied to 80% of Service Rating
= 343 A / (62.5% x 80% x 200 A)
= 3

1.2.8.3 Similarly, the secondary bus layout for 100 A services (limited to smaller residential and townhouse developments) would allow for a maximum of 7 services per bus as per the following calculation:

Maximum # of 100 A Services = Maximum Bus Rating / 62.5% Coincident Load Factor applied to 80% of Service Rating

= 343 A / (62.5% x 80% x 100 A)

= **7

***Note – the combined number of bus, 100 A service and unmetered supply connections is limited to seven.*

1.2.8.4 Where practicable and voltage drop permits, consideration shall be given to installing a dedicated 500 kcmil Al secondary bus cable to service a single customer at the end of a run in efforts to minimize the number of tap boxes required on the project. The bus cable shall be connected to the customer's service cable in the last tap box of the run.

1.2.8.5 Each secondary tap box will contain Homac secondary terminal clusters with the capacity for making six or eight 120/240 V connections. Of the six or eight available positions, one is reserved for the secondary bus cable and the remaining are for residential services and unmetered supplies. For 200 amp services, it is recommended that the six-position Homac be utilized, as the eight-position Homac requires the installation of the larger and more expensive tap box. Where at all possible, avoid using the larger tap box when 200 amp services are being installed.

1.2.9 Secondary Voltage Drop

1.2.9.1 After selection of the appropriate cable size to satisfy the service rating, the electrical design must also satisfy voltage drop guidelines.

1.2.9.2 Toronto Hydro maintains service voltage at the Customer's service entrance within the guidelines of C.S.A. Standard CAN3-C235-83 (latest edition), which allows variations from nominal voltage in accordance with Table 12.

Table 12 - Voltage Variation Limits

Nominal Voltage	**Voltage Variation Limits**			
	Extreme Conditions			
		Normal Conditions		
	A	B	C	D
Single Phase				
120/240	106/212	110/220	125/250	127/254
Two Phase (3 Wire - Open WYE)				
120/208	110/190	112/194	125/216	127/220
Three Phase (4 Wire)				
120/208	110/190	112/194	125/216	127/220
347/600	306/530	318/550	360/625	367/635

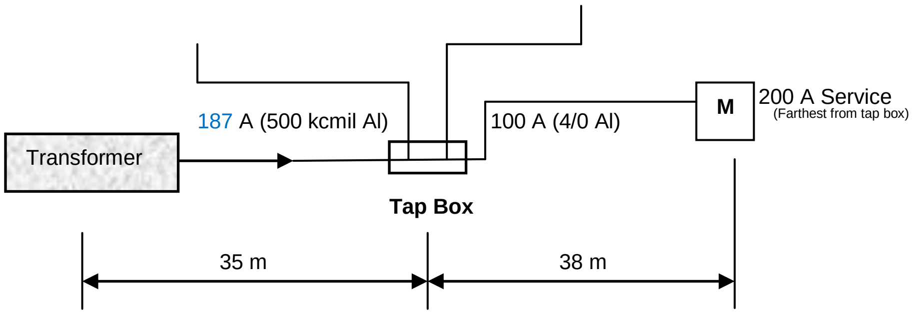
1.2.9.3 The maximum allowable voltage drop on the secondary bus and service cables shall not exceed column "B" in Table 12.

1.2.9.4 Voltage drop tables for standard size secondary bus and service cables used for single phase, 120/240 V residential services have been developed and can be found in Appendix "A".

1.2.9.5 For two phase or three phase systems, multiply the voltage drop values obtained from the tables in Appendix "A" by 87%.

1.2.9.6 The following examples 1 and 2 have been prepared based on the coincident service loading and voltage drop tables from Appendix "A":

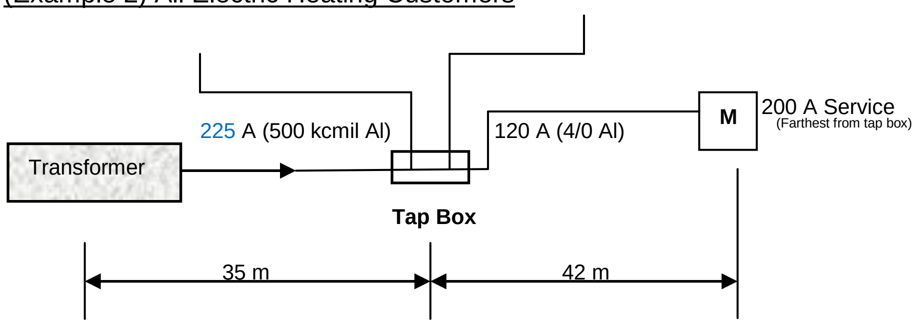
(Example 1) Non-Electric Heating Customers



Coincident Service Loading of Cable
See Appendix "A" - Table A2
Tap Box to Meter Base = 100 A
Transformer to Tap Box (3 – 4/0 Services) = 187 A
Voltage Drop
See Appendix "A" – Table A1
35 m of 500 kcmil Al @ 187 A = 2.16 V
See Appendix "A" – Table B1
38 m of 4/0Al @ 100 A = 2.58 V
Total Voltage Drop = *4.74 Volts*

Designed Service Voltage = 120 V - 4.74 V = 115.26 V
Minimum Voltage Requirement (column B of Table 12) = 110 V

(Example 2) All Electric Heating Customers



<u>Coincident Service Loading of Cable</u>
See Appendix "A" - Table A2
Tap Box to Meter Base = 120 A
Transformer to Tap Box (3 – 4/0 Services) = 225 A

<u>Voltage Drop</u>
See Appendix "A" – Table A1
35m of 500 kcmil Al @ 225 A = 2.60 V
See Appendix "A" – Table B1
42m of 4/0Al @ 120 A = <u>3.43 V</u>
Total Voltage Drop = <u>6.03 *Volts*</u>

Designed Service Voltage = 120 V – 6.03 V = 113.97 V
Min. Voltage Requirement at Service Entrance (Column B of Table 12) =110 V

1.2.10 Fusing

1.2.10.1 All three phase laterals and sub-laterals off main feeders are to be fused using the appropriately sized protective devices, refer to Toronto Hydro Distribution Construction Standards, Sections 12 and 13.

1.2.10.2 The standard ratings for protective devices shall follow Table 13.

Table 13 - Fusing for Laterals

Fusing for Laterals				
Operating Voltage	Laterals		Sub-Laterals	
	Disconnect Voltage Rating	Fuse Rating	Disconnect Voltage Rating	Fuse Rating
27.6 kV	25 kV	140K	25 kV	100K
13.8 kV	15 kV	140K	15 kV	100K

1.2.10.3 The ratings from the table would apply for both three phase and single phase laterals.

1.2.10.4 Sub-sub laterals are to be fused at 40K.

1.2.11 Switchgear

1.2.11.1 Padmount and submersible switchgear may be required depending on the supply arrangements to the new subdivision area. This switchgear is primarily used for tapping into a main feeder and supplying distribution load.

1.2.11.2 Padmount switchgear shall be installed in accordance with Toronto Hydro Distribution Construction Standards 13-7810, 13-7820, and 13-7830. The preferred orientation of the padmount switchgear units is to have the doors open parallel with the roadway. As well, access to any of the switch compartments should be clear of obstructions such as trees, poles etc.

1.2.11.3 Placement of new padmount switchgear should be 15 m clear of any intersection. This would be for reasons of safety and to minimize any financial impacts in the event of future intersection improvements.

1.2.11.4 To assist in the sectionalizing of any future underground primary cable faults, 800 Amp current reset Faulted Circuit indicators are to be installed at 600 Amp U/G terminations on open loop feeders and main loop cables (URD). Refer to Toronto Hydro Distribution Construction Standards, Section 20.

1.2.12 Street Lighting

1.2.12.1 Toronto Hydro (Toronto Hydro Electric System Ltd.) is responsible for the Street Lighting design based on Toronto Hydro's design requirements, where the underground Street Lighting cable from the supply point to the pole's handhole is owned by Toronto Hydro and the Street Lighting Poles are a Street Lighting asset (owned by Toronto Hydro Energy Services Inc.) for poles that are installed on residential streets. The lighting levels and pole placement require approval from the Secondary Distribution Services design section.

1.2.12.2 Street Lighting plant, facilities, equipment and installation must meet the requirements of the Ontario Electrical Safety Code, which includes inspection by the Electrical Safety Authority (ESA).

1.2.12.3 Toronto Hydro or the Contractor, depending on who completes the installation will be responsible to arrange for an ESA inspection on all Street Lighting beyond the ownership demarcation point.

1.2.12.4 Toronto Hydro shall make all new Street Lighting service connections to the distribution system upon receipt of a connection authorization from ESA.

1.2.12.5 The street light design should incorporate a 24hr supply arrangement whereby there is a supply point for each individual light. Where individual supply points cannot be achieved then a single supply point can be used to supply a group of Street Lights.

1.2.12.6 Upon receiving the site plan from the Developer, the Designer in Customer Offers & Sustainment shall send the site plan to the Secondary Distribution Services (SDS) – Design Supervisor. A SDS Designer will then indicate on the site plan the placement of the street lighting poles, and determine appropriate lighting levels indicating the type of luminaries and lamp wattage to be used. This information shall be sent back to the Designer of Customer Offers & Sustainment so that the Street Lighting can be incorporated with the rest of the electrical design.

1.2.12.7 Before finalizing the Street Lighting electrical design the Designer of Customer Offers & Sustainment or the Developer shall send the Street Lighting electrical drawing(s) to the Secondary Distribution Services (SDS) – Design Supervisor for review and approval.

1.2.12.8 Toronto Hydro or the Developer shall be responsible for constructing the civil infrastructure (including but not limited to poles, U/G conduits, tap boxes) on public road allowance that is deemed required by Toronto Hydro to house or support Toronto Hydro's electrical equipment. These civil infrastructures shall be in accordance with Toronto Hydro's Construction Standards, practices, specifications and Conditions of Service.

1.2.12.9 Charges related to the new connections to the distribution system are to be recovered in accordance with Table 3 of the "Conditions of Service" document.

1.2.12.10 The Ownership Demarcation point for the street light service cable shall be the line side of the protective device (i.e. circuit breaker, fuse) in the pole's handhole.

1.2.12.11 All street light work associated with the project shall be indicated in the Work Breakdown Structure II document.

1.2.12.12 Designers shall indicate on the drawings any changes to street light energy billing based on the proposed design. Refer to Drawing Guidelines – Title Sheet section for template.

1.2.12.13 The Designer shall inform the Secondary Distribution Services – Design Supervisor of any Street Lighting changes as per SP#022 "Street Light Energy Billing".

1.2.12.14 For Street Lighting infrastructure that was built by other than Toronto Hydro, Toronto Hydro shall inspect the Street Lighting assets prior to assuming ownership of these assets.

1.2.12.15 The Designer shall refer to SDP#009 Street Lighting for further design information.

1.2.13 Unmetered Connections

1.2.13.1 There are some instances where a new service can be provided without a meter installation. Designers should consult Section 3.8 of the Conditions of Service to determine what loads can be unmetered and the new connection charges.

1.3 Drawing Guidelines

In addition to the alignment of project designs with business strategies, it is also necessary that framework be established that will support the delivery of consistent project drawings. The following guidelines will provide the necessary information that will assist in achieving this objective.

The guideline will consist of the following three key elements:

a) Drawing Structure
b) Equipment Numbering
c) Symbology

1.3.1 Drawing Structure

The drawing structure shall consist of the following:

a) Standard drawing sheet sizes to be used are as follows:
 Imperial C (17" X 22")
 Imperial D (22" X 34")

b) Templates for these standard sheet sizes are in ProjectWise and are to be used when creating a new drawing. See ProjectWise User Manual for details.

c) Drawing sheet sizes shall be a maximum size of Imperial D (22" x 34"). Field staff have, in past requested the use of ½ size prints for reference use in the field. To ensure text is legible in a ½ size format, use a sufficient sized font for the text.

d) Drawing numbers, title blocks and page borders are to be generated using ProjectWise. Title block information will be filled in automatically as the ProjectWise attribute tables are filled in. Drawing numbers are generated using ProjectWise – Do not modify the drawing numbers from the standard format in any way. See ProjectWise User Manual for details.

e) Sufficient white space shall be reserved to the left of each Title Block for placement of the "As-Constructed" stamp.

f) Every drawing must be created using a separate file.

g) All attribute data fields in ProjectWise must be filled in as part of assigning a new drawing number. See ProjectWise User Manual for details.

h) All drawings shall be stored in ProjectWise in folders named after the project number. See ProjectWise User Manual for details.

i) ProjectWise workflow shall be updated as the drawing moves from the 1) <u>Proposed</u> to 2) <u>Approval</u> (before packaging) then on to 3) <u>Issued</u>. A new version should be created at this state, if modification is requested, as all drawings that have reached this state are assumed to be signed and therefore legal copies. The Records Management Section will perform the final state change to <u>Archived</u> when they receive the "As Constructed" mark-up. See ProjectWise User Manual for details.

j) Designers shall use the White Space Management Guidelines when preparing the project drawings.

k) Drawing type grouping selection through ProjectWise and drawing titles shall be consistent with Table 14.

Table 14 - Project Drawings

Project Drawings	
Drawing Type Grouping from ProjectWise	**Project Drawing Title**
Title Sheet	Title Sheet
General Notes	General Notes and Details
Primary Schematic	Primary Schematic
Civil	Civil Plan
Underground	Cable and Duct Layout
Existing Feeder or Reference Drawing	Existing Feeder or Reference Drawing
Overview - Electrical	Overview of Electrical Plan

1.3.1.1 Title Sheet

1.3.1.1.1 The title sheet shall include the full project name, key map with north arrow, Drawing Index, and a note indicating that the plan has been prepared in accordance with Ontario Regulation 22/04.

1.3.1.1.2 Include the full last name of the Designer, CAD Operator, Supervisor, etc. in the drawing title blocks (do not use initials).

1.3.1.1.3 The key map will encompass the entire limits of the project and shall be "blocked-off" in sections. Each section shall be numbered according to the ProjectWise plan drawing number and sheet number.

1.3.1.1.4 In accordance with Ontario Regulation 22/04, the following note shall be placed in the area of the title block where the assembly of the drawings utilizes only certified construction standards, technical specifications or authorized legacy standards in cases where maintaining a portion of line when current certified standards would be problematic:

> **THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS AND APPROVED EQUIPMENT AND MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF ONTARIO REGULATION 22/04.**

1.3.1.1.5 A street light "Energy Billing" table as per Table 15 shall be placed on the title sheet indicating the street lights being proposed in the project.

Table 15 - Energy Billing

ENERGY BILLING		
CHANGES	QUANTITY	TYPE
ADD		
DELETE		
NO CHANGE		

1.3.1.2 General Notes and Details

1.3.1.2.1 The General Notes shall include civil and electrical responsibilities of the Contractor, Developer, Toronto Hydro, and of Third Parties.

1.3.1.2.2 Indicate all known "Designated Substances" that may be encountered in the project.

1.3.1.2.3 The General Notes shall include a reference that minimum horizontal and vertical clearances from other foreign utilities shall be maintained in accordance with the requirements that are specified in the City of Toronto-Development Infrastructure Policy & Standards (DIPS), "Policy and Standards For Public Local Residential Streets and Private Streets" document.

1.3.1.2.4 The Specification and Construction Standards table shall list the applicable specifications (i.e. CV-CON-01) followed by the construction standards. The table shall consist of three columns: column i) the construction standard name, column ii) document number and column iii) latest revision # or date.

1.3.1.2.5 Any new construction involving the use of legacy construction standards will require a certificate of approval be prepared by a Professional Engineer from the Standards & Materials section identifying the construction standard used, specific location (i.e. P123) and placed on the drawing.

1.3.1.2.6 The Cut Repair table shall total all the exclusive hydro and joint-use cut repairs on the project that will be completed by the City. This information will be used for comparison against the City invoices for the actual repair work. The table shall be similar to Table 16.

Table 16 – Cut Repairs

	Approximate Cut Repairs		
Roadways	----------------	________	m² +/-
Concrete Sidewalk	----------------	________	m² +/-
Curb	----------------	________	m² +/-
Other	----------------	________	m² +/-

1.3.1.2.7 The General Notes shall include a note requiring field crews to re-label existing equipment locations where identified on the drawing.

1.3.1.2.8 Designers should include a listing of all the original installation drawings and reference drawings applicable to the project. When the project includes Third Party Joint-use trenching, Third Party drawing numbers should be referenced as well.

1.3.1.2.9 For construction within the existing road allowance a typical road crossing profile shall be included on the drawing showing foreign utility crossings in accordance with the City of Toronto's Municipal Consent Requirements. If a road crossing is not typical (i.e. non-standard storm sewer depth, etc.) a separate road crossing profile shall be prepared and noted on the applicable Civil Plan drawing.

1.3.1.2.10 Any details shall be included on the drawing.

1.3.1.3 Primary Schematic

1.3.1.3.1 The purpose of the Primary Schematic is to provide an overall view of the proposed project.

1.3.1.3.2 This Primary Schematic can be separated from the rest of the project drawings and used by the Control Centre. For this reason, the repetition of certain information (i.e. key map, legend, etc) is required.

1.3.1.3.3 The entire limits of the project shall be shown on one drawing, where possible.

1.3.1.3.4 Prepare the drawing(s) in accordance with the White Space Management Guidelines.

1.3.1.3.5 The Primary Schematic shall be "Not to Scale" and indicate the following:

a) be semi-geographic, showing all relevant civil (i.e. cable chambers, vaults, pads, tap boxes, poles, street names, etc.) and electrical (i.e. primary cables, switches, transformers, switchgear, fault indicators, elbows, pole numbers, etc.) components to facilitate ones "orientation".
b) identify customers on life support and include contact person and telephone number.
c) include a legend of proposed and existing plant, and plant to be recovered or abandoned.
d) include a key map similar to the Title sheet (reduced size) without the "blocked-off" sections and numbering.
e) a north arrow shall be shown pointing to the top right of the sheet only.
f) proposed connections to the exiting plant either solidly connected or via switches.
g) the feeder designations involved.
h) indicate clearly the voltage rating(s) of the system and cable sizes.
i) where unmetered supply connections to Third Parties are required, they shall be identified and shown up to the ownership demarcation point.
j) the primary schematic should be submitted to the Control Room for review, comments and approval.

1.3.1.3.6 Include the following note in the top right corner of the drawing.

> **REFER TO TITLE SHEET DRAWING #200# – ######,**
> **FOR ACCOMPANYING PROJECT DRAWINGS.**

1.3.1.4 Civil Plan

1.3.1.4.1 The plan shall be a scaled working drawing(s) showing the area of the new construction.

1.3.1.4.2 The Developer will provide the digital survey drawings for the new development.

1.3.1.4.3 Where expansions to the existing distribution system are required to supply the new development in the public road allowance prepare drawings using the City Land Base Maps, including the City Sewer and water information, available through G/NetViewer. In the former City of Toronto area (District 1), the Digital Map Owners Group (DMOG) base maps shall be used.

1.3.1.4.4 The plan shall be plotted to a scale consistent with the Developer's digital survey drawings.

1.3.1.4.5 If the area of proposed construction requires more than one plan drawing, divide the area evenly from sheet to sheet using match lines. Maximize the use of drawing white space to minimize the number of drawings. Be careful when dividing sheets to ensure match lines do not run through lot lines, poles, new vaults etc.

1.3.1.4.6 Prepare drawing(s) in accordance with the White Space Management Guidelines.

1.3.1.4.7 North arrow shall be on each plan, pointing to the top or right of the sheet only.

1.3.1.4.8 Notes specific to the individual plan drawings shall be noted on the drawing.

1.3.1.4.9 Plan drawings shall include street lines, lot lines, standard iron bars (SIB), road pavement, sidewalk, boulevard and curbs. Also include the street names and addresses (if provided).

1.3.1.4.10 Storm and Sanitary mains should be indicated on the plan at hydro road crossings and sewer connections.

1.3.1.4.11 Include civil legend and identify proposed and existing plant, and any plant that is to be recovered.

1.3.1.4.12 For expansions of the existing distribution system in the public road allowance, tie dimensions for new installations (i.e. centre line of trench, cable chambers vaults etc.) shall be indicated to adjacent street lines and to existing curb lines or any other permanent existing structure (i.e. poles, hydrant etc.). When using the DMOG Base Maps tie dimensions to street lines are not required for new installations within the road allowance.

1.3.1.4.13 The plan for the expansion shall be plotted to a scale of 1:200 horizontal and dimensioned with S.I. units.

1.3.1.4.14 When using the DMOG base maps, existing utility plant and sizes shall be indicated at the match lines or cross streets. All other utility identifiers shown on the base maps shall be removed to avoid clutter. For projects outside the DMOG areas, existing utility plant and size shall be noted within the single line and identified in the legend.

1.3.1.4.15 The plan shall indicate the number of electrical cable ducts required in the main trench. The appropriate number of ducts shall be shown inside a hexagon symbol placed within the trench lines. Each time there is a change in the number of ducts within the trench line, the new number shall be indicated.

1.3.1.4.16 Identify customers on life support and include contact person and telephone number.

1.3.1.4.17 Third Party ducts within the main trench shall not be included with the hydro ducts indicated in the hexagon symbol. It will be necessary for the Contractor to consult Third Party drawings to determine where Third Party infrastructure is to be installed in the common trench and where Third Parties have exclusive installations.

1.3.1.4.18 Vault drains shall be indicated on the Civil Plan drawings. The depth of cover to the storm sewer at the proposed connection shall be indicated on the plan. An additional road crossing profile shall be shown on the applicable Civil Plan for non typical road crossings (i.e. shallow storm sewer depth, etc.).

1.3.1.4.19 Construction methods other than open trench (i.e. directional boring) shall be identified on the plans.

1.3.1.4.20 Existing utility locations (i.e. water mains, gas, Bell, CATV, etc.) shall be shown on the plan drawings when available. Storm and Sanitary mains shall be indicated on the plan and profiles at road crossings, submersible vaults (for drains) or any locations where the hydro trench is in close proximity.

1.3.1.4.21 For projects utilizing the DMOG base maps, existing utility plant and sizes shall be indicated at the match lines or cross streets. All other utility identifiers shown on the base maps shall be removed to avoid clutter. For projects outside the DMOG areas, existing utility plant and size shall be similarly noted.

1.3.1.4.22 Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######,
FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.5 Cable and Duct Layout

1.3.1.5.1 The Cable and Duct Layout drawing shall be "Not to Scale" and include the primary cable, secondary bus cable, service cables, spare ducts, transformers, tap boxes, splice vaults, distribution poles, legend, "Transformer Secondary Services Address" table and if applicable streetlight poles, cables, relays, etc.

1.3.1.5.2 The drawing shall be diagrammatic and plotted to a scale of approx. 1:400 (two Civil Plans represented on one Cable and Duct Layout drawing).

1.3.1.5.3 Street lines, lot lines and the buildings to be taken from the plan drawings for preparing this drawing.

1.3.1.5.4 North arrow shall be on each plan, pointing to the top or right of the sheet only.

1.3.1.5.5 Reference to the applicable Civil Plan shall be shown on the Cable and Duct Layout drawing.

1.3.1.5.6 Include a legend, identify proposed and existing plant and any plant that is to be recovered/abandoned.

1.3.1.5.7 Identify customers on life support and include contact person and telephone number.

1.3.1.5.8 Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######, FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.6 Existing Feeder or Reference Drawing

1.3.1.6.1 The Existing feeder or Reference Drawing shall be used to indicate existing electrical or civil plant in the project area.

1.3.1.6.2 It can also serve as an appendix to the project and include any specific details of the project requiring graphic explanation not covered by a Construction Standard or that cannot be shown on the civil or electrical layout drawing due to space restrictions. Examples of these details could include breakouts, duct diversions, etc.

1.3.1.6.3 Each detail shall make reference to the project drawing and sheet number from which it originates.

1.3.1.7 Overview of Electrical Plan

1.3.1.7.1 The Overview of Electrical Plan drawing shall be used whenever there are multiple electrical drawings, to indicate an overview of the project's existing and proposed electrical plan.

1.3.1.7.2 The drawing shall have the complete electrical project shown on one drawing. Typically this involves one drawing by reducing OH or UG electrical drawings.

1.3.1.7.3 The drawing shall make reference to the detail project electrical drawings (Primary Schematic, Cable and Duct Layout).

1.3.2 Equipment Numbering

1.3.2.1 Equipment numbering standards are included in Section 21 of Toronto Hydro Distribution Construction Standards.

1.3.2.2 Location numbers for new equipment (with the exception of poles, vaults or transformer switches and elbows) can be obtained through the "New Location Number Request Application" program accessible by clicking on the following link: http://assetmgmt.torontohydro.com/nomenclature/

1.3.2.3 For each new number requested through the "New Location Number Request Application", Designers should receive a "Nomenclature Labeling Report" which shall be included in the design folder for completion by the field crews.

1.3.2.4 Designers must be identified in the Requestors list to access the program. If you are unable to access the program, contact the Records Management Supervisor of System Reliability Planning to get on the list.

1.3.2.5 In addition to the numbering of new equipment, some existing equipment within the limits of a project may require re-numbering as well. In general, the following guidelines shall apply for new projects:

New Installations

a) All new equipment identified in Toronto Hydro Distribution Construction Standard 21-1000 shall be numbered to the new Standard.
b) For poles, the new Standard shall apply when:
   - installing new pole lines;
   - replacing the majority of poles along an entire street or city block (the few remaining poles would be included in the re-numbering).
c) For spot pole replacements or when not re-numbering an entire street or block, use the legacy numbering standards for the area with the new numbering materials.

Re-Numbering of Existing Equipment

a) The following re-numbering standards shall be applied:
   - All existing switchable devices (i.e. transformers, switches, elbows) within the limits of the project shall be re-numbered to the new standard.
   - Existing cable chambers within the limits of a project shall not be re-numbered.
   - Existing vaults within the limits of the project may be re-numbered.
   - Existing poles within the limits of a project may be re-numbered to the new standard.
b) On the project drawings, both the new location number and former number (in brackets) will be shown.
c) Location numbers for the re-numbering of existing equipment can also be obtained through the “New Location Number Request Application” program.

1.3.3 Symbology

The new symbols shall now be used for new projects. The symbols and cell libraries can be viewed by clicking on the following link:
http://pluggedin.torontohydro.com/am/crp/Pages/GEAR.aspx

1.4 Project Deliverables

1.4.1 New subdivision projects are primarily customer initiated and designs will normally be completed by Customer Offers & Sustainment. Project designs are completed and forwarded directly to construction to meet customer in-service dates. For these projects to proceed, the customer must meet all Toronto Hydro financial and legal requirements.

1.4.2 To ensure a seamless process between the design and construction phase, Designers must be cognizant of all the construction requirements (i.e. approvals, notifications etc.). To assist in this area, a Project Design Deliverables checklist has been developed and can be used by Designers to ensure all pertinent information, documents are included in the construction folder when signed-off.

1.4.3 Upon construction approval, the Design folder will be returned to the Designer for final assembly and for execution of the remaining “prior to construction” issues (i.e. cut permits, notification letters, etc.) in accordance to the Project Distribution List.

1.4.4 The Project Design Deliverables checklist can be viewed on the Y drive; **Y:\THESL\Asset Mgmt\AM Common\PAS\Standard Design Practice\Project Design Deliverables checklist**, and the Project Distribution List can be viewed on the y drive; **Y:\THESL\Asset Mgmt\AM Common\PAS\Standard Design Practice\Project Distribution List**

Section 2 - Rationale:

To ensure new underground residential subdivision designs are aligned with business strategies and project design packages are delivered in a consistent fashion.

Section 3 - References:

- Toronto Hydro Distribution Construction Standards
- Toronto Hydro Technical Specification for Civil Construction Work #CV-CON-01
- Toronto Hydro “Conditions of Service”
- Field Consultation Meeting – Terms of Reference
- Work Breakdown Structure II
- Job Planning Process
- White Space Management Guidelines
- As-Constructed Map Products Process
- City of Toronto Municipal Consent Requirements
- Distribution Grid Operations Project Review Form
- Ontario Hydro – Overhead Distribution Standards (1992 Edition)
- ESA Bulletins 30-9-1 for Roadway Lighting
- Ontario Regulation 22/04
- Electrical Safety Authority Technical Guidelines for Sections 6, 7 & 8.
- Ontario Electrical Safety Code
- SP#022 Street Light Energy Billing
- *Occupational Health and Safety Act*
- SDP#009 Street Lighting
- Toronto Hydro Distribution System Planning Guidelines

March 21, 2012

APPENDIX "A"

TABLE A1 - VOLTAGE DROP CALCULATION FOR 500KCMIL AL BUS CABLE

(Single Phase 3 Wire 120/240 V Residential Circuits)
Voltage drop for 500 kcmil Al bus is calculated as: (0.33 x load (amps) x length (m)) / 1000

Length	Load (Amps)														
(meters)	60	75	100	112	125	150	175	187	200	225	250	275	300	325	350
5	0.10	0.12	0.17	0.18	0.21	0.25	0.29	0.31	0.33	0.37	0.41	0.45	0.50	0.54	0.58
10	0.20	0.25	0.33	0.37	0.41	0.50	0.58	0.62	0.66	0.74	0.83	0.91	0.99	1.07	1.16
15	0.30	0.37	0.50	0.55	0.62	0.74	0.87	0.93	0.99	1.11	1.24	1.36	1.49	1.61	1.73
20	0.40	0.50	0.66	0.74	0.83	0.99	1.16	1.23	1.32	1.49	1.65	1.82	1.98	2.15	2.31
25	0.50	0.62	0.83	0.92	1.03	1.24	1.44	1.54	1.65	1.86	2.06	2.27	2.48	2.68	2.89
30	0.59	0.74	0.99	1.11	1.24	1.49	1.73	1.85	1.98	2.23	2.48	2.72	2.97	3.22	3.47
35	0.69	0.87	1.16	1.29	1.44	1.73	2.02	2.16	2.31	2.60	2.89	3.18	3.47	3.75	4.04
40	0.79	0.99	1.32	1.48	1.65	1.98	2.31	2.47	2.64	2.97	3.30	3.63	3.96	4.29	4.62
45	0.89	1.11	1.49	1.66	1.86	2.23	2.60	2.78	2.97	3.34	3.71	4.08	4.46	4.83	5.20
50	0.99	1.24	1.65	1.85	2.06	2.48	2.89	3.09	3.30	3.71	4.13	4.54	4.95	5.36	5.78
55	1.09	1.36	1.82	2.03	2.27	2.72	3.18	3.39	3.63	4.08	4.54	4.99	5.45	5.90	6.35
60	1.19	1.49	1.98	2.22	2.48	2.97	3.47	3.70	3.96	4.46	4.95	5.45	5.94	6.44	6.93
65	1.29	1.61	2.15	2.40	2.68	3.22	3.75	4.01	4.29	4.83	5.36	5.90	6.44	6.97	7.51
70	1.39	1.73	2.31	2.59	2.89	3.47	4.04	4.32	4.62	5.20	5.78	6.35	6.93	7.51	
75	1.49	1.86	2.48	2.77	3.09	3.71	4.33	4.63	4.95	5.57	6.19	6.81	7.43		
80	1.58	1.98	2.64	2.96	3.30	3.96	4.62	4.94	5.28	5.94	6.60	7.26			
85	1.68	2.10	2.81	3.14	3.51	4.21	4.91	5.25	5.61	6.31	7.01				
90	1.78	2.23	2.97	3.33	3.71	4.46	5.20	5.55	5.94	6.68	7.43				
95	1.88	2.35	3.14	3.51	3.92	4.70	5.49	5.86	6.27	7.05					
100	1.98	2.48	3.30	3.70	4.13	4.95	5.78	6.17	6.60	7.43					
105	2.08	2.60	3.47	3.88	4.33	5.20	6.06	6.48	6.93						
110	2.18	2.72	3.63	4.07	4.54	5.45	6.35	6.79	7.26						
115	2.28	2.85	3.80	4.25	4.74	5.69	6.64	7.10							
120	2.38	2.97	3.96	4.44	4.95	5.94	6.93	7.41							
125	2.48	3.09	4.13	4.62	5.16	6.19	7.22								
130	2.57	3.22	4.29	4.80	5.36	6.44									
135	2.67	3.34	4.46	4.99	5.57	6.68									
140	2.77	3.47	4.62	5.17	5.78	6.93									
145	2.87	3.59	4.79	5.36	5.98	7.18									
150	2.97	3.71	4.95	5.54	6.19	7.43									
155	3.07	3.84	5.12	5.73	6.39										
160	3.17	3.96	5.28	5.91	6.60										
165	3.27	4.08	5.45	6.10	6.81										
170	3.37	4.21	5.61	6.28	7.01										
175	3.47	4.33	5.78	6.47	7.22										
180	3.56	4.46	5.94	6.65	7.43										
185	3.66	4.58	6.11	6.84											
190	3.76	4.70	6.27	7.02											
195	3.86	4.83	6.44	7.21											
200	3.96	4.95	6.60	7.39											
205	4.06	5.07	6.77												
210	4.16	5.20	6.93												
215	4.26	5.32	7.10												
220	4.36	5.45	7.26												
225	4.46	5.57	7.43												
230	4.55	5.69													
235	4.65	5.82													
240	4.75	5.94													
245	4.85	6.06													
250	4.95	6.19													
255	5.05	6.31													
260	5.15	6.44													
265	5.25	6.56													
270	5.35	6.68													
275	5.45	6.81													
280	5.54	6.93													
285	5.64	7.05													
290	5.74	7.18													
295	5.84	7.30													
300	5.94	7.43													

Table A2 - COINCIDENT SERVICE LOADING FOR 500 KCMIL AL BUS

	Non-Electric Heating			All-Electric Heating		
Number of Services	100 Amp Service	200 Amp Service	400 Amp Service	100 Amp Service	200 Amp Service	400 Amp Service
1	60A	100A	200A	60A	120A	240A
2	75A	125A	250A	75A	150A	300A
3	112A	187A		112A	225A	
4	150A	250A		150A	300A	
5	187A			187A		
6	225A			225A		
7	262A			262A		

Notes:
1. Coincident service loading (more than 1 service) for voltage drop calculations = estimate load of single service (Table A2) x No. of services x 62.5%

March 21, 2012

APPENDIX "A"

TABLE B1 - VOLTAGE DROP CALCULATION FOR 4/0 AL SERVICE CABLE

(Single Phase 3 Wire 120/240 V Residential Circuits)

Voltage drop for 4/0 Al is calculated as: (0.68 x load (amps) x length (m)) / 1000

Length	Load (Amps)										
(meters)	60	75	80	100	112	120	125	150	160	187	200
4	0.16	0.20	0.22	0.27	0.30	0.33	0.34	0.41	0.44	0.51	0.54
5	0.20	0.26	0.27	0.34	0.38	0.41	0.43	0.51	0.54	0.64	0.68
6	0.24	0.31	0.33	0.41	0.46	0.49	0.51	0.61	0.65	0.76	0.82
8	0.33	0.41	0.44	0.54	0.61	0.65	0.68	0.82	0.87	1.02	1.09
10	0.41	0.51	0.54	0.68	0.76	0.82	0.85	1.02	1.09	1.27	1.36
12	0.49	0.61	0.65	0.82	0.91	0.98	1.02	1.22	1.31	1.53	1.63
14	0.57	0.71	0.76	0.95	1.07	1.14	1.19	1.43	1.52	1.78	1.90
16	0.65	0.82	0.87	1.09	1.22	1.31	1.36	1.63	1.74	2.03	2.18
18	0.73	0.92	0.98	1.22	1.37	1.47	1.53	1.84	1.96	2.29	2.45
20	0.82	1.02	1.09	1.36	1.52	1.63	1.70	2.04	2.18	2.54	2.72
22	0.90	1.12	1.20	1.50	1.68	1.80	1.87	2.24	2.39	2.80	2.99
24	0.98	1.22	1.31	1.63	1.83	1.96	2.04	2.45	2.61	3.05	3.26
26	1.06	1.33	1.41	1.77	1.98	2.12	2.21	2.65	2.83	3.31	3.54
28	1.14	1.43	1.52	1.90	2.13	2.28	2.38	2.86	3.05	3.56	3.81
30	1.22	1.53	1.63	2.04	2.28	2.45	2.55	3.06	3.26	3.81	4.08
32	1.31	1.63	1.74	2.18	2.44	2.61	2.72	3.26	3.48	4.07	4.35
34	1.39	1.73	1.85	2.31	2.59	2.77	2.89	3.47	3.70	4.32	4.62
36	1.47	1.84	1.96	2.45	2.74	2.94	3.06	3.67	3.92	4.58	4.90
38	1.55	1.94	2.07	2.58	2.89	3.10	3.23	3.88	4.13	4.83	5.17
40	1.63	2.04	2.18	2.72	3.05	3.26	3.40	4.08	4.35	5.09	5.44
42	1.71	2.14	2.28	2.86	3.20	3.43	3.57	4.28	4.57	5.34	5.71
44	1.80	2.24	2.39	2.99	3.35	3.59	3.74	4.49	4.79	5.60	5.98
46	1.88	2.35	2.50	3.13	3.50	3.75	3.91	4.69	5.00	5.85	6.26
48	1.96	2.45	2.61	3.26	3.66	3.92	4.08	4.90	5.22	6.10	
50	2.04	2.55	2.72	3.40	3.81	4.08	4.25	5.10	5.44	6.36	
52	2.12	2.65	2.83	3.54	3.96	4.24	4.42	5.30			
54	2.20	2.75	2.94	3.67	4.11	4.41	4.59	5.51			
56	2.28	2.86	3.05	3.81	4.26	4.57	4.76	5.71			
58	2.37	2.96	3.16	3.94	4.42	4.73	4.93	5.92			
60	2.45	3.06	3.26	4.08	4.57	4.90	5.10				
62	2.53	3.16	3.37	4.22	4.72	5.06	5.27				
64	2.61	3.26	3.48	4.35	4.87	5.22	5.44				
66	2.69	3.37	3.59	4.49	5.03	5.39	5.61				
68	2.77	3.47	3.70	4.62	5.18	5.55	5.78				
70	2.86	3.57	3.81	4.76	5.33	5.71	5.95				
72	2.94	3.67	3.92	4.90	5.48	5.88					
74	3.02	3.77	4.03	5.03	5.64	6.04					
76	3.10	3.88	4.13	5.17	5.79						
78	3.18	3.98	4.24	5.30	5.94						
80	3.26	4.08	4.35	5.44							
82	3.35	4.18	4.46	5.58							
84	3.43	4.28	4.57	5.71							
86	3.51	4.39	4.68	5.85							
88	3.59	4.49	4.79	5.98							
90	3.67	4.59									
92	3.75	4.69									
94	3.84	4.79									
96	3.92	4.90									
98	4.00	5.00									
100	4.08	5.10									
102	4.16	5.20									
104	4.24	5.30									
106	4.32	5.41									
108	4.41	5.51									
110	4.49	5.61									
112	4.57	5.71									
114	4.65	5.81									
116	4.73	5.92									
118	4.81	6.02									

Notes:

1. Coincident service loading (more than 1 service) for voltage drop calculations = estimate load of single service (Table B2) x No. of services x 62.5%

Toronto Hydro-Electric System Limited
EB-2012-0064
Tab 6F
Schedule 7-52
Appendix C
Filed: 2012 Oct 5
(27 pages)

Standard Design Practice

NEW UNDERGROUND SERVICES

SDP #003 Rev. 1

Prepared by: Standard Design Practice Team

Approved by: John Petras
Manager, Standards & Materials

Issue Date: June 9, 2005

SDP #003 – New Underground Services

Revision History			
Rev. #	**Date**	**Description**	**Approved by:**
00	21-July-04	- Original Issue	R. Sironi
01	9-June-05	- Added cover sheet, contents page and revision history table. - Added new requirements resulting from Ontario Regulation 22/04. - Revised drawing to include the requirements of the City of Toronto's Municipal Consent Requirements. - Removed the nomenclature standards from the document as they will form Section 21 in the Construction Standards. - Removed the secondary cable selection table from the Customer Vaults section as it appears in Construction Standard 15-1600. - General revisions based on stakeholder feedback and alignment with current processes.	J. Petras

SDP #003 – New Underground Services

CONTENTS

Section 1 - Practice:

The purpose of this document is to provide a guideline for the design of projects involving underground primary or secondary services via Customer-owned switchgear or Toronto Hydro-owned transformation on customer property. These projects would include new underground services to commercial & industrial customers, apartment & condominium buildings, padmounted transformers and customer vaults. The document provides the necessary framework to ensure project designs are aligned with business strategies and completed design packages are delivered in a consistent fashion.

Four key issues are addressed in this document:

1. Design Checklist: identifies the activities, which should be considered during the design phase.
2. Design Considerations: supplements the Construction Standards by identifying key design components and strategies for new projects.
3. Drawing Guidelines: identifies key information to be shown on project drawings.
4. Project Deliverables: identifies the documents & drawings required when signing-off on a design file.

1.1 Design Checklist

Many issues need to be considered in the design of projects involving new customer services. To ensure a comprehensive design package is delivered, designers must be cognisant of all issues during the design. To assist designers in this area, "New Underground Services Design Project Checklist" (Appendix "A") has been developed and should be used as a guide to ensure all aspects of the design stage are successfully completed.

1.2 Design Considerations

1.2.1 General

- Designers shall ensure project designs satisfy the requirements of Section 7 of Ontario Regulation 22/04 "Electrical Distribution Safety" under the Electricity Act, 1998.
- Designers shall employ "Safety by Design" concept in their project designs.
- Designers shall endorse the use of only certified construction standards, specifications in the assembly of the project drawings. The use of authorized legacy standards should be limited to the maintaining of lines where certified construction standards would be problematic. Any new construction specifying the use of legacy standards will require a certificate of approval prepared by a Professional Engineer.
- In accordance with Bill 208, all known "Designated Substances" that may be encountered in the project shall be identified on the drawing. Examples of "Designated Substances" and their applications may include:
  Asbestos - cables and ducts
  Lead - PILC and AILC cables meter backer boards, listing tape and older station batteries
  Mercury - mercury vapor lamps and street light relays
  Vinyl Chloride - 4" PVC ducts and PVC jacketed cables

Arsenic - arsenical lead sheathed cables
Ethylene Oxide - polyethylene insulated cables
Silica - current limiting fuses and lightning arresters (4kV)
and other substances and applications that may be added from time to time.

- Typically, Toronto Hydro provides either an underground primary service to Customer-owned switchgear or a secondary service via transformation on customer's property to each customer location. A primary service would involve the installation of a Customer-owned station while a secondary service would require a Customer-owned civil infrastructure to house Toronto Hydro-owned transformation and/or switchgear.
- The primary supply voltage will depend on the supply voltage available in the area. The preferred primary supply voltage is 27.6/16kV grounded Y, three phase, four wire. However, in the downtown core where the 27.6/16kV system does not exist, the primary supply voltages will be either 13.8/8kV grounded Y, three phase, four wire; *or* 13.8kV three phase, three wire, depending on the area.
- A primary supply voltage of 4.16/2.4kV, grounded Y, three phase, four wire may be available in certain areas, albeit limited to a demand of 300kVA. This supply voltage should only be used in areas where the 27.6kV and 13.8kV supply voltages are not readily available.
- The standard secondary service voltages are 120/240V, single phase, 120/208V and 347/600V, three phase.
- The primary supply may be provided from a main feeder(s) or distribution system from either an overhead or an underground system.
  - ***For the Overhead System***, the primary supply for a single building will typically consist of a single radial supply. For multiple buildings on a single property requiring multiple padmount transformers or customer vaults, the primary supply will typically be a loop supplied from the same feeder or two different feeders off the same station bus. Both ends supplying the loop shall be fused and terminated on different poles or structures.
  - ***For the Underground System***, the primary supply will vary depending on the supply arrangement available in the area:
    - ***For radial feeders***, the primary supply will be a dual radial arrangement supplied from two different feeders from the same station bus. For a dual radial supply the Customer must provide a customer vault to house the switchgear and transformers.
    - ***For open loop feeders***, the primary supply will be a radial arrangement supplied from a new padmounted switchgear. Where the switchgear supplies only one property, it shall be installed on the customer's property. If the switchgear is used to supply multiple properties, then it is preferred that that the switchgear be installed on public road allowance. If this is not possible, the switchgear may be installed on private property provided an easement is obtained from the Customer.
    - ***For distribution loop or sub loop (URD)***, the primary supply will be part of a loop system. For a Customer-owned station supplied from a distribution loop or sub loop, the primary service shall be a radial arrangement supplied from a new padmounted switchgear, similarly to the open loop feeder arrangement noted above. Wheeling power through Customer-owned switchgear to supply other customers should be avoided.
- In instances where the customer requests a looped primary supply and our standard supply offering is a single radial arrangement, the Customer will be responsible for all costs associated with the additional equipment. When supplying a loop from either the overhead or underground systems, avoid installing both ends of the loop on the same pole or within the same switchgear.

- For multiple buildings on a single property supplied from the 27.6kV or 13.8kV distribution systems, more than one padmount transformer or customer vault may be installed to house the transformation capacity up to the maximum available demand loads (for max. loads refer to Transformers section).
- For multiple adjacent properties with one owner, each legally severed property or parcel of land is to have its own primary supply and transformation point. Requests for one primary supply and transformation point to service multiple adjacent buildings may be considered, provided all the following conditions are met:
  - Easements are required to be registered on title for all secondary services supplying adjacent properties from the transformation point.
  - An agreement must be registered on title that, whenever the property that has been serviced with secondary supply is severed or sold, a separate primary service and transformation point must be constructed to Toronto Hydro Standards for the service by the new owner. The existing secondary service would normally be discontinued.
- Registered easements are required whenever Toronto Hydro's plant is to be located on private property to service a customer other than the owner of the property where the plant is to be located. Refer to section 2.1.6 in the "Conditions of Service".
- If the Customer requires supply voltages or demand loads other then those offered by Toronto Hydro, the Customer will be required to supply and install their own switchgear and transformation. The Customer may also elect to supply and install their own switchgear and transformation even if their requirements are within Toronto Hydro available supply voltages or demands.
- Customer-owned switchgear and transformation must meet the "Toronto Hydro's Requirements for the Design and Construction of Customer-Owned High Voltage Substations".
- Through the "Feeder Request Form" process, Investment Planning will determine whether additional primary supplies are necessary to supply large customer loads.
- The Customer will be responsible to supply, install and maintain the necessary civil infrastructures on private property that are required to house all electrical equipment, including the incoming primary supply cables, transformation and/or switchgear.

1.2.2 Civil

1.2.2.1 Ducts

- All primary cable ducts located on customer property or road allowance shall be concrete encased 100mm dia. constructed in accordance with Toronto Hydro's Construction Standards, Section 31 and Technical Specification for Civil Construction Work Spec # CV-CON-01.
- The minimum cover over the electrical ducts in an open trench installation shall be in accordance with Toronto Hydro Construction Standard 31-1120.
- Minimum horizontal and vertical clearances from foreign utilities shall be in accordance with Appendix "O" of the City of Toronto's Municipal Consent Requirements and Construction Standard 31-0100.
- The primary cable ducts to a customer vault shall be sloped away from the building.
- The Customer will be responsible for the supply, installation and maintenance of all concrete encased duct structures, transformer foundations, equipment vaults, customer vaults, cable chambers, tap boxes etc. in private property that are required to house the electrical equipment to service that property.

- Toronto Hydro will normally complete the concrete encased duct structure portion required on the public road allowance including any road crossings and other required civil structures.
- In case the Customer elect to follow the alternative bid process, the Customer will be responsible to supply and install all concrete encased duct structures, foundations, vaults, cable chambers, tap boxes etc. in the road allowance that are required to service the property.
- The Customer duct structure shall be installed so that they enter the public road allowance at right angles to the property/street line. It is recommended that individual primary supply cables (either 1/C-1ø <u>or</u> 3/C-3ø) be installed in a separate duct. If a neutral wire is required, it may be installed in the same duct as one of the primary supply cables.
- Where primary ducts are required to be installed within the customer's building structure (i.e. floors, ceilings, walls etc.), the customer shall be responsible for the installation of these ducts in accordance with Building Code requirements. Ducts installed within the building structure must be identified in accordance with Construction Standard 31-8100.
- The recommended number of concrete encased ducts for XLPE primary supply cables shall be as follows:

  ***<u>Single Building</u>* - Radial Supply from the O/H or U/G System**
  - 1ø primary – 2 ducts (1 occupied, 1 spare)
  - 3ø primary – 6 ducts (3 occupied, 3 spares)

  Where the pole is located in close proximity to the new primary ducts including the road crossing, if applicable, spare ducts are to be capped and plugged 1.0m from the riser pole in accordance with Construction Standard 31-1160. Otherwise cap and plug spare(s) ducts at the customer's property line in accordance with Construction Standard 31-1160.

  ***<u>Single Building</u>* – Loop Supply from a Distribution or Sub Loop (URD)**
  - 1ø primary – 3 ducts (2 occupied, 1 spare)
  - 3ø primary – 9 ducts (6 occupied, 3 spares)

  Terminate spare duct(s) in the cable chamber or switch/splice vault on the public road allowance including the road crossing, if applicable. If no civil structure exists, cap and plug spare(s) ducts at the customer's property line in accordance with Construction Standard 31-1160.

  ***<u>Multiple Building</u>* – Loop Supply from a Distribution or Sub Loop (URD)**
  - 1ø primary – 2 or *3 ducts (1 or *2 occupied, 1 spare)
  - 3ø primary – 6 or *9 ducts (3 or *6 occupied, 3 spares)

  * Assume both ends of the loop installed in the same duct structure.
  Terminate spare duct(s) in cable chamber or switch/splice vault on the public road allowance including the road crossing, if applicable. If no civil structure exists, cap and plug spare(s) ducts at the customer's property line in accordance with Construction Standard 31-1160.
  The recommended number of concrete encased ducts for existing PILC primary supply cables shall be as follows:

  ***<u>Single Building</u>* – U/G Dual Radial Supply (customer vaults only)**
  - 3ø primary – 3 ducts (2 occupied, 1 spare)

  Terminate spare duct in cable chamber on the public road allowance including the road crossing, if applicable. If no civil structure exists, cap and plug spare(s) ducts at the customer's property line in accordance with Construction Standard 31-1160.

  ***<u>Multiple Building</u>* – U/G Dual Radial Supply**
  - 3ø primary - 4 ducts (2 occupied, 2 spare) from cable chamber to new 600 Amp switching vaults preferably located on customer property (1 occupied, 1 spare

per vault). From the switching vaults to the multiple customer vaults or padmount transformers – install 6 ducts (3 occupied, 3 spares) to accommodate the sub loop XLPE cables (Refer to the "13.8kV URD/ Loop System" schematic in the PSAM Strategy Document located in the Strategy & Policy Documents folder on the shared x:\ drive - "System Planning Document" section Figure 12).

Terminate spare duct in cable chamber on the public road allowance including the road crossing, if applicable. If no civil structure exists, cap and plug spare ducts at the customer's property line in accordance with Construction Standard 31-1160.

- Where road crossings are required, the suggested duct configurations shall be 3Wx1H, 3Wx2H or 3Wx3H where practical. Any additional spare road crossing duct(s) not required for connection to the primary supply ducts identified above shall be capped and plugged 1.0m from back of curb in accordance with Construction Standard 31-1160.

1.2.2.2 Customer Vaults

- Where there is no available space on the customer property to install a padmount transformer or the size of the Customer's electrical service warrants, the Customer shall provide a suitable grade level vault on the premises to be served to contain the necessary transformation to provide service to that Customer.
- If a suitable at grade level location is not available, a below grade vault may be acceptable, provided it is located at the floor immediately below the ground level.
- The preferred location for a vault is along the perimeter of the building, adjacent to the street, and closest to Toronto Hydro point of distribution supply.
- Customer vaults constructed by the Customers to contain the necessary transformation must meet the current requirements of Toronto Hydro Construction Standards Section 31-6000 to 31-6080.
- Based on the transformer rating, vaults are classified as:
  Type 1 – up to 2000kVA, Single Phase Banks
  Type 2 – 2500kVA to 4000kVA (Customer Owned > 2.5MVA), Three Phase Units
- Vaults shall be in a location accessible at all times by Toronto Hydro personnel and vehicles for maintenance.
- Avoid installing vaults at the following locations:
  - close to loading docks,
  - close to storage areas,
  - areas like restaurants, processing plants due to their potential of generating liquid waste,
  - directly under building egress/exits,
  - in parking lots,
  - beneath garage ramps and driveways,
- A 5.0m wide paved driveway access is required to the vault.

1.2.2.3 Padmount Foundation

- The Customer shall supply and install precast concrete foundations for 1ø mini–pad & 3ø padmount transformer installations on private property, as required. The foundation and installation must meet the requirements of Toronto Hydro Construction Standards 31-4020 & 31-4040.
- Padmount transformer locations must meet minimum clearance requirements from any combustible surface or material on a building, window, and door inlet or outlet vents in accordance with Section 26-242 of the Ontario Electrical Safety Code. For

the minimum clearance requirements refer to Toronto Hydro Construction Standard Section 03-5100(7).

- The following additional location and access requirements are to be considered for the placement of new padmounted transformers:
  - Clearance from driveway curbs –1.5m
  - Minimum horizontal clearance from other utilities – 3.0m
  - Minimum clearance from side or property lines – 1.0m
  - Minimum width of paved vehicle access to pad – 5.0m
  - Sufficient overhead clearances shall also be provided to allow for ease of transformer replacement.

1.2.2.4 Cable Chambers, Switchgear Vaults & Foundations, Splice Vaults etc.

- The Customer will be responsible for the supply, installation and maintenance of all additional civil infrastructure on private property as required to house Toronto Hydro's connection assets. Refer to Toronto Hydro Construction Standards Section 31.

1.2.3 Transformers

- The following table indicates the standard voltage offerings, transformer sizes and types offered by Toronto Hydro:

Standard Transformer Listing			
Transformation Type	**Transformation Type**	**Secondary Supply Voltage**	**Standard Sizes (Type)**
Customer Pad	4.16/2.4kV	120/240V	100kVA (1Ø Pad)
			167kVA (1Ø Pad)
	13.8/8kV	120/240V	100kVA (1Ø Pad)
			167kVA (1Ø Pad)
	27.6/16kV	120/240V	100kVA (1Ø Pad)
			167kVA (1Ø Pad)
	4.16/2.4kV	120/208V	150kVA (3Ø Pad)
			300kVA (3Ø Pad)
		347/600V	150kVA (3Ø Pad)
			300kVA (3Ø Pad)
	13.8kV Delta (or) 13.8/8kV	120/208V	150kVA (3Ø Pad)
			300kVA (3Ø Pad)
			500kVA (3Ø Pad)
		347/600V	150kVA (3Ø Pad)
			300kVA (3Ø Pad)
			500kVA (3Ø Pad)
	27.6/16kV	120/208V	150kVA (3Ø Pad)
			300kVA (3Ø Pad)
			500kVA (3Ø Pad)
		347/600V	150kVA (3Ø Pad)
			300kVA (3Ø Pad)
			500kVA (3Ø Pad)
			750kVA (3Ø Pad)
			1000kVA (3Ø Pad)
			1500kVA (3Ø Pad)

Standard Transformer Listing

Transformation Type	Transformation Type	Secondary Supply Voltage	Standard Sizes (Type)
Customer Vaults	4.16/2.4kV	120/208V	300kVA (3 x 100kVA Bank)
		347/600V	300kVA (3 x 100kVA Bank)
	13.8/8kV	120/208V	150kVA (3 x 50kVA Bank)
			300kVA (3 x 100kVA Bank)
			500kVA (3 x 167kVA Bank)
			750kVA (3 x 250kVA Bank)
			1000kVA (3 x 333KVA Bank)
			1500kVA (3 x 500kVA Bank)
		347/600V	300kVA (3 x 100kVA Bank)
			500kVA (3 x 167kVA Bank)
			750kVA (3 x 250kVA Bank)
			1000kVA (3 x 333KVA Bank)
			1500kVA (3 x 500kVA Bank)
	13.8kV Delta	120/208V	225kVA (3Ø Subway)
			300kVA (3Ø Subway)
			500kVA (3Ø Subway)
			750kVA (3Ø Subway)
			1000kVA (3Ø Subway)
		347/600V	500kVA (3Ø Subway)
			750kVA (3Ø Subway)
			1000kVA (3Ø Subway)
			1500kVA (3Ø Subway)
			2000kVA (3Ø Subway)
			2500kVA (3Ø Subway)
	27.6/16kV	120/208V	150kVA (3 x 50kVA Bank)
			300kVA (3 x 100kVA Bank)
			500kVA (3 x 167kVA Bank)
			750kVA (3 x 250kVA Bank)
			1000kVA (3 x 333KVA Bank)
			1500kVA (3 x 500kVA Bank)
	27.6/16kV	347/600V	150kVA (3 x 50kVA Bank)
			300kVA (3 x 100kVA Bank)
			500kVA (3 x 167kVA Bank)
			750kVA (3 x 250kVA Bank)
			1000kVA (3 x 333KVA Bank)
			1500kVA (3 x 500kVA Bank)
			2000kVA (3 x 667kVA Bank)
			2500kVA (3Ø Power XFMER)
	27.6kV Delta	120/208V	300kVA (3 x 100kVA Bank)
			500kVA (3 x 167kVA Bank)
			750kVA (3 x 250kVA Bank)
			1000kVA (3 x 333KVA Bank)
			1500kVA (3 x 500kVA Bank)
		347/600V	300kVA (3 x 100kVA Bank)
			500kVA (3 x 167kVA Bank)
			750kVA (3 x 250kVA Bank)
			1000kVA (3 x 333KVA Bank)
			1500kVA (3 x 500kVA Bank)
			2000kVA (3 x 667kVA Bank)

- All 3Ø padmount and 1Ø minipad transformers rated 27.6/16kV, 13.8/8kV contain internal current limiting fuses and pressure relief devices.
- 3Ø padmount and 1Ø minipad transformers rated 4.16/2.4kV are available in both live-front and dead-front designs. Both designs have pressure relief and current limiting

fuses however the live-front designs utilize external current limiting fuse protection. The live-front units may be required in the core area due to the higher system fault levels as the separable components (i.e. elbows, inserts) used in the dead-front designs are not rated to withstand the higher system fault levels.

- For clearance requirements refer to Toronto Hydro Construction Standard Section 03-5100(7a).
- For new customer vault installations, banked 1Ø transformer units are preferred over 3Ø units, where practicable.
- Padmounted transformers are not available to customers supplied directly from a Dual Radial supply however can be used when the supply is through a switchgear unit with current limiting fuse protection. The switchgear and transformation is required to be housed in a customer-supplied vault.
- 13.8kV Delta primary rated transformers may be permitted in areas within the former Toronto district where feeders are supplied from a three-wire station bus.
- 27.6kV Delta primary rated transformers are limited to new installations that lie along the subway lines in the former North York district (i.e. Yonge St., Sheppard Ave. E).
- 300/400 Amp current reset Faulted Circuit Indicators are to be installed on either the incoming (for radial) or incoming and outgoing (for loop) primary distribution cables at each padmount and customer vault location.
- 800 Amp current reset Faulted Circuit Indicators are to be installed at 600 Amp U/G terminations on open loop feeders and main loop cables (URD).

1.2.4 Customer Vault (*Electrical Design*)

- For a radial overhead primary supply to a customer vault, supply cables shall terminate directly on the transformers (i.e. no switches or fusing in vault). See “Fusing” Section 1.2.7 for fuse requirements from the O/H system.
- From a 13.8kV U/G Dual Radial supply to a customer vault, utilize the 13.8kV Radial Vault design. Refer to Toronto Hydro Construction Standards Section 13.
- For a 13.8kV loop supply to multiple customer vaults on a single property, utilize the 13.8kV URD Design Transformer Room. Refer to Toronto Hydro Construction Standards Section 13.
- For a 27.6kV loop supply to a customer vault, utilize the Delta or Grd.Y Vault design. Refer to Toronto Hydro Construction Standards Section 13.

1.2.5 Primary Cables

- Incoming primary cables will normally be supplied and installed by Toronto Hydro.
- The standard primary cables shall be in accordance with the following table.

Primary Cables			
Distribution System	Cable Size and Type	***Ampacity Rating	MVA Rating
*4.16kV (or) 13.8kV	3/C 500 Cu 15kV PILC	450 Amps	10.8 MVA
	3-1/C Triplex 500 Cu 15kV TRXLPE	470 Amps	11.3 MVA
	3/C 2/0 Cu 15kV PILC	210 Amps	5.1 MVA
	3-1/C Triplex 3/0 Cu 15kV TRXLPE	270 Amps	6.5 MVA
	1/C 1/0 Al 15kV TRXLPE	200 Amps	4.8 MVA

Primary Cables			
Distribution System	**Cable Size and Type**	*****Ampacity Rating**	**MVA Rating**
27.6kV	1/C 1000 Al 28kV TRXLPE LC	700 Amps	33.6 MVA
	**1/C 350 Al 28kV TRXLPE CN	370 Amps	17.9 MVA
	1/C 1/0 Al 28kV TRXLPE CN	180 Amps	8.3 MVA

Note:
- * New loads on the 4.16kV distribution system shall be limited to 300kVA max.
- ** 1/C 350 Al 28kV TRXLPE CNJ cable may be used when installing a new primary service with an existing 350 Al 28kV sub loop.
- *** For the conditions under which the above Ampacity Ratings apply, consult the following Construction Standards:
  - 13.8kV PILC cable – Construction Standard 16-0980 1/5
  - 13.8kV XLPE Cu or Al cable - Construction Standard 16-1060 1/5
  - 27.6kV XLPE Al cable - Construction Standard 16-1140 1/5

- 15kV cables are only to be used on the 13.8kV & 4.16kV distribution system in the downtown core area where there is no possibility of future 27.6kV system expansion.
- In the downtown core, Y splices are installed in cable chambers to provide Dual Radial supply to the customer.
  - Install Y splice from 3/C 500 Cu 15kV PILC to 3/C 2/0 Cu 15kV PILC for primary supply to customer.
  - On a wall within the customer vault, install a transition splice in the incoming 3/C 2/0 Cu 15kV PILC to Triplex 1/C 3/0 Cu 15kV XLPE cable for termination at the switchgear.
  - For a primary supply from the overhead system, install 3-1/C 1/0 Al 15kV TRXLPE cable plus a #2 Str. Cu. PVC insulated white neutral to the padmount transformer or customer vault.
- In the horseshoe area, primary supply cables to the customer vault are 3 - 1/C 1/0 Al 28kV TRXLPE CNJ.
  - When the street circuit is an underground main feeder, install a padmounted switchgear (i.e. PMH9) in the feeder and supply customer 3 - 1/C 1/0 Al 28kV TRXLPE CNJ through a fused disconnect.

1.2.6 Secondary Cables

1.2.6.1 Padmount Transformers

- For padmount transformers owned by Toronto Hydro, the customer is required to supply and install the appropriate sized CSA approved secondary copper or aluminum cables (sized in accordance with the Ontario Electrical Safety Code) from the main switch to the secondary compartment of the padmount transformer. The customer is also required to supply the appropriate number of 2-hole (NEMA drilling) compression connectors (compatible with CSA dies) for the secondary cables. Toronto Hydro will install the connectors and make the connections at the transformer secondary terminals.
- For padmount transformers owned by the Customer, the Customer is required to supply and install the appropriate sized CSA approved secondary cables in accordance with the Ontario Electrical Safety Code.

- Prior to Toronto Hydro making the final connection to the distribution system, the Customer must provide Toronto Hydro with an ESA Connection Order.

1.2.6.2 Customer Vaults

- Where transformation is owned by Toronto Hydro, Toronto Hydro will provide and install the required secondary cables and compression connectors and make final connections at the transition bus inside the customer vault or at the collector bus inside the Customer's electrical room.
- Prior to Toronto Hydro making the final connection to the distribution system, the Customer must provide Toronto Hydro with an ESA Connection Order.
- The recommended secondary cable shall be copper and sized in accordance with Construction Standard 15-1600 1/3.
- For aluminium secondary cable sizes refer to Toronto Hydro Construction Standard 15-1600.

1.2.7 Fusing

- 3ø padmount and 1ø minipad transformers rated 27.6/16kV, 13.8/8kV are protected by internal fusing comprising of Bay-O-Net type primary fuse link and backup CLF.
- 3ø padmount and 1ø minipad transformers rated 4.16/2.4kV are available in both live-front and dead-front designs. Live-front units that may be required in the core area do not contain internal current-limiting fuses while the dead-front units are protected by internal fusing comprising of Bay-O-Net type primary fuse link and backup CLF.
- 1ø vault transformers, 3ø subway or 3ø power class transformers installed in customer vaults have no internal fusing or CLF protection.
- The fusing requirements and sizes for the various supply arrangements shall be in accordance with the following table:

Fusing Requirements for Primary Service			
Primary Supply	**Transformation Type**	**Fusing Requirements**	**Fuse Sizing**
O/H System (Radial)	Padmount	Fuse at Pole(s)	Refer to Construction Standard 24-1200
	Customer Vault	Fuse at Pole(s)	Refer to Construction Standard 24-1200
O/H System (Loop)	Padmount	Fuse at Pole(s)	Refer to Construction Standard 24-1200
	Customer Vault	Fuse at Pole(s)	Refer to Construction Standard 24-1200
		Fuse in Customer Vault	Refer to Construction Standard: i) 24-1400 for 27.6kV Transformers ii) 24-1500 for 13.8kV Subway Transformers iii) 24-1700 for 4.16kV Transformers

Fusing Requirements for Primary Service			
Primary Supply	**Transformation Type**	**Fusing Requirements**	**Fuse Sizing**
U/G System (Distribution Loop, Dual Radial)	Padmount	No Fusing required at Street Circuit	N/A
	Customer Vault	Fuse in Customer Vault	Refer to Construction Standard: i) 24-1400 for 27.6kV Transformers ii) 24-1500 for 13.8kV Subway Transformers iii) 24-1700 for 4.16kV Transformers
U/G System (13.8kV URD/Loop System)	Padmount	Fuse in Switching Vault (Sub loop)	Refer to Construction Standard 24-1600
	Customer Vault	Fuse in Switching Vault (Sub loop)	Refer to Construction Standard 24-1600
		Fuse in Customer Vault	Refer to Construction Standard 24-1500
U/G System (Open Loop Feeder - Radial or Loop)	Padmount	Fuse at Switchgear (i.e. PMH)	Refer to Construction Standard 24-1200
	Customer Vault	Fuse at Switchgear (i.e. PMH)	Refer to Construction Standard 24-1200
		Fuse in Customer Vault	Refer to Construction Standard 24-1400 for 27.6kV Transformers

- When supply to a customer(s) requires the installation of a new 13.8kV URD/Loop system, a new switching vault containing 2 - 600 Amp SF6 4-Way switchgear is required. The Customer would then be supplied from the sub loop between the two switches. For a sample of this design, refer to the “13.8kV URD/ Loop System” schematic in the PSAM Strategy Document located in the Strategy & Policy Documents folder on the shared x:\ drive - “System Planning Document” Figure 12.
- Where the Customer is supplied from an open loop feeder, a switchgear unit (PMH9) would be required. The Customer would then be supplied a single fused primary radial from the switchgear unit. Where multiple buildings exist on a single property and a loop supply is required, two separate switchgear units would be required to complete the loop (Note- both ends of the loop should not terminate in the same switchgear).

1.2.8 Grounding

- Ground rods shall be installed at riser poles, padmounted switchgear, padmounted transformers, submersible switching vaults, customer vaults and cable chambers in accordance with Construction Standard 18-1000.
- For customer vaults with open space beneath (i.e. underground parking), ground rods are to be installed outside the vault. Refer to Construction Standard 18-1000 for specific requirements.
- All electrical equipment associated with the project shall be equipped with the appropriate grounding provisions as required to facilitate future Work Protection requests.

1.2.9 Surge Arresters

- Surge arresters are to be installed at the riser poles for both radial and loop supplies in accordance with Toronto Hydro Construction Standard Section 19.
- Surge arresters are not required on Toronto Hydro-owned equipment in customer vaults.

1.2.10 Metering

- Toronto Hydro will typically install metering equipment at the customer supply voltage. Secondary metering is preferred for all new services and service upgrades especially where there is one metering point.
- The Customer must provide a convenient and safe location satisfactory to Toronto Hydro, for the installation of meters, wires and ancillary equipment in accordance with Ontario Regulation 22/04.
- The Customer design and drawings must satisfy the requirements of Section 2.3.7 and Section 6 – Ref. Document 3 in the "Conditions of Service" for metering and Ontario Regulation 22/04.
- The following table outlines the metering charges that would apply to the different metering scenarios. The costs from the table shall be factored into the Work Order and the metering requirements provided to the Meter Services Dept. An actual dollar figure is provided to the designer upon receipt of the switchgear drawings for approval. A Work Order number is required before any metering equipment is ordered.

METERING CHARGES			
Type of Metering	**Number of Metering Points**	**Type of Billing**	**Associated Costs**
Secondary	1 or More	NON Totalized	No metering charges to the customer
Secondary	2	Totalized	<u>First Metering Point:</u> No charges to the customer <u>Second Metering Point:</u> Customer pays Full Cost - Material cost of Meter, CTs and PTs plus the Labour for installation
Secondary	More than 2	Totalized	Customer required to provide Primary Metering.
Primary	1	NON Totalized	Customer pays Material Costs for CTs, PTs, Fuse Supports and Fuses only. No charge for the Meter or Labour for installation
Primary	2 or More	NON Totalized	<u>All Metering Points:</u> Customer pays Material Costs for CTs, PTs, Fuse Supports and Fuses only. No charge for Meter or Labour installation

METERING CHARGES			
Type of Metering	**Number of Metering Points**	**Type of Billing**	**Associated Costs**
Primary	2 or More	Totalized	First Metering Point: Customer pays Material Costs for CTs, PTs, Fuse Supports and Fuses only. No charge for Meter or Labour for installation Second or More Metering Points: Customer pays Full Cost - Material cost of Meter, CTs, PTs, Fuse Supports and Fuses plus the Labour for installation

1.2.11 Customer-Owned Stations

- If the Customer requires voltages or demands other than Toronto Hydro's standard offerings, the Customer will be required to provide his own switchgear and transformation. The Customer may also elect to supply their own switchgear and transformation even if their requirements are within Toronto Hydro available supply voltages or demands.
- Toronto Hydro will be responsible for generating the civil drawing indicating the infrastructure requirements and supply location from the street circuit.
- The customer's electrical design must be in accordance with "Toronto Hydro Requirements for Design and Construction of Customer-Owned High Voltage Substations".

1.3 Drawing Guidelines

In addition to the alignment of project designs with business strategies, it is also necessary that framework be established that will support the delivery of consistent project drawings. The following guidelines will provide the necessary information that will assist in achieving this objective.
The guideline will consist of the following three key elements:

1. Drawing Structure
2. Nomenclature (Equipment Numbering)
3. Symbology

1.3.1 Drawing Structure

- Standard drawing sheet sizes to be used are as follows:
  Imperial B (11" X 17")
  " C (17" X 22")
  " D (22" X 34")
  Templates for these standard sheet sizes are in ProjectWise and are the only ones that shall be used when creating a new drawing. See ProjectWise User Manual for details.
- Drawing numbers, title blocks and page borders shall be generated using ProjectWise. Title block information will be filled in automatically as the ProjectWise attribute tables

are filled in. Drawing numbers are generated using ProjectWise – Do not modify the drawing numbers from the standard format in any way. See ProjectWise User Manual for details.

- Every drawing shall be created using a separate file.
- All attribute data fields in ProjectWise shall be filled in as part of assigning a new drawing number. See ProjectWise User Manual for details.
- All drawings shall be stored in ProjectWise in Vaults named after the project number. See ProjectWise User Manual for details.
- ProjectWise workflow shall be updated as the drawing moves from the 1) Proposed to 2) Approval then on to 3) Issued. Since issued drawings are assumed to be signed and therefore legal copies, where a modification of an issued drawing is required, a new version should be created. The Records Services Section will perform the final state change to Archived when they receive the "As Constructed" mark-up. See ProjectWise User Manual for details.
- The project design drawing shall include the following:
  - Key Map
  - Primary Schematic
  - Civil Plan & Legend
  - Duct Section Detail
  - Road Crossings
  - Notes
  - Install/Remove Details
  - Cut Repair Table
  - Work Order Numbers
- A sample drawing is included in this document for reference.

1.3.1.1 Key Map

- Locate on the top right corner of the drawing and show location of the project.

1.3.1.2 Primary Schematic

- The primary schematic shall be located at the top of the drawing. The nomenclature and symbology used shall be in accordance with the Nomenclature and Symbology sections. The schematic shall include the following:
  - the next existing switch point(s), at each end of the project-
  - the existing hydro plant along the route
  - the feeder designation(s) involved
  - all new and existing customer address(es) and equipment numbering.

1.3.1.3 Civil Plan & Legend

- The civil plan will show the infrastructure requirements associated with the new primary service. The customer will supply a digital survey drawing. For civil requirements in the public road allowance prepare drawings using the City Land Base Maps available through ProjectWise. In the former City of Toronto area (District 1) and parts of the former City of Etobicoke (District 2), the Digital Map Owners Group (DMOG) base maps shall be used.
- The civil plan shall be plotted to a scale of 1:200 horizontal and dimensioned with S.I. units.
- North arrow shall be on each plan, pointing to the top or right of the sheet only.

- Include street names and building addresses near the proposed work. If a municipal address is not available, provide dimensions from the location of the work to the nearest intersection of street lines.
- Include all Horizontal Control Monuments within 5.0 meters of the proposed plant.
- Illustrate and clearly label street lines, road pavement, sidewalks, driveways, boulevards, curbs, buildings and retaining walls. Identify street furniture including vaults, transformers, pedestals, regulators, hydrants, poles etc., and structures such as areaways, TTC tracks and entrances, tunnels, encroachments etc. that may impact on the work.
- Indicate the proposed plant in bold and identify as such in the legend.
- Indicate existing plant to be abandoned and identify as such in the legend.
- For new installations above grade (i.e. switchgear, poles etc.), all existing above grade plant within 10.0m of the new installation shall be indicated.
- Where available, indicate on the plan the existing underground services within a 2.0 metre buffer around the proposed underground plant.
- Tie dimensions for new installations (i.e. centre line of trench, cable chambers vaults etc.) shall be indicated to adjacent street lines and to existing curb lines or any other permanent existing structure (i.e. poles, hydrant etc.). When using the DMOG Base Maps tie dimensions to street lines are not required for new installations within the road allowance.
- The duct structure size and configuration shall be identified on the plan.
- Trees, tree pits and planters shall be identified on the plans. Tree diameters shall also be indicated on the plan.
- The construction method (i.e. open trench, boring etc.) and related details shall be identified on the plans.
- Existing utility locations (i.e. watermains, gas, Bell, CATV etc.) shall be shown on the plan and the cross-sections where applicable. Storm and Sanitary mains shall be indicated on the plan at road crossings, vaults or cable chambers (for drains) or any location where the electrical trench is in close proximity.
- The General Notes shall include a reference that minimum horizontal clearances from foreign utilities shall be maintained in accordance with Appendix O of the City of Toronto's Municipal Consent Requirements (*Note- the City clearance requirements are consistent with Toronto Hydro Construction Standard 31-0100).*
- Cable chamber and vaults drains to the sewer shall be indicated on the plan only, where there are no crossings of other utilities. The depth of cover to the sewer at the proposed connection shall be indicated on the plan. Where utility crossing(s) are required to accommodate the installation of a cable chamber or vault drain, the drain shall be shown in a cross-section.
- Indicate the orientation for new padmount and switchgear foundation installations (i.e. opening in top slab of padmount foundation to face north, long side of switchgear foundation to face south).

1.3.1.4 Duct Section Detail

- Place "Duct Section Detail" at the bottom of the civil plan.
- Identify ducts to be occupied by cables in the cross section detail.
- Where multiple duct sections are involved in a project, cross-sections of each shall be shown and clearly identified.

1.3.1.5 Road Crossings

- Cross-sections shall be shown on the drawing for all road crossings in accordance with the City of Toronto's Municipal Consent Requirements. The cross-section shall be plotted to a scale of 1:200 horizontal and 1:100 vertical and dimensioned with S.I. units and shall include all foreign utilities.

1.3.1.6 Notes

- Include the civil and electrical responsibilities of the Customer and for Toronto Hydro.
- Indicate all known "Designated Substances" that may be encountered in the project.
- Indicate all applicable Toronto Hydro Construction Standards and Technical Specifications for both the Customer and Toronto Hydro.
- Include a note indicating Minimum horizontal and vertical clearances from foreign utilities shall be in accordance with Appendix "O" of the City of Toronto's Municipal Consent Requirements and Construction Standard 31-0100.
- In accordance with Ontario Regulation 22/04, the following note shall be placed in the area of the title block where the assembly of the drawings utilizes only certified construction standards, technical specifications or authorized legacy standards in cases where maintaining a portion of line when current certified standards would be problematic:

THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS AND APPROVED EQUIPMENT AND MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF ONTARIO REGULATION 22/04.

- Any new construction involving the use of legacy standards will require a certificate of approval be prepared by a Professional Engineer identifying the standard and placed on the drawing.

1.3.1.7 Install/Remove Detail

- Place "Install/Remove Detail" in the bottom left corner of the drawing.
- The detail will indicate the civil and equipment requirements and applicable Toronto Hydro Construction Standards for the project.

1.3.1.8 Cut Repair Table

- Include a table indicating City cut repairs. This information will be used for comparison against the City invoices for the actual repair work on the City road allowance. The table shall be similar to the following:

Approx. Cut Repairs				
Roadways	----------------	+/-	_______	m^2
Concrete Sidewalk	----------------	+/	_______	m^2
Curb	----------------	+/	_______	m
Other		+/-		m^2

1.3.1.9 Work Order Numbers

- Place "Work Order Numbers" table between the "Install/Remove Detail" and drawing title block.

1.3.2 Nomenclature (Equipment Location Numbers)

- **New nomenclature standards have been developed and will be included in Section 21 of the Construction Standards. Utilization of these new standards for new projects shall be put into practice as the former utility nomenclature has been converted to the new standards through the Work Practice harmonization MANS team initiative.**

1.3.3 Symbology

The proposed new symbology standards have been finalized and will appear in GEAR as the former utililty record data is converted. The new symbols shall not be used for new projects until instructed. The new Symbology can be viewed by clicking on the following link:

http://thehub.torontohydro.com/gear/Users/SymbologyPage/SymbologyPage.html

1.4 <u>Project Deliverables</u>

Requirements for new underground supply is primarily customer initiated and design will normally be completed by CFDC. Project designs are completed and forwarded directly to construction to meet customer in-service dates. Before these projects can proceed, the customer must meet all applicable Toronto Hydro financial and legal requirements.

To ensure a seamless process between the design and construction phase, designers must be cognizant of all the construction requirements (i.e. approvals, notifications etc.). To assist in this area, a Project Design Deliverables checklist (Appendix "C") has been developed and can be used by designers to ensure all pertinent information, documents are included in the construction folder when signed-off.

Section 2 - Rationale:

To ensure new underground customer service designs are aligned with business strategies and project design packages are delivered in a consistent fashion.

Section 3 - References:

- Standard Design Practice Template – SDP #000
- Toronto Hydro Construction Standards

- Toronto Hydro Technical Specification for Civil Construction Work #CV-CON-01
- Toronto Hydro “Conditions of Service”
- Toronto Hydro Distribution System Planning Guidelines
- Field Consultation Meeting – Terms of Reference
- Job Planning Process (Latest Version)
- As-Constructed Map Products Process (Latest Version)
- Engineering Bulletin #2004-02 “Customer-Owned High Voltage Substations”
- Toronto Hydro Requirements for the Design and Construction of Customer-Owned High Voltage Substation
- Ontario Electrical Safety Code
- Work Breakdown Structure (Latest Version)
- City of Toronto – Municipal Consent Requirements
- Ontario Regulation 22/04
- Electrical Safety Authority Technical Guidelines for Sections 6, 7 & 8.

Link to SDP References Folder

APPENDIX “A”

NEW UNDERGROUND SERVICES DESIGN PROJECT CHECKLIST

Project Name: ____________________

This checklist is intended to act as a guideline for the various activities involved in the design phase of projects involving new U/G services. In addition, it includes those activities required in finalizing the project design package prior to issuing to construction. It should be kept in your working design file. Activities listed may not necessarily be in sequential order. The activities listed can be used as a reference in updating your departmental Project Tracking-CFDC.

Item #	Design Activities	Date Completed (or) N/A
1	Receive Customer initiated project / Initial contact with Customer by phone.	
2	Prepare and forward letter to Customer outlining our requirements and the design costs.	
3	Receive Customer project details, construction schedule, drawings, and confirm whether Customer will be providing their own switchgear and transformer.	
4	Receive Customer design deposit.	
5	Submit Project Notification Form (PNF) to PMO scheduling.	
6	Coordinate preliminary conceptual meeting with Customer to discuss our requirements.	
7	Initiate project & TRIM files and obtain design work order number.	
8	Assemble record maps and pertinent drawings.	
9	Define limits of the project design.	
10	Forward completed “Feeder Request Form” to Investment Planning for approval.	
11	Receive approved “Transmittal and Feeder Request Form” from Investment Planning.	
12	Arrange Field Consultation Meeting (as per T of R) with area Construction Supervisor to: 1) Review the project. 2) Address construction issues (i.e. identify conflicts, relocations and connection to the existing distribution system). 3) Identify the safety hazards associated with the project and measures to eliminate and/or control during construction phase.	
13	Set-up new “prem” in Banner.	
14	Determine location of transformer vault, padmount transformer, padmount switchgear, cable chamber and duct structure on Consultant's plan drawings.	
15	Return set of “marked-up” plan drawings to Consultant to facilitate their design.	
16	Prepare base maps.	
17	Prepare preliminary design utilizing certified construction standards and technical specifications and add to base maps.	
18	Review preliminary designs with Supervisor and sign drawings.	
19	Send out for printing.	
20	Forward Project Checklist to Legal Department.	
21	Initiate requests for easements with Consultant and agreements with Legal Dept.	
22	Receive Customer switchgear drawings and forward along with “Advanced Meter Information Sheet” (AMIS) to Meter Dept for approval.	
23	Distribute preliminary drawings to other utilities, authorities and Consultant for comments/approvals/line release.	
24	Obtain revised plan and profile drawings from Consultant along with any comments/revisions pertaining to the preliminary project drawings.	
25	For Customer-Owned Stations: 1) Review and approve station equipment drawings. 2) Review and approve Bill of Material. 3) Review and approve fuse coordination study.	
26	Make revisions to drawings.	
27	Prepare Contractor cost sheets.	
28	Prepare estimate and material requirements in Ellipse.	
29	Prepare NPV calculation for expansion costs and install in the CFDC/Economic Evaluation NPV Calculations folder on the shared y:\ drive.	
30	Provide information to the Legal Dept. for preparing the “Offer to Connect”.	

Item #	Design Activities	Date Completed (or) N/A
31	Obtain final draft “Offer to Connect” from Legal Dept. for approval and return to Legal for submission to the Customer.	
32	Prepare "Alternative Bid" if “Offer to Connect” is declined and forward to Legal Dept. for comment.	
33	Receive signed “Offer to Connect” from Customer.	
34	Receive signed “Alternative Bid” from Customer.	
35	Send out “Supply Agreement” where applicable.	
36	Send out “Connection Agreement” where applicable.	
37	Receive signed “Supply Agreement” from Customer.	
38	Receive signed “Connection Agreement” from Customer.	
39	Receive “Letter of Credit” from Customer.	
40	Receive full payment from Customer.	
41	Obtain sign-off/authorization from Design Supervisor on project estimate in Ellipse.	
42	Initiate project drawings through Project Wise.	
43	Arrange meeting with Construction Supervisor to review final design, BOM, validation of CU’s, “Steps and Conditions” and obtain sign-off.	
44	Make necessary changes to estimate and finalize BOM.	
45	Package job, prepare work orders and material requisitions in Ellipse.	
46	Obtain all necessary external Approvals.	
47	Coordinate the scheduling of in-service date and feeder outages with Construction Supervisor (for the downtown core).	
48	Obtain update on construction schedule from Customer.	
49	Obtain “digital” survey plans from Customer.	
50	Make final revisions to drawings and include note on drawing indicating compliance with Section 7 of Ontario Regulation 22/04.	
51	Obtain final drawing Approval from Supervisor and stamp drawings "Approved for Construction".	
52	Order prints for construction.	
53	Update status of project drawings in Project Wise from “Approved” state to “Issued”.	
54	Submit “Notice of Project” to Ministry of Labour.	
55	Prepare “Steps and Conditions Chart” identifying the safety hazards and control measures to be used during the construction phase.	
56	Prepare “Installed Units Summary“ (WBS2) form.	
57	Prepare “Equipment Changeout Record” forms.	
58	Prepare Work Order and Job Cards.	
59	Prepare Construction Folder.	
60	Design Supervisor to sign-off on Construction Folder.	
61	Forward Construction Folder to Construction.	
62	Distribute approved construction drawings to all internal parties as per “Drawing Circulation List”; see attached Appendix “D”.	
63	For Customer-Owned Stations review and approve Pre-Service Inspection Report.	
64	Arrange for Inspector to conduct a pre-construction visit to verify site conditions.	
65	Arrange pre-construction site meeting with construction, contractor, consultant, customer and all other authorities.	
66	Obtain ESA Connection Authorization.	
67	Issue Line and Meter Orders through Banner.	
68	Arrange billing session with Contractor and other utilities upon completion of civil construction.	
69	Upon completion of civil and electrical construction, forward copies of “As Constructed” drawings to Data & Mapping and System Operations.	
70	Conduct post construction site inspection (check for deficiencies, damage to plant, grading etc.).	

Item #	Design Activities	Date Completed (or) N/A
71	Prepare Inspection Report to Customer detailing any required repairs and their associated costs to perform the repairs.	
72	Upon receipt of payment from Customer, initiate the necessary repairs.	
73	Maintain approved project drawings and the “as-constructed” drawings in the department central filing system for a period of one year following the annual audit required under Ontario Regulation 22/04.	
74	Purge Project Folder and submit to Trim System for archiving.	
75	Close all remaining material requirements with Demand Management.	
76	Participate in post construction meetings, as required.	

APPENDIX "B"

PROJECT DESIGN DELIVERABLES

Project Name: ______________________________ Project No.: ______________________

Project Estimate $: ___________________________

Legend: **X -** *Items are Mandatory*

✓ - *Additional items to be included if applicable to the project*

Item #	Deliverables	
1	Project documents filed in appropriate folder	**X**
2	Completed "Installed Units Summary" (Work Breakdown Structure II form - Latest Version)	**X**
3	Approved Project drawings (see attached Appendix "C")	**X**
4	Include "Requirement Summary" from Ellipse (Job Estimating - MSQ655) of the resource, vehicle and material requirements.	**X**
5	"Equipment Changeout Record" forms for key assets.	**X**
6	Construction Estimate break down (e.g. Material, labour, O/H, U/G, Civil, etc.) through Ellipse	**X**
7	'Notice of Project' – The Occupational Health & Safety Act – with any necessary sketch(es)/drawing(s) attached – **for projects with Hydro portion over $50,000.00**	**X** (1 Completed copy)
8	'Steps & Conditions' chart	**X** (1 copy)
9	Job Cards	**X**
10	Cover Sheet	**X**
11	Action Log and Minutes from Field Staff Consultation Meeting	✓
12	Notification letters, etc issued.	✓
13	External approvals (ESA Connection Order, Pre-service Inspection Report for Customer-Owned Station).	**X/✓**
14	Attach exist. Feeder Prints showing the proposed mark-ups as required by the area Control Centre.	✓
15	For 'Unit Price' contract, attach UNIT PRICE SHEET with estimated price	✓
16	Tender Package	
	Tender Items List	✓
	Technical Specification	✓
	Price Schedule	✓
	Project Information	✓
	Tender Estimate	✓
17	Stakeouts & Locates.	✓
18	Attach Easement Agreements / Letters of Understanding.	✓

Additional Comments: ____

____

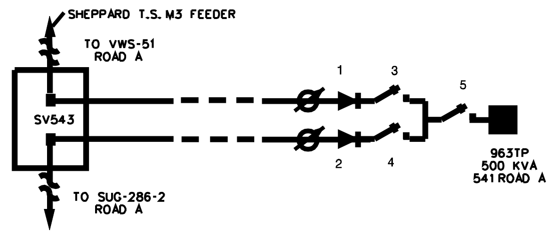
Design Supervisor: __________________ Ext. ________ Date: ____________

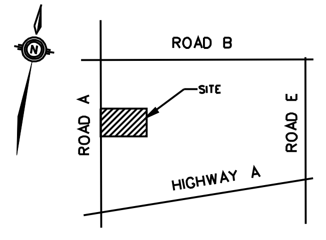
Designer: __________________ Ext. ________ Date: ____________

Issue for Construction - Drawing Distribution Chart

9-Jan-04

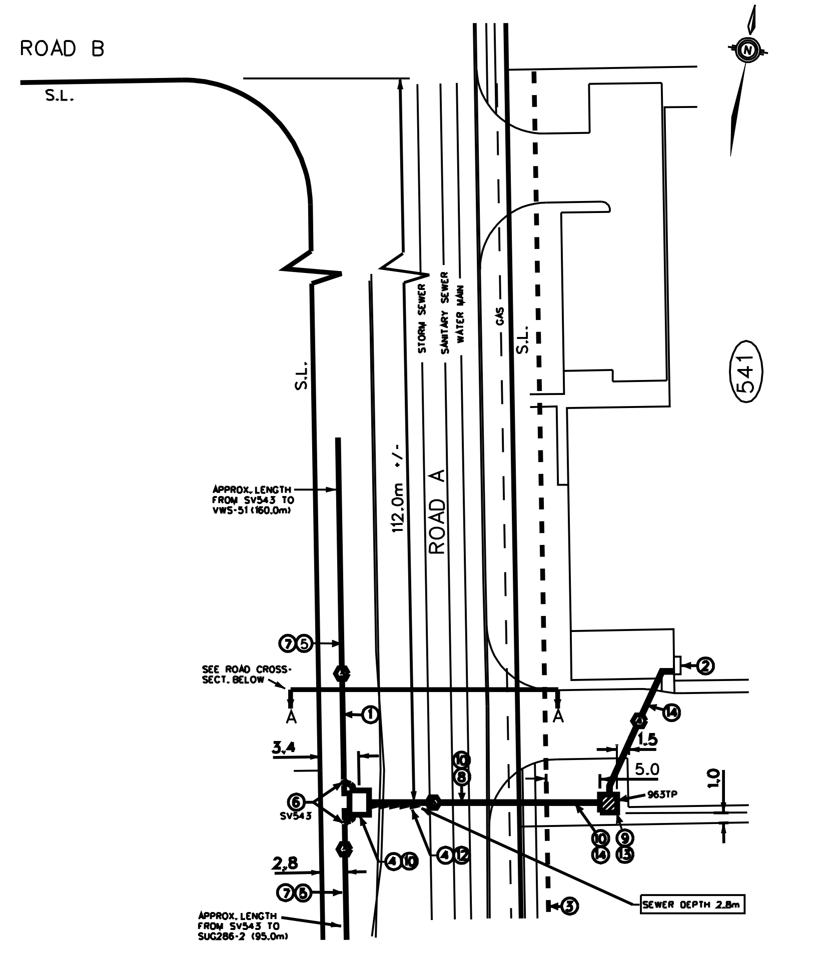
Department	Location & Contact	CIVIL DRAWINGS		CIVIL/ELECT DRAWINGS		ELECT DRAWINGS		STR LGHTG DRAWINGS	
		Full	Half	Full	Half	Full	Half	Full	Half
	MANDATORY								
Investment Planning	**Tony Nguyen** 500 Commissioner St. 3rd Flr		1		1		1		
Records	**Robert McNabney** 500 Commissioner St. 3rd Flr		1		1		1		1
Cable Locates	**Robert Gregoris** 28 Underwriters Rd.		1		1				
Operations	**Hilton Meade** Control Centre 5800 Yonge St.				1	1			
Field Supervisor	Drawings	2	4	2	4	2	4	2	1
Originating Dept.	Dept File Copy		1		1		1		1
	ONLY WHEN REQUIRED - "Need to be identified by Design Technician"								
Station & Network	**Herman Thissen** 500 Commissioners St		1		1	1			
CROMS Mtce	**Joe Waite** Control Centre 5800 Yonge St.		1		1	1			
Operations	**Charlene Mueller** Control Centre 5800 Yonge St.				1	1			
Customer Accounts	**Grace Chau** 5800 Yonge St				1				
C/F Staking Group	**Dave Graham** 28 Underwriters Rd.	2		2		1		2	
Unit Price Civil	Drawings Cost Summary Sheets	4	2	4	2			4	2
QA/QC Inspection	**Earl Galaski** 500 Commissioners St	4	2	4	2	4	2	4	2
	TOTAL DRAWINGS	12	15	12	17	11	9	12	7





PRIMARY SCHEMATIC

KEY MAP



NOTES:

GENERAL

ALL CIVIL WORK ON THIS CONTRACT SHALL BE DONE IN ACCORDANCE WITH TORONTO HYDRO'S LATEST ISSUE OF TECHNICAL PECIFICATION FOR CIVIL CONSTRUCTION WORK #CV-CON-01

1-EXISTING 3 - #1/0 STR. PRIMARY CABLES (FOR CONTINUATION SEE HOGAN IND. SUBDIVISION - DWG. # HU88-067-1)
2-ELECTRICAL METER LOCATION
3-FUTURE STREET LINE

BY TORONTO HYDRO

4-SUPPLY & INSTALL A 3 PIECE PRE-CAST SPLICE VAULT AND DRAIN TO STORM SEWER AS PER CONSTRUCTION DWG & T.H. CONSTRUCTION STANDARD 31-2240.
5-REMOVE EXISTING #1/0 STR. AL. PRIMARY FROM EXISTING 3WX1H DUCT STRUCTURE BETWEEN SWITCHES #VWS-51 (ROAD A.) & SUG-286-2 (ROAD A).
6-BREAK INTO EXISTING 3WX1H CONCRETE ENCASED DUCT STRUCTURE & RE-ROUTE NEW CONCRETE ENCASED DUCTS INTO NEW SPLICE VAULT #SV543 AS PER CONSTRUCTION DWG & T.H. CONSTRUCTION STANDARDS 31-1120 & 31-1130.
7-INSTALL NEW #1/0 AL. PRIMARY CABLES IN EXISTING DUCTS FROM EXISTING SWITCHES #VWS-51 AND #SUG-286-2 TO THE NEW SPLICE VAULT #SV543.
8-SUPPLY & CONSTRUCT 3WX2H CONCRETE ENCASED DUCT STRUCTURE ON ROAD ALLOWANCE AS PER CONSTRUCTION DWG & T.H. CONSTRUCTION STANDARDS 31-1120 & 31-1130.
9-INSTALL PADMOUNT TRANSFORMER AS PER CONSTRUCTION DWG & T.H. CONSTRUCTION STANDARD 14-3600 & COMPLETE ALL CONNECTIONS & TERMINATIONS AS PER PRIMARY SCHEMATIC.
10-INSTALL NEW #1/0 STR. AL. PRIMARY CABLES IN DUCTS AS PER DETAIL "A" FROM NEW SPLICE VAULT #SV543 TO THE TRANSFORMER PAD FOUNDATION.
11-INSTALL 6 - #1.0 STR. AL. PRIMARY CABLE SPLICES IN NEW SPLICE VAULT #SV543.
12-ARRANGE FOR INSPECTION OF DRAIN CONNECTION TO STORM SEWER BY CONNTACTING CITY OF TORONTO PUBLIC WORKS DEPT., 48 HRS. PRIOR TO CONNECTION PHONE 416-395-6223(EAST OF YONGE ST.) OR 416-395-6258 (WEST OF YONGE ST.)

BY CUSTOMER

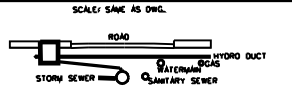
13-SUPPLY & INSTALL A PRE-CAST CONCRETE TRANSFORMER PAD FOUNDATION AS PER CONSTRUCTION DWG & T.H. CONSTRUCTION STANDARD 31-4030. 31-4070, 31-4080, SLOT IN TOP OF SLAB FACES WEST.
14-SUPPLY & CONSTRUCT 3WX2H & 2WX2H CONCRETE ENCASED DUCT STRUCTURES ON PRIVATE PROPERTY AS PER CONSTRUCTION DWG & T.H. CONSTRUCTION STANDARDS 31-1120, 31-1130 & 31-1160.

THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS AND APPROVED EQUIPMENT AND MEETS SAFETY REQUIREMENTS OF SECTION 4 OF THE ONTARIO REGULATION 22/04.

MINIMUM HORIZONTAL AND VERTICAL CLEARANCES FROM FOREIGN UTILITIES ARE IN ACCORDANCE WITH THE CITY OF TORONTO'S MUNICIPAL CONSENT REQUIREMENTS AND CONSTRUCTION STANDARD 31-0100.

ROAD CROSS SECTION 'A'

SCALE: SAME AS DWG.



DETAILS

AS PER BILL 208, THE FOLLOWING "DESIGNATED SUBSTANCES" MAY BE ENCOUNTERED ON THE PROJECT: VINYL CHLORIDE AND ETHYLENE OXIDE.

NOTE: OBTAIN NECESSARY CLEARANCES BEFORE DIGGING

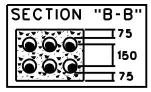
48 HRS. NOTICE IS REQUIRED PRIOR TO COMMENCEMENT OF TRENCH WORK CALL TORONTO HYDRO FOR INSPECTION PRIOR TO POURING CONCRETE.

DUCTS MUST BE CONSTRUCTED TO TORONTO HYDRO STANDARDS, ALONG INDICATED ROUTE. SHOULD DEVIATIONS BE DEEMED NECESSARY THEY MUST BE APPROVED PRIOR TO CONSTRUCTION.

DUCTS THAT DO NOT MEET THIS SPECIFICATION WILL BE REBUILT AT THE CUSTOMERS EXPENSE.

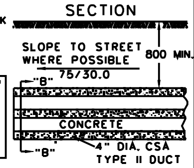
NOTE: DUCTS TO HAVE BELL FITTINGS AT EACH END EXCEPT WHERE DUCTS WILL BE CONTINUED BY T.H. LEAVE END AS PER STD. 31-1160.

SECTION "B-B"



DETAIL "A"
(N.T.S.)

SECTION



LEGEND

- PRECAST CONCRETE TRANSFORMER PAD
- 5 INDICATES THE NUMBER OF DUCTS
- PRECAST CONCRETE SPLICE VAULT
- CONCRETE ENCASED DUCT STRUCTURE
- 11 SIDE-NOTE
- DRAIN TO STORM SEWER

DUCT	LENGTH	17.0m +/- BY T.H., 5.0m +/-(PRIMARY)& 15.0m +/-(SECONDARY) BY CUSTOMER	
CABLE		INSTALL	REMOVE
	SIZE	1/0Al 28kV TRXLPE ECNJ	
	LENGTH	885m +/- (3x295.0m)	
TRANS. 963TP	SIZE	1-3/0/500kVA PAD SEP. CON.	
	VOLTAGE	27600GRD.Y/16000-600/347V	
	CUST VOLT	600/347V	
TERM.	FUSE No.		
	SWITCHES		
	FUSE		
	T.O. STD.		
PAD	FUSE		
	T.O. STD.		

APPROX. CUT REPAIRS

ROADWAYS .... +/- 6.0 m.sq.
SIDEWALK .... +/- 9.0 m.sq.
CURB .... +/- ______ m.sq.
OTHER .... +/- ______ m.sq.

WORK ORDER NUMBERS	
UNDERGROUND	12346
TRANSFORMER	61805
CIVIL	12348
DESIGN	60806
MAP NO.	81
APPROVALS	
METRO ROADS	NO

rev.	date	description	by	appd.

toronto hydro

section_name

SCARBOROUGH

drawn by drawn_by	civil design	date yy/ mm/ dd __/__/__
ip reference #	civil approval	date yy/ mm/ dd __/__/__
ellipse project # project_no	electrical design	date yy/ mm/ dd __/__/__
construction project #	electrical approval	date yy/ mm/ dd __/__/__
scale scale	construction approval	date yy/ mm/ dd __/__/__

dwg. title:

541 ROAD A

UNDERGROUND ELECTRICAL

dwg. no. 2004-000853

rev. no.

toronto hydro
electric system

Standard Design Practice

UNDERGROUND CABLE INSTALLATIONS

SDP #005

Prepared by: Standard Design Practice Team

Approved by: Romano Sironi
Manager, Policy & Standards

Issue Date: June 16, 2006

SDP #005 – Underground Cable Installations

Revision History			
Rev. #	**Date**	**Description**	**Approved by:**
00	16-June-06	- Original Issue	R. Sironi

SDP #005 – Underground Cable Installations

CONTENTS

Page #

Section 1 - Practice:

The purpose of this document is to provide a guideline for the design of projects involving the installation and removal of primary distribution cables in new and existing major civil infrastructures that may include concrete encased duct structures, cable chambers, switch foundations and vaults. The document provides the necessary framework to ensure project designs are aligned with business strategies and completed design packages are delivered in a consistent fashion.

Four key issues are addressed in the document:

1. Design Checklist: identifies the activities, which should be considered during the design phase.
2. Design Considerations: supplements the Construction Standards by identifying key design components and strategies for new projects.
3. Drawing Guidelines: identifies key information to be shown on project drawings.
4. Project Deliverables: identifies the documents & drawings required when signing-off on a design file.

1.1 Design Checklist

Many issues need to be considered in the design of projects involving the installation and removal of primary distribution cables from the civil infrastructures. To ensure a comprehensive design package is delivered, designers must be cognisant of all issues during the design. To assist designers in this area, "Underground Cable Installations Projects Design Checklist" (Appendix "A") has been developed for Distribution Projects-Design and Customer Connections & Maintenance and should be used as a guide to ensure all aspects of the design stage are successfully completed.

1.2 Design Considerations

1.2.1 General

- Designers shall ensure project designs satisfy the requirements of Section 7 of Ontario Regulation 22/04 "Electrical Distribution Safety" under the Electricity Act, 1998.
- Designers shall employ "Safety by Design" concept in their project designs.
- Designers shall endorse the use of only certified construction standards, specifications in the assembly of the project drawings. The use of authorized legacy standards should be limited to the maintaining of lines where certified construction standards would be problematic. Any new construction specifying the use of legacy standards will require a certificate of approval prepared by a Professional Engineer.
- If the project scope requires installation of both civil infrastructure and distribution cable under the same project, consult SDP #004 – Major Civil Projects for the civil component of the project.
- In accordance with Bill 208, all known "Designated Substances" that may be encountered in the project shall be identified on the drawing. Examples of "Designated Substances" and their applications may include:
  Asbestos - cables and ducts
  Lead - PILC and AILC cables meter backer boards, listing tape and older station batteries
  Mercury - mercury vapour lamps and street light relays

Vinyl Chloride - 4" PVC ducts and PVC jacketed cables
Arsenic - arsenical lead sheathed cables
Ethylene Oxide - polyethylene insulated cables
Silica - current limiting fuses and lightning arresters (4kV)
and other substances and applications that may be added from time to time.

1.2.2 Cable Installation

1.2.2.1 Ducts

- The numbering of new ducts shall be in accordance with Construction Standard 31-1180. It should be noted that some former utility numbering standards were different. For projects involving civil infrastructures installed prior to amalgamation, it may be necessary to consult legacy standards.
- The ampacity rating of cable in duct is heavily influenced by the ability of the cables to dissipate the heat generated through current flow. In concrete encased duct, the extent of thermal de-rating on the cable would be dependant upon the cables placement within the duct structure.
- Where it is likely that the duct structure will be fully occupied it is suggested that the cables occupy the peripheral ducts of the structure starting from the lower ducts and working upward. The following detail provides the suggested cable placements based on four circuits consisting of single conductor cables:

C3	**C4**	**C4**
C3	T	**C4**
C3	**N/N**	**C2**
C1		**C2**
C1	**C1**	**C2**

3 Wide x 5 High
Duct Structure

T			
C4	**C4**	**C3**	**C3**
C4	**N/N**		**C3**
C1			**C2**
C1	**C1**	**C2**	**C2**

4 Wide x 5 High
Duct Structure

LEGEND

☐ - cable ducts

C1, C2, etc. - circuits #1, #2 etc.
N/N – two neutral conductors
T – Third Party cables (such as THSLI, Rogers, THTI etc.)

- The system neutral conductor(s) shall occupy a middle duct.
- Third Party cables shall occupy either a top or middle duct.
- The duct lengths between civil infrastructures (i.e. cable chamber to cable chamber) shall be obtained from the civil installation project drawings. For new civil installations, lengths can be obtained from the “Duct Length” table located on the title sheet of the civil installation project drawings. If duct lengths are not available from either the civil project drawings or previous cable installation drawings, duct

runs shall be measured at grade level from centre to centre of cable chambers or vaults.

- Designers shall note that additional cable should be added to the duct lengths to allow for racking and terminating. For the additional cable requirements refer to Section 1.2.3 Primary Cables.
- All efforts shall be made to remove cables no longer required from duct and cable chambers. If it is not feasible or practical to remove the cables, they shall be cut-off so not to be inadvertently energized. The cable ends shall also be capped in accordance with Construction Standard 16-0020 4/5.

1.2.2.2 Cable Chambers

- With the exception of the downtown core area, the number of feeder circuits running through a cable chamber shall be limited to four.
- The placement of 27.6kV & 13.8kV primary distribution cables in cable chambers in the horseshoe area should be avoided.
- Due to space restrictions within the road allowance, cable chambers located in the core area may contain both primary and secondary distribution cables.
- Breaking-out of ducts from existing structures and the diverting of ducts from a new structure shall be designed in accordance with Construction Standard 31-1100 2/5 and 31-1170.
- Cables shall be racked in accordance with Construction Standard 31-2170 and 31-2180. Also see Construction Standard 16-4540 for additional racking details for XLPE cable.

1.2.3 Primary Cables

- The standard primary feeder cables shall be in accordance with the following table:

Primary Cables			
Distribution System	**Cable Size and Type**	***Ampacity Rating**	**MVA Rating**
13.8kV	3-1/C 1500 Cu 15kV TRXLPE	670 Amps	16.0 MVA
	3-1/C 1000 Cu 15kV TRXLPE	590 Amps	14.1 MVA
	3/C 500 Cu 15kV PILC	450 Amps	10.8 MVA
	3-1/C Triplex 500 Cu 15kV TRXLPE	470 Amps	11.3 MVA
	3/C 2/0 Cu 15kV PILC	210 Amps	5.1 MVA
	3-1/C Triplex 3/0 Cu 15kV TRXLPE	270 Amps	6.5 MVA
	1/C 1/0 Al 15kV TRXLPE	200 Amps	4.8 MVA
27.6kV	1/C 1000 Al 28kV TRXLPE LC	700 Amps	33.6 MVA
	1/C 1000 Cu 28kV TRXLPE LC	820 Amps	39.2 MVA
	1/C 1/0 Al 28kV TRXLPE CN	180 Amps	8.3 MVA

Note:

* For the conditions under which the ampacity ratings apply, consult the following Construction Standards:

- 13.8kV PILC cable – Construction Standard 16-0980 1/5
- 13.8kV XLPE Cu or Al cable - Construction Standard 16-1060 1/5
- 27.6kV XLPE Al cable - Construction Standard 16-1140 1/5

- 15kV cables are only to be used on the 13.8kV & 4.16kV distribution system where there is no possibility of future 27.6kV system expansion.
- For installations involving the 13.8kV system, TRXLPE cables shall be used over PILC where practicable. Consult Construction Standard 16-0340 for the various conditions.
- Some examples where PILC cables are to be used over XLPE cables shall include the following:
  - In areas of high groundwater table mixed with oil and oil by-products (toluene, methane, etc.), e.g., Basin Station, PILC cable is to be used at all times since the lead sheath offers greater protection from these chemicals.
  - Where replacing sections of PILC cable, replace with same, provided section to be replaced extends over a minimum of five (5) cable chambers or covers a length of 300+/- metres.
- The predominant cable type used on the 27.6kV system shall be 1000 Al and 1000 Cu 28kV TRXLPE.
- 1000 Cu 28kV TRXLPE cable shall be used for station egress from the breaker to the first riser pole or switching device within close proximity to the station. Where no riser or switching device exists in close proximity, the 1000 Cu 28kV TRXLPE cable shall be installed from the breaker to the 1st cable chamber where the feeders split. This distance may range a min. of 100m to 500m from the breaker.
- 1000 Cu 28kV TRXLPE cable shall also be installed at locations where there are two or more feeder circuits existing within the civil infrastructure.
- Primary feeder cables (500kcmil and above) shall be supplied in specific lengths. Specific length is defined as the duct face to duct face measured length plus additional cable lengths for splicing and terminating. The specific lengths shall be recorded in a “Cable Pulling Schedule” table and provided to Procurement when requisitioning for the cable. Refer to Section 1.3.1.3 Cable Installation.
- It is suggested that the following additional cable quantities be added to the duct length when determining cable length requirements:
  - Add 5.0m for each cable chamber, switchgear or vault.
  - Add the above grade height of the pole for riser terminations.
  - Where it is necessary to measure the duct lengths from cable chamber centre to centre, it is recommended that an additional 5%-10% be added to the total lengths to account for deviations in the duct route.

1.2.3.1 Neutral Conductors

- For both the 13.8kV and 27.6kV main feeder circuits, a 300 kcmil Cu jacketed conductor shall be used as the neutral conductor.
- The number of main feeder circuits in the duct structure shall determine the number of neutral conductors required. Refer to the following table:

Neutral Conductor Requirements		
Number of Neutrals	Number of Main Feeder Circuits in Structure	
	1	=/> 2
1	√	
2		√

- When installing feeder cables in a new civil infrastructure for the first time, it is suggested that the installation should include the installation of two neutral conductors in a middle duct.
- Inside a station, the neutral conductor shall be terminated at the ground bus of the appropriate breaker compartment.

1.2.4 Grounding

- Ground rods shall be installed at riser poles, padmounted switchgear, submersible switching vaults and cable chambers in accordance with Construction Standard 18-1000.

1.2.5 Splicing and Terminating

- Designers shall consult with the Crew Leader-Cable & Jointer to identify those cable chambers where cables can be pulled through without having to introduce splices.
- Cable splices and terminations shall be installed to the same voltage rating as the installed primary cable.
- Both ends supplying a distribution loop shall be fused and shall not be terminated within the same switching device.
- Primary cables shall be spliced and/or terminated in accordance with Section 16.4 and 16.5 of the Construction Standards.
- Crossbonding may be required when using 1500 and 1000 Cu 15kV TRXLPE cable to minimize the affects of thermal de-rating of the cables. For application of crossbonding consult Construction Standard 16-0350.
- For a 27.6kV underground primary feeder riser consult Construction Standard 12-4000.

1.2.6 Switchgear

- Padmounted switchgear shall be installed in accordance with Construction Standard 13-7600.
- Submersible switches used on the 13.8kV URD shall be installed in accordance with Section 13-6 of the Construction Standards.
- 800 Amp current reset faulted circuit indicators are to be installed at 600 Amp U/G terminations on open loop feeders and main loop cables (URD).

1.2.7 Overhead Switches

- Switches may be either manual or remote operation. Remote switch locations shall be identified in accordance with Standard Practice #005 “Installation of SCADA Switches and Planning Guideline”.
- Manual or automated load interrupter switches shall be installed at riser poles in accordance with Section 10 of the Construction Drawings.

1.3 Drawing Guidelines

In addition to the alignment of project designs with business strategies, it is also necessary that framework be established that will support the delivery of consistent project drawings. The following guidelines will provide the necessary information that will assist in achieving this objective.

The guideline will consist of the following three key elements:

1. Drawing Structure
2. Nomenclature (Equipment Numbering)
3. Symbology

1.3.1 Drawing Structure

- Drawing sheet sizes shall be a maximum size of Imperial D (22" X 34"). Field staff have, in past requested the use of ½ size prints for use as reference in the field. To ensure text is legible in a ½ size format, utilize a sufficient sized font for the text.
- Templates for the standard sheet size are in ProjectWise and are to be used when creating a new drawing. See ProjectWise User Manual for details.
- Drawing numbers, title blocks and page borders are to be generated using Project Wise. Title block information will be filled in automatically as the ProjectWise attribute tables are filled in. Drawing numbers are generated using ProjectWise – Do not modify the Drawing numbers from the standard format in any way. See ProjectWise User Manual for details.
- Sufficient white space shall be reserved to the left of each Title Block for placement of the "As-Constructed" stamp.
- Every drawing must be created using a separate file.
- All attribute data fields in ProjectWise must be filled in as part of assigning a new Drawing Number. See ProjectWise User Manual for details.
- All Drawings must be stored in ProjectWise in Vaults named after the Project Number. See ProjectWise User Manual for details.
- ProjectWise workflow must be updated as the drawing moves from the 1) Proposed to 2) Approval then on to 3) Issued. A new version should be created at this state, if modification is requested, as all drawings that have reached this state are assumed to be signed and therefore legal copies. The Records Services Section will perform the final state change to Archived when they receive the As Constructed mark-up. See ProjectWise User Manual for details.
- The project design drawing shall include the following:
  - Title Sheet
  - Primary Schematic
  - Cable Installation
  - Various Details (if required)
  - Reference Sheet (if required)

  ***Note** – if the project scope includes the installation of both new civil infrastructure and cable, project packages shall include the Plan/Profile sheets and any other drawing requirements.*
- A set of sample project drawings has been included in this SDP document.

1.3.1.1 Title Sheet

- The title sheet shall include the full project name, key map with north arrow, Drawing Index, General Notes and a Specification/Construction Standard table.
- The key map shall encompass the entire limits of the project and be "blocked-off" and numbered by the cable installation ProjectWise drawing number and sheet number.
- The Specification and Standard Drawing table shall list the applicable specifications followed by the Construction Standards. The table shall consist of two columns: i) Specification or Construction Standard title, ii) Specification or Construction Standard #, including latest revision.

- The General Notes shall include any specific requirements pertaining to the installation or removal of cables and indicate all known “Designated Substances” that may be encountered in the project.
- The General Notes shall include a note requiring field crews to re-number existing equipment where identified on the drawings.
- In accordance with Ontario Regulation 22/04, the following note shall be placed in the top right corner of the drawing where the assembly of the drawings utilizes only certified construction standards, technical specifications or authorized legacy standards in cases where maintaining a portion of line with current standards would be problematic:

THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS AND APPROVED EQUIPMENT AND MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF ONTARIO REGULATION 22/04.

- Any new construction involving the use of legacy standards will require a certificate of approval be prepared by a Professional Engineer identifying the standard and placed on the drawing.

1.3.1.2 Primary Schematic

- A Primary Schematic shall be prepared and included with the project drawings.
- The purpose of the drawing is to provide an electrical overview of the proposed project.
- This drawing can be separated from the rest of the project drawings and used by the Control Centre. For this reason, the repetition of certain information (i.e. key map, legend etc) is required.
- The entire limits of the project shall be shown on one page.
- The Primary Schematic shall be “Not to Scale” and indicate the following:
  - be semi-geographic, showing all relevant civil (i.e. cable chambers, vaults etc.) and electrical (i.e. primary cables, switches, switchgear etc.) components to facilitate ones “orientation”.
  - include a legend of proposed, existing and abandoned civil and electrical plant.
  - include a key map similar to the Title sheet without the “blocked-off” sections and numbering.
  - include the proposed connections to the exiting plant either solidly connected or via switches.
  - include the feeder designations involved.
  - indicate clearly the voltage rating(s) of the system and cable sizes.
- When re-numbering existing equipment locations to the new standard, the new location number shall be shown in the vicinity of the equipment followed by the existing number in brackets.

1.3.1.3 Cable Installation

- The purpose of these drawings is to provide details of the new primary and neutral (as required) cable installations and removals within the civil infrastructures.
- Cable installation would typically be performed by THESL cable pulling crews however, it could also be performed by our Unit Price Contractor.
- Include the following note in the top right corner of each cable installation drawing filling in the appropriate drawing number.

REFER TO TITLE SHEET DRAWING # 200*X* – *XXXXXX*, SHEET 1 FOR ACCOMPANYING PROJECT DRAWINGS.

- Where practicable show the entire limits of the project on one sheet. When using one sheet, information should be legible when reduce to a ½ size drawing.
- The drawing shall be "Not to Scale" and indicate the following:
  - be semi-geographic, showing the street lines and street names.
  - north arrow shall be shown pointing to the top or right of the sheet only.
  - include the proposed and existing civil infrastructures (i.e. cable chambers, vaults, pads) in which the new cables will occupy (do not indicate duct structures).
  - new infrastructure and new cable shall be indicated in bold. Three phase circuits shall be identified as a single line with neutral conductor shown separately.
  - indicate splicing in cable chambers as required. No splice would indicate cables are to be pulled through the cable chamber.
  - indicate cables to be removed from the infrastructure as required. Also identify the resulting empty duct(s).
  - include a legend of the proposed and existing civil infrastructures (do not include duct structures) and proposed primary cables, neutrals and terminations. Include on all Cable Installation sheets.
  - include the proposed connections to the existing plant either solidly connected or via switches.
  - include the feeder designations involved.
  - indicate clearly the voltage rating(s) of the system and cable sizes.
  - include a cross-section of the typical duct structure and the duct numbering. Include on each Cable Installation sheet.
  - total cable length (duct face to duct face plus the additional coil lengths for racking, terminating, and splicing) shall be identified between the civil infrastructures. For new civil installations, the duct face to duct face lengths shall be obtained from the "Duct Lengths" table located on the title sheet of the civil installation project drawings. Additional coil lengths are to be added to the duct face to duct face measurement based on the last bullet in Section 1.2.3.
    If the duct lengths are not available from the civil project drawings or previous cable installation drawings, measure duct runs at grade level using a measuring wheel from centre to centre of the cable chambers. Additional coil lengths are to be added to this measurement based on the last bullet in Section 1.2.3.
  - For each cable section (i.e. cable chamber to cable chamber) indicate the duct # (s) in which the new cable(s) and neutral (if required) will occupy. For 1/C cables include the phase identification (i.e. red, white, blue) with the duct #.
  - identify all applicable construction standards (such as cable racking, grounding, splicing, crossbonding etc.) in the general notes.
- When re-numbering existing equipment locations to the new standard, the new location number shall be shown in the vicinity of the equipment followed by the existing number in brackets.
- A "Cable Pulling Schedule" table shall be placed on the last cable installation sheet and will include the total cable requirements for the project. The table will identify the cable quantities, cable designation and location. Refer to the sample drawings for the table format.

1.3.1.4 Various Details

- This sheet shall serve as an appendix to the project and include any specific details of the project requiring graphic explanation not covered by a Construction Standard or that cannot be shown on the plan/profile sheet due to space restrictions. Examples of these details could include grounding details, duct bank cross-sections etc.
- Each detail shall make reference to the project drawing and sheet # from which it originates.

1.3.1.5 Reference Sheet

- The reference sheet will be used to indicate existing electrical plant in the project area.

1.3.2 Equipment Numbering

- New equipment numbering standards have been developed and are included in Section 21 of the Construction Standards.
- Location numbers for new equipment (with the exception of poles, tap boxes, vault or transformer switches and elbows) can be obtained through the "New Location Numbering Request Application" program accessible by clicking on the following link: http://mssvr06.torontohydro.com/nomenclature/login.jsp
- Designers must be identified in the Requestors list to access the program. If you are unable to access the program, contact the Supervisor of Asset Data Management-Investment Planning to get on the list.
- There is currently no harmonized labeling standard for primary cables/circuits. Until a standard has been developed the legacy labeling practices for the area shall be followed.
- In addition to the numbering of new equipment, some existing equipment within the limits of a project may require re-numbering as well. In general, the following guidelines shall apply for new projects:

  New Installations
  - All new equipment identified in Construction Standard 21-1000 shall be numbered to the new Standard.
  - For poles, the new Standard shall apply when:
    i. installing new pole lines;
    ii. replacing the majority of poles along an entire street or city block (the few remaining poles would be included in the re-numbering).

    For spot pole replacements or when not renumbering an entire street or block, use the legacy numbering standards for the area with the new numbering materials.

  Re-Numbering of Existing Equipment
  - All existing switchable devices (i.e. transformers, switches, elbows) within the limits of the project shall be re-numbered to the new standard.
  - Existing cable chambers within the limits of a project shall not be re-numbered.
  - Existing vaults within the limits of the project may be re-numbered provided the entire string or loop of vaults/pads can be re-numbered.
  - Existing poles within the limits of a project may be re-numbered to the new standard provided an entire street is completed; for example a side street where all the poles on the street are within the project scope.

- On the project drawings, both the new location number and former number (in brackets) will be shown.
- Location numbers for the re-numbering of existing equipment can also be obtained through the "New Location Numbering Request Application" program.

1.3.3 Symbology

The proposed new symbology standards have been finalized and will appear in GEAR as the former utililty record data is converted. The new symbols shall not be used for new projects until instructed. The new Symbology can be viewed by clicking on the following link:
http://thehub.torontohydro.com/gear/Users/SymbologyPage/SymbologyPage.html

1.4 Project Deliverables

Projects that are initiated through the Investment Plan are typically designed approx. one year in advance of construction. To ensure a seamless process between the design and construction phase, designers must be cognizant of the outstanding pre-construction requirements (i.e. cut permits, notifications etc.). To assist in this area, a Project Design Deliverables checklist (Appendix "B") has been developed and can be used by designers to ensure all required documentation is included and/or noted in the Design folder when signed-off. Upon construction approval, the Design folder will be returned to the designer for final assembly and for execution of the remaining "prior to construction" issues (i.e. to-do list, permits, notification letters etc.).

Customer Connections & Maintenance projects are primarily customer initiated. Project designs are completed and forwarded directly to construction to meet customer in-service dates. For these projects to proceed, the customer must meet all Toronto Hydro financial and legal requirements.

Section 2 - Rationale:

To ensure major civil project designs are aligned with business strategies and project design packages are delivered in a consistent fashion.

Section 3 - References:

- Standard Design Practice Template – SDP #000
- Toronto Hydro "Conditions of Service"
- Toronto Hydro Construction Standards
- Field Consultation Meeting – Terms of Reference
- Job Planning Process (Latest Version)
- As-Constructed Map Products Process (Latest Version)
- Work Breakdown Structure (Latest Version)
- Standard Practice SP #005 "Installation of SCADA Switches and Planning Guideline"
- City of Toronto Municipal Consent Requirements
- Ontario Regulation 22/04
- Electrical Safety Authority Technical Guidelines for Sections 6, 7 & 8.

APPENDIX “A”

UNDERGROUND CABLE INSTALLATIONS PROJECT DESIGN CHECKLIST

(Distribution Projects - Design)

Project Name: ______________________________

This checklist is intended to act as a guideline for the various activities involved in the design phase of an underground cable installation project. In addition, it includes those activities required in finalizing the project design package prior to issuing to construction. It should be kept in your working design file. Activities listed may not necessarily be in sequential order and may not apply to all major civil projects. The activities listed can be used as a reference in updating your departmental “Design Work Completion Report – Distribution”.

Item #	Design Activities	Date Completed (or) N/A
1	Review project scope package from Investment Planning.	
2	Assemble record maps and pertinent drawings.	
3	Define limits of the project design.	
4	Coordinate preliminary design meeting with Investment Planning, Investment Delivery, Program Management, Dist. Proj. - Construction, System Operations and other key stakeholders to review the project proposal (as required).	
5	Arrange Field Staff Consultation meeting (as per T of R) with area Construction Supervisor to: 1) Review the project. 2) Address construction issues 3) Identify the safety hazards associated with the project and measures to eliminate and/or control during construction phase.	
6	Prepare preliminary design concept and review with Design Supervisor.	
7	Forward “Design Scope Revision Request” form to Investment Planning for proposed revisions to original project scope (as required).	
8	Initiate project drawings through Project Wise.	
9	Prepare base maps.	
10	Prepare preliminary design utilizing certified construction standards and technical specifications and add to base maps.	
11	Make final revisions to drawings and include note on drawing indicating compliance with Section 7 of Ontario Regulation 22/04.	
12	Review designs with Supervisor and sign drawings.	
13	Prepare estimate and material requirements in Ellipse.	
14	Obtain the necessary external preliminary approvals as required.	
15	Arrange meeting with Construction Supervisor to review final design, validation of MU/LUs and obtain sign-off.	
16	Make necessary changes to estimate and finalize MU/LUs.	
17	Submit copy of the completed “Cable Pulling Schedule” table to Procurement to coordinate the purchase of specific cable lengths for feeder cables.	
18	Include “Steps and Conditions Chart” template for completion by Construction Supervisor/Crew Leader identifying the safety hazards and control measures to be used during the construction phase.	
19	Obtain sign-off/authorization from Design Supervisor on project estimate.	
20	Advise SCADA Services Dept. of projects involving the installation of any new automated switches.	
21	Prepare “Installed Units Summary” (WBS2) form.	

Item #	Design Activities	Date Completed (or) N/A
22	Prepare “Equipment Changeout Record” forms (as required).	
23	Submit list of unique P.O. #’s for the specific cable length reels to the Cable Installation Lead Hand.	
24	Complete “Prior to Construction” deliverables upon budget approval for construction.	
25	Confirm installation dates with SCADA Services Dept. for projects involving installation of new automated switches.	
26	Obtain final sign-off/approval from Design Supervisor on project drawings.	
27	Obtain P.Eng. approval if using legacy standards for new construction.	
28	Update status of project drawings in Project Wise from “Approved” state to “Issued”.	
29	Prepare project package in Ellipse.	
30	Prepare purchase requisition in Ellipse.	
31	Update as-constructed units and prepare final billing.	
32	Maintain approved project drawings and the “as-constructed” drawings in the department central filing system for a period of one year following the annual audit required under Ontario Regulation 22/04.	
33	Participate in Post Construction meeting, as required.	

UNDERGROUND CABLE INSTALLATIONS PROJECT DESIGN CHECKLIST

(Customer Connections & Maintenance)

Project Name: ______________________________

This checklist is intended to act as a guideline for the various activities involved in the design phase of underground cable installation projects. In addition, it includes those activities required in finalizing the project design package prior to issuing to construction. It should be kept in your working design file. Activities listed may not necessarily be in sequential order and may not apply to all major civil projects. The activities listed can be used as a reference in updating your departmental Project Tracking. (Investment Delivery are now responsible for the NPV calculations and Offer to Connects for projects involving customers of Class 3C, 4 & 5)

Item #	Design Activities	Date Completed (or) N/A
1	Receive Customer initiated project/initial contact with Customer by phone.	
2	Prepare and forward letter to customer outlining our requirements and the design costs.	
3	Receive Customer project details, construction schedule and drawings.	
4	For projects involving Customer Class 3C, 4 & 5 provide project details and contacts to Investment Delivery.	
5	Receive Customer design deposit. For projects involving Customer Class 3C, 4 & 5, Investment Delivery will submit design deposit request and receive payment from the Customer.	
6	Submit Project Notification Form (PNF) to PMO scheduling.	
7	Coordinate preliminary conceptual schematic meeting with Customer to review our requirements.	
8	Initiate project & TRIM files and obtain design work order number.	
9	Assemble record maps and pertinent drawings.	
10	Define limits of the project design.	
11	Coordinate preliminary design meeting with Investment Planning, Investment Delivery, Program Management, Dist. Proj. - Construction, System Operations and other key stakeholders to review the project proposal (as required).	
12	Forward completed “Feeder Request Form” to Investment Planning for approval.	
13	Receive approved “Transmittal and Feeder Request Form” from Investment Planning.	
14	Arrange Field Staff Consultation meeting (as per T of R) with area Construction Supervisor to: 4) Review the project. 5) Address construction issues 6) Identify the safety hazards associated with the project and measures to eliminate and/or control during construction phase.	
15	Prepare preliminary design concept and review with Design Supervisor.	
16	Initiate project drawings through Project Wise.	
17	Prepare base maps.	
18	Prepare preliminary design utilizing certified construction standards and technical specifications and add to base maps.	

Item #	Design Activities	Date Completed (or) N/A
19	Make final revisions to drawings and include note on drawing indicating compliance with Section 7 of Ontario Regulation 22/04.	
20	Review designs with Supervisor and sign drawings.	
21	Prepare Contractor (UPCMS) cost sheets (if required).	
22	Prepare estimate and material requirements in Ellipse.	
23	Design Supervisor to authorize project estimate in Ellipse.	
24	Prepare NPV calculation for expansion costs and install in the Economic Evaluation NPV Calculations folder on the shared y:\ drive. (for projects involving Customer Class 3C, 4 & 5 calculation shall be performed by Investment Delivery)	
25	Prepare and submit the Standard form and Contract to the Customer (for projects involving Customer Class 3C, 4 & 5, Investment Delivery shall provide the Legal Dept. with information required to prepare the “Offer to Connect”)	
26	Investment Delivery shall obtain the final draft “Offer to Connect” from Legal Dept. for approval and return to Legal Dept. for submission to the Customer.	
27	Prepare “Alternate Bid” if “Offer to Connect” is declined and forward to Legal Dept. for comment.	
28	Receive signed Contract from Customer (Investment Delivery receives signed “Offer to Connect” from the Customer).	
29	Received signed “Alternate Bid” from Customer.	
30	Send out “Supply Agreement” where applicable.	
31	Send out “Connection Agreement” where applicable.	
32	Receive signed “Supply Agreement” from Customer.	
33	Receive signed “Connection Agreement” from Customer.	
34	Receive “Letter of Credit” from Customer (by Investment Delivery).	
35	Receive full payment from Customer (by Investment Delivery).	
36	Obtain the necessary external final approvals/permits as required.	
37	Arrange meeting with Construction Supervisor to review final design, validation of MU/LUs and obtain sign-off.	
38	Make necessary changes to estimate and finalize MU/LUs.	
39	Submit copy of the completed “Cable Pulling Schedule” table to Procurement to coordinate the purchase of specific cable lengths for feeder cables.	
40	Include “Steps and Conditions Chart” template for completion by Construction Supervisor/Crew Leader identifying the safety hazards and control measures to be used during the construction phase.	
41	Obtain sign-off/authorization from Design Supervisor on project estimate.	
42	Obtain final drawing Approval from Supervisor and stamp drawings "Approved for Construction".	
43	Order prints for construction.	
44	Advise SCADA Services Dept. of projects involving the installation of new automated switches.	
45	Update status of project drawings in Project Wise from “Approved” state to “Issued”.	
46	Prepare “Installed Units Summary” (WBS2) form.	
47	Prepare “Equipment Changeout Record” forms (as required).	
48	Prepare project package in Ellipse.	
49	Prepare purchase requisition in Ellipse.	
50	Prepare Work Order and Job Cards.	

Item #	Design Activities	Date Completed (or) N/A
51	Submit list of unique P.O. #'s for the specific cable length reels to the Cable Installation Lead Hand.	
52	Prepare Construction folder.	
53	Design Supervisor to sign-off on Construction folder.	
54	Submit "Notice of Project" to Ministry of Labour.	
55	Forward Construction folder to Project Management.	
56	Distribute approved project drawings to internal parties as per "Drawing Circulation List"; see attached Appendix "C".	
57	Obtain P.Eng. approval if using legacy standards for new construction.	
58	Arrange pre-construction site meeting with construction, contractor (as required) and other authorities.	
59	Update as-constructed units and prepare final billing.	
60	Arrange billing session with Contractor upon completion of cable installation (if required).	
61	Notify Legal Dept. and Investment Delivery upon project completion.	
62	Maintain approved project drawings and the "as-constructed" drawings in the department central filing system for a period of one year following the annual audit required under Ontario Regulation 22/04.	
63	Purge project folder and submit to TRIM System for archiving.	
64	Close all remaining material requirements with Demand Management.	
65	Participate in Post Construction meeting, as required.	

APPENDIX "B"
PROJECT DESIGN DELIVERABLES

Project Name: ______________________ IP Project No.: ______________________

Design / Construction Project No.: ______________________

Construction Estimate $ ______________________ Estimate # ______________________

Legend: **X -** *Items are Mandatory*

✓ - *Additional items to be included if applicable to the project*

Deliverables	Customer Connections & Maintenance	Distribution Projects: Design Completion	Distribution Projects: Prior to Construction
Project documents filed in appropriate folder	X	X	X
Completed "Installed Units Summary" (Work Breakdown Structure II form)	X	X	X
Drawings – 1 full size set. Each drawing to include the following note above the title block "DESIGN COMPLETE - SUBJECT TO FINAL APPROVAL".		X	
Remove the note "DESIGN COMPLETE-SUBJECT TO FINAL APPROVAL" from the drawings.			X
Approved Project drawings – full & ½ size sets (see attached Appendix "C")	X		X
"Requirement Summary" from Ellipse (Job Estimating - MSQ655) of the resource, vehicle and material requirements.	X	X	X
"Equipment Changeout Record" forms for key assets (as required).	✓	✓	✓
Construction Estimate break down (e.g. material, labour, O/H, U/G Civil etc.) through Ellipse	X	X	X
Draft request form for Cut Permit.			
Draft Approval & Notification letters etc.		✓	
Prepare a "To do" list of outstanding issues to be addressed prior to construction start.		X	
Preliminary Civil Contract Unit Price/Tender Package.			
'Notice of Project' – The Occupational Health & Safety Act – with any necessary sketch(es)/drawing(s) attached – **for projects with Hydro portion over $50,000.00**	X (1 Completed copy)	X (1 Completed copy)	X (1 Completed copy per trade)
'Steps & Conditions' chart	✓ (1 copy)	X (1 copy)	X (8 copies)
Job Cards	X		
Cover Sheet	X		
Action Log and Minutes from Field Staff Consultation Meeting	✓	✓	
Notification letters, etc issued.	✓		✓
City Cut Permit and other Permits.			
Include existing Feeder Prints/Concession Maps, showing the proposed mark-ups as required by the area Control Centre.	✓	✓	
For 'Unit Price' contract, attach UNIT PRICE SHEET with estimated price			
Tender Package			
Tender Items List			
Technical Specification			
Price Schedule			
Project Information			
Tender Estimate			
Joint Use civil drawings, billing details & forms			
Stakeout & Locates			
Attach Easement Agreements / Letters of Understanding.			

Additional Comments: ______________________

Design Supervisor: ______________ Ext. ________ Date: ________

Designer: ______________ Ext. ________ Date: ________

APPENDIX “C” 16-June-06

Issue for Construction - Drawing Distribution Chart

9-Jan-04

Department	Location & Contact	CIVIL DRAWINGS		CIVIL/ELECT DRAWINGS		ELECT DRAWINGS		STR LGHTG DRAWINGS	
		Full	Half	Full	Half	Full	Half	Full	Half
	MANDATORY								
Investment Planning	**Tony Nguyen** 500 Commissioner St. 3rd Flr		1		1		1		
Records	**Robert McNabney** 500 Commissioner St. 3rd Flr		1		1		1		1
Cable Locates	**Robert Gregoris** 28 Underwriters Rd.		1		1				
Operations	**Hilton Meade** Control Centre 5800 Yonge St.				1	1			
Field Supervisor	Drawings	2	4	2	4	2	4	2	1
Originating Dept.	Dept File Copy (1) Design Supervisor (1)		2		2		2		2
	ONLY WHEN REQUIRED - "Need to be identified by Design Technician"								
Station & Network	**Herman Thissen** 500 Commissioners St		1		1	1			
CROMS Mtce	**Joe Waite** Control Centre 5800 Yonge St.		1		1	1			
Operations	**Charlene Mueller** Control Centre 5800 Yonge St.				1	1			
Customer Accounts	**Grace Chau** 5800 Yonge St				1				
Cust. Conn. & Maintenance Staking Group	**Dave Graham** 28 Underwriters Rd.	2		2		1		2	
Unit Price Civil	Drawings Cost Summary Sheets	4	2	4	2			4	2
QA/QC Inspection	**Earl Galaski** 500 Commissioners St	4	2	4	2	4	2	4	2
	TOTAL DRAWINGS	12	15	12	17	11	9	12	7

TORONTO HYDRO
UNDERGROUND INSTALLATION
W6073 KING ST
U / G ROUTE OF VC B – 5 – 6 – 9 – PQ

THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS AND APPROVED EQUIPMENT AND MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF THE ONTARIO REGULATION 22/04.

GENERAL NOTES

BY CONTRACTOR

GENERAL

1. WHOLE NUMBERS INDICATE MILLIMETRES. DECIMALIZED NUMBERS INDICATE METRES.
2. LOCATION OF OTHER UTILITIES SHOWN ON TRENCH DRAWINGS ARE ASSUMED UNLESS OTHERWISE NOTED.
3. AS PER THE REQUIREMENTS OF BILL 208, THE FOLLOWING "DESIGNATED SUBSTANCES" MAY BE ENCOUNTERED ON THE PROJECT:
   - ASBESTOS – CABLES AND DUCTS
   - LEAD – PILC AND AILC CABLES, METER BACKER BOARDS, LISTING TAPE AND OLDER STATION BATTERIES
   - VINYL CHLORIDE – 4" PVC DUCTS AND PVC JACKETED CABLES
   - ARSENIC – ARSENICAL LEAD SHEATHED CABLES
   - ETHYLENE OXIDE – POLYETHYLENE INSULATED CABLES
   - SILICA – CURRENT LIMITING FUSES AND LIGHTNING ARRESTERS(4kV)
4. MINIMUM HORIZONTAL CLEARANCES FROM FOREIGN UTILITIES SHALL BE MAINTAINED IN ACCORDANCE WITH APPENDIX O OF THE CITY OF TORONTO'S MUNICIPAL CONSENT REQUIREMENTS. FOR CLEARANCES, REFER TO TORONTO HYDRO'S STANDARD 31–0100.

EXISTING UTILITIES

5. ARRANGE FOR "HOLD–OFFS" AND USE EXTREME CAUTION WHEN WORKING IN THE VICINITY OF ENERGIZED EQUIPMENT OR CABLES.
6. ANY DAMAGE TO THE EXISTING UTILITIES IS TO BE DOCUMENTED AND WILL REQUIRE IMMEDIATE REPAIR. THE COST OF THE REPAIR IS TO BE BORNE BY THE CONTRACTOR.

TRENCHING AND DUCT INSTALLATION

7. TRENCH, SUPPLY AND INSTALL 100mm CONCRETE ENCASED DUCTS ON BOULEVARD AND ROAD CROSSINGS AS PER CONSTRUCTION DRAWINGS AND STD. 31–1100, 31–1120, 31–1130, 31–1150 AND 31–1160. STUBBED DUCTS TO EXTEND 1.5m PAST CURB UNLESS OTHERWISE SPECIFIED. ALL ASPHALT CUTS TO BE DONE BY SAW.
8. CONTRACTOR MUST COMPLETE ALL CIVIL CONSTRUCTION PRIOR TO HANDING OVER THE CONSTRUCTION SITE TO TORONTO HYDRO FOR ELECTRICAL INSTALLATION.
9. AT INTERSECTIONS, STUBBED DUCTS IN ROAD CROSSINGS TO EXTEND 1.5m PAST SIDEWALK UNLESS OTHERWISE SPECIFIED. ALL ASPHALT CUTS TO BE DONE BY SAW.

VAULT/TAPBOX INSTALLATION

10. CORE DRILL NEW AND EXISTING VAULTS/FOUNDATIONS/CABLE CHAMBERS WHERE EXTRA DUCTS ARE REQUIRED TO ENTER VAULT/FOUNDATIONS/CABLE CHAMBERS.
11. THE CONTRACTOR SHALL OVERDIG EXISTING HYDRO, BELL OR ROGERS CABLES TO ALLOW SUFFICEINT SLACK FOR THE PLACEMENT OF HYDRO PLANT AS REQUIRED.

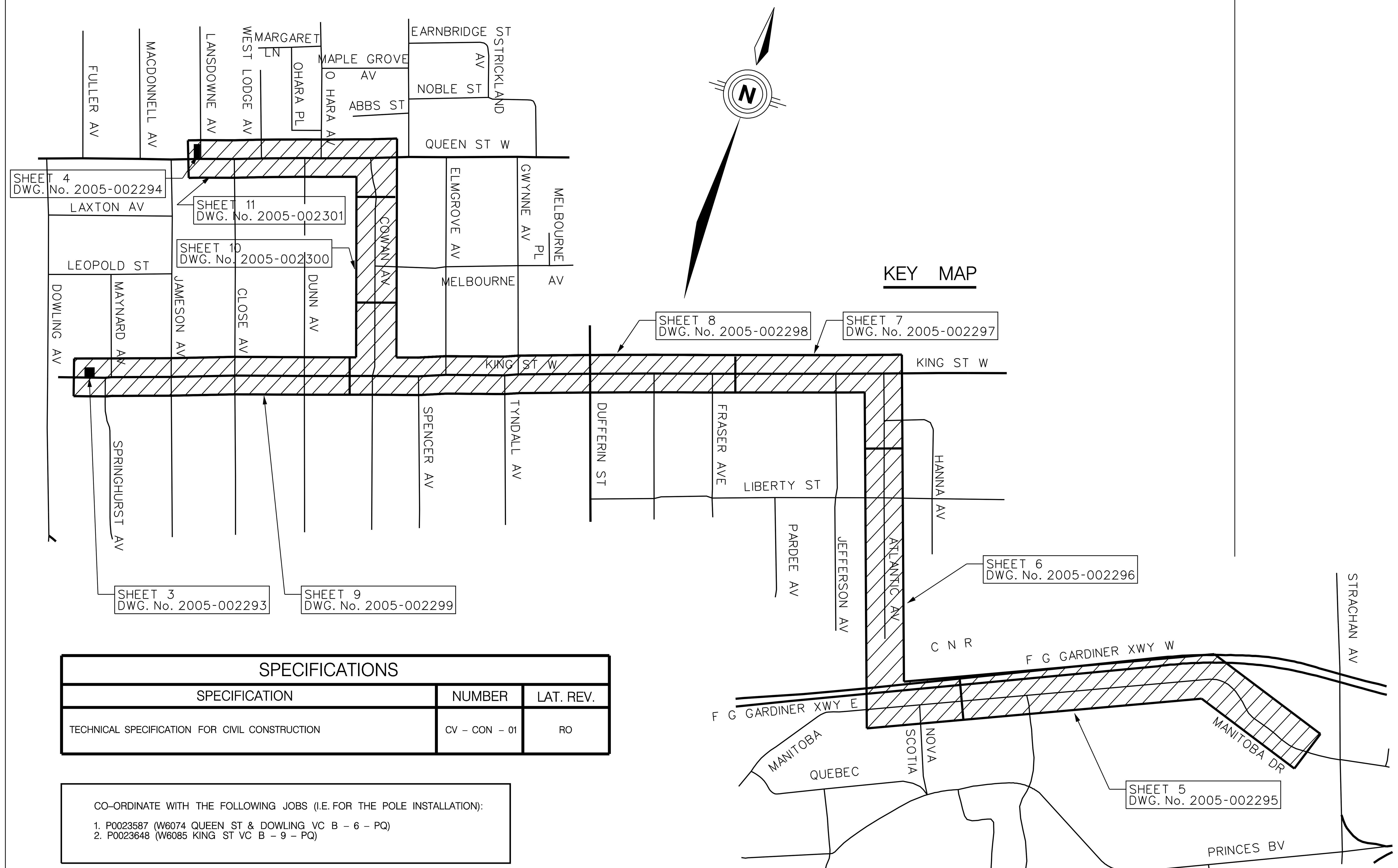
BY TORONTO HYDRO

CABLE INSTALLATION

12. INSTALL PRIMARY, SECONDARY AND SERVICE CABLES AS PER CONSTRUCTION DRAWINGS. SEAL DUCT ENDS.
13. LEAVE 5.0m COILS OF PRIMARY CABLES IN TRANSFORMER VAULTS/STATIONS AND 3.0m COILS IN SPLICE BOXES/VAULTS. LEAVE 5.0m COILS OF SECONDARY CABLES IN SUBMERSIBLE VAULTS AND 1.5m COILS IN TAP BOXES. WATERPROOF ALL CABLE ENDS.

PRIMARY AND SECONDARY

14. SUBSTATION DEPARTMENT TO HANDLE ALL CABLE (EG. RECOVER, INSTALL, TERMINATE) WITHIN TRANSFORMER STATIONS.



SAMPLE DRAWINGS FOR SDP #005

STANDARD DRAWINGS

STANDARD DRAWING	NUMBER	LAT. REV.
3–PH LIS SWITCH MANUALLY OPERATED 13.8KV FEEDER RISER	10 – 2400 (TH)	03 – 07 – 02
TEMP. ATTACHMENT OF PRIMARY CABLES ON POLE	12 – 1100 (TH)	03 – 03 – 11
CABLE GUARD, CONCRETE/WOOD POLE	12 – 1200 (TH)	03 – 03 – 11
SIM. TO PRIMARY SVC RISER 13.8KV	12 – 3550 (TH)	03 – 03 – 11
TABLE OF RATINGS OF CABLES 13.8KV, TRXLPE CABLES	16 – 1060 (TH)	00 – 10 – 02
PRIMARY – TRXLPE – STRAIGHT JOINT	16 – 3700 (TH)	00 – 10 – 23
PRIMARY – TRXLPE – WYE JOINT, HEAT SHRINK, 15KV	16 – 3940 (TH)	00 – 11 – 24
TRXLPE CABLE TERMINATION INDOOR, 15KV	16 – 4060 (TH)	00 – 11 – 25
TRXLPE CABLE TERMINATION OUTDOOR, 15KV	16 – 4100 (TH)	00 – 11 – 25
CABLE TAGGING AT SWITCHGEAR AND CABLE CHAMBERS	21 – 5010 (TH)	01 – 09 – 10
UNDERGROUND CLEARANCES	31 – 0100 (TH)	02 – 06 – 24
CONCRETE ENCASED DUCT BANK	31 – 1120 (TH)	02 – 07 – 11
LAYING DUCTS USING SPACERS	31 – 1130 (TH)	02 – 06 – 20
DEPTH OF CONDUITS	31 – 1150 (TH)	00 – 06 – 20
CAPPING PROPOSED DUCTS FOR FUTURE EXTENSION	31 – 1160 (TH)	00 – 12 – 30
DIVERTING DUCT BANK	31 – 1170 (TH)	02 – 07 – 11
DUCT NUMBERING	31 – 1180 (TH)	00 – 12 – 19
TRANSFORMATION OF DUCT BANKS	31 – 1190 (TH)	00 – 12 – 12
INSTALLATION OF DUCTS FROM POLES	31 – 1220 (TH)	02 – 07 – 11
WALL REINFORCEMENT AT OPENINGS FOR DUCT ENTRY	31 – 2220 (TH)	00 – 12 – 20
WALL REINFORCEMENT AT OPENINGS FOR DUCT ENTRY ON AN IN–LINE POLE	E–17–TP–3200 (TO)	97 – 03 – 11
OH SWITCHES: LI, 3–PH, L–HAND MANUALLY OPERATED FEEDER RISER ON AN IN–LINE POLE	E–17–TP–3260 (TO)	97 – 03 – 12

SPECIFICATIONS

SPECIFICATION	NUMBER	LAT. REV.
TECHNICAL SPECIFICATION FOR CIVIL CONSTRUCTION	CV – CON – 01	RO

CO–ORDINATE WITH THE FOLLOWING JOBS (I.E. FOR THE POLE INSTALLATION):

1. P0023587 (W6074 QUEEN ST & DOWLING VC B – 6 – PQ)
2. P0023648 (W6085 KING ST VC B – 9 – PQ)

DRAWINGS FOR P0023535

SHEET	DWG No.	DESCRIPTION	SHEET	DWG No.	DESCRIPTION
1	2005 – 002291	TITLE SHEET	2	2005 – 002292	PRIMARY SCHEMATIC
3	2005 – 002293	PLAN	4	2005 – 002294	PLAN
5	2005 – 002295	CABLE INSTALLATION	6	2005 – 002296	CABLE INSTALLATION
7	2005 – 002297	CABLE INSTALLATION	8	2005 – 002298	CABLE INSTALLATION
9	2005 – 002299	CABLE INSTALLATION	10	2005 – 002300	CABLE INSTALLATION
11	2005 – 002301	CABLE INSTALLATION			

APPROX. CUT REPAIRS

ROADWAYS	+/–	12.5	sq m
CONCRETE SIDEWALK	+/–	7.0	sq m
CURB	+/–	5.0	m
OTHER	+/–		sq m

ENERGY BILLING

CHANGES	QUANTITY	TYPE
ADD	—	—
DELETE	—	—
NO CHANGE	X	X

rev.		date	description	by	appd.

TORONTO HYDRO (WEST)
TORONTO DISTRICT

toronto hydro

drawn by: L. WONG	civil design: L. WONG	date yy / mm / dd: / /
ip reference #: W6073	civil approval: J. MELLOR	date yy / mm / dd: / /
ellipse project #: P0015533	electrical design: L. WONG	date yy / mm / dd: / /
construction project #: P0023535	electrical approval: J. MELLOR	date yy / mm / dd: / /
scale: N.T.S.	construction approval: S. POLAK	date yy / mm / dd: / /

dwg. title:

W6073 KING ST UG VC
B – 5 – 6 – 9 – PQ

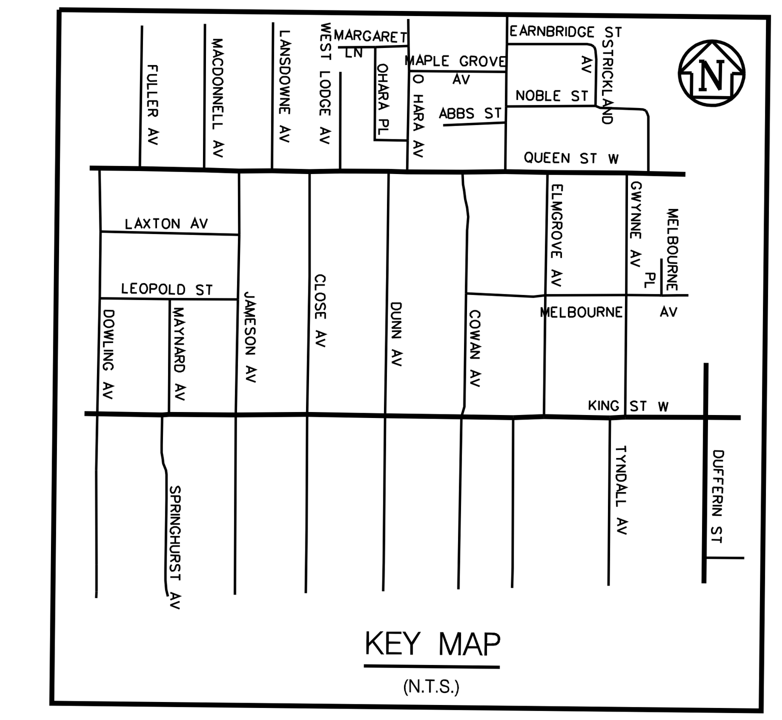
TITLE SHEET

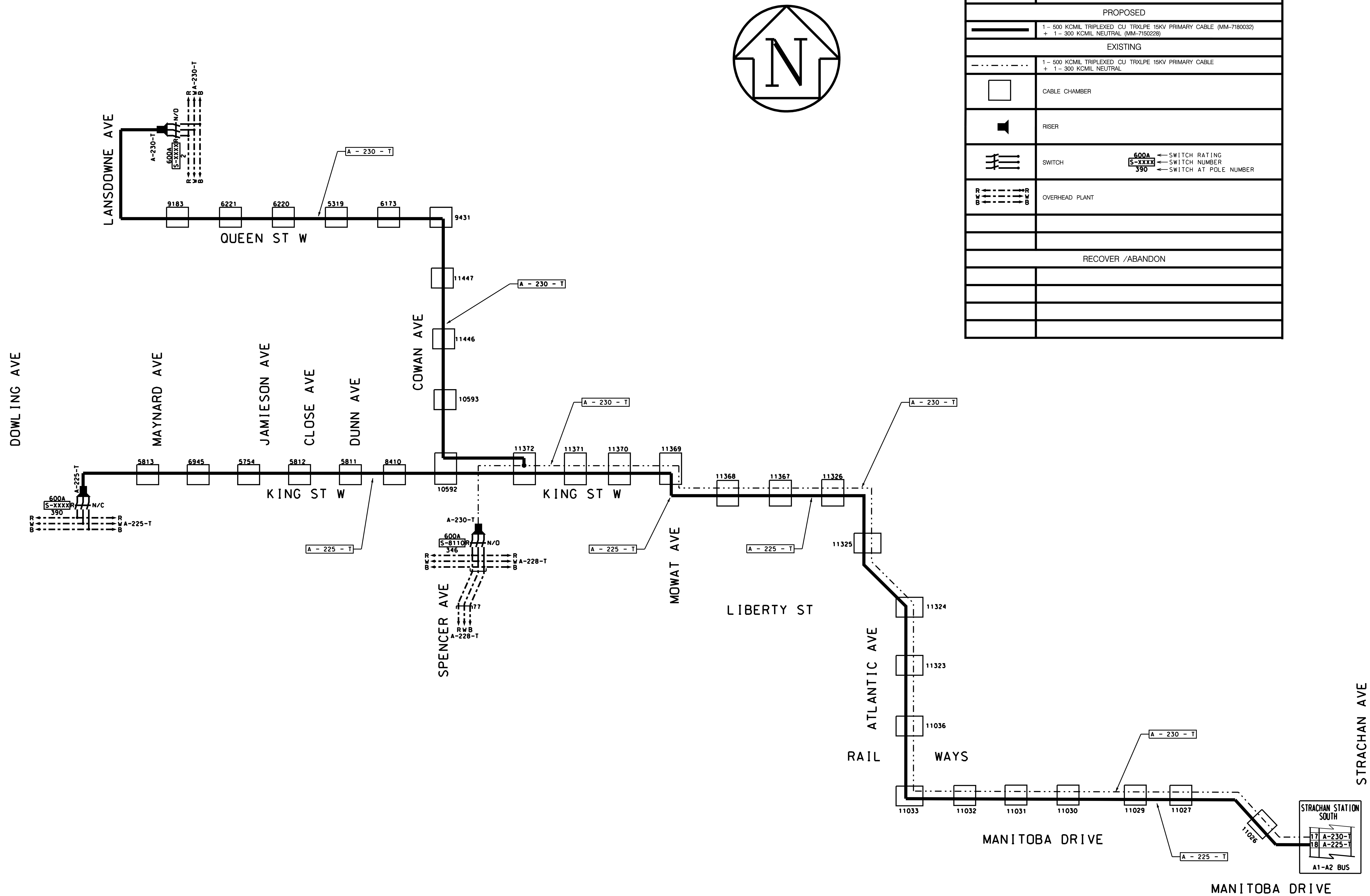
dwg. no.	sheet no.	rev. no.
2005 – 002291	1	

$$date$$

REFER TO TITLE SHEET DRAWING #2005 – 002291
FOR ACCOMPANYING PROJECT DRAWING

LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
	1 – 500 KCMIL TRIPLEXED CU TRXLPE 15KV PRIMARY CABLE (MM-7180032) + 1 – 300 KCMIL NEUTRAL (MM-7150228)
EXISTING	
	1 – 500 KCMIL TRIPLEXED CU TRXLPE 15KV PRIMARY CABLE + 1 – 300 KCMIL NEUTRAL
	CABLE CHAMBER
	RISER
	SWITCH 600A ← SWITCH RATING; S-XXXX ← SWITCH NUMBER; 390 ← SWITCH AT POLE NUMBER
	OVERHEAD PLANT
RECOVER /ABANDON	





SAMPLE DRAWINGS FOR SDP #005

rev.	date	description	by	appd.

TORONTO HYDRO (WEST)
TORONTO DISTRICT

toronto hydro

drawn by: L. WONG	civil design	date yy / mm / dd
ip reference #: W6073	civil approval	date yy / mm / dd
ellipse project #: P0015533	electrical design: L. WONG	date yy / mm / dd
construction project #: P0023535	electrical approval: L.MELLOR	date yy / mm / dd
scale: N.T.S.	construction approval: S. POLAK	date yy / mm / dd

dwg. title:

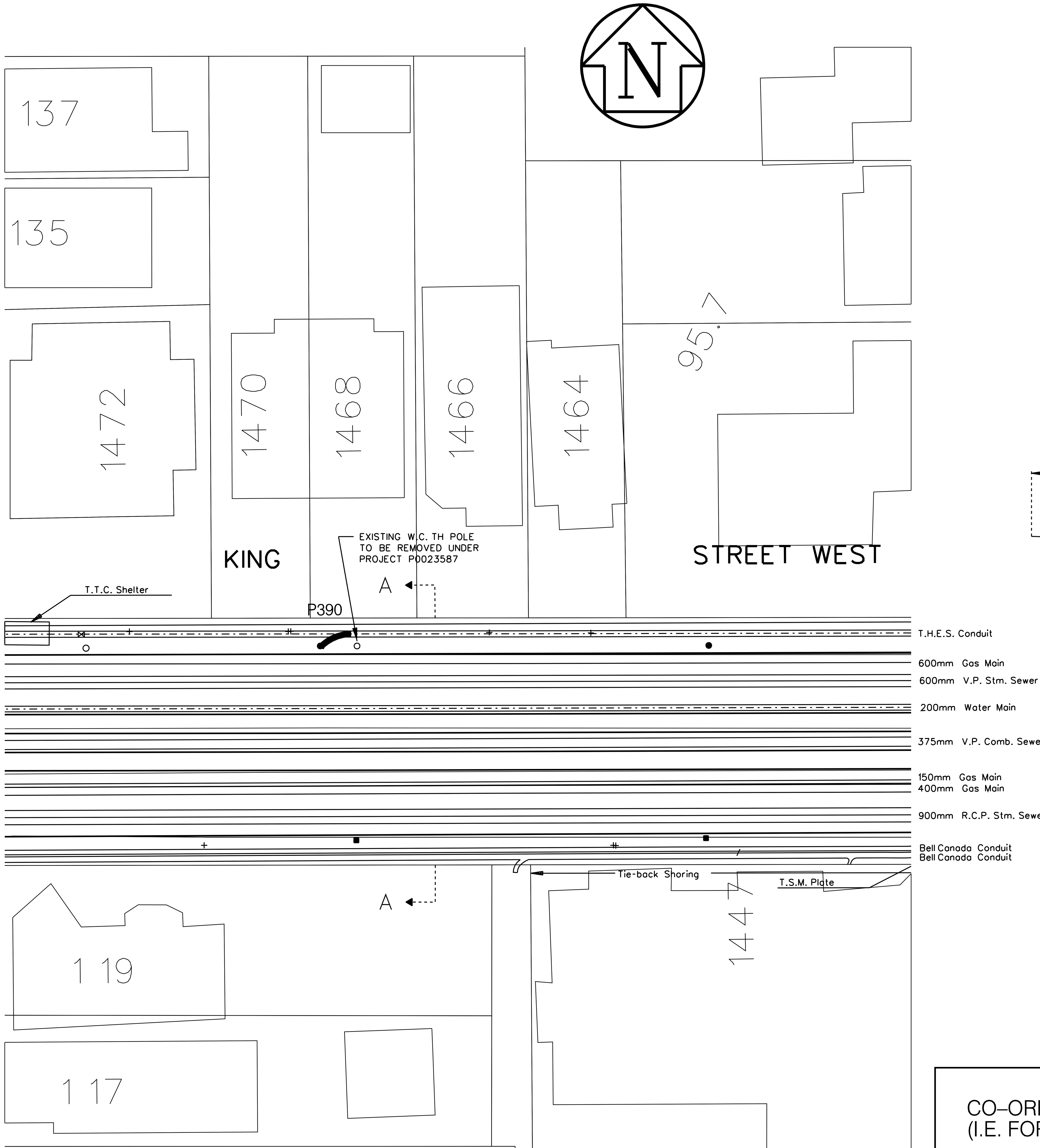
W6073 KING ST UG VC
B – 5 – 6 – 9 – PQ

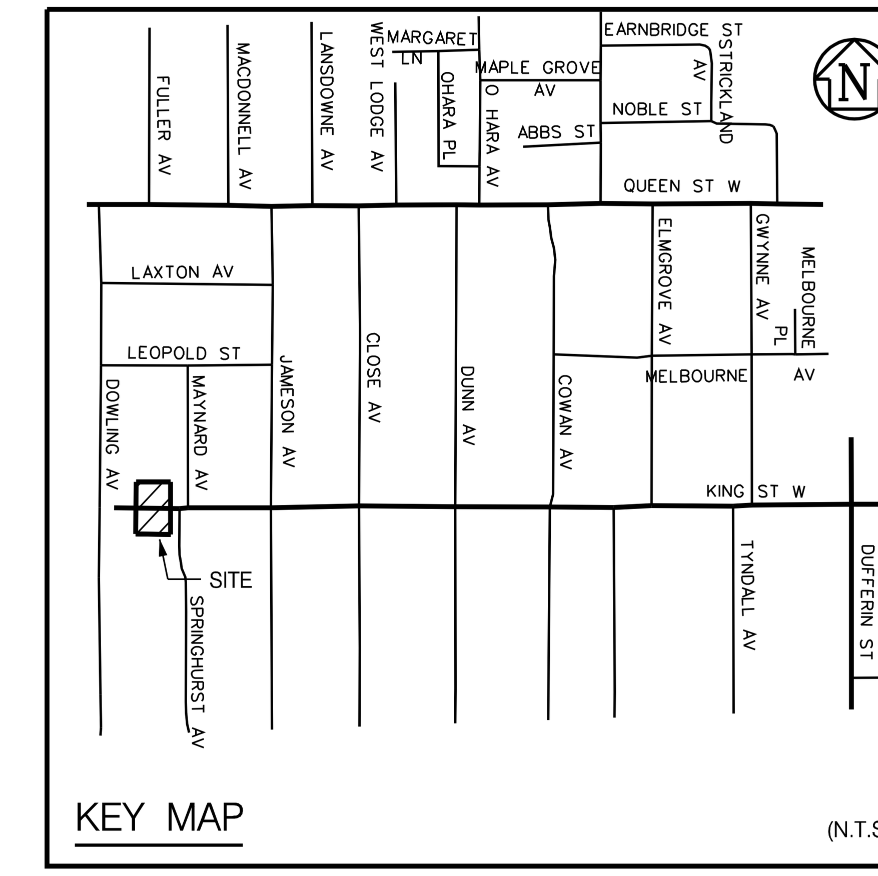
PRIMARY SCHEMATIC

dwg. no.: 2005 – 002292 | sheet no.: 2 | rev. no.:

LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
▬	3 – 100mm DUCTS FROM EXISTING DUCT STRUCTURE TO TERM. POLE
EXISTING	
●	W.C. POLE
– – – –	DUCT STRUCTURE

REFER TO TITLE SHEET DRAWING #2005 – 002291
FOR ACCOMPANYING PROJECT DRAWING

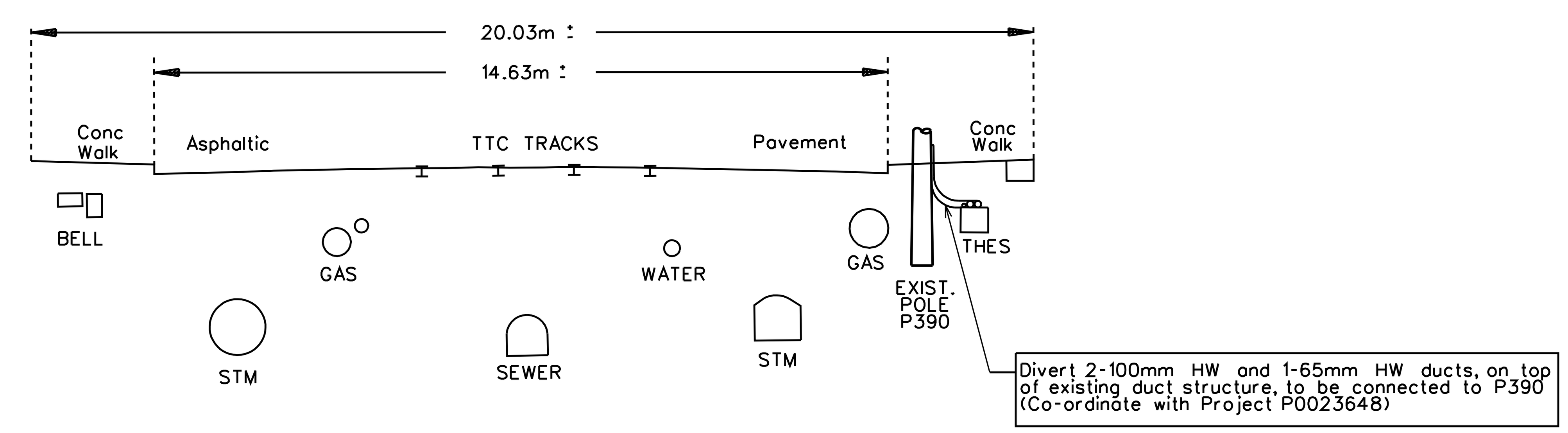




NOTES

BY CONTRACTOR

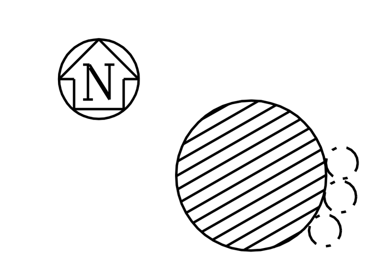
1. BREAK INTO EXISTING DUCT STRUCTURE AND DIVERT 3 - 100 mm DUCTS TO P390 KING STREET WEST (I.E. DUCTS • 7, 8 AND 9)
2. INSTALL SHORT G.I. BENDS AT P390 KING STREET WEST
3. PLUG DUCTS IN CC5814 (KING/DOWLING), WHICH IS WEST OF CC5813 (KING/MAYNARD)



A —— A

SCALE 1:100
LOOK WEST

SAMPLE DRAWINGS FOR SDP #005



P390
DUCTS 7, 8 AND 9
C/W SHORT G. I. BENDS ON THE EAST SIDE OF POLE

CO–ORDINATE WITH THE FOLLOWING JOBS
(I.E. FOR THE POLE INSTALLATION):

1. P0023587 (W6074 QUEEN ST & DOWLING VC B – 6 – PQ)
2. P0023648 (W6085 KING ST VC B – 9 – PQ)

rev.	date	description	by	appd.
--	--------		----	----

toronto hydro

TORONTO HYDRO (West)
TORONTO DISTRICT

drawn by: L. WONG	civil design: L. WONG	date yy/mm/dd
ip reference #: W06073	civil approval: J. MELLOR	date yy/mm/dd
ellipse project #: P0015533	electrical design: L. WONG	date yy/mm/dd
construction project #: P0023535	electrical approval: J. MELLOR	date yy/mm/dd
scale: 1:200	construction approval: S. POLAK	date yy/mm/dd

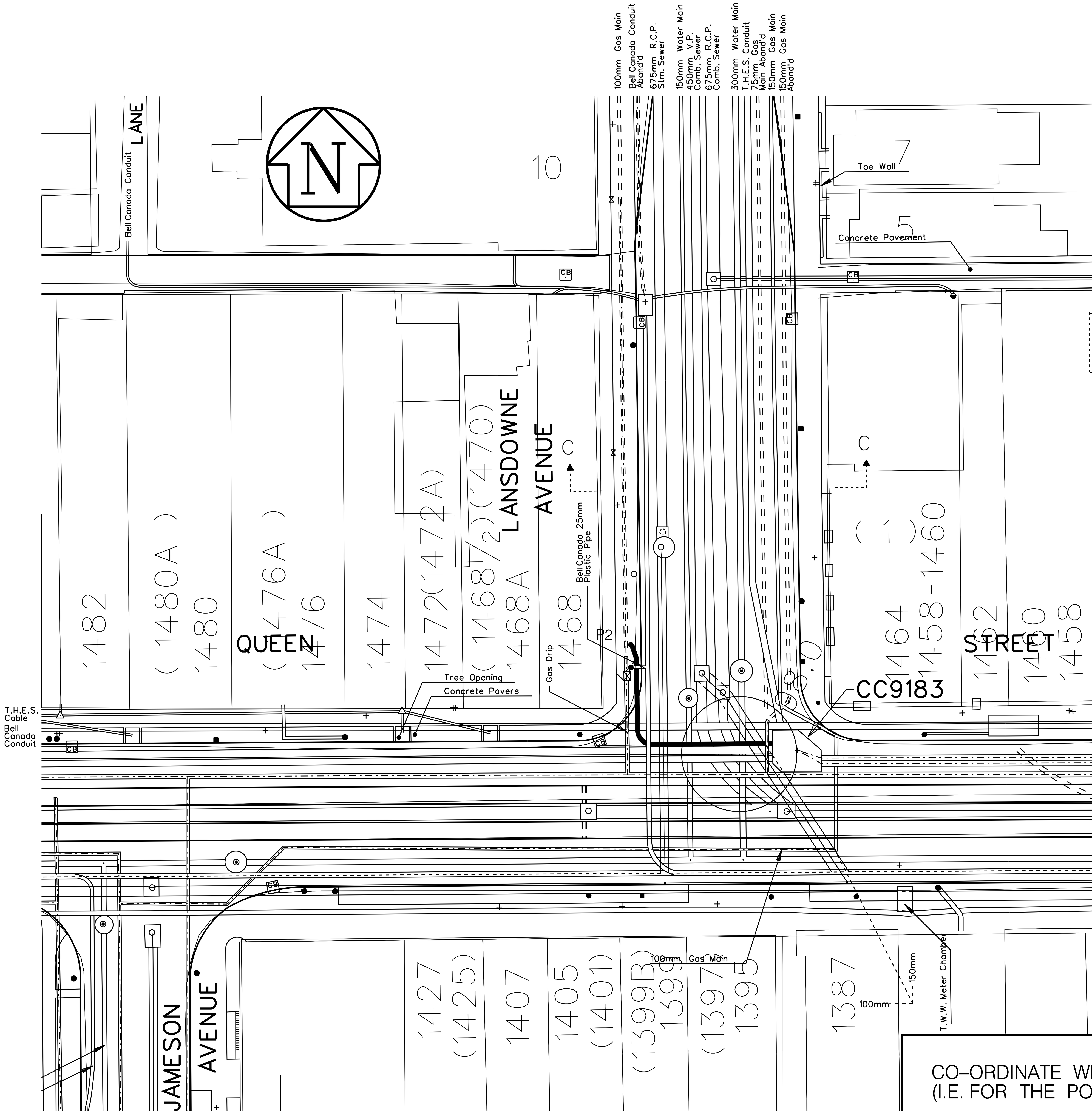
dwg. title:
W06073 KING ST UG VC
B – 5 – 6 – 9 – PQ

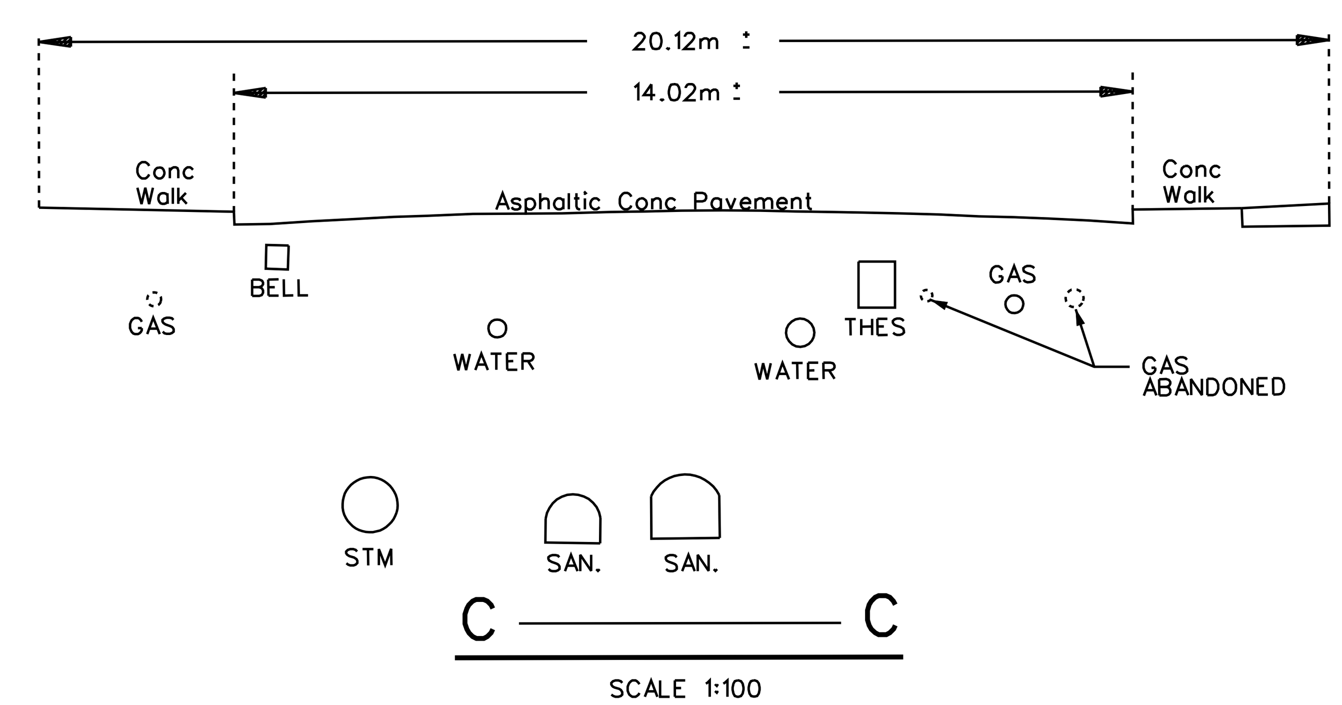
PLAN

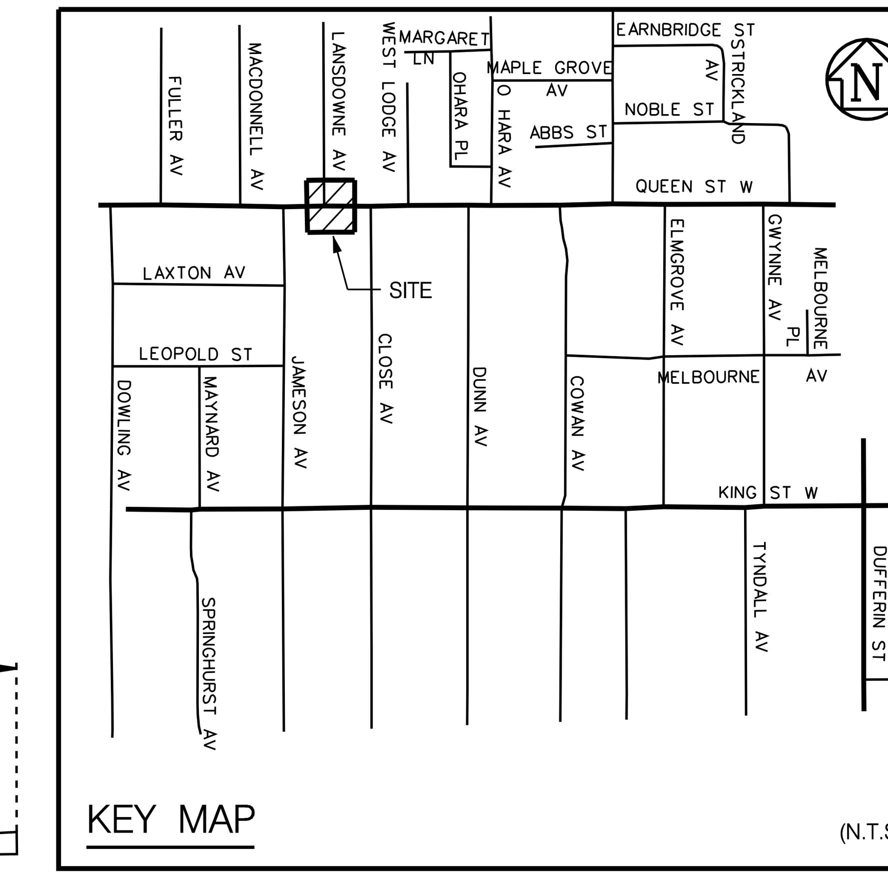
dwg. no.	sheet no.	rev. no.
2005 – 002293	3	

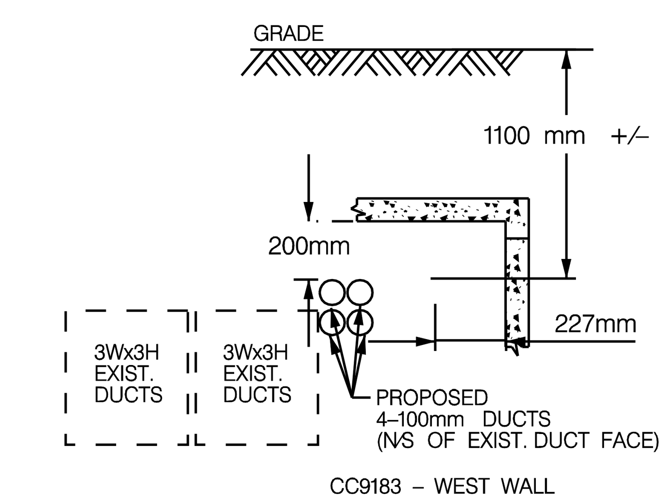
REFER TO TITLE SHEET DRAWING #2005 – 002291 FOR ACCOMPANYING PROJECT DRAWING

LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
(heavy line)	4 – 100mm DUCTS FROM EXISTING CABLE CHAMBER TO TERM. POLE
EXISTING	
●	W.C. POLE
(duct line)	DUCT STRUCTURE
(chamber symbol)	CABLE CHAMBER 9183 (CC9183)







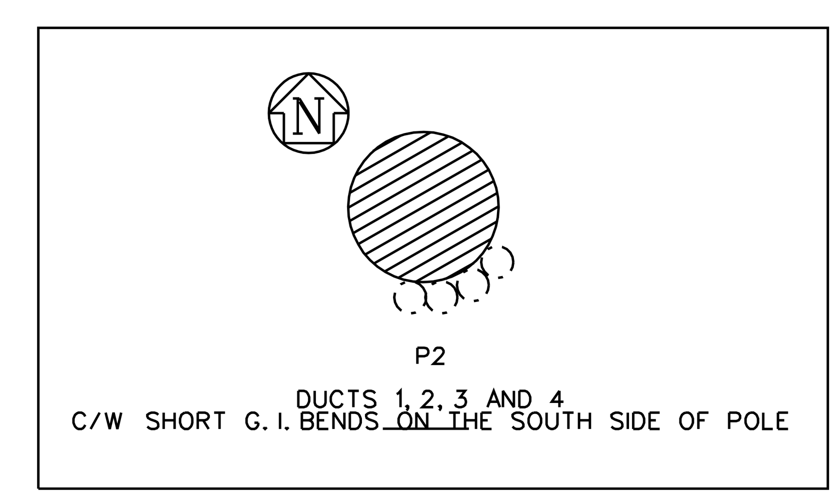


NOTES

BY CONTRACTOR

1. CORE DRILL WEST WALL OF CC9183 (QUEEN/LANSDOWNE, N/E CORNER) FOR 4-100mm DUCTS.
2. INSTALL 20.0 m+/- OF 4-100mm DUCTS FROM CC9183 TO TERMINATION POLE P2 LANSDOWNE AVENUE (SEE DRAWING).
3. INSTALL SHORT G.I. BENDS AT P2 LANSDOWNE AVENUE.

SAMPLE DRAWINGS FOR SDP #005



CO-ORDINATE WITH THE FOLLOWING JOBS
(I.E. FOR THE POLE INSTALLATION):

1. P0023587 (W6074 QUEEN ST & DOWLING VC B – 6 – PQ)
2. P0023648 (W6085 KING ST VC B – 9 – PQ)

rev.	date	description	by	appd.

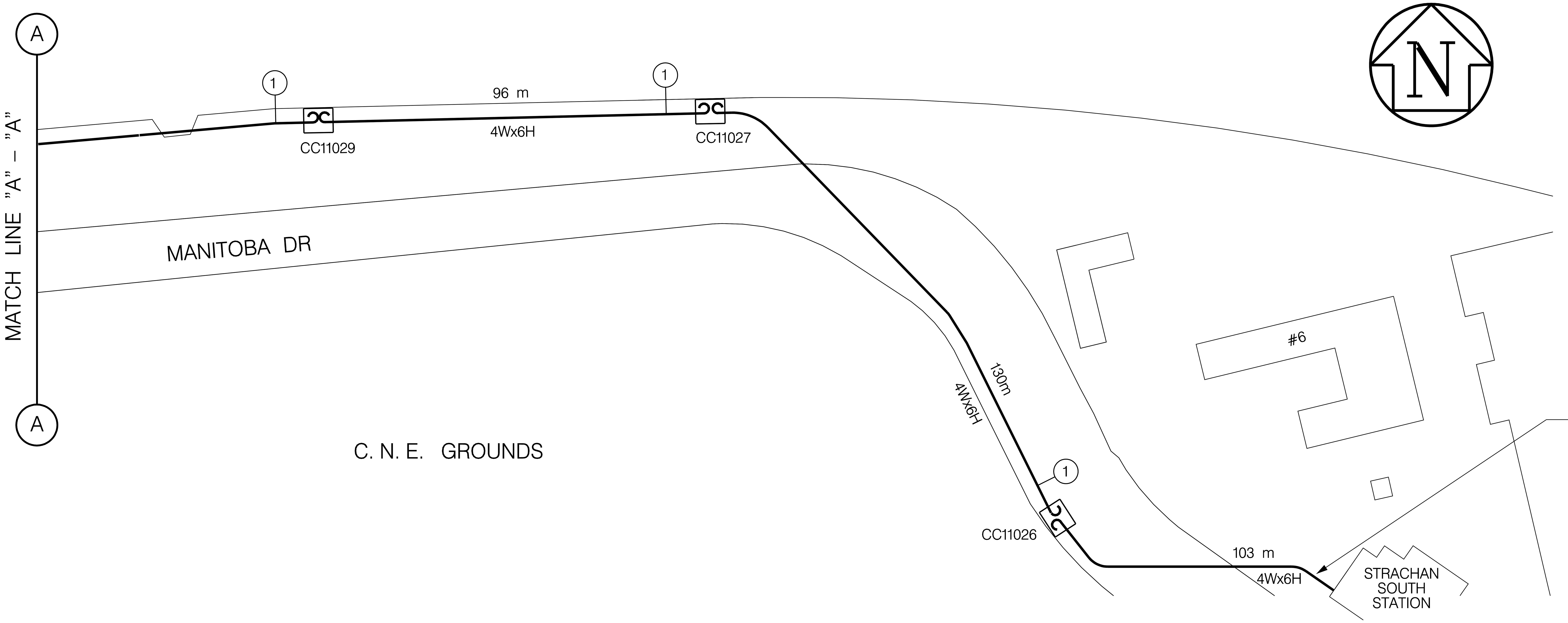
TORONTO HYDRO (West)
TORONTO DISTRICT
toronto hydro

drawn by: L. WONG	civil design: L. WONG	date yy/mm/dd
ip reference #: W06073	civil approval: J. MELLOR	date yy/mm/dd
ellipse project #: P0015533	electrical design: L. WONG	date yy/mm/dd
construction project #: P0023535	electrical approval: J. MELLOR	date yy/mm/dd
scale: 1:200	construction approval: S. POLAK	date yy/mm/dd

dwg. title: W06073 KING ST UG VC B – 5 – 6 – 9 – PQ

PLAN

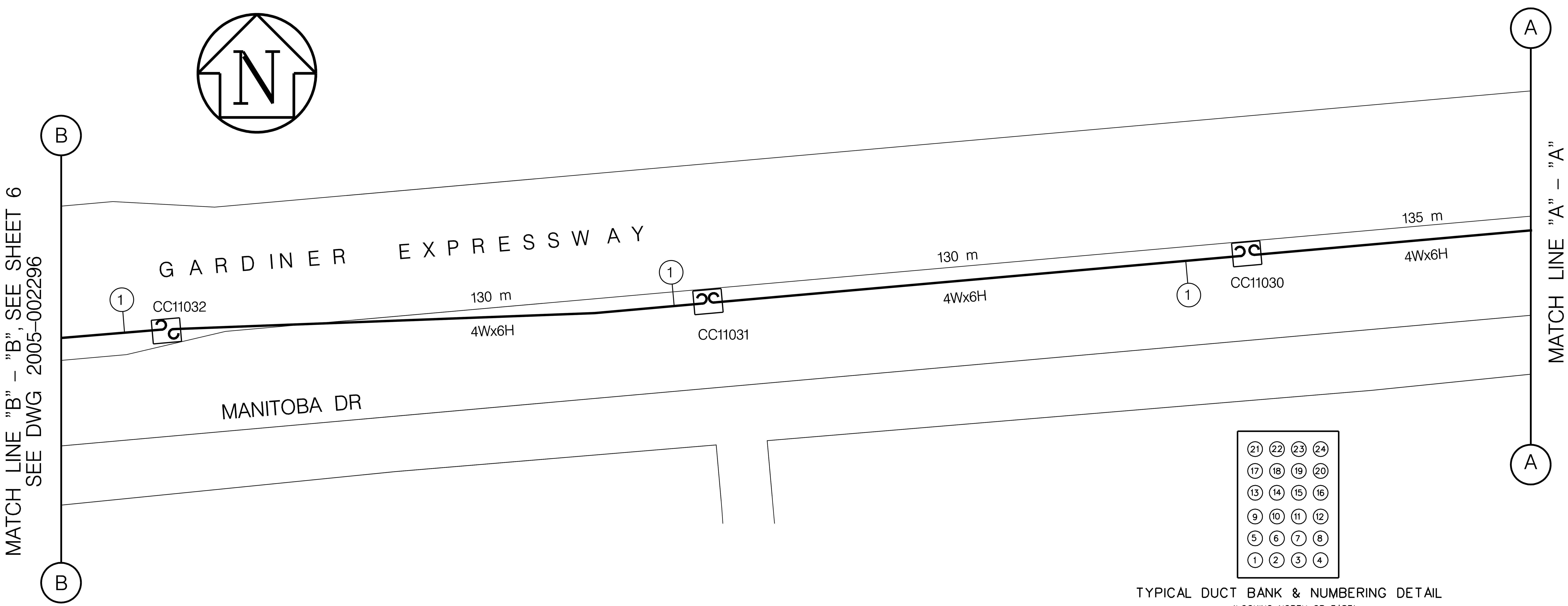
dwg. no. 2005 – 002294 | sheet no. 4 | rev. no.



REFER TO TITLE SHEET DRAWING #2005 – 002291
FOR ACCOMPANYING PROJECT DRAWING

LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
	1 – 500 KCMIL TRIPLEXED CU TRXLPE 15KV PRIMARY CABLE (MM–7180032)
	1 – 300 KCMIL NEUTRAL (MM–7150228)
	LOCATION OF SPLICES
1	DUCT ID
120 m	CABLE LENGTH
4W x 6H	DUCT CONFIGURATION
EXISTING	
	CABLE CHAMBER
-	W.C. POLE

CABLE TO BE TERMINATED AT
SWITCHGEAR A1–A2, CELL 18.
CO–ORDINATE WORK WITH
STATIONS DEPARTMENT.



TYPICAL DUCT BANK & NUMBERING DETAIL
(LOOKING NORTH OR EAST)

SAMPLE DRAWINGS FOR SDP #005

rev.	date	description	by	appd.

TORONTO HYDRO (WEST)
TORONTO DISTRICT
toronto hydro

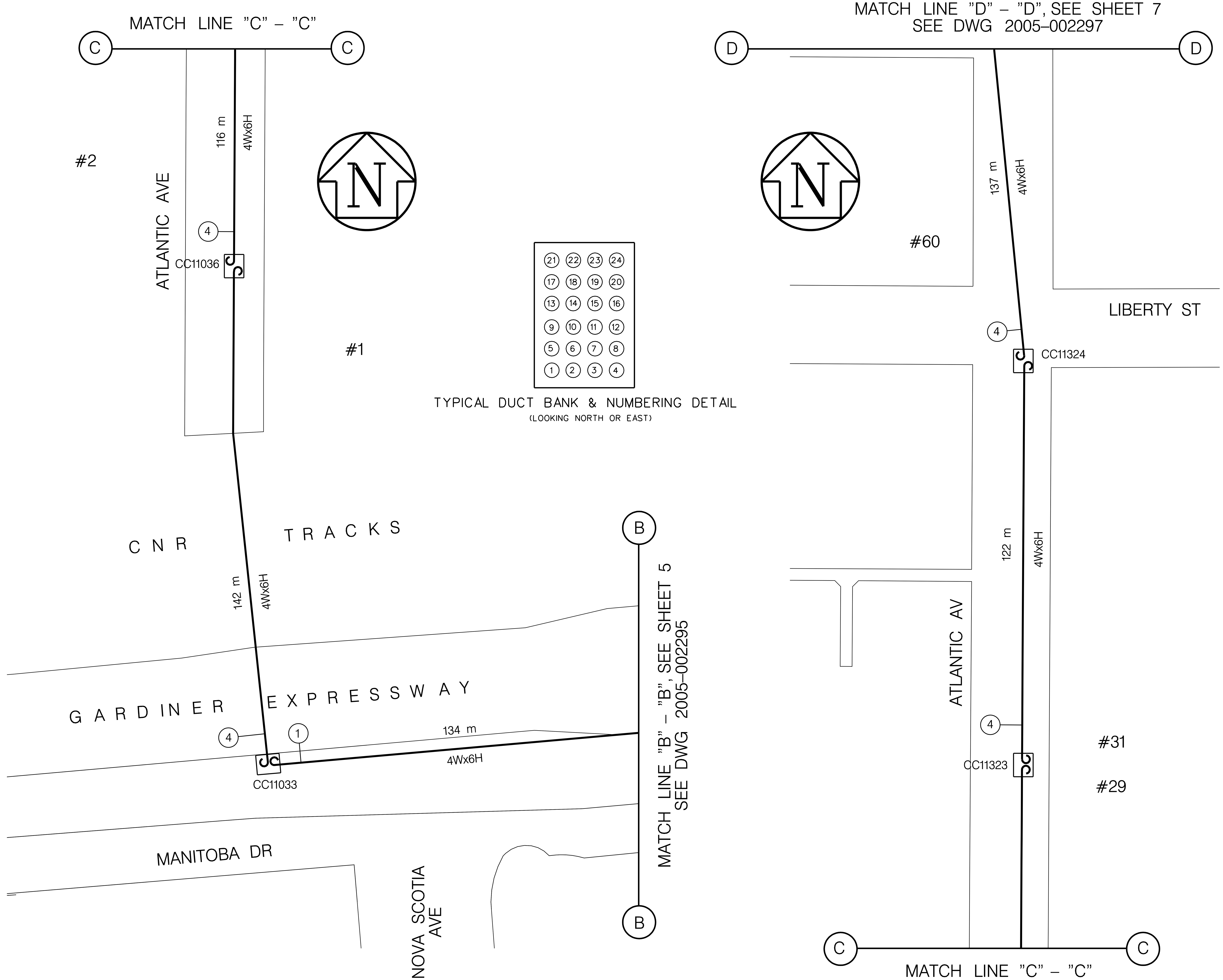
drawn by L. WONG	civil design	date yy / mm / dd / /
ip reference # W6073	civil approval	date yy / mm / dd / /
ellipse project # P0015533	electrical design L. WONG	date yy / mm / dd / /
construction project # P0023535	electrical approval J. MELLOR	date yy / mm / dd / /
scale N.T.S.	construction approval S. POLAK	date yy / mm / dd / /

dwg. title:

W6073 KING ST UG VC
B – 5 – 6 – 9 – PQ

CABLE INSTALLATION

dwg. no.	sheet no.	rev. no.
2005 – 002295	5	



REFER TO TITLE SHEET DRAWING #2005 – 002291
FOR ACCOMPANYING PROJECT DRAWING

LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
	1 – 500 KCMIL TRIPLEXED CU TRXLPE 15KV PRIMARY CABLE (MM–7180032)
	1 – 300 KCMIL NEUTRAL (MM–7150228)
	LOCATION OF SPLICES
1	DUCT ID
120 m	CABLE LENGTH
4W x 6H	DUCT CONFIGURATION
EXISTING	
	CABLE CHAMBER
-	W.C. POLE

SAMPLE DRAWINGS FOR SDP #005

rev.	date	description	by	appd.

TORONTO HYDRO (WEST)
TORONTO DISTRICT

toronto hydro

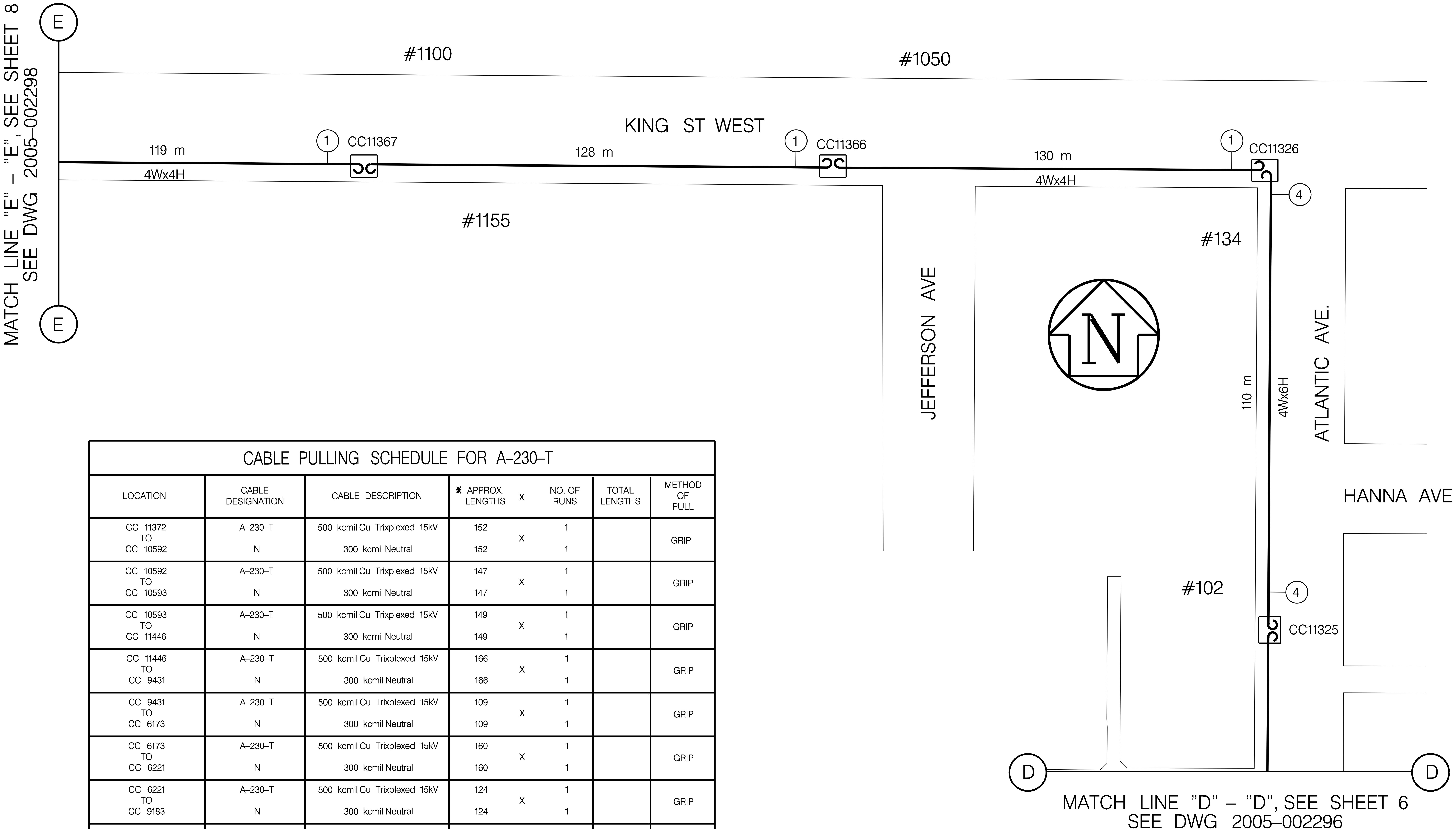
drawn by L. WONG	civil design	date yy / mm / dd / /
ip reference # W6073	civil approval	date yy / mm / dd / /
ellipse project # P0015533	electrical design L. WONG	date yy / mm / dd / /
construction project # P0023535	electrical approval J. MELLOR	date yy / mm / dd / /
scale N.T.S.	construction approval S. POLAK	date yy / mm / dd / /

dwg. title:

W6073 KING ST UG VC
B – 5 – 6 – 9 – PQ

CABLE INSTALLATION

dwg. no.	sheet no.	rev. no.
2005 – 002296	6	



REFER TO TITLE SHEET DRAWING #2005 – 002291
FOR ACCOMPANYING PROJECT DRAWING

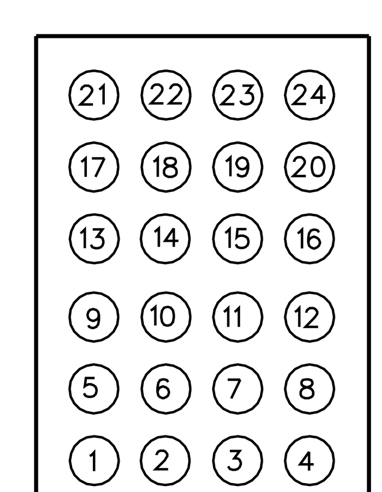
LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
	1 – 500 KCMIL TRIPLEXED CU TRXLPE 15KV PRIMARY CABLE (MM–7180032)
	1 – 300 KCMIL NEUTRAL (MM–7150228)
	LOCATION OF SPLICES
1	DUCT ID
120 m	CABLE LENGTH
4W x 6H	DUCT CONFIGURATION
EXISTING	
	CABLE CHAMBER
-	W.C. POLE

SAMPLE DRAWINGS FOR SDP #005

CABLE PULLING SCHEDULE FOR A–230–T

LOCATION	CABLE DESIGNATION	CABLE DESCRIPTION	* APPROX. LENGTHS	X	NO. OF RUNS	TOTAL LENGTHS	METHOD OF PULL
CC 11372 TO CC 10592	A–230–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	152 152	X	1 1		GRIP
CC 10592 TO CC 10593	A–230–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	147 147	X	1 1		GRIP
CC 10593 TO CC 11446	A–230–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	149 149	X	1 1		GRIP
CC 11446 TO CC 9431	A–230–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	166 166	X	1 1		GRIP
CC 9431 TO CC 6173	A–230–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	109 109	X	1 1		GRIP
CC 6173 TO CC 6221	A–230–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	160 160	X	1 1		GRIP
CC 6221 TO CC 9183	A–230–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	124 124	X	1 1		GRIP
CC 9183 TO P2 LANSDOWNE	A–230–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	49 49	X	1 1		GRIP

* APPROX. LENGTHS INCLUDE ADDITIONAL CABLE QUANTITIES FOR SPLICING, RACKING AND/OR TERMINATING



TYPICAL DUCT BANK & NUMBERING DETAIL
(LOOKING NORTH OR EAST)

rev.	date	description	by	appd.

TORONTO HYDRO (WEST)
TORONTO DISTRICT

toronto hydro

drawn by L. WONG	civil design	date yy / mm / dd
ip reference # W6073	civil approval	date yy / mm / dd
ellipse project # P0015533	electrical design L. WONG	date yy / mm / dd
construction project # P0023535	electrical approval J. MELLOR	date yy / mm / dd
scale N.T.S.	construction approval S. POLAK	date yy / mm / dd

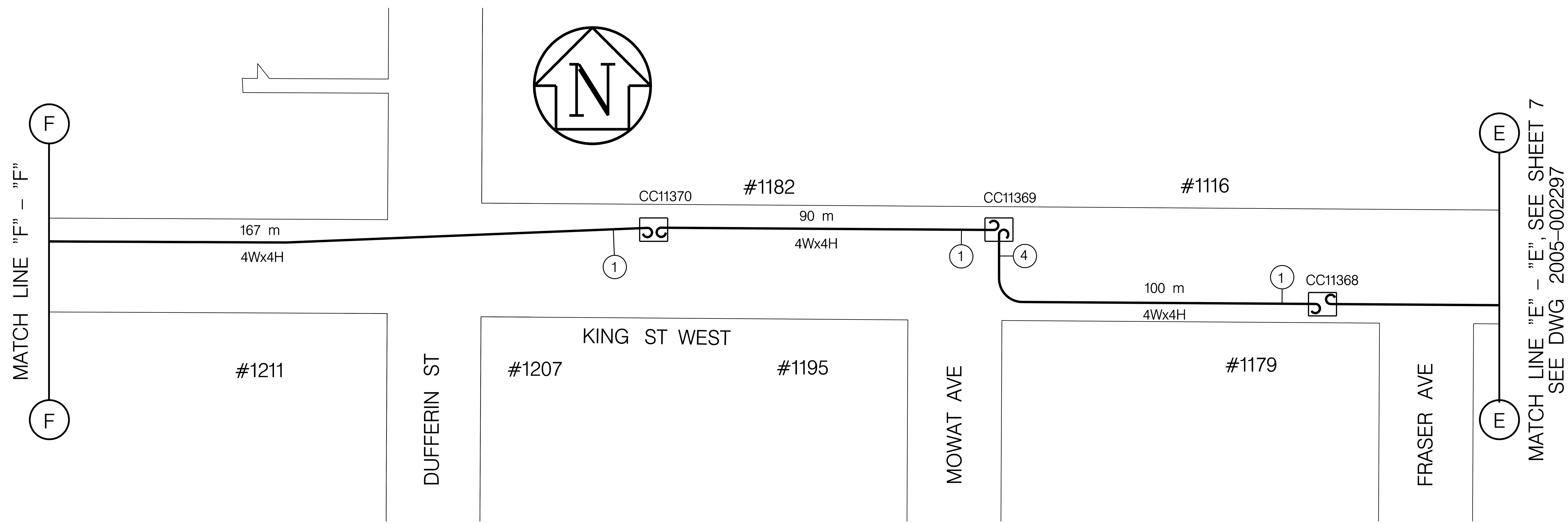
dwg. title:

W6073 KING ST UG VC
B – 5 – 6 – 9 – PQ

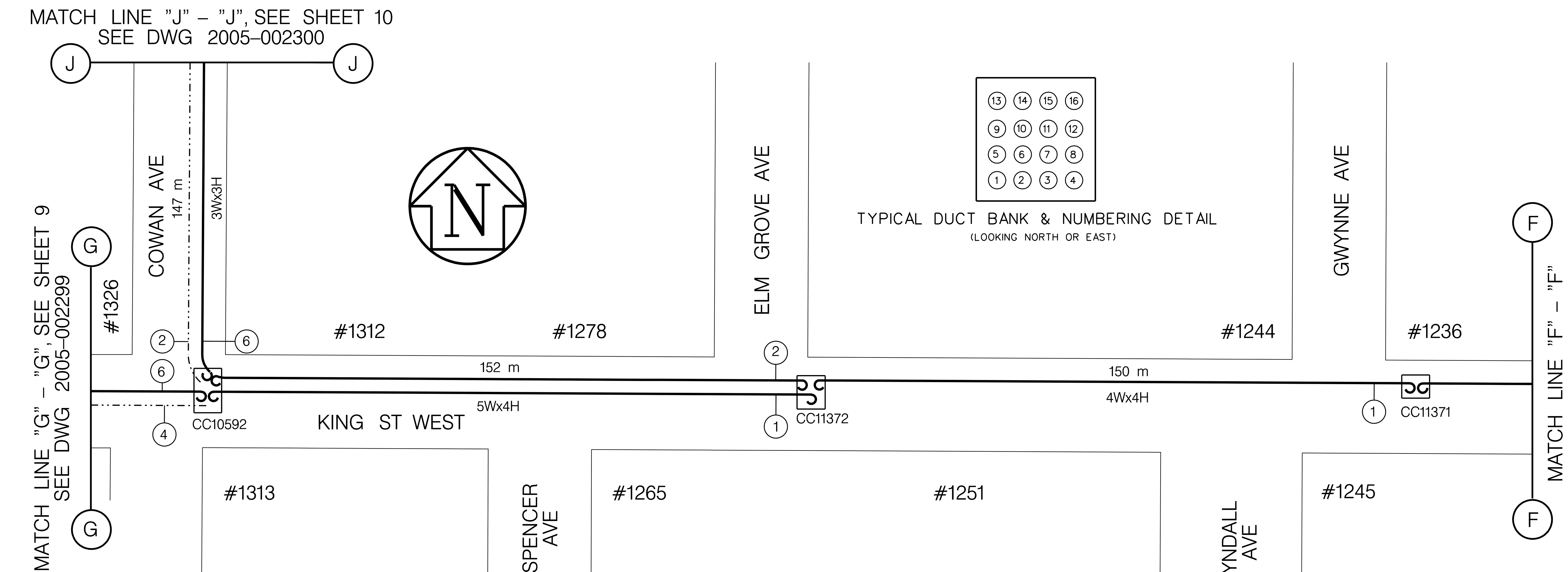
CABLE INSTALLATION

dwg. no.	sheet no.	rev. no.
2005 – 002297	7	

REFER TO TITLE SHEET DRAWING #2005 – 002291
FOR ACCOMPANYING PROJECT DRAWING



LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
	1 – 500 KCMIL TRIPLEXED CU TRXLPE 15KV PRIMARY CABLE (MM–7180032)
	1 – 300 KCMIL NEUTRAL (MM–7150228)
	LOCATION OF SPLICES
1	DUCT ID
120 m	CABLE LENGTH
4W x 6H	DUCT CONFIGURATION
EXISTING	
	CABLE CHAMBER
-	W.C. POLE



SAMPLE DRAWINGS FOR SDP #005

rev.	date	description	by	appd.

TORONTO HYDRO (WEST)
TORONTO DISTRICT
toronto hydro

drawn by L. WONG	civil design	date yy / mm / dd / /
ip reference # W6073	civil approval	date yy / mm / dd / /
ellipse project # P0015533	electrical design L. WONG	date yy / mm / dd / /
construction project # P0023535	electrical approval J. MELLOR	date yy / mm / dd / /
scale N.T.S.	construction approval S. POLAK	date yy / mm / dd / /

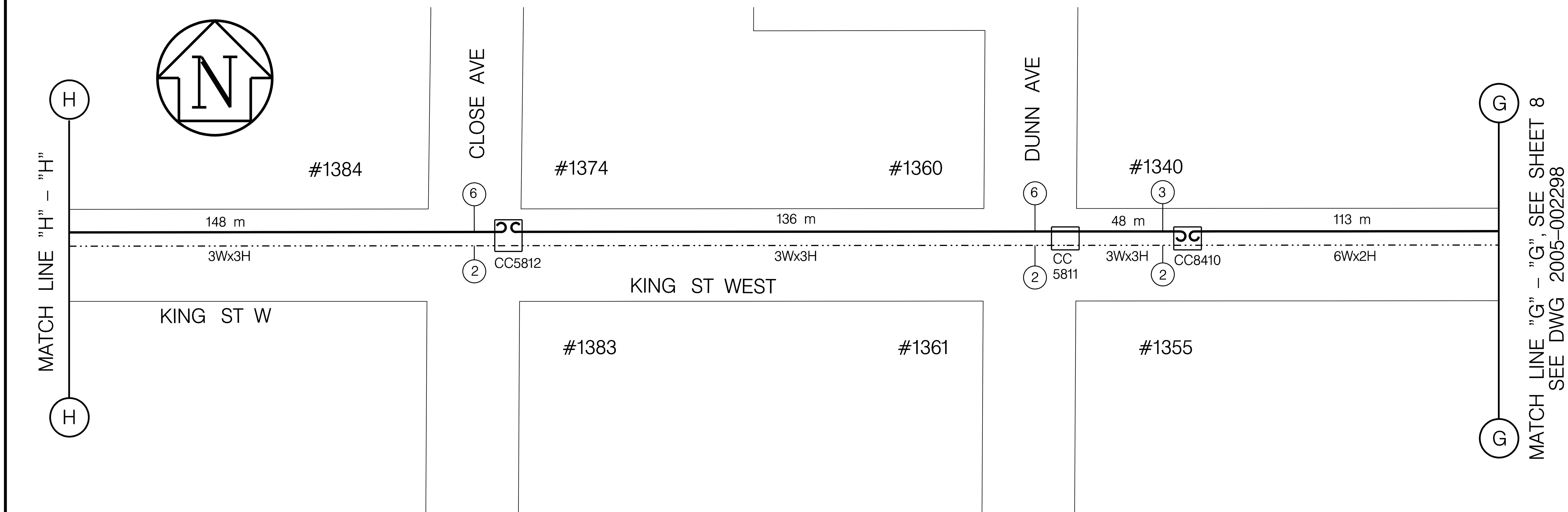
dwg. title:

W6073 KING ST UG VC
B – 5 – 6 – 9 – PQ

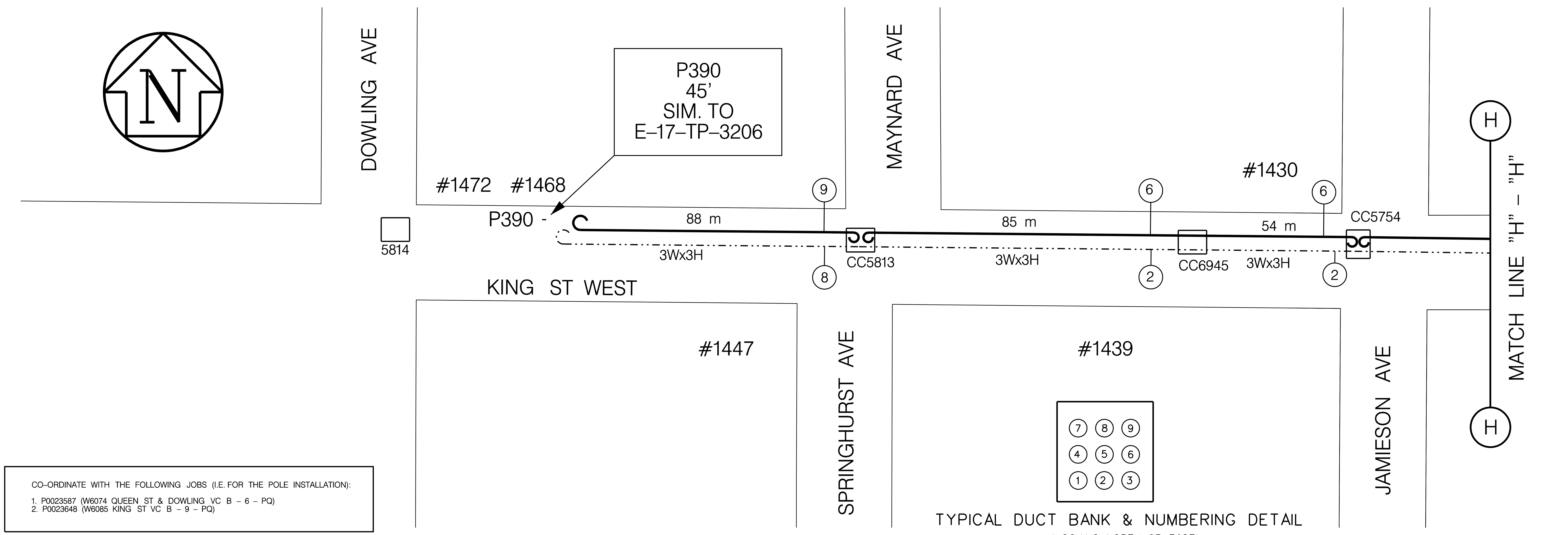
CABLE INSTALLATION

dwg. no.	sheet no.	rev. no.
2005 – 002298	8	

REFER TO TITLE SHEET DRAWING #2005 – 002291
FOR ACCOMPANYING PROJECT DRAWING



LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
	1 – 500 KCMIL TRIPLEXED CU TRXLPE 15KV PRIMARY CABLE (MM–7180032)
	1 – 300 KCMIL NEUTRAL (MM–7150228)
	LOCATION OF SPLICES
1	DUCT ID
120 m	CABLE LENGTH
4W x 6H	DUCT CONFIGURATION
EXISTING	
	CABLE CHAMBER
-	W.C. POLE



CO–ORDINATE WITH THE FOLLOWING JOBS (I.E. FOR THE POLE INSTALLATION):
1. P0023587 (W6074 QUEEN ST & DOWLING VC B – 6 – PQ)
2. P0023648 (W6085 KING ST VC B – 9 – PQ)

SAMPLE DRAWINGS FOR SDP #005

rev.		date	description	by	appd.

toronto hydro

TORONTO HYDRO (WEST)
TORONTO DISTRICT

drawn by L. WONG	civil design	date yy / mm / dd / /
ip reference # W6073	civil approval	date yy / mm / dd / /
ellipse project # P0015533	electrical design L. WONG	date yy / mm / dd / /
construction project # P0023535	electrical approval J. MELLOR	date yy / mm / dd / /
scale N.T.S.	construction approval S. POLAK	date yy / mm / dd / /

dwg. title:

W6073 KING ST UG VC
B – 5 – 6 – 9 – PQ

CABLE INSTALLATION

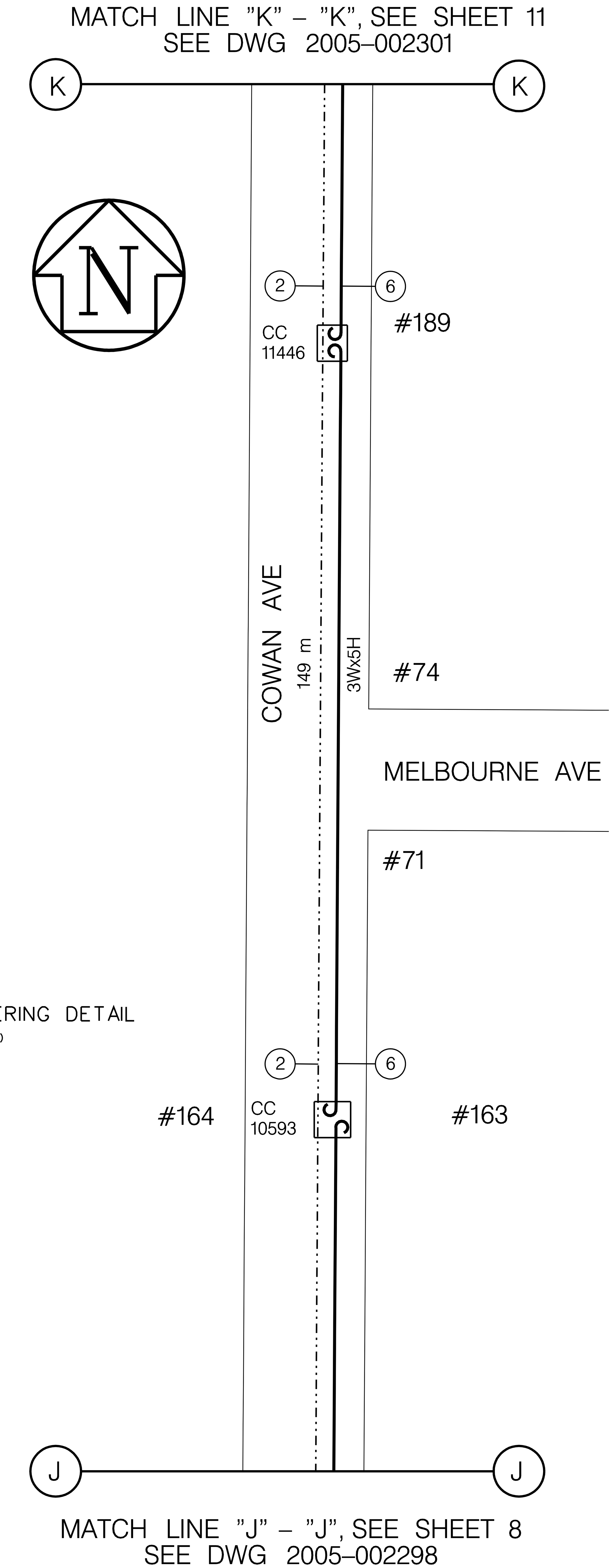
dwg. no.	sheet no.	rev. no.
2005 – 002299	9	

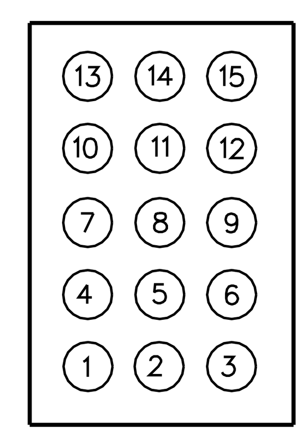
$$date$$

CABLE PULLING SCHEDULE FOR A–225–T

LOCATION	CABLE DESIGNATION	CABLE DESCRIPTION	⁕ APPROX. LENGTHS	X	NO. OF RUNS	TOTAL LENGTHS	METHOD OF PULL
CC 11026 TO CC 11027	A–225–T —	500 kcmil Cu Triplexed 15kV —	130 —	X	1 —		GRIP
CC 11027 TO CC 11029	A–225–T —	500 kcmil Cu Triplexed 15kV —	96 —	X	1 —		GRIP
CC 11029 TO CC 11030	A–225–T —	500 kcmil Cu Triplexed 15kV —	135 —	X	1 —		GRIP
CC 11030 TO CC 11031	A–225–T —	500 kcmil Cu Triplexed 15kV —	130 —	X	1 —		GRIP
CC 11031 TO CC 11032	A–225–T —	500 kcmil Cu Triplexed 15kV —	130 —	X	1 —		GRIP
CC 11032 TO CC 11033	A–225–T —	500 kcmil Cu Triplexed 15kV —	134 —	X	1 —		GRIP
CC 11033 TO CC 11036	A–225–T —	500 kcmil Cu Triplexed 15kV —	142 —	X	1 —		GRIP
CC 11036 TO CC 11323	A–225–T —	500 kcmil Cu Triplexed 15kV —	116 —	X	1 —		GRIP
CC 11323 TO CC 11324	A–225–T —	500 kcmil Cu Triplexed 15kV —	122 —	X	1 —		GRIP
CC 11324 TO CC 11325	A–225–T —	500 kcmil Cu Triplexed 15kV —	137 —	X	1 —		GRIP
CC 11325 TO CC 11326	A–225–T N	500 kcmil Cu Triplexed 15kV —	110 —	X	1 1		GRIP
CC 11326 TO CC 11366	A–225–T N	500 kcmil Cu Triplexed 15kV —	130 —	X	1 1		GRIP
CC 11366 TO CC 11367	A–225–T N	500 kcmil Cu Triplexed 15kV —	128 —	X	1 1		GRIP
CC 11367 TO CC 11368	A–225–T N	500 kcmil Cu Triplexed 15kV —	119 —	X	1 1		GRIP
CC 11368 TO CC 11369	A–225–T N	500 kcmil Cu Triplexed 15kV —	100 —	X	1 1		GRIP
CC 11369 TO CC 11370	A–225–T N	500 kcmil Cu Triplexed 15kV —	90 —	X	1 1		GRIP
CC 11370 TO CC 11371	A–225–T N	500 kcmil Cu Triplexed 15kV —	167 —	X	1 1		GRIP
CC 11371 TO CC 11372	A–225–T N	500 kcmil Cu Triplexed 15kV —	150 —	X	1 1		GRIP
CC 11372 TO CC 10592	A–225–T N	500 kcmil Cu Triplexed 15kV —	152 —	X	1 1		GRIP
CC 10592 TO CC 8410	A–225–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	113 113	X	1 1		GRIP
CC 8410 TO CC 5811	A–225–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	48 48	X	1 1		GRIP
CC 5811 TO CC5812	A–225–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	136 136	X	1 1		GRIP
CC 5812 TO CC 5754	A–225–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	148 148	X	1 1		GRIP
CC 5754 TO CC 6945	A–225–T N	500 kcmil Cu Triplexed 15kV 300 kcmil Neutral	54 54	X	1 1		GRIP

⁕ APPROX. LENGTHS INCLUDE ADDITIONAL CABLE QUANTITIES FOR SPLICING, RACKING AND/OR TERMINATING





TYPICAL DUCT BANK & NUMBERING DETAIL
(LOOKING NORTH OR EAST)

REFER TO TITLE SHEET DRAWING #2005 – 002291 FOR ACCOMPANYING PROJECT DRAWING

LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
———	1 – 500 KCMIL TRIPLEXED CU TRXLPE 15KV PRIMARY CABLE (MM–7180032)
–··–··–	1 – 300 KCMIL NEUTRAL (MM–7150228)
	LOCATION OF SPLICES
1	DUCT ID
120 m	CABLE LENGTH
4W x 6H	DUCT CONFIGURATION
EXISTING	
	CABLE CHAMBER
-	W.C. POLE

SAMPLE DRAWINGS FOR SDP #005

rev.	date	description	by	appd.

TORONTO HYDRO (WEST)
TORONTO DISTRICT

toronto hydro

drawn by L. WONG	civil design	date yy / mm / dd
ip reference # W6073	civil approval	date yy / mm / dd
ellipse project # P0015533	electrical design L. WONG	date yy / mm / dd
construction project # P0023535	electrical approval J. MELLOR	date yy / mm / dd
scale N.T.S.	construction approval S. POLAK	date yy / mm / dd

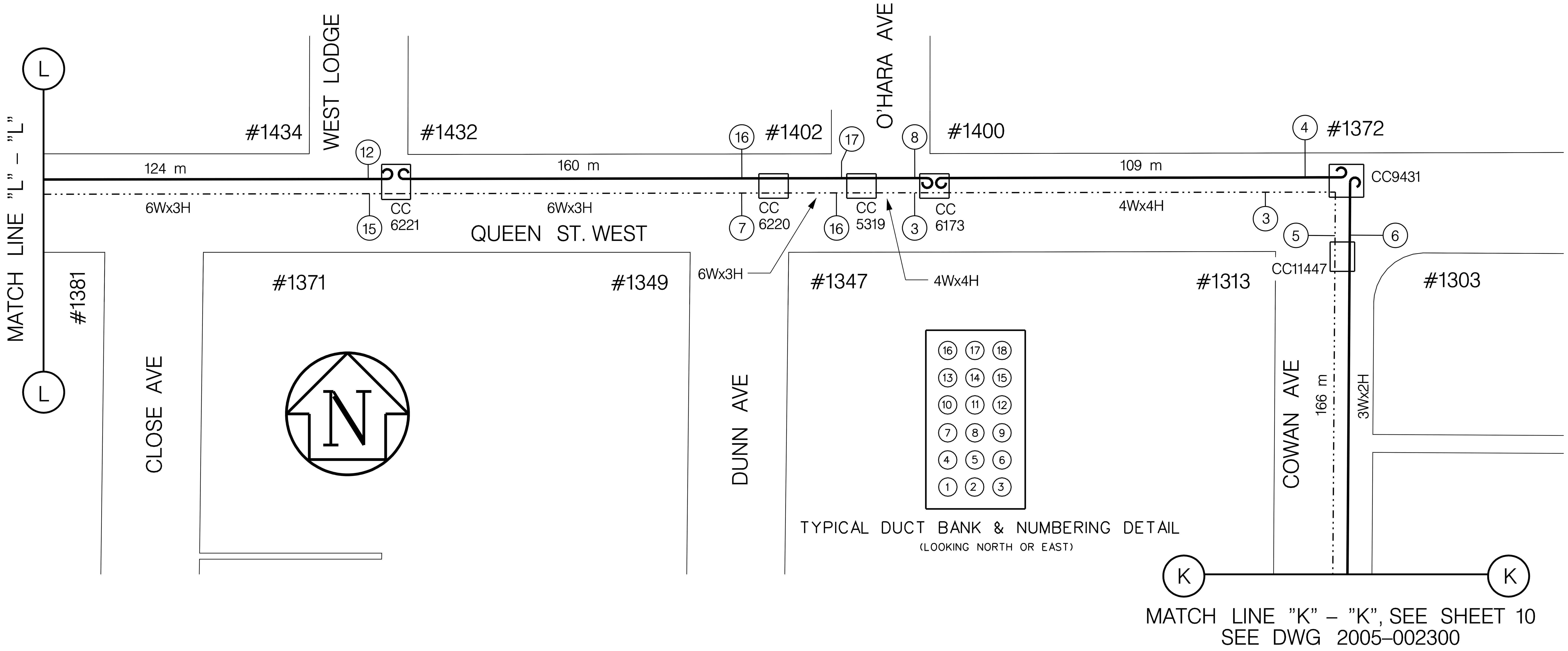
dwg. title:

W6073 KING ST UG VC
B – 5 – 6 – 9 – PQ

CABLE INSTALLATION

dwg. no.	sheet no.	rev. no.
2005 – 002300	10	

REFER TO TITLE SHEET DRAWING #2005 – 002291
FOR ACCOMPANYING PROJECT DRAWING

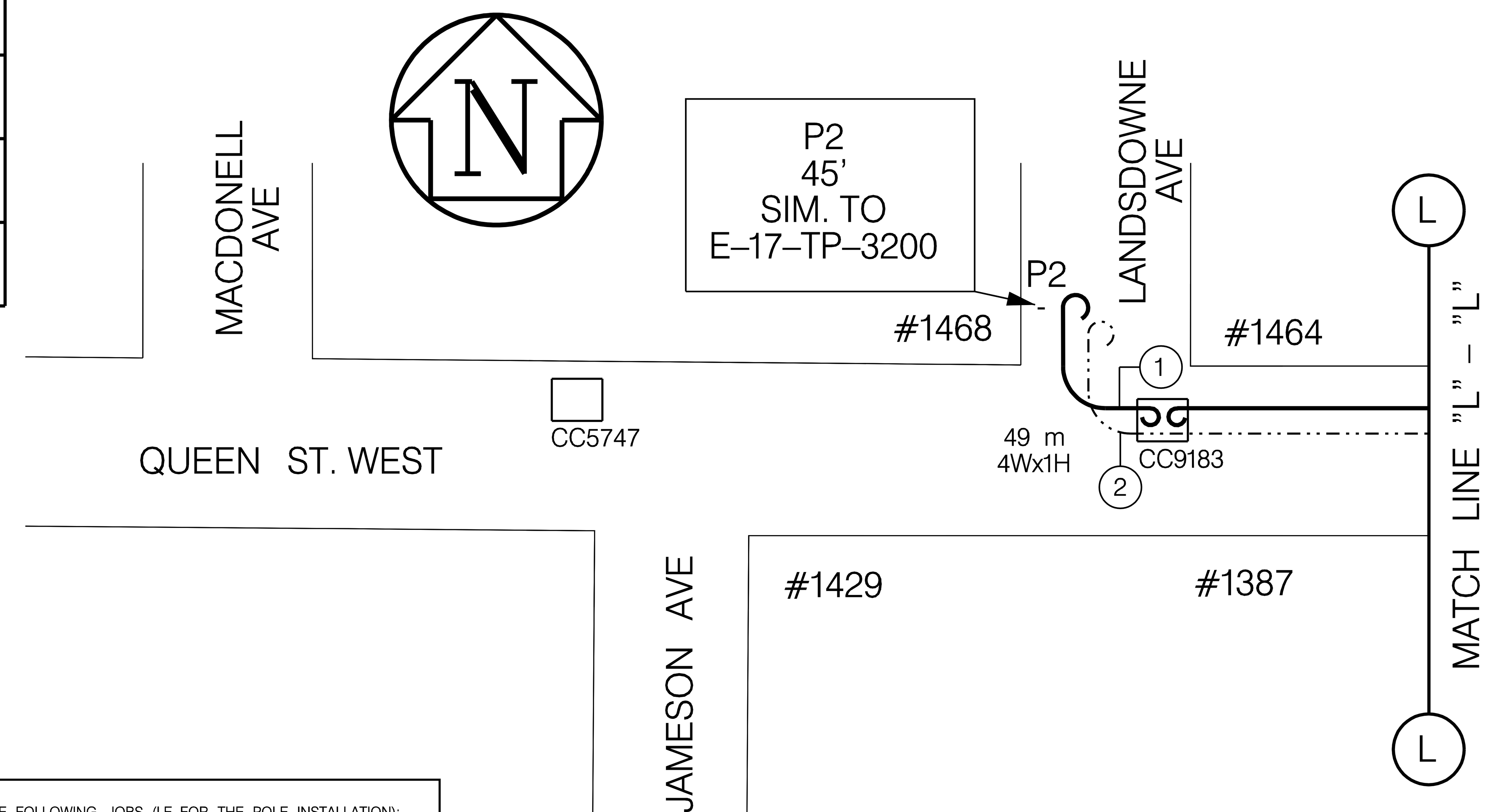


LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
	1 – 500 KCMIL TRIPLEXED CU TRXLPE 15KV PRIMARY CABLE (MM-7180032)
	1 – 300 KCMIL NEUTRAL (MM-7150228)
	LOCATION OF SPLICES
1	DUCT ID
120 m	CABLE LENGTH
4W x 6H	DUCT CONFIGURATION
EXISTING	
	CABLE CHAMBER
-	W.C. POLE

CABLE PULLING SCHEDULE FOR A–225–T (CONTINUED FROM PAGE 10)

LOCATION	CABLE DESIGNATION	CABLE DESCRIPTION	* APPROX. LENGTHS	X	NO. OF RUNS	TOTAL LENGTHS	METHOD OF PULL
CC 6945 TO CC 5813	A–225–T N	500 kcmil Cu Trixplexed 15kV 300 kcmil Neutral	85 85	X	1 1		GRIP
CC 5813 TO P390 KING	A–225–T N	500 kcmil Cu Trixplexed 15kV 300 kcmil Neutral	88 88	X	1 1		GRIP
CC 11026 TO STRACHAN SOUTH STN	A–225–T —	500 kcmil Cu Trixplexed 15kV —	103 —	X	1 —		GRIP

* APPROX. LENGTHS INCLUDE ADDITIONAL CABLE QUANTITIES FOR SPLICING, RACKING AND/OR TERMINATING



SAMPLE DRAWINGS FOR SDP #005

CO–ORDINATE WITH THE FOLLOWING JOBS (I.E. FOR THE POLE INSTALLATION):
1. P0023587 (W6074 QUEEN ST & DOWLING VC B – 6 – PQ)
2. P0023648 (W6085 KING ST VC B – 9 – PQ)

rev.	date	description	by	appd.

TORONTO HYDRO (WEST)
TORONTO DISTRICT

toronto hydro

drawn by: L. WONG	civil design	date yy / mm / dd
ip reference #: W6073	civil approval	date yy / mm / dd
ellipse project #: P0015533	electrical design: L. WONG	date yy / mm / dd
construction project #: P0023535	electrical approval: J. MELLOR	date yy / mm / dd
scale: N.T.S.	construction approval: S. POLAK	date yy / mm / dd

dwg. title:

W6073 KING ST UG VC
B – 5 – 6 – 9 – PQ

CABLE INSTALLATION

dwg. no.	sheet no.	rev. no.
2005 – 002301	11	

Standard Design Practice Amendment

Date: May 25, 2012
Effective Date: June 18, 2012

Issue Number: SDP-2012-01 Rev.1

This amendment is issued to inform all the affected stakeholders that there is a change to **Standard Design Practice** (**SDP**) **#005 Rev.00 – Underground Cable Installations**. This change is enforceable by the effective date, and will be included in the next SDP update.

Change	Summary of Changes	Training Requirements
Section 1.2.2.1	**1. A sentence was added to describe how cables shall be placed in ducts and a new reference designation was added to represent Toronto Hydro Communication Cable.** **2. A sentence was added to specify the removal of unused primary cables of 750 volts or more. If removal of such cables is not feasible or practical, they shall be cut-off and grounded at each end in accordance with Toronto Hydro Distribution Construction Standards 16-0020.** **3. A sentence was added to explain how to handle situations where the unused cables cannot be removed and grounded.**	☐ **Yes** √ **No, awareness only** **Affected stakeholders:** Design Supervisors, Designers, Project Planning Supervisors, Project Planners and Construction & Maintenance Supervisors.

This SDP Amendment is issued by email to all the affected stakeholders. You can also find this information in the following location on Plugged In: **Plugged In > Asset Management > Standards and Policy Planning > Standard Practices**

The purpose of a SDP Amendment is to communicate changes that are required throughout the year and will be incorporated in the next SDP revision. This will ensure that the affected stakeholders receive the latest information in a timely manner, and that the latest changes can be incorporated in new designs.

A SDP Amendment adds, removes or revises information in an existing Standard Design Practice. It also identifies training requirements, if applicable, regarding the changes described in the amendment. Each SDP Amendment consists of a cover sheet, the entire updated section(s) from the SDP with changes included in blue and any relevant attachments such as drawings or tables. It does not contain information that is applicable to other sections of the SDP.

Originator	**Frank Yu**
Sponsor(s)	**Sheikh Nahyaan**
Reviewers	**Kal Sarkar, Ian Maikawa, (SDP Committee)**
Supervisor / Signature / Date	**James Schofield**
Manager / Signature / Date	**Mary Byrne**

Updated Section in SDP #005 Rev.00 – Underground Cable Installations

1.2.2 Cable Installation

1.2.2.1 Ducts

- The numbering of new ducts shall be in accordance with Construction Standard 31-1180. It should be noted that some former utility numbering standards were different. For projects involving civil infrastructures installed prior to amalgamation, it may be necessary to consult legacy standards.
- The ampacity rating of cable in duct is heavily influenced by the ability of the cables to dissipate the heat generated through current flow. In concrete encased duct, the extent of thermal de-rating on the cable would be dependant upon the cables placement within the duct structure.
- Where it is likely that the duct structure will be fully occupied, it is suggested that the cables occupy the peripheral ducts of the structure starting from the lower ducts and working upward. The following detail provides the suggested cable placements based on four circuits consisting of single conductor cables:

C3	**C4**	**C4**
C3	T/TH	**C4**
C3	**N/N**	**C2**
C1		**C2**
C1	**C1**	**C2**

3 Wide x 5 High
Duct Structure

C4	**C4**	**C3**	**C3**
C4	**N/N**	T/TH	**C3**
C1			**C2**
C1	**C1**	**C2**	**C2**

4 Wide x 5 High
Duct Structure

<u>LEGEND</u>

☐ - cable ducts

C1, C2, etc. - circuits #1, #2 etc.
N/N – two neutral conductors
T – Third Party cables (such as Rogers, etc.)
TH – Toronto Hydro communication cable

- The system neutral conductor(s) shall occupy a middle duct.
- **Third Party or Toronto Hydro communication cables shall occupy the middle ducts if available, otherwise use the middle ducts in the top row.**
- The duct lengths between civil infrastructures (i.e. cable chamber to cable chamber) shall be obtained from the civil installation project drawings. For new civil installations, lengths can be obtained from the "Duct Length" table located on the title sheet of the civil installation project drawings. If duct lengths are not available from either the civil project drawings or previous cable installation drawings, duct runs shall be measured at grade level from centre to centre of cable chambers or vaults.

- Designers shall note that additional cable should be added to the duct lengths to allow for racking and terminating. For the additional cable requirements refer to Section 1.2.3 Primary Cables.
- **All efforts shall be made to remove cables of 750 volts or more that are no longer in use. If it is not feasible or practical to remove the these cables, example direct buried cable, they shall be cut-off and grounded at each end so not to be inadvertently energized in accordance with Toronto Hydro Distribution Construction Standard 16-0020.**
- **In situations where the unused cables cannot be removed and grounded, the Supervisor in the Standards & Materials section shall be contacted.**

Standard Design Practice

UNDERGROUND RESIDENTIAL REBUILDS

SDP #006 Rev. 2

Prepared by: Standard Design Practice Team

Originally Approved by: Jim Trgachef, Interim Manager, Policy & Standards Issue Date: March 15, 2007
Rev. 1 Approved by: Mary Byrne, Manager, Standards & Policy Planning Issue Date: September 21, 2009
Rev. 2 Approved by: Mary Byrne, Manager, Standards & Policy Planning Issue Date: March 15, 2011

SDP #006 – Underground Residential Rebuilds

Revision History				
Rev. #	**Date**	**Description**	**Issued by:**	**Approved by:**
00	15-Mar-07	- Original Issue	D. Pernerowski	J. Trgachef
1	21-Sep-09	- Added reference to the “Distribution Grid Operations Project Review Form”, “Job Planning Process”, and “Occupational Health and Safety Act”, revised asbestos and lead examples, revised Design Guideline Table, added grounding requirements in vaults and pads, deleted bullets pertaining to pad foundations, and maintaining existing transformer vaults and pads, (section 1.2.1 General) - Revised location of electrical trench line, added bullet to reference Municipal Consent Requirements (section 1.2.2.1 General) - Deleted bullet in reference to spare duct, added bullet to install splice connections, and installation of red ducts, revised bullet referencing service cable ducts (section 1.2.2.2 Ducts) - Deleted bullet pertaining to use existing submersible vaults as tap boxes, added wording to core drill for primary cable and secondary bus cable (section 1.2.2.3 Vaults/Foundation) - Updated portions within section (section 1.2.2.5 Joint-Use Trench Cost Sharing) - Deleted bullet pertaining to installing secondary bus cable between existing and new transformer vault (section 1.2.5 Secondary Bus Cables) - Added wording pertaining to unmetered connections, deleted bullets pertaining to the tagging of service cables (section 1.2.6 Service Cables) - Revised voltage drop formula (section 1.2.9 Secondary Voltage Drop) - Added bullet pertaining to installation of switches (section 1.2.10 Fusing) - Added bullets referencing non-standard switchgear installations, orientation of switchgear, feeder circuit entering and exiting cable chamber, and no tap-offs in switchgear compartments (section 1.2.11 Switchgear) - Revise customer speciality letters (section 1.2.13 Customer Communications & Public Relations) - Added bullet referencing Municipal Consent Requirements (section 1.3.1 Drawing Structure) - Added bullet pertaining to information required for obtaining permits, deleted bullets pertaining to information on drawings (section 1.3.1.3 Civil Plan) - Added wording to include service cable, and building land bases (section 1.3.1.4 Cable & Duct Layout) - Added section 1.3.1.6 Overview of Electrical Plan - Reworded paragraph (section 1.3.3 Symbology) - Added two references to Section 3 - References - Revised Appendix A, B, C, D, E, F,G and Sample Project Drawings	I. Maikawa	M. Byrne

SDP #006 – Underground Residential Rebuilds

Revision History				
Rev. #	**Date**	**Description**	**Issued by:**	**Approved by:**
02	15-Mar-11	- Section 1.2.1 General: added City map of asbestos locations; added reference to a Construction Standard for guard posts; updated the design guideline table - Section 1.2.2.1 General: deleted reference to a new standard by the Public Utilities Co-ordinating Committee - Section 1.2.2.2 Ducts: updated the number of cables to be placed in ducts; added the installation of ducts for service cable up to the meter base; added the installation of ducts for street lighting cable; added reference to a Construction Standard for 3rd party ducts - Section 1.2.2.3 Vaults/Foundations: updated reference to a Construction Standard for clearances of pad-mounted transformers; added proposed duct hole locations in submersible transformer vault; added to change out vault grills if not to the current standard - Section 1.2.2.4 Tap (Splice) Boxes: updated the type of tap boxes that can be used - Section 1.2.2.5 Joint-Use trench (Cost Sharing): updated joint-use cost figures; added third parties to attend meeting - Section 1.2.3 Transformers: updated un-metered and street lighting connections; added references to Construction Standard for transformer clearances; added where not to install new pad-mounted transformers - Section 1.2.4 Primary Cables: added to abandon or remove existing cable as per Construction Standard - Section 1.2.5 Secondary Bus Cables: updated maximum bus loading rating - Section 1.2.6 Service Cables: updated unmetered connections - Section 1.2.7 Service Connections: added new section - Section 1.2.8 Transformer Loading: deleted reference to "load and supply information system" - Section 1.2.9 Secondary Bus Loading: updated the number of 200A services; added how a customer at the end of a run can be connected - Section 1.2.10 Secondary Voltage Drop: updated the Coincident Service Loading for Bus & Service Cable table - 1.2.13 Street Lighting: revised the entire section - Section 1.2.14 Customer & Councillor Notifications: revised section title and section name; combined certain customer notification letters into one letter - Section 1.3.1 Drawing Structure: added bullet to note standard drawing sizes; added to the project drawing table - Sections 1.3.1.2 General Notes & Details: added new section - Section 1.3.1.3 Primary Schematic and section 1.3.1.5 Cable & Duct Layout: Revised direction of the north arrow - Section 3- References: added SP#022 - updated appendices A, B, C, D, E, F; removed appendix G - Section 3: removed sample drawings	I. Maikawa	M. Byrne

SDP team members for SDP#006 Rev.2:
Ian Maikawa (RC 2400), Daniel Smart (RC 2400), James Daniel (RC 2400), Tarek Turk (RC 2400), Alan Hung (RC 3160), Garbis Kerestecioglu (RC 3160), Tony Falcone (RC 3620), Stephen Plant (RC 3620), Paul Rossi (RC 3110), Rod Partridge (RC 3110), Dave Maraj (RC 2200), Domenic Zurzolo (RC 4330), Michael Meleca (RC 3720), Masis Kerestecioglu (RC 3130)

SDP #006 – Underground Residential Rebuilds

CONTENTS

Page #

Section 1 - Practice:

The purpose of this document is to provide a guideline for the design of projects involving the rebuilding in residential areas of direct buried primary cables and secondary cables that have reached the end of their useful life or conversion projects from 4.16kV to either 13.8kV or 27.6kV. The document provides the necessary framework to ensure project designs are aligned with business strategies and completed design packages are delivered in a consistent fashion.

This document can be used as a guideline for cable rebuilding projects involving both Class 3B & 3C Customers.

Four key issues addressed in this document:

1. Design Checklist: identifies the activities, which should be considered during the design phase.
2. Design Considerations: supplements the Construction Standards by identifying key design components and strategies for new projects.
3. Drawing Guidelines: identifies key information to be shown on project drawings.
4. Project Deliverables: identifies the documents and drawings required when signing-off on a design file.

1.1 Design Checklist

Many issues need to be considered in the design of projects involving underground residential cable rebuild projects. To ensure a comprehensive design package is delivered, designers must be cognisant of all issues during the design. To assist designers in this area, “Underground Residential Rebuilds Design Project Checklist” (Appendix “A”) has been developed and should be used as a guide to ensure all aspects of the design stage are successfully completed.

1.2 Design Considerations

1.2.1 General

- Designers shall ensure project designs satisfy the requirements of Section 7 of Ontario Regulation 22/04 “Electrical Distribution Safety” under the Electricity Act, 1998.
- Designers shall employ the “Job Planning Process” and the “Safety by Design” concept in project designs.
- Designers shall endorse the use of only certified construction standards, specifications in the assembly of the project drawings. The use of authorized legacy standards should be limited to the maintaining of lines where certified construction standards would be problematic. Any new construction specifying the use of legacy standards will require a certificate of approval prepared by a Professional Engineer.
- In accordance with the Occupational Health and Safety Act, all known “Designated Substances” that may be encountered in the project shall be identified on the drawing. Examples of “Designated Substances” and their applications may include:

Asbestos - AILC cables, ducts, pavement asphalt, listing tape, barrier boards and meter backer boards
Lead - PILC and AILC cables, and older station batteries
Mercury - mercury vapor lamps and street light relays
Vinyl Chloride - 4" PVC ducts and PVC jacketed cables
Arsenic - arsenical lead sheathed cables
Ethylene Oxide - polyethylene insulated cables
Silica - current limiting fuses and lightning arresters (4kV),
and other substances and applications that may be added from time to time.

- Refer to the City map "Asbestos Locations" to determine if the asphalt in the proposed construction area requires asbestos testing. Streets that are **GREEN** do not require testing. Streets that are **RED** do not require testing as these will be treated as being contaminated with Asbestos. Only streets indicated in **PURPLE** on the City map need to be tested. Driveway aprons do not require testing. Conduct one test per road crossing. Boulevard pole locations do not require testing. If test results are positive or you are working in a **RED** area, adhere to Type II Asbestos Handling Procedures for Removal & Disposal of any Contaminated Asphalt.
- When preparing scope packages & project designs, both Planners and Designers shall consider the requirements of Distribution Grid Operations. These requirements are identified in a "Distribution Grid Operations Project Review Form" that can be obtained by contacting a Control Room Operations Supervisor.
- Unless indicated otherwise by System Reliability Planning, the new primary distribution supply arrangement shall reflect the primary cable being replaced.
- If a rebuild area is fed from a radial supply, it is recommended that a distribution loop arrangement be installed. In addition:
  - Both ends supplying the distribution loop shall be fused and should not terminate within the same switching device or at the same structure.
  - In the horseshoe area, the distribution loop can be supplied from the same feeder or two different feeders off the same station bus. When using the same feeder, ends of the loop are to be connected at two different switch locations.
  - Open point is to be located at a transformer in the middle of the distribution loop.
- Customers on life support should be clearly noted on all applicable plans.
- In general, designers shall use the following table in determining the design requirements for their underground residential rebuild projects:

Design Guideline Table	
Electrical	
Transformers	1. Replace all non-switchable transformers with switchable units. Replace with "like for like" (i.e. submersibles with submersibles, etc.).
Primary Distribution Cable	2. Install between new/existing transformers, splice boxes, switchgear and pole locations. 3. Abandon or remove existing primary cable.
Secondary Bus	4. Install from new/existing transformer location to new tap box location(s).
Secondary Service Cables	5. Install from new tap box to customer meter base. 6. Existing service cables that are replaced to be abandoned.
Single-phase pad-mounted switches (SU)	7. Remove single-phase pad-mounted switches (SU).
Street Lighting	8. Replace existing street light circuits along the trench route. Install new cable from the tap box to the existing pole's handhole.
Civil	
Transformer Vaults/Pads	9. Re-use existing transformer vaults/pads where possible.
Tap Boxes	10. Install tap boxes as required to supply secondary services.
Primary Cable Duct	11. Install new concrete encased duct(s) between existing or new vaults/pads, splice boxes, switching cubicles and poles.
Secondary Bus Duct	12. Install new concrete encased duct(s) from existing vault/pad to new tap boxes.
Secondary Service Cable Duct	13. Install duct from tap box to meter base with the portion under the road allowance being concrete encased. The portion from the street line to the customer's meter base shall be direct buried duct.
Pad for Single-phase switches (SU)	14. Remove pad for single-phase switches (SU).
Street Lighting Duct	15. Install new concrete encased duct(s) from new tap boxes in the main trench and terminate 450mm from the base of pole. Connect the 100mm duct to a 50mm poly pipe and install inside the pole's aperture.

Refer to Appendix "D" for sample illustrations on the above design guidelines.

- In situations where the existing transformer vault or pad foundation is deteriorated a new vault or pad foundation shall be installed.
- When maintaining existing structures (e.g. vaults, pads) ensure grounding meets current standards.
- The existing submersible vault or pad foundation shall be core drilled to accommodate the new primary and secondary service bus ducts.
- Opportunities for Joint-use trenching initiatives shall be discussed with 3rd Parties in the early stage of design. See Section 1.2.2.5 - Joint-Use Trench for cost sharing formula.
- For rebuilds which cross over or may be in close proximity to gas pipelines, CN/CP tracks, Hydro One corridors, etc. consult SDP #004 - Major Civil Projects, Section 1.2.4 - Special Permits & Approvals for instruction.
- For rebuilds located in private property, Planners and Designers should consult SP #024 “Conversion & Rebuild Work in Private Property (Class 3B Customers)”, as the Customer may be required to provide some civil infrastructure or an easement.
- For projects involving water heater relays or service cable rebuilds to flat-rate water heater customers, Designers shall consult the Conversions & Rebuilds section in SP #001 “Ownership Transfer of Water Heater Assets”.
- Designers shall include in the General Notes, the customer notification instructions as identified in SP #006 “Customer Isolations”.
- When installing above grade structures such as switchgear or pad-mounted transformers consider installing guard posts, as per Toronto Hydro Construction Standards, section 31-4080, in situations where there is a risk of vehicle impact.

1.2.2 Civil

1.2.2.1 General

- The standard location for the centre line of the new electrical trench would typically be 3.5m from street line. Should that location be occupied 1.8m from street line (beneath sidewalk) would be the alternative. There may be exceptions where a 3rd party may have occupied these locations. In these instances the location of the new electrical trench should be discussed with the City.
- The City enforces a moratorium on all newly improved streets. Refer to the latest Municipal Consent Requirements for the restrictions. The link to the document is http://www.toronto.ca/engineering/mcr/.
- The minimum cover over the electrical ducts in an open trench installation shall be in accordance with Toronto Hydro Construction Standards, section 31.
- For street classifications refer to Municipal Consent Requirements Appendix S “Street Classifications” and Appendix T “Classification of City Streets“. Refer to Appendix T for updated street classifications. The following is the link to the documents:
  http://www.toronto.ca/engineering/mcr/
- Minimum horizontal and vertical clearances from foreign utilities shall be in accordance with Appendix O “Vertical and Horizontal Clearance Guidelines” of the City of Toronto’s Municipal Consent Requirements and Toronto Hydro Construction Standards, section 31. Additional horizontal clearances should be considered to prevent proposed foreign utility excavations from damaging electrical cables and equipment.
- Efforts shall be made to install the edge of transformer pads, vaults and tap boxes a minimum horizontal clearance of 1.0m from the paved portion of driveways.

1.2.2.2 Ducts

- For open trench installations, all primary and secondary cable ducts located in the public road allowance or on private property of Class 3B customers shall be concrete encased 100mm diameter PVC constructed as per Toronto Hydro Construction Standards section 31 and Technical Specification for Civil Construction Work Spec # CV-CON-01.
- Excavations shall be backfilled in accordance with Section 5.1.17 of Technical Specification for Civil Construction Work Spec # CV-CON-01 and the City's Municipal Consent Requirements.
- When preparing Unit Price Contract Management System (UPCMS) costs sheets, designers shall consider the additional unit requirements for duct descents from the normal depth leading to submersible vaults, tunnelling under trees, etc.
- For new concrete encased ducts being installed in poor soil conditions or where there is a high water table, re-bar shall be used to reinforce the structure in accordance with Toronto Hydro Construction Standards section 31-1120 Note #4.
- When a new concrete encased duct structure is in conflict with existing direct buried cable, the new structure shall be installed below the cables. If this is not practical, split ducts shall be sleeved over the existing cables to allow future accessibility. This instruction to the contractor shall be included in the project General Notes.
- At existing transformer vaults new ducts to the vault may need to rise above the existing cables provided the proper depth of cover is met. In this case split ducts do not have to be sleeved over the existing cables.
- Each primary cable (1-phase), service cable and secondary bus shall be installed in separate ducts. For the primary system, neutral cables shall be installed in a separate duct.
- For road crossings, it is recommended that a minimum of 6 ducts be installed. If additional capacity is required, ducts should be added in multiples of 3 (i.e. 3W3H, 3W4H). Road crossing ducts that are installed for future extension shall be terminated a minimum of 1.0m from back of curb in accordance with Toronto Hydro Construction Standards section 31-1160. Terminating of these ducts shall be noted in the General Notes.
- Efforts should be made to minimize the number of road crossings.
- Road crossing ducts are to be installed in a common trench with new vault drains where practicable.
- The project drawings shall identify the number of Toronto Hydro required ducts in the main trench and any spare duct requirements.
- Primary cable ducts that run concurrently from vault to vault shall run below new tap boxes. Cable pulling calculations shall be performed to ensure maximum pulling tensions on the primary cables and future secondary bus cables are not exceeded.

  Service cable ducts from the customer meter base shall be installed in parallel with the lot line and perpendicular to the street line or main trench. Follow existing utility clearance requirements. The portion from the street line to the customer's meter base shall be direct buried duct.
- The duct route shall be designed with a minimum of bends both horizontal and vertical to keep cable-pulling tensions within allowable limits. Cable pulling software shall be used when necessary to ensure pulling tensions on the cables are within acceptable limits for both pulling directions.

- Where field conditions permit, attempts shall be made to slope the ducts toward underground structures (such as vaults, pads, etc.) in efforts to minimize the accumulation of water in the ducts.
- Galvanized iron (GI) or rigid PVC bends may be required when terminating ducts at riser poles in accordance with Toronto Hydro Construction Standards, section 31-1220. To protect against accidental damage, bends should be placed on the side of the pole that is opposite to the oncoming traffic, where practicable.
- 3rd Party ducts would typically be direct buried and installed in accordance with Toronto Hydro Construction Standards, sections 31-1390 and 31-1395.
- Any direct buried hydro ducts must be red in colour.
- Install concrete encased duct(s) for street lighting cable, and terminate 450mm from base of pole. Connect the 100mm duct to a 50mm poly pipe and install inside the pole's aperture. Refer to Toronto Hydro Construction Standards, section 30-3800.

1.2.2.3 Vaults / Foundations

- In determining possible new locations, transformer vaults or pad-mounted foundations should be located as close as possible to lot lines. In selecting locations, designers should also attempt to anticipate customer acceptance. In townhouse areas, end of unit blocks tend to be more acceptable than the typical small front yards. Consideration should also be given to avoiding children's play areas, minimizing exposure to traffic and maintaining minimum clearances as per the Ontario Electrical Safety Code.
- Pad-mounted transformer locations must meet minimum clearance requirements from any combustible surface or material on a building, window, and door inlet or outlet vents in accordance with Section 26-242 of the Ontario Electrical Safety Code. For the minimum clearance requirements refer to Toronto Hydro Construction Standards, sections 03-5100 and 31-4070.
- Submersible transformer vaults shall be equipped with a "Petro-plug" interceptor and drained to the storm sewer using a 100mm Diameter Nominal (DN), PVC pipe with a minimum slope to sewer of 2.5%. The entire length of pipe shall be installed on a bedding of 75mm select granular 'A' material. Refer to section 5.6.4 of the Civil Specification No. CV-CON-01 for additional requirements.
- The "Petro-plug" interceptor shall be installed in the drain opening inside the submersible transformer vault. A minimum of 310mm of straight section of sewer drainpipe from the transformer vault wall is required to facilitate the Petro-plug installation (Refer to Toronto Hydro Construction Standards, section 31-5100).
- Submersible vault drains shall be installed in a common trench with road crossing ducts.
- Pad-mounted foundations do not require the installation of drains to the sewer.
- Where no sewers are immediately available, consideration shall be given to installing pad-mounted transformers.
- When core drilling existing submersible transformer vaults or existing pads to accommodate new primary and secondary bus and service cable ducts, the holes shall be located a safe distance from the existing hydro cables and in such a location that will allow for the installation of the new primary cable and secondary bus cables while the existing transformer is still energized. Designers shall consider the additional Toronto Hydro resources (i.e. Qualified Stand-by person) necessary when performing this work. Proposed duct hole locations for existing submersible transformer vaults to be as per Toronto Hydro Sketch # SK-038.

- Currently there are design layouts with two/three grills for existing single-phase submersible vaults:
  - 1140mm x 2160mm (45" x 85") – Layout has one/two checker plate(s) and two/three grills.
    - Designers are to field verify and proceed with **grill** replacement if necessary as per Toronto Hydro Construction Standards, section 31-8290. The checker plates can remain for vaults that have three grills.
  - 1140mm x 1730mm (45" x 68") – Layout has one checker plate and two grills:
    - Designers are to field verify and proceed with **grill** replacement if necessary as per Toronto Hydro Construction Standards, section 31-8290. The checker plate can remain.

1.2.2.4 Tap (Splice) Boxes

- Tap boxes shall be installed in accordance with Design Guideline Table in the Design Considerations Section.
- Tap boxes shall be strategically placed to allow for the connection of new secondary bus and service cables to existing service cable at lot lines. When selecting locations, designers should attempt to anticipate customer acceptance.
- The available tap box sizes and their applications are indicated in the following table:

Tap (Splice) Box Sizes									
Item #	Type	Construction Standard	Item ID#	Size			Available Knockouts	Cover Type	Installation Type
				Length	Width	Height			
1	A	31-3120	3530037	900mm	600mm	900mm	20	Plastic	Grass
2	A	31-3120	3530038	900mm	600mm	900mm	20	Polymer Concrete	Asphalt/ Concrete
3	B	31-3125	9656478	1200mm	900mm	900mm	28	Plastic	Grass Only
4	B	31-3125	9662429	1200mm	900mm	900mm	28	Polymer Concrete	Asphalt/ Concrete
5	C	31-3135	9662865	1500mm	900mm	1050mm	44	Plastic	Grass

- Type A tap box can be used to make secondary bus and service cable connections for reasons of cost and physical size. It should be noted that their application is limited to 3 – 6 way maximum Homac terminal bus for connecting line 1, line 2, and neutral cables.
- Type B tap box can be used for **either** one 1/0, 28kV primary cable splice where the cable length exceeds the maximum pulling tension, **or** utilized for secondary bus and service cable connections. Tap box Type B is limited to splice one single-phase primary cable **or** to the use of 3 – 8 way maximum Homac terminal bus for connecting line 1, line 2, and neutral cables.
- Type C tap box can be used only for primary cable splices where cable lengths exceed the maximum pulling tensions. Tap box Type C can accommodate a maximum of three 1/0, 28kV primary cables.
- The preferred tap box locations are at lot lines in the sod boulevard. Alternatively, Type A and B can be installed in asphalt or concrete boulevards. Installations in sidewalks should be avoided where possible.
- Avoid installing tap boxes in low-lying areas where they may be susceptible to flooding.

- Tap boxes used for both secondary connections and primary splices shall be numbered in accordance with the "Equipment Numbering" in the Drawing Guidelines Section.

1.2.2.5 Joint-Use Trench (Cost Sharing)

- Toronto Hydro shall encourage and participate in Joint-use trench initiatives with foreign utilities.
- Joint-use trench participation shall be limited to the scope of the project. If exclusive trench is required by a 3rd party it will be their responsibility to develop drawings, submit permits, and negotiate civil costs with our contractor.
- Minimum depths for 3rd Party installations shall be in accordance with the City of Toronto's Municipal Consent Requirements under section "Depth of Cover".
- Cost sharing shall apply to the "trench only" portion of the project where 3rd Parties share a common trench with hydro. 3rd Parties shall be 100% responsible for their exclusive trench, extra trench depth and their incidental items (i.e. ducts and/or cables in common or exclusive trench, sand padding, concrete encasement, pedestals, etc.).
- Costing for the Joint-use "Trench Only" shall be in accordance with the following table:

"Trench Only" Costs									
Cost for Year 20__	2 Party Trench			3 Party Trench			4 Party Trench		
	Single Duct (tr/m)	Additional Ducts		Single Duct (tr/m)	Additional Ducts		Single Duct (tr/m)	Additional Ducts	
		1	2		1	2		1	2
2010	$43.60	15%	30%	$34. 90	15%	30%	$26.20	15%	30%
2011	$45.15	15%	30%	$36.10	15%	30%	$27.10	15%	30%
2012	$46.75	15%	30%	$37.40	15%	30%	$28.05	15%	30%
2013	$48.40	15%	30%	$38.70	15%	30%	$29.05	15%	30%

Notes:
1. **Single Duct**: would include up to 1 – 4" dia. (or) up to 3 – 1" dia. poly pipes. Cost sharing is based on a percentage of the average UPCMS unit cost for "trench only" plus any tunnelling past trees and an estimate of the City final restoration costs. The cost of the duct(s) and its placement in the trench is a 3rd Party exclusive item.
2. **Additional Ducts**: 3rd Parties that elect to install ducts in excess of "Single Duct" as defined above, shall incur additional Joint-use trench costs in accordance with the above table (example: if in 2010 Company X requires the installation of 2-4" ducts in a Joint-use trench, their per metre trench cost would be $43.60 for the 1st duct plus an additional 15% for the second duct for a total per metre trench cost of $50.14).
3. **Road Crossings**: use the same cost sharing methodology as 1) & 2) above. 3rd Party road crossing ducts must be concrete encased. The cost of the duct(s) and its placement in the road crossing trench is a 3rd Party exclusive item.
4. **Services**: use the same cost sharing principles as 1) above.
5. The above costs shall be revised upon termination of the 2010 UPCMS Contract.

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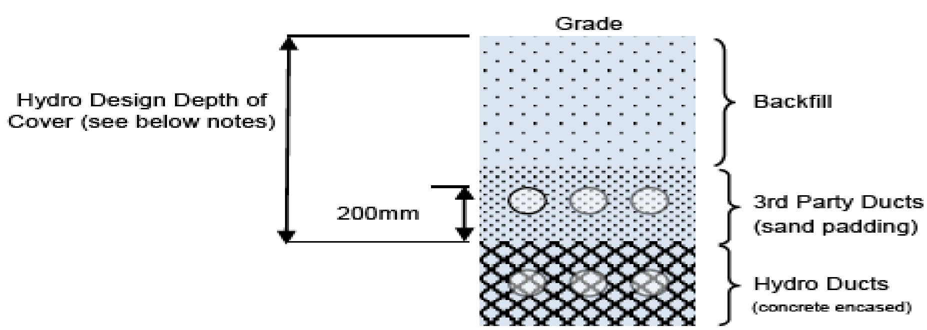
- Costing for extra trench depth shall be in accordance with the following table:

Extra Trench Depth Costs (per 250mm increment)				
Year →	2010	2011	2012	2013
Cost →	$47.15 tr/m	$48.80 tr/m	$50.50 tr/m	$52.30 tr/m

Notes:

1. Additional trench depth will be necessary to accommodate Joint-Use trench initiatives involving 3rd Parties. In these cases where there are more than one 3rd Party occupying the trench the additional excavation cost shall be shared proportionally (i.e. if the number of 3rd Party ducts in the trench total 5, and 1 Party has 2 ducts, that Party would be responsible for 2/5 of the extra depth costs or $18.86 per trench metre in 2010). Additional excavation costs shall be included with the “trench only” cost estimate to the 3rd Parties.
2. The above costs shall be revised upon termination of the 2010 UPCMS Contract.

Typical trench section is illustrated below:



Typical Joint-Use Trench

Notes:

1. If 3rd party ducts can be installed on top of hydro without affecting the depth of cover for Toronto Hydro, then no extra trench depth charge is applied.

2. If 3rd party ducts are to be installed on the top of hydro which forces Toronto Hydro to be at an additional depth of cover, then extra trench depth charges shall apply.

- Trenching costs involving directional boring shall be shared equally among the Parties.
- THESL will assume the role of Prime Contractor on the Joint-Use “trench only” portion. To encourage 3rd Party participation and competitive pricing, 3rd Parties shall be requested to negotiate their exclusive item costs directly with the civil contractor. Staking for exclusive items should be included when negotiating item costs with the civil contractor.
- 3rd Parties shall be responsible for coordinating the installation and payment of their exclusive items with the civil contractor.
- 3rd Parties will not be permitted to employ another contractor to complete any of their installation associated with the project including their exclusive items while the Prime Contractor is still on site.
- 3rd Parties shall be assessed an administrative fee of 15% to cover THESL costs of project coordination, providing of electronic drawings, inspection, staking, preparing estimates and cost sheets and other miscellaneous expenses associated with the Joint-Use “trench only” portion. The administrative fee shall only be applied to the “trench only” and extra trench depth costs and not to the exclusive items 3rd Parties negotiate with the civil contractor.
- The Designer shall provide the cost estimated for the Joint-Use trench to the 3rd Parties.

- 3rd Parties shall be responsible for obtaining the necessary City permits for their exclusive civil installations. To expedite the permit process, Designers are encouraged to assemble all 3rd Party plans and make one submission to the City. Each 3rd Party shall be responsible for preparing and providing the Designer with all necessary permit applications for their exclusive civil work.
- 3rd Parties shall be responsible for providing an on-site inspector who shall report directly to the civil contractor as required, to interpret the work plans and specifications.
- The contractor will be responsible for providing each 3rd Party with signed-off “As-Constructed” drawings for Joint-Use trench portion. 3rd Parties should include in their negotiations with the civil contractor, the receipt of the “As-Constructed” drawings for their exclusive items.
- An example of a Joint-use trench cost estimate for a project involving multiple parties can be found in Appendix F.
- 3rd Parties should attend the pre-construction meeting.

1.2.3 Transformers

- Existing transformers in the u/g rebuild areas shall be replaced with “like for like” units. (Toronto Hydro will continue to lobby the City of Toronto for approval to install pad-mounted transformers in existing submersible transformer locations).
- The available 1ø transformer sizes are indicated in the following tables:

1ø Pad-mounted Transformers (120/240V Secondary)		
Distribution System	100kVA	167kVA
13.8kV	X	X
27.6kV	X	X

1ø Submersible Transformers (120/240V Secondary)			
Distribution System	50kVA	100kVA	167kVA
13.8kV	X	X	X
27.6kV	X	X	X

- Where loading permits, efforts shall be made to reduce the overall number of existing transformers in the new design. Refer to Sections 1.2.7 – Transformer Loading, 1.2.8 - Secondary Bus Loading and 1.2.9 - Secondary Voltage Drop to maximize the number of services per new transformer. It is recommended that the maximum number of services (< 200amps) connected to a new transformer not exceed 24.
- The number of new transformers installed on a 1ø 16kV distribution loop (fused at 140K) shall be limited to 8 units on each side of the open point for a total of 16 units on the entire distribution loop. For 1ø 16kV sub-distribution loops (fused at 100K), the number of transformers shall be limited to 5 units on each side of the open point for a total of 10 units on the entire sub-distribution loop. For rebuilds on the 13.8kV system, the number of transformers installed on a loop shall be one half those indicated above for the 27.6kV system.

- In conversion or rebuild areas, efforts shall be made to replace "kicker bank" transformers to the current standards (primarily in former North York area).
- Placement of new three phase pad-mounted transformers should be clear of any major intersections. This would be for reasons of safety and to minimize any financial impacts in the event of future intersection improvements.
- To assist in the sectionalizing of any future underground primary cable faults, 300 Amp current reset faulted circuit indicators are to be installed on both the incoming and outgoing primary cables at each transformer location. Refer to Toronto Hydro Construction Standards, section 20.
- Un-metered and street lighting connections shall be installed at the new tap boxes. Existing group controlled street lighting relays should be converted to individual controlled photo cells.
- Water heater control relays located at existing transformers shall be recovered and not re-installed at the new transformer locations. Existing flat rate customers should be connected in accordance with SP #001 "Ownership Transfer of Water Heater Assets".
- It is necessary that "Equipment Changeout Record" forms be included in the Design Folder for all recovered pad-mounted and submersible transformers as well as for new equipment installations. The forms are to be completed by field staff indicating in the "Location Status" field that the transformers have been "Decommissioned" for recovered units and "In Service" for new equipment installations. This will ensure that recovered transformers and vault location numbers are no longer active in Ellipse. To obtain copies of the "Equipment Changeout Record" forms for inclusion in the white design folder click on the following link:
  http://assetmgmt.torontohydro.com/
- For transformer clearance requirements refer to Toronto Hydro Construction Standards, sections 03 and 31, and the City's Municipal Consent Requirements (appendix O "Vertical and Horizontal Clearance Guidelines").
- Placement of new pad-mounted transformers should be clear of any major intersections. This would be for reasons of safety and to minimize any financial impacts in the event of future intersection improvements.

1.2.4 Primary Cables

- Primary cables shall be installed in concrete encased ducts.
- The standard primary distribution cable sizes are indicated in the following table:

Primary Distribution Cables			
Distribution System	Cable Type	***Ampacity Rating (max)	MVA Rating (max)
13.8kV	*1/C 1/0 Al 15kV TRXLPE *(or)* **1/C 1/0 Al 28kV TRXLPE CN	200 Amps	4.8 MVA
27.6kV	1/C 1/0 Al 28kV TRXLPE CN	180 Amps	8.6 MVA

Note:

* *1/C 1/0 Al 15kV TRXLPE cable is only to be used on the 13.8kV distribution system in the downtown core area where there is no possibility of future 27.6kV system expansion.*

** *1/C 1/0 Al 28kV TRXLPE CN cable is to be used on the 13.8kV distribution system in the horseshoe and bordering core areas where there is the possibility of future 27.6kV system expansion.*

*** *For the conditions under which the above Ampacity ratings apply, consult the following Construction Standards:*
- 13.8kV XLPE Al cable – Construction Standards section 16-1060 1/5
- 27.6kV XLPE Al cable – Construction Standards section 16-1140 1/5

- A #2 stranded Cu, PVC insulated white neutral shall be installed and run concurrently with the 1/0 Al 15kV TRXLPE cable. A separate neutral conductor is not required when using 1/0 Al 28kV TRXLPE CN as this cable has a full sized concentric neutral.
- The above MVA ratings indicate the maximum permissible load for a 3Ø distribution circuit.
- Abandon or remove existing primary cable, refer to Toronto Hydro Construction Standards, section 16-0020.

1.2.5 Secondary Bus Cables

- The number of secondary bus cables from the new transformer would typically be determined by the total loads and number of services to be connected. Refer to Section 1.2.8 - Secondary Bus Loading.
- It is recommended that aluminum be the standard secondary bus type however in cases where voltage drop or loading may be a problem, copper bus should be considered in efforts to maximize the number of services per transformer.
- The following table represents the secondary bus type & size that can be used:

Secondary Bus Cables		
Application	**Max. Bus Loading**	**Cable Type**
120/240V	343 Amps	3-1/C 500kcmil Al. 600V XLPE PVCJ Triplex (Black, Black, White)
	430 Amps	3-1/C 500kcmil Cu. 600V XLPE PVCJ Triplex (Black, Black, White)

1.2.6 Service Cables

- Service cables including those supplying unmetered connections (such as phone booths, CATV power supplies, traffic lights, cross-walks, etc.) shall be replaced. Terminating of new service cables at the transformer secondary bushings should be avoided.
- Unmetered services require a demarcation point.
- The new service cables shall be connected to the new secondary bus cable(s) in tap boxes using Homac connectors. If there is a requirement to replace the service cables, standard sizes would be as indicated in the following table:

Secondary Service Cables		
Service Size	Application	Cable Type
100, 200 Amp, Dual Meter Bases	120/240V	3 – 1/C #4/0 Al 600V XLPE PVCJ Triplex (Black, Black, White)
400 Amp	120/240V	3 -1/C 500kcmil Al 600V XLPE PVCJ Triplex (Black, Black, White)
Unmetered Connections (i.e. Street Light Supply, etc.)	120V	2 - 1/C #2 Al 600V XLPE PVCJ Duplex (Black, White) with 1 – 1/C #6 Sol. Cu. Ground (SKU # 007150276)

1.2.7 Service Connections

- Toronto Hydro may have to replace the meterbase at the existing location to accommodate the new underground connection. Based on site conditions, if it is not feasible to replace the meterbase at the existing location, an alternate location is to be selected and communicated to the customer.
- Standard CSA approved 200 Amp meterbases with lug type connections are to be utilized. In cases where the existing meterbase is larger than 200 Amp (i.e. 400 amp), it will be replaced with a CSA approved 400 Amp meterbase with lug type connections, a test switch and bypass (i.e. Microlectric JS4AB or equivalent). Refer to Conditions of Service reference document "Metering Requirements 750 Volts or Less", and Toronto Hydro Construction Standards, section 31-1250.
- The electrical work by the contractor is covered in the Unit Price Contract Management System (UPCMS) under series 32000 (Secondary Service Rebuild). The electrical Contractor (Subcontractor to the General Civil Contractor) and a representative from the meter department should be invited to the pre-construction meeting to harmonize the conversion work.
- A single 4" conduit is to be installed on private property utilizing directional boring. For special cases where hard surfaces exist and directional boring is not feasible, alternate arrangements shall be agreed upon by the Designer and customer. (i.e. Relocate the meterbase or open-cut trench and restoration).
- In cases where the duct alignment to the meterbase runs along the driveway, refer to "Technical Specification for Civil Construction Work" # CV-CON-01 for driveway restoration.

1.2.8 Transformer Loading

- The typical number of secondary bus connections made at the transformer secondary bushings shall be four. These connections are to be made "back to back" and directly to the transformer secondary bushings. If more than four bus connections are required, the Homac eight position connector shall be requisitioned. (Refer to Toronto Hydro Construction Standards section 16-6000).
- Efforts shall be made to maximize the number of services per transformer. Spacing of transformers shall be determined based on connected customers' estimated maximum summer and winter loads. These can be obtained from Transformer Load Management (TLM) available in G/NetViewer.

- Upon determination of the estimated loading, use the following loading guide for selecting the transformer size:

Transformer Loading Guide	
Transformer Size & Type	Existing Load
50kVA Submersible or 100kVA Pad-mounted	< 37.5kVA
100kVA Submersible or Pad-mounted	>/= 37.5kVA </= 75kVA
167kVA Submersible or Pad-mounted	> 75kVA up to 125kVA
Split bus and add additional transformer	> 125kVA

Note: Loading guide allows for future load growth.

1.2.9 Secondary Bus Loading

- The maximum number of 200A services per 500kcmil Al and 500kcmil Cu secondary bus shall be limited to three and four respectively.
- The maximum number of 100A services per 500kcmil Al secondary bus shall be limited to seven (limited by the # of connections on the Homac connector).
- Efforts shall be made by the designer to identify the service sizes within the project area. Because this information is not available through the customer billing account information, a method that can be used for determining the existing service size of a house is to check the conduit on the load side of the meter base. Conduits with an inner diameter of 1 ¼” to 1 ½” have 60 A or 100A services and conduits 2” to 2 ½” have 200A services. A second method would be to use persons through the accommodated work program to conduct random samplings of the homes in the area by knocking on doors. To initiate this work, designers should contact Environmental Health & Safety to check on the availability of staff to perform this task.
- Homac eight or six position secondary terminal clusters shall be used to connect the new secondary bus to the new services cables in the tap box. Of the eight or six available positions, one shall be reserved for the secondary bus cable and the remaining would be available for the new services cables and any un-metered service connection requirements.
- Where practical and voltage drop permits, consideration shall be given to installing a dedicated 500kcmil Al secondary bus cable to service a single customer at the end of a run in efforts to minimize the number of tap boxes required on the project. The bus cable shall be connected to the customer’s service cable in the last tap box of the run.

1.2.10 Secondary Voltage Drop

- After locating the new transformer location, it will be necessary to ensure that the electrical design satisfies voltage drop guidelines.
- Toronto Hydro maintains service voltage at the Customer's service entrance within the guidelines of C.S.A. Standard CAN3-C235-83 (latest edition), which allows variations from nominal voltage in accordance with the following table:

Nominal Voltage	Voltage Variation Limits			
	Extreme Conditions			
		Normal Conditions		
	A	B	C	D
Single Phase				
120/240	106/212	110/220	125/250	127/254
Two Phase (3 Wire - Open WYE)				
120/208	110/190	112/194	125/216	127/220
Three Phase (4 Wire)				
120/208	110/190	112/194	125/216	127/220
347/600	306/530	318/550	360/625	367/635

- The maximum allowable voltage drop on the secondary bus and service cables shall not exceed column "B" in the above table.
- Voltage drop tables for 500kcmil Al secondary bus and 4/0 Al service cables can be found in Appendix B in the SDP#002 - New U/G Residential Subdivisions. To determine the voltage drop for the various cable sizes the formula used for calculating is as follows:

$$\text{Voltage Drop}_{(volts)} = K_{(factor)} \times F_{(factor)} \times \text{Current}_{(amps)} \times \frac{\text{Length of Run}_{(metres)}}{1000}$$

$K_{(factor)}$ = Line to neutral voltage drop per ampere per circuit kilometre
$F_{(factor)}$ = Correction Factor

Voltage Drop Tables		
Cable Size & Type	$K_{(factor)} \times F_{(factor)}$	
	120/240V	120/208V (open Wye)
500 kcmil Cu	0.236	0.204
500 kcmil Al	0.330	0.285
4/0 Al	0.678	0.586
3/0 Al	0.836	0.723
1/0 Al	1.284	1.110
#2 Al	1.984	1.716

Current $_{(amps)}$ for 500kcmil Cu Bus - use load that coincides with the number of services connected to the bus from table below.
Current $_{(amps)}$ for service cable – use the load for a single service from the following table:

Coincident Service Loading for Bus & Service Cable				
Number of Services	Non-Electric Heating		All-Electric Heating	
	100 A Service	200A Service	100A Service	200A Service
1	60A	100A	60A	120A
2	75A	125A	75A	150A
3	112A	187A	112A	225A
4	150A	250A	150A	300A
5	187A		187A	
6	225A		225A	
7	262A		262A	

1.2.11 Fusing

- The standard ratings for switch cutouts and power fuses shall be as per the following table:

Fusing for Laterals				
Operating Voltage	Laterals		Sub-Laterals	
	Disconnect Voltage Rating	Fuse Rating	Disconnect Voltage Rating	Fuse Rating
27.6kV	25kV	140K	25kV	100K
13.8kV	15kV	140K	15kV	100K

- The ratings from the table would apply for both three phase & single-phase laterals.
- Sub-sub laterals are to be fused at 40K.
- Replace all existing porcelain SMD20 switches with polymeric SMD20 switches at riser poles, except for 35 kV class.

1.2.12 Switchgear

- Pad-mounted or submersible switchgear may be required depending on the supply arrangements in the rebuild area. This switchgear is primarily used for tapping into a main feeder and supplying distribution load.
- Pad-mounted switchgear installations are preferred over the submersible switchgear where practicable. The benefits of pad-mounted switchgear include: costs, ease of maintenance & operability and accessibility. Where space is limited in the public road allowance it may be necessary to install submersible switchgear.
- Pad-mounted switchgear shall be installed in accordance with Toronto Hydro Construction Standards, section13. “Maintenance only items” should not be used for new construction.
- Non-standard pad-mounted switchgear (i.e. PMH-10, PMH-5, and PMH-210) used in non-standard configuration within rebuild area should be replaced by pad-mounted switchgear(s) listed in Toronto Hydro Construction Standards, section 13-7600.
- The preferred orientation of the pad-mounted switchgear units is to have the doors open parallel with the roadway. As well, access to any of the switch compartments should be clear of obstructions such as trees, poles, etc.

- Placement of new pad-mounted switchgear should be clear of any intersections. This would be for reasons of safety and to minimize any financial impacts in the event of future intersection improvements.
- For available 13.8kV and 27.6kV submersible switchgear refer to Toronto Hydro Construction Standards, section 13. To assist in the sectionalizing of any future underground primary cable faults, 800 Amp current reset Faulted Circuit indicators are to be installed at 600 Amp U/G terminations on open loop feeders and main loop cables (URD). Refer to Toronto Hydro Construction Standards section 20.
- In order to ensure reliability, the feeder circuit (600A) supplying the switchgear should not enter and exit the same cable chamber. Care should be taken to re-direct the outgoing feeder duct around the cable chamber. Similarly, the distribution circuit (200A) should be designed in the same manner. See drawing package.
- No multiple tap-offs (double lugging) should be considered in the feeder or distribution compartments of the switchgear unit as this will adversely affect system reliability when attempting to isolate the switchgear in the future.

1.2.13 Street Lighting

- All requests made to the Customer & Reliability Services – Design Supervisor for information should include suitable timelines to respond.
- The Designer shall select the street lighting supply points and send the street lighting design to the Customer & Reliability Services – Design Supervisor for review.
- Street Lighting plant, facilities, equipment and installation must meet the requirements of the Ontario Electrical Safety Code, which includes inspection by the Electrical Safety Authority (ESA).
- The Designer shall be responsible to arrange for ESA inspections.
- Toronto Hydro shall make the new street light service connections to the distribution system upon receipt of approval from ESA.
- The Designer shall be responsible for obtaining City permits for civil installations.
- The Designer shall inform the Customer & Reliability Services - Design Supervisor of any street lighting changes as per SP #022 “Street Light Energy Billing”.
- The type of underground cable, to be installed in the concrete encased ducts (from tap box to handhole), used for street lighting circuits is a “DUPLEX 2#2 AL XLPE/PVCJ BLACK/WHITE 600V WITH 1#6 SOL CU BARE” (SKU # 7150276).
- The Designer shall refer to SDP#009 Street Lighting for further design information.

1.2.14 Customer & Councillor Notifications

- In order to notify customers of our proposed work and ensure that construction proceeds smoothly, Customer Operations will undertake to contact the impacted customers by sending “tailored” letters to advise of specific plant installations. Refer to Appendix E for the required scenarios.

Appendix	Remarks
E1	General Notification Letter
E2	Councillor Notification
E3	Detailed Customer Notification

- During the design stage, Designers shall arrange with Customer Operations to send the appropriate project notification letters (see attached Appendix E) to all property owners within the limits of the project in accordance with the Municipal Consent Requirements (Chapter 5 – Above-Ground Plant, Notification). A PDF key map of the project area, a list of customers affected by the rebuild, a list of specialty letters required, approved start date and street boundaries shall be submitted to Customer Operations for distribution to the City Councillor and affected customers. Customer Operations will create and distribute General Notification Letter, the Councillor Notification of project letter and the Detailed Customer Notification of project letters. As well, Designers are to include the General Notification Letter, the Councillor Notification of project letter, the Detailed Customer Notification of project letters, and the list of customer addresses with the full-stream permit application request.

- Upon completion of the project drawings, the Designer shall forward the project drawings in PDF format and a hard copy to Customer Operations. The drawing package should only include the Title Sheet and Civil Plan drawings. In addition, the Designer shall submit a list of house addresses within the project that were identified through field visits to have unique/serious issues (i.e. damage to property, driveways, fences, hedges, etc.). The list should identify the issues and include accompanying photos if available.

1.3 Drawing Guidelines

In addition to the alignment of project designs with business strategies, it is also necessary that framework be established that will support the delivery of consistent project drawings. The following guidelines will provide the necessary information that will assist in achieving this objective.

The guideline will consist of the following three key elements:

1. Drawing Structure
2. Equipment Numbering
3. Symbology

1.3.1 Drawing Structure

- Standard drawing sheet sizes to be used are as follows:
  Imperial C (17” X 22”)
  Imperial D (22” X 34”)
- Drawing sheet sizes shall be a maximum size of Imperial D (22” X 34”). Field staff have, in past requested the use of ½ size prints for use as reference in the field. To ensure text is legible in a ½ size format, use a sufficient sized font for the text.
- Templates for the standard sheet size are in ProjectWise and are to be used when creating a new drawing. See ProjectWise User Manual for details.
- Drawing numbers, title blocks and page borders are to be generated using Project Wise. Title block information will be filled in automatically as the ProjectWise attribute tables are filled in. Drawing numbers are generated using ProjectWise – Do not modify the Drawing numbers from the standard format in any way. See ProjectWise User Manual for details.

- Sufficient white space shall be reserved to the left of each Title Block for placement of the "As-Constructed" stamp.
- Every drawing must be created using a separate file.
- All attribute data fields in ProjectWise must be filled in as part of assigning a new Drawing Number. See ProjectWise User Manual for details.
- All Drawings must be stored in ProjectWise in folders named after the Project Number. See ProjectWise User Manual for details.
- ProjectWise workflow must be updated as the drawing moves from the 1) Proposed to 2) Approval (before packaging) then on to 3) Issued. A new version should be created at this state, if modification is requested, as all drawings that have reached this state are assumed to be signed and therefore legal copies. The Records Management Section will perform the final state change to Archived when they receive the As Constructed mark-up. See ProjectWise User Manual for details.
- Designers shall use the White Space Management Guidelines when preparing the project drawings.
- Drawing type grouping selection through ProjectWise and drawing titles shall be consistent with the following table:

Project Drawings	
Drawing Type Grouping from ProjectWise	**Project Drawing Title**
Title Sheet	Title Sheet
General Notes	General Notes & Details
Primary Schematic	Primary Schematic
Civil	Civil Plan
Underground	Cable & Duct Layout
Existing Feeder or Reference Drawing	Existing Feeder or Reference Drawing
Overview - Electrical	Overview of Electrical Plan

- Plans must be prepared in accordance with the Municipal Consent Requirements. The following is the link to the document: http://www.toronto.ca/engineering/mcr/
- For reference purposes only a sample set of project drawings will be included as part of this document at a later date.

1.3.1.1 Title Sheet

- The title sheet shall include the full project name, key map with north arrow, Drawing Index, and a note indicating that the plan has been prepared in accordance with Ontario Regulation 22/04.
- Include the full last name of the Designer, CAD Operator, Supervisor, etc. in the drawing title blocks (do not use initials).

- The key map will encompass the entire limits of the project and shall be "blocked-off" in sections. Each section shall be numbered according to the ProjectWise plan drawing number and sheet number and include the relevant Concession Map #(s).
- In accordance with Ontario Regulation 22/04, the following note shall be placed in the top right corner of the title sheet where the assembly of the drawings uses only certified construction standards, technical specifications or authorized legacy standards in cases where maintaining a portion of line with current standards would be problematic:

> **THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS AND APPROVED EQUIPMENT AND MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF ONTARIO REGULATION 22/04.**

1.3.1.2 General Notes & Details

- The General Notes shall include civil and electrical responsibilities of the Contractor, Toronto Hydro and of 3rd Parties (if applicable).
- Indicate all known "Designated Substances" that may be encountered in the project.
- The General Notes shall include a reference that minimum horizontal and vertical clearances from other foreign utilities shall be maintained in accordance with Appendix O of the City of Toronto's Municipal Consent Requirements (*Note- the City clearance requirements are consistent with Toronto Hydro Construction Standards, section 31-0100).*
- The Specification and Construction Standards table shall list the applicable specifications (i.e. CV-CON-01) followed by the construction standards. The table shall consist of two columns: column i) the specification or construction standard name and column ii) document number.
- The Cut Repair table shall total all the exclusive hydro & joint-use cut repairs on the project that will be completed by the City. This information will be used for comparison against the City invoices for the actual repair work. The table shall be similar to the following:

	Approximate Cut Repairs		
Roadways	----------------	________	m² +/-
Concrete Sidewalk	----------------	________	m² +/-
Curb	----------------	________	m² +/-
Other	----------------	________	m² +/-

- Any new construction involving the use of legacy standards will require a certificate of approval be prepared by a Professional Engineer identifying the standard used, specific location (i.e. P123) and placed on the General Notes sheet.
- The General Notes shall include a note requiring field crews to re-label existing equipment locations where identified on the drawing.
- Designers should include a listing of all the original installation drawings and reference drawings applicable to the project. When the project includes 3rd Party Joint-use trenching, 3rd Party drawing numbers should be referenced as well.

- A typical road crossing profile shall be included on the drawing showing foreign utility crossings in accordance with the City of Toronto's Municipal Consent Requirements. If a road crossing is not typical (i.e. non-standard storm sewer depth, etc.) a separate road crossing profile shall be prepared and noted on the applicable Civil Plan drawing.
- Any details shall be included on the drawing.

1.3.1.3 Primary Schematic

- The purpose of this drawing is to provide an overall view of the proposed project.
- This drawing can be separated from the rest of the project drawings and used by the Control Centre. For this reason, the repetition of certain information (i.e. key map, legend, etc) is required.
- The entire limits of the project shall be shown on one drawing, where possible.
- Prepare the drawing in accordance with the White Space Management Guidelines.
- The Primary Schematic shall be "Not to Scale" and indicate the following:

- be semi-geographic, showing all relevant civil (i.e. vaults, pads, splice/tap boxes, poles, street names, etc.) and electrical (i.e. primary cables, switches, transformers, switchgear, fault indicators, elbows, pole numbers, etc.) components to facilitate ones "orientation".
- identify customers on life support and include contact person & telephone number.
- include a legend of proposed and existing plant and plant to be recovered or abandoned.
- include a key map similar to the Title sheet (reduced size) without the "blocked-off" sections and numbering.
- north arrow shall be shown pointing to the top or right of the sheet only.
- proposed connections to the existing plant either solidly connected or via switches.
- the feeder designations involved.
- indicate clearly the voltage rating(s) of the system and cable sizes.
- where unmetered supply connections to 3rd Parties are required, they shall be identified and shown up to the ownership demarcation point.

- Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######, FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.4 Civil Plan

- The Civil Plan drawings shall show the area of the proposed construction and shall be clipped from G/NetViewer and exported into a Microstation file.
- If the area of proposed construction requires more than one plan drawing, divide the area evenly from sheet to sheet using match lines. Maximize the use of drawing white space to minimize the number of drawings.
- Prepare drawing in accordance with the White Space Management Guidelines.
- Notes specific to the individual plan drawings shall be noted on the drawing.
- Prepare drawings using the City Land Base Maps, including the City Sewer and Water information, available through G/NetViewer. In the former City of Toronto area (District 1) the Digital Map Owners Group (DMOG) base maps shall be used.
- Unlike the City Land Base Maps available for the horseshoe area, the DMOG base maps provide some typical cross sections showing depth of cover of the various utilities.
- Include civil legend and identify proposed and existing plant and any plant that is to be recovered.
- Plans must be prepared in accordance with the Municipal Consent Requirements. The following is the link to the document:
  http://www.toronto.ca/engineering/mcr/
  In efforts to avoid any unnecessary delays in obtaining permits, it is extremely important that all information requested in Appendix Q "Permit Drawing Standards" of the Municipal Consent Requirements be shown on the Plan.
- Storm and Sanitary mains should be indicated on the plan at proposed hydro road crossings and sewer connections.
- Identify customers on life support and include contact person & telephone number.
- The plan shall indicate the number of electrical cable ducts required in the main trench. The appropriate number of ducts shall be shown inside a hexagon symbol placed within the trench lines. Each time there is a change in the number of ducts within the trench line, the new number shall be indicated. Spare duct requirements shall be noted on the plan.
- 3rd Party ducts within the main trench shall not be included with the hydro ducts indicated in the hexagon symbol. It will be necessary for the Contractor to consult 3rd Party drawings to determine where 3rd Party infrastructure is to be installed in the common trench and where 3rd Parties have exclusive installations.
- Indicate the proposed plant in bold and identify as such in the legend.
- Indicate existing plant to be abandoned and identify as such in the legend.
- Tie dimensions for new installations (i.e. centre line of trench, cable chambers vaults, etc.) shall be indicated to adjacent street lines and to existing curb lines or any other permanent existing structure (i.e. poles, hydrant, etc.). When using the DMOG Base Maps, tie dimensions are to be made to existing features (i.e. curbs, etc.).
- Vault drains shall be indicated on the Civil Plan drawings. The depth of cover to the storm sewer at the proposed connection shall be indicated on the plan. An additional road crossing profile shall be shown on the applicable Civil Plan for non typical road crossings (i.e. shallow storm sewer depth, etc.).
- Construction methods other than open trench (i.e. directional boring) shall be identified on the plans.
- Existing utility locations (i.e. water mains, gas, Bell, CATV, etc.) shall be shown on the plan drawings when available. Storm and Sanitary mains shall be indicated on the plan and profiles at road crossings, submersible vaults (for drains) or any locations where the hydro trench is in close proximity.

- For projects utilizing the DMOG base maps, existing utility plant and sizes shall be indicated at the match lines or cross streets. All other utility identifiers shown on the base maps shall be removed to avoid clutter. For projects outside the DMOG areas, existing utility plant and size shall be similarly noted.
- Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######,
FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.5 Cable & Duct Layout

- The Cable & Duct Layout drawing shall be “Not to Scale” and include the primary cable, secondary bus cable, service cable, service cable ducts, spare ducts, tap boxes, splice vaults/boxes, transformers, switchgear, and distribution poles.
- The drawing shall be diagrammatic and plotted to a scale of approx. 1:400 (two Civil Plans represented on one Cable & Duct Layout drawing).
- Reference to the applicable Civil Plan shall be shown on the Cable & Duct Layout drawing.
- Street lines, lot lines and the building land bases are to be taken from the plan drawings for preparing this drawing.
- A North arrow shall be on each plan, pointing to the top or right of the sheet only.
- Include a legend, identify proposed and existing plant and any plant that is to be recovered/abandoned.
- Identify customers on life support and include contact person & telephone number.
- Include a “Transformer Service Changes” table similar to the following on each Cable & Duct Layout drawing:

TRANSFORMER SERVICE CHANGES		
ADDRESS	TO (Transf. #)	FROM (Transf. #)
Transformers to be recovered	UT1234, UT1235, UT1236, etc.	

- Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######,
FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.6 Existing Feeder or Reference Drawing

- This drawing shall be used to indicate existing electrical or civil plant in the project area.
- It can also serve as an appendix to the project and include any specific details of the project requiring graphic explanation not covered by a Construction Standard or that cannot be shown on the civil or electrical layout drawing due to space restrictions. Examples of these details could include breakouts, duct diversions, etc.

- Each detail shall make reference to the project drawing and sheet number from which it originates.

1.3.1.7 Overview of Electrical Plan

- This drawing shall be used whenever there are multiple electrical drawings, to indicate an overview of the project's existing and proposed electrical plan.
- The intend of this drawing shall be to have the complete electrical project shown on one drawing. Typically this involves one drawing by reducing OH or UG electrical drawings.
- The drawing shall make reference to the detail project electrical drawings (Primary Schematic, Cable & Duct Layout).

1.3.2 Equipment Numbering

- New equipment numbering standards have been developed and are included in Section 21 of Toronto Hydro Construction Standards.
- Location numbers for new equipment (with the exception of poles, tap boxes, vault or transformer switches and elbows) can be obtained through the "New Location Number Request Application" program accessible by clicking on the following link: http://assetmgmt.torontohydro.com/nomenclature/
- For each new number requested through the "New Location Number Request Application", Designers should receive a "Nomenclature Labeling Report" which shall be included in the design folder for completion by the field crews.
- Designers must be identified in the Requestors list to access the program. If you are unable to access the program, contact the Supervisor of Asset Data Management-Capacity Planning to get on the list.
- In addition to the numbering of new equipment, some existing equipment within the limits of a project may require re-numbering as well. In general, the following guidelines shall apply for new projects:

  New Installations
  - All new equipment identified in Toronto Hydro Construction Standards section 21-1000 shall be numbered to the new Standard.
  - For poles, the new Standard shall apply when:
    i. installing new pole lines;
    ii. replacing the majority of poles along an entire street or city block (the few remaining poles would be included in the re-numbering).
  - For spot pole replacements or when not renumbering an entire street or block, use the legacy numbering standards for the area with the new numbering materials.

  Re-Numbering of Existing Equipment

  - The re-numbering of existing equipment shall generally apply in the respective operating districts where GEAR is functional. GEAR is currently functional in the former York, Etobicoke, and North York operating districts only, through Belfield Control. GEAR will be functional in the other operating district in the near future. Designer should contact System Operations to determine the status of GEAR in the project area.

- If the limits of the project are within the GEAR functioning areas, the following re-numbering standards shall be applied:
  - All existing switchable devices (i.e. transformers, switches, elbows) within the limits of the project shall be re-numbered to the new standard.
  - Existing cable chambers within the limits of a project shall <u>not</u> be re-numbered.
  - Existing vaults within the limits of the project may be re-numbered.
  - Existing poles within the limits of a project may be re-numbered to the new standard.
- On the project drawings, both the new location number and former number (in brackets) will be shown.
- Location numbers for the re-numbering of existing equipment can also be obtained through the “New Location Number Request Application” program.

1.3.3 Symbology

The new symbology shall now be used for all new projects. The symbols and cell libraries can be viewed by clicking on the following link: http://thehub.torontohydro.com/gear/Users/SymbologyPage/SymbologyPage.html

1.4 Project Deliverables

Projects that are initiated through the Investment Plan are typically designed approximately one year in advance of construction. To ensure a seamless process between the design and construction phase, Designers must be cognizant of the outstanding pre-construction requirements (i.e. cut permits, notifications, etc.). To assist in this area, a Project Design Deliverables checklist (Appendix “B”) has been developed and can be used by Designers to ensure all required documentation is included and/or noted in the Design folder when signed-off. Upon construction approval, the Design folder will be returned to the Designer for final assembly and for execution of the remaining “prior to construction” issues (i.e. cut permits, notification letters, etc.).

Section 2 - Rationale:

To ensure underground residential rebuild project designs are aligned with business strategies and project design packages are delivered in a consistent fashion.

Section 3 - References:

- Toronto Hydro Construction Standards
- Toronto Hydro Technical Specification for Civil Construction Work #CV-CON-01
- Toronto Hydro “Conditions of Service”
- Field Consultation Meeting – Terms of Reference
- Work Breakdown Structure
- Job Planning Process
- White Space Management Guidelines
- As-Constructed Map Products Process

- SDP #002 – New U/G Residential Subdivisions (Appendix B – Voltage Drop Tables)
- Standard Practice SP #001 “Ownership Transfer of Water Heater Assets”
- Standard Practice SP #006 “Customer Isolation”
- Standard Practice SP #024 “Conversion & Rebuild Work in Private Property (Class 3B Customers)”
- City of Toronto Municipal Consent Requirements
- Distribution Grid Operations Project Review Form
- Ontario Regulation 22/04
- Electrical Safety Authority Technical Guidelines for Sections 6, 7 & 8.
- Ontario Electrical Safety Code
- Occupational Health and Safety Act
- Standard Practice SP #022 “Street Light Energy Billing”

APPENDIX "A"

UNDERGROUND RESIDENTIAL REBUILDS DESIGN PROJECT CHECKLIST

Project Name: ______________________________

This checklist is intended to act as a guideline for the various activities involved in the design phase of underground residential rebuild projects. In addition, it includes those activities required in finalizing the project design package prior to issuing to construction. It should be kept in your working design file. Activities listed may not necessarily be in sequential order and may not apply to all major civil projects. The activities listed can be used as a reference in updating your departmental "Design Work Completion Report – Distribution".

Item #	Design Activities	Date Completed (or) N/A
1	Review project scope package from System Reliability Planning.	
2	A signed Letter of Agreement from the Customer should accompany rebuild projects on private property that require a civil infrastructure or easement contribution from the Customer.	
3	Assemble record maps and pertinent drawings.	
4	Define limits of the project design.	
5	Define limits of the project design in G/NetViewer and submit redline file to ProjectWise in accordance with the New Design Process.	
6	Receive Microstation file of the design area from Design/Records and ensure project drawings are deposited into the appropriate "set" within ProjectWise in accordance with the New Design Process.	
7	Coordinate preliminary design meeting with System Reliability Planning, Operational Performance Measurement, Dist. Proj. - Construction, System Operations and other key stakeholders to review the project proposal (as required).	
8	Verify with the City that no work moratorium currently exists in the area of proposed construction.	
9	Refer to the City map to determine if the asphalt in the proposed construction area requires asbestos testing.	
10	Initiate preliminary discussions with 3rd Parties (Rogers, Bell) regarding possible Joint-use initiatives.	
11	Arrange Field Staff Consultation meeting (as per T of R) with area Construction Supervisor to: 1) Review the project. 2) Address construction issues (i.e. vault/tap box locations). 3) Identify properties that have unique/serious issues (i.e. damage to property, driveways, fences, hedges etc.). 4) Identify the safety hazards associated with the project and measures to eliminate and/or control during construction phase.	
12	Prepare preliminary design concept and review with Design Supervisor.	
13	Forward "Design Scope Revision Request" form to System Reliability Planning for proposed revisions to original project scope (as required).	
14	Initiate project drawings through Project Wise.	
15	Compile a PDF key map of the project area, a list of customers affected by the rebuild, approved start date and street boundaries.	
16	Send compiled information (item 15) to Customer Operations, which will create and distribute General Notification Letter, Councillor Notification of project letter and Detailed Customer Notification letters to the City Councillor and affected customers. As well, Designer to include the General Notification Letter, Councillor Notification of project letter, Detailed Customer Notification of project letters, and a list of customer addresses with the full-stream permit application request.	

Item #	Design Activities	Date Completed (or) N/A
17	Prepare drawings using Microstation files.	
18	Prepare preliminary design utilizing certified construction standards and technical specifications and add to base maps.	
19	Obtain new equipment numbers and Nomenclature Labeling Reports through the “New Location Number Request Application”.	
20	Distribute preliminary drawings to other utilities, authorities for comments/approvals/line release.	
21	Submit near completed Civil Plan drawings to those 3rd Parties participating in Joint-use trench.	
22	Make final revisions to drawings and include note on drawing indicating compliance with Section 7 of Ontario Regulation 22/04.	
23	For projects involving Joint-use trenching, obtain 3rd Party civil drawings and listing of all 3rd Party civil unit items (by UPCMS item #) and the quantities.	
24	Review designs with Supervisor and sign drawings.	
25	Prepare Contractor (UPCMS) cost sheets and preliminary estimate for 3rd Party involvement.	
26	Prepare estimate and material requirements in Ellipse.	
27	Obtain the necessary external preliminary approvals as required.	
28	Initiate requests for easements or agreements with Legal Dept.	
29	Arrange meeting with Construction Supervisor to review final design, validation of MU/LUs and obtain sign-off.	
30	Make necessary changes to estimate and finalize MU/LUs.	
31	Obtain Ellipse authorization from Design Supervisor on project estimate.	
32	Prepare “Installed Units Summary” (WBS2) form.	
33	Prepare “Equipment Changeout Record” forms (as required).	
34	Complete “Prior to Construction” deliverables upon budget approval for construction.	
35	Fill out Full Stream Application Compliance check list and attach to the permit applications.	
36	Obtain the required number of approved 3rd Party plan drawings (see Appendix “C”) and completed City Permit Applications for any exclusive civil work.	
37	Obtain final sign-off/approval from Design Supervisor on project drawings.	
38	Obtain P.Eng. approval if using legacy standards for new construction.	
39	Update status of project drawings in ProjectWise from “Approved” state to “Issued”.	
40	Forward to Customer Operations a set of project drawings in PDF format and a hard copy (Title sheet and Civil Plan drawings only) and a list of house addresses within the project that were identified through field visits to have unique/serious issues (i.e. damage to property, driveways, fences, hedges etc.). The list should identify the issues and include accompanying photos if available.	
41	Arrange pre-construction site meeting with construction, contractor, foreign utilities and all other authorities.	
42	Prepare project package in Ellipse.	
43	Prepare purchase requisition in Ellipse.	
44	Update as-constructed units and prepare final billing.	
45	Prepare billing summaries and invoices for 3rd Party Joint-use trench and exclusive items where applicable.	
46	Maintain approved project drawings and the “As-constructed” drawings in the department central filing system for a period of one year following the annual audit required under Ontario Regulation 22/04.	
47	Participate in Post Construction meeting, as required.	

Jan. 7, 2011

APPENDIX "B"
PROJECT DESIGN DELIVERABLES

Project Name: ______________________ Scope Application # ______________

Design / Construction Project No.: ______________________

Construction Estimate $ ______________________ Estimate # ______________

Legend: **X -** *Items are Mandatory*

✓ - *Additional items to be included if applicable to the project*

Item #	Deliverables	Design Completion	Prior to Construction
1	Project documents filed in appropriate folder	X	X
2	Completed "Installed Units Summary" (Work Breakdown Structure II form)	X	X
3	Drawings – 1 full size set. Each drawing to include the following note above the title block "DESIGN COMPLETE - SUBJECT TO FINAL APPROVAL".	X	
4	Remove the note "DESIGN COMPLETE-SUBJECT TO FINAL APPROVAL" from the drawings.		X
5	Prepare documents as per "Project Distribution List" (see attached Appendix "C")		X
6	3rd Party Drawings		✓
7	"Requirement Summary" from Ellipse (Job Estimating - MSQ655) of the resource, vehicle and material requirements.	X	X
8	"Equipment Changeout Record" forms for key assets to be installed and recovered.	X	X
9	Nomenclature Labelling Reports	X	X
10	Storm Sewer Connection approvals for submersible vaults.	✓	✓
11	Construction Estimate break down (e.g. material, labour, O/H, U/G Civil etc.) through Ellipse	X	X
12	Preliminary Civil Contract Unit Price/Tender Package.	X	
13	'Notice of Project' – The Occupational Health & Safety Act – with any necessary sketch(es)/drawing(s) attached – **for projects with Hydro portion over $50,000.00** *(For electrical work only, Contractor is required to prepare for civil installations)*	X (1 Completed copy)	X (1 Completed copy per trade)
14	Action Log and Minutes from Field Staff Consultation Meeting	✓	
15	Customer & City Councillor Notification of Project letters etc. issued.	X (1 copy of each)	X (1 copy of each)
16	City Cut Permit including those for 3rd Parties and other approvals.		X
17	Include existing Feeder Prints/Concession Maps, showing the proposed mark-ups as required by the area Control Centre.	✓	
18	Joint Use civil drawings, billing details & forms		✓
19	Attach Easement Agreements / Letters of Understanding.		✓

Additional Comments: ______________________

Design Supervisor: ______________ Ext. ________ Date: ____________

Designer: ______________ Ext. ________ Date: ____________

Aug. 18, 2010

APPENDIX "C"
PROJECT DISTRIBUTION LIST (SAMPLE)

PROJECT DISTRIBUTION LIST **PROJECT # P0060372** **DESCRIPTION: E11189 BARCHESTER PH 3 CIVIL (TIEN)**

PROJECT DISTRIBUTION LIST	DR	Drawings: Full	Drawings: Half Size (11*17)	Drawings: Design Dwgs. Stamped "City Approval" (Scarborough Area or Where Applicable)	Drawings: "Poles Only Dwg"	Detail Schedule (GANTT Chart)	Work Break Down Structure	MSQ660	Material Printout (from EMRT)	CIVIL PERMITS AND POLE PERMITS/LOCATES PROVIDED BY CONTRACTOR	UPCMS Civil Sheet AND if UPCMS > $50,000 Forward Approved PO #	UPCMS Civil Construction Sheet Pole Holes	Notice of Project (> 50k) KEY MAP (8.5*11)	Nomenclature Labelling Form(s)	Equipment Changeout Form(s)	"Yellow" Feeder Prints (Downtown)	Joint Use	Street Lighting Cost Sheet (MSQ655)	Material Finalization Form Signed By Construction	"APPLICATION FORM" INDICATING THE CUT REPAIR COST
MDF (Shelda)	1		1			1	0	1	1	1	1	1	0	0	0	0	0	0	0	1
Records	1	1														0				
Power System Schedulers Control Rm	1	1														0				
Cindy Gillis	1					1														
Design Supervisor	1																			
Planner (Designer)	1																			
Control Room Joe Waite (NY Area)	0		0																	
Supervisor (Ken/Ray/Jerry/Earl/Dean/Mike)	0	0				0	0	0	0				0			0	0			
CPLP Or CPCP Crew	0	0				0	0	0	0				0	0	0	0	0			
Downtown Supervisor (Paul/Greg)	0	0				0	0	0	0				0							
Steve/Greg's CPCP Crew	0	0				0	0	0	0				0							
Poles - GERRY	1				1	1		1	1			1								
Pole CCL BERNIE	1				1	1		1	1	1		1								
Permits/Locate By Contractor Pole Excavation Crew (2)	1				1	1		1		1		1								
Supervisor Jack Leddy (Cable Crew)	0	0				0	0	0	0				0			0				
SAM HIFAWI	1		1			1		1		1	1									
Inspector	1	3				1		1		1	1									
Contractor (S & M OR PLP)	1	5	2	1		1		1		1	1									
Supervisor Tom Cook (Internal Civil)	0	0				0	0	0	0				0							
Robert Gregoris (Locates)	1		1																	
Street Lighting	0		0															0		
Kate Parkinson - Joint Use	0																0			
Stations Mike Stoddart P&C East - CCL	0		0			0	0	0												
Stations P. Papoutsis P&C S/W & N/W - CCL	0		0			0	0	0												
Stations T. Nguygen Scada Switch (INFORMATION ONLY)	0		0																	
Stn's Telecom East B. Tutka - CCL Stn's Telecom West P. Papoutsis - CCL	0		0			0	0	0												
Metering	0							0												0
TOTALS	**13**	**10**	**5**	**1**	**3**	**8**	**0**	**7**	**3**	**6**	**4**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

TOTAL GREEN CONSTRUCTION FOLDERS THAT HAVE YELLOW DR'S	2	YELLOW DR'S
TOTAL GREEN CONSTRUCTION FOLDERS THAT HAVE WHITE DR'S	1	WHITE DR'S
TOTAL WHITE FILE FOLDERS THAT HAVE WHITE DR'S	3	WHITE DR'S
EXTRA DR'S	6	WHITE DR'S
RECORDS	1	PINK DR
2010 ORANGE DEP'T FOLDER	1	SIGNED DR

NOTE: WITH CIVIL PROJECTS HAVING POLES, CONTRACTOR TO PROVIDE POLE PERMIT & LOCATES (NOT BEN)

THE PSD FOR THE POLE IS SEPT 10, 2010

PLEASE PROVIDE THE TOTALS THAT ARE IN THE WHITE BOXES.

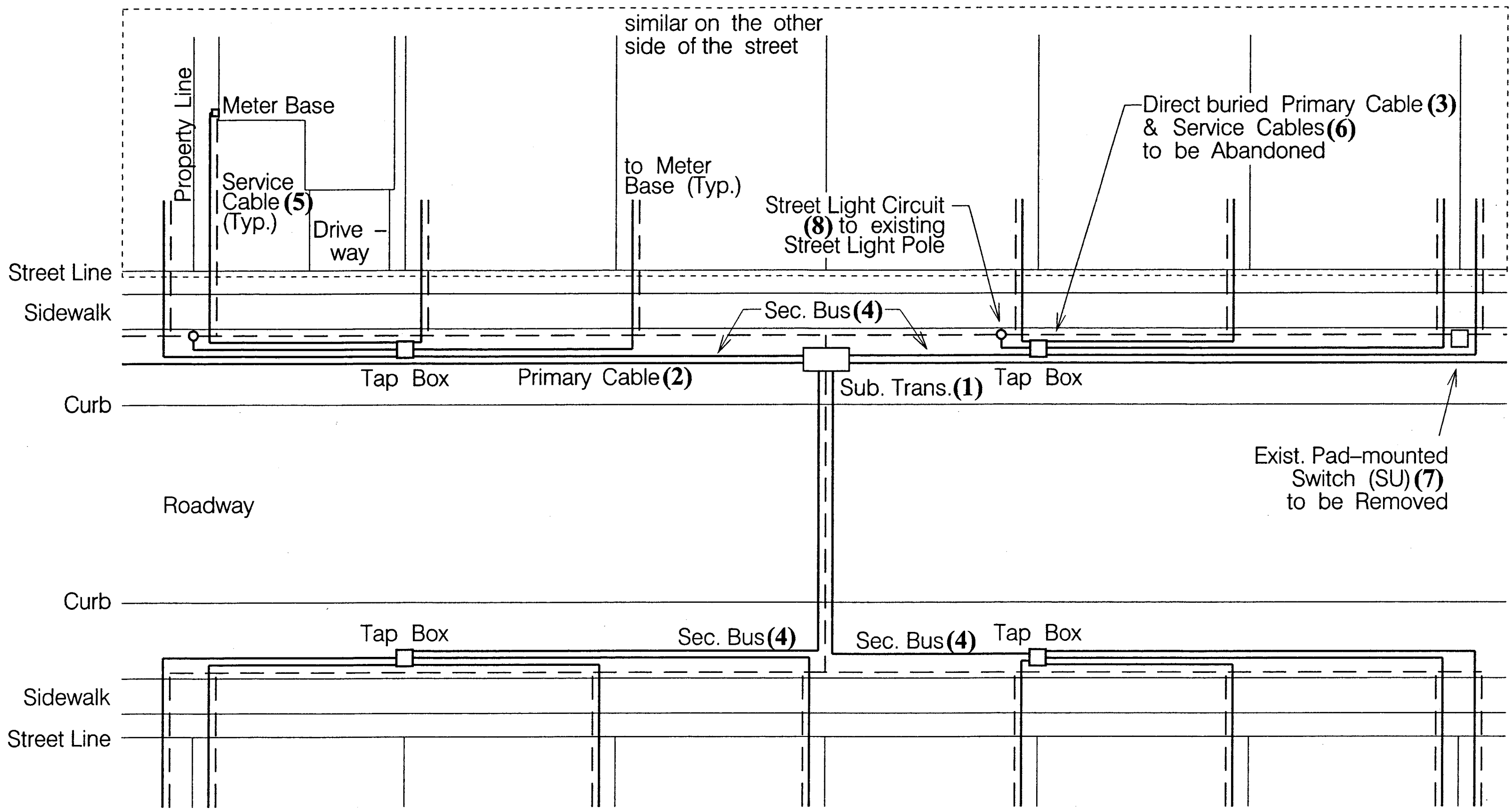
PLEASE ENSURE THAT THE .dgn CONSTRUCTION FILES ARE IN THE APPROPRIATE "SET" IN PROJECTWISE.

APPENDIX "D"
Design Guideline Illustrations

(refer to Design Guideline Table on page 3 of SDP#006)

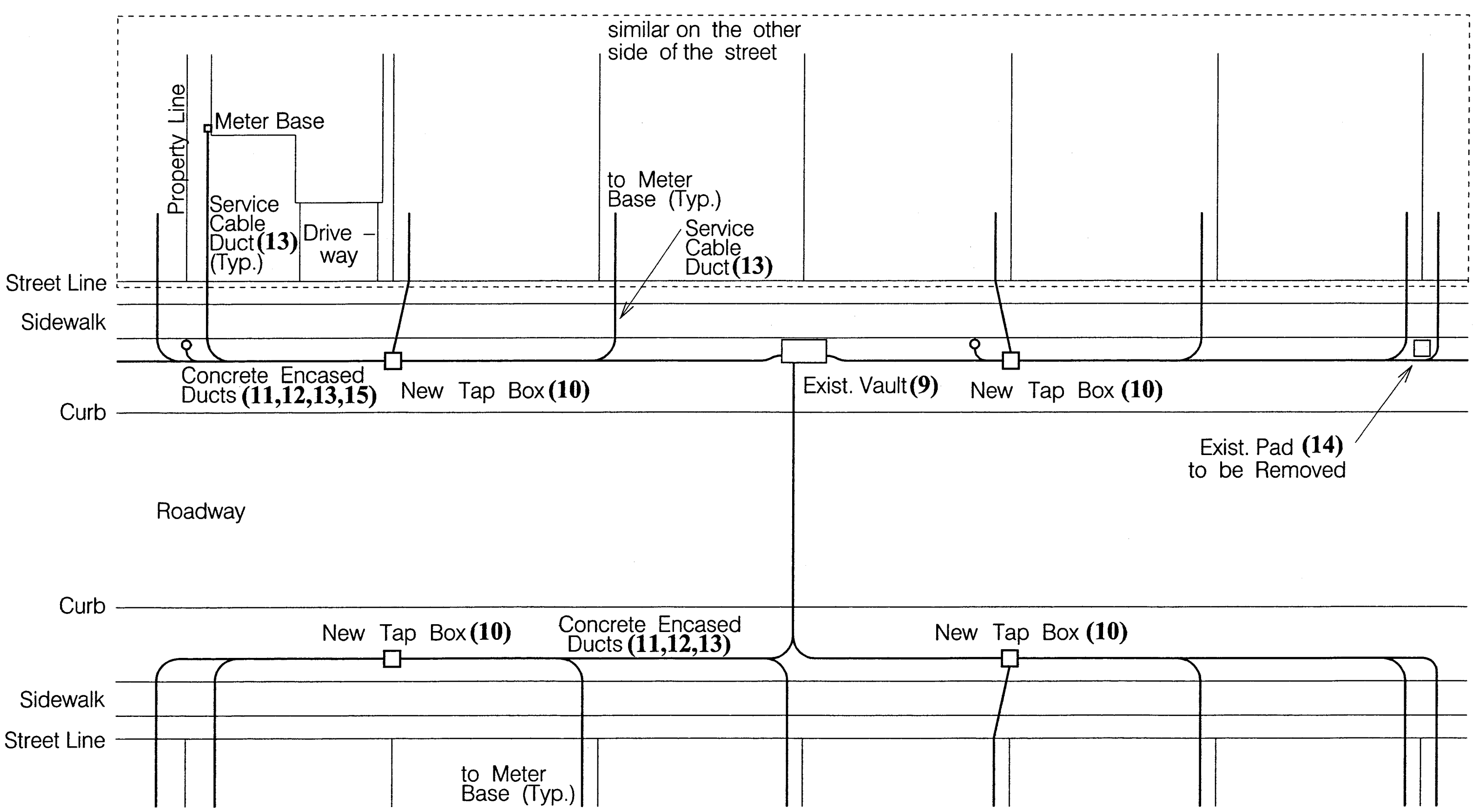
ELECTRICAL

(Number in brackets represents the item # from the Design Guideline Table on page 3 of SDP#006)



CIVIL

(Number in brackets represents the item # from the Design Guideline Table on page 3 of SDP#006)



Appendix E1 – General Notification Letter

Toronto Hydro-Electric System Limited
14 Carlton Street		Email: capitalprojects@torontohydro.com
Toronto, Ontario		Website: http://poweruptoronto.ca/
M5B 1K5			416.542.3366

April 14, 2010

To our valued customer:

RE: Hydro Underground Construction – Cable Replacement - IMPORTANT NOTICE

We are planning to rebuild the underground electrical system on your street. The existing system is nearing the end of its life expectancy and if left unattended, it could hamper our ability to maintain a reliable level of service to you and your neighbours.

The proposed work will involve the replacement of Toronto Hydro's existing electrical plant within the public road allowance and the underground cables to the meterbase of your house. A Toronto Hydro representative will be in contact with you to explain the nature of our work on your property.

Entry to your house will not be required. If you have any doubts about someone claiming to be "from Hydro", ask to see the person's Toronto Hydro identity card, which includes the employee's name and colour photograph.

We expect the civil work to get underway by mid June 2011. Our construction personnel are instructed to take extra care and precautions in order to minimize disruptions on both public and private property. During the course of our electrical work to follow in 2012, you may experience some power interruptions when we switch from the old to the new supply arrangements. We will endeavour to keep the interruptions to a minimum and to give you prior notice.

Once construction begins, Toronto Hydro Inspectors will be on site on a regular basis. Any concerns that arise **during construction** can be discussed with them.

Restoration will be done in various stages during construction of the project. The grass will be replaced with new sod where we excavate. All asphalt will be replaced between the curb and sidewalk if affected by our excavation. Where no sidewalk exists, we will replace the portion of the driveway between 300 mm on either side of our excavation trench or right up to the curb if the curb is within 1.0m of our trench. All disturbed concrete sidewalks will be temporarily repaired with asphalt. After Hydro's construction, the City will make permanent concrete repairs to these sidewalks within two years.

If you were considering repaving / repairing your driveway, we would encourage you to hold off until our work has been completed.

We thank you in advance for your co-operation and understanding in this matter. For project information and any ongoing updates please visit: http://www.poweruptoronto.ca/. Should you require additional information please contact the PowerUp office at 416-542-3366 or capitalprojects@torontohydro.com and **reference Project __________.**

Sincerely,

Paul Reesor
Customer Operations Representative,
Customer Operations

Appendix E2 – Councillor Notification

Toronto Hydro-Electric System Limited
14 Carlton Street		Email: capitalprojects@torontohydro.com
Toronto, Ontario		Website: http://poweruptoronto.ca/
M5B 1K5			416.542.3366

December 14, 2010

Toronto City Hall
100 Queen Street West, Suite A1
Toronto, ON M5H 2N2

Attn: Mike Del Grande
City Councillor, Ward 39
Scarborough-Agincourt

Re: Fundy Bay Project

For your information, please find attached a copy of our first notification letter which will soon be delivered to customers concerning the above mentioned project. Also, enclosed is a map of the area that will be affected by this important hydro upgrade.

The streets affected are as follows:

- Fundy Bay Blvd
- Ambercroft Blvd
- Hawkshead Crescent
- Hood Crescent

If any additional information is required, please do not hesitate to contact me at 416.542.3366.

Sincerely,

Paul Reesor
Customer Operations Representative,
Customer Operations

Appendix E3 – Detailed Customer Notification

Toronto Hydro-Electric System Limited
14 Carlton Street — Email: capitalprojects@torontohydro.com
Toronto, Ontario — Website: http://poweruptoronto.ca/
M5B 1K5 — 416.542.3366

September 14, 2010

Mr. / Ms. Smith
123 Anywhere Street
Toronto ON
M1B 2V3

Dear Valued Customer,

Toronto Hydro is preparing to rebuild a section of the electrical system on your street. The project is scheduled to begin in April 2011. We are doing this to improve the electricity system reliability in your neighbourhood. The existing system is nearing the end of its life expectancy and this project will improve service and reliability and reduce the frequency of outages.

During the design stage of this project, we assessed your area and identified where and how the new system will be upgraded. The electrical system is made up of transformers and underground cables delivering electricity to the street and then to each house.

In an effort to keep our customers informed, we are advising you that in addition to replacing the underground cables, we will be installing within the public road allowance on your street,

1) a below ground cable pulling chamber or secondary tap box whose top is flush to grade (in front of your property) Typical size is 800mm in diameter or 900mm by 1.3 metres, respectively.

and / or

2) a below ground submersible type transformer covered by a metal grill / grate whose top is flush to grade, (in front of your property). Typical size is 2.2 metres by 1.1 metres.

or

3) an above ground pad-mount type transformer on a concrete base (in front of your property). Typical size is 0.9 metres by 1.1 metres by 0.7 metres in height and is green in colour.

We will also be replacing the underground service cables that provide electricity to your house. This work will require access onto the front of your property, from street line to the location of your hydro meter. All efforts will me made to minimize any disturbance to your landscaping. A Toronto Hydro representative will be in contact with you to explain the nature of the work on your property.

Toronto Hydro and its contracted suppliers will take all reasonable care to protect the area during the construction of this project. We will repair any damage to the area caused during construction.

We thank you in advance for your co-operation and understanding in this matter. For project information and any ongoing updates please visit: http://www.poweruptoronto.ca/. Should you require additional information please contact the PowerUp office at 416-542-3366 or capitalprojects@torontohydro.com and **reference Project __________.**

Sincerely,

Paul Reesor
Customer Operations Representative,
Customer Operations

APPENDIX "F"
EXAMPLE OF JOINT-USE TRENCH COST ESTIMATE

3-June-10

Project "X" - 2010

JOINT USE TRENCH REQUIREMENTS

1. 125m of 2 Party Joint-Use Road Crossing Trench (extra trench depth required, also road crossing ducts must be concrete encased)
   Cable TV requires 1- 4" duct @1.0m trench depth (Hydro forced below the MCR depth requirement)
2. 400m of 2 Party Joint-Use Trench in Boulevard
   Cable TV requires 1- 4" duct @ 0.6m trench depth
3. 700m of 3 Party Joint-Use Trench in Boulevard
   Cable TV requires 1- 4" duct @ 0.6m trench depth
   Bell requires 1- 4" duct @0.6m trench depth
4. 1,100m of 2 Party Joint Use Trench in Boulevard
   Cable TV requires 2- 4" ducts @ 0.6m trench depth

JOINT USE TRENCH COST SHARING

1. 125m of 2 Party Joint-Use Road Crossing Trench
   125m X $43.60 tr/m = $5,450.00 (Cable TV)
   125m X $47.15 tr/m = $5,893.75 (Cable TV) extra trench depth cost
   $11,343.75
2. 400m of 2 Party Joint-Use Trench in Boulevard
   400m X $43.60 tr/m = $17,440 (Cable TV)

3. 700m of 3 Party Joint-Use Trench in Boulevard
   i. 700m X $34.90 tr/m = $24,430 (Cable TV)
   ii. 700m X $34.90 tr/m = $24,430 (Bell)

4. 1,100m of 2 Party Joint Use Trench in Boulevard
   1,100m X $50.14 tr/m = $55,154 (Cable TV)
   Note - $50.14 tr/m = single duct cost ($43.60) + 15% for second duct in trench

ESTIMATED 3RD PARTY JOINT-USE TRENCH COSTS

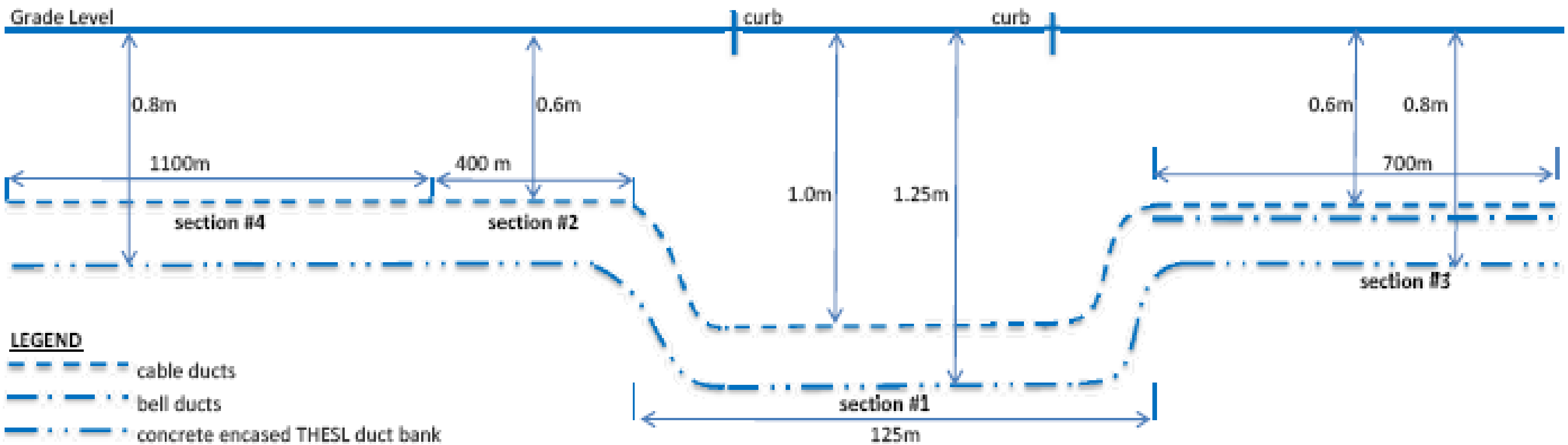
Cable TV
Joint-Use Trench - $ 108,367.75
15% Admin. Fee - $ 16,255.16
Total - $124,622.91

Bell
Joint-Use Trench - $ 24,430
15% Admin. Fee - $ 3,664.50
Total - $ 28,094.50

APPENDIX "F" CONTINUED

EXAMPLE OF JOINT-USE TRENCH COST ESTIMATE

June 3, 2010



Standard Design Practice Amendment

Date: May 25, 2012
Effective Date: June 18, 2012

Issue Number: SDP-2012-02 Rev.1

This amendment is issued to inform the affected stakeholders that there is a change to **Standard Design Practice** (**SDP) #006 Rev.2 – Underground Residential Rebuilds**. This change is enforceable by the effective date, and will be included in the next SDP update.

Change	Summary of Changes	Training Requirements
Section 1.2.1	**The words "abandon or" have been removed in the Design Guideline Table regarding Primary Distribution Cable.**	☐ **Yes** √ **No, awareness only** **Affected stakeholders:** Design Supervisors, Designers, Project Planning Supervisors, Project Planners and Construction & Maintenance Supervisors.
Section 1.2.2.1	**A sentence was added identifying that cables shall be temporarily supported during underground cable chamber and vault rebuilds. Incorrect support of cables can result in damage to the cables as well as splices, creating potential hazards.**	
Section 1.2.4	**A sentence was added to specify the removal of unused primary cables of 750 volts or more. If removal of such cables is not feasible or practical, example direct buried cable, they shall be cut-off and grounded at each end in accordance with Toronto Hydro Distribution Construction Standard 16-0020. Also a sentence was added to explain how to handle situations where the unused cables cannot be removed and grounded.**	

This SDP Amendment is issued by email to all the affected stakeholders. You can also find this information in the following location on Plugged In: **Plugged In > Asset Management > Standards and Policy Planning > Standard Practices**

The purpose of a SDP Amendment is to communicate changes that are required throughout the year and will be incorporated in the next SDP revision. This will ensure that the affected stakeholders receive the latest information in a timely manner, and that the latest changes can be incorporated in new designs.

A SDP Amendment adds, removes or revises information in an existing Standard Design Practice. It also identifies training requirements, if applicable, regarding the changes described in the amendment. Each SDP Amendment consists of a cover sheet, the entire updated section(s) from the SDP with changes included in blue and any relevant attachments such as drawings or tables. It does not contain information that is applicable to other sections of the SDP.

Originator	**Frank Yu**
Sponsor(s)	**Sheikh Nahyaan**
Reviewers	**Kal Sarkar, Ian Maikawa, James Daniel, (SDP Committee)**
Supervisor / Signature / Date	**James Schofield**
Manager / Signature / Date	**Mary Byrne**

Updated Sections in SDP #006 Rev.2 – Underground Residential Rebuilds

1.2 <u>Design Considerations</u>

1.2.1 General

- Designers shall ensure project designs satisfy the requirements of Section 7 of Ontario Regulation 22/04 “Electrical Distribution Safety” under the Electricity Act, 1998.
- Designers shall employ the “Job Planning Process” and the “Safety by Design” concept in project designs.
- Designers shall endorse the use of only certified construction standards, specifications in the assembly of the project drawings. The use of authorized legacy standards should be limited to the maintaining of lines where certified construction standards would be problematic. Any new construction specifying the use of legacy standards will require a certificate of approval prepared by a Professional Engineer.
- In accordance with the Occupational Health and Safety Act, all known “Designated Substances” that may be encountered in the project shall be identified on the drawing. Examples of “Designated Substances” and their applications may include:

  <u>Asbestos</u> - AILC cables, ducts, pavement asphalt, listing tape, barrier boards and meter backer boards
  <u>Lead</u> - PILC and AILC cables, and older station batteries
  <u>Mercury</u> - mercury vapor lamps and street light relays
  <u>Vinyl Chloride</u> - 4" PVC ducts and PVC jacketed cables
  <u>Arsenic</u> - arsenical lead sheathed cables
  <u>Ethylene Oxide</u> - polyethylene insulated cables
  <u>Silica</u> - current limiting fuses and lightning arresters (4kV),
  and other substances and applications that may be added from time to time.
- Refer to the City map “Asbestos Locations” to determine if the asphalt in the proposed construction area requires asbestos testing. Streets that are **GREEN** do not require testing. Streets that are **RED** do not require testing as these will be treated as being contaminated with Asbestos. Only streets indicated in **PURPLE** on the City map need to be tested. Driveway aprons do not require testing. Conduct one test per road crossing. Boulevard pole locations do not require testing. If test results are positive or you are working in a **RED** area, adhere to Type II Asbestos Handling Procedures for Removal & Disposal of any Contaminated Asphalt.
- When preparing scope packages & project designs, both Planners and Designers shall consider the requirements of Distribution Grid Operations. These requirements are identified in a “Distribution Grid Operations Project Review Form” that can be obtained by contacting a Control Room Operations Supervisor.
- Unless indicated otherwise by System Reliability Planning, the new primary distribution supply arrangement shall reflect the primary cable being replaced.
- If a rebuild area is fed from a radial supply, it is recommended that a distribution loop arrangement be installed. In addition:
  - Both ends supplying the distribution loop shall be fused and should <u>not</u> terminate within the same switching device or at the same structure.
  - In the horseshoe area, the distribution loop can be supplied from the same feeder or two different feeders off the same station bus. When using the same feeder, ends of the loop are to be connected at two different switch locations.
  - Open point is to be located at a transformer in the middle of the distribution loop.
- Customers on life support should be clearly noted on all applicable plans.

- In general, designers shall use the following table in determining the design requirements for their underground residential rebuild projects:

Design Guideline Table	
Electrical	
Transformers	1. Replace all non-switchable transformers with switchable units. Replace with "like for like" (i.e. submersibles with submersibles, etc.).
Primary Distribution Cable	2. Install between new/existing transformers, splice boxes, switchgear and pole locations. 3. Remove existing primary cable of 750 volts or more where feasible or practical.
Secondary Bus	4. Install from new/existing transformer location to new tap box location(s).
Secondary Service Cables	5. Install from new tap box to customer meter base. 6. Existing service cables that are replaced to be abandoned.
Single-phase pad-mounted switches (SU)	7. Remove single-phase pad-mounted switches (SU).
Street Lighting	8. Replace existing street light circuits along the trench route. Install new cable from the tap box to the existing pole's handhole.
Civil	
Transformer Vaults/Pads	9. Re-use existing transformer vaults/pads where possible.
Tap Boxes	10. Install tap boxes as required to supply secondary services.
Primary Cable Duct	11. Install new concrete encased duct(s) between existing or new vaults/pads, splice boxes, switching cubicles and poles.
Secondary Bus Duct	12. Install new concrete encased duct(s) from existing vault/pad to new tap boxes.
Secondary Service Cable Duct	13. Install duct from tap box to meter base with the portion under the road allowance being concrete encased. The portion from the street line to the customer's meter base shall be direct buried duct.
Pad for Single-phase switches (SU)	14. Remove pad for single-phase switches (SU).

Street Lighting Duct	15. Install new concrete encased duct(s) from new tap boxes in the main trench and terminate 450mm from the base of pole. Connect the 100mm duct to a 50mm poly pipe and install inside the pole's aperture.

Refer to Appendix "D" for sample illustrations on the above design guidelines.

- In situations where the existing transformer vault or pad foundation is deteriorated a new vault or pad foundation shall be installed.
- When maintaining existing structures (e.g. vaults, pads) ensure grounding meets current standards.
- The existing submersible vault or pad foundation shall be core drilled to accommodate the new primary and secondary service bus ducts.
- Opportunities for Joint-use trenching initiatives shall be discussed with 3rd Parties in the early stage of design. See Section 1.2.2.5 - Joint-Use Trench for cost sharing formula.
- For rebuilds which cross over or may be in close proximity to gas pipelines, CN/CP tracks, Hydro One corridors, etc. consult SDP #004 - Major Civil Projects, Section 1.2.4 - Special Permits & Approvals for instruction.
- For rebuilds located in private property, Planners and Designers should consult SP #024 "Conversion & Rebuild Work in Private Property (Class 3B Customers)", as the Customer may be required to provide some civil infrastructure or an easement.
- For projects involving water heater relays or service cable rebuilds to flat-rate water heater customers, Designers shall consult the Conversions & Rebuilds section in SP #001 "Ownership Transfer of Water Heater Assets".
- Designers shall include in the General Notes, the customer notification instructions as identified in SP #006 "Customer Isolations".
- When installing above grade structures such as switchgear or pad-mounted transformers consider installing guard posts, as per Toronto Hydro Construction Standards, section 31-4080, in situations where there is a risk of vehicle impact.

1.2.2 Civil

1.2.2.1 General

- The standard location for the centre line of the new electrical trench would typically be 3.5m from street line. Should that location be occupied 1.8m from street line (beneath sidewalk) would be the alternative. There may be exceptions where a 3rd party may have occupied these locations. In these instances the location of the new electrical trench should be discussed with the City.
- The City enforces a moratorium on all newly improved streets. Refer to the latest Municipal Consent Requirements for the restrictions. The link to the document is http://www.toronto.ca/engineering/mcr/.
- The minimum cover over the electrical ducts in an open trench installation shall be in accordance with Toronto Hydro Construction Standards, section 31.
- For street classifications refer to Municipal Consent Requirements Appendix S "Street Classifications" and Appendix T "Classification of City Streets". Refer to Appendix T for updated street classifications. The following is the link to the documents: http://www.toronto.ca/engineering/mcr/
- Minimum horizontal and vertical clearances from foreign utilities shall be in accordance with Appendix O "Vertical and Horizontal Clearance Guidelines" of the City of Toronto's Municipal Consent Requirements and Toronto Hydro Construction Standards, section 31. Additional horizontal clearances should be considered to prevent proposed foreign utility excavations from damaging electrical cables and equipment.
- Efforts shall be made to install the edge of transformer pads, vaults and tap boxes a minimum horizontal clearance of 1.0m from the paved portion of driveways.
- **During the rebuilding of underground cable chambers and vaults, cables shall be temporarily supported during construction in accordance with Toronto Hydro Distribution Construction Standard 31-2250.**

1.2.4 Primary Cables

- Primary cables shall be installed in concrete encased ducts.
- The standard primary distribution cable sizes are indicated in the following table:

Primary Distribution Cables			
Distribution System	Cable Type	***Ampacity Rating (max)	MVA Rating (max)
13.8kV	*1/C 1/0 Al 15kV TRXLPE *(or)* **1/C 1/0 Al 28kV TRXLPE CN	200 Amps	4.8 MVA
27.6kV	1/C 1/0 Al 28kV TRXLPE CN	180 Amps	8.6 MVA

Note:

***** *1/C 1/0 Al 15kV TRXLPE cable is only to be used on the 13.8kV distribution system in the downtown core area where there is no possibility of future 27.6kV system expansion.*

****** *1/C 1/0 Al 28kV TRXLPE CN cable is to be used on the 13.8kV distribution system in the horseshoe and bordering core areas where there is the possibility of future 27.6kV system expansion.*

******* *For the conditions under which the above Ampacity ratings apply, consult the following Construction Standards:*
- 13.8kV XLPE Al cable – Construction Standards section 16-1060 1/5
- 27.6kV XLPE Al cable – Construction Standards section 16-1140 1/5

- *A #2 stranded Cu, PVC insulated white neutral shall be installed and run concurrently with the 1/0 Al 15kV TRXLPE cable. A separate neutral conductor is not required when using 1/0 Al 28kV TRXLPE CN as this cable has a full sized concentric neutral.*
- *The above MVA ratings indicate the maximum permissible load for a 3Ø distribution circuit.*
- **All efforts shall be made to remove cables of 750 volts or more that are no longer in use. If it is not feasible or practical to remove these cables, example direct buried cable, they shall be cut-off and grounded at each end so not to be inadvertently energized in accordance with Toronto Hydro Distribution Construction Standard 16-0020.**
- **In situations where the unused cables cannot be removed and grounded, the Supervisor in the Standards & Materials section shall be contacted.**

Toronto Hydro-Electric System Limited
EB-2012-0064
Tab 6F
Schedule 7-52
Appendix H
Filed: 2012 Oct 5
(48 pages)

Standard Design Practice

UNDERGROUND REBUILDS INDUSTRIAL/COMMERCIAL AREAS SDP #007 Rev.1

Prepared by: Standard Design Practice Team

Originally Approved by: Francis Szto, Manager, Standards & Policy Planning — Issue Date: February 25, 2009
Revision #1 Approved by: Mary Byrne, Manager, Standards & Policy Planning — Issue Date: March 21, 2011

Revision History				
Rev. #	**Date**	**Description**	**Issued by:**	**Approved by:**
00	25-Feb-09	- Original Issue	I. Maikawa	F. Szto
1	21-Mar-11	- section 1 PRACTICE: removed the option of using micro-tunnel duct system for the installation of primary cable - section 1.2.1 General: changed Bill 208 to Occupational Health and Safety Act; added City map of Asbestos Locations; revised content in Design Guideline Table and added reference to street lighting; added wording to pad foundations; added bullet to ground existing civil structures to current standards - section 1.2.2.1 General: added web site address for the Municipal Consent Requirements - section 1.2.2.2 Ducts: added service cable to be installed in separate duct; added duct installation for street lighting - section 1.2.2.3 Foundations/Splice Chambers: added to where to install pad-mounted foundations; revised what to do with existing pad-mounted transformer foundations; added reference standards - section 1.2.2.4 Joint-Use Trench: updated joint-use cost figures; added third parties to attend meeting - section 1.2.4 Primary Cables: removed reference to micro-tunnel ducts; added bullet to abandon or remove existing primary cable - section 1.2.7 Switchgear: added bullet regarding pad-mounted switchgear; added bullet to change out non-standard switchgear; added to consider vehicle sightlines when installing above grade switchgear - section 1.2.10 Street Lighting: revised entire section - section 1.2.11 Customer & Councillor Notifications: revised section title and section name; combined certain customer notification letters into one letter - section 1.3.1 Drawing Structure: added bullet to note standard drawing sizes; added to the project drawing table - section 1.3.1.3 Primary Schematic and section 1.3.1.5 Cable & Duct Layout: Revised direction of the north arrow - sections 1.3.1.2 General Notes & Details, and 1.3.1.7 Overview of Electrical Plan; added new sections - section 3- References: added SP#022 - updated appendices A, B, C, D, E, F; removed appendix G - section 3: replaced sample project drawings with new drawings	I. Maikawa	M. Byrne

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CONTENTS

Section 1 - Practice:

The purpose of this document is to provide a design guideline for rebuilding the existing direct buried underground cable in industrial/commercial areas.

Typically, the existing direct buried primary cables and possibly secondary cables that have reached the end of their useful life or conversion projects from 4.16kV to either 13.8kV or 27.6kV. The intent is to provide a continuous concrete encased duct system and splice chambers when interfacing with existing customers.

The document provides the necessary framework to ensure project designs are aligned with business strategies and completed design packages are delivered in a consistent fashion.

This document can be used as a guideline for cable rebuilding projects involving industrial/commercial areas:

Industrial refers to industrial buildings and complexes where manufacturing, industrial production, research and development are performed.

Commercial encompasses all buildings other than industrial buildings and private dwellings. It includes office and apartment buildings, hotels, schools, governmental buildings, hospitals, sports arenas, and other buildings serving the public directly.

Four key issues addressed in this document:

1. Design Checklist: identifies the activities, which should be considered during the design phase.
2. Design Considerations: supplements the Construction Standards by identifying key design components and strategies for new projects.
3. Drawing Guidelines: identifies key information to be shown on project drawings.
4. Project Deliverables: identifies the documents and drawings required when signing-off on a design file.

1.1 Design Checklist

Many issues need to be considered in the design of projects involving underground Industrial/Commercial cable rebuild projects. To ensure a comprehensive design package is delivered, designers must be cognisant of all issues during the design. To assist designers in this area, "Underground Rebuilds Industrial/Commercial Areas Design Project Checklist" (Appendix "A") has been developed and should be used as a guide to ensure all aspects of the design stage are successfully completed.

1.2 Design Considerations

1.2.1 General

- Designers shall ensure project designs satisfy the requirements of Section 7 of Ontario Regulation 22/04 "Electrical Distribution Safety" under the Electricity Act, 1998.
- Designers shall employ the "Job Planning Process" and the "Safety by Design" concept in project designs.
- Designers shall endorse the use of only certified construction standards, specifications in the assembly of the project drawings. The use of authorized legacy standards should be limited to the maintaining of lines where certified construction standards would be problematic. Any new construction specifying the use of legacy standards will require a certificate of approval prepared by a Professional Engineer.
- In accordance with the Occupational Health and Safety Act, all known "Designated Substances" that may be encountered in the project shall be identified on the drawing. Examples of "Designated Substances" and their applications may include:
  Asbestos - AILC cables, ducts, pavement asphalt, listing tape, barrier boards and meter backer boards
  Lead - PILC and AILC cables, and older station batteries.
  Mercury - mercury vapor lamps and street light relays
  Vinyl Chloride - 4" PVC ducts and PVC jacketed cables
  Arsenic - arsenical lead sheathed cables
  Ethylene Oxide - polyethylene insulated cables
  Silica - current limiting fuses and lightning arresters (4kV)
  and other substances and applications that may be added from time to time.
- Refer to the City map "Asbestos Locations" to determine if the asphalt in the proposed construction area requires asbestos testing. Streets that are **GREEN** do not require testing. Streets that are **RED** do not require testing as these will be treated as being contaminated with Asbestos. Only streets indicated in **PURPLE** on the City map need to be tested. Driveway aprons do not require testing. Conduct one test per road crossing. Boulevard pole locations do not require testing. If test results are positive or you are working in a **RED** area, adhere to Type II Asbestos Handling Procedures for Removal & Disposal of any Contaminated Asphalt.
- When preparing scope packages & project designs, both Planners and Designers shall consider the requirements of Distribution Grid Operations. These requirements are identified in a "Distribution Grid Operations Project Review Form" that can be obtained by contacting a Control Room Operations Supervisor.
- Unless indicated otherwise by System Reliability Planning, the new primary distribution supply arrangement shall reflect the primary cable being replaced.
- If a rebuild area is fed from a radial supply, it is recommended that a distribution loop arrangement be installed. In addition:
  - Both ends supplying the distribution loop shall be fused and should not terminate within the same switching device or at the same structure.
  - In the horseshoe area, the distribution loop can be supplied from the same feeder or two different feeders off the same station bus. When using the same feeder, ends of the loop are to be connected at two different switch locations.
  - Open point is to be located at a transformer in the middle of the distribution loop.
- Customers on life support should be clearly noted on all applicable plans.

- In general, Designers shall utilize the following table in determining the design requirements for their underground rebuilds projects:

Design Guideline Table	
Electrical	
Primary Cable	1. Install between existing transformers, splice chamber/box, switchgear and pole locations. 2. Abandon or remove existing primary cable.
Equipment in Customer Transformer Rooms	3. Evaluate the condition and the operation of the equipment, change out where it is necessary.
Pad-mounted Transformers	4. Install to current Standards as required.
Secondary Services	5. Convert to current Standards, e.g. Open Delta to Grounded Four Wire Services.
Street Lighting	6. Replace existing street light circuits along the trench route. Install new cable between the existing poles' handholes.
Civil	
Transformer Pads	7. Install to current Standards as required.
Primary Cable Duct	8. Install new concrete encased duct(s) between new vaults, pads and poles. Road crossings to be concrete encased.
Street Lighting Duct	9. Install new concrete encased duct(s) and terminate 450mm from the base of the pole. Connect the 100mm duct to a 50mm poly pipe and install inside of the pole's aperture.
Handwell	10. Install new handwell as required.
Splice Chamber, Splice Box	11. Install new splice chamber/box as required.

Refer to **Appendix "D"** for sample illustrations on the above design guidelines.

- In rebuild areas that utilize pad-mounted transformers and the existing pad foundation is not to current standard, a new pad foundation should be installed in close proximity to existing foundation. The existing pad is to be replaced with a tap box for splicing to the existing service cables.
- When maintaining existing structures (e.g. vaults, pads) ensure grounding meets current standards.
- Opportunities for Joint-use trenching initiatives shall be discussed with 3rd Parties in the early stage of design. See Section 1.2.2.4 - Joint-Use Trench for cost sharing formula.

- For rebuilds which cross over or may be in close proximity to gas pipelines, CN/CP tracks, Hydro One corridors etc. consult SDP #004 - Major Civil Projects, Section 1.2.4 - Special Permits & Approvals for instruction.
- For rebuilds located in private property, planners and designers should consult SP #024 "Conversion & Rebuild Work in Private Property (Class 3B Customers)", as the Customer may be required to provide some civil infrastructure or an easement.
- Designers shall include in the General Notes, the customer notification instructions as identified in SP #006 "Customer Isolations".
- Connecting single-phase load to a three-phase loop between two three-phase gang operated switches should be avoided. When this situation exists, the 3 phase customers on either side of the single-phase load would experience multiple outages in order to accommodate repairs and/or isolations with that portion of the loop. Additionally, Distribution Grid Operations would have to execute an increased amount of switching operations. There may be instances where this practice is the only reasonable alternative, if so this situation should be reviewed with Distribution Grid Operations to determine appropriate design.
- No Customer owned Switchgear is to be part of a Distribution Loop. An upstream switching device should separate the customer owned equipment from the loop.
- When installing above grade structures such as switchgear or pad-mounted transformers consider installing guard posts, as per Toronto Hydro Construction Standards, section 31-4080, in situations where there is a risk of vehicle impact.

1.2.2 Civil

1.2.2.1 General

- The standard location for the centre line of the new electrical trench would typically be in the boulevard, 3.5m from street line. There may be exceptions where a 3rd party may have occupied this location. In these instances the location of the new electrical trench should be discussed with the City. Trenching in the roadway should be avoided if possible.
- The City enforces a moratorium on all newly improved streets. Refer to the latest Municipal Consent Requirements for the restrictions. The link to the document is http://www.toronto.ca/engineering/mcr/.
- The minimum cover for all underground Toronto Hydro conduits and cable chambers shall be in accordance with Toronto Hydro Construction Standards, section 31-0300.
- For street classifications refer to Municipal Consent Requirements Appendix S "Street Classifications" and Appendix T "Classification of City Streets". Refer to Appendix T for updated street classifications. The following is the link to the documents:
  http://www.toronto.ca/engineering/mcr/
- Minimum horizontal and vertical clearances from foreign utilities shall be in accordance with Appendix "O" of the City of Toronto's Municipal Consent Requirements and Toronto Hydro Construction Standards, section 31. Additional horizontal clearances should be considered to prevent proposed foreign utility excavations from damaging electrical cables and equipment.

- Efforts shall be made to install the edge of transformer pads, vaults, splice chambers and tap boxes a minimum horizontal clearance of 1.0m from the paved portion of driveways.

1.2.2.2 Ducts

- For open trench installations, all primary ducts located in the public road allowance or on private property of Class 3B customers shall be concrete encased 100mm dia. PVC constructed as per Toronto Hydro's Construction Standards, section 31 and Technical Specification for Civil Construction Work Spec # CV-CON-01.
- Excavations shall be backfilled in accordance with Section 5.1.17 of Technical Specification for Civil Construction Work Spec # CV-CON-01 and the City's Municipal Consent Requirements.
- When preparing Unit Price Contract Management System (UPCMS) costs sheets, designers shall consider the additional unit requirements for duct descents from the normal depth leading to submersible vaults, tunnelling under trees, etc.
- For new concrete encased ducts being installed in poor soil conditions or where there is a high water table, re-bar shall be used to reinforce the structure in accordance with Toronto Hydro Construction Standards, section 31-1120 Note #4.
- When a new concrete encased duct structure is in conflict with existing direct buried cable, the new structure shall be installed below the cables. If this is not practical, split ducts shall be sleeved over the cables to allow future accessibility. This instruction to the contractor shall be included in the project General Notes.
- Each primary cable (1-phase), and service cable shall be installed in separate ducts. For the primary system, neutral cables shall be installed in a separate duct.
- For road crossings, it is recommended that a minimum of 6 ducts be installed. If additional capacity is required, ducts should be added in multiples of 3 (i.e. 3W3H, 3W4H). Road crossing ducts that are installed for future extension shall be terminated a minimum of 1.0m from back of curb in accordance with Toronto Hydro Construction Standards, section 31-1160. Terminating of these ducts shall be noted in the General Notes.
- Efforts should be made to minimize the number of road crossings.
- Road crossing ducts shall be installed in a common trench with new vault drains where practicable.
- The project drawings shall identify the number of Toronto Hydro required ducts in the main trench and any spare duct requirements.
- The duct route shall be designed with a minimum of bends both horizontal and vertical to keep cable-pulling tensions within allowable limits. Cable pulling software shall be used when necessary to ensure pulling tensions on the cables are within acceptable limits for both pulling directions.
- Where field conditions permit, attempts shall be made to slope the ducts toward underground structures (such as vaults, pads etc.) in efforts to minimize the accumulation of water in the ducts.
- Galvanized iron (GI) or rigid PVC bends may be required when terminating ducts at riser poles in accordance with Toronto Hydro Construction Standards, section 31-1220. To protect against accidental damage, bends should be placed on the side of the pole that is opposite to the oncoming traffic, where practicable.
- 3rd Party ducts would typically be direct buried and installed in accordance with Toronto Hydro Construction Standards, sections 31-1390 and 31-1395.

- Any direct buried hydro ducts must be red in colour.
- Install concrete encased duct(s) for street lighting cable, and terminate 450mm from the base of the pole. Connect the 100mm duct to a 50mm poly pipe and install inside of the pole's aperture. Refer to Toronto Hydro Construction Standards, section 30-3800.

1.2.2.3 Foundations / Splice Chambers

- In determining possible new locations for padmount foundations they should be located as close as possible to lot lines. In selecting locations, designers should also attempt to anticipate customer acceptance. Consideration should also be given to avoiding children's play areas, minimizing exposure to traffic and maintaining minimum clearances as per the Ontario Electrical Safety Code.
- Pad-mounted transformer locations must meet minimum clearance requirements from any combustible surface or material on a building, window, and door inlet or outlet vents in accordance with Section 26-242 of the Ontario Electrical Safety Code. For the minimum clearance requirements refer to Toronto Hydro Construction Standards, sections 3-5100 and 31-4070, as well as the City's Municipal Consent Requirements (Appendix O "Vertical and Horizontal Clearance Guidelines").
- Splice chambers (Toronto Hydro Construction Standards, section 31-2240) shall be drained to the storm sewer using a 100mm dia. Diameter Nominal (DN), PVC pipe with a minimum slope to sewer of 2.5%. The entire length of pipe shall be installed on a bedding of 75mm select granular 'A' material. Refer to sections 5.6.1 and 5.6.4 of the Civil Specification No. CV-CON-01 for additional requirements.
- Splice chamber drains shall be installed in a common trench with road crossing ducts.
- When an existing pad-mounted transformer foundation is in good structural condition it can be reused for new primary duct connections. If the existing pad-mounted transformer is installed on a floating pad or the foundation is in poor structural condition, a new tap box would be required in the same location as, or in very close proximity to the pad for ease in making the service cable connections to the new secondary bus cables.
- Existing pad-mounted transformer foundations that are to be converted to tap boxes will require labelling with a new tap box number. Refer to "Equipment Numbering" in the Drawing Guidelines Section.
- When connecting to existing customer ducts in the road allowance or on private property, Toronto Hydro Construction Standards, section 31-2240 (Splice Chamber) or section 31-3135 (Plastic Splice Box) shall be used. The splice chamber allows for the separation of the distribution circuit in loop scenarios and for the "de-energizing" of one side of the loop while maintaining supply to the customer.
A minimum of 1 plastic splice box is required between customers to avoid interruptions of both customers.

Splice Chamber/Box			
Item #	**Construction Standards**	**Cover Type**	**Installation Type**
1	31-2240	Metal	Asphalt/ Concrete
2	31-3135	Plastic	Grass

- Splice chamber/box should be installed within the road allowance. If there is not enough space within the road allowance and the installation services that customer only, then written customer approval is required. If multiple customers are supplied from the service on private property then an easement is required. Contact our Legal Department early, as this may be a long process.

1.2.2.4 Joint-Use Trench (Cost Sharing)

- Toronto Hydro shall encourage and participate in Joint-use trench initiatives with foreign utilities.
- Joint-use trench participation shall be limited to the side of the street where the new primary cable is being installed.
- Minimum depths for 3rd Party installations shall be in accordance with the City of Toronto's Municipal Consent Requirements under section "Depth of Cover".
- Cost sharing shall apply to the "trench only" portion of the project where 3rd Parties share a common trench with hydro. 3rd Parties shall be 100% responsible for their exclusive trench, extra trench depth and their incidental items (i.e. ducts and/or cables in common or exclusive trench, sand padding, concrete encasement, pedestals, etc.).
- Costing for the Joint-use "Trench Only" shall be in accordance with the following table:

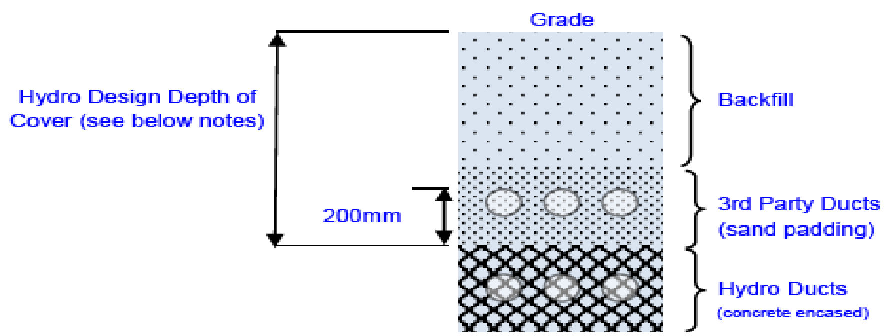
"Trench Only" Costs									
Cost for Year 20__	2 Party Trench			3 Party Trench			4 Party Trench		
	Single Duct (tr/m)	Additional Ducts		Single Duct (tr/m)	Additional Ducts		Single Duct (tr/m)	Additional Ducts	
		1	2		1	2		1	2
2010	$43.60	15%	30%	$34.90	15%	30%	$26.20	15%	30%
2011	$45.15	15%	30%	$36.10	15%	30%	$27.10	15%	30%
2012	$46.75	15%	30%	$37.40	15%	30%	$28.05	15%	30%
2013	$48.40	15%	30%	$38.70	15%	30%	$29.05	15%	30%

Notes:
1. **Single Duct**: would include up to 1 – 4" dia. (or) up to 3 – 1" dia. poly pipes. Cost sharing is based on a percentage of the average UPCMS unit cost for "trench only" plus any tunnelling past trees and an estimate of the City final restoration costs. The cost of the duct(s) and its placement in the trench is a 3rd Party exclusive item.
2. **Additional Ducts**: 3rd Parties that elect to install ducts in excess of "Single Duct" as defined above, shall incur additional Joint-use trench costs in accordance with the above table (example: if in 2010 Company X requires the installation of 2-4" ducts in a Joint-use trench, their per metre trench cost would be $43.60 for the 1st duct plus an additional 15% for the second duct for a total per metre trench cost of $50.14).
3. **Road Crossings**: use the same cost sharing methodology as 1) & 2) above. 3rd Party road crossing ducts must be concrete encased. The cost of the duct(s) and its placement in the road crossing trench is a 3rd Party exclusive item.
4. **Services**: use the same cost sharing principles as 1) above.
5. The above costs shall be revised upon termination of the 2010 UPCMS Contract.

- Costing for extra trench depth shall be in accordance with the following table:

Extra Trench Depth Costs (per 250mm increment)				
Year →	**2010**	**2011**	**2012**	**2013**
Cost →	$47.15 tr/m	$48.80 tr/m	$50.50 tr/m	$52.30 tr/m

Notes:
1. Additional trench depth will be necessary to accommodate Joint-Use trench initiatives involving 3rd Parties. They would be responsible for the additional excavation costs per the above table. In cases where there are more than one 3rd Party occupying the trench the additional excavation cost shall be shared proportionally (i.e. if the number of 3rd Party ducts in the trench total 5, and 1 Party has 2 ducts, that Party would be responsible for 2/5 of the extra depth costs or $18.86 per trench metre in 2010). Additional excavation costs shall be included with the "trench only" cost estimate to the 3rd Parties.
2. The above costs shall be revised upon termination of the 2010 UPCMS Contract.



Typical Joint-Use Trench

Notes:

1. If 3rd party ducts can be installed on top of hydro without affecting the depth of cover for Toronto Hydro, then no extra trench depth charge is applied.

2. If 3rd party ducts are to be installed on the top of hydro which forces Toronto Hydro to be at an additional depth of cover, then extra trench depth charges shall apply.

- Trenching costs involving directional boring shall be shared equally among the Parties.
- THESL will assume the role of Prime Contractor for the Joint-Use "trench only" portion. To encourage 3rd Party participation and competitive pricing, 3rd Parties shall be requested to negotiate their exclusive item costs directly with the civil

contractor. Staking for exclusive items should be included when negotiating item costs with the civil contractor.

- 3rd Parties shall be responsible for coordinating the installation and payment of their exclusive items with the civil contractor.
- 3rd Parties will not be permitted to employ another civil contractor to complete any of their installation associated with the project including their exclusive items while the civil contractor is still on site.
- 3rd Parties shall be assessed an administrative fee of 15% to cover THESL costs of project coordination, providing of electronic drawings, inspection, staking, preparing estimates and cost sheets and other miscellaneous expenses associated with the Joint-Use “trench only” portion. The administrative fee shall only be applied to the “trench only” and extra trench depth costs and not to the exclusive items 3rd Parties negotiate with the civil contractor.
- The Designer shall provide the cost estimated for the Joint-Use trench to the 3rd Parties.
- 3rd Parties shall be responsible for obtaining the necessary City permits for their exclusive civil installations. To expedite the permit process, Designers are encouraged to assemble all 3rd Party plans and make one submission to the City. Each 3rd Party shall be responsible for preparing and providing the Designer with all necessary permit applications for their exclusive civil work.
- 3rd Parties shall be responsible for providing an on-site inspector who shall report directly to the civil contractor as required, to interpret the work plans and specifications.
- The contractor will be responsible for providing each 3rd Party with signed-off “As-Constructed” drawings for Joint-Use trench portion. 3rd Parties should include in their negotiations with the civil contractor, the receipt of the “As-Constructed” drawings for their exclusive items.
- An example of a Joint-use trench cost estimate for a project involving multiple parties can be found in Appendix F.
- 3rd Parties should attend the pre-construction meeting.

1.2.3 Transformers

Voltage Conversions

- Change out transformers to appropriate voltage.
- Convert all associated equipment in vault/padmounts to current standards.

Rebuilds w/o Voltage Conversions

- The decision to re-use or replace existing transformers is one that is based on Asset Condition Assessment and field condition assessment from the districts and Asset Management.
- In projects where vault equipment may be re-used or partially upgraded to current standard are to be dealt on a case-by-case bases, as directed by Asset Management.

- To assist in the sectionalizing of any future underground primary cable faults, 300 Amp current reset faulted circuit indicators are to be installed on both the incoming and outgoing primary cables at each transformer location. Refer to Toronto Hydro Construction Standards, section 20.

- It is necessary that "Equipment Changeout Record" forms be included in the Design Folder for all recovered transformers and as well as for new equipment installations. The forms are to be completed by field staff indicating in the "Location Status" field that the transformers have been "Decommissioned" for recovered units and "In Service" for new equipment installations. This will ensure that recovered transformers and vault location numbers are no longer active in Ellipse. To obtain copies of the "Equipment Changeout Record" forms for inclusion in the white design folder click on the following link: http://assetmgmt.torontohydro.com/

1.2.4 Primary Cables

- Primary cables shall be installed in concrete encased ducts.
- The standard primary distribution cable sizes are indicated in the following table:

Primary Distribution Cables			
Distribution System	Cable Type	***Ampacity Rating (max)	MVA Rating (max)
13.8kV	*1/C 1/0 Al 15kV TRXLPE *(or)*	200 Amps	4.8 MVA
	**1/C 1/0 Al 28kV TRXLPE CN	180 Amps	4.3 MVA
27.6kV	1/C 1/0 Al 28kV TRXLPE CN	180 Amps	8.6 MVA
	1/C 350 kcmil Al 28kV TRXLPE CN	370 Amps	17.7 MVA

Note:

***** *1/C 1/0 Al 15kV TRXLPE cable is only to be used on the 13.8kV distribution system in the downtown core area where there is no possibility of future 27.6kV system expansion.*

****** *1/C 1/0 Al 28kV TRXLPE CN cable is to be used on the 13.8kV distribution system in the horseshoe and bordering core areas where there is the possibility of future 27.6kV system expansion.*

*** *For the conditions under which the above Ampacity ratings apply, consult the following Toronto Hydro Construction Standards:*
- 13.8kV XLPE Al cable – Construction Standards section 16-1060 1/5
- 27.6kV XLPE Al cable – Construction Standards section 16-1140 1/5

- A #2 str. Cu. PVC insulated white neutral shall be installed and run concurrently with the 1/0 Al 15kV TRXLPE cable.
- A separate neutral conductor is not required when using 1/0 Al 28kV TRXLPE CN as this cable has a full sized concentric neutral. Also, a separate neutral conductor is not required using 350 kcmil, 28 kV TRXLPE CN.
- The above MVA ratings indicate the maximum permissible load for a 3Ø distribution circuit.
- Abandon or remove existing primary cable, refer to Toronto Hydro Construction Standards, section 16-0020.

1.2.5 Transformer Loading

- Check whether overload condition exists on transformers and upgrade when required. Attention should be paid to secondary service cables to customer equipment to determine if an upgrade is required.
- If a customer is requesting an upgrade during a rebuild, refer them to CCM for consultation.

1.2.6 Fusing

- The standard ratings for switch cutouts and power fuses shall be as per the following table:

Fusing for Laterals				
Operating Voltage	Laterals		Sub-Laterals	
	Disconnect Voltage Rating	Fuse Rating	Disconnect Voltage Rating	Fuse Rating
27.6kV	25kV	140K	25kV	100K
13.8kV	15kV	140K	15kV	100K

- The ratings from the table would apply for both three phase & single-phase laterals.
- Sub-sub laterals are to be fused at 40K.
- Replace all existing porcelain SMD20 switches with polymeric SMD20 switches at riser poles, except for 35kV class.

1.2.7 Switchgear

- Pad-mounted switchgear may be required depending on the supply arrangements in the rebuild area. This switchgear is primarily used for tapping into a main feeder and supplying distribution load.

- Pad-mounted switchgear installations are preferred over the submersible switchgear where practicable. The benefits of pad-mounted switchgear include: costs, ease of maintenance & operability and accessibility. Where space is limited in the public road allowance it may be necessary to install submersible switchgear.
- Pad-mounted switchgear shall be installed in accordance with Toronto Hydro Construction Standards, section 13. "Maintenance only items" should not be used for new construction.
- Non-standard pad-mounted switchgear (i.e. PMH-10, PMH-5, and PMH-210) used in non-standard configuration within conversion area should be replaced by pad-mounted switchgear(s) listed in Toronto Hydro Construction Standards, section 13-7600.
- The preferred orientation of the pad-mounted switchgear units is to have the doors open parallel with the roadway. As well, access to any of the switch compartments should be clear of obstructions such as trees, poles, etc.
- Placement of new pad-mounted switchgear should be clear of any intersections. This would be for reasons of safety and to minimize any financial impacts in the event of future intersection improvements. Vehicle sightlines should be considered when placing pad-mounted switchgear.
- For available 13.8 kV and 27.6kV submersible switchgear refer to Toronto Hydro Construction Standards, section 13.
- To assist in the sectionalizing of any future underground primary cable faults, 800 Amp current reset Faulted Circuit indicators are to be installed at 600 Amp U/G terminations on open loop feeders. 300 Amp current reset Faulted Circuit indicators are to be installed at 200 Amp U/G terminations on distribution loop. Refer to Toronto Hydro Construction Standards, section 20.
- In order to ensure reliability, the feeder circuit (600A) supplying the switchgear should not enter and exit the same cable chamber. Care should be taken to re-direct the outgoing feeder duct around the cable chamber. Similarly, the distribution circuit (200A) should be designed in the same manner.
- No multiple tap-offs (double lugging) are permitted in the feeder or distribution compartments of the switchgear unit, as this will adversely affect system reliability when attempting to isolate the switchgear in the future.

1.2.8 Building (Electrical) Vaults

In the former North York and Scarborough areas, as a condition of supply, the owner of an industrial/commercial building was required to provide an electrical vault usually located on the outside wall of the building.

Electrical supply was made available by means of a looped primary supply (North York 27.6kV, Scarborough 27.6kV & 13.8kV).

The vault would contain transformers, fuses, primary and secondary cables and primary switches. In older installations the primary loop switches for North York were typically NX hinge style arc-strangler switch blades and for Scarborough disconnect switches c/w connecting bars. In more recent installations both areas installed mini-rupter arrangements.

- Designers, with assistance of a construction DRP, should assess the condition of equipment and consider rebuilding as required. Items for consideration include; condition of transformers (overloaded, "live" front vs "dead" front), switching arrangements, condition of secondary services, adequate grounding provisions and ventilation.
- When rebuilding the underground and space permits, the new primary cables servicing the building should be terminated in a mini-rupter arrangement as per Toronto Hydro Construction Standards, section 13-7200.
- Where space is inadequate and does not permit safe limits of approach or significant renovation is required for the building vault, other methods of rebuilding should be considered. This could include installing a pad-mounted transformer and using the vault as a connection point.
- Toronto and East York are supplied radially using existing concrete encased duct structure. For these areas typically SDP#007 will not apply.
- The exception would be when moving the primary hydro equipment from building vaults or customer transformer room to a pad-mounted transformer or overhead transformer bank outside the building because of certain issues such as safe limits of approach or significant renovation is required for the existing vault, etc. In those cases, a concrete encased duct bank is required from the transformer pad foundation or riser pole to the connection point to existing secondary cable to hold the new service cables.

1.2.9 600V Delta to 600/347V Grounded WYE Voltage Conversions

- Refer to Standard Practice SP#002 "Voltage Conversion from 600V Delta to 600/347V Wye".

1.2.10 Street Lighting

- All requests made to the Customer & Reliability Services – Design Supervisor for information should include suitable timelines to respond.
- The Designer shall select the street lighting supply points and send the street lighting design to the Customer & Reliability Services – Design Supervisor for review.
- Street Lighting plant, facilities, equipment and installation must meet the requirements of the Ontario Electrical Safety Code, which includes inspection by the Electrical Safety Authority (ESA).
- The Designer shall be responsible to arrange for ESA inspections.
- Toronto Hydro shall make the new street light service connections to the distribution system upon receipt of approval from ESA.
- The Designer will be responsible for obtaining City permits for their exclusive civil installations.
- The Designer shall inform the Customer & Reliability Services – Design Supervisor of any street lighting changes as per SP#022 "Street Light Energy Billing".
- The type of underground cable, to be installed in the concrete encased ducts, used for street lighting circuits is a "DUPLEX 2#2 AL XLPE/PVCJ BLACK/WHITE 600V WITH 1#6 SOL CU BARE" (item ID # 7150276).

- Existing group controlled street lighting relays should be converted to individual controlled photo cells.
- The Designer shall refer to SDP#009 "Street Lighting" for further design information.

1.2.11 Customer & Councillor Notifications

- In order to notify customer of our proposed work and ensure that construction proceeds smoothly, Customer Operations will undertake to contact the impacted customers by sending "tailored" letters to advise of specific plant installations. Refer to Appendix E for the required scenarios.

Letters	
Appendix	**Remarks**
E1	General Notification Letter
E2	Councillor Notification
E3	Detailed Customer Notification

- During the design stage, Designers shall arrange with Customer Operations to send the appropriate notification letters (see attached Appendix E) to all property owners within the limits of the project in accordance with the Municipal Consent Requirements (Chapter 5 – Above-Ground Plant, Notification). A PDF key map of the project area, a list of customers affected by the rebuild, approved start date and street boundaries shall be submitted to Customer Operations for distribution to the City Councillor and affected customers. Customer Operations will create and distribute the General Notification Letter, the Councillor Notification of project letter and the Detailed Customer Notification of project letters. As well, Designers are to include the General Notification Letter, the Councillor Notification of project letter, the Detailed Customer Notification of project letters, and the list of customer addresses with the full-stream permit application request.

- Upon completion of the project drawings, the Designer shall forward the project drawings in PDF format and a hard copy to Customer Operations. The drawing package should only include the Title Sheet and Civil Plan drawings. In addition, the Designer shall submit a list of house addresses within the project that were identified through field visits to have unique/serious issues (i.e. damage to property, driveways, fences, hedges etc.). The list should identify the issues and include accompanying photos if available.

1.3 <u>Drawing Guidelines</u>

In addition to the alignment of project designs with business strategies, it is also necessary that framework be established that will support the delivery of consistent project drawings. The following guidelines will provide the necessary information that will assist in achieving this objective.

The guideline will consist of the following three key elements:

1. Drawing Structure
2. Equipment Numbering
3. Symbology

1.3.1 Drawing Structure

- Standard drawing sheet sizes to be used are as follows:
  Imperial C (17" X 22")
  Imperial D (22" X 34")
- Drawing sheet sizes shall be a maximum size of Imperial D (22" X 34"). Field staff have, in past requested the use of ½ size prints for use as reference in the field. To ensure text is legible in a ½ size format, utilize a sufficient sized font for the text.
- Templates for the standard sheet size are in ProjectWise and are to be used when creating a new drawing. See ProjectWise User Manual for details.
- Drawing numbers, title blocks and page borders are to be generated using Project Wise. Title block information will be filled in automatically as the ProjectWise attribute tables are filled in. Drawing numbers are generated using ProjectWise – Do not modify the Drawing numbers from the standard format in any way. See ProjectWise User Manual for details.
- Sufficient white space shall be reserved to the left of each Title Block for placement of the "As-Constructed" stamp.
- Every drawing must be created using a separate file.
- All attribute data fields in ProjectWise must be filled in as part of assigning a new Drawing Number. See ProjectWise User Manual for details.
- All Drawings must be stored in ProjectWise in folders named after the Project Number. See ProjectWise User Manual for details.
- ProjectWise workflow must be updated as the drawing moves from the 1) Proposed to 2) Approval (before packing) then on to 3) Issued. A new version should be created at this state, if modification is requested, as all drawings that have reached this state are assumed to be signed and therefore legal copies. The Records Management Section will perform the final state change to Archived when they receive the As Constructed mark-up. See ProjectWise User Manual for details.
- Designers shall utilize the White Space Management Guidelines when preparing the project drawings.
- Drawing type grouping selection through Projectwise and drawing titles shall be consistent with the following table:

Project Drawings	
Drawing Type Grouping from ProjectWise	**Project Drawing Title**
Title Sheet	Title Sheet
General Notes	General Notes & Details
Primary Schematic	Primary Schematic
Civil	Civil Plan
Underground	Cable & Duct Layout
Existing Feeder or Reference Drawing	Existing Feeder or Reference Drawing
Overview - Electrical	Overview of Electrical Plan

- Plans must be prepared in accordance with the Municipal Consent Requirements. The following is the link to the document: http://www.toronto.ca/engineering/mcr/index.htm#mcr
- A sample set of project drawings is included in this document for reference purposes only.

1.3.1.1 Title Sheet

- The title sheet shall include the full project name, key map with north arrow, Drawing Index, and a note indicating that the plan has been prepared in accordance with Ontario Regulation 22/04.
- In accordance with Ontario Regulation 22/04, the following note shall be placed in the top right corner of the title sheet where the assembly of the drawings utilizes only certified construction standards, technical specifications or authorized legacy standards in cases where maintaining a portion of line with current standards would be problematic:

THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS AND APPROVED EQUIPMENT AND MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF ONTARIO REGULATION 22/04.

- Include the full last name of the Designer, CAD Operator, Supervisor, etc. in the drawing title blocks (do not use initials).
- The key map will encompass the entire limits of the project and shall be "blocked-off" in sections. Each section shall be numbered according to the ProjectWise plan drawing number and sheet number and include the relevant Concession Map #(s).

1.3.1.2 General Notes & Details

- The General Notes shall include civil and electrical responsibilities of the Contractor, Toronto Hydro and of 3rd Parties. Only notes applicable to the particular project shall be noted.
- Indicate all known "Designated Substances" that may be encountered in the project.
- The General Notes shall include a reference that minimum horizontal and vertical clearances from other foreign utilities shall be maintained in accordance with Appendix O of the City of Toronto's Municipal Consent Requirements (*Note- the City clearance requirements are consistent with Toronto Hydro Construction Standards, section 31-0100).*
- The Specification and Construction Standards table shall list the applicable specifications (i.e. CV-CON-01) followed by the construction standards. The table shall consist of two columns: column i) the specification or construction standards name and column ii) document number.
- The Cut Repair table shall totalize all the exclusive hydro & joint-use cut repairs on the project that will be completed by the City. This information will be used for comparison against the City invoices for the actual repair work. The table shall be similar to the following:

Approx. Cut Repairs			
Roadways			m² +/-
Concrete Sidewalk			m² +/-
Curb			m² +/-
Other			m² +/-

- Any new construction involving the use of legacy standards will require a certificate of approval be prepared by a Professional Engineer identifying the standard used, specific location (i.e. P123) and placed on the General Notes sheet.
- The General Notes shall include a note requiring field crews to re-label existing equipment locations where identified on the drawing.
- Designers should include a listing of all the original installation drawings and reference drawings applicable to the project. When the project includes 3rd Party Joint-use trenching, 3rd Party drawing numbers should be referenced as well.
- A typical road crossing profile shall be included on the drawing showing foreign utility crossings in accordance with the City of Toronto's Municipal Consent Requirements. If a road crossing is not typical (i.e. non-standard storm sewer depth etc.) a separate road crossing profile shall be prepared and noted on the applicable Civil Plan drawing.
- Any details shall be included on the drawing.

1.3.1.3 Primary Schematic

- The purpose of this drawing is to provide an overall view of the proposed project.
- This drawing can be separated from the rest of the project drawings and used by the Control Centre. For this reason, the repetition of certain information (i.e. key map, legend, etc) is required.
- The entire limits of the project shall be shown on one drawing, where possible.
- Prepare the drawing in accordance with the White Space Management Guidelines.
- The Primary Schematic shall be "Not to Scale" and indicate the following:
  - be semi-geographic, showing all relevant civil (i.e. vaults, pads, splice/tap boxes, poles, street names, etc.) and electrical (i.e. primary cables, switches, transformers, switchgear, fault indicators, elbows, pole numbers, etc.) components to facilitate ones "orientation".
  - identify customers on life support and include contact person & telephone #.
  - include a legend of proposed and existing plant and plant to be recovered or abandoned.
  - include a key map similar to the Title sheet (reduced size) without the "blocked-off" sections and numbering.
  - north arrow shall be shown pointing to the top or right of the sheet only.
  - proposed connections to the existing plant either solidly connected or via switches.
  - the feeder designations involved.
  - indicate clearly the voltage rating(s) of the system and cable sizes.
  - where unmetered supply connections to 3rd Parties are required, they shall be identified and shown up to the ownership demarcation point.

- Include the following note in the top right corner of the drawing.

> **REFER TO TITLE SHEET DRAWING #200# – ######,**
> **FOR ACCOMPANYING PROJECT DRAWINGS.**

1.3.1.4 Civil Plan

- The Civil Plan drawings shall show the area of the proposed construction and shall be clipped from G/NetViewer and exported into a Microstation file.
- If the area of proposed construction requires more than one plan drawing, divide the area evenly from sheet to sheet using match lines. Maximize the use of drawing white space to minimize the number of drawings.
- Prepare the drawing in accordance with the White Space Management Guidelines.
- Notes specific to the individual plan drawings shall be noted on the drawing.
- Prepare drawings using the City Land Base Maps, including the City Sewer and Water information, available through G/NetViewer. In the former City of Toronto area (District 1) the Digital Map Owners Group (DMOG) base maps shall be used.
- Unlike the City Land Base Maps available for the horseshoe area, the DMOG base maps provide some typical cross sections showing depth of cover of the various utilities.
- Include civil legend and identify proposed and existing plant and any plant that is to be recovered.
- Plans <u>must</u> be prepared in accordance with the Municipal Consent Requirements. The following is the link to the document:
  http://www.toronto.ca/engineering/mcr/
  In efforts to avoid any unnecessary delays in obtaining permits, It is extremely important that all information requested in Appendix Q “Permit Drawing Standards” of the Municipal Consent Requirements be shown on the Plan.
- Storm and Sanitary mains should be indicated on the plan at proposed hydro road crossings and sewer connections.
- Identify customers on life support and include contact person & telephone number.
- The plan shall indicate the number of electrical cable ducts required in the main trench. The appropriate number of ducts shall be shown inside a hexagon symbol placed within the trench lines. Each time there is a change in the number of ducts within the trench line, the new number shall be indicated. Spare duct requirements shall be noted on the plan.
- 3rd Party ducts within the main trench shall not be included with the hydro ducts indicated in the hexagon symbol. It will be necessary for the Contractor to consult 3rd Party drawings to determine where 3rd Party infrastructure is to be installed in the common trench and where 3rd Parties have exclusive installations.
- Indicate the proposed plant in bold and identify as such in the legend.
- Indicate existing plant to be abandoned and identify as such in the legend.
- Tie dimensions for new installations (i.e. centre line of trench, cable chambers vaults, etc.) shall be indicated to adjacent street lines <u>and</u> to existing curb lines or any other permanent existing structure (i.e. poles, hydrant, etc.). When using the DMOG Base Maps, tie dimensions are to made to existing features (i.e. curbs, etc.).
- Vault drains shall be indicated on the Civil Plan drawings. The depth of cover to the storm sewer at the proposed connection shall be indicated on the plan. An

additional road crossing profile shall be shown on the applicable Civil Plan for non-typical road crossings (i.e. shallow storm sewer depth, etc.).

- Construction methods other than open trench (i.e. micro-tunnel) shall be identified on the plans.
- Existing utility locations (i.e. water mains, gas, Bell, CATV, etc.) shall be shown on the plan drawings when available. Storm and Sanitary mains shall be indicated on the plan and profiles at road crossings, submersible vaults (for drains) or any locations where the electrical trench is in close proximity.
- For projects utilizing the DMOG base maps, existing utility plant and sizes shall be indicated at the match lines or cross streets. All other utility identifiers shown on the base maps shall be removed to avoid clutter. For projects outside the DMOG areas, existing utility plant and size shall be similarly noted.
- Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######,
FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.5 Cable & Duct Layout

- The Cable & Duct Layout shall be “Not to Scale” and include the primary cable, secondary bus cable, service cable ducts, spare ducts, tap boxes, splice vaults/boxes, transformers, switchgear, and distribution poles.
- The drawing shall be diagrammatic and plotted to a scale of approx. 1:400 (two Civil Plans represented on one Cable & Duct Layout drawing).
- Reference to the applicable Civil Plan shall be shown on the Cable & Duct Layout drawing.
- Street lines, lot lines and the buildings to be taken from the plan drawings for preparing this drawing.
- North arrow shall be on each plan, pointing to the top or right of the sheet only.
- Include legend and identify proposed and existing plant and any plant that is to be recovered/abandoned.
- Identify customers on life support and include contact person & telephone #.
- Include a “Transformer Service Changes” table similar to the following on each Cable & Duct Layout drawing:

TRANSFORMER SERVICE CHANGES		
ADDRESS	TO (Transf. #)	FROM (Transf. #)
Transformers to be recovered	UT1234, UT1235, UT1236 etc.	

- Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######,
FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.6 Existing Feeder or Reference Drawing

- This drawing shall be used to indicate existing electrical or civil plant in the project area.
- It can also serve as an appendix to the project and include any specific details of the project requiring graphic explanation not covered by a Construction Standards or that cannot be shown on the civil or electrical layout drawing due to space restrictions. Examples of these details could include breakouts, duct diversions etc.
- Each detail shall make reference to the project drawing and sheet number from which it originates.

1.3.1.7 Overview of Electrical Plan

- This drawing shall be used whenever there are multiple electrical drawings, to indicate an overview of the project's existing and proposed electrical plan.
- The intend of this drawing shall be to have the complete electrical project shown on one drawing. Typically this involves one drawing by reducing OH or UG electrical drawings.
- The drawing shall make reference to the detail project electrical drawings (Primary Schematic, Cable & Duct Layout).

1.3.2 Equipment Numbering

- New equipment numbering standards have been developed and are included in Section 21 of the Construction Standards.
- Location numbers for new equipment (with the exception of poles, tap boxes, vault or transformer switches and elbows) can be obtained through the "New Location Number Request Application" program accessible by clicking on the following link: http://assetmgmt.torontohydro.com/nomenclature/
- For each new number requested through the "New Location Number Request Application", Designers should receive a "Nomenclature Labeling Report" which shall be included in the design folder for completion by the field crews.
- Designers must be identified in the Requestors list to access the program. If you are unable to access the program, contact the Supervisor of Asset Data Management-Capacity Planning to get on the list.
- In addition to the numbering of new equipment, some existing equipment within the limits of a project may require re-numbering as well. In general, the following guidelines shall apply for new projects:

  New Installations
  - All new equipment identified in Construction Standards 21-1000 shall be numbered to the new Standard.
  - For poles, the new Standard shall apply when:
    i. installing new pole lines;
    ii. replacing the majority of poles along an entire street or city block (the few remaining poles would be included in the re-numbering).

- For spot pole replacements or when not renumbering an entire street or block, use the legacy numbering standards for the area with the new numbering materials.

Re-Numbering of Existing Equipment

- The re-numbering of existing equipment shall generally apply in the respective operating districts where GEAR is functional. GEAR is currently functional in the former York, Etobicoke, and North York operating districts only. GEAR will be functional in the other operating district in the near future. Designer should contact System Operations to determine the status of GEAR in the project area.
- If the limits of the project are within the GEAR functioning areas, the following re-numbering standards shall be applied:
  - All existing switchable devices (i.e. transformers, switches, elbows) within the limits of the project shall be re-numbered to the new standard.
  - Existing cable chambers within the limits of a project shall not be re-numbered.
  - Existing vaults within the limits of the project may be re-numbered.
  - Existing poles within the limits of a project may be re-numbered to the new standard.
- On the project drawings, both the new location number and former number (in brackets) will be shown.
- Location numbers for the re-numbering of existing equipment can also be obtained through the "New Location Number Request Application" program.

1.3.3 Symbology

The new symbology shall now be used for all new projects. The symbols and cell libraries can be viewed by clicking on the following link:
http://thehub.torontohydro.com/gear/Users/SymbologyPage/SymbologyPage.html

1.4 Project Deliverables

Projects that are initiated through the Investment Plan are typically designed approx. one year in advance of construction. To ensure a seamless process between the design and construction phase, designers must be cognizant of the outstanding pre-construction requirements (i.e. cut permits, notifications etc.). To assist in this area, a Project Design Deliverables checklist (Appendix "B") has been developed and can be used by designers to ensure all required documentation is included and/or noted in the Design folder when signed-off. Upon construction approval, the Design folder will be returned to the designer for final assembly and for execution of the remaining "prior to construction" issues (i.e. cut permits, notification letters, etc.).

Section 2 - Rationale:

To ensure underground project designs in commercial and industrial rebuilds are aligned with business strategies and project design packages are delivered in a consistent fashion.

Section 3 - References:

- Toronto Hydro Construction Standards
- Toronto Hydro Technical Specification for Civil Construction Work #CV-CON-01
- Toronto Hydro "Conditions of Service"
- Field Consultation Meeting – Terms of Reference
- Work Breakdown Structure II (Latest Version)
- Job Planning Process (Latest Version)
- White Space Management Guidelines
- As-Constructed Map Products Process (Latest Version)
- Standard Practice SP #006 "Customer Isolation"
- Standard Practice SP #024 "Conversion & Rebuild Work in Private Property (Class 3B Customers)"
- City of Toronto Municipal Consent Requirements
- Distribution Grid Operations Project Review Form
- Ontario Regulation 22/04
- Electrical Safety Authority Technical Guidelines for Sections 6, 7 & 8.
- Ontario Electrical Safety Code
- Standard Practice SP #002 "Voltage Conversion From 600V Delta to 600/347V Wye"
- Standard Practice SP #022 "Street Light Energy Billing"

APPENDIX “A”

UNDERGROUND REBUILDS INDUSTRIAL/COMMERCIAL AREAS DESIGN PROJECT CHECKLIST

Project Name: ______________________________

This checklist is intended to act as a guideline for the various activities involved in the design phase of underground industrial/commercial rebuild projects. In addition, it includes those activities required in finalizing the project design package prior to issuing to construction. It should be kept in your working design file. Activities listed may not necessarily be in sequential order and may not apply to all major civil projects. The activities listed can be used as a reference in updating your departmental “Design Work Completion Report – Distribution”.

Item #	Design Activities	Date Completed (or) N/A
1	Review project scope package from System Reliability Planning.	
2	A signed Letter of Agreement from the Customer should accompany rebuild projects on private property that require a civil infrastructure or easement contribution from the Customer.	
3	Assemble record maps and pertinent drawings.	
4	Define limits of the project design.	
5	Define limits of the project design in G/NetViewer and submit redline file to ProjectWise in accordance with the New Design Process.	
6	Receive Microstation file of the design area from Design/Records and ensure project drawings are deposited into the appropriate “set” within ProjectWise in accordance with the New Design Process.	
7	Coordinate preliminary design meeting with System Reliability Planning, Operational Performance Measurement, Dist. Proj. - Construction, System Operations and other key stakeholders to review the project proposal (as required).	
8	Verify with the City that no work moratorium currently exists in the area of proposed construction.	
9	Refer to the City map to determine if the asphalt in the proposed construction area requires asbestos testing.	
10	Initiate preliminary discussions with 3rd Parties (Rogers, Bell) regarding possible Joint-use initiatives.	
11	Arrange Field Staff Consultation meeting (as per T of R) with area Construction Supervisor to: 1) Review the project. 2) Address construction issues (i.e. vault/tap box locations). 3) Identify properties that have unique/serious issues (i.e. damage to property, driveways, fences, hedges etc.). 4) Identify the safety hazards associated with the project and measures to eliminate and/or control during construction phase.	
12	Prepare preliminary design concept and review with Design Supervisor.	
13	Forward “Design Scope Revision Request” form to System Reliability Planning for proposed revisions to original project scope (as required).	
14	Initiate project drawings through Project Wise.	
15	Compile a PDF key map of the project area, a list of customers affected by the rebuild, approved start date and street boundaries.	

Item #	Design Activities	Date Completed (or) N/A
16	Send compiled information (item 15) to Customer Operations, which will create and distribute General Notification Letter, Councillor Notification of project letter and Detailed Customer Notification letters to the City Councillor and affected customers. As well, Designer to include the General Notification Letter, Councillor Notification of project letter, Detailed Customer Notification of project letters, and a list of customer addresses with the full-stream permit application request.	
17	Prepare drawings using Microstation files.	
18	Prepare preliminary design utilizing certified construction standards and technical specifications and add to base maps.	
19	Obtain new equipment numbers and Nomenclature Labeling Reports through the "New Location Number Request Application".	
20	Distribute preliminary drawings to other utilities, authorities for comments/approvals/line release.	
21	Submit near completed Civil Plan drawings to those 3rd Parties participating in Joint-use trench.	
22	Make final revisions to drawings and include note on drawing indicating compliance with Section 7 of Ontario Regulation 22/04.	
23	For projects involving Joint-use trenching, obtain 3rd Party civil drawings and listing of all 3rd Party civil unit items (by UPCMS item #) and the quantities.	
24	Review designs with Supervisor and sign drawings.	
25	Prepare Contractor (UPCMS) cost sheets and preliminary estimate for 3rd Party involvement.	
26	Prepare estimate and material requirements in Ellipse.	
27	Obtain the necessary external preliminary approvals as required.	
28	Initiate requests for easements or agreements with Legal Dept.	
29	Arrange meeting with Construction Supervisor to review final design, validation of MU/LUs and obtain sign-off.	
30	Make necessary changes to estimate and finalize MU/LUs.	
31	Obtain Ellipse authorization from Design Supervisor on project estimate.	
32	Prepare "Installed Units Summary" (WBS2) form.	
33	Prepare "Equipment Changeout Record" forms (as required).	
34	Complete "Prior to Construction" deliverables upon budget approval for construction.	
35	Fill out the Full Stream Application Compliance check list and attach to the permit applications.	
36	Obtain the required number of approved 3rd Party plan drawings (see Appendix "C") and completed City Permit Applications for any exclusive civil work.	
37	Obtain final sign-off/approval from Design Supervisor on project drawings.	
38	Obtain P.Eng. approval if using legacy standards for new construction.	
39	Update status of project drawings in Project Wise from "Approved" state to "Issued".	
40	Forward to Customer Operations a set of project drawings in PDF format and a hard copy (Title sheet and Civil Plan drawings only) and a list of house addresses within the project that were identified through field visits to have unique/serious issues (i.e. damage to property, driveways, fences, hedges etc.). The list should identify the issues and include accompanying photos if available.	
41	Arrange pre-construction site meeting with construction, contractor, foreign utilities and all other authorities.	
42	Prepare project package in Ellipse.	
43	Prepare purchase requisition in Ellipse.	
44	Update as-constructed units and prepare final billing.	
45	Prepare billing summaries and invoices for 3rd Party Joint-use trench and exclusive items where applicable.	

Item #	Design Activities	Date Completed (or) N/A
46	Maintain approved project drawings and the "As-constructed" drawings in the department central filing system for a period of one year following the annual audit required under Ontario Regulation 22/04.	
47	Participate in Post Construction meeting, as required.	

Nov. 17/10

APPENDIX "B"
PROJECT DESIGN DELIVERABLES

Project Name: ____________________ Scope Application # ____________________

Design / Construction Project No.: ____________________

Construction Estimate $ ____________________ Estimate # ____________________

Legend: **X -** *Items are Mandatory*

✓ - *Additional items to be included if applicable to the project*

Item #	Deliverables	Design Completion	Prior to Construction
1	Project documents filed in appropriate folder	**X**	**X**
2	Completed "Installed Units Summary" (Work Breakdown Structure II form)	**X**	**X**
3	Drawings – 1 full size set. Each drawing to include the following note above the title block "DESIGN COMPLETE - SUBJECT TO FINAL APPROVAL".	**X**	
4	Remove the note "DESIGN COMPLETE-SUBJECT TO FINAL APPROVAL" from the drawings.		**X**
5	Prepare documents as per "Project Distribution List" (see attached Appendix "C")		**X**
6	3rd Party Drawings		✓
7	"Requirement Summary" from Ellipse (Job Estimating - MSQ655) of the resource, vehicle and material requirements.	**X**	**X**
8	"Equipment Changeout Record" forms for key assets to be installed and recovered.	**X**	**X**
9	Nomenclature Labelling Reports	**X**	**X**
10	Storm Sewer Connection approvals for splice chamber/submersible vaults.	✓	✓
11	Construction Estimate break down (e.g. material, labour, O/H, U/G Civil etc.) through Ellipse	**X**	**X**
12	Preliminary Civil Contract Unit Price/Tender Package.	**X**	
13	'Notice of Project' – The Occupational Health & Safety Act – with any necessary sketch(es)/drawing(s) attached – **for projects with Hydro portion over $50,000.00** *(For electrical work only, Contractor is required to prepare for civil installations)*	**X** (1 Completed copy)	**X** (1 Completed copy per trade)
14	Action Log and Minutes from Field Staff Consultation Meeting	✓	
15	Customer & City Councillor Notification of Project letters etc. issued.	**X** (1 copy of each)	**X** (1 copy of each)
16	City Cut Permit including those for 3rd Parties and other approvals.		**X**
17	Include existing Feeder Prints/Concession Maps, showing the proposed mark-ups as required by the area Control Centre.	✓	
18	Joint Use civil drawings, billing details & forms		✓
19	Attach Easement Agreements / Letters of Understanding.		✓

Additional Comments: ____________________

Design Supervisor: ____________________ Ext. __________ Date: __________

Designer: ____________________ Ext. __________ Date: __________

Aug. 18, 2010

APPENDIX "C"

PROJECT DISTRIBUTION LIST (SAMPLE)

PROJECT DISTRIBUTION LIST **PROJECT # P0060372** **DESCRIPTION: E11189 BARCHESTER PH 3 CIVIL (TIEN)**

PROJECT DISTRIBUTION LIST	DR	Drawings: Full	Drawings: Half Size (11*17)	Drawings: Design Dwgs. Stamped "City Approval" (Scarborough Area or Where Applicable)	Drawings: "Poles Only Dwg"	Detail Schedule (GANTT Chart)	Work Break Down Structure	MSQ660	Material Printout (from EMRT)	CIVIL PERMITS AND POLE PERMITS/LOCATES PROVIDED BY CONTRACTOR	UPCMS Civil Sheet AND if UPCMS > $50,000 Forward Approved PO #	UPCMS Civil Construction Sheet Pole Holes	Notice of Project (> 50k) KEY MAP (8.5*11)	Nomenclature Labelling Form(s)	Equipment Changeout Form(s)	"Yellow" Feeder Prints (Downtown)	Joint Use	Street Lighting Cost Sheet (MSQ655)	Material Finalization Form Signed By Construction	"APPLICATION FORM" INDICATING THE CUT REPAIR COST
MDF (Shelda)	1		1			1	0	1	1	1	1	1	0	0	0	0	0	0	0	1
Records	1	1														0				
Power System Schedulers Control Rm	1	1														0				
Cindy Gillis	1					1														
Design Supervisor	1																			
Planner (Designer)	1																			
Control Room Joe Waite (NY Area)	0		0																	
Supervisor (Ken/Ray/Jerry/Earl/Dean/Mike)	0	0				0	0	0	0				0			0	0			
CPLP Or CPCP Crew	0	0				0	0	0	0				0	0	0	0	0			
Downtown Supervisor (Paul/Greg)	0	0				0	0	0	0				0							
Steve/Greg's CPCP Crew	0	0				0	0	0	0				0							
Poles - GERRY	1				1	1		1	1			1								
Pole CCL BERNIE	1				1	1		1	1	1		1								
Permits/Locate By Contractor Pole Excavation Crew (2)	1				1	1		1		1		1								
Supervisor Jack Leddy (Cable Crew)	0	0				0	0	0	0				0			0				
SAM HIFAWI	1		1			1		1		1	1									
Inspector	1	3				1		1		1	1									
Contractor (S & M OR PLP)	1	5	2	1		1		1		1	1									
Supervisor Tom Cook (Internal Civil)	0	0				0	0	0	0				0							
Robert Gregoris (Locates)	1		1																	
Street Lighting	0		0															0		
Kate Parkinson - Joint Use	0																0			
Stations Mike Stoddart P&C East - CCL	0		0			0	0	0												
Stations P. Papoutsis P&C S/W & N/W - CCL	0		0			0	0	0												
Stations T. Nguygen Scada Switch (INFORMATION ONLY)	0		0																	
Stn's Telecom East B. Tutka - CCL Stn's Telecom West P. Papoutsis - CCL	0		0			0	0	0												
Metering	0							0												0
TOTALS	**13**	**10**	**5**	**1**	**3**	**8**	**0**	**7**	**3**	**6**	**4**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

TOTAL GREEN CONSTRUCTION FOLDERS THAT HAVE YELLOW DR'S	2	YELLOW DR'S
TOTAL GREEN CONSTRUCTION FOLDERS THAT HAVE WHITE DR'S	1	WHITE DR'S
TOTAL WHITE FILE FOLDERS THAT HAVE WHITE DR'S	3	WHITE DR'S
EXTRA DR'S	6	WHITE DR'S
RECORDS	1	PINK DR
2010 ORANGE DEP'T FOLDER	1	SIGNED DR

NOTE: WITH CIVIL PROJECTS HAVING POLES, CONTRACTOR TO PROVIDE POLE PERMIT & LOCATES (NOT BEN)

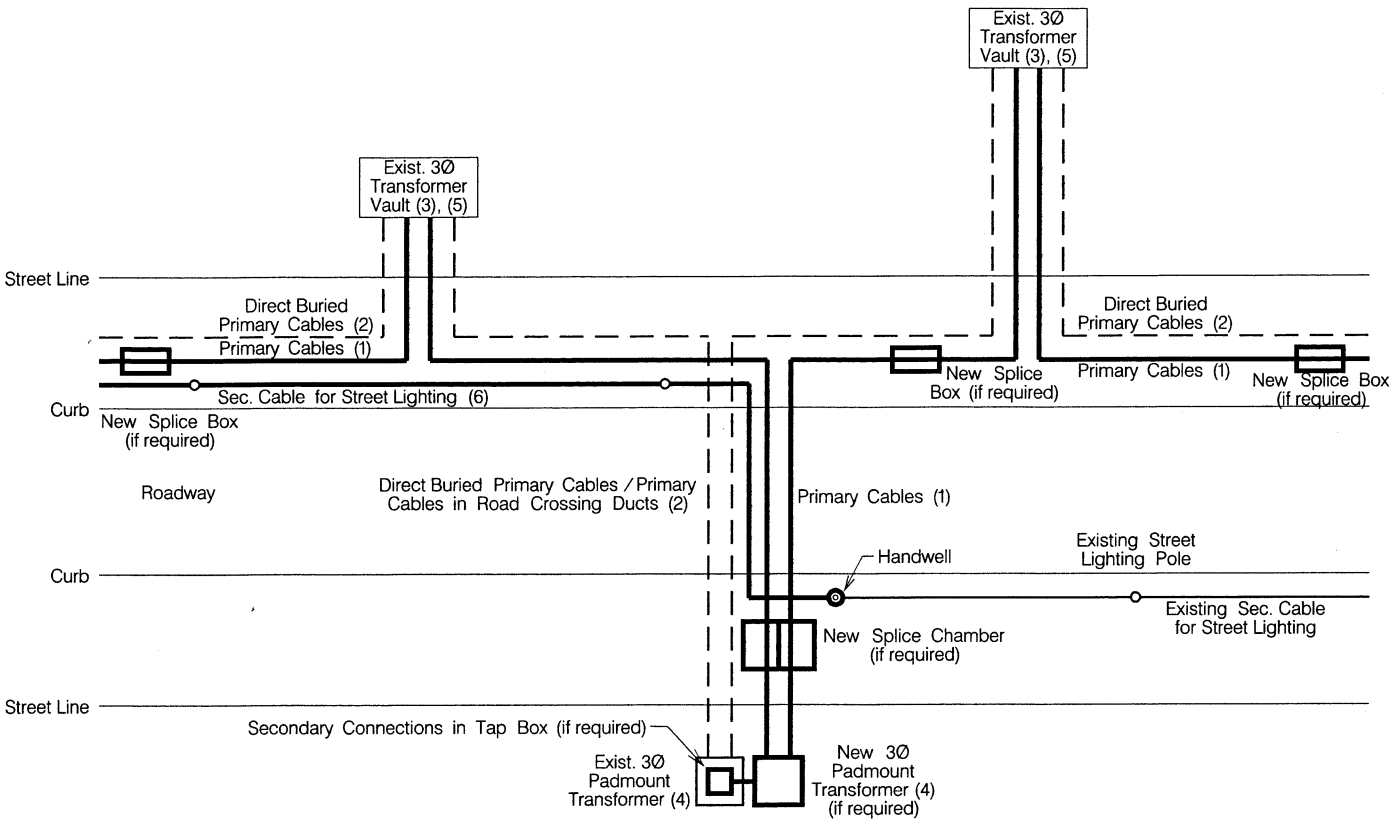
THE PSD FOR THE POLE IS SEPT 10, 2010

PLEASE PROVIDE THE TOTALS THAT ARE IN THE WHITE BOXES.

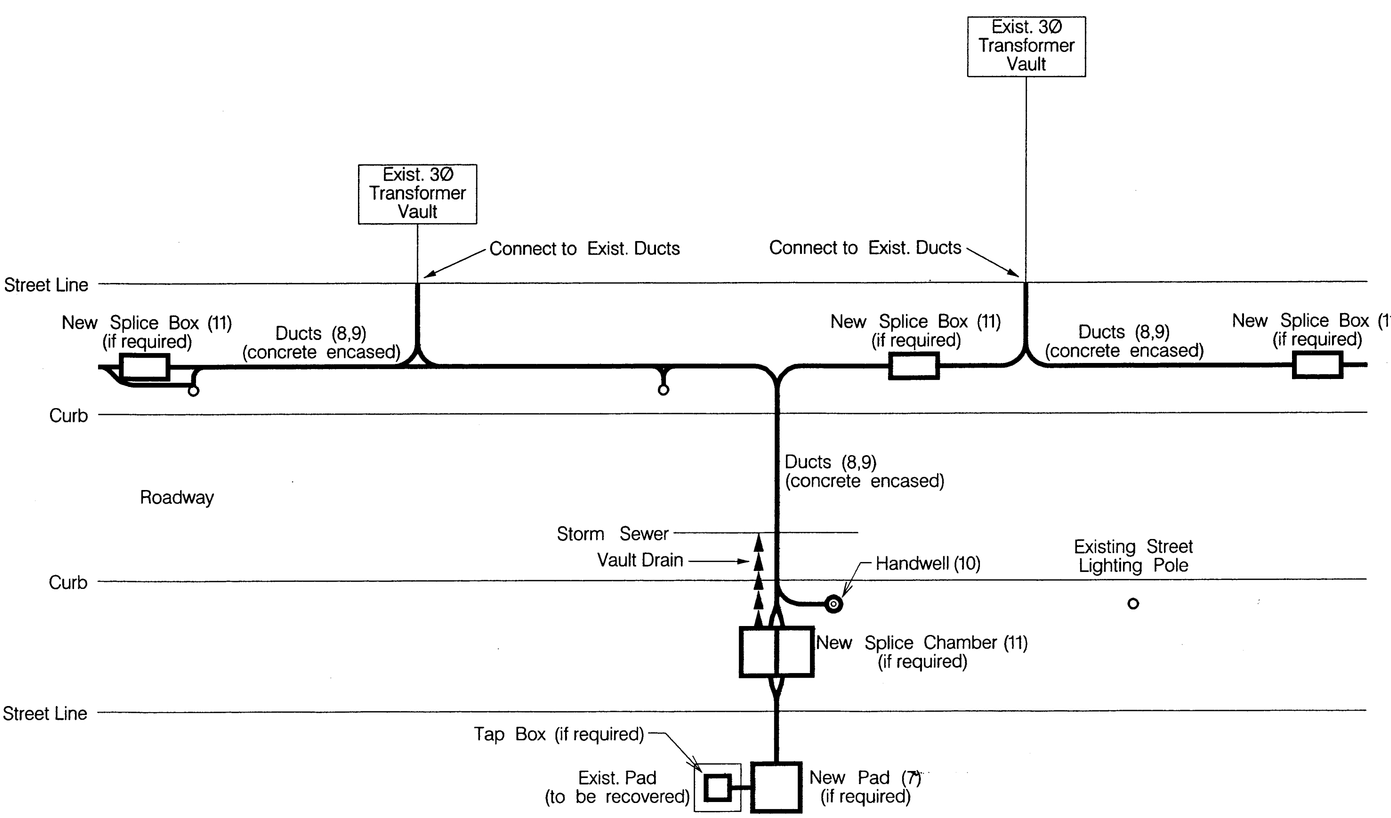
PLEASE ENSURE THAT THE .dgn CONSTRUCTION FILES ARE IN THE APPROPRIATE "SET" IN PROJECTWISE.

APPENDIX "D"
Design Guideline Illustrations
(refer to Design guideline Table on page 3)

ELECTRICAL
(Number in brackets represents the item # from the Design guideline Table on page 3)



CIVIL
(Number in brackets represents the item # from the Design guideline Table on page 3)



Appendix E1 – General Notification Letter

Toronto Hydro-Electric System Limited
14 Carlton Street Email: capitalprojects@torontohydro.com
Toronto, Ontario Website: http://poweruptoronto.ca/
M5B 1K5 416.542.3366

April 14, 2010

To our valued customer:

RE: Hydro Underground Construction – Cable Replacement - IMPORTANT NOTICE

We are planning to rebuild the underground electrical system on your street. The existing system is nearing the end of its life expectancy and if left unattended, it could hamper our ability to maintain a reliable level of service to you and everyone on the street.

The proposed work will involve the replacement of the existing electrical plant within the public road allowance and/or your electrical vault or pad mount transformer. If it is determined that our project will necessitate civil work on your property, a Toronto Hydro representative will be in contact with you for approval purposes.

Entry to your business will not be required. If you have any doubts about someone claiming to be "from Hydro", ask to see the person's Toronto Hydro identity card, which includes the employee's name and colour photograph.

We expect the civil work to get underway by mid June 2011. Our construction personnel are instructed to take extra care and precautions in order to minimize disruptions on both public and private property. During the course of our electrical work to follow in 2012, you may experience some power interruptions when they switch from the old to the new supply arrangements. We will endeavour to keep the interruptions to a minimum and to give you prior notice.

Once construction begins, Toronto Hydro Inspectors will be on site on a regular basis. Any concerns that arise **during construction** can be discussed with them.

Restoration will be done in various stages during construction of the project. The grass will be replaced with new sod where we excavate. All asphalt will be replaced between the curb and sidewalk if affected by our excavation. Where no sidewalk exists, we will replace the portion of the driveway between 300 mm on either side of our excavation trench or right up to the curb if the curb is within 1.0m of our trench. All disturbed concrete sidewalks will be temporarily repaired with asphalt. After Hydro's construction, the City will make permanent concrete repairs to these sidewalks within two years.

If you were considering repaving / repairing your driveway, we would encourage you to hold off until our work has been completed.

We thank you in advance for your co-operation and understanding in this matter. For project information and any ongoing updates please visit: http://www.poweruptoronto.ca/. Should you require additional information please contact the PowerUp office at 416-542-3366 or capitalprojects@torontohydro.com and **reference Project __________.**

Sincerely,

Paul Reesor
Customer Operations Representative,
Customer Operations

Appendix E2 – Councillor Notification

Toronto Hydro-Electric System Limited
14 Carlton Street Email: capitalprojects@torontohydro.com
Toronto, Ontario Website: http://poweruptoronto.ca/
M5B 1K5 416.542.3366

December 14, 2010

Toronto City Hall
100 Queen Street West, Suite A1
Toronto, ON M5H 2N2

Attn: Mike Del Grande
City Councillor, Ward 39
Scarborough-Agincourt

Re: Fundy Bay Project

For your information, please find attached a copy of our first notification letter which will soon be delivered to customers concerning the above mentioned project. Also, enclosed is a map of the area that will be affected by this important hydro upgrade.

The streets affected are as follows:

- Fundy Bay Blvd
- Ambercroft Blvd
- Hawkshead Crescent
- Hood Crescent

If any additional information is required, please do not hesitate to contact me at 416.542.3366.

Sincerely,

Paul Reesor
Customer Operations Representative,
Customer Operations

Appendix E3 – Detailed Customer Notification

Toronto Hydro-Electric System Limited
14 Carlton Street Email: capitalprojects@torontohydro.com
Toronto, Ontario Website: http://poweruptoronto.ca/
M5B 1K5 416.542.3366

September 14, 2010

X Company
2 Building Lane
Toronto ON
M1B 2V3

Dear Valued Customer,

Toronto Hydro is preparing to rebuild a section of the electrical system on your street. The project is scheduled to begin in April 2011. We are doing this to improve the electricity system reliability in your area. The existing system is nearing the end of its life expectancy and this project will improve service and reliability and reduce the frequency of outages.

During the design stage of this project, we assessed your area and identified where and how the new system will be upgraded. The electrical system is made up of underground cables, switches and transformers delivering electricity to the street and then to each building.

In an effort to keep our customers informed, we are advising you that in addition to replacing the underground cables, we will be installing within the public road allowance on your street,

1) a below ground cable pulling chamber whose top is flush to grade (in front of your property).

and / or

2) an above ground pad-mount type switching cubicle on a concrete base (in front of your property). Typical size is 1.9 metres by 2.1 metres by 1.4 metres in height and is green in colour.

and / or

3) an above ground pad-mount type transformer on a concrete base on your property. Typical size is 1.5 metres by 1.7 metres by 1.4 metres in height and is green in colour

Toronto Hydro and its contracted suppliers will take all reasonable care to protect the area during the construction of this project. We will repair any damage to the area caused during construction.

We thank you in advance for your co-operation and understanding in this matter. For project information and any ongoing updates please visit: http://www.poweruptoronto.ca/. Should you require additional information please contact the PowerUp office at 416-542-3366 or capitalprojects@torontohydro.com and **reference Project __________.**

Sincerely,

Paul Reesor
Customer Operations Representative,
Customer Operations

APPENDIX “F”
EXAMPLE OF JOINT-USE TRENCH COST ESTIMATE

3-June-10

Project “X” - 2010

JOINT USE TRENCH REQUIREMENTS

1. 125m of 2 Party Joint-Use Road Crossing Trench (extra trench depth required, also road crossing ducts must be concrete encased)
   Cable TV requires 1- 4” duct @1.0m trench depth (Hydro forced below the MCR depth requirement)
2. 400m of 2 Party Joint-Use Trench in Boulevard
   Cable TV requires 1- 4” duct @ 0.6m trench depth
3. 700m of 3 Party Joint-Use Trench in Boulevard
   Cable TV requires 1- 4” duct @ 0.6m trench depth
   Bell requires 1- 4” duct @0.6m trench depth
4. 1,100m of 2 Party Joint Use Trench in Boulevard
   Cable TV requires 2- 4” ducts @ 0.6m trench depth

JOINT USE TRENCH COST SHARING

1. 125m of 2 Party Joint-Use Road Crossing Trench
   125m X $43.60 tr/m = $5,450.00 (Cable TV)
   125m X $47.15 tr/m = $5,893.75 (Cable TV) extra trench depth cost
   $11,343.75
2. 400m of 2 Party Joint-Use Trench in Boulevard
   400m X $43.60 tr/m = $17,440 (Cable TV)

3. 700m of 3 Party Joint-Use Trench in Boulevard
   i. 700m X $34.90 tr/m = $24,430 (Cable TV)
   ii. 700m X $34.90 tr/m = $24,430 (Bell)

4. 1,100m of 2 Party Joint Use Trench in Boulevard
   1,100m X $50.14 tr/m = $55,154 (Cable TV)
   Note - $50.14 tr/m = single duct cost ($43.60) + 15% for second duct in trench

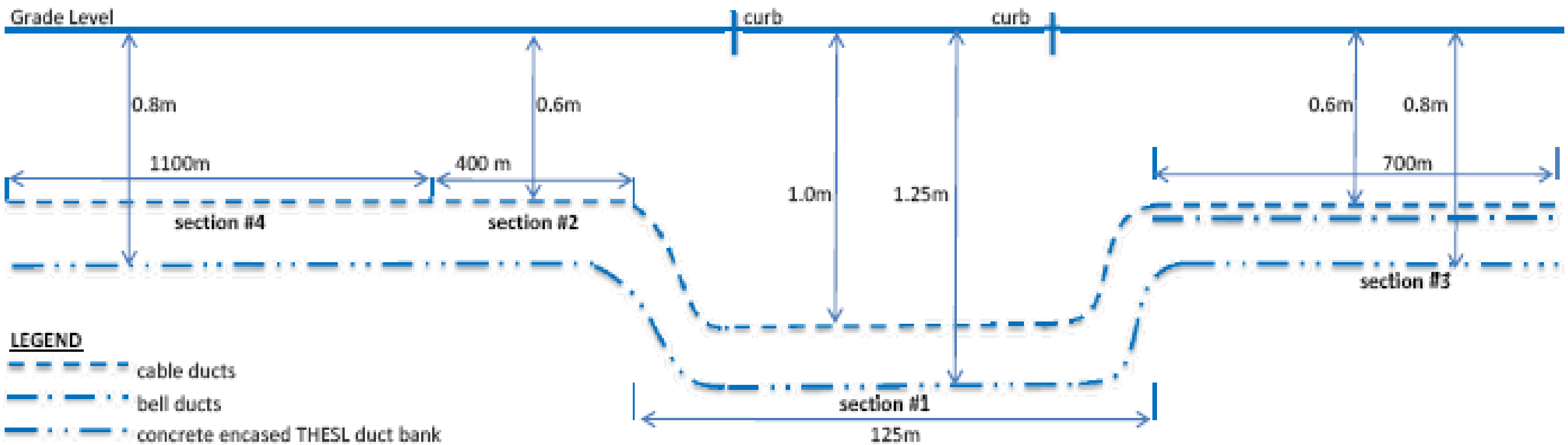
ESTIMATED 3RD PARTY JOINT-USE TRENCH COSTS

Cable TV	Joint-Use Trench - $ 108,367.75
	15% Admin. Fee - $ 16,255.16
	Total - $124,622.91
Bell	Joint-Use Trench - $ 24,430
	15% Admin. Fee - $ 3,664.50
	Total - $ 28,094.50

APPENDIX "F" CONTINUED

June 3, 2010

EXAMPLE OF JOINT-USE TRENCH COST ESTIMATE



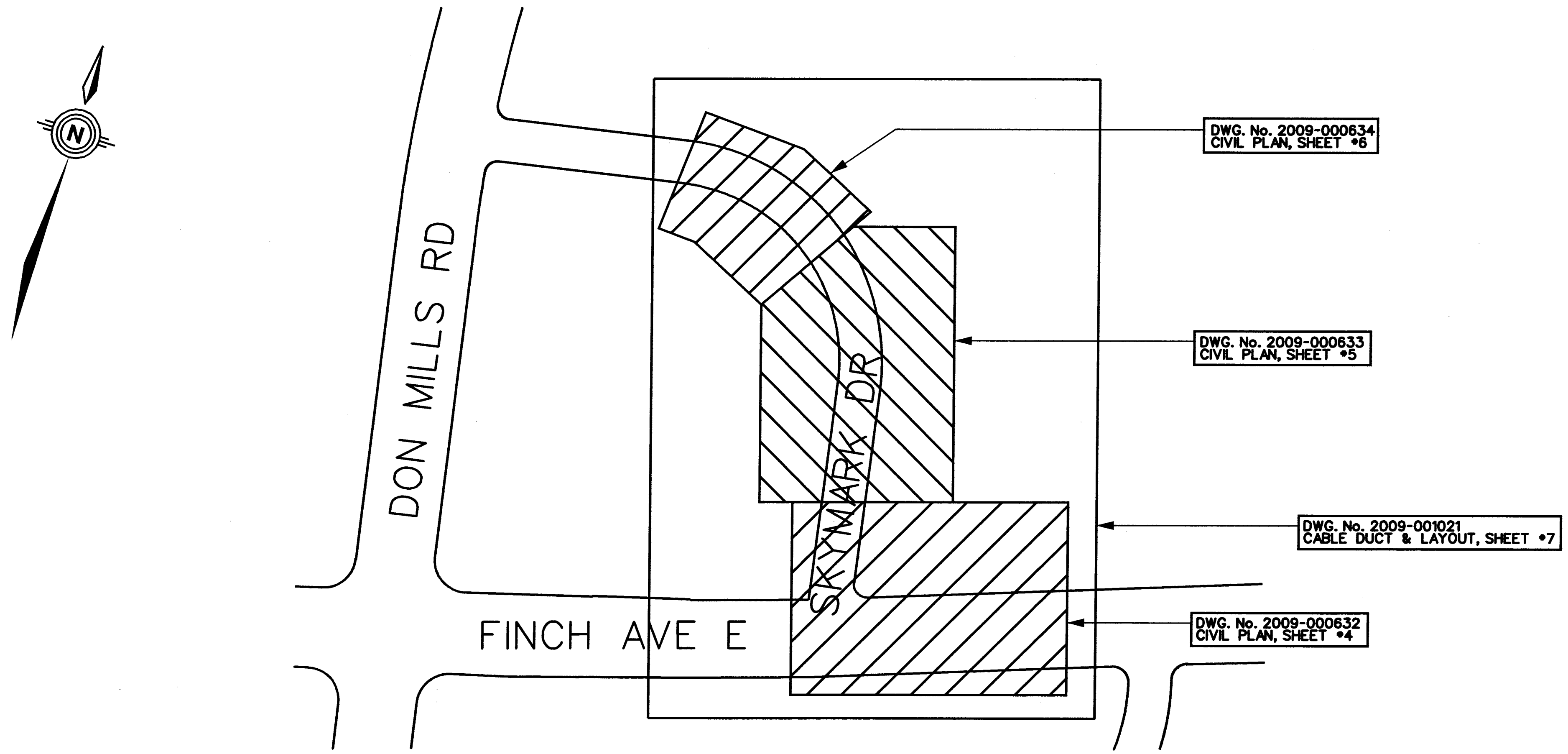
THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS AND APPROVED EQUIPMENT AND MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF ONTARIO REGULATION 22/04.

TORONTO HYDRO

UNDERGROUND INSTALLATION

E10189 SKYMARK NY51M25

UNDERGROUND CABLE REPLACEMENT



CONTRACT DRAWINGS

SHEET	DWG No.	DESCRIPTION	SHEET	DWG No.	DESCRIPTION
1	2009 - 000629	TITLE SHEET	2	2009 - 000630	PRIMARY SHCEMATIC
3	2009 - 000631	GENERAL NOTES & LEGEND	4	2009 - 000632	CIVIL PLAN
5	2009 - 000633	CIVIL PLAN	6	2009 - 000634	CIVIL PLAN
7	2009 - 001021	CABLE & DUCT LAYOUT			
9					

rev.		date	description	by	appd.
		15			

toronto hydro

DP E

NORTH YORK

drawn by R. MIFSUD	civil design R. MIFSUD	date yy/ mm/ dd 10/03/15
ip reference # E10189	civil approval D. BARNES	date yy/ mm/ dd 10/03/15
design project # P0047705	electrical design R. MIFSUD	date yy/ mm/ dd 10/03/15
construction project # P0057959	electrical approval D. BARNES	date yy/ mm/ dd 10/03/15
scale N.T.S.	construction approval G. MURPHY	date yy/ mm/ dd 10/03/15

dwg. title:

UNDERGROUND CABLE REPLACEMENT

E10189 SKYMARK NY51M25

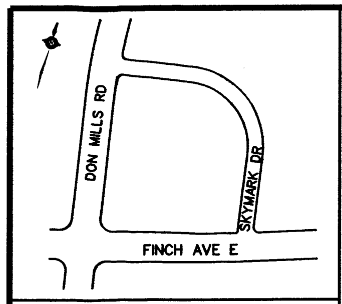
TITLE SHEET

dwg. no.	sheet no.	rev. no.
2009-000629	1 of 7	0

Proposed

$$date$$

REFER TO TITLE PAGE DRAWING #2009-000629
FOR ACCOMPANYING PROJECT DRAWINGS

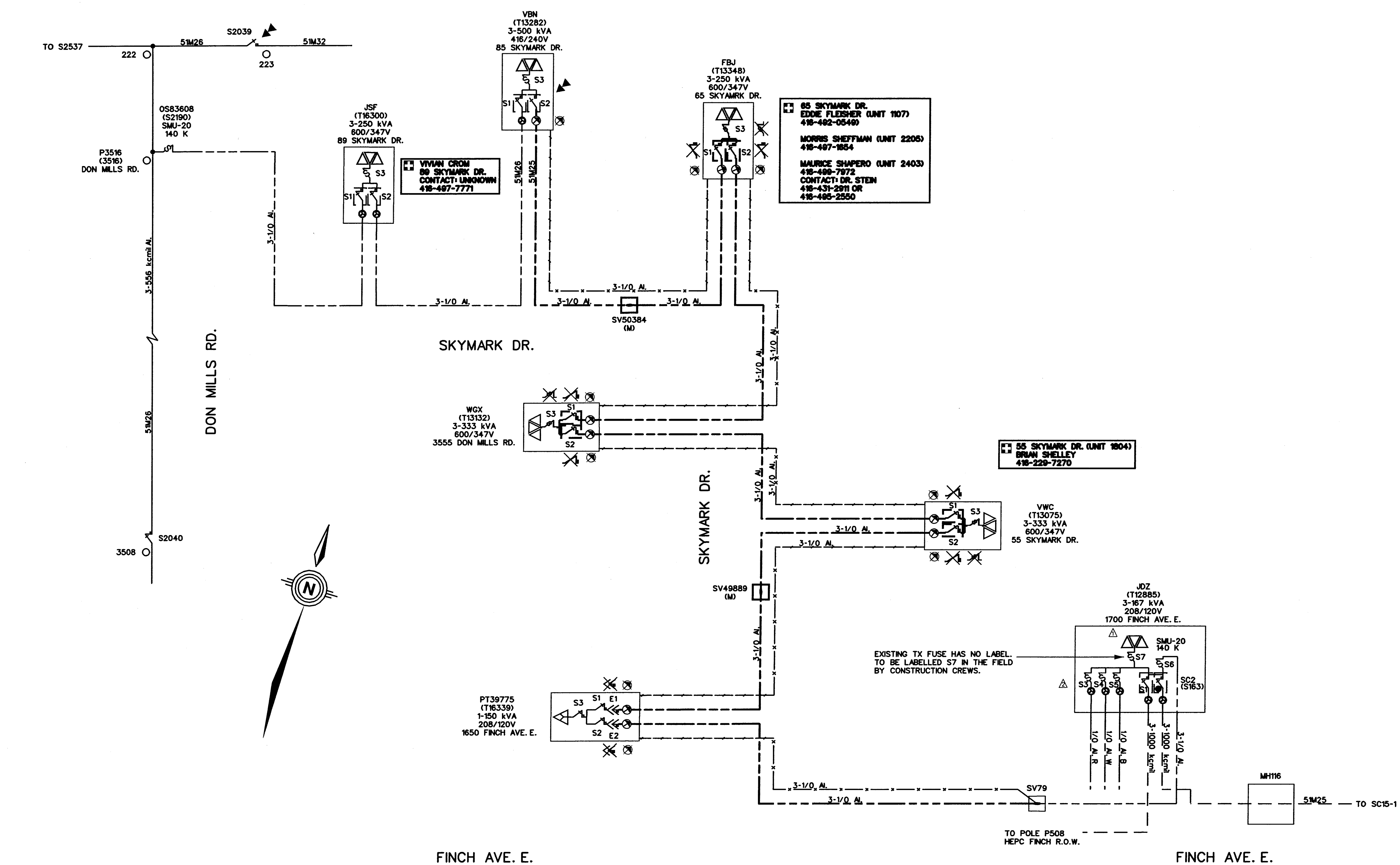


TORONTO HYDRO

UNDERGROUND INSTALLATION

E10189 SKYMARK NY51M25

SCHEMATIC DRAWING



LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
	3/C - 1/0 STR. Al. 28kV TRXPLE U/G PRIMARY CABLE
	MINIRUPTER SWITCH
	PRIMARY FUSED SWITCH
	200A LOAD BREAK ELBOW
	FAULT INDICATOR
SV49889 (M)	3 PHASE SPLICE BOX (1210 x 1810 x 1050mm DEEP) WITH LOCATION NUMBER (STD. 31-3135) (3 SLPICES MAX).
	SPLICE
EXISTING	
	3/C - 1000kcmil U/G PRIMARY CABLE
	3/C - 1/0 STR. Al. U/G PRIMARY CABLE
	1/C - 1/0 STR. Al. U/G PRIMARY CABLE
	3/C - 556 kcmil O/H PRIMARY CABLE
	1 - 3 PHASE PADMOUNT TRANSFORMER
	3 - 1 PHASE SUBMERSIBLE TRANSFORMER
	SCADA LOAD BREAK SWITCH
	MINIRUPTER SWITCH
	LOAD BREAK GANG-OPERATED SWITCH
	PRIMARY FUSED SWITCH
	CUSTOMER ON LIFE SUPPORT
	FAULT INDICATOR
	POLE
	NORMALLY OPEN POINT
RECOVER / ABANDON	
	3 - 1/0 STR. Al. PRIMARY CABLE (TO BE ABANDONED)
	3 - 1/0 STR. Al. PRIMARY CABLE (TO BE RECOVERED)
	PRIMARY FUSED SWITCH
	PRIMARY SWITCH
	FAULT INDICATOR

rev.		yy/mm/dd date	description	by	appd.
2		June 8, 2010	changed the nonmenclature of the exist. fuses in vault JDZ (T12885) according to grid operations.	R.M.	
1		December 7, 2009	changed symbology of exist. transformer JDZ (T12885) to the proper transformer symbol.	R.M.	

toronto hydro

DP E

NORTH YORK

drawn by R. MIFSUD	civil design	date yy/ mm/ dd / /
ip reference # E10189	civil approval	date yy/ mm/ dd / /
design project # P0047705	electrical design R. MIFSUD	date yy/ mm/ dd 10/03/15
construction project # P0057959	electrical approval D. BARNES	date yy/ mm/ dd 10 /03/15
scale N.T.S.	construction approval G. MURPHY	date yy/ mm/ dd 10 /03/15

dwg. title: UNDERGROUND CABLE REPLACEMENT
E10189 SKYMARK NY51M25

PRIMARY SCHEMATIC

dwg. no.	sheet no.	rev. no.
2009-000630	2 Of 7	0

Proposed $$date$$

GENERAL NOTES

BY CONTRACTOR

1. WHOLE NUMBERS INDICATE MILLIMETRES. DECIMALIZED NUMBERS INDICATE METRES.

2. ALL RADII ON CIVIL DRAWINGS ARE 1.5m UNLESS OTHERWISE NOTED.

2. LOCATION OF OTHER UTILITIES SHOWN ON TRENCH DRAWINGS ARE ASSUMED UNLESS OTHERWISE NOTED.

3. AS PER THE REQUIREMENTS OF BILL 208, THE FOLLOWING "DESIGNATED SUBSTANCES" MAY BE ENCOUNTERED ON THE PROJECT:
   - ASBESTOS - CABLES AND DUCTS
   - LEAD - PILC AND AILC CABLES, METER BACKER BOARDS, LISTING TAPE AND OLDER STATION BATTERIES
   - MERCURY - MERCURY VAPOR LAMPS AND STREET LIGHT RELAYS
   - VINYL CHLORIDE - 4" PVC DUCTS AND PVC JACKETED CABLES
   - ARSENIC - ARSENICAL LEAD SHEATHED CABLES
   - ETHYLENE OXIDE - POLYETHYLENE INSULATED CABLES
   - SILICA - CURRENT LIMITING FUSES AND LIGHTNING ARRESTERS(4kV)

5. MINIMUM HORIZONTAL CLEARANCES FROM FOREIGN UTILITIES SHALL BE MAINTAINED IN ACCORDANCE WITH APPENDIX O OF THE CITY OF TORONTO'S MUNICIPAL CONSENT REQUIREMENTS. FOR CLEARANCES, REFER TO TORONTO HYDRO'S STANDARD 31-0100.

EXISTING UTILITIES

6. ARRANGE FOR "HOLD-OFFS" AND USE EXTREME CAUTION WHEN WORKING IN THE VICINITY OF ENERGIZED EQUIPMENT OR CABLES.

7. ANY DAMAGE TO THE EXISTING UTILITIES IS TO BE DOCUMENTED AND WILL REQUIRE IMMEDIATE REPAIR. THE COST OF THE REPAIR IS TO BE BORNE BY THE CONTRACTOR.

TRENCHING AND DUCT INSTALLATION

8. TRENCH, SUPPLY AND INSTALL 100mm CONCRETE ENCASED DUCTS ON BOULEVARD AND ROAD CROSSINGS AS PER CONSTRUCTION DRAWINGS AND STD. 31-1100, 31-1120, 31-1130, 31-1150 AND 31-1160. STUBBED DUCTS TO EXTEND 1.0m PAST CURB UNLESS OTHERWISE SPECIFIED. ALL ASPHALT CUTS TO BE DONE BY SAW.

9. CONTRACTOR MUST COMPLETE ALL CIVIL CONSTRUCTION PRIOR TO HANDING OVER THE CONSTRUCTION SITE TO TORONTO HYDRO FOR ELECTRICAL INSTALLATION.

10. AT INTERSECTIONS, STUBBED DUCTS IN ROAD CROSSINGS TO EXTEND 1.5m PAST SIDEWALK UNLESS OTHERWISE SPECIFIED. ALL ASPHALT CUTS TO BE DONE BY SAW.

11. CONCRETE DRIVEWAY SHALL BE REPLACED FROM SIDEWALK TO CURB. IF NO SIDEWALK EXISTS, CONCRETE SHALL BE REPLACED FROM EXPANSION JOINT TO EXPANSION JOINT. WHEN ON CUSTOMER SIDE OF SIDEWALK, REPLACE FROM EXPANSION JOINT TO SIDEWALK.

12. WHEN A NEW CONCRETE ENCASED DUCT STRUCTURE IS IN CONFLICT WITH EXISTING DIRECT BURIED CABLE, THE NEW STRUCTURE SHALL BE INSTALLED BELOW THE CABLES. IF THIS IS NOT PRACTICAL, SPLIT PIPE SHALL BE SLEEVED OVER THE CABLES TO ALLOW FUTURE ACCESSABILITY.

VAULT/TAPBOX INSTALLATION

13. CORE DRILL NEW AND EXISTING VAULTS/FOUNDATIONS/CABLE CHAMBERS WHERE EXTRA DUCTS ARE REQUIRED TO ENTER VAULT/FOUNDATIONS/CABLE CHAMBERS.

14. TRANSFORMER VAULTS, SECONDARY TAP BOXES AND PRIMARY SPLICE BOXES SHALL BE CENTERED ON LOT LINES UNLESS OTHERWISE NOTED.

15. THE CONTRACTOR SHALL OVERDIG EXISTING HYDRO, STREET LIGYT, BELL OR ROGERS CABLES TO ALLOW SUFFICIENT SLACK FOR THE PLACEMENT OF HYDRO PLANT AS REQUIRED.

BY TORONTO HYDRO

CABLE INSTALLATION

16. INSTALL PRIMARY, SECONDARY AND SERVICE CABLES AS PER CONSTRUCTION DRAWINGS. SEAL DUCT ENDS.

17. LEAVE 3.0m COILS IN SPLICE BOXES/VAULTS. WATERPROOF ALL CABLE ENDS.

PRIMARY AND SECONDARY

18. MAKE PRIMARY SPLICES IN SPLICE BOXES AS PER CONSTRUCTION DRAWINGS.

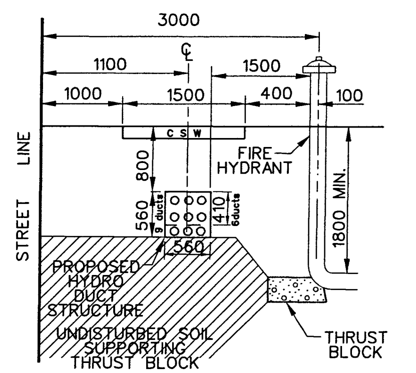
GENERAL

19. NEW CIVIL INFRASTRUCTURES ARE TO BE RELABELED AS INDICATED. BOTH THE NEW LOCATION NUMBER AND FORMER NUMBER (IN BRACKETS) ARE SHOWN AT EACH VAULT/EQUIPMENT LOCATION (i.e. ABC(1020TV)).

STANDARD DESIGNS

TITLE	NUMBER (LATEST VERSION)
SPECIFICATIONS	
TECHNICAL SPECIFICATION FOR CIVIL CONSTRUCTION WORK	CV-CON-01
CIVIL CONSTRUCTION STANDARDS	
U.G. CLEARANCES AND GENERAL NOTES	31-0100
CONDUIT - GENERAL INFORMATION	31-1100
CONCRETE ENCASED DUCT BANK	31-1120
LAYING DUCTS USING SPACERS	31-1130
DEPTH OF CONDUITS	31-1150
CAPPING PROPOSED DUCTS FOR FUTURE EXTENSION	31-1160
CONDUIT - DIVERTING DUCTS	31-1170
DUCT NUMBERING	31-1180
TRANSFORMATION OF DUCT BANKS	31-1190
SPLICE BOX (M)	31-3135
ELECTRICAL STANDARDS	
GRD. Y (BUILDING) VAULT - TYPICAL LAYOUT	13-7200
27.6kV TRXLPE CABLE RATINGS - 3 CIRCUIT	16-1180
STRIAGHT JOINT - COLD SHRINK METHOD	16-3860
TERMINATIONS - INDOOR COLD SHRINK METHOD	16-4140
TERMINATIONS - ELBOWS CONNECTOR TERMINATION	16-4300

APPROX. CUT REPAIRS			
ROADWAYS	85.5		$m^2\pm$
CONCRETE SIDEWALKS	391.5		$m^2\pm$
CURB			$m^2\pm$
OTHER	85.5		$m^2\pm$



FIRE HYDRANT BY-PASS FOR TORONTO HYDRO DUCT STRUCTURE

SCALE (N.T.S.)

NOTES

GENERAL

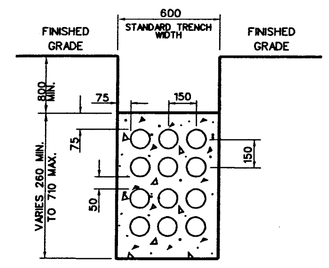
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. THIS DETAIL COVERS A FIRE HYDRANT BY-PASS BY TORONTO HYDRO DUCT STRUCTURE OF 1.5 METRES.
3. THE SUBJECT FIRE HYDRANTS ARE 3.0m OFF STREET LINE (NOT AT THE STANDARD 3.4m OFFSET FROM STREET LINE.)

SAFETY

1. CAUTION MUST BE EXERCISED BY THE CONTRACTOR WHEN EXCAVATING AROUND AND AT REAR OF HYDRANT DUE TO EXISTING THRUST BLOCK AND TO PROTECT THE FIRE HYDRANT FROM ANY MOVEMENT.
2. EXISTING SOIL CONDITIONS SUCH AS TYPE 3 AND/OR TYPE 4 AS DEFINED BY THE OCCUPATIONAL HEALTH AND SAFETY ACT-O REG. 213/91, ITEM 226 REQUIRES FIRE HYDRANT TO BE ISOLATED AND SUPPORTED.

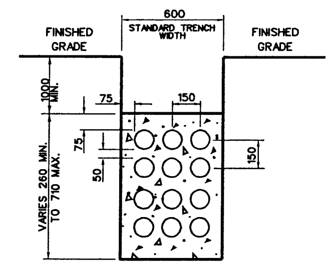
OPERATIONAL - WHERE ISOLATION/SUPPORT IS NECESSARY

1. TORONTO HYDRO TO MAKE ARRANGEMENTS WITH TORONTO WATER 24HRS. IN ADVANCE FOR ISOLATION OF FIRE HYDRANT-CONTACT TORONTO WATER AT 416-338-8888.
2. ONLY TORONTO WATER REPRESENTATIVES ARE ALLOWED TO OPERATE FIRE HYDRANTS AND VALVES.
3. THERE MUST NOT BE TWO CONSECUTIVE FIRE HYDRANTS OUT OF SERVICE AT ANY GIVEN TIME.
4. ALL FIRE HYDRANTS OUT OF SERVICE MUST BE PROPERLY BAGGED WITH APPROVED FIRE HYDRANT BAGS.
5. ISOLATED FIRE HYDRANT MUST BE PUT INTO SERVICE FOLLOWING INSTALLATION WHEN THE SURROUNDING GROUND CONDITIONS ARE ADEQUATELY STABILIZED TO SUSTAIN OPERATIONAL SUPPORT.



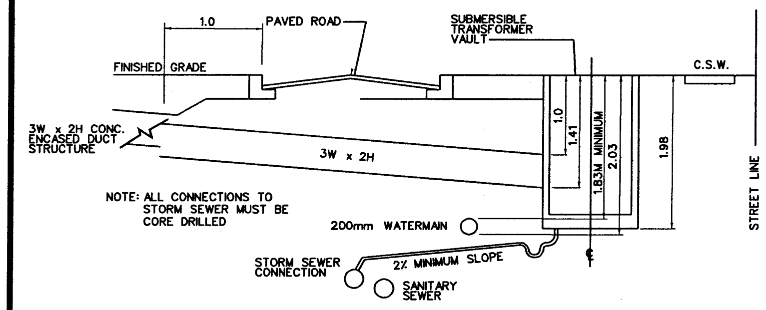
TYPICAL BOULEVARD TRENCH CROSS SECTION

SCALE (N.T.S.)



TYPICAL ROAD TRENCH CROSS SECTION

SCALE (N.T.S.)



PROFILE
TYPICAL ROAD CROSSING
N.T.S.

REFERENCE DRAWINGS

1. FINCH AVE. E.
   DON MILLS RD. TO CHEROKEE BLVD.
   DUCT & MANHOLE SYSTEM
   DWG. • U-72-4 SH. 2
2. LESLIE T.S. F9/M25
   MH116 RECONFIGURATION
   DWG. • U-71-45
3. CONCESSION MAP • 220-D
4. UNDERGROUND DUCT ROUTE
   55 SKYMARK DR. "CONDOMINIUM APARTMENT"
   DWG. • US-3056-1
5. UNDERGROUND DUCT ROUTE
   3555 DON MILLS RD.
   DWG. • US-3056-2
6. UNDERGROUND DUCT ROUTE
   65 SKYMARK DR. "CONDOMINIUM APARTMENTS"
   DWG. • US-3056-4
7. UNDERGROUND DUCT ROUTE
   85 SKYMARK DR.
   DWG. • US-3056-5
8. UNDERGROUND DUCT ROUTE
   1650 FINCH AVE. E. ZION CHURCH
   DWG. • US-3056-7
9. UNDERGROUND DUCT ROUTE
   1700 FINCH AVE. E.
   DWG. • US-71-29
10. U/G ST. LT. & CABLE TRENCH ROUTE
    SKYMARK DR.
    DWG. • US-72-7

HYDRO PLANT TO BE INSTALLED

SYMBOL	SIZE	DESCRIPTION	TOTAL	MAX • OF SPLICES (SV)	STANDARD	UPCMS CODE	STOCK CODE	INSIDE DIMENSION (m)	OUTSIDE DIMENSION (m)
	M	3 PH. FIBERGLASS SPLICE BOX	2	3	31-3135	16007	9662865	0.9 x 1.5	1.2 x 1.81

CIVIL LEGEND

SYMBOL	DESCRIPTION
	PROPOSED
	CENTRE LINE OF TRENCH
SV50384 (M)	3 PHASE SPLICE BOX (1210 x 1810 x 1050mm DEEP) WITH LOCATION NUMBER (STD. 31-3135) (3 SLPICES MAX).
6	NUMBER OF HYDRO DUCTS TO BE INSTALLED
	EXISTING
EC	CENTRE LINE OF DIRECT BURIED CABLE
ED	CENTRE LINE OF CONCRETE ENCASED DUCTS
PT30775 (T16339)	3 PHASE PADMOUNT TRANSFORMER (WITH NEW LOCATION NUMBER)
V WGX (T13132)	CUSTOMER TRANSFORMER VAULT (WITH LOCATION NUMBER)
	STREET LIGHT / HYDRO POLE
+	BELL MANHOLE
B	BELL PLANT
G	GAS MAIN
	JUNCTION BOX
RC	ROGERS PLANT
CG	COGECO PLANT
SAN	SANITARY SEWER
STM	STORM SEWER
	CATCH BASIN
W	WATER MAIN / VALVE
	FIRE HYDRANT
150	TREE & DIAMETER IN mm
	CUSTOMER ON LIFE SUPPORT
65	ADDRESS NUMBER

rev.	date	description	by	appd.

toronto hydro

DP E

NORTH YORK

drawn by R. MIFSUD	civil design R. MIFSUD	date yy/ mm/ dd 10/03/15
ip reference • E10189	civil approval D. BARNES	date yy/ mm/ dd 10/03/15
design project • P0047705	electrical design	date yy/ mm/ dd / /
construction project • P0057959	electrical approval	date yy/ mm/ dd / /
scale N.T.S.	construction approval G. MURPHY	date yy/ mm/ dd 10/03/15

dwg. title:

UNDERGROUND CABLE REPLACEMENT

E10189 SKYMARK NY51M25

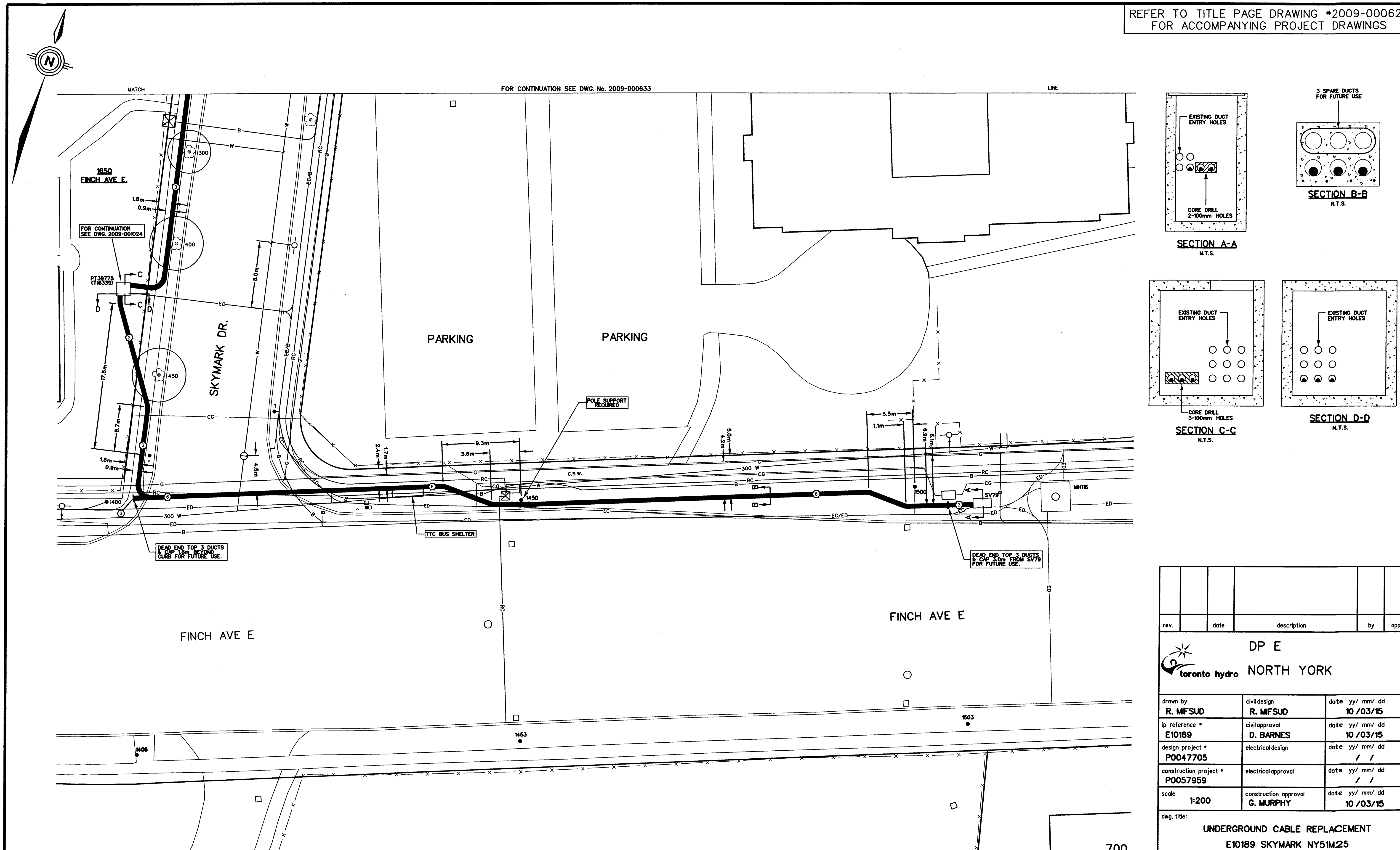
GENERAL NOTES & LEGEND

dwg. no.	sheet no.	rev. no.
2009-000631	3 of 7	0

Proposed

$$date$$

REFER TO TITLE PAGE DRAWING #2009-000629
FOR ACCOMPANYING PROJECT DRAWINGS



rev.	date	description	by	appd.

toronto hydro

DP E
NORTH YORK

drawn by R. MIFSUD	civil design R. MIFSUD	date yy/ mm/ dd 10 /03/15
ip reference # E10189	civil approval D. BARNES	date yy/ mm/ dd 10 /03/15
design project # P0047705	electrical design	date yy/ mm/ dd / /
construction project # P0057959	electrical approval	date yy/ mm/ dd / /
scale 1:200	construction approval G. MURPHY	date yy/ mm/ dd 10 /03/15

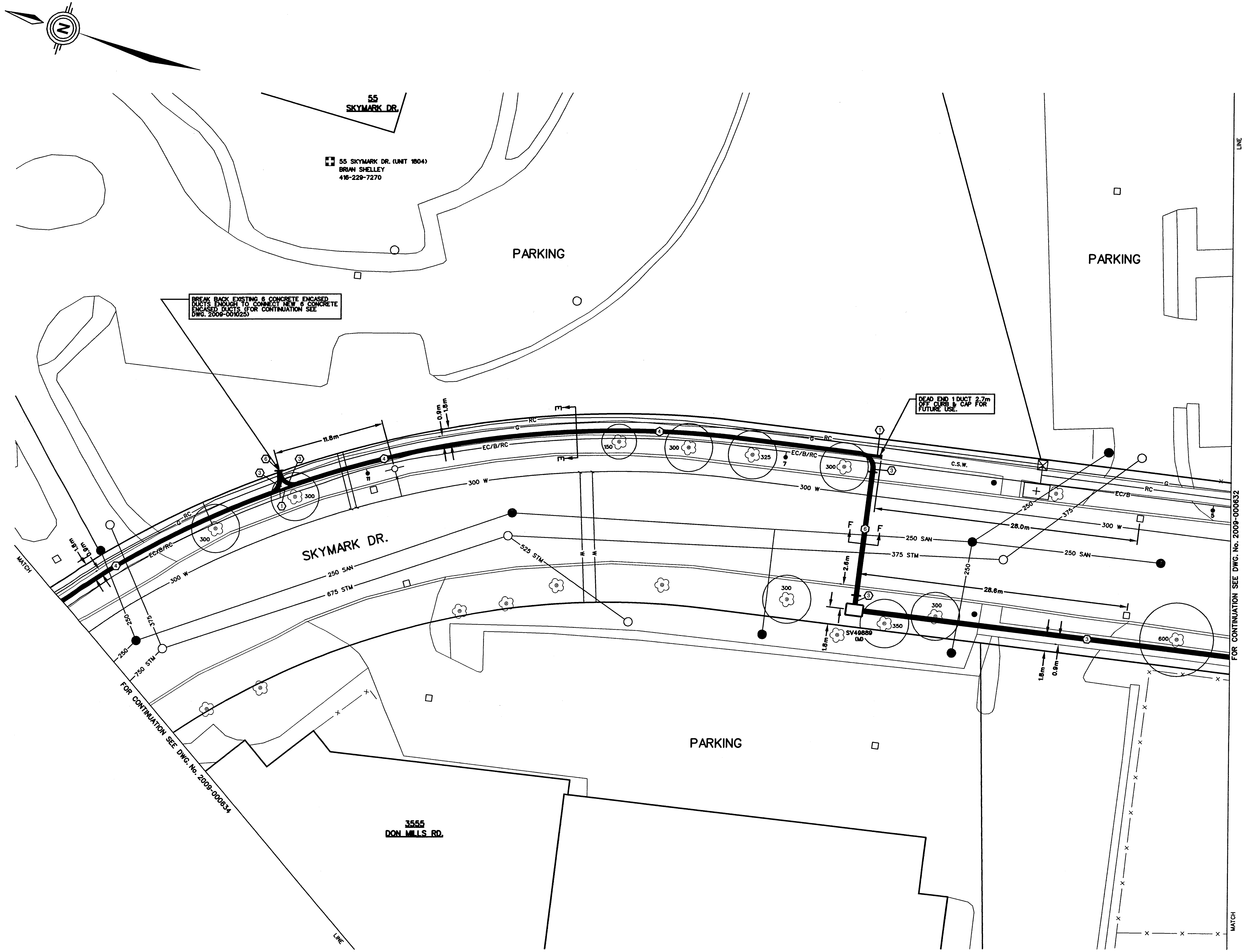
dwg. title:
UNDERGROUND CABLE REPLACEMENT
E10189 SKYMARK NY51M25

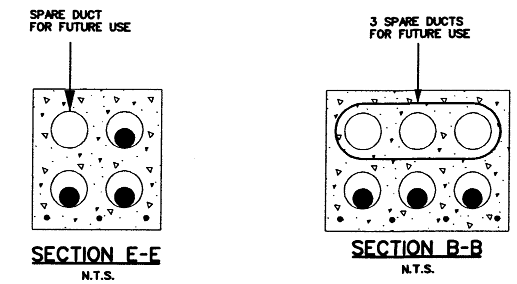
CIVIL PLAN

dwg. no.	sheet no.	rev. no.
2009-000632	4 of 7	0

Proposed $$date$$

REFER TO TITLE PAGE DRAWING #2009-000629
FOR ACCOMPANYING PROJECT DRAWINGS





NOTES

1. CAUTION: CUSTOMER UNDERGROUND SPRINKLERS ARE PRESENT IN THE AREA.

rev.	date	description	by	appd.

toronto hydro
DP E
NORTH YORK

drawn by R. MIFSUD	civil design R. MIFSUD	date yy/ mm/ dd 10 /03/15
ip reference # E10189	civil approval D. BARNES	date yy/ mm/ dd 10 /03/15
design project # P0047705	electrical design	date yy/ mm/ dd / /
construction project # P0057959	electrical approval	date yy/ mm/ dd / /
scale 1:200	construction approval G. MURPHY	date yy/ mm/ dd 10 /03/15

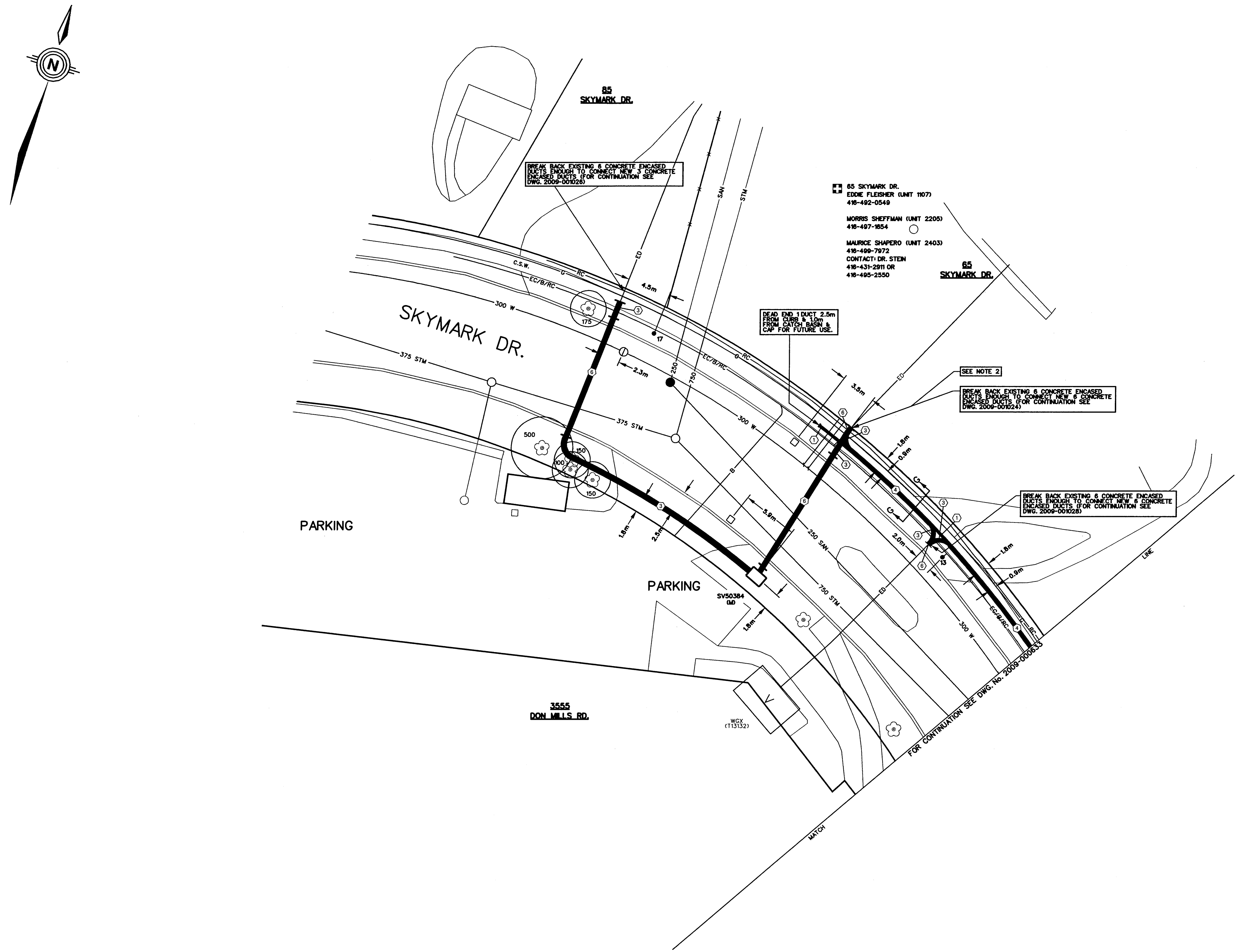
dwg. title:
UNDERGROUND CABLE REPLACEMENT
E10189 SKYMARK NY51M25

CIVIL PLAN

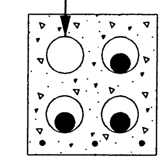
dwg. no.	sheet no.	rev. no.
2009-000633	5 of 7	0

Proposed $$date$$

REFER TO TITLE PAGE DRAWING #2009-000629
FOR ACCOMPANYING PROJECT DRAWINGS



SPARE DUCT
FOR FUTURE USE



SECTION G-G
N.T.S.

NOTES

1. CAUTION: CUSTOMER UNDERGROUND SPRINKLERS ARE PRESENT IN THE AREA.
2. LOCATE END OF THE EXISTING DUCT STRUCTURE AT 65 SKYMARK DR. BEFORE EXCAVATION.

rev.	date	description	by	appd.

toronto hydro
DP E
NORTH YORK

drawn by R. MIFSUD	civil design R. MIFSUD	date yy/ mm/ dd 10 /03/15
ip reference # E10189	civil approval D. BARNES	date yy/ mm/ dd 10 /03/15
design project # P0047705	electrical design	date yy/ mm/ dd / /
construction project # P0057959	electrical approval	date yy/ mm/ dd / /
scale 1:200	construction approval G. MURPHY	date yy/ mm/ dd 10 /03/15

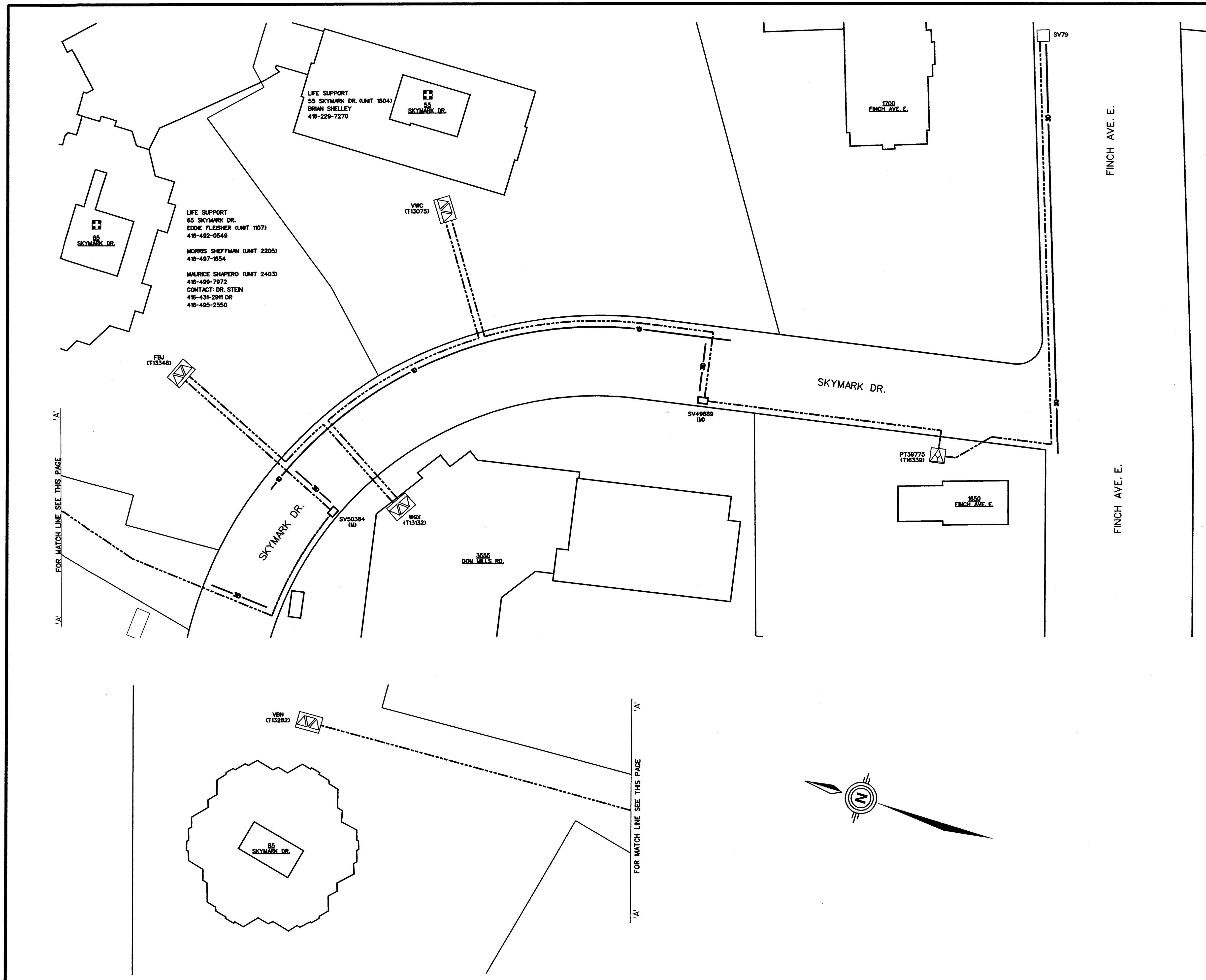
dwg. title:
UNDERGROUND CABLE REPLACEMENT
E10189 SKYMARK NY51M25

CIVIL PLAN

dwg. no.	sheet no.	rev. no.
2009-000634	6 of 7	0

Proposed $$date$$

REFER TO TITLE PAGE DRAWING #2009-000629 FOR ACCOMPANYING PROJECT DWGS. OR TO CIVIL PLAN DWGS. 2009-000632, 2009-000633 & 2009-000634



LEGEND	
SYMBOL	DESCRIPTION
PROPOSED	
	3/C - 1/0 STR. Al. 28kV TRXPLE PRIMARY CABLE IN 100mm DUCT (ONE CABLE PER DUCT)
3D	NUMBER OF 100mm SPARE DUCTS
SV49889 (M)	3 PHASE SPLICE BOX (1210 x 1810 x 1050mm DEEP) WITH LOCATION NUMBER (STD. 31-3135) (3 SPLICES MAX).
EXISTING	
	3 PHASE TRANSFORMER VAULT
	3 PHASE PADMOUNT TRANSFORMER
SV79	3 PHASE SPLICE BOX WITH LOCATION NUMBER
	CUSTOMER ON LIFE SUPPORT

rev.	date	description	by	appd.

toronto hydro

DP E
NORTH YORK

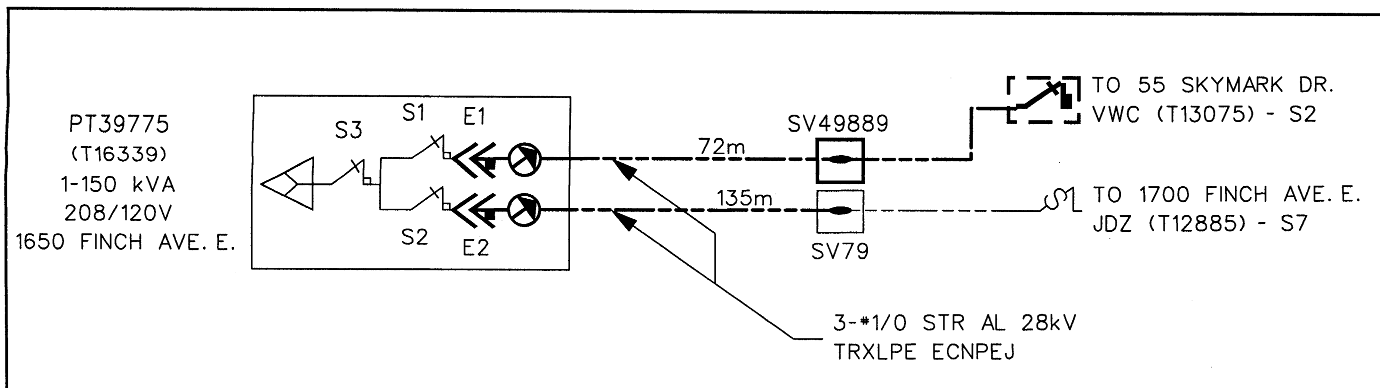
drawn by R. MIFSUD	civil design	date yy/ mm/ dd / /
ip reference # E10189	civil approval	date yy/ mm/ dd / /
design project # P0047705	electrical design R. MIFSUD	date yy/ mm/ dd 10 /03/15
construction project # P0057959	electrical approval D. BARNES	date yy/ mm/ dd 10 /03/15
scale N.T.S.	construction approval G. MURPHY	date yy/ mm/ dd 10 /03/15

dwg. title:
UNDERGROUND CABLE REPLACEMENT
E10189 SKYMARK NY51M25

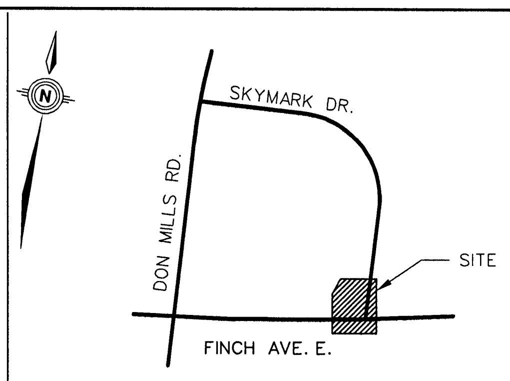
CABLE DUCT & LAYOUT

dwg. no.	sheet no.	rev. no.
2009-001021	7 of 7	0

Proposed $$date$$



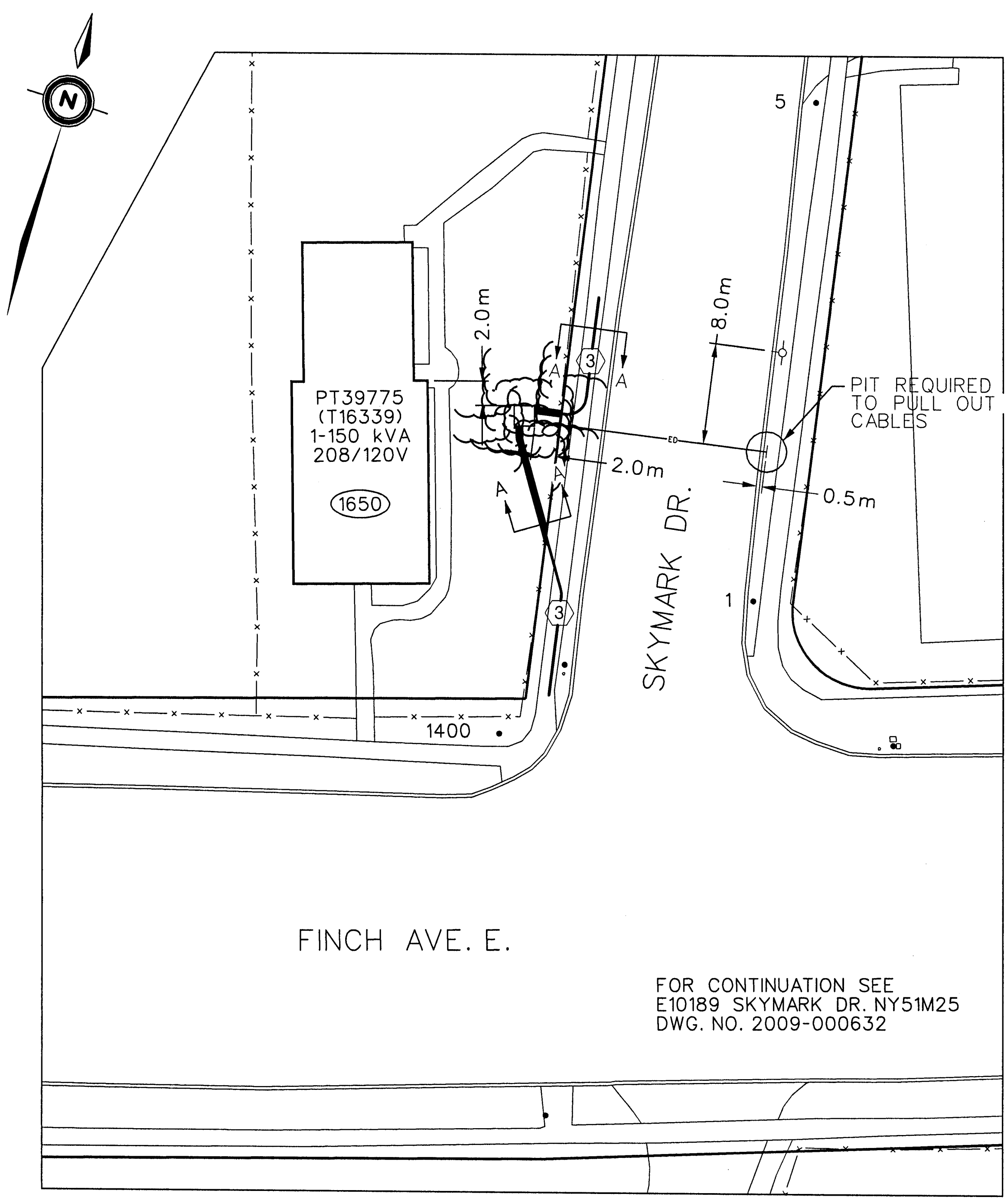
PRIMARY SCHEMATIC



KEY MAP

THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS, APPROVED EQUIPMENT AND MEETS SAFETY REQUIREMENTS OF SECTION 4 OF THE ONTARIO REGULATION 22/04.

MINIMUM HORIZONTAL AND VERTICAL CLEARANCES FROM FOREIGN UTILITIES ARE IN ACCORDANCE WITH THE CITY OF TORONTO'S MUNICIPAL CONSENT REQUIREMENTS AND CONSTRUCTION STANDARDS 31-0100.



NOTES

GENERAL

ALL CIVIL WORK ON THIS CONTRACT SHALL BE DONE IN ACCORDANCE WITH TORONTO HYDRO'S LATEST ISSUE OF TECHNICAL SPECIFICATION FOR CIVIL CONSTRUCTION WORK CV-CON-01.

BY CONTRACTOR

1. INSTALL CONCRETE ENCASED DUCT STRUCTURES INTO THE EXISTING PADMOUNT TRANSFOMER PT39775 (T16339) AS PER T.H. STANDARDS 31-1120, 31-1130 & DWG. NO. 2009-000632.
2. LOCATE AND EXPOSE EXISTING END OF ROAD CROSSING. COORDINATE WITH T.H. PERSONNEL.

BY TORONTO HYDRO

3. CUT AND REMOVE THE EXISTING 3-#1/0 STR.Al. PRIMARY CABLES FROM THE EXISTING 3Wx2H DUCT STRUCTURE BETWEEN EXISTING PADMOUNT PT39775 (T16339) AND EXISTING END OF ROAD CROSSING.
4. PULL IN NEW 3-#1/0 STR. Al. PRIMARY CABLES ACCORDING TO PRIMARY SCHEMATIC AND COMPLETE ALL TERMINATIONS & CONNECTIONS AS PER T.H. STANDARDS 16-4300.

THIS DRAWING SUPERSEDES US-3056-7

AS PER BILL 208, THE FOLLOWING "DESIGNATED SUBSTANCES" MAY BE ENCOUNTERED ON THE PROJECT: VINYL CHLORIDE AND ETHYLENE OXIDE.

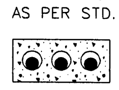
NOTE: OBTAIN NECESSARY CLEARANCES BEFORE DIGGING

48 HRS. NOTICE IS REQUIRED PRIOR TO COMMENCEMENT OF TRENCH WORK CALL TORONTO HYDRO FOR INSPECTION PRIOR TO POURING CONCRETE.

DUCTS MUST BE CONSTRUCTED TO TORONTO HYDRO STANDARDS, ALONG INDICATED ROUTE. SHOULD DEVIATIONS BE DEEMED NECESSARY THEY MUST BE APPROVED PRIOR TO CONSTRUCTION.

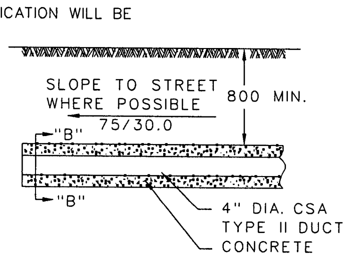
DUCTS THAT DO NOT MEET THIS SPECIFICATION WILL BE REBUILT AT THE CUSTOMERS EXPENSE.

NOTE: DUCTS TO HAVE BELL FITTINGS AT EACH END EXCEPT WHERE DUCTS WILL BE CONTINUED BY T.H. LEAVE END AS PER STD. 31-1160.



PROPOSED CABLE CONFIGURATION

SECTION A-A



SECTION B-B

DETAIL "A"
(N.T.S.)

LEGEND

- EX. 3PH PADMOUNT TRANSFORMER
- (6) INDICATES NUMBER OF DUCTS
- PROPOSED CONCRETE ENCASED DUCT BANK STRUCTURE
- EXISTING CONCRETE ENCASED DUCT BANK STRUCTURE

APPROX. CUT REPAIRS

ROADWAYS	.... +/-	____________	m sq.
CONCRETE SIDEWALK	.... +/-	____________	m sq.
CURB	.... +/-	____________	m sq.
OTHER	.... +/-	____________	m sq.

DUCT	LENGTH	19.0m (EXIST)	
CABLE		INSTALL LOC PT39775	REMOVE LOC T16339
	SIZE	6-1/C #1/0 STR. AL. 28kV TRXLPE ECNPEJ	6-1/C #1/0 STR. AL. 28kV XLPE ENCJ
	LENGTH	REFER TO PRIMARY SCHEMATIC ABOVE	180.0m (30.0m x 6)
TRANS. (EXIST)	SIZE		
	VOLTAGE		
	CUST VOLT		
TERM.	FUSE No.		
	ELBOWS	6 - 200A LOAD BREAK ELBOWS	6 - LOAD BREAK ELBOWS
	FUSE		
	T.O. STD.		
PAD	FUSE		
	T.O. STD.		

WORK ORDER NUMBERS	
CIVIL	290829
SWITCHING	290823
TERMINATIONS	290825
TRANSFORMER	N/A
DESIGN	236379
MAP NO.	220-D
APPROVALS	
METRO ROADS	

rev.	date	description	by	appd.

toronto hydro

distribution services
☒ distribution services (east)
☐ distribution services (west)

drawn by R. MIFSUD	civil design R. MIFSUD	date yy / mm / dd 10/03/15
ip reference • E10189	civil approval D. BARNES	date yy / mm / dd 10/03/15
ellipse project • P0047705	electrical design R. MIFSUD	date yy / mm / dd 10/03/15
construction project • P0057959	electrical approval D.BARNES	date yy / mm / dd 10/03/15
scale 1:500	construction approval G. MURPHY	date yy / mm / dd 10/03/15

dwg. title:

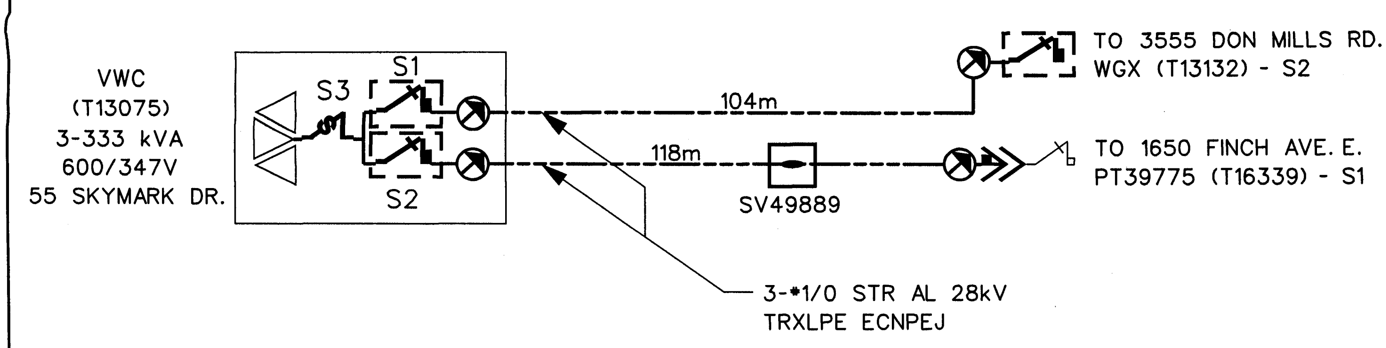
1650 FINCH AVE. E.
UNDERGROUND ELECTRICAL

dwg. no. 2009-001024

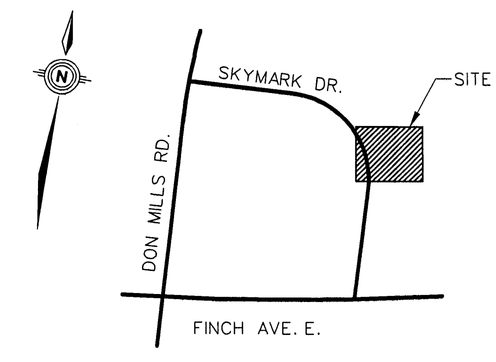
rev. no.

CAD

LAST PLOT 2008-06-11



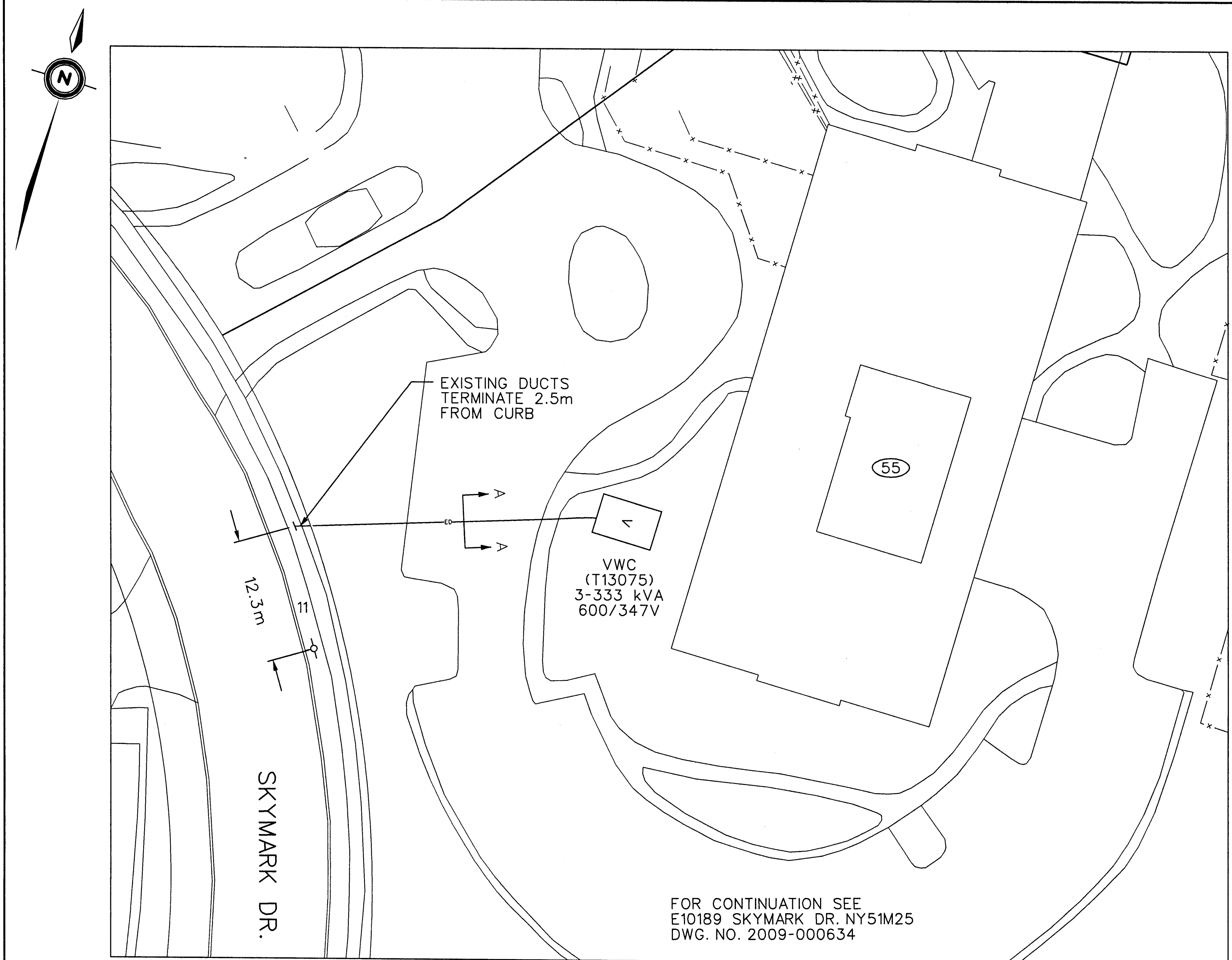
PRIMARY SCHEMATIC



KEY MAP

THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS, APPROVED EQUIPMENT AND MEETS SAFETY REQUIREMENTS OF SECTION 4 OF THE ONTARIO REGULATION 22/04.

MINIMUM HORIZONTAL AND VERTICAL CLEARANCES FROM FOREIGN UTILITIES ARE IN ACCORDANCE WITH THE CITY OF TORONTO'S MUNICIPAL CONSENT REQUIREMENTS AND CONSTRUCTION STANDARDS 31-0100.



AS PER BILL 208, THE FOLLOWING "DESIGNATED SUBSTANCES" MAY BE ENCOUNTERED ON THE PROJECT: VINYL CHLORIDE AND ETHYLENE OXIDE.

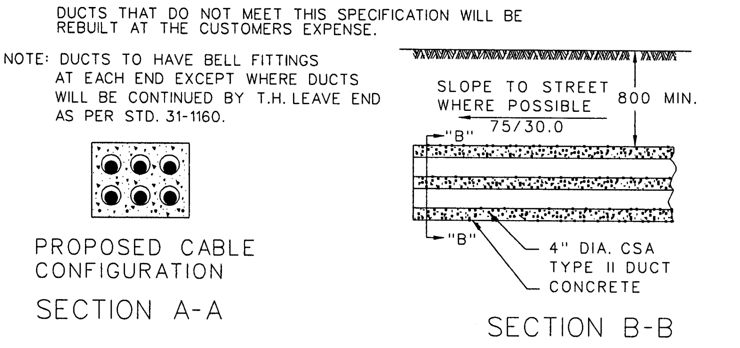
NOTE: OBTAIN NECESSARY CLEARANCES BEFORE DIGGING

48 HRS. NOTICE IS REQUIRED PRIOR TO COMMENCEMENT OF TRENCH WORK CALL TORONTO HYDRO FOR INSPECTION PRIOR TO POURING CONCRETE.

DUCTS MUST BE CONSTRUCTED TO TORONTO HYDRO STANDARDS, ALONG INDICATED ROUTE. SHOULD DEVIATIONS BE DEEMED NECESSARY THEY MUST BE APPROVED PRIOR TO CONSTRUCTION.

DUCTS THAT DO NOT MEET THIS SPECIFICATION WILL BE REBUILT AT THE CUSTOMERS EXPENSE.

NOTE: DUCTS TO HAVE BELL FITTINGS AT EACH END EXCEPT WHERE DUCTS WILL BE CONTINUED BY T.H. LEAVE END AS PER STD. 31-1160.



PROPOSED CABLE CONFIGURATION

SECTION A-A

SECTION B-B

DETAIL "A"
(N.T.S.)

DUCT	LENGTH	34.1m (EXIST.)	
CABLE		INSTALL LOC VWC	REMOVE LOC T13075
	SIZE	6-1/C #1/0 STR. Al. 28kV TRXLPE ECNPEJ	6-1/C #1/0 Al. 28kV CN XLPE
	LENGTH	REFER TO PRIMARY SCHEMATIC ABOVE	277.8m +/- (46.3m x 6)
TRANS. (EXIST.)	SIZE		
	VOLTAGE		
	CUST VOLT		
TERM.	FUSE No.		
	SWITCHES	MINI RUPTER SWITCH 25K 600A (2)	15kV NX MOUNT (9)
	FUSE	40A NX (3)	40K NX (3)
	T.O. STD.	13-7200	
PAD	FUSE		
	T.O. STD.		

WORK ORDER NUMBERS	
CIVIL	290829
SWITCHING	290823
TERMINATIONS	290825
TRANSFORMER	N/A
DESIGN	236379
MAP NO.	220-D
APPROVALS	
METRO ROADS	

THIS DRAWING SUPERSEDES US-3056-1

rev.	date	description	by	appd.
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toronto hydro

distribution services

☒ distribution services (east)

☐ distribution services (west)

drawn by: R. MIFSUD	civil design: R. MIFSUD	date yy / mm / dd: 10/03/15
ip reference *: E10189	civil approval: D. BARNES	date yy / mm / dd: 10/03/15
ellipse project *: P0047705	electrical design: R. MIFSUD	date yy / mm / dd: 10/03/15
construction project *: P0057959	electrical approval: D. BARNES	date yy / mm / dd: 10/03/15
scale: 1:500	construction approval: G. MURPHY	date yy / mm / dd: 10/03/15

dwg. title:

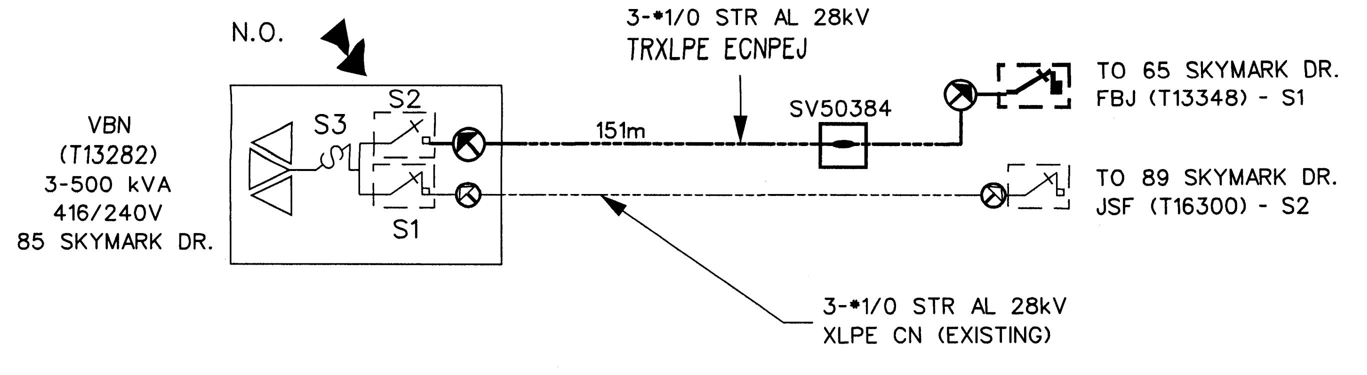
55 SKYMARK DR.
UNDERGROUND ELECTRICAL

dwg. no. 2009-001025

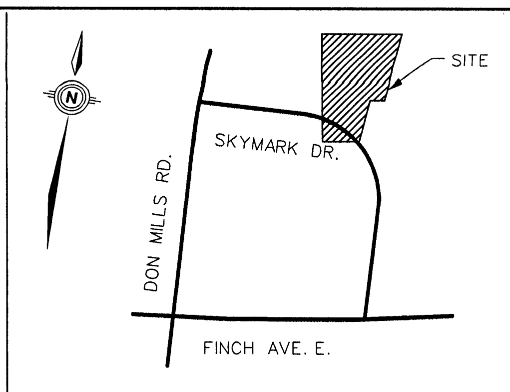
rev. no.

CAD

LAST PLOT 2008-06-11



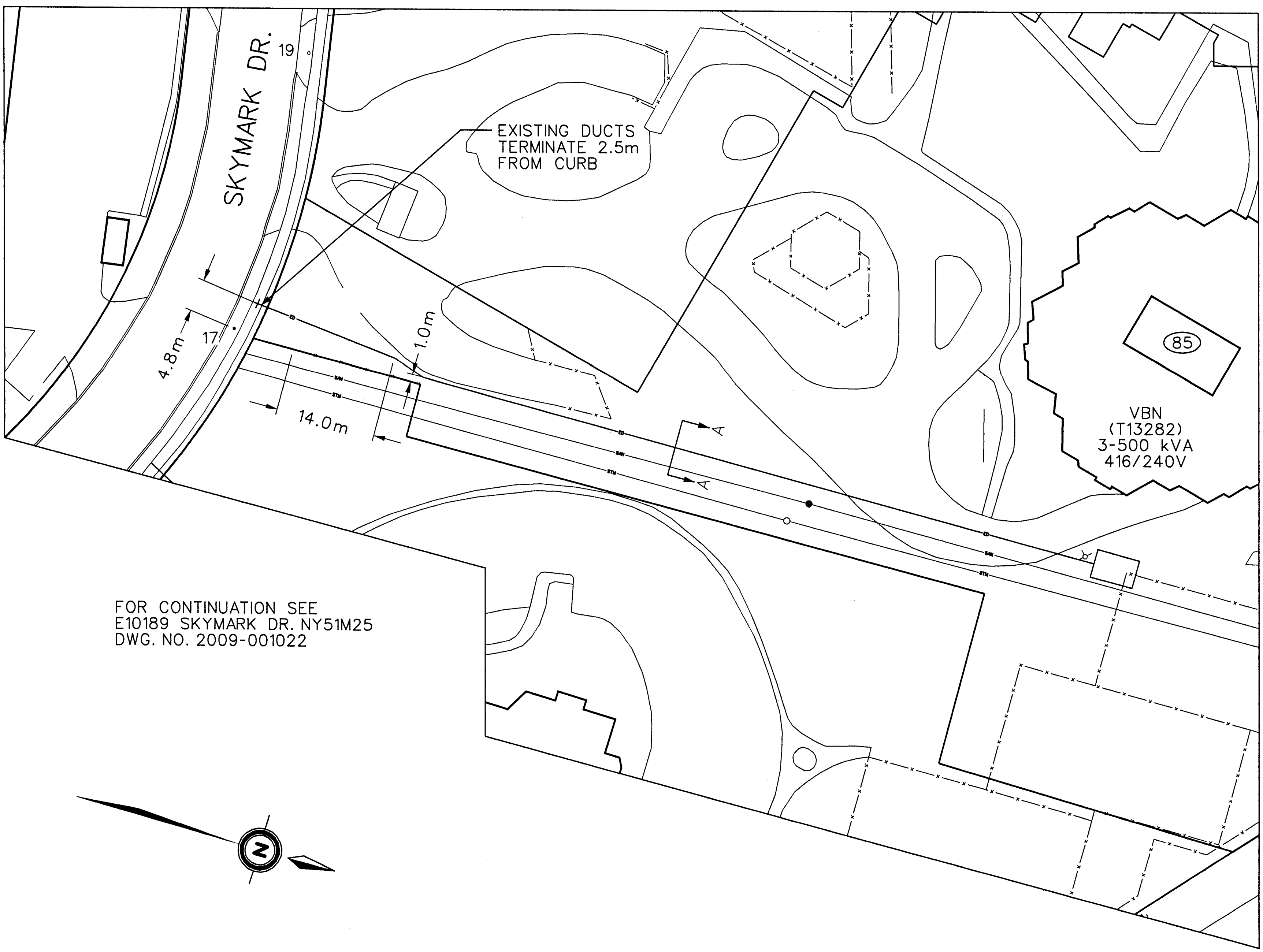
PRIMARY SCHEMATIC



KEY MAP

THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS, APPROVED EQUIPMENT AND MEETS SAFETY REQUIREMENTS OF SECTION 4 OF THE ONTARIO REGULATION 22/04.

MINIMUM HORIZONTAL AND VERTICAL CLEARANCES FROM FOREIGN UTILITIES ARE IN ACCORDANCE WITH THE CITY OF TORONTO'S MUNICIPAL CONSENT REQUIREMENTS AND CONSTRUCTION STANDARDS 31-0100.



FOR CONTINUATION SEE
E10189 SKYMARK DR. NY51M25
DWG. NO. 2009-001022

THIS DRAWING SUPERSEDES US-3056-5

AS PER BILL 208, THE FOLLOWING "DESIGNATED SUBSTANCES" MAY BE ENCOUNTERED ON THE PROJECT: VINYL CHLORIDE AND ETHYLENE OXIDE.

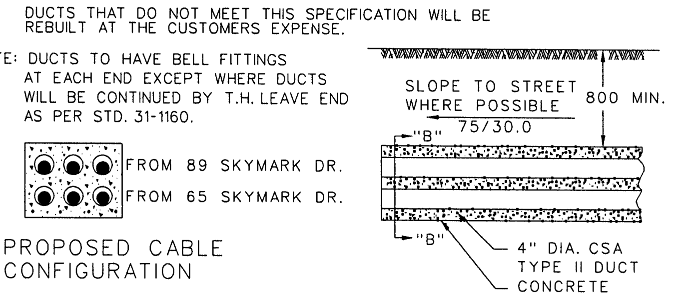
NOTE: OBTAIN NECESSARY CLEARANCES BEFORE DIGGING

48 HRS. NOTICE IS REQUIRED PRIOR TO COMMENCEMENT OF TRENCH WORK CALL TORONTO HYDRO FOR INSPECTION PRIOR TO POURING CONCRETE.

DUCTS MUST BE CONSTRUCTED TO TORONTO HYDRO STANDARDS, ALONG INDICATED ROUTE. SHOULD DEVIATIONS BE DEEMED NECESSARY THEY MUST BE APPROVED PRIOR TO CONSTRUCTION.

DUCTS THAT DO NOT MEET THIS SPECIFICATION WILL BE REBUILT AT THE CUSTOMERS EXPENSE.

NOTE: DUCTS TO HAVE BELL FITTINGS AT EACH END EXCEPT WHERE DUCTS WILL BE CONTINUED BY T.H. LEAVE END AS PER STD. 31-1160.



PROPOSED CABLE CONFIGURATION

SECTION A-A

SECTION B-B

DETAIL "A"
(N.T.S.)

DUCT	LENGTH	130.0m (EXIST)	
CABLE		INSTALL LOC VBN	REMOVE LOC T13282
	SIZE	3-1/C #1/0 STR. Al. 28kV TRXLPE ECNPEJ	3-1/C #1/0 STR. AL. 28kV XPLE CN
	LENGTH	REFER TO PRIMARY SCHEMATIC ABOVE	852.0 (142 x 6)
TRANS. (EXIST)	SIZE		
	VOLTAGE		
	CUST VOLT		
TERM.	FUSE No.		
	SWITCHES		
	FUSE		
	T.O. STD.		
PAD	FUSE		
	T.O. STD.		

WORK ORDER NUMBERS	
CIVIL	290829
SWITCHING	290826
TERMINATIONS	290825
TRANSFORMER	N/A
DESIGN	236379
MAP NO.	220-D
APPROVALS	
METRO ROADS	

rev.	date	description	by	appd.
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toronto hydro

distribution services
☒ distribution services (east)
☐ distribution services (west)

drawn by: R. MIFSUD	civil design: R. MIFSUD	date yy / mm / dd: 10/03/15
ip reference •: E10189	civil approval: D. BARNES	date yy / mm / dd: 10/03/15
ellipse project •: P0047705	electrical design: R. MIFSUD	date yy / mm / dd: 10/03/15
construction project •: P0057959	electrical approval: D. BARNES	date yy / mm / dd: 10/03/15
scale: 1:750	construction approval: G. MURPHY	date yy / mm / dd: 10/03/15

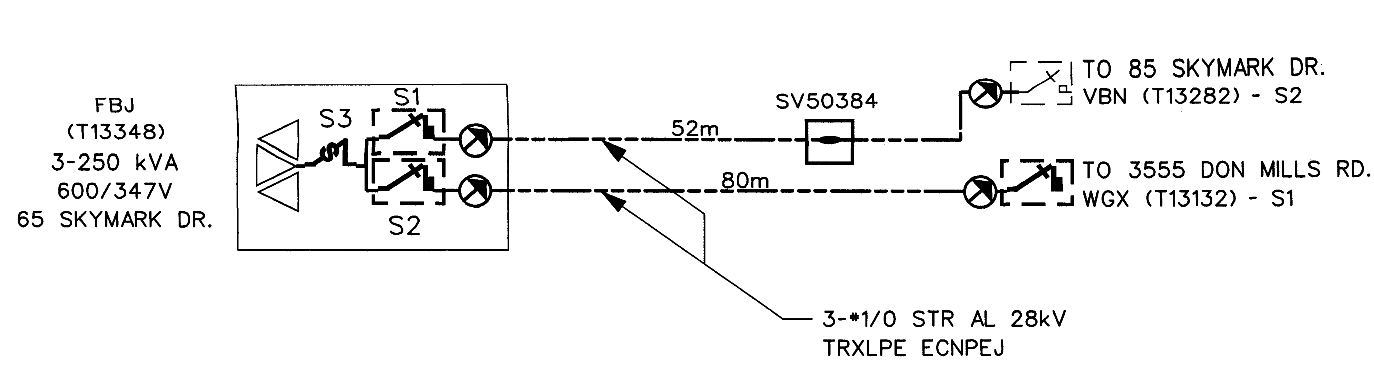
dwg. title:

85_SKYMARK_DR.
UNDERGROUND_ELECTRICAL

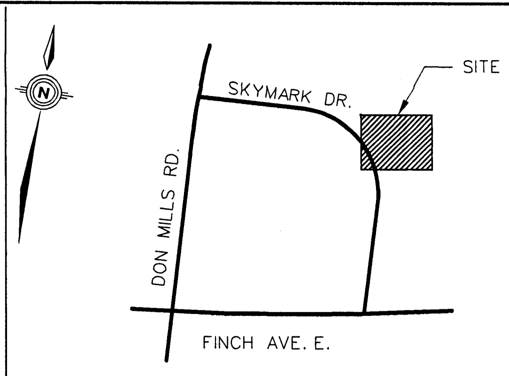
dwg. no. 2009-001026 rev. no.

LAST PLOT 2008-06-11

CAD



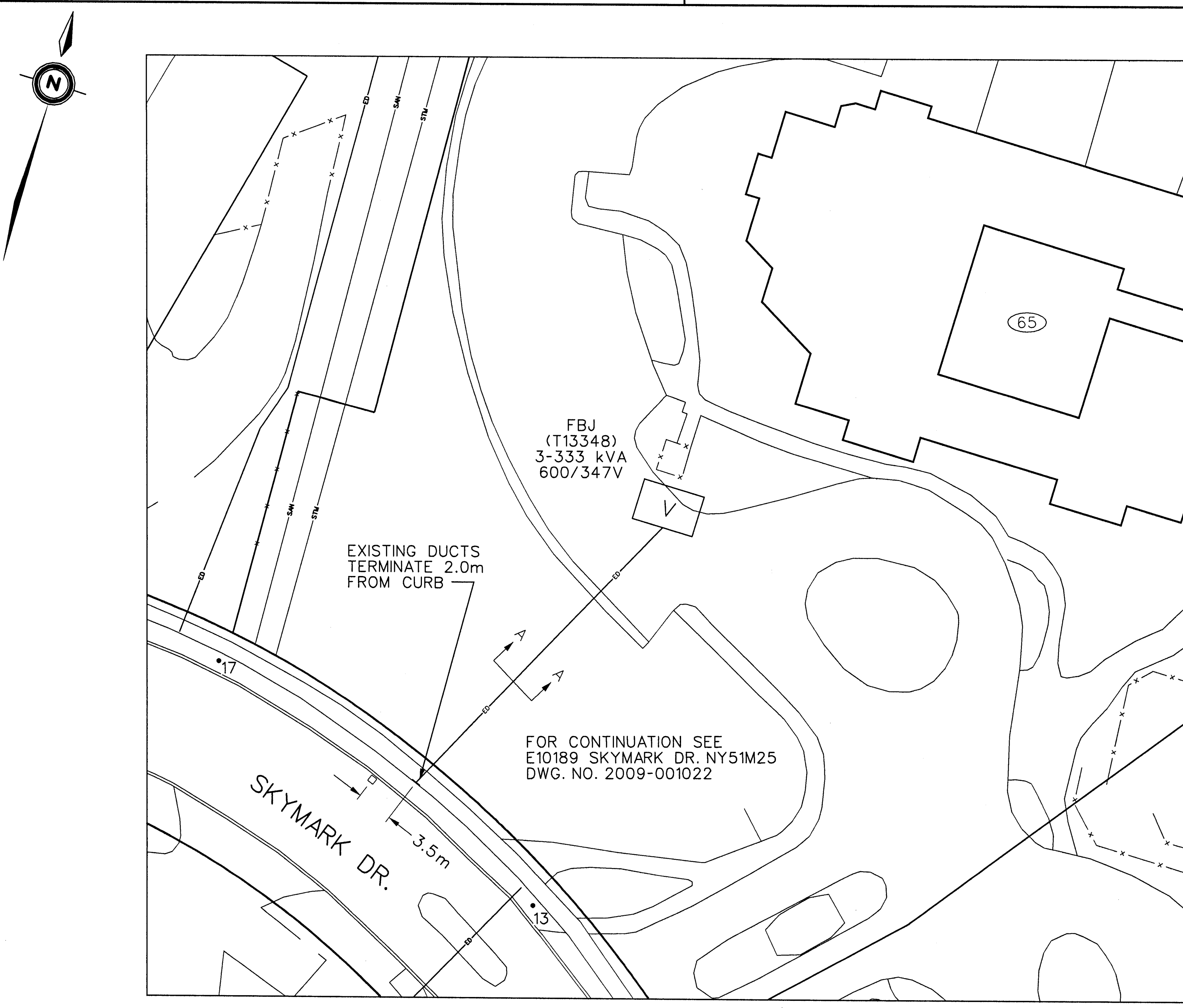
PRIMARY SCHEMATIC



KEY MAP

THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS, APPROVED EQUIPMENT AND MEETS SAFETY REQUIREMENTS OF SECTION 4 OF THE ONTARIO REGULATION 22/04.

MINIMUM HORIZONTAL AND VERTICAL CLEARANCES FROM FOREIGN UTILITIES ARE IN ACCORDANCE WITH THE CITY OF TORONTO'S MUNICIPAL CONSENT REQUIREMENTS AND CONSTRUCTION STANDARDS 31-0100.



AS PER BILL 208, THE FOLLOWING "DESIGNATED SUBSTANCES" MAY BE ENCOUNTERED ON THE PROJECT: VINYL CHLORIDE AND ETHYLENE OXIDE.

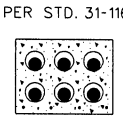
NOTE: OBTAIN NECESSARY CLEARANCES BEFORE DIGGING

48 HRS. NOTICE IS REQUIRED PRIOR TO COMMENCEMENT OF TRENCH WORK CALL TORONTO HYDRO FOR INSPECTION PRIOR TO POURING CONCRETE.

DUCTS MUST BE CONSTRUCTED TO TORONTO HYDRO STANDARDS, ALONG INDICATED ROUTE. SHOULD DEVIATIONS BE DEEMED NECESSARY THEY MUST BE APPROVED PRIOR TO CONSTRUCTION.

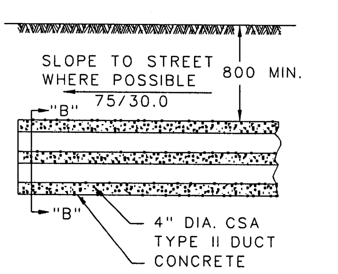
DUCTS THAT DO NOT MEET THIS SPECIFICATION WILL BE REBUILT AT THE CUSTOMERS EXPENSE.

NOTE: DUCTS TO HAVE BELL FITTINGS AT EACH END EXCEPT WHERE DUCTS WILL BE CONTINUED BY T.H. LEAVE END AS PER STD. 31-1160.



PROPOSED CABLE CONFIGURATION

SECTION A-A



SECTION B-B

DETAIL "A"
(N.T.S.)

THIS DRAWING SUPERSEDES US-3056-4

DUCT	LENGTH	40.0m +/- (EXIST.)	
CABLE		INSTALL LOC FBJ	REMOVE LOC T13348
	SIZE	6 - 1/C #1/0 STR. AL. 28kV TRXLPE ECNPEJ	6 - 1/C # 1/0 Al. 28kV XLPE CN
	LENGTH	REFER TO PRIMARY SCHEMATIC ABOVE	276.0m +/- (46.0m x 6)
TRANS. (EXIST.)	SIZE		
	VOLTAGE		
	CUST VOLT		
TERM.	FUSE No.		
	SWITCHES	MINI RUPTER SWITCH 25K 600A (2)	15kV NX MOUNT (9)
	FUSE	40A NX (3)	40K NX (3)
	T.O. STD.	13-7200	
PAD	FUSE		
	T.O. STD.		

WORK ORDER NUMBERS	
CIVIL	290829
SWITCHING	290823
TERMINATIONS	290825
TRANSFORMER	N/A
DESIGN	236379
MAP NO.	220-D
APPROVALS	
METRO ROADS	

rev.	date	description	by	appd.

toronto hydro

distribution services

☒ distribution services (east)
☐ distribution services (west)

drawn by R. MIFSUD	civil design R. MIFSUD	date yy / mm / dd 10/03/15
ip reference • E10189	civil approval D. BARNES	date yy / mm / dd 10/03/15
ellipse project • P0047705	electrical design R. MIFSUD	date yy / mm / dd 10/03/15
construction project • P0057959	electrical approval D. BARNES	date yy / mm / dd 10/03/15
scale 1:500	construction approval G. MURPHY	date yy / mm / dd 10/03/15

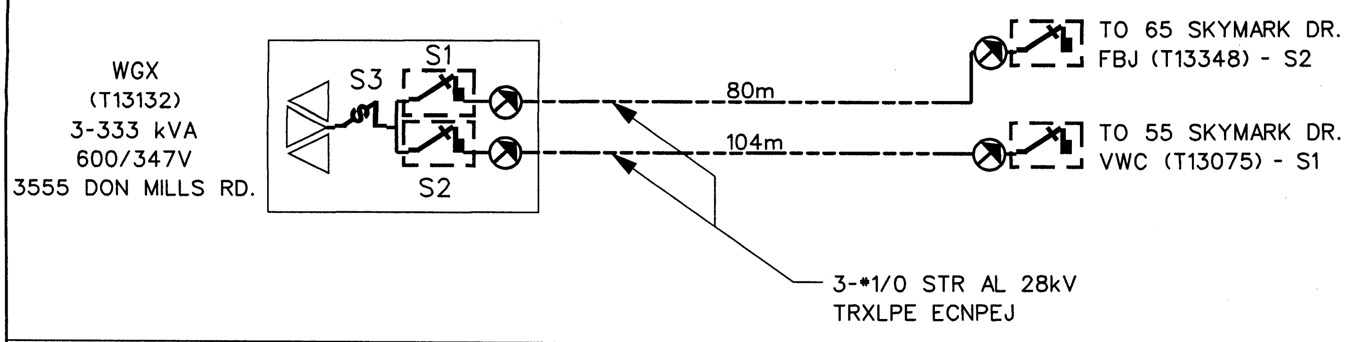
dwg. title:

65 SKYMARK DR.
UNDERGROUND ELECTRICAL

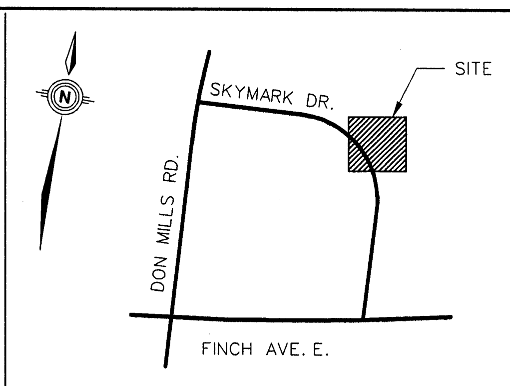
dwg. no. 2009-001027 rev. no.

CAD

LAST PLOT 2008-06-11



PRIMARY SCHEMATIC



KEY MAP

THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS, APPROVED EQUIPMENT AND MEETS SAFETY REQUIREMENTS OF SECTION 4 OF THE ONTARIO REGULATION 22/04.

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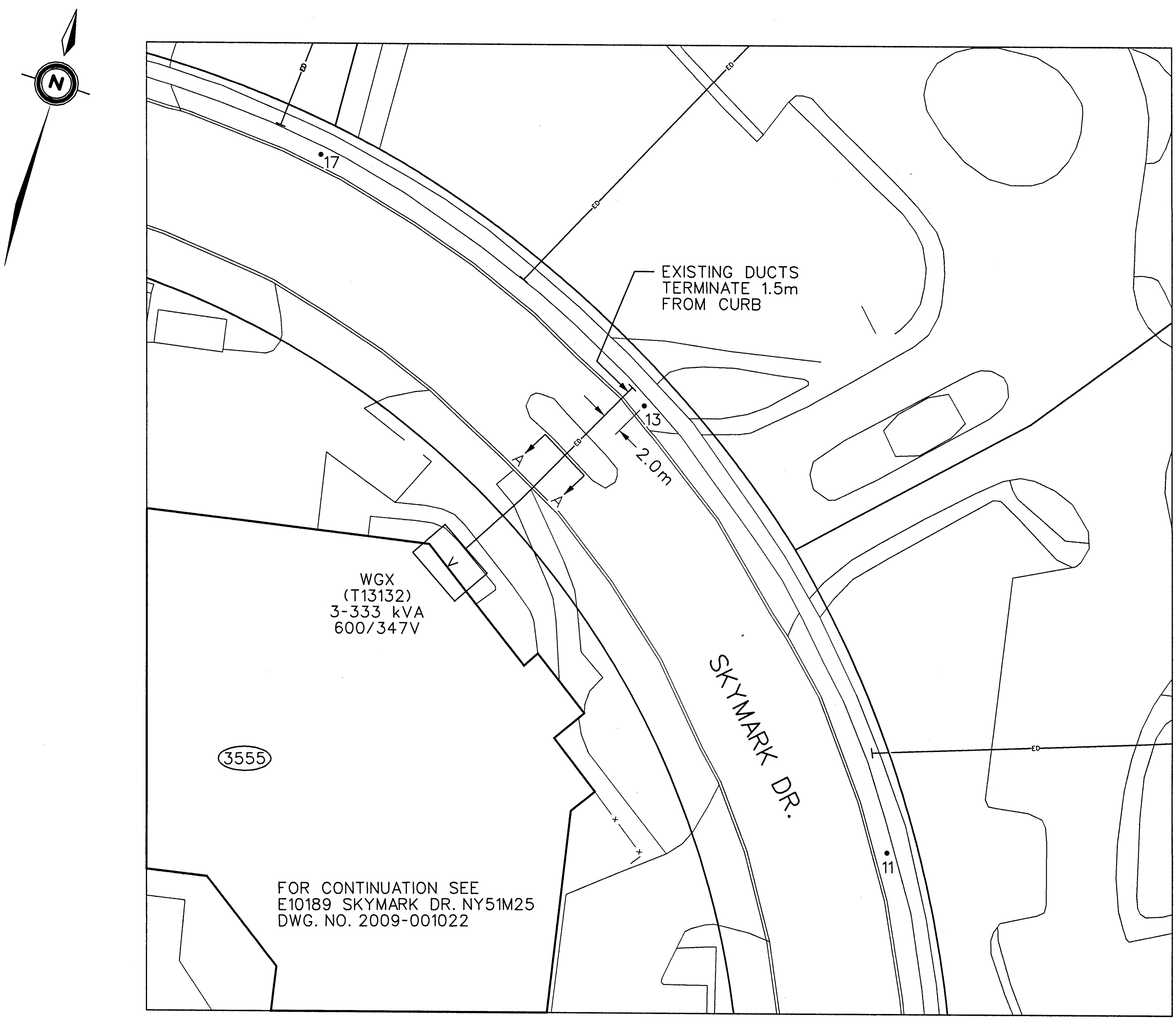

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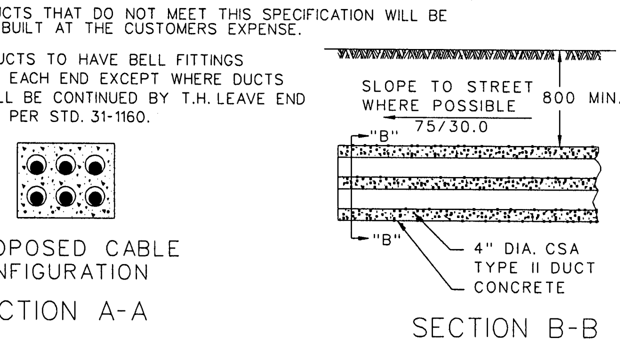

PROPOSED CABLE CONFIGURATION

SECTION A-A

SECTION B-B

DETAIL "A"
(N.T.S.)

THIS DRAWING SUPERSEDES US-3056-2

DUCT	LENGTH	24.0m (EXIST.)	
CABLE		INSTALL LOC WGX	REMOVE LOC T13132
	SIZE	6-1/C #1/0 STR. AI. 28kV TRXLPE ECNPEJ	6-1/C #1/0 AI. 28kV XLPE CN
	LENGTH	REFER TO PRIMARY SCHEMATIC ABOVE	192.0m (32.0m x 6)
TRANS. (EXIST.)	SIZE		
	VOLTAGE		
	CUST VOLT		
TERM.	FUSE No.		
	SWITCHES	MINI RUPTER SWITCH 25K 600A (2)	15kV NX MOUNT (9)
	FUSE	40A NX (3)	40K NX (3)
	T.O. STD.	13-7200	
PAD	FUSE		
	T.O. STD.		

WORK ORDER NUMBERS	
CIVIL	290829
SWITCHING	290823
TERMINATIONS	290825
TRANSFORMER	N/A
DESIGN	236379
MAP NO.	220-D
APPROVALS	
METRO ROADS	

rev.	date	description	by	appd.
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toronto hydro

distribution services

☒ distribution services (east)
☐ distribution services (west)

drawn by R. MIFSUD	civil design R. MIFSUD	date yy / mm / dd 10/03/15
ip reference • E10189	civil approval D. BARNES	date yy / mm / dd 10/03/15
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construction project • P0057959	electrical approval D. BARNES	date yy / mm / dd 10/03/15
scale 1:500	construction approval G. MURPHY	date yy / mm / dd 10/03/15

dwg. title:

3555 DON MILLS RD.
UNDERGROUND ELECTRICAL

dwg. no. 2009-001028

rev. no.

CAD

LAST PLOT 2008-06-11

TORONTO HYDRO

Standard Design Practice Amendment

Date: May 25, 2012
Effective Date: June 18, 2012

Issue Number: SDP-2012-03 Rev.1

This amendment is issued to inform the affected stakeholders that there is a change to **Standard Design Practice** (**SDP) #007 Rev.1 – Underground Rebuilds Industrial/Commercial Areas**. This change is enforceable by the effective date, and will be included in the next SDP update.

Change	Summary of Changes	Training Requirements
Section 1.2.1	**The words "abandon or" have been removed in the Design Guideline Table regarding Primary Distribution Cable.**	☐ **Yes** √ **No, awareness only** **Affected stakeholders:** Design Supervisors, Designers, Project Planning Supervisors, Project Planners and Construction & Maintenance Supervisors.
Section 1.2.2.1	**A sentence was added identifying that cables shall be temporarily supported during underground cable chamber and vault rebuilds. Incorrect support of cables can result in damage to the cables as well as splices, creating potential hazards.**	
Section 1.2.4	**A sentence was added to specify the removal of unused primary cables of 750 volts or more. If removal of such cables is not feasible or practical, example direct buried cable, they shall be cut-off and grounded at each end in accordance with Toronto Hydro Distribution Construction Standard 16-0020. Also a sentence was added to explain how to handle situations where the unused cables cannot be removed and grounded.**	

This SDP Amendment is issued by email to all the affected stakeholders. You can also find this information in the following location on Plugged In: **Plugged In > Asset Management > Standards and Policy Planning > Standard Practices**

The purpose of a SDP Amendment is to communicate changes that are required throughout the year and will be incorporated in the next SDP revision. This will ensure that the affected stakeholders receive the latest information in a timely manner, and that the latest changes can be incorporated in new designs.

A SDP Amendment adds, removes or revises information in an existing Standard Design Practice. It also identifies training requirements, if applicable, regarding the changes described in the amendment. Each SDP Amendment consists of a cover sheet, the entire updated section(s) from the SDP with changes included in blue and any relevant attachments such as drawings or tables. It does not contain information that is applicable to other sections of the SDP.

Originator	**Frank Yu**
Sponsor(s)	**Sheikh Nahyaan**
Reviewers	**Kal Sarkar, Ian Maikawa, James Daniel, (SDP Committee)**
Supervisor / Signature / Date	**James Schofield**
Manager / Signature / Date	**Mary Byrne**

Updated Sections in SDP #007 Rev.1 – Underground Rebuilds Industrial/Commercial Areas

1.2 Design Considerations

1.2.1 General

- Designers shall ensure project designs satisfy the requirements of Section 7 of Ontario Regulation 22/04 "Electrical Distribution Safety" under the Electricity Act, 1998.
- Designers shall employ the "Job Planning Process" and the "Safety by Design" concept in project designs.
- Designers shall endorse the use of only certified construction standards, specifications in the assembly of the project drawings. The use of authorized legacy standards should be limited to the maintaining of lines where certified construction standards would be problematic. Any new construction specifying the use of legacy standards will require a certificate of approval prepared by a Professional Engineer.
- In accordance with the Occupational Health and Safety Act, all known "Designated Substances" that may be encountered in the project shall be identified on the drawing. Examples of "Designated Substances" and their applications may include:
  Asbestos - AILC cables, ducts, pavement asphalt, listing tape, barrier boards and meter backer boards
  Lead - PILC and AILC cables, and older station batteries.
  Mercury - mercury vapor lamps and street light relays
  Vinyl Chloride - 4" PVC ducts and PVC jacketed cables
  Arsenic - arsenical lead sheathed cables
  Ethylene Oxide - polyethylene insulated cables
  Silica - current limiting fuses and lightning arresters (4kV)
  and other substances and applications that may be added from time to time.
- Refer to the City map "Asbestos Locations" to determine if the asphalt in the proposed construction area requires asbestos testing. Streets that are **GREEN** do not require testing. Streets that are **RED** do not require testing as these will be treated as being contaminated with Asbestos. Only streets indicated in **PURPLE** on the City map need to be tested. Driveway aprons do not require testing. Conduct one test per road crossing. Boulevard pole locations do not require testing. If test results are positive or you are working in a **RED** area, adhere to Type II Asbestos Handling Procedures for Removal & Disposal of any Contaminated Asphalt.
- When preparing scope packages & project designs, both Planners and Designers shall consider the requirements of Distribution Grid Operations. These requirements are identified in a "Distribution Grid Operations Project Review Form" that can be obtained by contacting a Control Room Operations Supervisor.
- Unless indicated otherwise by System Reliability Planning, the new primary distribution supply arrangement shall reflect the primary cable being replaced.
- If a rebuild area is fed from a radial supply, it is recommended that a distribution loop arrangement be installed. In addition:
  - Both ends supplying the distribution loop shall be fused and should not terminate within the same switching device or at the same structure.
  - In the horseshoe area, the distribution loop can be supplied from the same feeder or two different feeders off the same station bus. When using the same feeder, ends of the loop are to be connected at two different switch locations.
  - Open point is to be located at a transformer in the middle of the distribution loop.
- Customers on life support should be clearly noted on all applicable plans.

- In general, Designers shall utilize the following table in determining the design requirements for their underground rebuilds projects:

Design Guideline Table	
Electrical	
Primary Cable	1. Install between existing transformers, splice chamber/box, switchgear and pole locations. 2. Remove existing primary cable of 750 volts or more where feasible or practical.
Equipment in Customer Transformer Rooms	3. Evaluate the condition and the operation of the equipment, change out where it is necessary.
Pad-mounted Transformers	4. Install to current Standards as required.
Secondary Services	5. Convert to current Standards, e.g. Open Delta to Grounded Four Wire Services.
Street Lighting	6. Replace existing street light circuits along the trench route. Install new cable between the existing poles' handholes. 7.
Civil	
Transformer Pads	7. Install to current Standards as required.
Primary Cable Duct	8. Install new concrete encased duct(s) between new vaults, pads and poles. Road crossings to be concrete encased.
Street Lighting Duct	9. Install new concrete encased duct(s) and terminate 450mm from the base of the pole. Connect the 100mm duct to a 50mm poly pipe and install inside of the pole's aperture.
Handwell	10. Install new handwell as required.
Splice Chamber, Splice Box	11. Install new splice chamber/box as required.

Refer to **Appendix "D"** for sample illustrations on the above design guidelines.

- In rebuild areas that utilize pad-mounted transformers and the existing pad foundation is not to current standard, a new pad foundation should be installed in close proximity to existing foundation. The existing pad is to be replaced with a tap box for splicing to the existing service cables.
- When maintaining existing structures (e.g. vaults, pads) ensure grounding meets current standards.
- Opportunities for Joint-use trenching initiatives shall be discussed with 3rd Parties in the early stage of design. See Section 1.2.2.4 - Joint-Use Trench for cost sharing formula.

- For rebuilds which cross over or may be in close proximity to gas pipelines, CN/CP tracks, Hydro One corridors etc. consult SDP #004 - Major Civil Projects, Section 1.2.4 - Special Permits & Approvals for instruction.
- For rebuilds located in private property, planners and designers should consult SP #024 "Conversion & Rebuild Work in Private Property (Class 3B Customers)", as the Customer may be required to provide some civil infrastructure or an easement.
- Designers shall include in the General Notes, the customer notification instructions as identified in SP #006 "Customer Isolations".
- Connecting single-phase load to a three-phase loop between two three-phase gang operated switches should be avoided. When this situation exists, the 3 phase customers on either side of the single-phase load would experience multiple outages in order to accommodate repairs and/or isolations with that portion of the loop. Additionally, Distribution Grid Operations would have to execute an increased amount of switching operations. There may be instances where this practice is the only reasonable alternative, if so this situation should be reviewed with Distribution Grid Operations to determine appropriate design.
- No Customer owned Switchgear is to be part of a Distribution Loop. An upstream switching device should separate the customer owned equipment from the loop.
- When installing above grade structures such as switchgear or pad-mounted transformers consider installing guard posts, as per Toronto Hydro Construction Standards, section 31-4080, in situations where there is a risk of vehicle impact.

1.2.2 Civil

1.2.2.1 General

- The standard location for the centre line of the new electrical trench would typically be in the boulevard, 3.5m from street line. There may be exceptions where a 3rd party may have occupied this location. In these instances the location of the new electrical trench should be discussed with the City. Trenching in the roadway should be avoided if possible.
- The City enforces a moratorium on all newly improved streets. Refer to the latest Municipal Consent Requirements for the restrictions. The link to the document is http://www.toronto.ca/engineering/mcr/.
- The minimum cover for all underground Toronto Hydro conduits and cable chambers shall be in accordance with Toronto Hydro Construction Standards, section 31.
- For street classifications refer to Municipal Consent Requirements Appendix S "Street Classifications" and Appendix T "Classification of City Streets" Refer to Appendix T for updated street classifications. The following is the link to the documents: http://www.toronto.ca/engineering/mcr/
- Minimum horizontal and vertical clearances from foreign utilities shall be in accordance with Appendix "O" of the City of Toronto's Municipal Consent Requirements and Toronto Hydro Construction Standards, section 31. Additional horizontal clearances should be considered to prevent proposed foreign utility excavations from damaging electrical cables and equipment.
- **During the rebuilding of underground cable chambers and vaults, cables shall be temporarily supported during construction in accordance with Toronto Hydro Distribution Construction Standard 31-2250.**

1.2.4 Primary Cables

- Primary cables shall be installed in concrete encased ducts.
- The standard primary distribution cable sizes are indicated in the following table:

Primary Distribution Cables			
Distribution System	Cable Type	***Ampacity Rating (max)	MVA Rating (max)
13.8kV	*1/C 1/0 Al 15kV TRXLPE *(or)*	200 Amps	4.8 MVA
	**1/C 1/0 Al 28kV TRXLPE CN	180 Amps	4.3 MVA
27.6kV	1/C 1/0 Al 28kV TRXLPE CN	180 Amps	8.6 MVA
	1/C 350 kcmil Al 28kV TRXLPE CN	370 Amps	17.7 MVA

Note:

***** *1/C 1/0 Al 15kV TRXLPE cable is only to be used on the 13.8kV distribution system in the downtown core area where there is no possibility of future 27.6kV system expansion.*

****** *1/C 1/0 Al 28kV TRXLPE CN cable is to be used on the 13.8kV distribution system in the horseshoe and bordering core areas where there is the possibility of future 27.6kV system expansion.*

*** *For the conditions under which the above Ampacity ratings apply, consult the following Toronto Hydro Construction Standards:*
- 13.8kV XLPE Al cable – Construction Standards section 16-1060 1/5
- 27.6kV XLPE Al cable – Construction Standards section 16-1140 1/5

- A #2 str. Cu. PVC insulated white neutral shall be installed and run concurrently with the 1/0 Al 15kV TRXLPE cable.
- A separate neutral conductor is not required when using 1/0 Al 28kV TRXLPE CN as this cable has a full sized concentric neutral. Also, a separate neutral conductor is not required using 350 kcmil, 28 kV TRXLPE CN.
- The above MVA ratings indicate the maximum permissible load for a 3Ø distribution circuit.
- **All efforts shall be made to remove cables of 750 volts or more that are no longer in use. If it is not feasible or practical to remove these cables, example direct buried cable, they shall be cut-off and grounded at each end so not to be inadvertently energized in accordance with Toronto Hydro Distribution Construction Standard 16-0020.**

- **In situations where the unused cables cannot be removed and grounded, the Supervisor in the Standards & Materials section shall be contacted.**

Toronto Hydro-Electric System Limited
EB-2012-0064
Tab 6F
Schedule 7-52
Appendix J
Filed: 2012 Oct 5
(45 pages)

Standard Design Practice

REAR LOT CONVERSIONS

SDP #008

Prepared by: Standard Design Practice Team

Approved by: Mary Byrne, Manager of Standards & Policy Planning

Issue Date: August 24, 2010

SDP #008 – Rear Lot Conversions

Revision History				
Rev. #	**Date**	**Description**	**Issued by:**	**Approved by:**
00	Aug 24, 2010	- Original Issue	I. Maikawa	M. Byrne

SDP #008 – Rear Lot Conversions

CONTENTS

Page #

Section 1 - Practice:

The purpose of this document is to provide a guideline for the design of projects involving rear lot conversion. The document provides the necessary framework to ensure project designs are aligned with business strategies and completed design packages are delivered in a consistent fashion.

Four key issues addressed in this document:

1. Design Checklist: identifies the activities, which should be considered during the design phase.
2. Design Considerations: supplements the Construction Standards by identifying key design components and strategies for new projects.
3. Drawing Guidelines: identifies key information to be shown on project drawings.
4. Project Deliverables: identifies the documents and drawings required when signing-off on a design file.

1.1 Design Checklist

Many issues need to be considered in the design of projects involving rear lot conversions. To ensure a comprehensive design package is delivered, Designers must be cognizant of all issues during the design. To assist Designers in this area, “Rear Lot Conversion Design Project Checklist” (Appendix “A”) has been developed and should be used as a guide to ensure all aspects of the design stage are successfully completed.

1.2 Design Considerations

1.2.1 Design Options

Existing rear lot areas are to be converted to front lot underground with pad-mounted or submersible transformers, and underground conduit service lines to customers.

The first design initiative is to install pad-mounted transformers. If there is strong opposition from key stakeholders (customers and their representatives) to have pad-mounted transformers installed, then the alternative is to install submersible transformers and vaults. Customer Communications & Public Relations will handle all contacts and communications with customers and their representatives to obtain “buy-in”.

In general, Designers shall use the following table in determining the design requirements for their front lot conversion projects:

Design Guideline Table – *Front Lot Pad-mounted Transformers*	
Electrical	
Transformers	1. Install new single-phase pad-mounted transformers. 2. Remove existing overhead or pad-mounted transformers.
Primary Distribution Cable	3. Install between new transformers, splice boxes, switchgear and pole locations. 4. Remove existing primary cable where practical.
Overhead Distribution	5. Remove existing overhead primary and secondary lines.
Secondary Bus	6. Install from new transformer location to new tap box location(s).
Secondary Service Cables	7. Install from new tap box to existing or new customer meter base, which is to be maintained at existing location. 8. Existing overhead service cables are to be removed, and existing underground service cables are to be abandoned.
Street Lighting	9. Replace existing street light circuits. Install new cable from the tap box to the existing pole's handhole.
Civil	
Transformer Pads	10. Install new transformer pads. 11. Remove existing pad from the rear lot.
Tap Boxes	12. Install new tap boxes where necessary.
Primary Cable Duct/Trench	13. Install new concrete encased duct(s) between new pads, splice boxes, switching cubicles and poles. 14. Trench to remove existing primary cable where practical.
Secondary Bus Duct	15. Install new concrete encased duct(s) from new pad to new tap boxes.
Secondary Service Cable Duct	16. Install new concrete encased duct(s) from new tap boxes in the main trench and terminate at street line. Directional bore to the existing meter base location.
Poles	17. Remove existing hydro owned poles where appropriate.
Street Lighting Duct	18. Install new concrete encased duct(s) from new tap boxes in the main trench and terminate 450mm from base of pole.

Refer to Appendix "D" for sample illustrations on the above design guidelines.

Design Guideline Table – *Front Lot Submersible Transformers*	
Electrical	
Transformers	1. Install new single-phase submersible transformers. 2. Remove existing overhead or pad-mounted transformers.
Primary Distribution Cable	3. Install between new transformers, splice boxes, switchgear and pole locations. 4. Remove existing primary cable where practical.
Overhead Distribution	5. Remove existing overhead primary and secondary lines.
Secondary Bus	6. Install from new transformer location to new tap box location(s).
Secondary Service Cables	7. Install from new tap box to existing or new customer meter base, which is to be maintained at existing location. 8. Existing overhead service cables are to be removed, and existing underground service cables are to be abandoned.
Street Lighting	9. Replace existing street light circuits. Install new cable from the tap box to the existing pole's handhole.
Civil	
Transformer Vaults/Pads	10. Install new submersible transformer vaults with drain. 11. Remove existing pads from the rear lot.
Tap Boxes	12. Install new tap boxes where necessary.
Primary Cable Duct/Trench	13. Install new concrete encased duct(s) between new vaults, splice boxes, switching cubicles and poles. 14. Trench to remove existing primary cable where practical.
Secondary Bus Duct	15. Install new concrete encased duct(s) from new vault to new tap boxes.
Secondary Service Cable Duct	16. Install new concrete encased duct(s) from new tap boxes in the main trench and terminate at street line. Directional bore to the existing meter base location.
Poles	17. Remove existing hydro owned poles where appropriate.
Street Lighting Duct	18. Install new concrete encased duct(s) from new tap boxes in the main trench and terminate 450mm from base of pole.

Refer to Appendix "D" for sample illustrations on the above design guidelines.

1.2.2 General

- Designers shall ensure project designs satisfy the requirements of Section 7 of Ontario Regulation 22/04 "Electrical Distribution Safety" under the Electricity Act, 1998.
- Designers shall employ the "Job Planning Process" and the "Safety by Design" concept in project designs.
- Designers shall endorse the use of only certified construction standards, specifications in the assembly of the project drawings. The use of authorized legacy standards should be limited to the maintaining of lines where certified construction standards would be problematic. Any new construction specifying the use of legacy standards will require a certificate of approval prepared by a Professional Engineer.
- In accordance with the Occupational Health and Safety Act, all known "Designated Substances" that may be encountered in the project shall be identified on the drawing. Examples of "Designated Substances" and their applications may include:
  Asbestos - AILC cables, ducts, pavement asphalt, listing tape, barrier boards and meter backer boards
  Lead - PILC and AILC cables, and older station batteries
  Mercury - mercury vapor lamps and street light relays
  Vinyl Chloride - 4" PVC ducts and PVC jacketed cables
  Arsenic - arsenical lead sheathed cables
  Ethylene Oxide - polyethylene insulated cables
  Silica - current limiting fuses and lightning arresters (4kV),
  and other substances and applications that may be added from time to time.
- Refer to the City map "Asbestos Locations" to determine if the asphalt in the proposed construction area requires asbestos testing. Streets that are **GREEN** do not require testing. Streets that are **RED** do not require testing as these will be treated as being contaminated with Asbestos. Only streets indicated in **PURPLE** on the City map need to be tested. Driveway aprons do not require testing. Conduct one test per road crossing. Boulevard pole locations do not require testing. If test results are positive or you are working in a **RED** area, adhere to Type II Asbestos Handling Procedures for Removal & Disposal of any Contaminated Asphalt.
- When preparing scope packages & project designs, both Planners and Designers shall consider the requirements of Distribution Grid Operations. These requirements are identified in a "Distribution Grid Operations Project Review Form".
- All new underground front lot conversions shall utilize an underground loop design. In addition:
  - Both ends supplying the distribution loop shall be fused and should not terminate within the same switching device or at the same structure.
  - In the horseshoe area, the distribution loop can be supplied from the same feeder or two different feeders off the same station bus. When using the same feeder, ends of the loop are to be connected at two different switch locations.
  - Open point is to be located at a transformer in the middle of the distribution loop.
- Customers on life support should be clearly noted on all applicable plans.
- The preferred distribution voltage systems shall be 27.6kV and 13.8kV.
- Conversion area is to be supplied from either the overhead or underground distribution systems.
- Extend/provide single-phase or three-phase underground distribution loop from existing primary feeder.
- The standard civil design for new underground front lot conversions will utilize a total raceway system consisting of concrete encased and direct buried ducts, pre-cast vaults

or pads and tap boxes. This design will minimize the need for future excavations within the road allowance should distribution or secondary cables require repair or replacement.

- The use of cable chambers in new underground front lot conversions designs to contain primary, secondary or service cables should be avoided. Separate tap boxes shall be used for primary cable splicing and secondary bus/service connections.
- The electrical design will utilize a secondary bus system that eliminates the need for multiple service cable ducts installed from each transformer location.
- Customer service cable connections will be made to the secondary bus system inside the tap boxes which should ideally be located at lot lines.
- For new installations which cross over or may be in close proximity to gas pipelines, CN/CP tracks, Hydro One corridors etc. consult SDP #004 - Major Civil Projects, Section 1.2.4 - Special Permits & Approvals for instruction.
- Opportunities for Joint-use trenching initiatives shall be discussed with 3rd Parties in the early stages of design. Refer to Section 1.2.3.5 – Joint-Use Trench (Cost Sharing).
- For projects involving water heater relays or service cable rebuilds to flat-rate water heater customers, Designers shall consult the Conversions & Rebuilds section in SP #001 “Ownership Transfer of Water Heater Assets”.
- Load control equipment (i.e. relays, control wires etc.) for water heaters is no longer required on secondary bus installations (refer to Standard Practice SP #001 “Ownership Transfer of Water Heater Assets”).
- Verify the existing ownership of the poles in the rear lots. If poles are determined to be Bell owned or having Bell attachments, consult Standard Practice SP #009 “Joint Use Bell Poles/Attachments” to determine each parties responsibilities including cost sharing. Set up a joint field visit with Bell and other foreign attachments (i.e. Rogers, etc) to inspect the site and review the conversion requirements. Contact information can be obtained from the External Demand & Customer Relations section – Infrastructure Occupancy Representative.

  If poles are owned by Toronto Hydro then consult with Bell and other foreign attachments to relocate their facilities to a front lot joint-use trench. If Bell decides they want to remain on the existing pole then Toronto Hydro will remove its plant. Bell is to take ownership of the easement and the pole. 3rd parties that also wish to remain must get consent from Bell.

  If poles are owned by Bell then consult with Bell and other foreign attachments to relocate their plant with ours to a front lot joint-use trench. Toronto Hydro will remove its plant from the pole. Otherwise, Bell can retain their pole.

- For projects involving three-phase supply arrangements where vehicles can gain access, the supply arrangements are to remain (i.e. front lot conversion for the three-phase supply is not required).

1.2.3 Civil

1.2.3.1 General

- The standard location for the centre line of the new electrical trench would typically be 2.8m from street line. Should that location be occupied 3.5m from street line would be the alternative. There may be exceptions where a 3rd party may have occupied these locations. In these instances the location of the new electrical trench should be discussed with the City.

- The City enforces a moratorium on all newly improved streets. Refer to the latest Municipal Consent Requirements for the restrictions. The link to the document is http://www.toronto.ca/engineering/mcr/.
- The minimum cover over the electrical ducts in an open trench installation shall be in accordance with Toronto Hydro Construction Standards, section 31.
- For street classifications refer to Municipal Consent Requirements Appendix S "Street Classifications" and Appendix T "Classification of City Streets". Refer to Appendix T for updated street classifications. The following is the link to the documents: http://www.toronto.ca/engineering/mcr/
- Efforts shall be made to install the edge of transformer pads, vaults and tap boxes a minimum horizontal clearance of 1.0m from the paved portion of driveways.
- Minimum horizontal and vertical clearances from foreign utilities shall be in accordance with Appendix O "Vertical and Horizontal Clearance Guidelines" of the City of Toronto's Municipal Consent Requirements and Toronto Hydro Construction Standards, section 31. Additional horizontal clearances should be considered to prevent proposed foreign utility excavations from damaging electrical cables and equipment.

1.2.3.2 Ducts

- For open trench installations, all primary and secondary cable ducts located in the public road allowance or on private property of Class 3B (town houses) customers shall be concrete encased 100mm dia. PVC constructed as per Toronto Hydro Construction Standards, section 31 and Technical Specification for Civil Construction Work Spec # CV-CON-01. Service cable ducts located in private property shall be direct buried 100mm dia. PVC. Direct buried service ducts shall be RED PVC (in accordance with CSA Standard 22.3 No. 7.94 "Underground Systems") and shall run from the customer meter base to the lot line.
- Any direct buried hydro ducts being installed must be red in colour.
- Excavations shall be backfilled in accordance with Section 5.1.17 of Technical Specification for Civil Construction Work Spec # CV-CON-01 and the City's Municipal Consent Guidelines.
- For new concrete encased ducts being installed in poor soil conditions or where there is a high water table, re-bar shall be used to reinforce the structure in accordance with Toronto Hydro Construction Standards, section 31-1120 Note #4.
- Service cable ducts from the customer meter base shall be installed in parallel with the lot line and perpendicular to the street line or main trench.
- When preparing Unit Price Contract Management System (UPCMS) costs sheets, designers shall consider the additional unit requirements for duct descents from the normal depth leading to submersible vaults and transformer pads, tunnelling under trees, etc.
- Each primary cable, secondary bus and service cable are to be installed in a separate duct. Primary neutral cables shall be installed in a separate duct.
- For road crossings, it is recommended that a minimum of 6 ducts be installed. If additional capacity is required, ducts should be added in multiples of 3 (i.e. 3W3H, 3W4H). Spare duct(s) are to be terminated 1.0m from back of curb in accordance with Toronto Hydro Construction Standards, section 31-1160. Terminating of these ducts shall be noted in the General Notes.
- Road crossing ducts shall be installed in a common trench with new vault drains where practicable.

- Efforts should be made to minimize the number of road crossings.
- The project drawings shall identify the number of Toronto Hydro required ducts in the main trench and any spare duct requirements.
- Primary cable ducts are to run concurrently from vault to vault (or pad to pad) and run below the secondary tap boxes. Cable pulling calculations shall be performed to ensure maximum pulling tensions on the primary, secondary bus and service cables are not exceeded.
- The duct route shall be designed with a minimum of bends both horizontal and vertical to keep cable-pulling tensions within allowable limits. Cable pulling software shall be used when necessary to ensure pulling tensions on the cables are within acceptable limits for both pulling directions.
- Where field conditions permit, attempts shall be made to slope the ducts toward underground structures (such as vaults, pads, etc.) in efforts to minimize the accumulation of water in the ducts.
- Galvanized iron (GI) or rigid PVC bends may be required when terminating ducts at riser poles in accordance with Toronto Hydro Construction Standards, section 31-1220. To protect against accidental damage, bends should be placed on the side of the pole that is opposite to oncoming traffic, where practicable.
- 3rd Party ducts would typically be direct buried and installed in accordance with Toronto Hydro Construction Standards, section 31-1390 and 31-1395.
- When a new concrete encased duct structure is in conflict with existing direct buried cable, the new structure shall be installed below the cables. If this is not practical, split ducts shall be sleeved over the existing cables to allow future accessibility. This instruction to the contractor shall be included in the project General Notes.
- Ducts for street lighting cable shall be terminated 450mm from base of pole.

1.2.3.3 Vaults / Foundations

- In determining possible new locations, transformer vaults and padmount foundations should be located as close as possible to lot lines. In selecting locations, designers should also attempt to anticipate customer acceptance. In townhouse areas, end of unit blocks tend to be more acceptable than the typical small front yards. Consideration should also be given to avoiding children's play areas, minimizing exposure to traffic and maintaining minimum clearances as per the Ontario Electrical Safety Code.
- Pad-mounted transformer locations must meet minimum clearance requirements from any combustible surface or material on a building, window, and door inlet or outlet vents in accordance with Section 26-242 of the Ontario Electrical Safety Code. For the minimum clearance requirements refer to Toronto Hydro Construction Standards, section 03-5100.
- Submersible transformer vaults equipped with a "Petro-plug" interceptor shall be drained to the storm sewer using a 100mm dia. Diameter Nominal (DN), PVC pipe with a minimum slope to sewer of 2.5%. The entire length of pipe to be installed on a bedding of 75mm select granular 'A' material. Refer to section 5.6.4 of the Civil Specification No. CV-CON-01 for additional requirements.
- The "Petro-plug" interceptor shall be installed in the drain opening inside the submersible transformer vault. A minimum of 310mm of straight section of sewer drainpipe from the transformer vault wall is required to facilitate the Petro-plug installation (Refer to Toronto Hydro Construction Standards, section 31-5100).
- Padmount foundations do not require the installation of drains to the sewer.

- Where no sewers are immediately available, consideration shall be given to installing pad-mounted transformers.
- On streets where there are no curbs and storm drainage is achieved by ditches, transformer vaults and pad foundations are to be installed as per Toronto Hydro Construction Standards, section 31-0200.

1.2.3.4 Tap (Splice) Boxes

- Tap boxes shall be installed in accordance with Design Guideline Table in the Design Considerations Section.
- Tap boxes shall be strategically placed to allow for the connection of new secondary bus and service cables. When selecting locations, designers should attempt to anticipate customer acceptance.
- Designers should be aware of the limitations when preparing designs. The available tap box sizes and their applications are indicated in the following table:

Tap (Splice) Boxes									
Item #	Type	Construction Standard	Item ID#	Size			Available Knockouts	Cover Type	Installation Type
				Length	Width	Height			
1	A	31-3120	3530037	900mm	600mm	900mm	20	Plastic	Grass
2	A	31-3120	3530038	900mm	600mm	900mm	20	Polymer Concrete	Asphalt/ Concrete
3	B	31-3125	9656478	1200mm	900mm	900mm	28	Plastic	Grass
4	B	31-3125	9662429	1200mm	900mm	900mm	28	Polymer Concrete	Asphalt/ Concrete
5	C	31-3135	9662865	1500mm	900mm	1050mm	44	Plastic	Grass

- Type A tap box can be used to make secondary bus and service cable connections for reasons of cost and physical size. It should be noted that their application is limited to 3 – 6 way maximum Homac terminal bus for connecting line 1, line 2, and neutral cables.
- Type B tap box can be used for **either** one primary cable splice where the cable length exceeds the maximum pulling tension, **or** utilized for secondary bus and service cable connections. Tap box Type B is limited to splice one single-phase primary cable **or** to the use of 3 – 8 way maximum Homac terminal bus for connecting line 1, line 2, and neutral cables.
- Type C tap box can be used only for primary cable splices where cable lengths exceed the maximum pulling tensions. Tap box Type C can accommodate a maximum of three 1/0, 28kV primary cables**.**
- The preferred tap box locations are at lot lines in the grass boulevard. Alternatively, Type A and B can be installed in asphalt or concrete boulevards. Installations in sidewalks should be avoided where possible.
- Avoid installing tap boxes in low-lying areas where they may be susceptible to flooding.

- Tap boxes used for either secondary connections or primary splices shall be numbered in accordance with the “Equipment Numbering” in the Drawing Guidelines Section.

1.2.3.5 Joint Use Trench (Cost Sharing)

- Toronto Hydro shall encourage and participate in Joint-use trench initiatives with foreign utilities.
- Minimum depths for 3rd Party installations shall be in accordance with the City of Toronto’s Municipal Consent Requirements under section “Depth of Cover”.
- Cost sharing shall apply to the “trench only” portion of the project where 3rd Parties share a common trench with hydro. 3rd Parties shall be 100% responsible for their exclusive trench, extra trench depth and their incidental items (i.e. ducts and/or cables in common or exclusive trench, sand padding, concrete encasement, pedestals, etc.).
- Costing for the Joint-use “Trench Only” shall be in accordance with the following table:

“Trench Only” Costs

Cost for Year 20__	2 Party Trench			3 Party Trench			4 Party Trench		
	Single Duct (tr/m)	Additional Ducts		Single Duct (tr/m)	Additional Ducts		Single Duct (tr/m)	Additional Ducts	
		1	2		1	2		1	2
2010	$43.60	15%	30%	$34.90	15%	30%	$26.20	15%	30%
2011	$45.15	15%	30%	$36.10	15%	30%	$27.10	15%	30%
2012	$46.75	15%	30%	$37.40	15%	30%	$28.05	15%	30%
2013	$48.40	15%	30%	$38.70	15%	30%	$29.05	15%	30%

Notes:

1. **Single Duct**: would include up to 1 – 4” dia. (or) up to 3 – 1” dia. poly pipes. Cost sharing is based on a percentage of the average UPCMS unit cost for “trench only” plus any tunnelling past trees and an estimate of the City final restoration costs. The cost of the duct(s) and its placement in the trench is a 3rd Party exclusive item.
2. **Additional Ducts**: 3rd Parties that elect to install ducts in excess of “Single Duct” as defined above, shall incur additional Joint-use trench costs in accordance with the above table (example: if in 2010 Company X requires the installation of 2-4” ducts in a Joint-use trench their per metre trench cost would be $43.60 for the 1st duct plus an additional 15% for the second duct for a total per metre trench cost of $50.14).
3. **Road Crossings**: use the same cost sharing methodology as 1) & 2) above. 3rd Party road crossing ducts must be concrete encased. The cost of the duct(s) and its placement in the road crossing trench is a 3rd Party exclusive item.
4. **Services**: use the same cost sharing principles as 1) above.
5. The above costs shall be revised upon termination of the 2010 UPCMS Contract.

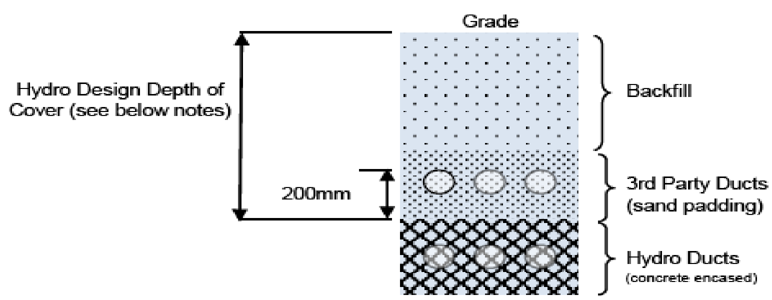
- Costing for extra trench depth shall be in accordance with the following table:

Extra Trench Depth Costs (per 250mm increment)

Year →	2010	2011	2012	2013
Cost →	$47.15 tr/m	$48.80 tr/m	$50.50 tr/m	$52.30 tr/m

Notes:

1. Additional trench depth will be necessary to accommodate Joint-Use trench initiatives involving 3rd Parties. They would be responsible for the additional excavation costs per the above table. In cases where there are more than one 3rd Party occupying the trench the additional excavation cost shall be shared proportionally (i.e. if the number of 3rd Party ducts in the trench total 5, and 1 Party has 2 ducts, that Party would be responsible for 2/5 of the extra depth costs or $18.86 per trench metre in 2010). Additional excavation costs shall be included with the "trench only" cost estimate to the 3rd Parties.
2. The above costs shall be revised upon termination of the 2010 UPCMS Contract.



Typical Joint-Use Trench

Notes:

1. If 3rd party ducts can be installed on top of hydro without affecting the depth of cover for Toronto Hydro, then no extra trench charge is applied.

2. If 3rd party ducts are to be installed on the top of hydro which forces Toronto Hydro to be at an additional depth of cover, then extra trench depth charges shall apply.

- Trenching costs involving directional boring shall be shared equally among the Parties.
- THESL will assume the role of Prime Contractor on these Joint-Use "trench only" portion. To encourage 3rd Party participation and competitive pricing, 3rd Parties shall be requested to negotiate their exclusive item costs directly with the civil contractor. Staking for exclusive items should be included when negotiating item costs with the civil contractor.
- 3rd Parties shall be responsible for coordinating the installation and payment of their exclusive items with the civil contractor.
- 3rd Parties will not be permitted to employ another contractor to complete any of their installation associated with the project including their exclusive items while the Prime Contractor is still on site.
- 3rd Parties shall be assessed an administrative fee of 15% to cover THESL costs of project coordination, providing of electronic drawings, inspection, staking, preparing estimates and cost sheets and other miscellaneous expenses associated with the Joint-Use "trench only" portion. The administrative fee shall only be applied to the

"trench only" costs and not to the exclusive items 3rd Parties negotiate with the civil contractor.

- The Designer shall provide the cost estimated for the Joint-Use trench to the 3rd Parties.
- 3rd Parties shall be responsible for obtaining the necessary City permits for their exclusive civil installations. To expedite the permit process, Designers are encouraged to assemble all 3rd Party plans and make one submission to the City. Each 3rd Party shall be responsible for preparing and providing the Designer with all necessary permit applications for their exclusive civil work.
- 3rd Parties shall be responsible for providing an on-site inspector who shall report directly to the civil contractor as required, to interpret the work plans and specifications.
- The contractor will be responsible for providing each 3rd Party with signed-off "As-Constructed" drawings for Joint-Use trench portion. 3rd Parties should include in their negotiations with the civil contractor, the receipt of the "As-Constructed" drawings for their exclusive items.
- An example of a Joint-use trench cost estimate for a project involving multiple parties can be found in Appendix F.
- 3rd Parties should attend the pre-construction meeting.

1.2.4 Transformers

Underground Conversion

- Pad-mounted transformers will typically be used for underground conversion areas, while submersible transformer shall be considered as an alternative.
- The transformer secondary voltages are 120/240V.
- The available 1ø transformer sizes are indicated in the following tables:

1ø Submersible Transformers (120/240V Secondary)			
Distribution System	50kVA	100kVA	167kVA
13.8kV	X	X	X
27.6kV	X	X	X

1ø Pad-mounted Transformers (120/240V Secondary)		
Distribution System	100kVA	167kVA
13.8kV	X	X
27.6kV	X	X

- The number of new transformers installed on a 1ø, 16 kV distribution loop (fused at 140K) shall be limited to 8 units on each side of the open point for a total of 16 units on the entire 1ø distribution loop. For 1ø, 16kV sub-distribution loops (fused at 100K), the number of transformers shall be limited to 5 units on each side of the open point for a total number of 10 units on the entire sub-distribution loop. On the 13.8kV system, the number of transformers installed on a loop shall be one half those indicated above for the 27.6kV system.

- Where loading permits, efforts shall be made to minimize the overall number of transformers in the new design. Refer to Sections 1.2.9 – Transformer Loading, 1.2.10 - Secondary Bus Loading and 1.2.11 - Secondary Voltage Drop to maximize the number of services per new transformer. It is recommended that the maximum number of services (< 200amps) connected to a new transformer not exceed 24.
- To assist in the sectionalizing of any future underground primary cable faults, 300 Amp current reset faulted circuit indicators are to be installed on both the incoming and outgoing primary cables at each transformer location. Refer to Toronto Hydro Construction Standards, section 20**.**
- Un-metered connections including street lighting relays shall not to be installed at new pad-mounted transformers or in submersible transformer vaults.
- Water heater control relays located at existing transformers shall be recovered and not re-installed at the new transformer locations. Existing flat rate customers should be connected in accordance with SP #001 “Ownership Transfer of Water Heater Assets”.
- It is necessary that “Equipment Changeout Record” forms be included in the Design Folder for all recovered pad-mounted and polemounted transformers as well as for new equipment installations. The forms are to be completed by field staff indicating in the “Location Status” field that the transformers have been “Decommissioned” for recovered units and “In Service” for new equipment installations. This will ensure that recovered transformers and vault location numbers are no longer active in Ellipse. To obtain copies of the “Equipment Changeout Record” forms for inclusion in the white design folder click on the following link:
  http://assetmgmt.torontohydro.com/
- For transformer clearance requirements refer to Toronto Hydro Construction Standards, sections 03 and 31.
- Placement of new pad-mounted transformers should be clear of any major intersections. This would be for reasons of safety and to minimize any financial impacts in the event of future intersection improvements.

1.2.5 Primary Cables

- Primary cables shall be installed in concrete encased ducts.
- The standard primary distribution cable sizes are indicated in the following table:

Primary Distribution Cables			
Distribution System	Cable Type	***Ampacity Rating (max)	MVA Rating (max)
13.8kV	*1/C 1/0 Al 15kV TRXLPE **1/C 1/0 Al 28kV TRXLPE CN	200 Amps	4.8 MVA
27.6kV	1/C 1/0 Al 28kV TRXLPE CN	180 Amps	8.3 MVA

Note:

*** 1/C 1/0 Al 15kV TRXLPE cable is only to be used on the 13.8kV distribution system in the downtown core area where there is no possibility of future 27.6kV system expansion.***

*** 1/C 1/0 Al 28kV TRXLPE CN cable is to be used on the 13.8kV distribution system in the horseshoe and bordering core areas where there is the possibility of future 27.6kV system expansion.*

***** For the conditions under which the above Ampacity ratings apply, consult the following Construction Standards:*

- *13.8kV XLPE Al cable – Construction Standards section 16-1060 1/5*
- *27.6kV XLPE Al cable – Construction standards section 16-1140 1/5*

- A #2 str. Cu. PVC insulated white neutral shall be installed and run concurrently with the 1/0 Al 15kV TRXLPE cable. A separate neutral conductor is not required when using 1/0 Al 28kV TRXLPE CN as this cable has a full sized concentric neutral.
- The above MVA ratings indicate the maximum permissible load for a 3Ø distribution circuit.

1.2.6 Secondary Bus Cables

- The number of secondary bus cables from the new transformer would typically be determined by the total loads and number of services to be connected. Refer to Section 1.2.10 - Secondary Bus Loading.
- It is recommended that aluminum be the standard secondary bus type however in cases where voltage drop or loading may be a problem, copper bus should be considered in efforts to maximize the number of services per transformer.
- The following table represents the standard secondary bus size:

Secondary Bus Cables		
Application	**Max. Bus Loading**	**Cable Type**
120/240V	343 Amps	3-1/C 500kcmil Al. 600V XLPE PVCJ Triplex (Black, Black, White)
	430 Amps	3-1/C 500kcmil Cu. 600V XLPE PVCJ Triplex (Black, Black, White)

1.2.7 Service Cables

- Service cables including those supplying unmetered connections (such as street lights, phone booths, CATV power supplies, traffic lights, cross-walks, etc.) shall be replaced. Terminating of new service cables at the transformer secondary bushings should be avoided.
- Unmetered services require a demarcation point.
- The new service cables shall be connected to the new secondary bus cable(s) in tap boxes using Homac connectors. If there is a requirement to replace the service cables, standard sizes would be as indicated in the following table:

Secondary Service Cables		
Service Size	Application	Cable Type
100, 200 Amp, Dual Meter Bases	120/240V	3 – 1/C #4/0 Al 600V XLPE PVCJ Triplex (Black, Black, White)
400 Amp	120/240V	3 -1/C 500kcmil Al 600V XLPE PVCJ Triplex (Black, Black, White)
Unmetered Connections (i.e. Street Light Supply, etc.)	120V	2 - 1/C #2 Al 600V XLPE PVCJ Duplex (Black, White) with 1 – 1/C #6 Sol. Cu. Ground (SKU # 007150276)

- Service cable selection is in accordance with the Ontario Electrical Safety Code, Section 8-104, 5(a), which requires that conductor ampacity be at least 80% of the continuous rating of the main switch.

1.2.8 Service Connections

Toronto Hydro is to replace the meterbase at the existing location to accommodate the new underground connection. Based on site conditions, if it is not feasible to replace the meterbase at the existing location, an alternate location is to be selected and communicated to the customer.

Standard CSA approved 200 Amp meterbases with lug type connections are to be utilized. In cases where the existing meterbase is larger than 200 Amp (i.e. 400 amp), it will be replaced with a CSA approved 400 Amp meterbase with lug type connections, a test switch and bypass (i.e. Micro Electric JS4AB or equivalent). Refer to Conditions of Service reference document “Metering Requirements 750 Volts or Less”, and Toronto Hydro Construction Standards, section 31-1250.

In cases where the existing standpipe goes through the roof, it is to be cut approximately 2 feet below the soffit and sealed/plugged at both ends. Where the standpipe does not go through the roof, it is to be completely removed. All screw holes in the building wall are to be sealed.

The Designer is to refer to the current approved contractor list which can be viewed on the Y drive “Y:\THESL\Asset Mgmt\AM Common\Procurement\Approved Contractor List”, tender out the subdivision to the contactors and award the contract. The successful contractor will be responsible for obtaining an ESA connection authorization for each service. The electrical contractor and a representative from the meter department should be invited to the pre-construction meeting to harmonize the conversion work.

A single 4” conduit is to be installed on private property utilizing directional boring. For special cases where hard surfaces exist and directional boring is not feasible, alternate arrangements shall be agreed upon by the Designer and customer. (i.e. Relocate the meterbase or open-cut trench and restoration).

Rear lots with swimming pools shall meet the clearance requirements as per Toronto Hydro Construction Standards, section 03-2350.

1.2.9 Transformer Loading

- The typical number of secondary bus connections made at the transformer secondary bushings shall be four. These connections are to be made “back to back” and directly to the transformer secondary bushing. If more than four bus connections are required, the Homac eight position secondary terminal cluster (transformer secondary terminal extension) shall be requisitioned. (Refer to Toronto Hydro Construction Standards, section16-6000).
- Efforts shall be made to maximize the number of services per transformer. Spacing of transformers shall be determined based on connected customers’ estimated maximum summer and winter loads. These can be obtained from Transformer Load Management (TLM) available in G/NetViewer.
- Upon determination of the estimated loading, use the following loading guide for selecting the transformer size:

Transformer Loading Guide	
Transformer Size & Type	Existing Load
50kVA Submersible or 100kVA Pad-mounted	< 37.5kVA
100kVA Submersible or Pad-mounted	>/= 37.5kVA </= 75kVA
167kVA Submersible or Pad-mounted	> 75kVA up to 125kVA
Split bus and add additional transformer	> 125kVA

Note: Loading guide allows for future load growth.

1.2.10 Secondary Bus Loading

- The maximum number of 200A services per 500kcmil Al and 500kcmil Cu secondary bus shall be limited to three and four respectively.
- The maximum number of 100A services per 500kcmil Al or Cu secondary bus shall be limited to seven (limited by the # of connections on the Homac connector).
- Efforts shall be made by the designer to identify the service sizes within the project area. Because this information is not available through the customer billing account information, a method that can be used for determining the existing service size of a house is to check the conduit on the load side of the meter base. Conduits with an inner diameter of 1 ¼” to 1 ½” have 60 A or 100A services and conduits 2” to 2 ½” have 200A services. A second method would be to use persons through the accommodated work program to conduct random samplings of the homes in the area by knocking on doors. To initiate this work, designers should contact Environmental Health & Safety to check on the availability of staff to perform this task.
- Homac eight, six or four position secondary terminal clusters shall be used to connect the new secondary bus to the new services cables in the tap box. Of the eight, six or four available positions, one shall be reserved for the secondary bus cable and the remaining would be available for the new service cables and any un-metered service connection requirements.

- Where practical and voltage drop permits, consideration shall be given to installing a dedicated 500kcmil Al secondary bus cable to service a single customer at the end of a run in efforts to minimize the number of tap boxes required on the project. The bus cable shall be connected to the customer's service cable in the last tap box of the run.

1.2.11 Secondary Voltage Drop

- After locating the new transformer location, it will be necessary to ensure the electrical design must also satisfy voltage drop guidelines.
- Toronto Hydro maintains service voltage at the Customer's service entrance within the guidelines of C.S.A. Standard CAN3-C235-83 (latest edition), which allows variations from nominal voltage in accordance with the following table:

Nominal Voltage	Voltage Variation Limits			
	Extreme Conditions			
		Normal Conditions		
	A	B	C	D
Single Phase				
120/240	106/212	110/220	125/250	127/254
Two Phase (3 Wire - Open WYE)				
120/208	110/190	112/194	125/216	127/220
Three Phase (4 Wire)				
120/208	110/190	112/194	125/216	127/220
347/600	306/530	318/550	360/625	367/635

- The maximum allowable voltage drop on the secondary bus and service cables shall not exceed column "B" in the above table.
- Voltage drop tables for 500kcmil Al secondary bus and 4/0 Al service cables can be found in Appendix B in the SDP#002 - New U/G Residential Subdivisions. To determine the voltage drop for the various cable sizes the formula used for calculating is as follows:

$$\text{Voltage Drop}_{\text{(volts)}} = K_{\text{(factor)}} \times F_{\text{(factor)}} \times \text{Current}_{\text{(amps)}} \times \frac{\text{Length of Run}_{\text{(metres)}}}{1000}$$

$K_{\text{(factor)}}$ = Line to neutral voltage drop per ampere per circuit kilometre
$F_{\text{(factor)}}$ = Correction Factor

Voltage Drop Tables		
Cable Size & Type	$K_{\text{(factor)}} \times F_{\text{(factor)}}$	
	120/240V	120/208V (open Wye)
500 kcmil Cu	0.236	0.204
500 kcmil Al	0.330	0.285
4/0 Al	0.678	0.586
3/0 Al	0.836	0.723
1/0 Al	1.284	1.110
#2 Al	1.984	1.716

Current (amps) for 500kcmil Bus - use load that coincides with the number of services connected to the bus from table below.
Current (amps) for service cable – use the load for a single service from the following table:

Coincident Service Loading for Bus & Service Cable				
Number of Services	Non-Electric Heating		All-Electric Heating	
	100 A Service	200A Service	100A Service	200A Service
1	60A	100A	60A	120A
2	75A	125A	75A	150A
3	112A	187A	112A	225A
4	150A	250A	150A	300A
5	187A		187A	
6	225A		225A	
7	262A		262A	

1.2.12 Fusing

- The standard ratings for switch cutouts and power fuses shall be as per the following table:

Fusing for Laterals				
Operating Voltage	Laterals		Sub-Laterals	
	Disconnect Voltage Rating	Fuse Rating	Disconnect Voltage Rating	Fuse Rating
27.6kV	25kV	140K	25kV	100K
13.8kV	15kV	140K	15kV	100K

- The ratings from the table would apply for both three phase & single phase laterals.
- Sub-sub laterals are to be fused at 40K.
- Replace all existing porcelain SMD20 switches with polymeric SMD20 switches at riser poles, except for 35 kV class.

1.2.13 Switchgear

- Pad-mounted or submersible switchgear may be required depending on the supply arrangements to the new front lot conversion area. This switchgear is primarily used for tapping into a main feeder and supplying distribution load.
- Pad-mounted switchgear installations are preferred over the submersible switchgear where practicable. The benefits of pad-mounted switchgear include: costs, ease of maintenance & operability and accessibility. Where space is limited in the public road allowance it may be necessary to install submersible switchgear.
- Pad-mounted switchgear shall be installed in accordance with Toronto Hydro Construction Standards, section 13. ”Maintenance only items” should not be used for new construction.

- The preferred orientation of the pad-mounted switchgear units is to have the doors open parallel with the roadway. As well, access to any of the switch compartments should be clear of obstructions such as trees, poles etc.
- Placement of new pad-mounted switchgear should be clear of any major intersections. This would be for reasons of safety and to minimize any financial impacts in the event of future intersection improvements. Vehicle sightlines should be considered when placing pad-mounted switchgear.
- Non-standard pad-mounted switchgear (i.e. PMH-10, PMH-5, and PMH-210) used in non-standard configuration within conversion area should be replaced by pad-mounted switchgear(s) listed in Toronto Hydro Construction Standards, section 13-7600.
- For available 13.8kV and 27.6kV submersible switchgear refer to Toronto Hydro Construction Standards, section 13. To assist in the sectionalizing of any future underground primary cable faults, 800 Amp current reset Faulted Circuit indicators are to be installed at 600 Amp U/G terminations on open loop feeders and main loop cables (URD). Refer to Toronto Hydro Construction Standards, section 20.
- In order to ensure reliability, the feeder circuit (600A) supplying the switchgear should not enter and exit the same cable chamber. Care should be taken to re-direct the outgoing feeder duct around the cable chamber. Similarly, the distribution circuit (200A) should be designed in the same manner.
- No multiple tap-offs (double lugging) should be considered in the feeder or distribution compartments of the switchgear unit as this will adversely affect system reliability when attempting to isolate the switchgear in the future.

1.2.14 Street Lighting

- All requests made to THESL-Street Lighting Services for information should include suitable timelines to respond.
- The Designer shall select the street lighting supply points and send the street lighting design to THESL-Street Lighting Services for review.
- Street Lighting plant, facilities, equipment and installation must meet the requirements of the Ontario Electrical Safety Code, which includes inspection by the Electrical Safety Authority (ESA).
- The Designer shall be responsible to arrange for ESA inspections.
- THESL shall make the new street light service connections to the distribution system upon receipt of approval from ESA.
- The Designer will be responsible for obtaining City permits for civil installations.
- The Designer shall inform THESL-Street Light Services of any street lighting changes as per SP #022 “Street Light Energy Billing”.

1.2.15 Customer Communications & Public Relations

- In order to notify customers of our proposed work and ensure that construction proceeds smoothly, Customer Communications (CC) & Public Relations (PR) will undertake to contact the impacted customers by sending “tailored” letters to advise of specific plant installations. Refer to Appendix E for the required scenarios.

Appendix	Remarks
E1	Customer General Notification
E2	Councillor Notification
E3	Speciality letter – Customer Notification Pad-mounted Transformer
E4	Speciality letter – Customer Notification of U/G Vault
E5	Speciality letter – Customer Notification of U/G Tap Box
E6	Speciality letter – Customer Notification Switching Cubicle or Low Profile Transformer within Line of Sight
E7	Speciality letter - Customer Open House Notification

- During the design stage, Designers shall arrange with CC & PR to send the appropriate project notification letters (see attached Appendix E) to all property owners within the limits of the project in accordance with the Municipal Consent Requirements (Chapter 5 – Above-Found Plant, Notification). A PDF key map of the project area, a list of customers affected by the rebuild, a list of specialty letters required, approved start date and street boundaries shall be submitted to CC & PR for distribution to the City Councillor and affected customers. CC & PR will create and distribute General Notification of project letter, Councillor Notification of project letter and Specialty letter(s) (see attached Appendix E). As well, Designers are to include the General Notification of project letter, Councillor Notification of project letter, Specialty letters and the list of customer addresses with the full-stream permit application request.
- The notification letters shall be sent in accordance to the below timeline table:

Customer Letter Timeline

Letter	When To Distribute
Initial notification letter	Very beginning of design
Councillor notification letter	Same date as initial notification letter
Open House letter (if required)	2 weeks prior to Open House (Open House to be scheduled once civil design has been finalized)
Specialty letter (transformer in front of property or line of sight)	During circulation period

- Upon completion of the project drawings, the Designer shall forward the project drawings in PDF format and a hard copy to CC & PR. The drawing package should only include the Title Sheet and Civil Plan drawings. In addition, the Designer shall submit a list of house addresses within the project that were identified through field visits to have unique/serious issues (i.e. damage to property, driveways, fences, hedges, etc.). The list should identify the issues and include accompanying photos if available.

1.3 Drawing Guidelines

In addition to the alignment of project designs with business strategies, it is also necessary that framework be established that will support the delivery of consistent project drawings. The following guidelines will provide the necessary information that will assist in achieving this objective.

The guideline will consist of the following three key elements:

1. Drawing Structure
2. Equipment Numbering
3. Symbology

1.3.1 Drawing Structure

- Standard drawing sheet sizes to be used are as follows:
  Imperial C (17" X 22")
  Imperial D (22" X 34")
- Drawing sheet sizes shall be a maximum size of Imperial D (22" X 34"). Field staff have, in past requested the use of ½ size prints for use as reference in the field. To ensure text is legible in a ½ size format, use a sufficient sized font for the text.
- Templates for the standard sheet size are in ProjectWise and are to be used when creating a new drawing. See ProjectWise User Manual for details.
- Drawing numbers, title blocks and page borders are to be generated using ProjectWise. Title block information will be filled in automatically as the ProjectWise attribute tables are filled in. Drawing numbers are generated using ProjectWise – Do not modify the Drawing numbers from the standard format in any way. See ProjectWise User Manual for details.
- Sufficient white space shall be reserved to the left of each Title Block for placement of the "As-Constructed" stamp.
- Every drawing must be created using a separate file.
- All attribute data fields in ProjectWise must be filled in as part of assigning a new Drawing Number. See ProjectWise User Manual for details.
- All Drawings must be stored in ProjectWise in folders named after the Capital Project Number. See ProjectWise User Manual for details.
- ProjectWise workflow must be updated as the drawing moves from the 1) <u>Proposed</u> to 2) <u>Approval</u> (before packaging) then on to 3) <u>Issued</u>. A new version should be created at this state, if modification is requested, as all drawings that have reached this state are assumed to be signed and therefore legal copies. The Records Management Section will perform the final state change to <u>Archived</u> when they receive the As Constructed mark-up. See ProjectWise User Manual for details.
- Designers shall use the White Space Management Guidelines when preparing the project drawings.
- Drawing type grouping selection through ProjectWise and drawing titles shall be consistent with the following table:

Project Drawings	
Drawing Type Grouping from ProjectWise	**Project Drawing Title**
Title Sheet	Title Sheet
General Notes	General Notes & Details
Primary Schematic	Primary Schematic
Civil	Civil Plan
Underground	Cable & Duct Layout
Existing Feeder or Reference Drawing	Existing Feeder or Reference Drawing
Overview - Electrical	Overview of Electrical Plan

- Plans <u>must</u> be prepared in accordance with the Municipal Consent Requirements. The following is the link to the document: http://www.toronto.ca/engineering/mcr/
- For reference purposes only a sample set of project drawings will be included as part of this document at a later date.

1.3.1.1 Title Sheet

- The title sheet shall include the full project name, key map with north arrow, Drawing Index, and a note indicating that the plan has been prepared in accordance with Ontario Regulation 22/04.
- In accordance with Ontario Regulation 22/04, the following note shall be placed in the top right corner of the title sheet where the assembly of the drawings uses only certified construction standards, technical specifications or authorized legacy standards in cases where maintaining a portion of line with current standards would be problematic:

> **THIS WORK INSTRUCTION HAS BEEN ASSEMBLED UTILIZING ONLY CERTIFIED CONSTRUCTION STANDARDS, SPECIFICATIONS AND APPROVED EQUIPMENT AND MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF ONTARIO REGULATION 22/04.**

- Include the full last name of the Designer, CAD Operator, Supervisor, etc. in the drawing title blocks (do not use initials).
- The key map will encompass the entire limits of the project and shall be “blocked-off” in sections. Each section shall be numbered according to the ProjectWise plan drawing number and sheet number and include the relevant Concession Map #(s).

1.3.1.2 General Notes

- The General Notes shall include civil and electrical responsibilities of the Contractor, Toronto Hydro and of 3rd Parties (if applicable).
- Indicate all known “Designated Substances” that may be encountered in the project.

- The General Notes shall include a reference that minimum horizontal and vertical clearances from other foreign utilities shall be maintained in accordance with Appendix O of the City of Toronto's Municipal Consent Requirements (*Note- the City clearance requirements are consistent with Toronto Hydro Construction Standards, section 31-0100).*
- The Specification and Construction Standards table shall list the applicable specifications (i.e. CV-CON-01) followed by the construction standards. The table shall consist of two columns: column i) the specification or construction standard name and column ii) document number.
- The Cut Repair table shall total all the exclusive hydro & joint-use cut repairs on the project that will be completed by the City. This information will be used for comparison against the City invoices for the actual repair work. The table shall be similar to the following:

Approximate Cut Repairs			
Roadways	----------------	______________	m² +/-
Concrete Sidewalk	----------------	______________	m² +/-
Curb	----------------	______________	m² +/-
Other	----------------	______________	m² +/-

- Any new construction involving the use of legacy standards will require a certificate of approval be prepared by a Professional Engineer identifying the standard used, specific location (i.e. P123) and placed on the General Notes sheet.
- The General Notes shall include a note requiring field crews to re-label existing equipment locations where identified on the drawing.
- Designers should include a listing of all the original installation drawings and reference drawings applicable to the project. When the project includes 3rd Party Joint-use trenching, 3rd Party drawing numbers should be referenced as well.
- A typical road crossing profile shall be included on the drawing showing foreign utility crossings in accordance with the City of Toronto's Municipal Consent Requirements. If a road crossing is not typical (i.e. non-standard storm sewer depth, etc.) a separate road crossing profile shall be prepared and noted on the applicable Civil Plan drawing.

1.3.1.3 Primary Schematic

- The purpose of this drawing is to provide an overall electrical view of the proposed project.
- This drawing can be separated from the rest of the project drawings and used by the Control Centre. For this reason, the repetition of certain information (i.e. key map, legend, etc) is required.
- The entire limits of the project shall be shown on one drawing, where possible.
- Prepare the drawing in accordance with the White Space Management Guidelines.
- The Primary Schematic shall be "Not to Scale" and indicate the following:
  - be semi-geographic, showing all relevant civil (i.e. vaults, pads, splice boxes, poles etc.) and electrical (i.e. primary cables, switches, transformers, switchgear, fault indicators, elbows, etc.) components to facilitate ones "orientation".
  - identify customers on life support and include contact person & telephone number.

- include a legend of proposed and existing plant and plant to be recovered or abandoned.
- include a key map similar to the Title sheet (reduced size) without the “blocked-off” sections and numbering.
- north arrow shall be shown pointing to the top or right of the sheet only.
- proposed connections to the existing plant either solidly connected or via switches.
- the feeder designations involved.
- indicate clearly the voltage rating(s) of the system and cable sizes.
- where unmetered supply connections to 3rd Parties are required, they shall be identified and shown up to the ownership demarcation point.

- Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######, FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.4 Civil Plan

- The Civil Plan drawings shall show the area of the proposed construction and shall be clipped from G/NetViewer and exported into a Microstation file.
- If the area of proposed construction requires more than one plan drawing, divide the area evenly from sheet to sheet using match lines. Maximize the use of drawing white space to minimize the number of drawings.
- Prepare the drawing in accordance with the White Space Management Guidelines.
- Notes specific to the individual plan drawings shall be noted on the drawing.
- Prepare drawings using the City Land Base Maps, including the City Sewer and Water information, available through GNet Viewer. In the former City of Toronto area (District 1) the Digital Map Owners Group (DMOG) base maps shall be used.
- Unlike the City Land Base Maps available for the horseshoe area, the DMOG base maps provide some typical cross sections showing depth of cover of the various utilities.
- Include civil legend and identify proposed and existing plant and any plant that is to be recovered.
- Plans <u>must</u> be prepared in accordance with the Municipal Consent Requirements. The following is the link to the document:
  http://www.toronto.ca/engineering/mcr/
  In efforts to avoid any unnecessary delays in obtaining permits, it is extremely important that all information requested in Appendix Q “Permit Drawing Standards” of the Municipal Consent Requirements be shown on the Plan.
- Storm and Sanitary mains should be indicated on the plan at proposed hydro road crossings and sewer connections.
- Identify customers on life support and include contact person & telephone number.
- The plan shall indicate the number of electrical cable ducts required in the main trench. The appropriate number of ducts shall be shown inside a hexagon symbol placed within the trench lines. Each time there is a change in the number of ducts within the trench line, the new number shall be indicated. Spare duct requirements shall be noted on the plan.

- 3rd Party ducts within the main trench shall not be included with the hydro ducts indicated in the hexagon symbol. It will be necessary for the Contractor to consult 3rd Party drawings to determine where 3rd Party infrastructure is to be installed in the common trench and where 3rd Parties have exclusive installations.
- Indicate the proposed plant in bold and identify as such in the legend.
- Indicate existing plant to be abandoned and identify as such in the legend.
- Tie dimensions for new installations (i.e. centre line of trench, cable chambers vaults, etc.) shall be indicated to adjacent street lines and to existing curb lines or any other permanent existing structure (i.e. poles, hydrant, etc.). When using the DMOG Base Maps, tie dimensions are to be made to existing features (i.e. curbs, etc.).
- Vault drains shall be indicated on the Civil Plan drawings. The depth of cover to the storm sewer at the proposed connection shall be indicated on the plan. An additional road crossing profile shall be shown on the applicable Civil Plan for non typical road crossings (i.e. shallow storm sewer depth etc.).
- Construction methods other than open trench (i.e. directional boring) shall be identified on the plans.
- Existing utility locations (i.e. water mains, gas, Bell, CATV, etc.) shall be shown on the plan drawings when available. Storm and Sanitary mains shall be indicated on the plan and profiles at road crossings, submersible vaults (for drains) or any locations where the hydro trench is in close proximity.
- For projects utilizing the DMOG base maps, existing utility plant and sizes shall be indicated at the match lines or cross streets. All other utility identifiers shown on the base maps shall be removed to avoid clutter. For projects outside the DMOG areas, existing utility plant and size shall be similarly noted.
- Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######,
FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.5 Cable & Duct Layout

- The Cable & Duct Layout drawing shall indicate “Not to Scale” and include the primary cable, secondary bus cable, service cable, service cable ducts, spare ducts, tap boxes, splice vaults/boxes, transformers, switchgear, and distribution poles.
- The drawing shall be diagrammatic and plotted to a scale of approx. 1:400 (two Civil Plans represented on one Cable & Duct Layout drawing).
- Reference to the applicable Civil Plan shall be shown on the Cable & Duct Layout drawing.
- Street lines, lot lines and the building land bases are to be taken from the plan drawings for preparing this drawing.
- A North arrow shall be on each plan, pointing to the top or right of the sheet only.
- Include a legend, identify proposed and existing plant and any plant that is to be recovered/abandoned.
- Identify customers on life support and include contact person & telephone number.
- Include the following note in the top right corner of the drawing.

REFER TO TITLE SHEET DRAWING #200# – ######,
FOR ACCOMPANYING PROJECT DRAWINGS.

1.3.1.6 Existing Feeder or Reference Drawing

- This drawing shall be used to indicate existing electrical or civil plant in the project area.
- It can also serve as an appendix to the project and include any specific details of the project requiring graphic explanation not covered by a Construction Standard or that cannot be shown on the civil or electrical layout drawing due to space restrictions. Examples of these details could include breakouts, duct diversions, etc.
- Each detail shall make reference to the project drawing and sheet number from which it originates.

1.3.1.7 Overview of Electrical Plan

- This drawing shall be used whenever there are multiple electrical drawings, to indicate an overview of the project's existing and proposed electrical plan.
- The intend of this drawing shall be to have the complete electrical project shown on one drawing. Typically this involves one drawing by reducing OH or UG electrical drawings.
- The drawing shall make reference to the detail project electrical drawings (Primary & Secondary Schematic, Cable & Duct Layout).

1.3.2 Equipment Numbering

- New equipment numbering standards have been developed and are included in Section 21 of Toronto Hydro Construction Standards.
- Location numbers for new equipment (with the exception of poles, tap boxes, vault or transformer switches and elbows) can be obtained through the "New Location Number Request Application" program accessible by clicking on the following link: http://assetmgmt.torontohydro.com/nomenclature/
- For each new number requested through the "New Location Number Request Application", Designers should receive a "Nomenclature Labeling Report" which shall be included in the design folder for completion by the field crews.
- Designers must be identified in the Requestors list to access the program. If you are unable to access the program, contact the Supervisor of Asset Data Management-Capacity Planning to get on the list.
- In addition to the numbering of new equipment, some existing equipment within the limits of a project may require re-numbering as well. In general, the following guidelines shall apply for new projects:

  New Installations
  - All new equipment identified in Toronto Hydro Construction Standards section 21-1000 shall be numbered to the new Standard.
  - For poles, the new Standard shall apply when:
    i. installing new pole lines;
    ii. replacing the majority of poles along an entire street or city block (the few remaining poles would be included in the re-numbering).
  - For spot pole replacements or when not renumbering an entire street or block, use the legacy numbering standards for the area with the new numbering materials.

Re-Numbering of Existing Equipment

- The re-numbering of existing equipment shall generally apply in the respective operating districts where GEAR is functional. GEAR is currently functional in the former York, Etobicoke, and North York operating districts only. GEAR will be functional in the other operating district in the near future. Designer should contact System Operations to determine the status of GEAR in the project area.
- If the limits of the project are within the GEAR functioning areas, the following re-numbering standards shall be applied:
  - All existing switchable devices (i.e. transformers, switches, elbows) within the limits of the project shall be re-numbered to the new standard.
  - Existing cable chambers within the limits of a project shall not be re-numbered.
  - Existing vaults within the limits of the project may be re-numbered.
  - Existing poles within the limits of a project may be re-numbered to the new standard.
- On the project drawings, both the new location number and former number (in brackets) will be shown.
- Location numbers for the re-numbering of existing equipment can also be obtained through the “New Location Number Request Application” program.

1.3.3 Symbology

The new symbology shall now be used for all new projects. The symbols and cell libraries can be viewed by clicking on the following link:
http://thehub.torontohydro.com/gear/Users/SymbologyPage/SymbologyPage.html

1.4 Project Deliverables

Projects that are initiated through the Investment Plan are typically designed approximately one year in advance of construction. To ensure a seamless process between the design and construction phase, Designers must be cognizant of the outstanding pre-construction requirements (i.e. cut permits, notifications, etc.). To assist in this area, a Project Design Deliverables checklist (Appendix “B”) has been developed and can be used by Designers to ensure all required documentation is included and/or noted in the Design folder when signed-off. Upon construction approval, the Design folder will be returned to the Designer for final assembly and for execution of the remaining “prior to construction” issues (i.e. cut permits, notification letters, etc.).

Section 2 - Rationale:

- To ensure rear lot conversion designs are aligned with business strategies and project design packages are delivered in a consistent fashion.

Section 3 - References:

- Toronto Hydro Construction Standards
- Toronto Hydro Technical Specification for Civil Construction Work #CV-CON-01
- Toronto Hydro “Conditions of Service”
- Field Consultation Meeting – Terms of Reference
- Work Breakdown Structure II (Latest Version)

- Job Planning Process (Latest Version)
- White Space Management Guidelines
- As-Constructed Map Products Process (Latest Version)
- SDP #002- New Underground Residential Subdivisions (Appendix B- Voltage Drop Tables)
- Standard Practice SP #001 “Ownership Transfer of Water Heater Assets”
- Standard Practice SP #006 “Customer Isolation”
- Standard Practice SP #022 “Street Light Energy Billing”
- Standard Practice SP #024 “Conversion & Rebuild Work in Private Property (Class 3B Customers)
- City of Toronto Municipal Consent Requirements
- Distribution Grid Operations Project Review Form
- Ontario Regulation 22/04
- Electrical Safety Authority Technical Guidelines for Sections 6, 7 & 8.
- Ontario Electrical Safety Code
- Occupational Health and Safety Act

Aug. 20, 2010

APPENDIX "A"

REAR LOT CONVERSIONS DESIGN PROJECT CHECKLIST

Project Name: ______________________________

This checklist is intended to act as a guideline for the various activities involved in the design phase of underground residential rebuild projects. In addition, it includes those activities required in finalizing the project design package prior to issuing to construction. It should be kept in your working design file. Activities listed may not necessarily be in sequential order and may not apply to all major civil projects. The activities listed can be used as a reference in updating your departmental "Design Work Completion Report – Distribution".

Item #	Design Activities	Date Completed (or) N/A
1	Review project scope package from System Reliability Planning.	
2	A signed Letter of Agreement from the Customer should accompany rebuild projects on private property that require a civil infrastructure or easement contribution from the Customer.	
3	Assemble record maps and pertinent drawings.	
4	Define limits of the project design.	
5	Define limits of the project design in G/NetViewer and submit redline file to ProjectWise in accordance with the New Design Process.	
6	Receive Microstation file of the design area from Design/Records and ensure project drawings are deposited into the appropriate "set" within ProjectWise in accordance with the New Design Process.	
7	Coordinate preliminary design meeting with System Reliability Planning, Operational Performance Measurement, Dist. Proj. - Construction, System Operations and other key stakeholders to review the project proposal (as required).	
8	Verify with the City that no work moratorium currently exists in the area of proposed construction.	
9	Refer to the City map to determine if the asphalt in the proposed construction area requires asbestos testing.	
10	Initiate preliminary discussions with 3rd Parties (Rogers, Bell) regarding possible Joint-use initiatives.	
11	Arrange Field Staff Consultation meeting (as per T of R) with area Construction Supervisor to: 1) Review the project. 2) Address construction issues (i.e. vault/tap box locations). 3) Identify properties that have unique/serious issues (i.e. damage to property, driveways, fences, hedges etc.). 4) Identify the safety hazards associated with the project and measures to eliminate and/or control during construction phase.	
12	Prepare preliminary design concept and review with Design Supervisor.	
13	Forward "Design Scope Revision Request" form to System Reliability Planning for proposed revisions to original project scope (as required).	
14	Initiate project drawings through Project Wise.	
15	Compile a PDF key map of the project area, a list of customers affected by the rebuild, a list of specialty letters required, approved start date and street boundaries.	
16	Send compiled information (item 14) to Customer Communications & Public Relations (CC & PR), which will create and distribute general notification of project letter, Councillor Notification of project letter and Specialty letter to the City Councillor and affected customers. As well, Designer to include the General Notification of Project letter, Councillor Notification of project letter, Specialty letters and a list of customer addresses with the full-stream permit application request.	
17	Prepare drawings using Microstation files.	

Item #	Design Activities	Date Completed (or) N/A
18	Prepare preliminary design utilizing certified construction standards and technical specifications and add to base maps.	
19	Obtain new equipment numbers and Nomenclature Labeling Reports through the "New Location Number Request Application".	
20	Distribute preliminary drawings to other utilities, authorities for comments/approvals/line release.	
21	Submit near completed Civil Plan drawings to those 3rd Parties participating in Joint-use trench.	
22	Make final revisions to drawings and include note on drawing indicating compliance with Section 7 of Ontario Regulation 22/04.	
23	For projects involving Joint-use trenching, obtain 3rd Party civil drawings and listing of all 3rd Party civil unit items (by UPCMS item #) and the quantities.	
24	Review designs with Supervisor and sign drawings.	
25	Prepare Contractor (UPCMS) cost sheets and preliminary estimate for 3rd Party involvement.	
26	Prepare estimate and material requirements in Ellipse.	
27	Obtain the necessary external preliminary approvals as required.	
28	Initiate requests for easements or agreements with Legal Dept.	
29	Arrange meeting with Construction Supervisor to review final design, validation of MU/LUs and obtain sign-off.	
30	Make necessary changes to estimate and finalize MU/LUs.	
31	Prepare "Installed Units Summary" form.	
32	Prepare "Equipment Changeout Record" forms (as required).	
33	Obtain the required number of approved 3rd Party plan drawings and completed City Permit Applications for any exclusive civil work.	
34	Obtain final sign-off/approval from Design Supervisor on project drawings.	
35	Obtain P.Eng. approval if using legacy standards for new construction.	
36	Complete "Prior to Construction" deliverables (see Appendix "B") upon budget approval for construction.	
37	Prepare documents as per "Project Distribution List" (see Appendix "C").	
38	Update status of project drawings in Project Wise from "Approved" state to "Issued".	
39	Forward to CC & PR a set of project drawings in PDF format and a hard copy (Title sheet and Civil Plan drawings only) and a list of house addresses within the project that were identified through field visits to have unique/serious issues (i.e. damage to property, driveways, fences, hedges etc.). The list should identify the issues and include accompanying photos if available.	
40	Arrange pre-construction site meeting with construction, contractor, foreign utilities and all other authorities.	
41	Prepare project package in Ellipse.	
42	Prepare purchase requisition in Ellipse.	
43	Update as-constructed units and prepare final billing.	
44	Prepare billing summaries and invoices for 3rd Party Joint-use trench and exclusive items where applicable.	
45	Maintain approved project drawings and the "As-constructed" drawings in the department central filing system for a period of one year following the annual audit required under Ontario Regulation 22/04.	
46	Participate in Post Construction meeting, as required.	

APPENDIX "B"
PROJECT DESIGN DELIVERABLES

Project Name: ______________________ Scope Application # ______________

Design / Construction Project No.: ______________________

Construction Estimate $ ______________________ Estimate # ______________

Legend: **X -** *Items are Mandatory*

✓ *- Additional items to be included if applicable to the project*

Item #	Deliverables	Design Completion	Prior to Construction
1	Project documents filed in appropriate folder	X	X
2	Completed "Installed Units Summary" (Work Breakdown Structure II form)	X	X
3	Drawings – 1 full size set. Each drawing to include the following note above the title block "DESIGN COMPLETE - SUBJECT TO FINAL APPROVAL".	X	
4	Remove the note "DESIGN COMPLETE-SUBJECT TO FINAL APPROVAL" from the drawings.		X
5	Prepare documents as per "Project Distribution List" (see attached Appendix "C")		X
6	3rd Party Drawings		✓
7	"Requirement Summary" from Ellipse (Job Estimating - MSQ655) of the resource, vehicle and material requirements.	X	X
8	"Equipment Changeout Record" forms for key assets to be installed and recovered.	X	X
9	Nomenclature Labelling Reports	X	X
10	Storm Sewer Connection approvals for submersible vaults.	✓	✓
11	Construction Estimate break down (e.g. material, labour, O/H, U/G Civil etc.) through Ellipse	X	X
12	Preliminary Civil Contract Unit Price/Tender Package.	X	
13	'Notice of Project' – The Occupational Health & Safety Act – with any necessary sketch(es)/drawing(s) attached – **for projects with Hydro portion over $50,000.00** *(For electrical work only, Contractor is required to prepare for civil installations)*	X (1 Completed copy)	X (1 Completed copy per trade)
14	Action Log and Minutes from Field Staff Consultation Meeting	✓	
15	Customer & City Councillor Notification of Project letters etc. issued.	X (1 copy of each)	X (1 copy of each)
16	City Cut Permit including those for 3rd Parties and other approvals.		X
17	Include existing Feeder Prints/Concession Maps, showing the proposed mark-ups as required by the area Control Centre.	✓	
18	Joint Use civil drawings, billing details & forms		✓
19	Attach Easement Agreements / Letters of Understanding.		✓

Additional Comments: ______________________

Design Supervisor: ______________ Ext. ________ Date: ________

Designer: ______________ Ext. ________ Date: ________

Aug. 18, 2010

APPENDIX "C"
PROJECT DISTRIBUTION LIST (SAMPLE)

PROJECT DISTRIBUTION LIST **PROJECT # P0060372** **DESCRIPTION: E11189 BARCHESTER PH 3 CIVIL (TIEN)**

PROJECT DISTRIBUTION LIST	DR	Drawings				Detail Schedule (GANTT Chart)	Work Break Down Structure	MSQ660	Material Printout (from EMRT)	CIVIL PERMITS AND POLE PERMITS/LOCATES PROVIDED BY CONTRACTOR	UPCMS Civil Sheet AND if UPCMS > $50,000 Forward Approved PO #	UPCMS Civil Construction Sheet Pole Holes	Notice of Project (> 50k) KEY MAP (8.5*11)	Nomenclature Labelling Form(s)	Equipment Changeout Form(s)	"Yellow" Feeder Prints (Downtown)	Joint Use	Street Lighting Cost Sheet (MSQ655)	Material Finalization Form Signed By Construction	"APPLICATION FORM" INDICATING THE CUT REPAIR COST
		Full	Half Size (11*17)	Design Dwgs. Stamped "City Approval" (Scarborough Area or Where Applicable)	"Poles Only Dwg"															
MDF (Shelda)	1		1			1	0	1	1	1	1	1	0	0	0	0	0	0	0	1
Records	1	1														0				
Power System Schedulers Control Rm	1	1														0				
Cindy Gillis	1					1														
Design Supervisor	1																			
Planner (Designer)	1																			
Control Room Joe Waite (NY Area)	0		0																	
Supervisor (Ken/Ray/Jerry/Earl/Dean/Mike)	0	0				0	0	0	0				0			0	0			
CPLP Or CPCP Crew	0	0				0	0	0	0				0	0	0	0	0			
Downtown Supervisor (Paul/Greg)	0	0				0	0	0	0				0							
Steve/Greg's CPCP Crew	0	0				0	0	0	0				0							
Poles - GERRY	1				1	1		1	1			1								
Pole CCL BERNIE	1				1	1		1	1	1		1								
Permits/Locate By Contractor Pole Excavation Crew (2)	1				1	1		1		1		1								
Supervisor Jack Leddy (Cable Crew)	0	0				0	0	0	0				0			0				
SAM HIFAWI	1		1			1		1		1	1									
Inspector	1	3				1		1		1	1									
Contractor (S & M OR PLP)	1	5	2	1		1		1		1	1									
Supervisor Tom Cook (Internal Civil)	0	0				0	0	0	0				0							
Robert Gregoris (Locates)	1		1																	
Street Lighting	0		0															0		
Kate Parkinson - Joint Use	0																0			
Stations Mike Stoddart P&C East - CCL	0		0			0	0	0												
Stations P. Papoutsis P&C S/W & N/W - CCL	0		0			0	0	0												
Stations T. Nguygen Scada Switch (INFORMATION ONLY)	0		0																	
Stn's Telecom East B. Tutka - CCL Stn's Telecom West P. Papoutsis - CCL	0		0			0	0	0												
Metering	0							0												0
TOTALS	**13**	**10**	**5**	**1**	**3**	**8**	**0**	**7**	**3**	**6**	**4**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

TOTAL GREEN CONSTRUCTION FOLDERS THAT HAVE YELLOW DR'S	2	YELLOW DR'S
TOTAL GREEN CONSTRUCTION FOLDERS THAT HAVE WHITE DR'S	1	WHITE DR'S
TOTAL WHITE FILE FOLDERS THAT HAVE WHITE DR'S	3	WHITE DR'S
EXTRA DR'S	6	WHITE DR'S
RECORDS	1	PINK DR
2010 ORANGE DEP'T FOLDER	1	SIGNED DR

NOTE: WITH CIVIL PROJECTS HAVING POLES, CONTRACTOR TO PROVIDE POLE PERMIT & LOCATES (NOT BEN)

THE PSD FOR THE POLE IS SEPT 10, 2010

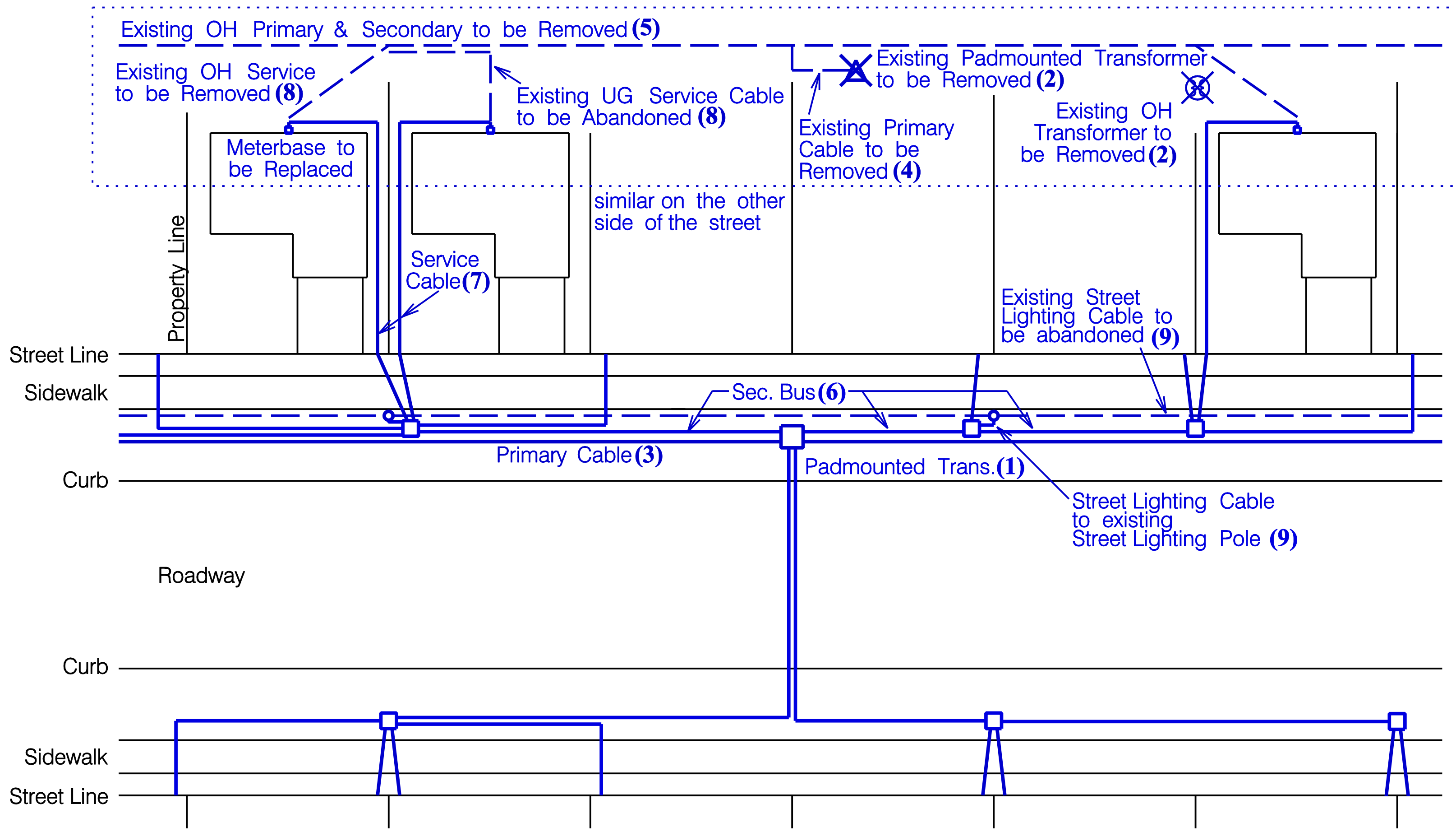
PLEASE PROVIDE THE TOTALS THAT ARE IN THE WHITE BOXES.

PLEASE ENSURE THAT THE .dgn CONSTRUCTION FILES ARE IN THE APPROPRIATE "SET" IN PROJECTWISE.

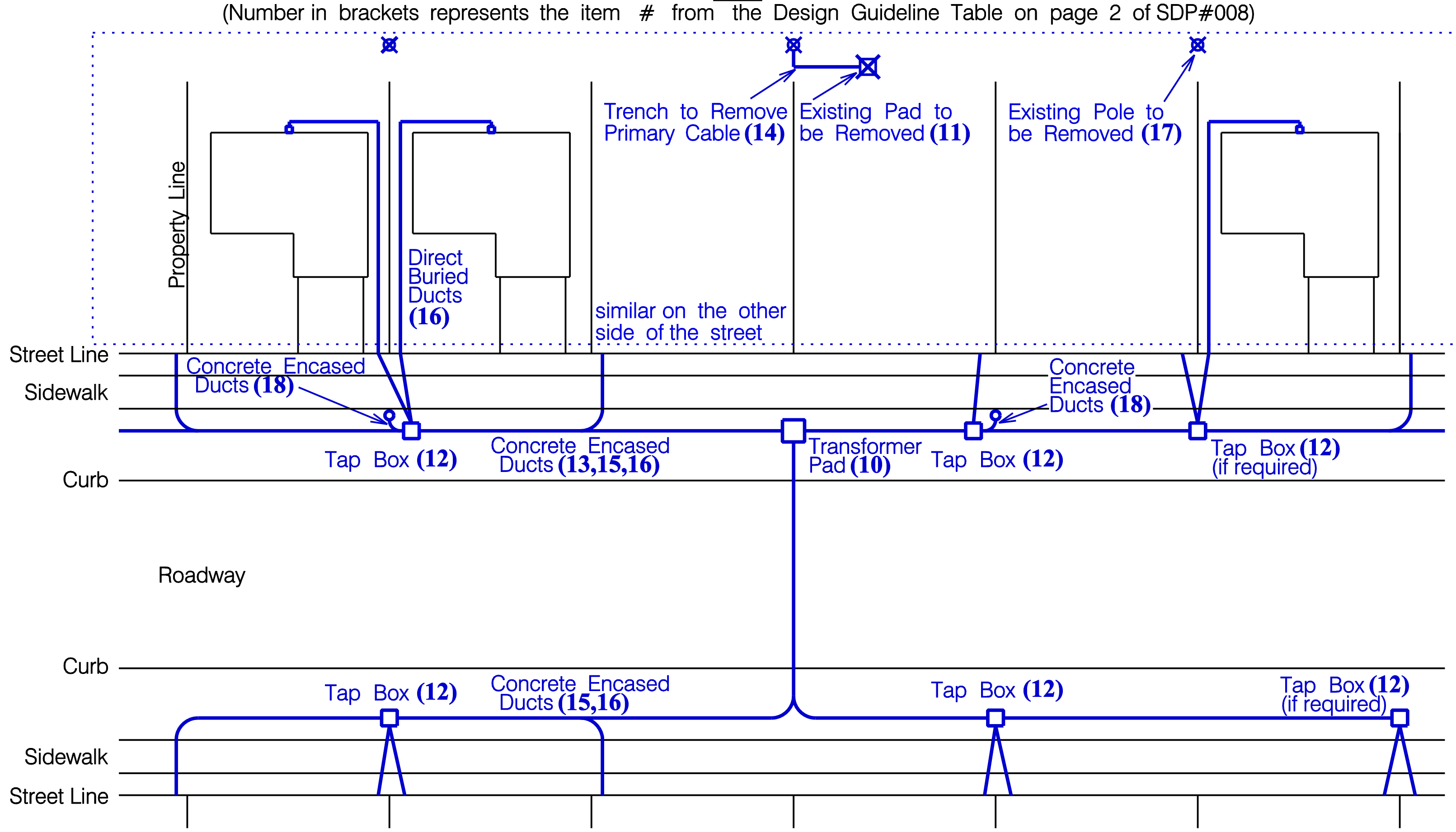
May 6, 2010

APPENDIX "D"
Design Guideline Illustrations – Front Lot UG Padmounted Transformer
(refer to Design Guideline Table on page 2 of SDP#008)

ELECTRICAL
(Number in brackets represents the item # from the Design Guideline Table on page 2 of SDP#008)



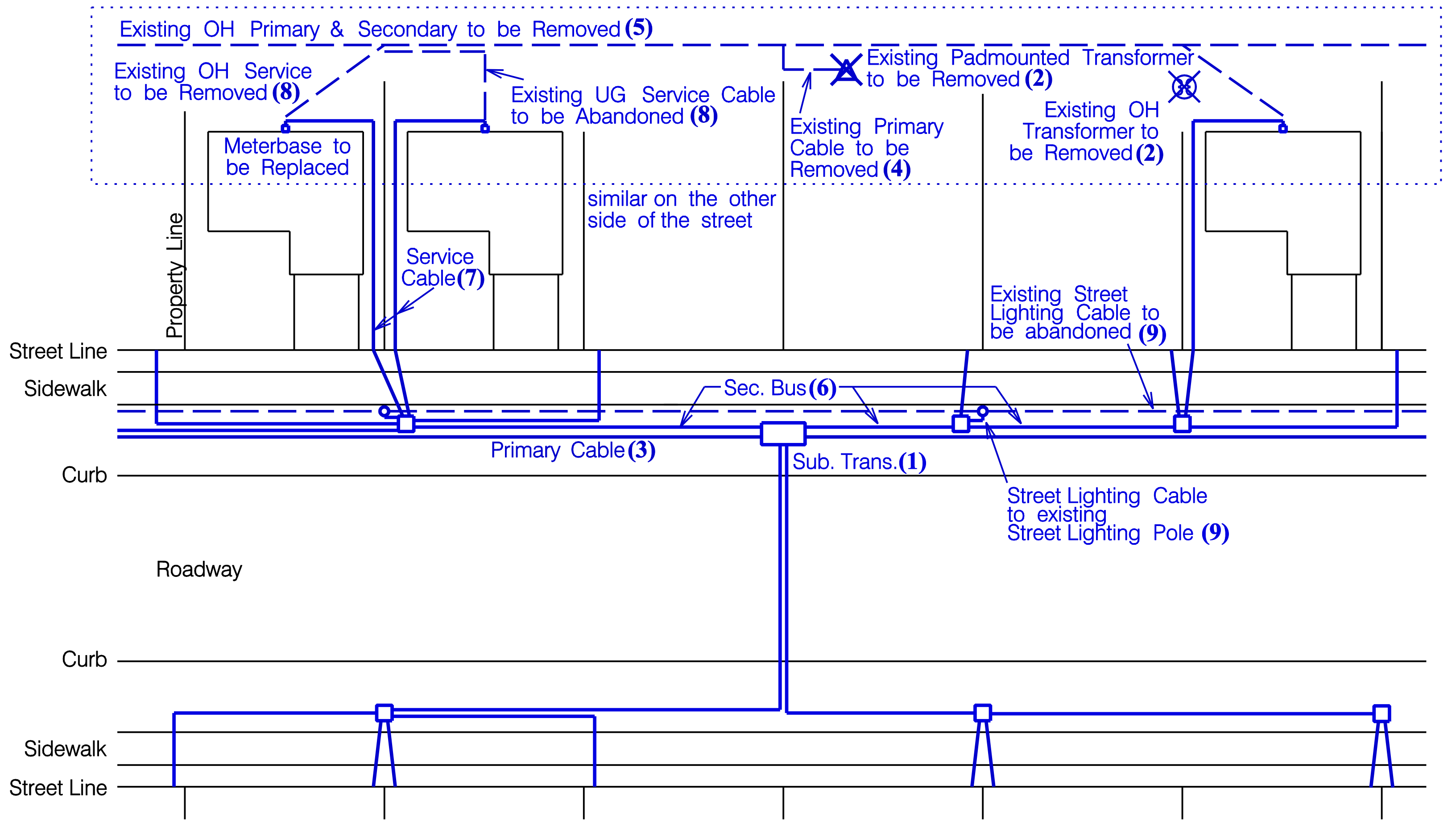
CIVIL
(Number in brackets represents the item # from the Design Guideline Table on page 2 of SDP#008)



APPENDIX "D"
Design Guideline Illustrations – Front Lot UG Submersible Transformer
(refer to Design Guideline Table on page 3 of SDP#008)

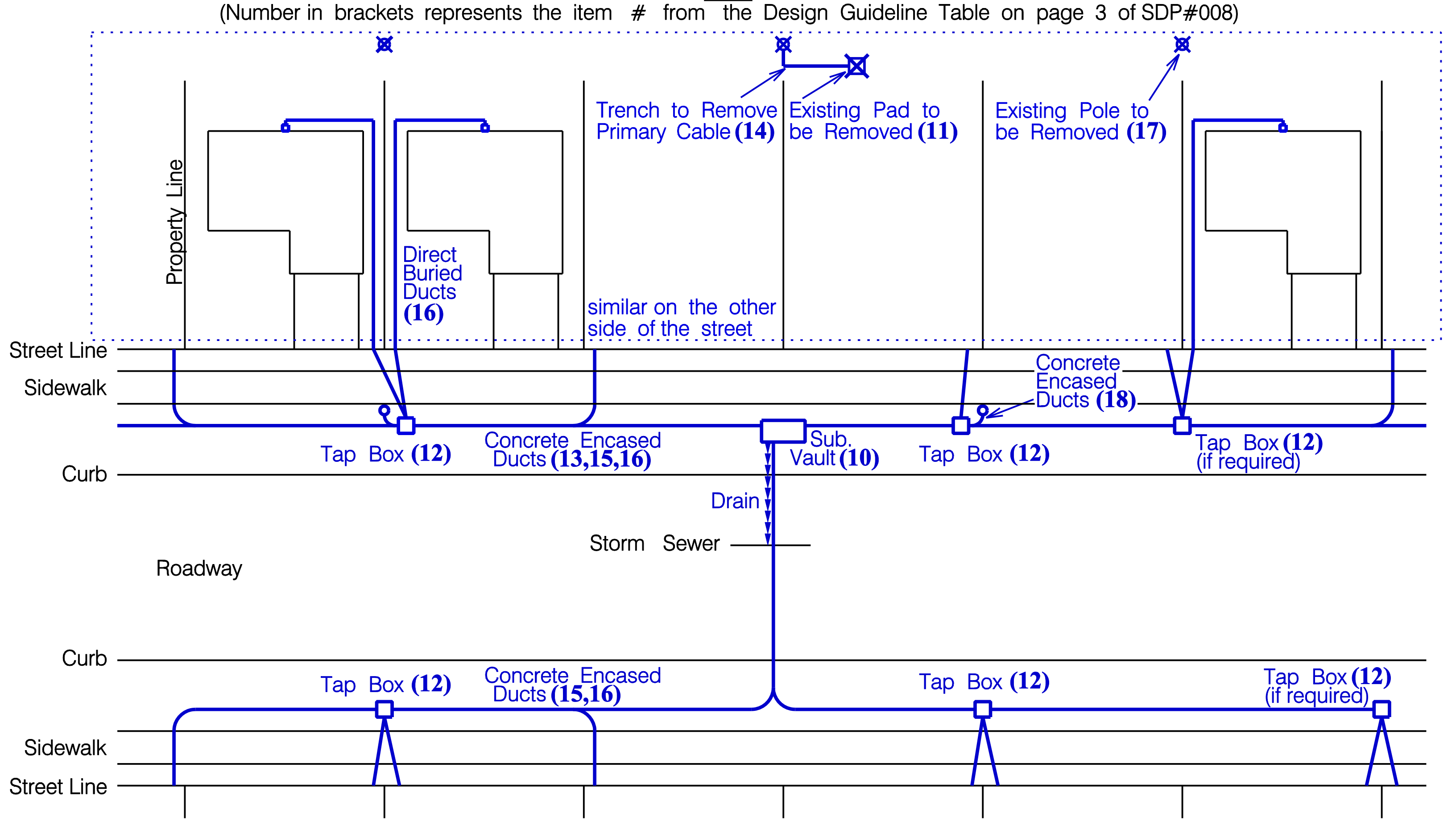
ELECTRICAL

(Number in brackets represents the item # from the Design Guideline Table on page 3 of SDP#008)



CIVIL

(Number in brackets represents the item # from the Design Guideline Table on page 3 of SDP#008)



Appendix E1 – Customer General Notification

Toronto Hydro-Electric System Limited

14 Carlton Street | Email: capitalprojects@torontohydro.com

Toronto, Ontario | Website: http://poweruptoronto.ca/

M5B 1K5 | 416.542.3366

April 24, 2010

RE: Hydro Construction – {Project Name} IMPORTANT NOTICE

Dear Customer,

We are planning to rebuild the overhead electrical system located at the rear of your property. The existing system is nearing the end of its life expectancy and if left unattended, could hamper our ability to maintain a reliable level of service to you and your neighbours.

Instead of replacing this plant in its present location, which would mean considerable disruption to your property, we intend to remove any above ground hydro equipment from your backyard and supply power to your house from new underground cables that will be buried in front of your property along the public boulevard.

During our design stage, we will be visiting your property to determine the route for your new underground electrical service cable. Entry to your house will not be required and if you have any doubts about someone claiming to be "from Hydro", ask to see the person's Toronto Hydro identity card which includes the employee's name and colour photograph.

We expect work to get underway by April, 2010. Our construction personnel are instructed to take extra care and precautions in order to minimize disruptions on both public and private property. During the course of our work, you may experience some power interruptions. They will be necessary to switch from the old to the new supply arrangements. We will endeavour to keep the interruptions to a minimum and to give you prior notice.

Restoration will be done in various stages during construction of the project. The grass will be replaced with new sod where we excavate and all asphalt will be replaced between the curb and sidewalk if affected by our excavation. Where no sidewalk exists, we will replace the portion of the driveway between 450mm on either side of our excavation trench or right up to the curb if the curb is within 1.0m of our trench. All disturbed concrete sidewalks will be temporarily repaired with asphalt. After Hydro's construction, the City will make permanent concrete repairs to these sidewalks. If you were considering repaving your driveway, we would encourage you to delay this until our work has been completed. Interlocking driveways will be lifted and reset to the homeowner's satisfaction. All work will be performed in a professional and expeditious manner.

Once construction begins, Toronto Hydro Inspectors will be on site on a regular basis. Any concerns that arise during construction can be discussed with them.

We thank you in advance for your co-operation and understanding in this matter. We apologize for any inconvenience and advise customer's to exercise caution around construction areas. Should you require additional information, please contact me at 416-542-3366 or send an e-mail to capitalprojects@torontohydro.com

Sincerely,

Jennifer Link

Community Relations

Toronto Hydro Electric System

Appendix E2 – Councillor Notification

Toronto Hydro-Electric System Limited
14 Carlton Street Email: capitalprojects@torontohydro.com
Toronto, Ontario Website: http://poweruptoronto.ca/
M5B 1K5 416.542.3366

December 10, 2009

Toronto City Hall
100 Queen Street West, Suite A10
Toronto, ON M5H 2N2

Attn: Chin Lee
City Councillor, Ward 42
Scarborough-Rouge River

Re: Goldhawk Phase 4

For your information, please find attached a copy of our notification letter which has been delivered to residents concerning the above mentioned project.

The streets affected are as follows:

- 350 Alton Towers Circle Condo
- 330 Alton Towers Circle Condo
- 300 Alton Towers Circle Condo
- 295 Alton Towers Circle Library/Community Centre
- 265 Alton Towers Circle Church
- 255 Alton Towers Circle School
- 250 Alton Towers Circle Shopping Centre
- 240 Alton Towers Circle Shopping Centre
- 380 Goldhawk Trail School
- 410 Goldhawk Trail Church

If any additional information is required, please do not hesitate to contact me at 416.542.3366.

Sincerely,

Jennifer Link
Community Relations
Toronto Hydro Electric System

powerUp

Appendix E3 – Customer Notification of Pad-mounted Transformer

Toronto Hydro-Electric System Limited
14 Carlton Street Email: capitalprojects@torontohydro.com
Toronto, Ontario Website: http://poweruptoronto.ca/
M5B 1K5 416.542.3366

September 24, 2010

Mr. Melvin Borins
51 Old Park Road
Toronto, ON M6B 3E5

RE: Hydro Construction – {Project Name} IMPORTANT NOTICE

Dear Borins Family:

As explained in our previous letter dated April 24, 2010, Toronto Hydro is planning to rebuild the overhead electrical system located at the rear of your property. The existing system is nearing the end of its life expectancy and if left unattended, could hamper our ability to maintain a reliable level of service to you and your neighbours. Instead of replacing this plant in its present location, which would mean considerable disruption to your property, we intend to remove any above ground hydro equipment from your backyard and supply power to your house from new underground cables that will be buried in front of your property along the public boulevard. We expect the initial civil construction work to run from January to April 2011.

As a part of this new electrical system, we will be installing a number of new pad- mounted transformers on your street. In an effort to keep our customers informed, we are advising you that a pad-mounted transformer will be installed in the public road allowance in front of your property. The location is identified in the sketch below.

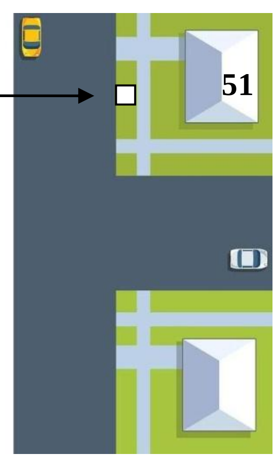
Toronto Hydro and its contractor will take all the necessary precautions to protect the area during our construction. All work will be performed in a professional and expeditious manner.

If you have any questions or concerns regarding the project please contact me at 416-542-3366 or send an e-mail to capitalprojects@torontohydro.com.

Sincerely,

Jennifer Link
Community Relations
Toronto Hydro Electric System

Pad-mounted transformer location



Appendix E4 – Customer Notification of U/G Vault

Toronto Hydro-Electric System Limited
14 Carlton Street Email: capitalprojects@torontohydro.com
Toronto, Ontario Website: http://poweruptoronto.ca/
M5B 1K5 416.542.3366

toronto hydro
electric system

John Smith
2 Ambercroft Blvd
Scarborough, ON
M1W 3L7

RE: Hydro Construction – {Project Name} IMPORTANT NOTICE

Dear Smith Family,

As explained in our previous letter dated April 24, 2010, Toronto Hydro is planning to rebuild the overhead electrical system located at the rear of your property. The existing system is nearing the end of its life expectancy and if left unattended, could hamper our ability to maintain a reliable level of service to you and your neighbours. Instead of replacing this plant in its present location, which would mean considerable disruption to your property, we intend to remove any above ground hydro equipment from your backyard and supply power to your house from new underground cables that will be buried in front of your property along the public boulevard. We expect the initial civil construction work to run from January to April 2011.

During the design stage of this project, we assessed your neighbourhood and identified areas where and how the new system will be upgraded. The electrical system is made up of underground cables and transformers, delivering electricity to the street and then to each home. Electricity is delivered via these cables to transformers in underground vaults.

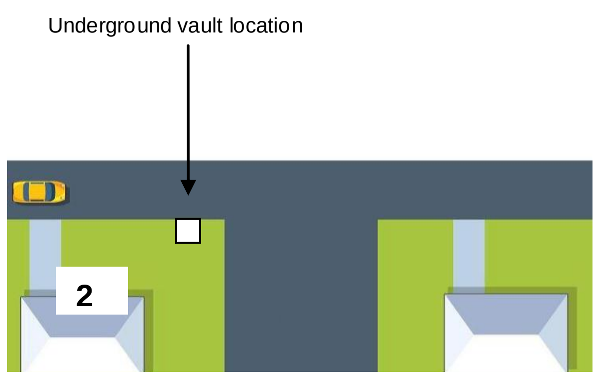
As part of this rebuild of the system, we will be installing a number of new vaults on your street. In an effort to keep our customers informed, we are advising you that an underground vault will be installed within the public road allowance along the front of your home.

Toronto Hydro and its contracted suppliers will take all reasonable care to protect the area during the construction of this project. We will repair and/or replace any damage to the area.

If you have any questions or concerns regarding the project, please feel free to contact me at 416-542-3366 or send an email to capitalprojects@torontohydro.com.

Sincerely,

Jennifer Link
Community Relations
Toronto Hydro Electric System Ltd.



Note: Image is not to scale

powerUp

Appendix E5 – Customer Notification of U/G Tap Box

Toronto Hydro-Electric System Limited

14 Carlton Street Email: capitalprojects@torontohydro.com

Toronto, Ontario Website: http://poweruptoronto.ca/

M5B 1K5 416.542.3366

May 29, 2010
Mr. John Smith
2 Ambercroft Blvd
Scarborough, ON
M1W 3L7

RE: Hydro Construction – {Project Name} IMPORTANT NOTICE

Dear Smith Family,

As explained in our previous letter dated April 24, 2010, Toronto Hydro is planning to rebuild the overhead electrical system located at the rear of your property. The existing system is nearing the end of its life expectancy and if left unattended, could hamper our ability to maintain a reliable level of service to you and your neighbours. Instead of replacing this plant in its present location, which would mean considerable disruption to your property, we intend to remove any above ground hydro equipment from your backyard and supply power to your house from new underground cables that will be buried in front of your property along the public boulevard. We expect the initial civil construction work to run from January to April 2011.

During the design stage of this project, we assessed your neighbourhood and identified areas where and how the new system will be upgraded. The electrical system is made up of underground cables and transformers, delivering electricity to the street and then to each home. Electricity is delivered via these cables to transformers in underground vaults.

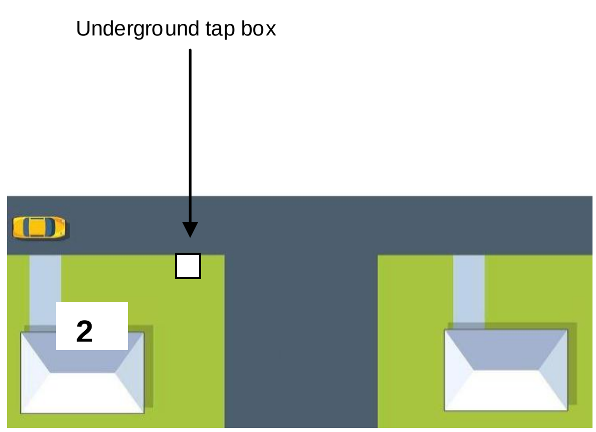
As part of this rebuild of the system, we will be installing a number of new tap boxes on your street. In an effort to keep our customers informed, we are advising you that an underground tap box will be installed within the public road allowance along the front of your home.

Toronto Hydro and its contracted suppliers will take all reasonable care to protect the area during the construction of this project. We will repair and/or replace any damage to the area.

If you have any questions or concerns regarding the project, please feel free to contact me at 416-542-3366 or send an email to capitalprojects@torontohydro.com.

Sincerely,

Jennifer Link
Community Relations
Toronto Hydro-Electric System Ltd.



Note: Image is not to scale

Appendix E6 – Customer Notification Switching Cubicle or Low Profile Transformer within Line of Sight

Toronto Hydro-Electric System Limited

14 Carlton Street Email: capitalprojects@torontohydro.com

Toronto, Ontario Website: http://poweruptoronto.ca/

M5B 1K5 416.542.3366

May 29, 2010

Patience Korto
75 Malvern Street, Unit 37
Scarborough, Ontario
M1B 2V3

RE: Hydro Construction – {Project Name} IMPORTANT NOTICE

Dear Korto Family,

As explained in our previous letter dated April 24, 2010, Toronto Hydro is planning to rebuild the overhead electrical system located at the rear of your property. The existing system is nearing the end of its life expectancy and if left unattended, could hamper our ability to maintain a reliable level of service to you and your neighbours. Instead of replacing this plant in its present location, which would mean considerable disruption to your property, we intend to remove any above ground hydro equipment from your backyard and supply power to your house from new underground cables that will be buried in front of your property along the public boulevard. We expect the initial civil construction work to run from January to April 2011.

During the design stage of this project, we assessed your neighbourhood and identified areas where and how the new system will be upgraded. The electrical system is made up of switching devices, underground cables and transformers, delivering electricity to the street and then to each home. Electricity is delivered via these cables to transformers.

In an effort to keep our customers informed, we are advising you that an aboveground pad-mounted switching cubicle {or low profile transformer} will also be installed within the public road allowance on your street. Please see the attached map which indicates where the new above-ground equipment will be placed in relation to your home*.

Toronto Hydro and its contracted suppliers will take all reasonable care to protect the area during the construction of this project. We will repair any damage to the area caused during construction.

If you have any questions or concerns regarding the project, please feel free to contact me at 416-542-3366. You may also send an email to capitalprojects@torontohydro.com.

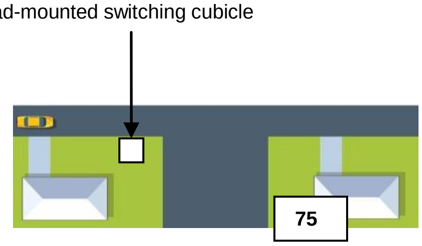
Sincerely,

Jennifer Link

Community Relations
Toronto Hydro-Electric System Ltd.

Note: Attached image is not to scale

Pad-mounted switching cubicle



Appendix E7 – Customer Open House Notification

Toronto Hydro-Electric System Limited
14 Carlton Street
Toronto, Ontario
M5B 1K5
Email: capitalprojects@torontohydro.com
Website: http://poweruptoronto.ca/
416.542.3366

toronto hydro electric system

June 30, 2010

Mr. Melvin Borins
51 Old Park Road
Toronto, ON M6B 3E5

Dear Borins Family:

As explained in our previous letter dated April 24, 2010, Toronto Hydro is planning to rebuild the overhead electrical system located at the rear of your property. The existing system is nearing the end of its life expectancy and if left unattended, could hamper our ability to maintain a reliable level of service to you and your neighbours. Instead of replacing this plant in its present location, which would mean considerable disruption to your property, we intend to remove any above ground hydro equipment from your backyard and supply power to your house from new underground cables that will be buried in front of your property along the public boulevard. **We expect the initial civil construction work to run from January to April 2011.**

In order to provide you with additional details and answer any questions you may have, Toronto Hydro, Rogers Communications, Bell Canada and your City Councillor, Joe Mihevc would like to invite you to attend an Open House as follows:

Date: Tuesday, July 14
Time: 6:15 – 8:15 p.m.
Location: Toronto Public Library - Forest Hill Branch
Address: 700 Eglinton Ave. W. (Between Avenue & Bathurst)

We hope you can join us at the Open House and in the meantime, if you have questions regarding the project, please contact me at 416-542-3366 or send an email to capitalprojects@torontohydro.com.

Sincerely,

Paul Reesor
Community Relations

Joe Mihevc
City Councillor Ward 21
City of Toronto

powerUp

APPENDIX "F"
EXAMPLE OF JOINT-USE TRENCH COST ESTIMATE

3-June-10

Project "X" - 2010

JOINT USE TRENCH REQUIREMENTS

1. 125m of 2 Party Joint-Use Road Crossing Trench (extra trench depth required, also road crossing ducts must be concrete encased)
   Cable TV requires 1- 4" duct @1.0m trench depth (Hydro forced below the MCR depth requirement)
2. 400m of 2 Party Joint-Use Trench in Boulevard
   Cable TV requires 1- 4" duct @ 0.6m trench depth
3. 700m of 3 Party Joint-Use Trench in Boulevard
   Cable TV requires 1- 4" duct @ 0.6m trench depth
   Bell requires 1- 4" duct @0.6m trench depth
4. 1,100m of 2 Party Joint Use Trench in Boulevard
   Cable TV requires 2- 4" ducts @ 0.6m trench depth

JOINT USE TRENCH COST SHARING

1. 125m of 2 Party Joint-Use Road Crossing Trench
   125m X $43.60 tr/m = $5,450.00 (Cable TV)
   125m X $47.15 tr/m = $5,893.75 (Cable TV) extra trench depth cost
   $11,343.75
2. 400m of 2 Party Joint-Use Trench in Boulevard
   400m X $43.60 tr/m = $17,440 (Cable TV)

3. 700m of 3 Party Joint-Use Trench in Boulevard
   i. 700m X $34.90 tr/m = $24,430 (Cable TV)
   ii. 700m X $34.90 tr/m = $24,430 (Bell)

4. 1,100m of 2 Party Joint Use Trench in Boulevard
   1,100m X $50.14 tr/m = $55,154 (Cable TV)
   Note - $50.14 tr/m = single duct cost ($43.60) + 15% for second duct in trench

ESTIMATED 3RD PARTY JOINT-USE TRENCH COSTS

Cable TV
Joint-Use Trench - $ 108,367.75
15% Admin. Fee - $ 16,255.16
Total - $124,622.91

Bell
Joint-Use Trench - $ 24,430
15% Admin. Fee - $ 3,664.50
Total - $ 28,094.50

APPENDIX "F" CONTINUED

EXAMPLE OF JOINT-USE TRENCH COST ESTIMATE

June 3, 2010