RATE BASE

1.0 INTRODUCTION

This Schedule provides an overview of Hydro Ottawa Limited's ("Hydro Ottawa") distribution rate base and a discussion of year over year variances.

In accordance with the Ontario Energy Board's ("the Board") Update to Chapter 2 of the Filing Requirements For Electricity Distribution Rate Applications, issued July 18, 2014, the rate base used to determine the revenue requirement for the Test Years include a forecast of net fixed assets, calculated on a mid-year average basis, plus working capital allowance ("WCA"). Net fixed assets are gross assets in service minus accumulated amortization and contributed capital.

Table 1 shows Hydro Ottawa's rate base values for historical years (2012 Approved, 2012 and 2013 Actual, 2014 forecast), bridge year 2015 and test years 2016 through 2020 Budget. Table 1 provides the opening, closing and average balances for gross assets and accumulated depreciation. Table 1 further provides the closing balance for net fixed assets and Hydro Ottawa's working capital allowance.

Table 2 shows the following variances:

- Historical Board-approved (2012) vs. Historical Actual (2012);
- Historical Actual (2013) vs. preceding Historical Actual (2012);
- Forecast (2014) vs. preceding Historical Actual (2013);
- Bridge (2015) vs. Forecast (2014)
- Test Year (2016) vs. Bridge (2015); and
- Test Years (2017 to 2020) vs. preceding Test Years (2016 to 2019)

Table 1 – Summary of Rate Base (000)

	2012 Approved	2012 Actual	2013 Actual	2014 Forecast	2015 Bridge Year	2016 Test Year	2017 Test Year	2018 Test Year	2019 Test Year	2020 Test Year
Opening Gross Assets	586,645	571,283	626,263	616,643[1]	728,873	834,010	920,628	1,005,754	1,098,217	1,165,068
Closing Gross Assets	653,691	626,263	730,170	728,873	834,010	920,628	1,005,754	1,098,217	1,165,068	1,276,967
Average Gross Assets	620,168	598,773	678,217	672,758	781,441	877,319	963,191	1,051,986	1,131,643	1,221,018
Opening Accumulated Depreciation	$39,178	$36,818	$75,370	$0[2]	$35,919	$73,464	$113,277	$156,409	$202,443	$250,379
Closing Accumulated Depreciation	$78,417	$75,370	$114,030	$35,919	$73,464	$113,277	$156,409	$202,443	$250,379	$299,661
Average Accumulated Depreciation	$58,798	$56,094	$94,700	$17,960	$54,692	$93,371	$134,843	$179,426	$226,411	$275,020
Average Net Fixed Assets Closing	561,371	542,679	583,517	654,798	726,750	783,948	828,348	872,559	905,231	945,998
Working Capital Allowance	107,692	111,188	119,825	119,859	132,740	139,358	142,234	147,738	145,493	148,273
Rate Base	**669,062**	**653,867**	**703,342**	**774,657**	**859,490**	**923,306**	**970,582**	**1,020,297**	**1,050,724**	**1,094,270**

[1] Includes one-time adjustment of a decrease to opening Gross Asset values of $114,030k as well as an adjustment of $502k for IFRS financial reporting as described in B-2-1

[2] Includes one-time adjustment of a decrease to opening Accumulated Depreciation values of $114,030k for IFRS financial reporting as described in B-2-1

Table 2 – Rate Base Variances (000)

	2012 Board Approved Vs Actual	2013 Vs 2012	2014 Vs 2013	2015 Vs 2014	2016 Vs 2015	2017 Vs 2016	2018 Vs 2017	2019 Vs 2018	2020 Vs 2019
Opening Gross Assets	15,362	54,980	(9,621)[3]	112,230	105,137	86,618	85,126	92,463	66,851
Closing Gross Assets	27,428	103,907	(1,297)	105,137	86,618	85,126	92,463	66,851	111,899
Average Gross Assets	21,395	79,443	(5,459)	108,684	95,878	85,872	88,795	79,657	89,375
Opening Accumulated Depreciation	2,360	38,551	(75,370)[4]	35,919	37,545	39,813	43,132	46,034	47,936
Closing Accumulated Depreciation	3,047	38,660	(78,110)[5]	37,545	39,813	43,132	46,034	47,936	49,282
Average Accumulated Depreciation	2,704	38,606	(76,740)	36,732	38,679	41,473	44,583	46,985	48,609
Average Net Fixed Assets	18,691	40,838	71,281[6]	71,952	57,199	44,400	44,211	32,672	40,766
Working Capital Allowance	(3,496)	8,637	35	12,881	6,617	2,876	5,504	(2,245)	2,780
Rate Base Change	**15,195**	**49,475**	**71,316**	**84,833**	**63,816**	**47,276**	**49,716**	**30,427**	**43,546**

[3] Includes one-time adjustment to opening Gross Asset values of $114,030k
[4] Includes one-time adjustment to opening Gross Asset values of $114,030k
[5] Includes one-time adjustment to opening Gross Asset values of $114,030k
[6] 2014 opening Net Fixed Asset balance includes a one-time adjustment $502k, please see Exhibit B-2-1

2.0 2012 ACTUAL RATE BASE VERSUS 2012 APPROVED

Hydro Ottawa's approved 2012 rate base was $15.2M higher than actual rate base

- Average assets were $18.7M lower in 2012 actual
    - Additional $16.4M in net assets, $11.4M less than Board approved
    - $27.1M more actual construction in progress ("CIP") than forecasted
- $3.5M more was required in WCA in 2012 actual over approved

3.0 2013 ACTUAL VERSUS 2012 ACTUAL

Hydro Ottawa's actual 2013 rate base was $49.5M higher than 2012 actual

- Average assets were $40.8M higher in 2013
    - $65.2M additions in 2013, $48.8M higher than 2012
    - $2.8M in net deletions, $3M higher than 2012
- $8.6 more was required in WCA over 2012

4.0 2014 FORECAST VERSUS 2013 ACTUAL

Hydro Ottawa's forecasted 2014 rate base was $71.3M higher than 2013 actual.

- Average assets are forecasted to be $71.3M higher
    - $76.3M additions are forecasted in 2014[7], $11.1M higher than 2013
    - $1.1M in net deletions, $1.7M less than 2013
    - $6.1M less is forecasted to be in CIP at the end of 2014
- WCA is forecasted to stay relatively flat

5.0 2015 BRIDGE VERSUS 2014 FORECAST

[7] Excluding one-time adjustment to 2014 opening net fixed assets

Hydro Ottawa's 2015 Bridge Year rate base is budgeted to be $84.8M higher than 2014 forecast.

- Average assets are budgeted to be $72.0M higher
  - $67.6M additions are budgeted in 2015, $8.7M less than 2014,
  - $18.2M less is budgeted to be in CIP at the end of 2015
- WCA is budgeted to be $12.9M more than required 2014 forecast

6.0 2016 TEST YEAR VERSUS 2015 BRIDGE YEAR

Hydro Ottawa's 2016 Test Year rate base is budgeted to be $63.8M higher than budgeted for the 2015 Bridge Year.

- Average assets are budgeted to be to be $57.2M higher
  - $46.8M additions planned in 2016, $20.8M less than 2015
  - $8.2M more is budgeted to be in CIP at the end of 2016
- WCA is budgeted to be $6.6M more than required 2015

7.0 2017 TEST YEAR VERSUS 2016 TEST YEAR

Hydro Ottawa's 2017 Test Year rate base is budgeted to be $47.3M higher than the 2016 Test Year.

- Average Assets are budgeted to be to be $44.4M higher
  - $42M additions planned for 2017, $4.8M less than 2016
  - $4.1M more is budgeted to be in construction in progress at the end of 2017
- WCA is budgeted to be $2.9M more than required in 2016

8.0 2018 TEST YEAR VERSUS 2017 TEST YEAR

Hydro Ottawa's 2018 Test Year rate base is budgeted to be $49.7M higher than 2017 Test Year.

- Average Assets are budgeted to be to be $44.2M higher

    - $46.4M additions planned for 2018, $4.4M more than 2017
    - $4.1M less is budgeted to be in CIP at the end of 2018
- WCA is budgeted to be $5.5M more than required in 2017

9.0 2019 TEST YEAR VERSUS 2018 TEST YEAR

Hydro Ottawa's 2019 Test Year rate base is budgeted to be $30.4M higher than the 2018 Test Year.

- Average Assets are budgeted to be to be $32.7M higher
    - $18.9M additions planned for 2019, $27.5M less than 2018
    - $29.0M more is budgeted to be in CIP at the end of 2019
- WCA is budgeted to be $2.2M less than required in 2018

10.0 2020 TEST YEAR VERSUS 2019 TEST YEAR

Hydro Ottawa's 2020 Test Year rate base is budgeted to be $43.5M higher than the 2019 Test Year.

- Average Net Assets are budgeted to be to be $40.8M higher
    - $62.6M additions planned in 2020, $43.7M more than 2019
    - $18M less is budgeted to be in CIP at the end of 2020
- WCA is budgeted to be $2.8M more than required in 2019

For more details on Capital Additions see Exhibit B-2-1. In addition, for more details related to the Allowance for Working Capital see Exhibit B-3-1.

HydroOttawa
Distribution System Plan
2016

2016 Hydro Ottawa Limited Electricity Distribution Rate Application

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1 # Glossary

AIP	Asset Investment Planning
AMP	Asset Management Process
AMPR	Asset Management Planning Report
APR	Annual Planning Report
BDC	Builder Developer Council
CAIDI	Customer Average Interruption Duration Index
CCRA	Connection & Cost Recovery Agreement
CDP	Community Design Plan
CEA	Canadian Electrical Association
CEATI	Centre for Energy Advancement through Technological Innovation
CGA	Common Ground Alliance
Chapter 5	Ontario Energy Board Filing Requirements for Electricity Transmission and Distribution Applications, Chapter 5, Consolidated Distribution System Plan Filing Requirements, March 28, 2013
CIA	Connection Impact Assessment
CSA	Canadian Standard Association
DC	Direct Current
DER	Distributed Energy Resources
DGA	Dissolved Gas Analysis
DS	Distribution Station
DSC	Distribution System Code
DSP	Distribution System Plan
ECA	Electrical Contractors Association
EDA	Electricity Distributors Association
ESA	Electrical Safety Authority
FEMI	Feeders Experiencing Multiple Interruptions
FIT	Feed-In-Tariff
FSM	Field Service Management

GEA	Green Energy Act
GIS	Geographic Information System
GOHBA	Greater Ottawa Home Builders Association
GTAP	Grid Transformation Action Plan
HCI	Hydroelectric Contract Initiative
HESOP	Hydroelectric Standard Offer Program
HOL	Hydro Ottawa Limited
HONI	Hydro One Networks Inc.
HVDS	High Voltage Distribution Station
Hydro One	Hydro One Networks Inc.
IEEE	Institute of Electrical and Electronics Engineers
IESO	Independent Electricity System Operator
IR	Infrared
IRRP	Integrated Regional Resource Planning
ITIC	Information Technology Industry Council
KPI	Key Performance Indicator
LDC	Local Distribution Company
LoS	Loss of Supply
LRT	Light Rail Transit
LTR	Limited Time Rating
NRC	National Research Council of Canada
O&M	Operation & Maintenance
O/H	Overhead
OEB	Ontario Energy Board
OLRT	Ottawa Light Rail Transit
OM&A	Operation, Maintenance & Administration
OMS	Outage Management System
OPA	Ontario Power Authority
ORCGA	Ontario Regional Common Ground Alliance
ORTAC	Ontario Resource and Transmission Assessment Criteria

PCB	Polychlorinated Biphenyl
PILC	Paper Insulated Lead Cable
PMBOK	Project Management Body of Knowledge
PSUI-CDM	Process and Systems Upgrade initiative - Conservation Demand Management
REG	Renewable Energy Generation
RESOP	Renewable Energy Standard Offer Program
RFP	Request for Proposal
RIP	Regional Infrastructure Planning
RTU	Remote Terminal Units
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SARFI	System Average Root Mean Square (RMS) Variation Frequency Index
SCADA	Supervisory Control And Data Acquisition
SF6	Sulfur Hexafluoride
SLA	Service Level Agreement
the Board	Ontario Energy Board
the City	City of Ottawa
TIM	Testing, Inspection & Maintenance
TOD	Transit Oriented Developments
TS	Transmission Station
U/G	Underground
UCC	Utility Coordinating Committee
XFMR	Transformer
XLPE	Cross-Linked Polyethylene

1 # Definitions

10 day Limited Time Rating (LTR)	the maximum loading level that can be applied to a station power transformer over a 10 day period resulting in a 0.1% loss in transformer life
Asset Management Planning Report	part of the Annual Planning Report (see Attachment B-1(B)) where asset management practices used by HOL are documented
Budget Program	A grouping of similar projects that address the same assets and primary drivers.
Capital Program	A grouping of Budget Programs that have a similar asset type which are grouped on a meaningful basis for management reporting and are associated with the OEB Investment Categories.
Cold Load Pick Up	the operation of restoring power to equipment that has been without power for a period of time and thus will require additional current for the equipment restart
Corrective Maintenance	activities aimed at fixing discovered issues of an asset
Distribution Assets	all infrastructure and equipment owned by HOL outside of the substation used to distribute power to customers
Distribution Station (DS)	A sub-transmission (44kV or 13.2kV) connected substation that steps down voltage to a distribution level (<44kV)
High Voltage Distribution Station (HVDS)	a transmission (≥50kV) connected substation that steps down voltage to a distribution or sub-transmission level (<50kV)
Key Performance Indicator	a measure of continuous improvement in asset management planning, capital investment planning and in customer oriented performance
LEAN	a continuous improvement program focused on eliminating waste from business processes
Maintenance Program	a set of planned activities which improve the condition of HOL's assets
Measures	a quantifiable unit used to identify KPIs
Overhead	all infrastructure and equipment used to distribute power to customers

	that is supported above ground level by a series of poles
Predictive Maintenance	activities that are used to determine the condition of an asset in order to predict when maintenance or replacement should be performed
Preventative Maintenance	activities that are regularly performed on equipment to lessen the likelihood of it failing
Program	an activity plan that includes multiple subprojects
Project	a specific plan carried out to address a need
Station Assets	all infrastructure and equipment owned by HOL inside the substation yard used to convert transmission voltages to distribution voltages
System Distribution Assets	all distribution and station assets owned by HOL used to convert transmission voltages to distribution voltages and distribute power to customers
Transmission Station (TS)	a transmission (≥50kV) connected substation that steps down voltage to a lower transmission voltage (≥50kV)
Underground	all infrastructure and equipment used to distribute power to customers that is located beneath ground level

HOL Substation Table

The following HOL and HONI owned stations in the table below are used to supply HOL's customers. The stations are herein referenced by the nomenclature (HOL Station Name) used by HOL.

HOL Station Name	Designation	Owner	Primary/Secondary Voltage (kV)
Albion TA	HVDS	HONI-HOL	230/13.2
Albion UA	DS	HOL	13.2/4.16
Alexander DS	DS	HONI	44/27.6
Augusta UD	DS	HOL	13.2/4.16
Bantree AL	DS	HOL	13.2/4.16
Barrhaven DS	DS	HOL	44/8.32
Bayshore DS	DS	HOL	44/8.32
Bayswater UJ	DS	HOL	13.2/4.16
Beaconhill MS	DS	HOL	44/8.32
Beaverbrook	DS	HOL	44/12.43
Beckwith DS	DS	HONI	44/27.6
Beechwood UB	DS	HOL	13.2/4.16
Bells Corner DS	DS	HOL	44/8.32
Bilberry TS	HVDS	HONI	115/27.6
Blackburn MS	DS	HOL	44/8.32
Borden Farm DS	DS	HOL	44/8.32
Bridlewood MS	HVDS DS HVDS DS	HOL	115/27.6 44/27.6 115/8.32 44/8.32
Bronson SB	DS	HOL	13.2/4.16
Brookfield AF	DS	HOL	13.2/4.16
Cahill AN	DS	HOL	13.2/4.16

Cambridge AM	DS	HOL	13.2/4.16
Carling SM	DS	HOL	13.2/4.16
Carling TM	HVDS	HONI-HOL	115/13.2
Casselman MS	DS	HOL	44/8.32
Centrepointe DS	HVDS	HOL	115/8.32
Church AA	DS	HOL	13.2/4.16
Clifton UL	DS	HOL	13.2/4.16
Clyde UC	DS	HOL	13.2/4.16
Cyrville MTS	HVDS	HOL	115/27.6
Dagmar AC	DS	HOL	13.2/4.16
Eastview UT	DS	HOL	13.2/4.16
Edwin UV	DS	HOL	13.2/4.16
Ellwood MTS	HVDS	HOL	230/13.2
Epworth DS	HVDS	HOL	115/8.32
Fallowfield MS	HVDS	HOL	115/27.6
Fisher AK	DS	HOL	13.2/4.16
Florence UF	DS	HOL	13.2/4.16
Gladstone UX	DS	HOL	13.2/4.16
Hawthorne TS	HVDS	HONI	230/44
Henderson UN	DS	HOL	13.2/4.16
Hillcrest AH	DS	HOL	13.2/4.16
Hinchey TH	HVDS	HONI-HOL	115/13.2
Holland SH	DS	HOL	13.2/4.16
Janet King DS	DS DS	HOL	44/27.6 44/8.32
Jockvale DS	DS	HOL	44/8.32
Kanata MTS	HVDS	HOL	230/27.6
King Edward SK	DS	HOL	13.2/4.16
King Edward TK	HVDS	HONI-HOL	115/13.2
Langs AP	DS	HOL	13.2/4.16

Leitrim MS	DS	HOL	44/27.6
Limebank MS	HVDS	HOL	115/27.6
Lincoln Heights TD	HVDS	HONI-HOL	115/13.2
Lisgar TL	HVDS	HONI-HOL	115/13.2
Longfields DS	DS	HOL	44/27.6
Manordale DS	HVDS	HOL	115/8.32
Manotick DS	HVDS	HONI	115/8.32
Marchwood MS	HVDS	HOL	115/27.6
McCarthy AQ	DS	HOL	13.2/4.16
Merivale DS	HVDS	HOL	115/8.32
Moulton MS	HVDS	HOL	115/27.6
Munster DS	DS	HOL	44/8.32
Nepean AB	DS	HOL	13.2/4.16
Nepean TS	HVDS	HONI	230/44
Overbrook SO	DS	HOL	13.2/4.16
Overbrook TO	HVDS	HONI-HOL	115/13.2
Parkwood Hills DS	DS	HOL	44/8.32
Playfair AJ	DS	HOL	13.2/4.16
Q.C.H. DS	DS	HOL	44/8.32
Queens UQ	DS	HOL	13.2/4.16
Richmond North DS	DS	HOL	44/8.32
Richmond South DS	HVDS	HOL	115/8.32
Rideau Heights DS	DS	HOL	44/8.32
Riverdale SR	DS	HOL	13.2/4.16
Riverdale TR	HVDS	HONI-HOL	115/13.2
Russell TB	HVDS	HONI-HOL	115/13.2
Shillington AD	DS	HOL	13.2/4.16
Slater SA	DS	HOL	13.2/4.16
Slater TS	HVDS	HONI-HOL	115/13.2
South Gloucester DS	HVDS	HONI	115/8.32

South March TS	HVDS	HONI	230/44
South March DS	DS	HOL	44/12.43
Stafford Road DS	DS	HOL	44/8.32
Startop MS	DS	HOL	44/8.32
Terry Fox MTS	HVDS	HOL	230/27.6
Uplands MS	HVDS	HOL	115/27.6
Urbandale AE	DS	HOL	13.2/4.16
Vaughan UG	DS	HOL	13.2/4.16
Walkley UZ	DS	HOL	13.2/4.16
Woodroffe DS	DS	HOL	44/8.32
Woodroffe TW	HVDS	HONI-HOL	115/13.2
Woodroffe UW	DS	HOL	13.2/4.16

1 Distribution System Plan

Hydro Ottawa Limited's (HOL) Distribution System Plan (DSP) has been put together in line with the Ontario Energy Board's Filing Requirements for Electricity Transmission and Distribution Applications, Chapter 5, Consolidated Distribution System Plan Filing Requirements (Chapter 5).

1.0 HOL DSP

Table 1.0.1 shows the mapping of the sections within HOL's DSP to those identified in Chapter 5.

Table 1.0.1 - DSP Section Mapping

HOL DSP Section		Chapter 5 Section	
1	**Distribution System Plan**	**5.2**	**Distribution System Plans**
1.0	**HOL DSP**	**5.2**	**Distribution System Plans**
1.0.1	Corporate Strategic Direction & Asset Management Objectives	5.2	Distribution System Plans
1.1	**Distribution System Plan Overview**	**5.2.1**	**Distribution System Plan overview**
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1.1.2	Sources of Cost Savings	5.2.1 b)	
1.1.3	DSP Period	5.2.1 c)	
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1.1.6	Aspects Contingent on Ongoing Activities or Future Events	5.2.1 f)	
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1.2.2	Deliverables	5.2.2 b)	
1.2.3	IESO Letter of Comment – HOL's REG Investments Plan	5.2.2 c)	

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1.3.2	Performance Summary	5.2.3 b)	
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2.1	**Asset Management Process Overview**	**5.3.1**	**Asset management process overview**
2.1.1	Asset Management Objectives	5.3.1 a)	
2.1.2	Asset Management Process Components	5.3.1 b)	
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2.2.4	Capacity of the Existing System Assets	5.3.2 d)	
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2.3.2	Asset Life Cycle Risk Management	5.3.3 b)	
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3.1.2	System Renewal	5.4.1	Summary

3.1.3	System Service	5.4.1	Summary
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3.1.10	Customer Engagement Activities	5.4.1 f)	
3.1.11	System Development Expectations	5.4.1 g)	
3.1.12	Impact of Customer Preferences, Technology, and Innovation on Total Capital Cost	5.4.1 h)	
3.2	**Capital Expenditure Planning Process Overview**	**5.4.2**	**Capital expenditure planning process overview**
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3.2.2	Non-Distribution System Alternatives	5.4.2 b)	
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3.5	**Justifying Capital Expenditures**	**5.4.5**	**Justifying capital expenditures**
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The purpose of the DSP is to consolidate HOL's practices as they relate to the planning and execution of System Access, System Renewal, System Service and General Plan investments through the Asset Management Process (Section 2 Asset Management Process). These practices will be detailed throughout the DSP. The DSP details the forecast years' (2016-2020) capital spending activities and the planning processes through which they are identified and prioritized, activities relating to third party coordination and information on customer engagement.

Historically, HOL has produced an Annual Planning Report (APR) which covers the four main areas of planning described above, with a 20-year outlook, summarizing the outcomes of the process described in Section 2 of this DSP. As the DSP and the Annual Planning Report share a number of commonalities, the 2014 APR has been included in Attachment B-1(B), and is referenced throughout the DSP.

HOL's DSP has been divided into three sections as outlined in Chapter 5:

Section 1 – Distribution System Plan (corresponding to Section 5.2 of Chapter 5)

The first section of the Distribution System Plan is intended to provide the Ontario Energy Board (OEB) and stakeholders with a high level overview of the information filed within the DSP including key elements that affect rate proposals and sources of cost savings expected to be achieved, information on coordinated planning with third parties, and performance measurements for continuous improvement.

Section 2 – Asset Management Process (corresponding to Section 5.3 of Chapter 5)

The purpose of the second section is to provide the Board and stakeholders with an understanding of the direct links between the asset management process and the expenditure decisions that comprise the capital investment plan and how they impact operation and maintenance (O&M) expenditures. Included in this section is an overview of the process, a description of the assets managed, and details of HOL's optimization policies and practices as they related to asset replacements, testing, inspection and maintenance.

Section 3 – Capital Expenditure Plan (corresponding to Section 5.4 of Chapter 5)

The third and final section of the DSP details HOL's O&M expenditures and capital system investments that have been derived from the asset management process (described in section 2) and the capital expenditure planning process. Details included are in relation to the capital expenditure planning process, the capability of the system to connect new load and embedded generation, a summary of capital expenditures and O&M expenditures and justifications for projects and Budget Programs that meet the materiality threshold of $750k.

1.0.1 Corporate Strategic Direction & Asset Management Objectives

HOL's planning practices and Asset Management Process tie back to the Corporate Strategic Direction. Understanding of this framework provides context for the Distribution System Plan and is referenced throughout.

Mission

To create long-term value for our shareholder, benefitting our customers and the communities we serve.

Vision

To be a leading and trusted utility services company.

- Leading – consistently being among the top performers in the business, in every critical area of our operations; and being regarded as a credible and trusted voice in our industry, helping to shape policy, regulatory and operational responses to the critical issues of the day.
- Trusted – Trust is fundamental to HOL's success – a continuing belief among our stakeholders that we will deliver on our mission, reliably, in a transparent and accountable fashion.
- Integrated – realizing synergies and economies of scale in 'close to the customer' utility services, to create additional value for the company's shareholder, and savings and enhanced service to customers.

Strategy

With our mission and vision in mind HOL's goal is two-fold:

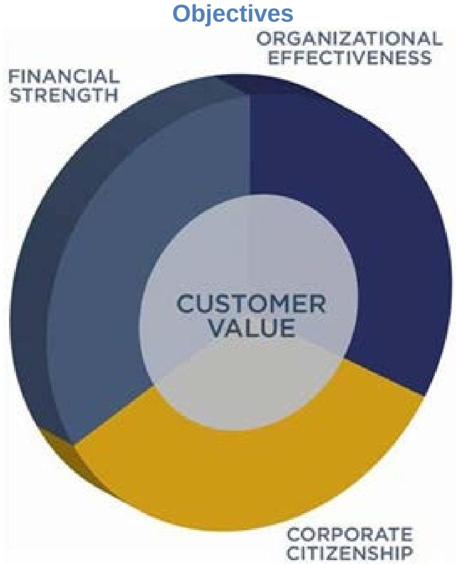
- To continue to fulfill our core mandate to provide a safe, reliable, affordable and sustainable supply of electricity to the homes and businesses that rely on us every day; and
- To ensure a more sustainable energy future for our community.

To achieve these goals, HOL's strategy is to put the customer at the centre of everything we do. Understanding and responding to the customer's needs and expectations – for service quality, cleaner energy, and greater control over the management of energy costs – will be key to HOL's continued success in an evolving landscape.

Corporate Strategic Objectives

To achieve our strategy, the plan is structured around four critical areas of performance that have driven our success to date, shown in Figure 1.0.1. In each of these areas, we have set one overreaching objective. These four areas of focus will continue to guide our activities throughout the current plan, but one, Customer Value, takes on central importance.

Figure 1.0.1 - Corporate Strategic Objectives



Customer Value – we will deliver value across the entire customer experience – by providing reliable, responsive and innovative services at competitive rates

Financial Strength – we will create sustainable growth in our business and our earnings – by improving productivity and pursuing business growth opportunities that leverage our strengths – our core capabilities, our assets and our people

Organizational Effectiveness – we will achieve performance excellence – by cultivating a culture of innovation and continuous improvement

Corporate Citizenship – we will contribute to the well-being of the community – by acting at all times as a responsible and engaged corporate citizen

Asset Management Objectives

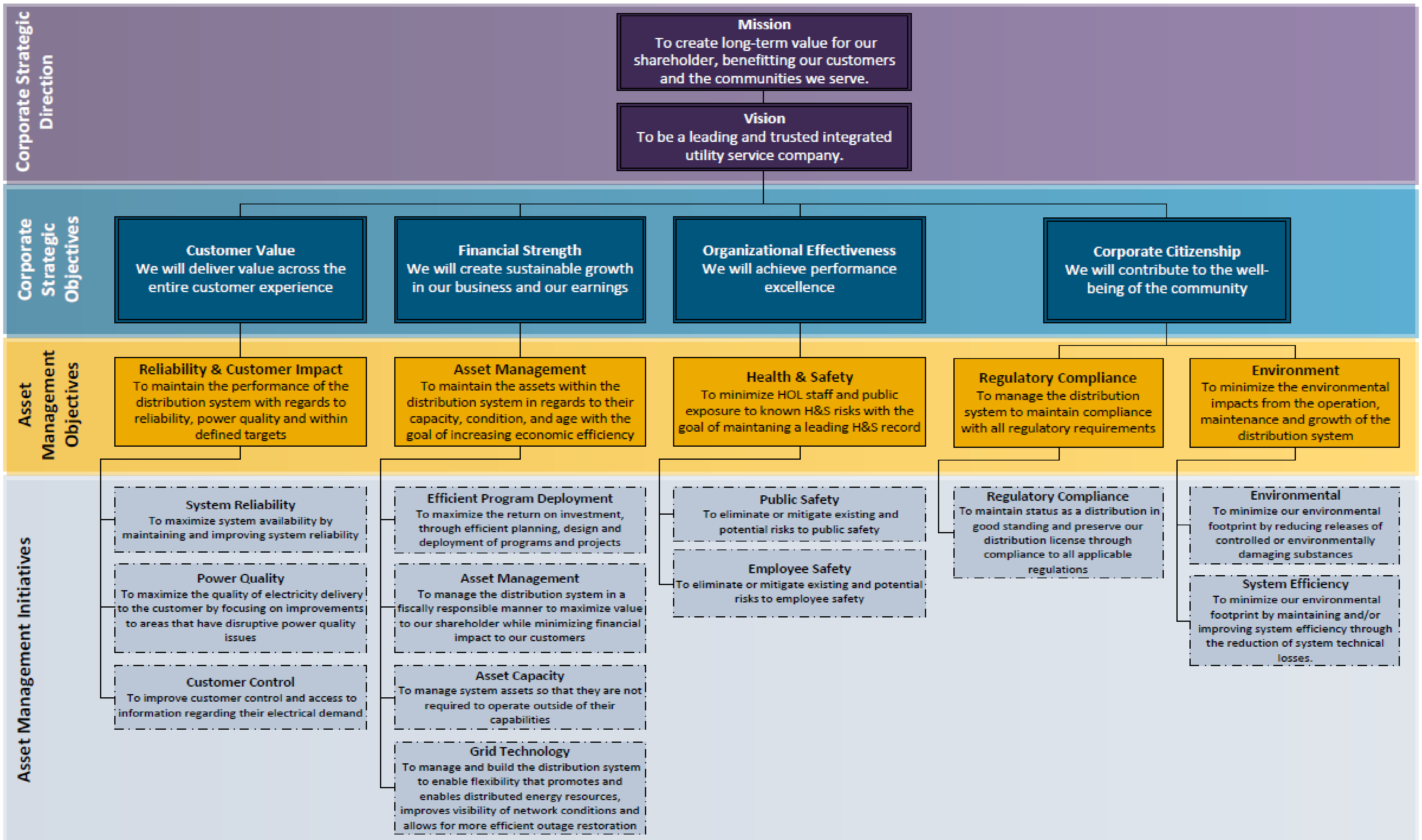
The goal of the Asset Management Process is to deliver a portfolio of projects which support the Key Areas of Focus in a transparent, consistent and sustainable manner. In this regard, there are five (5) key Asset Management Objectives, which have been identified in support of the Corporate Strategic Objectives.

Asset Management Initiatives

Support of the Asset Management Objectives is expressed in terms of initiatives. These are specific operational goals which are directly impacted by the work carried out under the Asset Management Process.

The hierarchy between the Corporate Strategic Direction through to the Asset Management Objectives is shown in Figure 1.0.2.

Figure 1.0.2 - Corporate Strategic Direction & Asset Management Objectives



1.1 Distribution System Plan Overview

The Distribution System Plan (DSP) overview provides a high level synopsis of the information that can be found in the DSP, providing context for the remaining document with regards to the capital expenditures, O&M expenditures and vintage of the information provided and the areas of cost savings found as a result of HOL's distribution system planning, i.e. - planning and execution of System Access, System Renewal, System Service and General Plant investments through the Asset Management Process.

1.1.1 Key Elements of the DSP

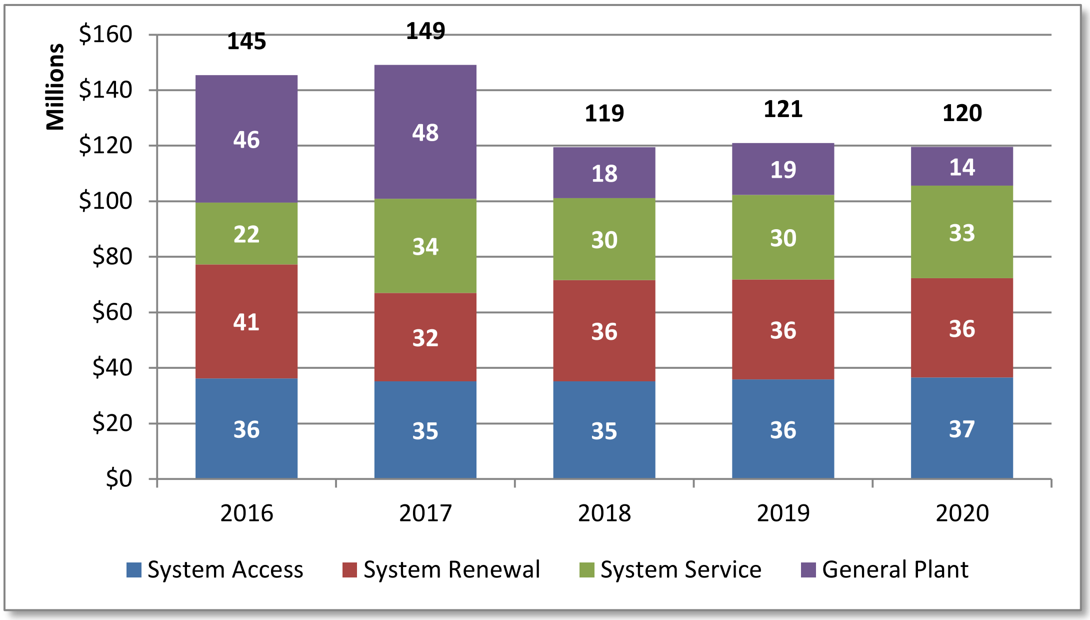
HOL's DSP details the planning process used by HOL as well as the process to take the system demographics and needs described to translate them into specific projects and expenditure plans. The DSP also addresses how productivity, lifecycle optimization, consultation with customers, coordination with third parties and requirements of Renewable Energy Generation (REG) play a key role in achieving Corporate Strategic Objectives of HOL.

Table 1.1.1 and Figure 1.1.1 show HOL's planned capital spending levels in each of the Ontario Energy Board's defined investment categories.

Table 1.1.1 - Forecast by Investment Category

Investment Category	$'000				
	2016	2017	2018	2019	2020
System Access (Gross)	36,263	35,156	35,132	35,835	36,551
System Renewal	41,033	31,823	36,491	35,980	35,718
System Service	22,235	33,957	29,518	30,473	33,314
General Plant	45,899	48,138	18,276	18,695	13,954
Grand Total	**145,430**	**149,073**	**119,418**	**120,982**	**119,538**

1 **Figure 1.1.1 - Forecast by Investment Category**



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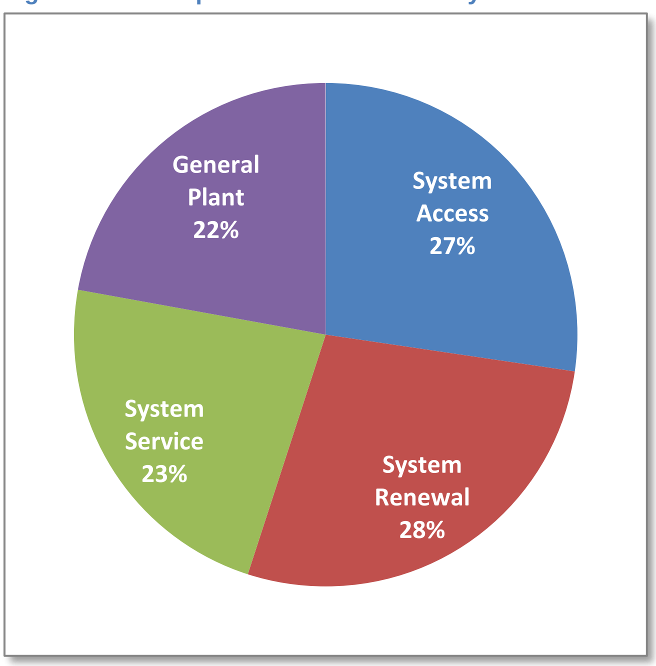
3 **Figure 1.1.2 - Average Forecast Expenditure Distribution by Investment Category (2016-2020)**



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1.1.2 Sources of Cost Savings

The DSP details HOL's prioritizations and optimization of distribution system expenditures. Through the Asset Management process outlined in the DSP, HOL strives to level investments to minimize the risks associated with reliability and customer impact, safety, environment while improving on our service to our customers and providing increasing value to our shareholder. As displayed in Section 3 Capital Expenditure Plan, business cases are created to evaluate project alternatives so that the most effective, in regards to cost and benefits, solution is identified for implementation. Annual expenditures are then paced so that the timing of investments are optimized to minimize overall risk to HOL`s business values as much as possible for every dollar spent.

HOL is focused on productivity and developing efficiencies as sources of cost savings in both capital and O&M programs. Examples such as asset lifecycle optimizing and increased planning can result in real cost savings. The following list outlines a number of key areas of cost savings HOL is focusing on:

Operational productivity

HOL is striving to create a culture of continuous improvement. Whether through process improvement or by leveraging new technology, HOL has been, and continues to look for new ways to more efficiently provide the best possible service to our customers. The following is a list of the initiatives introduced at HOL:

- *Lean Method of Management* – A continuous improvement program focused on eliminating waste from business processes;
- *Corporate Productivity Scorecard* – Development of a suite of KPIs to measure and monitor productivity across the organization; and
- *CEO Productivity and Innovation Award* – Intended to recognize those teams and individuals who have driven a tangible or measureable productivity improvement.

These directly relate to the DSP through the following:

- Capital Execution Process Review

- In 2011 HOL completed a Lean review of our capital execution process from project initiation and design through to project closure. A cross functional team of employees involved in different aspects of projects was assembled to review the current state, identify issues and opportunities and make recommendations for implementation that would demonstrate improvements to how we do business.

- Aligned Staff Geographically
  - The Asset Management and Design groups were realigned to match the geographical structure of our construction and maintenance groups. This improved communication and quality of projects from planning through to execution.
- Centralized Scheduling
  - HOL undertook a review of its scheduling systems for capital and maintenance programs and determined that greater efficiencies could be derived from implementing a centralized scheduling system.
- Multi-Disciplined System Designer
  - HOL is working towards changing from a model with functional specific designers to a system with multi-disciplined designers to enable designers to manage all aspects of a project.
- Operational Process Liaison Committee
  - A new cross functional committee was established within the Operations group consisting of staff and management from Design, Scheduling, Service Desk and Construction. The mandate of this cross functional group is to take a look at core business processes that cut across departmental lines to look for opportunities to improve overall efficiency and effectiveness of operational processes.
- Unit Bills
  - Unit bills are lists of material and construction components that are used to create estimates for distribution capital projects. In the old process, a Designer was required to input each unit of material and labour into JD Edwards (HOL Enterprise System) on a job by job basis. This made the task of creating material lists for projects very labour intensive. To reduce this, in 2014 Distribution Design undertook the task of assigning labour and trucking units to each overhead

standard. To avoid the task of building material lists for each overhead project, each standard had a list or unit bill of material, labour and trucking created for it.

Planning Effectiveness

Through an ever improving inspection, testing and maintenance planning and project prioritization process HOL has developed a plan that paces spending while still meeting the reliability requirements of the distribution system. The short term, 5-year plan is tied into the long-term 20-year plan which is developed to align with HOL's Corporate Strategic Objectives: Customer Value, Financial Strength, Organizational Effectiveness, and Corporate Citizenship. As part of the continuous betterment of the planning process, HOL is implementing a new asset investment planning software tool which will improve data flow, asset condition models and will take HOL to the next level of asset analytics and project optimization.

Increased Use of New Technology

When replacing assets at the end of life, or evaluating projects to improve reliability, HOL incorporates new technologies where feasible. This includes:

- Replacing end of life switches with a smart, Supervisory Control and Data Acquisition (SCADA) controlled switches capable of remote operation thus reducing crew and truck time previously required for switching and power restoration.
- Installing fault current indicators (FCIs) based on past experience and evaluation of single line diagrams for ideal installation locations. The smart FCIs report is communicated back to system office through the SCADA network which provides indication to the operators as to the location of the fault, speeding up switching and restoration time by reducing the time spent on trouble shooting.
- HOL is trialing cable rejuvenation through the use of cable injection to extend the life of direct buried XLPE cables. The cable injection process proves to be significantly more cost effective compared to the traditional asset replacement. Should this program prove successful, HOL will be able to redirect the savings obtained through injection versus replacement in the cable replacement program to other areas of the asset management process, helping to close the gap between the needs identified and available expenditure levels.

- HOL has invested in an Asset Investment Planning initiative to implement Copperleaf's C55 program. The C55 program will allow HOL to automate the optimization process further improving the ability to mitigate risks and increase benefits amongst a variety of project ideas. This is achieved by comparing all possible scenarios of projects which fit within the user specified constraints and recommends a list of projects which best meets the Corporate Strategic Objectives.
- HOL has recommended the acquisition of a Mobile Workforce Management (MWM) tool to address three core requirements; Unified Dispatching, Intelligent Job and Route Optimization, and Performance Management capability. MWM tools will enable the following:
    - Increase in daily job completion rates
    - Improve on-time performance
    - Decrease kilometers driven and reduce fuel consumption
    - Cut overtime
    - Reduce field service teams administrative load
    - Reduce morning preparation time before trucks roll
    - Reduce inbound "Where's My Tech" calls
    - Reduce unnecessary truck rolls
    - Improve customer satisfaction
    - Significantly enhance Performance Management discipline

Implementation of today's MWM tools will allow HOL to enjoy the benefits of improved productivity and cost reductions, while also staying a step ahead of the increasing demands of its customers.

Through the use of these technologies a reduction of manual efforts is achieved, thereby creating better efficiencies and overall better reliability. They also allow for greater O&M savings than their initial investments thus reducing the overall lifecycle cost.

Detailed Short Term Planning

Having multiple years' worth of projects identified and justified allows design packages to be created in advance, creating a more adaptive plan. Should a project be advanced or deferred due to third party constrains not previously know, crews are able to quickly redirect their time to a project whose construction package is ready for implementation, minimizing down time. As well, by having a detailed short term plan improves coordination with third parties by enabling HOL to start communications far in advance of work being scheduled.

Storm Hardening

The Storm Hardening project was a project identified to assess the current state of trees in proximity to HOL's overhead infrastructure and develop new trimming standards that would decrease the impact of tree contact cause outages during adverse weather conditions. Over the course of three years HOL inspected all of the overhead spans of conductor in its service territory. The data gathered is being used to evaluate the current tree trim cycles and look for opportunities to improve the effectiveness of the program with more information on tree species for each span. Also identified through the inspections were 2,650 spans with branches overhanging the conductor. This overhang increases the risk of an outage caused by fallen branches. To reduce this risk, HOL is working to eliminate all vegetation overhangs in the system through a dedicated vegetation management project. Reducing the number of outages caused by tree contacts will save resource costs associated with responding to an outage as well as the cost of repairing or replacing damaged equipment as a result of the fallen branches. This will also have a positive impact on reliability. Moving forward, the elimination of overhang will become part of HOL's tree trimming standards and will be maintained as part of regular trim cycles.

Committee Participation with Third Parties

HOL continues to actively participate in committees with third parties, which assist HOL in identifying deficiencies and improvements that allow the company to service customers with a reliable, cost effective supply of electricity at the lowest possible cost. HOL is a member of many technical and standards committees which allows the company to deploy best practices and processes. These committees include:

- Electricity Distributors Association (EDA) Operations Council;
- Electrical Contractors Association (ECA) Ottawa;
- Canadian Standards Association (CSA) Standards committees;
- Electrical Safety Authority (ESA);and
- Canadian Electricity Association (CEA)

Centre for Energy Advancement through Technological Innovation (CEATI)

CEATI is a user-driven organization that is committed to providing technology solutions to its electrical utility participants, who are brought together to collaborate and act jointly to advance the industry though the sharing and development of practical and applicable knowledge. These innovations address issues pertinent to day-to-day operations, maintenance, and planning.

In addition to enabling information exchange through topic-driven interest groups and industry conferences, CEATI International brings participants together to collaborate on technical projects. The outcome of these projects has great impact on the infrastructure that HOL plans to use in the future. HOL is a member of numerous interest groups and specialized task forces within CEATI. They are joined by over 120 participating organizations which include electric and gas utilities, governmental agencies, and provincial and state research bodies such as: Hydro One Networks Inc., PowerStream Inc., Toronto Hydro Electric System Limited, National Research Council, Ontario Power Generation, and Ontario Power Authority.

1.1.3 DSP Period

The DSP covers the historical period from 2011 to 2015 and outlines the forecast years 2016 to 2020.

1.1.4 Vintage of Information

All information and details provided have been compiled throughout 2014, unless otherwise stated, and should be considered as current.

1.1.5 Asset Management Process Updates

HOL has not previously filed a DSP, and as such there are no changes since the last filing.

1.1.6 Aspects Contingent on Ongoing Activities or Future Events

HOL is currently involved in the Integrated Regional Planning Process (IRRP) (1.2.1.1 Integrated Regional Resource Planning Process) for the Ottawa area, the results of which are currently not final. A number of regional and bulk system needs are currently being studied to determine optimal solutions. The results of the study may recommend specific projects that could impact capital expenditures over the forecast period of 2015 through 2020.

Through HOL's annual Capacity Plan evaluation process, a need for additional capacity in the Lisgar TL station area was identified. HOL opted to engage Hydro One through the IRRP, for the upgrade of the two station transformers to meet the capacity requirements. Hydro One is currently creating estimates for this work so the final costs are not yet determined, and it is anticipated that expenditures will be required within the forecast period of 2015-2020.

Also engaged through Regional Infrastructure Planning (RIP), HOL has a number of station projects identified in the forecast period whose costs are dependent on the outcome of Hydro One Network Inc. evaluation and estimating process – Connection & Cost Recovery Agreements (CCRA), timelines of which have not yet been determined. Refer to 3.4.5 General Plant for more details on the forecasted expenditures.

1.2 Coordinated Planning with Third Parties

HOL continues to actively participate in consultations with third parties, which assist HOL in identifying deficiencies and improvements that allow the company to service customers with a reliable, cost effective supply of electricity at the lowest possible cost. HOL consults with customers, the transmitter, the Ontario Power Authority (OPA) (now Independent Electricity System Operator (IESO)), local distribution companies (LDCs), the City of Ottawa, and other third parties to better coordinate infrastructure planning now and into the future. These consultations are described in detail below.

1.2.1 Consultations

The following sections provide details on the various groups that HOL consults with in relation to the coordination of infrastructure planning.

1.2.1.1 Integrated Regional Resource Planning Process

HOL is currently involved in an Integrated Regional Resource Planning (IRRP) process which is being developed by the IESO (includes former OPA). The IRRP began in 2011 but has since been updated due to the OEB's adoption of the Planning Process Working Group report in 2013.

The IRRP process develops and analyzes forecasts of demand growth for a 20-year time frame, determines supply adequacy in accordance with the Ontario Resource and Transmission

Assessment Criteria (ORTAC), and develops integrated solutions to address any needs that are identified. These include: conservation, demand management, distributed generation, large-scale generation, transmission, and distribution. HOL has provided the IESO (OPA) with an updated long term load forecast, which is provided in Appendix A. The forecast outlines several transmission and distribution stations that will exceed their capacity limitations within the near, medium, and long term. HOL also contributes to the IRRP by identifying feasibility limitations within the planning area that may not be known to the working group (i.e. Greenbelt). The IRRP is to address the arising needs, identifying cost effective and viable solutions. The working group, which consists of the IESO (OPA), HOL, Hydro One Network Inc., and Hydro One Distribution, holds several meetings throughout the year to discuss progress on the study.

The final deliverables from this study are:

- Handoff letters from the OPA to direct the implementation of near term actions; Delivered on June 27th, 2014, Appendix B
- Final 20 year IRRP report; expected in Q1 2015
- Handoff letters from the IESO (OPA) to implement actions addressed via the IRRP report; expected in Q1 2015

1.2.1.2 Customer Engagement

HOL recognizes customer value at the centre of its Corporate Strategic Objectives and annually engages customers to shape the Corporate Strategic Direction and incorporate their feedback into planning of the distribution system. HOL engages customers with two surveys; the Hydro Ottawa Customer Satisfaction Survey (referred to as the SIMUL Survey) and a Touch Logic Survey. The results of these surveys are used to identify areas of improvement and benchmark HOL's accomplishments against results of other utilities. Further details on HOL led customer engagement activities that have a direct impact on the DSP are discussed in section 3.1.10 Customer Engagement Activities.

1.2.1.3 E8 Smart Grid Working Group

The OEB established the E8 Smart Grid Working Group in 2012 in order to provide a forum for LDCs to share their experiences relating to smart grid technologies. The working group discussions focus on:

- Sharing views, strategic thinking, and development of investment drivers
- Verifying technology specifications
- Examining processes and methodologies
- Identifying business and technical challenges with developing smart grid technologies
- Pursuing opportunities to share these experiences with other LDCs

The members of the working group include the OEB, Hydro One, and the 8 largest LDCs in Ontario which are: HOL, Enersource, Hydro Mississauga Inc., Hydro One Brampton Networks Inc., London Hydro Inc., PowerStream Inc., Veridian Connections Inc., Toronto Hydro Electric System Limited, and Horizon Utilities Corp.

Each LDC has the opportunity to host a meeting and highlight its own smart grid endeavours. HOL continues to benefit from the furthered understanding of smart grid technologies and incorporates these technologies into HOL's system through future planning processes.

1.2.1.4 City of Ottawa Utility Coordinating Committee (UCC)

The UCC provides a forum for communication between invited utilities and the City of Ottawa in order to ensure safe and efficient management of the infrastructure within road allowances and other right-of-ways. Every fall, HOL provides the road authority with their proposed major works plan for the following year to gain efficiency enhancements through improved construction scheduling coordination, damage prevention initiatives, and development of standards.

The primary functions of the committee are:

- Jointly plan construction activities
- Set technical standards
- Protect plant
- Provide a quick communication network
- Maintain a central registry
- Resolve disputes
- Assist the road authority with proposed utility installation permit processes

The committee members are: City of Ottawa, HOL, Hydro One Networks Inc., Heavy Construction Association, Enbridge Gas Distribution, Birch Hill Telecom, Bell Canada, Rogers Cable Communications, Telus Communications, and Allstream.

1.2.1.5 Hydro One - LDC Generation Working Group

The LDC Generation Working Group provides an opportunity for its members to discuss, develop, and potentially adopt policies and best practices relating to LDC distributed generation connections. This allows for better management of the grid when using distributed energy resources, plus effectively and consistently delivering services to generators. The Working Group discussions have also addressed the operational challenges being experienced due to the increase of connected distributed generation. The primary areas addressed by the Working Group are:

- Program administration, both internally within the LDC, and externally to the customer
- Inter-utility communications (especially with embedded LDCs and the Transmitter)
- Engagement with the generation industry
- Engagement with the OEB, IESO (includes the former OPA), and ESA as needed on policy and procedural issues
- Forecast of and adaptation to generation trends and needs
- Technical concerns, resolutions, and standards with respect to:
    - Generation connection: enhancing the customer’s experience
    - Grid management: planning and assessing available generation capacity
    - Operations: outage planning and restoration, permitting temporary run on alternate feeders
    - Inspections and maintenance: ensure safety of people and assets
    - Assessing impact of distributed generation on existing customers and the distribution system

The working group meets quarterly and is comprised of: Hydro One Networks Inc., HOL, Kingston Hydro Corp., Horizons Utilities, Newmarket-Tay Power Distribution Limited, Greater Sudbury Hydro Inc., PowerStream Inc., Toronto Hydro Electric System Limited, London Hydro Inc., and the OPA (now IESO).

HOL believes that continued discussions with the Working Group will improve future planning and operating processes related to the integration of REGs.

1.2.1.6 Ontario Regional Common Ground Alliance (Ottawa)

The Ontario Regional Common Ground Alliance (ORCGA) was established after the amalgamation of the Ontario Prevention Committee and the Third Party Damage Prevention Task Force. It was formally recognized by the Common Ground Alliance (CGA) in 2003 as a partner. The ORCGA develops best practices which represent a dynamic statement of the type of activities that ORCGA believes would provide optimum levels of due diligence towards preventing damage to underground infrastructure. Beyond establishing standard practices, the committee allows for a forum between its members to discuss upcoming projects and local issues. The ORCGA actively tries to improve safety to all stakeholders by raising awareness about safe digging practices via Dig Safe Month in Ontario.

The committee members are: ORCGA, Ontario One Call, HOL, BayCadd Solutions, Promark-Telecon, Enbridge Gas Distribution, Broadband Maintenance, Bell, Hydro One Networks Inc., Goldie Mohr Limited, Drain All, Aecon Utilities, City of Ottawa, TransCanada Pipelines, TransNorthern Pipelines, TSSA, Oakwood Renovations, Marathon Drilling, Bell, UES, Dunda Powerline, and Taggart Construction.

HOL ensures that these standards and processes are used in its practices and through the forum discussions, actively plans future construction activities with the committee members.

1.2.1.7 Greater Ottawa Home Builders Association (GOHBA) – Builder Developer Council (BDC)

GOHBA represents home building and renovation professionals in the Greater Ottawa area with a primary goal of delivering quality housing for Canadians. HOL attends the BDC monthly meetings to take note of and provide input on development plans. The benefits of this council are:

- Customers provide feedback on HOL's practices
- HOL provides insight into developments in order to minimize cost and deliver a timely supply
- HOL provides updated standards and financial changes that may affect projects

- Future development plans allow HOL to forecast load growth and plan infrastructure in order to supply the area

The BDC has over 30 members representing home developers, law firms, and utilities. These members include: GOHBA, HOL, Bell Canada, Rogers Cable Communications, Minto, Mattamy Homes, Walton Development, Vice & Hunter LLP, and Borden Ladner Gervais LLP.

1.2.2 Deliverables

The numerous consultations between HOL and the various third parties described in Section 1.2.1 above continue to be ongoing. The outcome of these efforts result in better understanding and coordination between the various parties involved. Any final deliverables that arise from the coordinated efforts are used in HOL's planning process and capital expenditure plans.

At this time, the IRRP has produced a final deliverable in the form of a handoff letter from the OPA (now IESO) to Hydro One Networks Inc. as seen in Appendix B. This letter details the initiation of development work on near and mid-term transmission solutions to meet the needs identified by the working group. Specifically, the letter contains two transmission solutions that have been identified in impacting HOL's capital expenditure plan. These solutions will be developed and implemented by Hydro One Networks Inc. Currently, the date and cost to HOL is not known and it is unlikely that material investment will be identified for this Application's Test Year period. However, the date and costs of this work has the potential to fall within HOL's Forecast Years.

1.2.3 IESO Letter of Comment – HOL's REG Investments Plan

As described in Chapter 5, the IESO Comment Letter, which can be found in Appendix C, outlines the IESO's assessments of HOL's REG Investments Plan including:

- The applications the IESO has received from renewable generators through the Feed-In-Tariff (FIT) program for connection in the HOL distribution service area;
- Whether HOL has consulted or participated in planning meetings with the IESO;
- The need for co-ordination with other distributors and/or transmitters or others on implementing elements of the REG investments; and
- Whether the REG investments proposed in the DSP are consistent with any RIP.

1.3 Performance Measurement for Continuous Improvement

HOL uses Key Performance Indicators (KPI) to measure continuous improvement in asset management planning, capital investment planning and in customer oriented performance. These indicators include quantitative measures to monitor the effectiveness of utility's planning processes, efficiencies in carrying out those plans, as well as identifying shortfalls as areas for continuous improvement. Table 1.3.1 outlines the key performance indicators, by category, which are described in detail in the following sections.

Table 1.3.1 - Key Performance Indicators by Category

Category	Key Performance Indicator	Sub KPI
1.3.1.1 Customer Oriented Performance	1.3.1.1.1 Customer Engagement	
	1.3.1.1.2 System Reliability Performance Indicators	o SAIFI o SAIDI o CAIDI o $FEMI_{10}$
	1.3.1.1.3 Worst Feeder Analysis	
	1.3.1.1.4 System Average RMS Variation Frequency Index (SARFI)	
1.3.1.2 Cost Efficiency & Effectiveness	1.3.1.2.1 Cost Efficiency	
	1.3.1.2.2 Labour Utilization	o Productive Time o Labour Allocation
1.3.1.3 Asset Performance	1.3.1.3.1 Defective Equipment Contribution to SAIFI	
	1.3.1.3.2 Health, Safety and Environment	
1.3.1.4 System Operations Performance	1.3.1.4.1 Stations Exceeding Planning Capacity	
	1.3.1.4.2 Feeders Exceeding Planning Capacity	
	1.3.1.4.3 Stations Approaching Rated Capacity	
	1.3.1.4.4 Feeders Approaching Rated Capacity	
	1.3.1.4.5 System Losses	

1.3.1 Distribution System Planning Process Performance Indicators

The following sections describe the quantitative KPIs used by HOL to monitor the quality of the planning process and the efficiency with which the plans are implemented and the extent to which the planning objectives have been met.

1.3.1.1 Customer Oriented Performance

HOL continuously seeks feedback from customer on their satisfaction with the services provided by HOL. The customer satisfaction levels have proven to be greatly impacted by the distribution system's service reliability. Where gaps are found, the appropriate actions are identified to address the issues. Service reliability is integral to all work undertaken as part of system planning and asset management. Annually, as part of the Annual Planning Report (see Attachment B-1(B)), HOL undertakes a thorough review of system reliability and identifies planned works which are designed to directly impact system reliability.

1.3.1.1.1 Customer Engagement

HOL recognizes customer value at the centre of its Corporate Strategic Objectives and annually engages customers to shape the Corporate Strategic Direction and incorporate their feedback into planning of the distribution system. HOL engages customers with two surveys; the annual Hydro Ottawa Customer Satisfaction Survey (referred to as the SIMUL Survey) and monthly Touch Logic Surveys. The results of these surveys provide HOL with KPIs which HOL uses to identify areas of improvement and benchmark HOL's accomplishments against results of other utilities.

1.3.1.1.2 System Reliability Performance Indicators

HOL tracks system reliability performance using the following indicators:

System Average Interruption Frequency (SAIFI)

This index is designed to give information about the average frequency of sustained interruptions per customer over a predefined area. In words, the definition is:

$$SAIFI = \frac{Total\ number\ of\ customer\ interruptions}{Total\ number\ of\ customers\ served}$$

This index is reported both including and excluding Loss of Supply (LoS). *SAIFI including LoS* provides information as to the total interruptions which are seen by the ‘average’ customer. *SAIFI excluding LoS* indicates the ‘average’ customer interruptions which are the result of causes under the direct control of HOL.

HOL’s target is always to reduce SAIFI. Reliability driven sustainment projects along with better defined testing, inspection and maintenance programs will help to reduce the number of outages experienced.

System Average Interruption Duration Index (SAIDI)

This index is designed to provide information about the average time customers are interrupted. In words, the definition is:

$$SAIDI = \frac{Total\ hours\ of\ customer\ interruptions}{Total\ number\ of\ customers\ served}$$

This index is reported both including and excluding Loss of Supply (LoS). As with SAIFI, the *SAIDI including LoS* provides information as to the total duration of interruptions which are seen by the ‘average’ customer whereas *SAIDI excluding LoS* provides an indication as to the duration which the ‘average’ customer is interrupted as the result of causes under the control of HOL.

HOL’s target is always to reduce SAIDI. Increased investments in system automation and new equipment trials will help expedite restoration efforts after outages occur.

Customer Average Interruption Duration Index (CAIDI)

CAIDI represents the average time required to restore power to the average customer per sustained outage. In words, the definition is:

$$CAIDI = \frac{SAIDI}{SAIFI} = \frac{Total\ hours\ of\ customer\ interruptions}{Total\ number\ of\ customer\ interruptions}$$

Feeders Experiencing Multiple Sustained Interruptions ($FEMI_n$)

This index represents the number of feeders experiencing sustained (greater than 1 minute) outages greater than or equal to value n; current reporting is done for n=10. It is a customer centric measure as it provides an indication as to which regions have seen high localized issues. $FEMI_{10}$ is reported excluding Scheduled Outages as well as Loss of Supply, to more accurately track regions seeing issues, as opposed to including regions seeing multiple outages due to maintenance, repair and upgrade activities.

HOL's target is always to reduce FEMI. Reliability driven sustainment projects as well as better defined testing, inspection and maintenance programs will help to reduce the number of outages experienced.

1.3.1.1.3 Worst Feeder Analysis

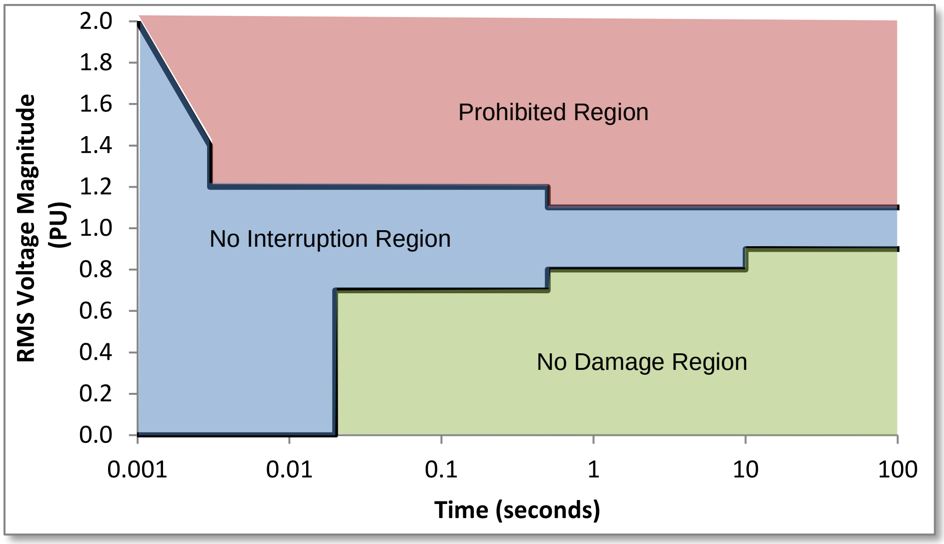
In 2011, a standard method to determine the "Worst Feeders" was defined. This method takes into consideration the duration, frequency and number of sustained outages as well as the number of momentary (duration < 1min) interruptions a feeder experiences. See Appendix D for details on how these factors are incorporated in the overall determination of the Worst Performing Feeders. Annually, based on the Worst Feeder Methodology, the 10 worst feeders are evaluated and potential improvements to the feeders are proposed.

The worst feeder program is designed to address short term reliability issues in an immediate time-frame. All work identified in the previous year review will be carried out in the following budget year, with targeted completion before the beginning of storm season. In the fall of 2015, identification and assessment of the worst feeders will again be carried out and appropriate actions will be undertaken to improve performance of the identified circuits.

1.3.1.1.4 System Average RMS Variation Frequency Index (SARFI)

The System Average Root Mean Square (RMS) Variation Frequency Index (SARFI) is an indicator of system power quality which measures the average number of voltage sags on the system. Poor voltage is considered to be outside ±6% of the system nominal voltage and it is HOL's objective to maintain voltage within these tolerances and below the prohibited region of the Information Technology Industry Council (ITIC) curve (see Figure 1.3.1). The target is to put corrective measures in place as soon as possible.

Figure 1.3.1 - ITIC Curve



1.3.1.2 *Cost Efficiency & Effectiveness*

On an annual basis, HOL uses the cost efficiency and labour utilization KPIs to report on the progress, efficiency and effectiveness to monitor the effectiveness of utility's planning processes, efficiencies in carrying out those plans, as well as identifying shortfalls as areas for continuous improvement.

1.3.1.2.1 Cost Efficiency

Cost Efficiency is an indicator of the amount of planned capital activities as a ratio to actual capital activities performed throughout the year. Cost efficiency is strictly a measure of all planned projects in System Renewal and System Service Investment Categories, but does not include System access or General Plant investments. Completion of the planned capital projects are monitored through HOL's financial system. Deviations from the project budget are managed through a change request process that must be justified and approved. Representatives from scheduling, construction, engineering and design meet on a bi-weekly basis to prioritize on-going and upcoming work in order to ensure work is completed on time and within budget. The target of the cost efficiency indicator is to achieve 100% completion of the annual planned work within the approved budget.

1.3.1.2.2 Labour Utilization

HOL tracks labour utilization performance using the following indicators:

Productive Time

Productive time represents the total regular hours charged to a work order as a ratio to total regular hours. The target of the productive time indicator is to maximize this index by identifying and improving efficiencies.

$$Productive\ Time = \frac{Percent\ of\ Billable\ Hours}{Total\ Regular\ Hours}$$

Labour Allocation

The labour allocation index represents the amount of labour spent on capital activities as a ratio to the total productive time. The target of the labour allocation indicator is to ensure that the appropriate amount of time is spent on Capital activities versus OM&A type activities as per annual work plans.

$$Labour\ Allocation = \frac{Percent\ of\ Labour\ Time\ on\ Capital\ Activities}{Total\ Productive\ Time}$$

1.3.1.3 *Asset Performance*

HOL tracks asset performance using the following KPIs:

1.3.1.3.1 Defective Equipment Contribution to SAIFI

This indicator tracks the contribution of defective equipment outages by asset class to the overall system SAIFI per 100 customers (SAIFI x 100). HOL's objective is to reduce the number of interruptions caused by defective equipment from year to year.

1.3.1.3.2 Health, Safety and Environment

The Health & Safety and Environment indicator tracks the number of public safety concerns and the amount of oil spilled into the environment. Public safety concerns and oil spills are addressed immediately; therefore no specific objective has been set, as the goal is to simply reduce these numbers.

1.3.1.4 *System Operations Performance Indicators*

HOL tracks system operation performance using the following KPIs:

1.3.1.4.1 Stations Exceeding Planning Capacity

This indicator is defined by the percentage of stations with a summer peak operating above 100% of their planned capacity rating.

The planned capacity rating is defined as the sum of either the transformers' 10 day LTR or the allowable top load rating if there is no published LTR for the remaining transformers following a single contingency loss of the largest element within the substation (N-1 contingency). An N-1 contingency for a station is defined as the loss of the largest transformer within the station. Note that for stations with a single supply and a single transformer, the planning capacity rating is considered to be the rated capacity of the single unit (10 day LTR or allowable top load rating if there is no published LTR).

1.3.1.4.2 Feeders Exceeding Planning Capacity

This indicator is defined by the percentage of feeders with a summer peak operating above 100% of their planned capacity rating.

The planned capacity rating for a feeder takes three factors into consideration:

1. Coordination with lo-set instantaneous protection;
   - Under normal pre-contingency operating conditions, a feeder cannot be loaded above a level that would result in the lo-set instantaneous protection preventing feeder restoration, see the description below for cold load pick up.
2. Feeder cold load pick up ability; and
   - Outage analysis indicates that the cold-load and hot load pick up phenomenon results in approximately 2-times the feeder pre-contingency loading at 0.2 seconds (trip time setting for lo-set instantaneous protection).

Voltage (kV)	Lo-set Inst. Pick Up (A)	Cold Load Factor	Feeder Load Limit (A)
4.16	600	2	300
8.32	600	2	300
12.47	700	2	350
13.2	1000	2.5	400
27.6	1000	2.5	400

3. Short term (8 hour) egress cable overload capabilities
   - Under normal pre-contingency operating conditions, a feeder cannot be loaded above the nominal capacity rating of the cable. In addition, a feeder must be capable of backing up neighbouring feeder(s) in the event of failure of supply of the neighbouring feeder or other contingency conditions. For the purposes of providing back-up ability, it is assumed that the feeder will be required to operate in the abnormal configuration with post-contingency loading levels for up to 8 hours.

Voltage (kV)	Typical Egress Cable	Design Rating (A)	8hr Rating (A)
4.16	5kV 4/0 Cu PILC, buried in duct	285	330
8.32	15kV, 500 MCM Cu XLPE, direct buried	675	870
12.47	15kV, 500 MCM Cu XLPE, direct buried	675	870
13.2	15kV 500 MCM Cu PILC, duct bank	425	510
27.6	29kV, 750 MCM Al XLPE, duct bank	450	620
27.6	29kV, 1000 MCM Al XLPE, duct bank	500	685

Given the constraints outlined above, the following limits are used based on feeder egress cable type:

Voltage (kV)	Typical Egress Cable	8hr Loading Limit (A)	Cold Load Limit (A)	Planning Limit (A)	Limiting Factor
4.16	5kV 4/0 Cu PILC	330	300	300	Coordination between Lo-set instantaneous protection and cold/hot load pick-up
8.32	15kV, 500 MCM Cu XLPE	870	300	300	Coordination between Lo-set instantaneous protection and cold/hot load pick-up
12.47	15kV, 500 MCM Cu XLPE	870	350	350	Coordination between Lo-set instantaneous protection and cold/hot load pick-up
13.2	15kV 500 MCM Cu PILC	510	400	255	Ability to provide adequate back-up capability for neighbouring circuits
27.6	29kV, 750 MCM Al XLPE	620	400	310	Ability to provide adequate back-up capability for neighbouring circuits
27.6	29kV, 1000 MCM Al XLPE,	685	400	340	Ability to provide adequate back-up capability for neighbouring circuits

1.3.1.4.3 Stations Approaching Rated Capacity

This indicator is defined by the percentage of stations at or above 100% of the station rated capacity.

The rated capacity is defined as the sum of the top rating (10-day LTR or allowable flat rating should an LTR not be published) of all transformers within the station. If the loading on a transformer exceeds this limit it will cause accelerated loss of life.

1.3.1.4.4 Feeders Approaching Rated Capacity

This indicator is defined by the percentage of feeders at or above 90% of the rated capacity.

The rated capacity is defined as the egress cable 8 hour loading limit. If the circuits are loaded above this limit for longer than 8 hours it will cause overheating and accelerated loss of life.

1.3.1.4.5 System Losses

Distribution losses are defined in the *Ontario Energy Board's Distribution System Code* as: "energy losses that result from the interaction of intrinsic characteristics of the distribution network such as electrical resistance with network voltages and current flows".

1.3.2 Performance Summary

The following sections provide a summary of performance and performance trends over the historical period using the methods and measures identified above.

1.3.2.1 Customer Oriented Performance

HOL continuously seeks feedback from customer on their satisfaction with the services provided by HOL. The customer satisfaction levels have proven to be greatly impacted by the distribution system's service reliability. Where gaps are found, the appropriate actions are identified to address the issues. Service reliability is integral to all work undertaken as part of system planning and asset management. Annually, as part of the Annual Planning Report (see Attachment B-1(B)), HOL undertakes a thorough review of system reliability and identifies planned works which are designed to directly impact system reliability.

1.3.2.1.1 Customer Satisfaction

Customer value is at the centre of HOL's Corporate Strategic Objectives and customers are engaged annually to shape the Corporate Strategic Direction and incorporate their feedback into planning of the distribution system. HOL engages customers with two surveys; the Hydro Ottawa Customer Satisfaction Survey (referred to as the SIMUL Survey) and a Touch Logic Survey. The results of these surveys provide HOL with KPIs which HOL uses to identify areas of improvement and benchmark HOL's accomplishments against results of other utilities.

1.3.2.1.2 System Reliability Performance Indicator

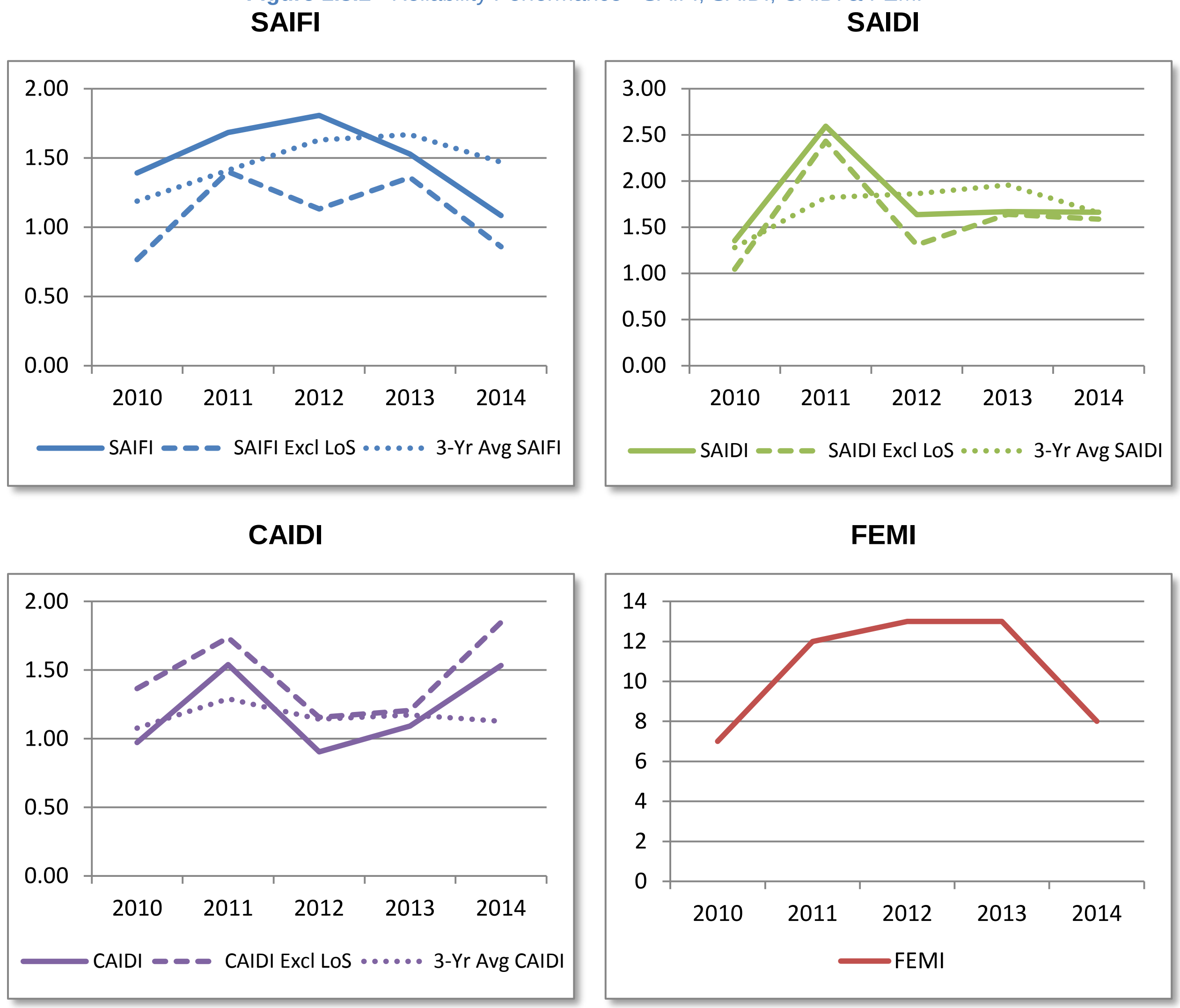
HOL's reliability performance in 2014 improved from previous years. Interruption categories such as defective equipment and adverse weather, or storm related outages have been progressively trending worse and have exceeded the previous 3-year averages. Improvements to the asset management processes are underway making use of the new C55 Asset Investment Planning software to enhance our ability to prioritize end of life asset replacements. Maintenance, inspection and testing of existing assets will continue to be essential to ensure equipment operates as expected and to identify failures before they occur. Consideration of new ways of operating to reduce system susceptibility to storm damage and foreign interference is vital. In addition, investing in grid technologies will benefit reliability by reducing restoration times and aid in predicting system faults. HOL's objective is to improve the System Reliability Performance Indicators from year to year.

Table 1.3.2 - Reliability Performance Summary

KPI	2010	2011	2012	2013	2014
Annual SAIFI	1.39	1.68	1.81	1.53	1.08
SAIFI Excl LoS	0.77	1.40	1.13	1.36	0.86
3-Yr Average SAIFI	1.19	1.41	1.63	1.67	1.47
Annual SAIDI	1.35	2.60	1.64	1.67	1.66
SAIDI Excl LoS	1.05	2.43	1.31	1.64	1.59
3-Yr Average SAIDI	1.28	1.82	1.86	1.96	1.66
Annual CAIDI	0.97	1.54	0.90	1.09	1.53
CAIDI Excl LoS	1.37	1.74	1.15	1.21	1.85

3-Yr Average CAIDI	1.08	1.29	1.14	1.17	1.13
$FEMI_{10}$	7	12	13	13	8

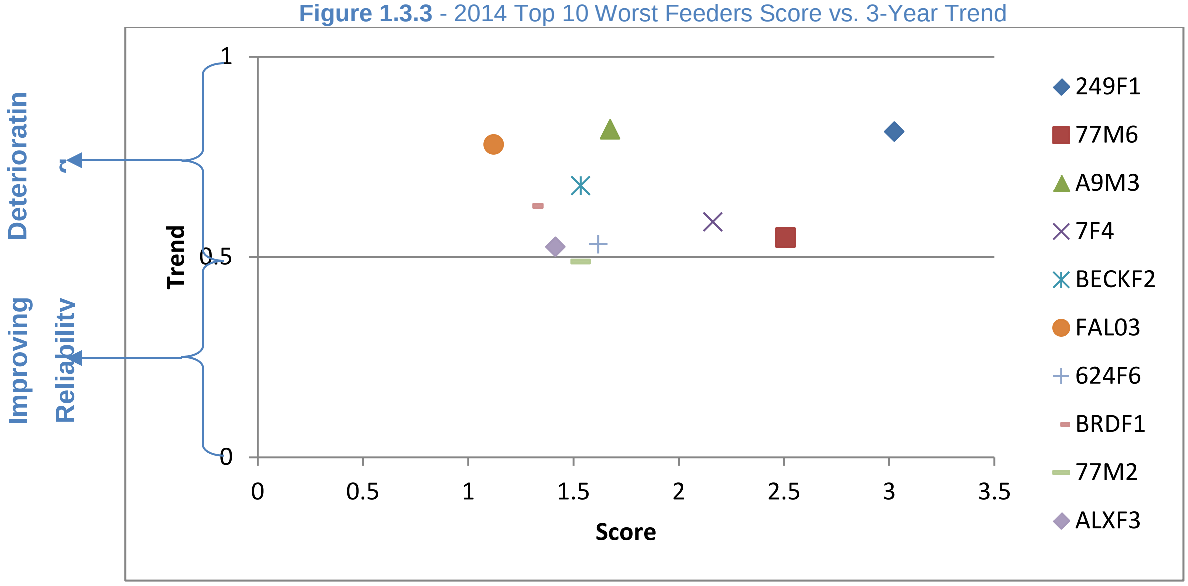
Figure 1.3.2 - Reliability Performance - SAIFI, SAIDI, CAIDI & FEMI



1.3.2.1.3 Worst Feeder Analysis

The Worst Feeder Methodology recommends tracking the worst feeders over a three year period to allow time for the improvements to be seen. The following figure outlines the 10 worst feeders for 2014 and where they sit in regards to Score versus Trend. Note that feeders that have a trend below 0.5 are seeing an improvement in reliability (1 feeder in 2014 – 77M2). Moving forward, the feeders will need to be continually tracked to determine whether the improvements made in the distribution have had an impact on improving the feeder's reliability. It is believed that there will be at least a three year lag in seeing the improvements on the feeder – 1 year for the improvement to be implemented and the two following years to develop a new trend.

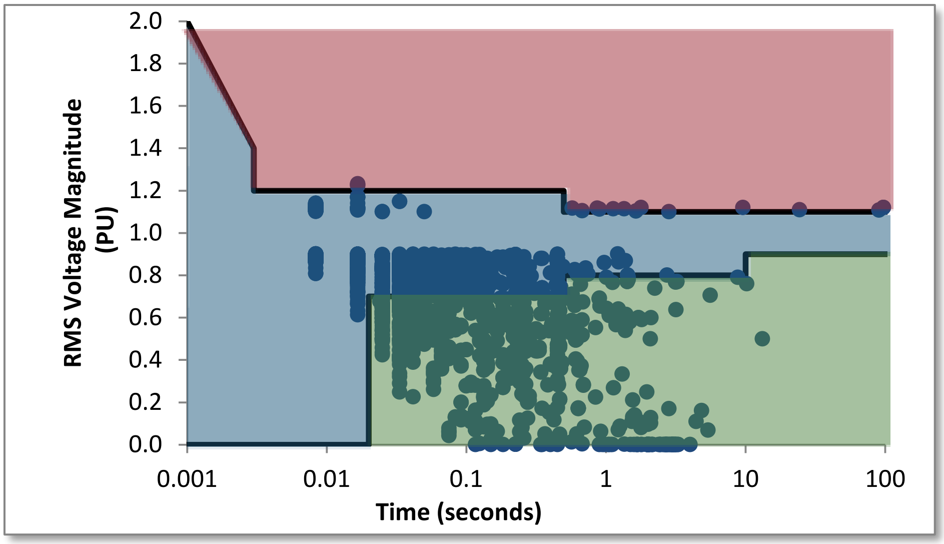
Figure 1.3.3 - 2014 Top 10 Worst Feeders Score vs. 3-Year Trend



1.3.2.1.4 System Average RMS Variation Frequency Index (SARFI)

The Information Technology Industry Council (ITIC) curve represents the 2013 RMS voltage variation events plotted against the variation envelope which single phase modern devices can tolerate. Of the 2820 events recorded in 2013, 16 fell within the prohibited region. The target is to put corrective measures in place as soon as possible. Of the 16 prohibited events, 11 were due to events on the transmission system (not owned by HOL), 2 were of unknown cause and 2 were due to HOL feeder faults.

Figure 1.3.4 - 2013 Power Quality Events ITIC Curve



*Note that 2014 Power Quality Events ITIC Curve is not yet available

1.3.2.2 Cost Efficiency & Effectiveness

On an annual basis, HOL uses the cost efficiency and labour utilization KPIs to report on the progress, efficiency and effectiveness to monitor the effectiveness of utility's planning processes, efficiencies in carrying out those plans, as well as identifying shortfalls as areas for continuous improvement.

1.3.2.2.1 Cost Efficiency

HOL identified the Cost Efficiency indicator in 2011 which annually targets to complete 100% of the work planned. In 2011 and 2012, the target was not achieved as a result of resources being unavailable due to the amount of plant failure repairs that were completed in those years. In 2013, HOL was able to complete an additional 5% above the target of the work planned as a result of unplanned work that was deemed required to increase the amount of risk mitigated.

Table 1.3.3 - Cost Efficiency

KPI	Target	2011	2012	2013	2014
Cost Efficiency	**100%**	94%	94%	105%	94%

1.3.2.2.2 Productive Time

HOL's annual target for the Productive Time indicator is to improve from the year before. The indicator which began being tracked in 2011, is affected by training, vacation and sick time, but also does not account for the work completed on overtime. Further efficiencies will need to be identified in order to maximize this index and contribute to trending improvement.

Table 1.3.4 - Productive Time

KPI	2011	2012	2013	2014
Productive Time	70%	71%	69%	69%

1.3.2.2.3 Labour Allocation

HOL identified the Labour Allocation indicator in 2011 which aims to aid in the evaluation that the proper amount of time is spent on capital versus OM&A as per each year's annual plan. Labour allocation is hindered by aging infrastructure requiring increased hours spent on O&M activities

Table 1.3.5 - Labour Allocation

KPI	2011	2012	2013	2014
Labour Allocation	61%	55%	56%	59%

1.3.2.3 Asset Performance

HOL tracks asset performance using the following KPIs:

1.3.2.3.1 Defective Equipment Contribution to SAIFI

Asset failures impact the ability to provide reliable customer service to different extents. The impact of asset failures on system reliability is currently on an upward trend. The specific assets which are contributing to this trend include Underground Cable Attachments, Station Switchgear, Overhead and Underground Transformers, and Poles. Increased or more targeted asset replacement may be required to manage these assets such that they do not adversely impact system reliability performance. Trends are reviewed in HOL's Asset Management Planning Report as part of the Annual Planning Report (see Attachment B-1(B)) on an annual basis to establish a target for the frequency and the quantity of assets to be replaced.

Table 1.3.6 - Defective Equipment SAIFI per 100 Customers

Asset	2010	2011	2012	2013
U/G Cable - Polymer	5	10	4	2
Insulator	2	7	0.3	0.1
Station Switchgear	2	5	0	3
O/H Switchgear	4	4	3	6
U/G Cable Attachment	2	3	2	5
Station Transformer	1.2	1.2	2	0
U/G Switchgear	1	1	7	0.1
U/G Cable - PILC	0.7	0.6	0.6	1.5
O/H Transformer	0	0	1	2
Pole	0	0	1	4
U/G Transformer	1	0	3	3
Other	6	9	6	5
Total	25	41	30	32

*Note that 2014 Defective Equipment SAIFI per 100 Customers data is not yet available

1.3.2.3.2 Health, Safety and Environment

HOL reports to the Ministry of the Environment on oil spilled and the cost of remediation. Recent trends are seeing more leaking residential padmounted transformers which have increased the cost of remediation. This emphasizes the importance of active inspection and replacement of padmounted transformers to mitigate this environmental impact.

Table 1.3.7 - Health & Safety and Environment

		2010	2011	2012	2013
Public Safety	Number of Public Safety Concern (PSCs)	9	4	2	10
Oil Spills	Annual Oil Spilled (L)	1,262	1,225	3,249	5,828
	Annual Oil Clean up ($'000)	$378	$563	$465	$792

*Note that 2014 Health & Safety and Environment indicators are not yet available

1.3.2.4 System Operations Performance Indicators

System capacity is currently trailing load growth in the City of Ottawa; this has resulted in fifteen percent of the stations owned by HOL operating above their planning capacity rating set to ensure that adequate capacity is reserved for reliable operation during system contingency.

In 2013, three stations were loaded above their equipment ratings at system peak: Richmond North DS, Nepean TS and Hawthorne TS. Work to increase capacity at Richmond South DS is scheduled to begin in 2015 and will allow for better load balancing between Richmond North and South to alleviate the overload condition. The Hawthorne TS units are currently planned for replacement by Hydro One and load balancing at Nepean TS should resolve the slight overload seen in 2013. There is a positive trend being shown in the data: as capacity projects progress the system is seeing less stress since 2010.

Losses remained within the acceptable range of between 2% to 4%. HOL continues to work to reduce system losses through better system planning and the updating or replacement of equipment.

Feeders exceeding their planning ratings are within target (≤ 10%), but careful review and planning is being undertaken to ensure adequate backup is maintained to allow for secure and reliable delivery of power for HOL's Customers.

Table 1.3.8 - System Operations Performance Indicators

KPI	Target	2010	2011	2012	2013
Stations Exceeding Planning Capacity	≤ 5%	26% (20)	24% (22)	20% (18)	15% (14)
Feeders Exceeding Planning Capacity	≤ 10%	3.5% (28)	3.4% (27)	3.3% (26)	3.2% (22)
Stations Approaching Rated Capacity	zero	4.4% (4)	2.2% (2)	2.2% (2)	3.3% (3)
Feeders Approaching Rated Capacity	zero	0.4% (3)	0.5% (4)	0.5% (4)	0.3% (2)
System Losses	≤ 4.00%	3.12%	3.13%	3.60%	2.63%

*Note that 2014 System Operations Performance Indicators are not yet available

1.3.3 Effect of Key Performance Indicators on the DSP

HOL's Corporate Strategic Objectives and targets provide the framework for the DSP. The KPIs used to evaluate the company are defined by the Customer Oriented Performance indicators, the Cost Efficiencies & Effectiveness indicators, the Asset Performance indicators and the System Operations Performance indicators. Tracking of these KPIs will allow HOL to set benchmarks and milestones to ensure that the company objectives of continuous improvement are achieved across all areas of business.

2 Asset Management Process

The following sections outline HOL's Asset Management Process – the systematic approach used to plan and optimize ongoing capital and operating and maintenance expenditures. The information is intended to provide the Board and stakeholders with an understanding of the process, and the direct links between the process and the expenditure decisions that comprise the investment plan.

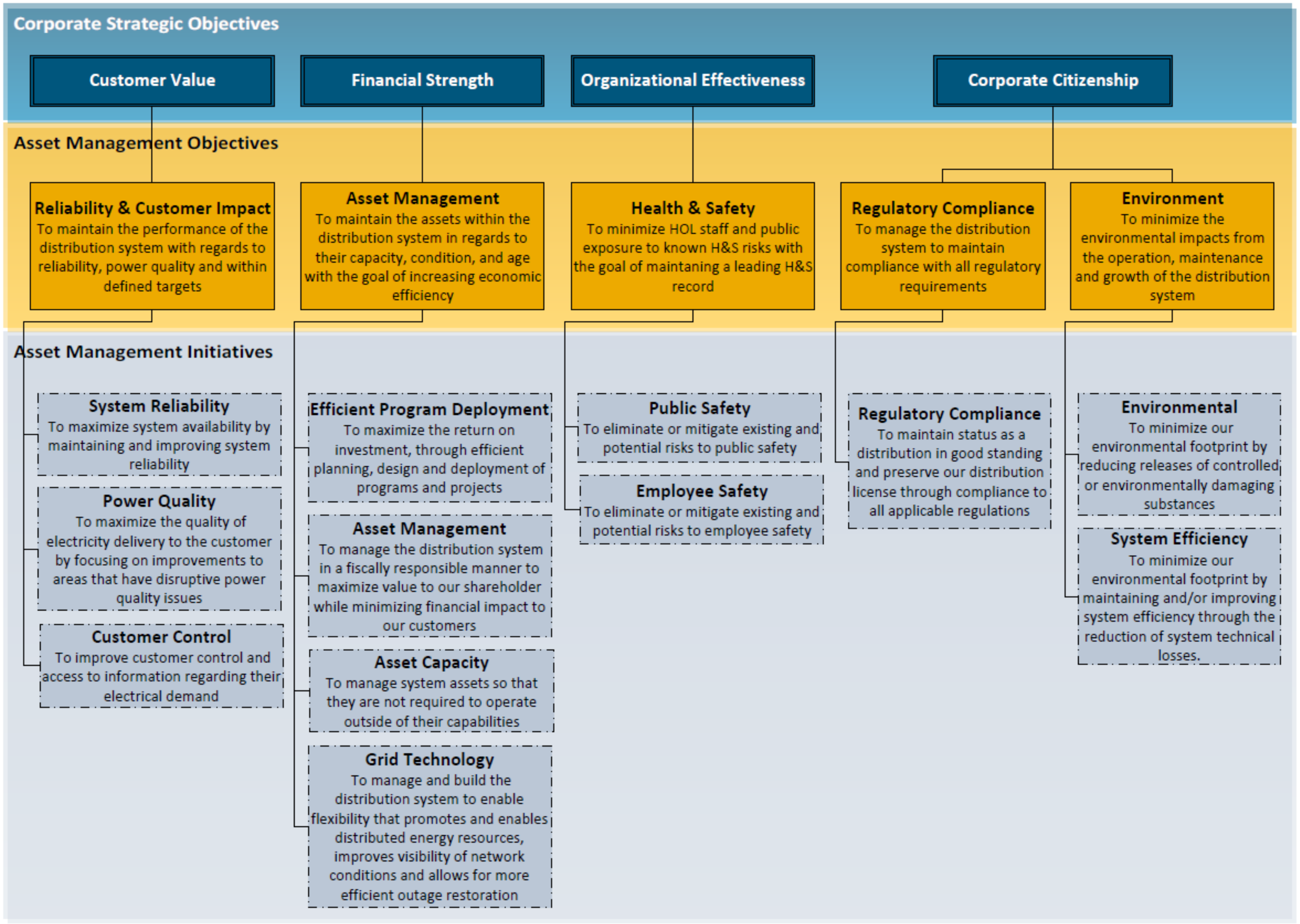
2.1 Asset Management Process Overview

The Asset Management Process Overview section details the Asset Management Objectives and each component in the Asset Management Process.

2.1.1 Asset Management Objectives

The Asset Management Process aligns with HOL's Corporate Strategic Direction by adhering to the Asset Management Initiatives that directly support the Corporate Strategic Objectives as outlined in Section 1.0.1. The hierarchy between the Corporate Strategic Direction through to the Asset Management Initiatives is shown in Figure 1.0.2. Figure 2.1.1 describes the Asset Management Objectives and the associated Asset Management Initiatives which drive the decision making through the Asset Management Process.

1 **Figure 2.1.1 - Asset Management Objectives & Asset Management Initiatives**



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2.1.2 Asset Management Process Components

HOL's Asset Management Process, as shown in Figure 2.1.2, is a function of 5 difference phases:

1) Project Concept Definition (Section 2.1.2.1)
2) Project Evaluation (Section 2.1.2.2)
3) Project Prioritization (Section 2.1.2.3)
4) Project Execution (Section 2.1.2.4)
5) Risk Assessment & Review (Section 2.1.2.5)

The Project Concept Definition phase gathers all internal and external drivers to describe the needs of the organization. Concept projects are created to meet requirements, mitigate or remove risk, and reach goals and objectives.

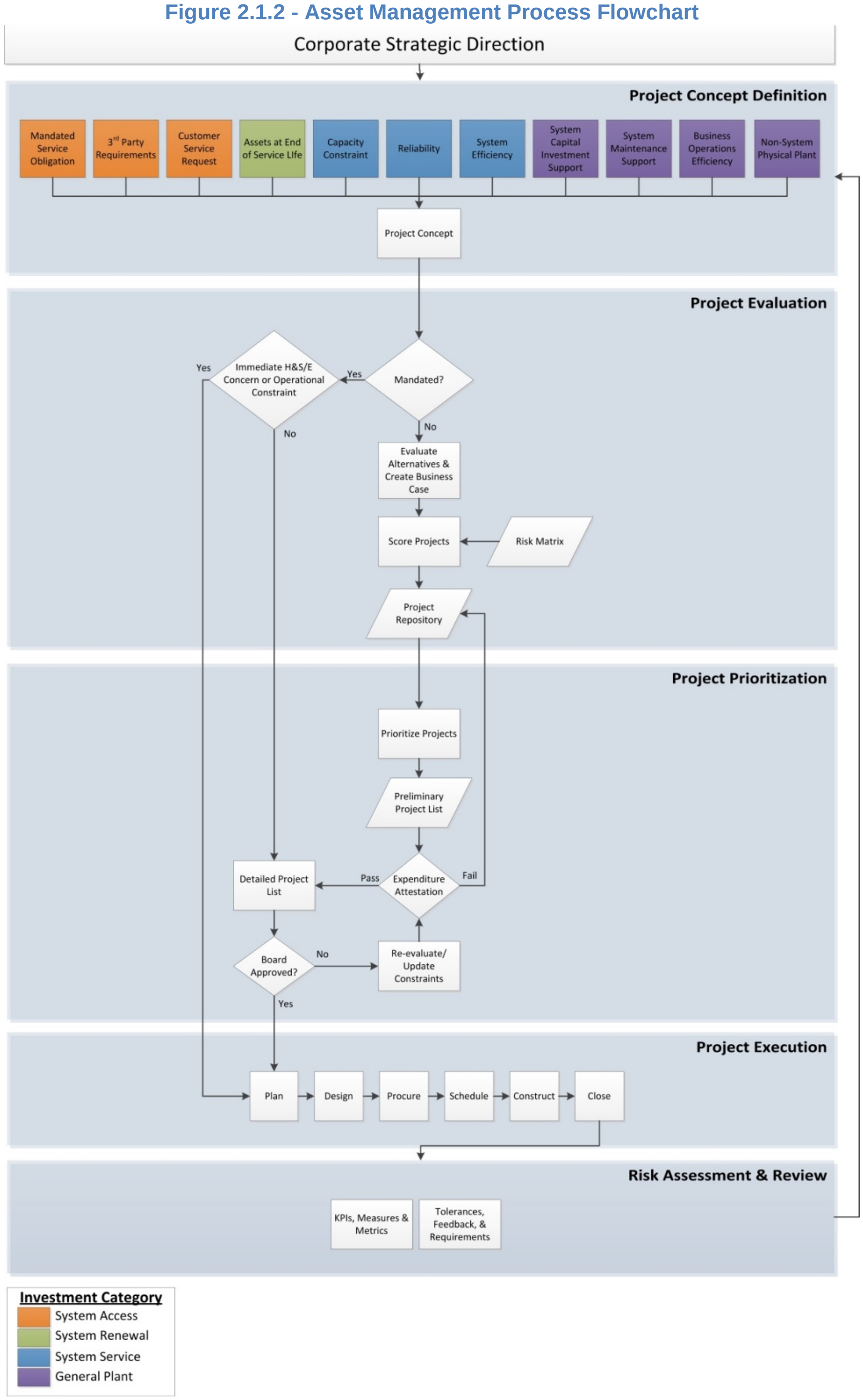
The Project Evaluation phase defines project alternatives and creates business cases in support of the feasible alternatives. Unless mandated, project alternatives are evaluated and valued based on their impact to HOL`s Corporate Strategic Objectives.

The Project Prioritization phase ranks each project based on their value. Resource constraints are used to create a detailed project list for HOL Executive Board approval.

The Project Execution phase uses HOL's Project Coach methodology to manage and execute the project plan. HOL's project coach is based on Project Management Institute best practices.

The Risk Assessment & Review phase measures progress on the Corporate Strategic Objectives, through the Asset Management Initiatives, and evaluates risk based on acceptable tolerances. This phase also captures feedback from the Project Execution phase to allow for continuous improvement and adjustments to the Asset Management Process such as lessons learned and increased forecast accuracy.

Figure 2.1.2 - Asset Management Process Flowchart



2.1.2.1 Project Concept Definition

The Project Concept Definition phase gathers all internal and external drivers to describe the needs of our organizational environment. Concept projects are created to meet requirements, mitigate or remove risk, and reach Corporate Strategic Objectives. Table 2.1.1 outlines the description of the drivers by Investment Category, which are detailed in following sections.

Table 2.1.1 - Driver Descriptions

Investment Category	Driver	Description
System Access	Mandated Service Obligation	Regulatory requirement to maintain distribution licence under the OEB's Distribution System Code or requirement as per HOL's Conditions of Service
	3rd Party Requirements	Request by a 3rd party for plant relocation or upgrade to an existing service
	Customer Service Request	Customer request for new connection (load or generation)
System Renewal	Assets at End of Service Life i. Failure ii. Failure Risk iii. Substandard Performance iv. High Performance Risk	i. Asset no longer meets functional requirements ii. Asset is at risk to no longer meet functional requirements iii. Asset still meets functional requirements; however, falls below standards for operability or efficiency iv. Asset is at risk of failure in a way that can cause harm or damage to other equipment or assets or would put the distribution system in a detrimental state
System	Capacity Constraint	Requirement for additional capacity

Service		(station transformation or circuit) due to planned or realized load increases
	Reliability	Requirements driven by poor distribution system performance such as abnormally (high) duration or frequency of interruptions
	System Efficiency	Requirements for improved system operability and visibility
General Plant	System Capital Investment Support	• Capital contributions to Hydro One for connection projects • Requirement for fleet/vehicle acquisition
	System Maintenance Support	Requirement for tools and associated equipment
	Business Operations Efficiency	Requirements for Information Technology software and systems
	Non-System Physical Plant	Building infrastructure requirements

2.1.2.1.1 System Access

Mandated Service Obligations

Mandated Service Obligations are requirements of a distributor as defined by the OEB's Distribution System Code, as well as any additional obligations as defined by HOL's Conditions of Service. For example, providing metering and making repairs to damaged equipment to provide service to customers.

3rd Party Requirements

3rd Party Requirements are initiated from requests received for the relocation or upgrade (modifications) of assets or infrastructure. For example, pole relocation for road widening.

Customer Service Request

Customer Service Requests arise from the needs of load or generation customers for new connections. For example, servicing for new commercial buildings, residential subdivisions, or generators including any system expansion required to supply the site of development.

2.1.2.1.2 System Renewal

Assets at End of Service Life

HOL describes its asset replacement strategy, or asset management plan, in the Asset Management Planning Report (AMPR), contained within the Annual Planning Report (Attachment B-1(B)). The intention of the AMPR is to document the asset management practices used by HOL as part of an optimized lifecycle strategy for distribution and station assets and to document the Asset Condition Assessment (ACA). The objective of the ACA is to confirm that the assets deliver the required functions at the desired level of performance and that this level of performance is sustainable for the foreseeable future while staying within the targeted levels of risk.

The ACA is a key component of the asset management planning process. Addressed in the asset management plan are the financial, technical, and management elements needed for making sound, innovative or best practice asset management decisions.

The asset management plan looks ahead 20 years with a main focus on the first five years – for this period most of the planned projects have been identified. Beyond this period, analysis is less precise. Based on long term trends, current asset demographics, known asset issues or needs on the system, it is likely that new and planned projects will evolve in the latter half of the forecasted period.

The intent of the asset management plan is on optimizing the lifecycle costs for each network asset group (including creation, operation, maintenance, renewal and disposal) to meet reliability service targets and future demand. Each year, the aim is to improve the plan by taking advantage of new information and changing technology.

HOL's system assets range in age from new to over 50 years old. The management of these assets is critical to providing safe, reliable and efficient electricity distribution services to its customers.

The following list describes the key variables that are used to inform the Asset Condition Assessment as part of the asset management plan.

- Testing, inspection & maintenance records to inform condition;
- Asset demographic and nameplate information;
- Asset failure statistics – number of failures and frequency by asset type (SAIFI);
- Financial useful lives; and
- Financial records – cost per replacement.

The following list describes the results of the asset management planning process.

- Recommended asset replacement rates, refurbishment and associated annual spend;
- Asset condition (health index); and
- Projected failure rates based on spending/replacement levels.

2.1.2.1.3 System Service

Capacity Constraints

HOL routinely assesses the capability and reliability of the distribution system in an effort to maintain adequate and reliable supply to customers. Where gaps are found, appropriate plans for additions and upgrades which are consistent with all regulatory requirements for the connection of customers and with due consideration for safety, environment, finance and supply system reliability/security are developed. HOL summarizes the results of this capacity planning process in the Capacity Planning Report, contained within the Annual Planning Report (Attachment B-1(B)), in which the short and long term capacity needs for the service territory are identified.

In this regard, the supply needs in the service territory have been assessed to determine if additions and/or upgrades are required to maintain adequate and reliable/secure system capacity. HOL, being an amalgamation of 5 utilities, is composed of several subsystems which are segregated by operating voltage and geographical boundaries. The capacity planning process reviews and summarizes the business case for each subsystem, identifying short and long term projects. Forecasted growth, asset replacement schedules, and reliability are all factors in planning the system.

The following describes the key variables that are used to inform the capacity planning process.

- Historical station transformer loading from the system wide annual peak day (weather normalized and adjusted to a one-in-ten year peak for forecasting);
- Historical feeder loading from the system wide annual peak day (weather normalized and adjusted to a one-in-ten year peak for forecasting);
- Station, station transformer and feeder planning capacity and ratings;
- Asset condition;
- System configuration and operating characteristics (and restrictions);
- Number of HOL customers;
- Historic energy purchased and delivered;
- Summer and winter peak load;
- City of Ottawa Official Plans and Community Development Plans;
- Land use designation and population and employment projections;
- Known developments through conversation with developers and City staff;
- Distributed generation connections and capacity;
- Station capacity to connect generation and plans in place to address any restrictions;
- Details and plans resulting from the Integrated Regional Resource Planning process with the IESO and Hydro One; and
- Details relating to Connection & Cost Recovery Agreements (CCRA) with Hydro One for station or transmissions projects

The following describes the results of the capacity planning process.

- One-in-ten year peak load forecasts (20 years) for each region/station;
- Need dates for capacity concerns; and

- Projects to address capacity needs (station upgrades, new stations, line extensions, transmission upgrades, voltage conversions);

Reliability

HOL continuously assesses the distribution system's service reliability. Where issues are found, the appropriate actions are identified to address these concerns. Service reliability is integral to all work undertaken as part of system planning and asset management. The reliability planning process is summarized in the Reliability Planning Report, contained within the Annual Planning Report (Attachment B-1(B)), and does not supersede the importance of good asset management and system capacity planning in the management of system reliability. Rather, it provides a platform for thorough review of system reliability and identifies planned works which are designed to directly impact system reliability.

Reliability driven projects are those which are designed to reduce outage frequency or duration regardless of the cause. Such initiatives are almost exclusively automation projects. In general, work considered as part of the system reliability plan are:

- Deployment of remote sensors;
- Deployment of remotely operable and autonomous devices;
- Deployment of field devices to provide fault indications locally;
- Supporting technologies to automation (i.e. communication & SCADA); and
- Modifications to existing standards (i.e. animal guards).

Successful lifecycle management of HOL's assets will have direct impact on system reliability – assets that are optimally maintained throughout their life, asset replacement prior to failure, and system planning to increase operability and reduce downtime.

The following describes the key variables that are used to inform the reliability planning process.

- Historical outage statistics (primary cause, secondary cause, duration, number of customers affected, circuit affected, station affected, date of interruption);
- Power quality measures (System Average RMS Frequency Index – voltage sags and swells); and
- Worst Feeder evaluation.

The following describes the results of the reliability planning process.

- Asset failure statistics – number of failures and frequency by asset type (SAIFI);
- Projects to improve the Worst Feeders reliability performance;
- Initiatives to improve overall reliability (specific to top 3 causes of interruption from the previous year); and
- Details on automation plans and how they will impact reliability.

System Efficiency

HOL's reliability planning process also reviews system efficiency, monitoring system losses and power quality. By maintaining voltage to CSA standards, customers can expect all of their devices, equipment and appliances to operate as intended and expected without damage or noticeable irritations such as dimming or flickering lights.

System Efficiency also comes from operating the system in an effective way. The SCADA system is key element for monitoring, controlling, and diagnosing HOL's network. It allows HOL's operators to quickly react to anomalies in the system by remotely operating devices or dispatching local crews to an accurate location.

2.1.2.1.4 General Plant

System Capital Investment Support

System Capital Investment Support captures the requirements for capital contributions to Hydro One for transmission connection projects as well as for HOL fleet acquisition.

System Maintenance Support

System Maintenance Support covers the requirements for tools and associated equipment used by HOL crews.

Business Operations Efficiency

Business Operations Efficiency is the requirement for Information Technology software and systems used to support daily business activities.

Non-System Physical Plant

Non-System Physical Plant captures the life cycle requirements for buildings.

2.1.2.2 Project Evaluation

The Project Evaluation phase defines project alternatives and creates business cases in support of the feasible alternatives. Unless mandated, project alternatives are evaluated and valued based on their impact to HOL`s Corporate Strategic Objectives.

Project concepts are first reviewed to determine if they are a mandatory project. Mandatory projects are typically dictated through the Distribution System Code or the Electricity Act. They range from customer connections, to line relocations, to restoring power in a timely fashion. Sometimes several alternatives are available to address a mandatory need in which case they are evaluated and one alternative is selected. These projects are then prioritized if they pose immediate concerns to health & safety, environment, or constrain the operation of the system. Immediate concerns move directly to the Execution phase and have the potential to take precedence over planned projects and cause deferral or delays. Otherwise, the projects make their way into the Detailed Project List, in the Investment Prioritization phase and are scheduled to be completed in an appropriate timely manner.

Non-mandated project concepts are reviewed and evaluated and possible alternatives are developed which will meet the desired objectives of the project. This evaluation is done through a business case development which clearly documents decisions.

Project alternatives are then scored by identifying their risk and/or benefit as it relates to HOL's Asset Management Initiatives through use of the Risk Matrix. The evaluation Consequence Matrix is shown in Table 2.1.2 which specifies the probability of an event occurring and the consequence of that event.

Event probability is specified either as a certainty or a variable associated with a state of a system element. The probability of an event is defined based on existing HOL process/evaluation or through sound engineering judgment. The key to the scoring process is that the probability is acknowledged to be variable in time (often increasing). To enable the development of a work plan, event probability reaching out to 20 years is required; with a 5 year window (i.e. probability is assessed for year 0, 5, 10, 15 and 20).

The consequence as it pertains to each measure is assessed on a linear scale. This scale covers the range of impact from *None* to *Severe* with an associated score of 0 to 6, respectively.

Each consequence has an associated weighting, see Figure 2.1.3, each having a dual function to normalize and to rank. While it is intended that the scoring scales between measures are normalized, the use of the weighting factors to assist in this is acceptable. Further, weighting is used to rank both the priority of a measure and its impact; a measure which has a relatively low impact on its associated initiative will also have a lower weighting. The sum of the weights of all the measures for a given Asset Management Objective must be equal to 1. The weighting of the measures is under the purview and approval of the Manager of Asset Planning.

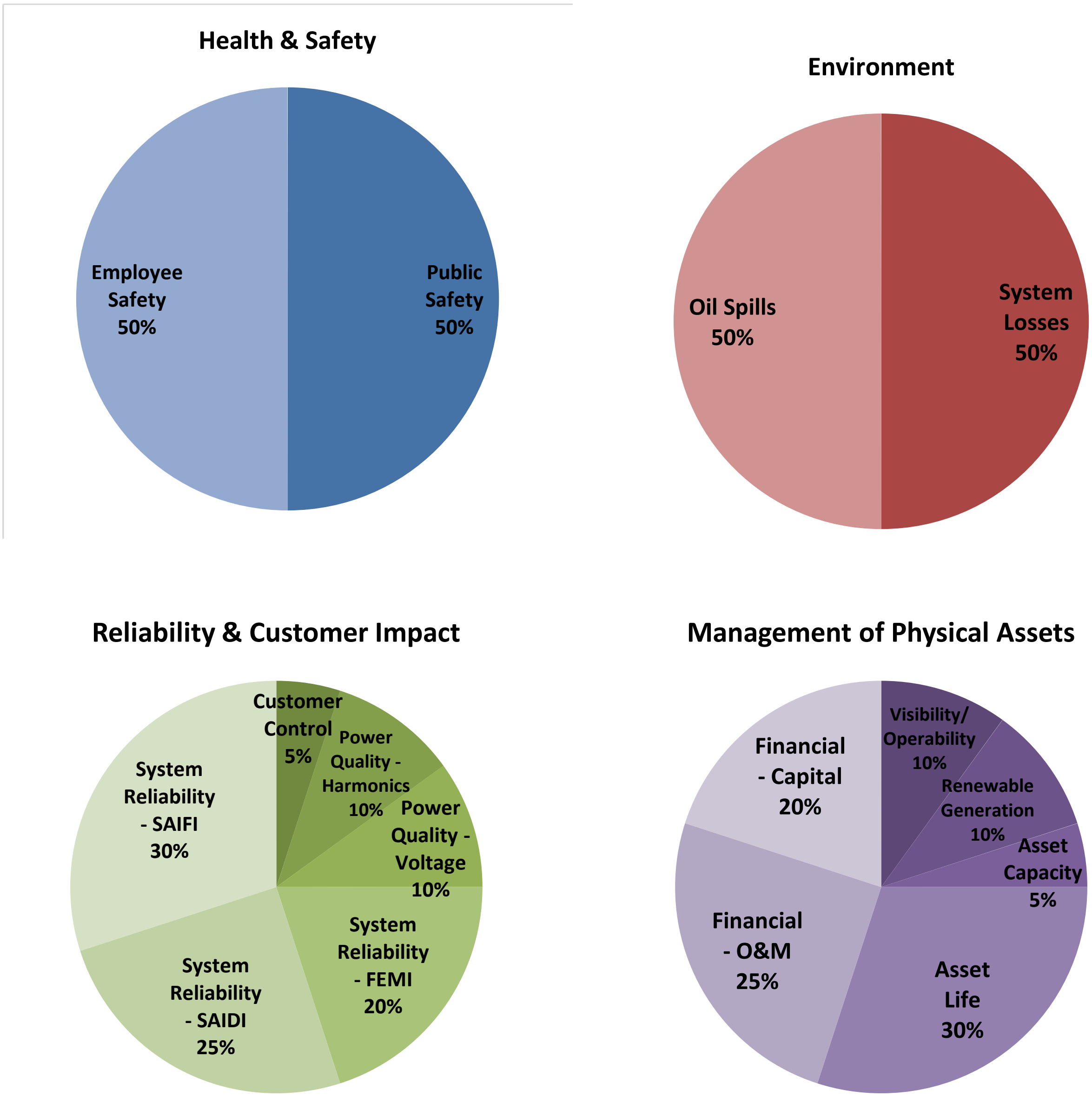
1 Table 2.1.2 - Asset Management Consequence Matrix (1/3)

Score	Level	Reliability & Customer Impact				
		System Reliability (SAIFI)	**System Reliability (SAIDI)**	**System Reliability (FEMI)**	**Power Quality (Voltage)**	**Power Quality (Harmonics)**
6	**Severe**	Will the project impact ≥ 5000 customers?	Will the project impact an area where restoration takes several days and may require additional resources?	Will this project impact feeder(s) within the upper decile of the FEMI score?	Will this project mitigate a customer investment of $5000 to rectify an issue?	Will this project mitigate a customer investment of $5000 to rectify an issue?
5	**Major**	Will the project impact ≥ 2500 customers?	Will the project impact an area where restoration takes up to 24 hours and will require all available crews?	Will this project impact feeder(s) within the upper quarter of the FEMI score?	Will this project mitigate a customer investment of ≤$5000 to rectify an issue?	Will this project mitigate a customer investment of ≤$5000 to rectify an issue?
4	**Significant**	Will the project impact ≥ 1000 customers?	Will the project impact an area where restoration takes up to 12 hours?	Will this project impact feeder(s) within the median and upper quarter of the FEMI score?	Will this project mitigate customer complaints and equipment damage?	Will this project mitigate customer complaints and equipment damage?
3	**Moderate**	Will the project impact ≥ 500 customers?	Will the project impact an area where restoration takes up to 8 hours?	Will this project impact feeder(s) within the lower quarter and median of the FEMI score?	Will this project mitigate customer complaints?	Will this project mitigate customer complaints?
2	**Minor**	Will the project impact ≥ 250 customers?	Will the project impact an area where restoration takes up to 6 hours?	Will this project impact feeder(s) within the lower quarter of the FEMI score?	Will this project mitigate customer complaints and voltages exceeding the standard levels defined in the Conditions of Service?	Will this project mitigate customer complaints and result in the generation of harmonics outside standard levels defined in the Conditions of Service?
1	**Minimal**	Will the project impact ≥ 100 customers?	Will the project impact an area where restoration will take up to 4 hours?	Will this project impact feeder(s) within the lower decile of the FEMI score?	Will this project mitigate voltages exceeding the standard levels defined in the Conditions of Service?	Will this project mitigate the generation of harmonics outside standard levels defined in the Conditions of Service?
0	**None**	Immaterial consequence or Not Applicable	Immaterial consequence or Not Applicable	Immaterial consequence or Not Applicable	Immaterial consequence or Not Applicable	Immaterial consequence or Not Applicable

Score	Level	Asset Management			
		Efficient Program Deployment	Asset Management (Asset Condition)	Asset Management (Asset Life)	Asset Capacity
6	**Severe**	Will the project eliminate an increase to O&M costs by >10% per year?	Will the project impact an asset that has failed?	Will the project impact an asset that will be required to operate beyond 50% of the useful life?	Will the project reduce the requirement of an asset to operate 20% beyond the rated capacity?
5	**Major**	Will the project eliminate an increase to O&M costs by ≤10% per year?	Will the project impact a Condition 5 asset?	Will the project impact an asset that will be required to operate beyond 35% of the useful life?	Will the project reduce the requirement of an asset to operate 17.5% beyond the rated capacity?
4	**Significant**	Will the project eliminate an increase to O&M costs by ≤8% per year?	Will the project impact a Condition 4 asset?	Will the project impact an asset that will be required to operate beyond 25% of the useful life?	Will the project reduce the requirement of an asset to operate 15% beyond the rated capacity?
3	**Moderate**	Will the project eliminate an increase to O&M costs by ≤6% per year?	Will the project impact a Condition 3 asset?	Will the project impact an asset that will be required to operate beyond 15% of the useful life?	Will the project reduce the requirement of an asset to operate 12.5% beyond the rated capacity?
2	**Minor**	Will the project eliminate an increase to O&M costs by ≤4% per year?	Will the project impact a Condition 2 asset?	Will the project impact an asset that will be required to operate beyond 10% of the useful life?	Will the project reduce the requirement of an asset to operate 10% beyond the rated capacity?
1	**Minimal**	Will the project eliminate an increase to O&M costs by ≤2% per year?	Will the project impact a Condition 1 asset?	Will the project impact an asset that will be required to operate beyond 5% of the useful life?	Will the project reduce the requirement of an asset to operate 5% beyond the rated capacity?
0	**None**	Immaterial consequence or Not Applicable	Immaterial consequence or Not Applicable	Immaterial consequence or Not Applicable	Immaterial consequence or Not Applicable

Score	Level	Health & Safety		Environment
		Public Safety	**Employee Safety**	**Oil Spills**
6	**Severe**	Will the project mitigate the possibility of a severe injury? (permanent injury)	Will the project mitigate the possibility of a severe injury? (permanent injury)	Will the project mitigate the potential release of more than 2000L of oil?
5	**Major**	Will the project mitigate the possibility of a minor injury? (require hospital stay)	Will the project mitigate the possibility of a minor injury? (require hospital stay)	Will the project mitigate the potential release of 1000L to 2000L of oil?
4	**Significant**	Will the project mitigate the possibility of a significant injury? (require hospital visit)	Will the project mitigate the possibility of a significant injury? (require hospital visit)	Will the project mitigate the potential release of 200L to 1000L?
3	**Moderate**	Will the project mitigate the possibility of an injury? (short term medical leave)	Will the project mitigate the possibility of an injury? (short term medical leave)	Will the project mitigate the potential release of 100L to 200L of oil?
2	**Minor**	Will the project mitigate the possibility of a minor injury? (require first aid)	Will the project mitigate the possibility of a minor injury? (require first aid)	Will the project mitigate the potential release of 50L to 100L of oil?
1	**Minimal**	Will the project mitigate the possibility of a very minor injury? (bump, bruise, etc.)	Will the project mitigate the possibility of a very minor injury? (bump, bruise, etc.)	Will the project mitigate the potential release of less than 50L of oil?
0	**None**	Immaterial consequence or Not Applicable	Immaterial consequence or Not Applicable	Immaterial consequence or Not Applicable

1 **Figure 2.1.3 - Measure Weighting**



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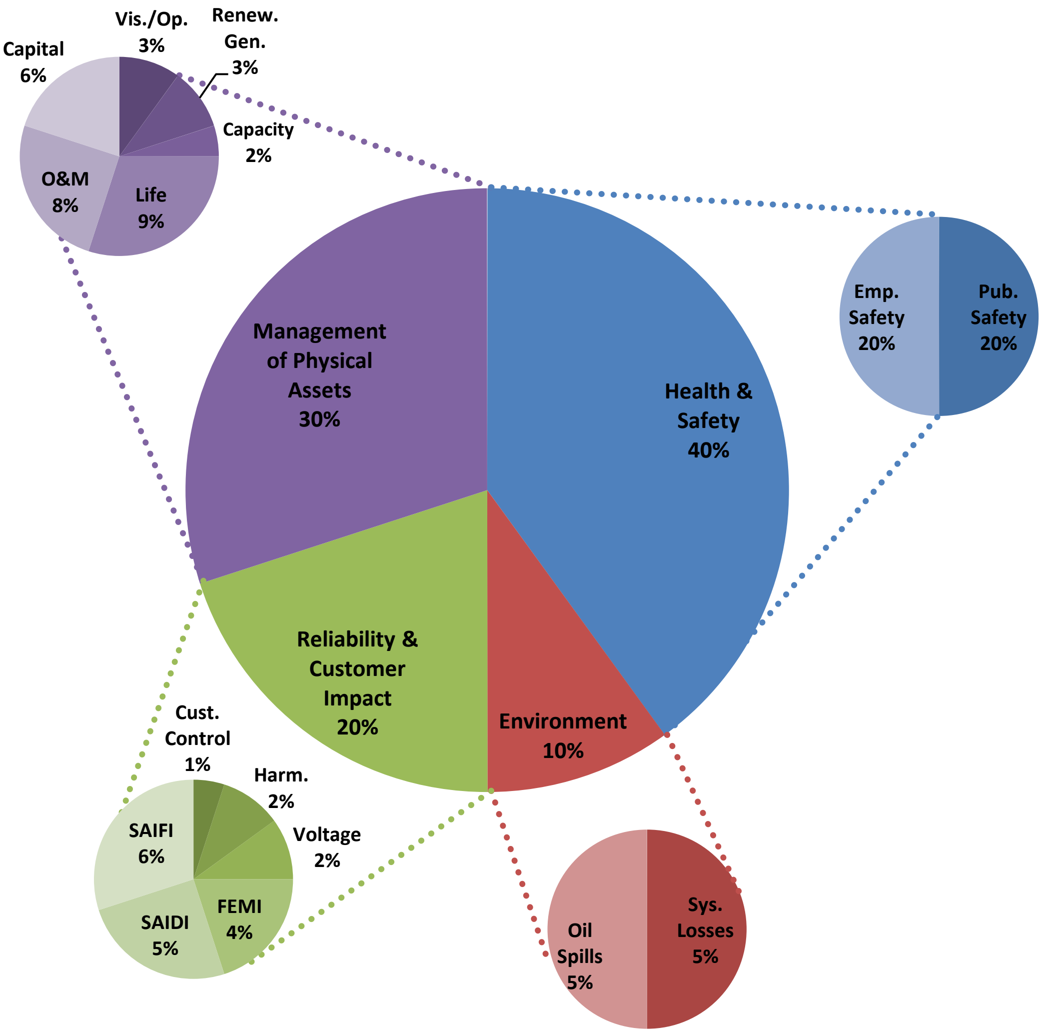
The risk associated with not undertaking an investment is calculated for each of the Asset Management Objectives first. Risk related for a given event is then calculated as the product of the event probability in a given year and the weighted sum of the associated consequences for each measure. Risk to the Asset Management Objective is calculated as the maximum risk, in a given year, of all of the associated events.

Each *Asset Management Objective* has an associated weight, which reflects the organizational prioritization of that objective and, as such, the associated weighting must be endorsed by the HOL Executive. The current objective weightings are summarized in Figure 2.1.4.

The Risk Score is a value which reflects a given overall investment's support of the Asset Management Objectives. This is calculated as the weighted sum of the risk for each Asset Management Objective in a given year. Although it is not quantified, Risk Score is considered to have an associated monetary value.

Figure 2.1.4 - Asset Management Objective Weightings



Once all projects have been scored on their risks and benefits, they are recorded in the Project Repository which contains all short and long term projects under consideration. This central location allows for all projects to be evaluated against one another and prioritized for planning.

2.1.2.3 Project Prioritization

The Project Prioritization phase ranks each project based on their value. All projects in the project repository are prioritized based on their risk score. This allows for all projects to be evaluated based on the same criteria to determine what projects will provide the most value based on the Asset Management Initiatives. Investments are prioritized to maximize the value (i.e. risk score per dollar of investment). This cost/benefit ratio is calculated as the present value of the project cost (maximum 5 year window) over the 5 year present value of the project Risk Score. Investments are then prioritized based on ranking of this cost/benefit ratio. Projects with the lowest cost/benefit ratio are given higher priority over those with higher cost/benefit ratios.

A Preliminary Project List is created based on the prioritization process and expert knowledge of the needs and impact of the proposed projects. This list is attested against expenditure and resource constraints to create the Detailed Project List.

While it is preferred that the timing for all investments are based on this prioritization, mandated investments will arise, typically due to external drivers. When such investments occur they will have reasoning clearly documented and the impact to planned objectives will be reviewed.

The Detailed Project List of prioritized investments then moves on for approval from HOL's Executive Management Team and Board of Directors before proceeding to execution. This ensures that Corporate Strategic Objectives are being met through the proposed investment plan. Constraints may be re-evaluated and updated to meet objectives or mitigate risk.

2.1.2.4 Execution

The Execution phase follows an HOL internal project management methodology called "Project Coach" which defines the core lifecycle for projects. Project Coach is based on the internationally accepted standard for project management: Project Management Body of Knowledge (PMBOK) issued by the Project Management Institute.

Project Coach provides specific guidelines, procedures, work instructions and industry best practices that will allow Hydro Ottawa personnel to perform project work in an efficient, effective and high quality manner. Processes described in Project Coach are intended to be scalable and applicable to all projects, regardless of complexity and implements a consistent approach to planning, scheduling and execution of projects.

Project Coach describes 6 steps in the execution of the project:

1) **Planning & Project Initiation (Plan) –** The project charter, scope and objectives are created. Key players take steps to initiate the project and engage any needed authorization.
2) **Design –** The project charter, scope and objectives is reviewed and approved. Preliminary and detailed project design and estimates are created.
3) **Procurement & Circulation (Procure) –** The project design is approved. Material and services are procured.
4) **Scheduling (Schedule) –** The project is scheduled with key milestones and deliverable dates.
5) **Construction (Construct) –** The project is executed with a continuous review on progress and risk to completion.
6) **Closure (Close) –** The project documentation, financials, and reviewed lessons learned are completed. Feedback and lessons learned are registered and communicated for continuous improvement.

2.1.2.5 Risk Assessment & Review

The Risk Assessment & Review phase measures progress on the Corporate Strategic Objectives, through the Asset Management Initiatives, and evaluates risk based on acceptable tolerances. This phase captures feedback from the Project Execution phase to allow for continuous improvement and adjustments to the Asset Management Process.

The results of the Execution Phase are measures on operational performance which can be compared against baselines to identify trends. These measures are used to support the performance measurements identified in Section 1.3. The results are used to re-establish drivers by identifying what work was completed, if objectives have been met, and if there is still unacceptable risk that needs to be addressed.

2.2 Overview of Assets Managed

The overview of assets managed section of the DSP provides a summary of the features of HOL's distribution service area, demographics and condition of the assets managed. It also summarizes the current state of the system loading as it relates to station and feeder capacity.

2.2.1 Features of the Distribution Service Area

HOL was formed in November 2000 following the amalgamation of 5 municipal utilities of the former region of Ottawa-Carleton, and the restructuring of the Ontario electricity sector as a result of the Electricity Act, 1998. This has resulted in a diverse system with multiple service voltages and a variety of construction standards. HOL has worked hard since amalgamation to unite the former utilities with common processes and design standards.

HOL distributes electricity to 318,706 (October 2014) metered customers within the City of Ottawa and the Village of Casselman – an urban environment. See Figure 2.2.1 - HOL Service Territory for a map of HOL's service territory. The service area covers 1,104 square kilometers and is supplied by an even mix of overhead and underground feeders. In 2013, HOL purchased a total of 7,722 Gigawatt hours of electricity from the provincial grid to supply our customers. As the City grows, former rural areas fed by long distribution lines are becoming urban centres. This demands higher reliability expectations from customers.

HOL's service territory is additionally challenged by the natural barrier of the Rideau River and the Greenbelt which limits distribution connectivity in some areas of the system. As a result, system planning must consider these barriers when mapping out the distribution circuitry and evaluating capacity options.

Large segments of the system were constructed in the 1960s, 70s and 80s – as most assets have a lifespan on the order of 50 years, a considerable proportion of the system is approaching or has exceeded the anticipated end of life. The increased potential of failures posed by these aging assets will, without intervention, impact the organization's ability to guard worker and public safety, maintain system reliability and protect organizational strength in the future.

Overall, the City of Ottawa continues to grow in population and developed lands, primarily focused in five regions: the Downtown Core, Nepean & Riverside South, South Kanata &

Stittsville, the Village of Richmond and Orleans. The City has not seen any slowing of development as a result of the economic downturn and growth is expected to continue into the future. This growth is being seen through the development of new mixed commercial/residential communities, intensification of existing communities as well as major projects like the Ottawa Light Rail Transit (OLRT) system.

Table 2.2.1 - Conference Board of Canada Population and GDP Forecast

		2009	2010	2011	2012	2013	2014	2015	2016
Pop	(‘000)	1,237	1,258	1,277	1,295	1,311	1,322	1,333	1,346
	(%)	0.44%	0.40%	0.37%	0.33%	0.29%	0.20%	0.21%	0.27%
GDP	($M)	$60,424	$62,273	$63,028	$62,459	$62,870	$63,676	$65,036	$ 66,518
	(%)	0.55%	0.70%	0.36%	-0.16%	0.00%	0.41%	0.53%	0.57%

*Source: Conference Board of Canada, Ottawa-Gatineau Region

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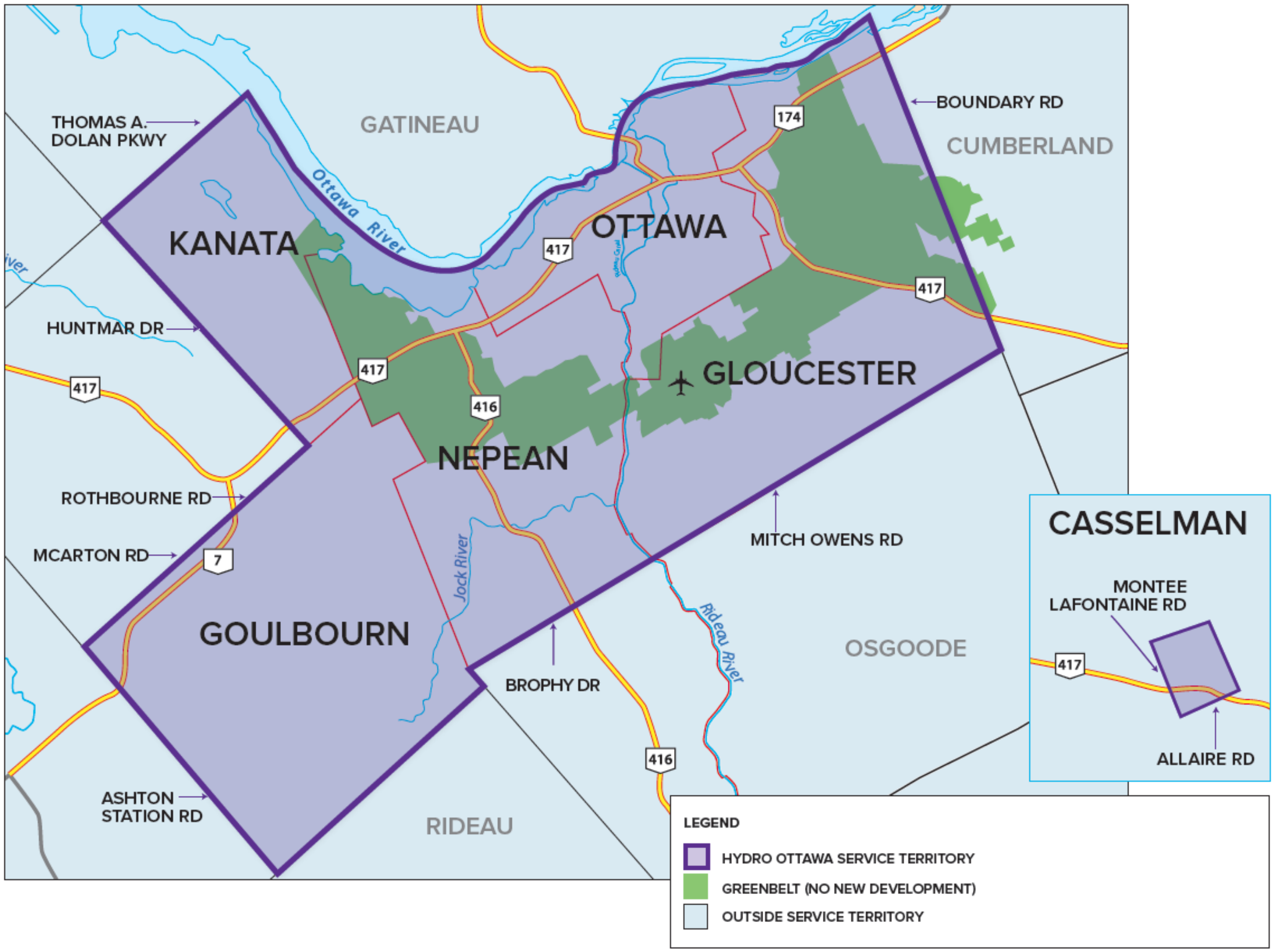
Figure 2.2.1 - HOL Service Territory



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The following examples outline some of the issues that need to be addressed while planning the distribution system in Ottawa.

Climate Normals Comparison

In comparison to other major Ontario cities, Ottawa is characterized by having generally lower wind speeds and colder winters with higher snowfall (with the exception of Sudbury).

HOL strives to complete capital work year round; however, work must be scheduled to accommodate the winter months in which there are greater hazards to our crews and more challenges to overcome in the field, such as snow removal before work can even begin.

The data presented in the following charts represents the Climate Normals from 1981-2010 as recorded by the Government of Canada.

Figure 2.2.2 - Daily Maximum Temperature

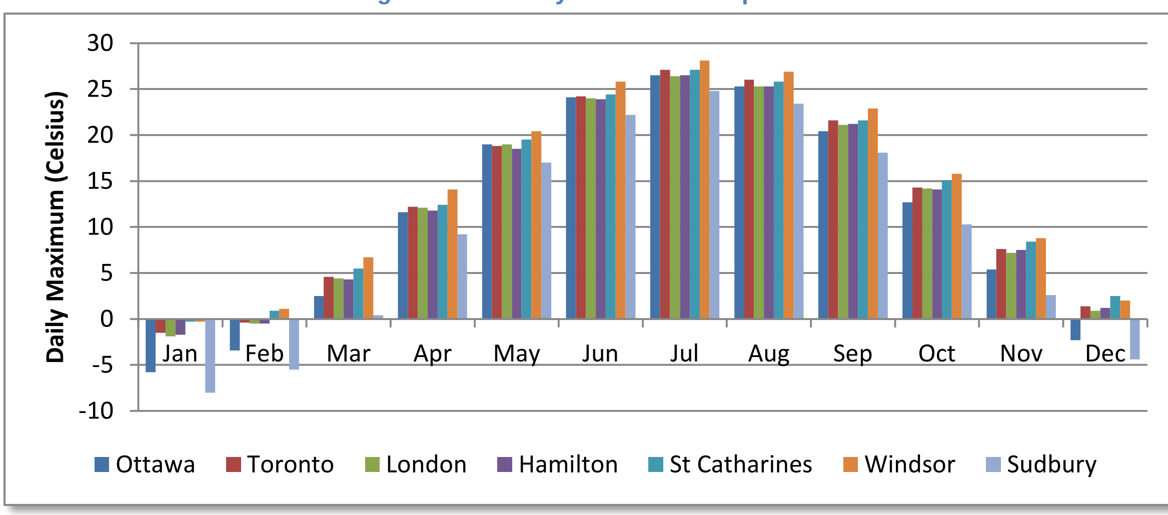


Figure 2.2.3 - Daily Minimum Temperature

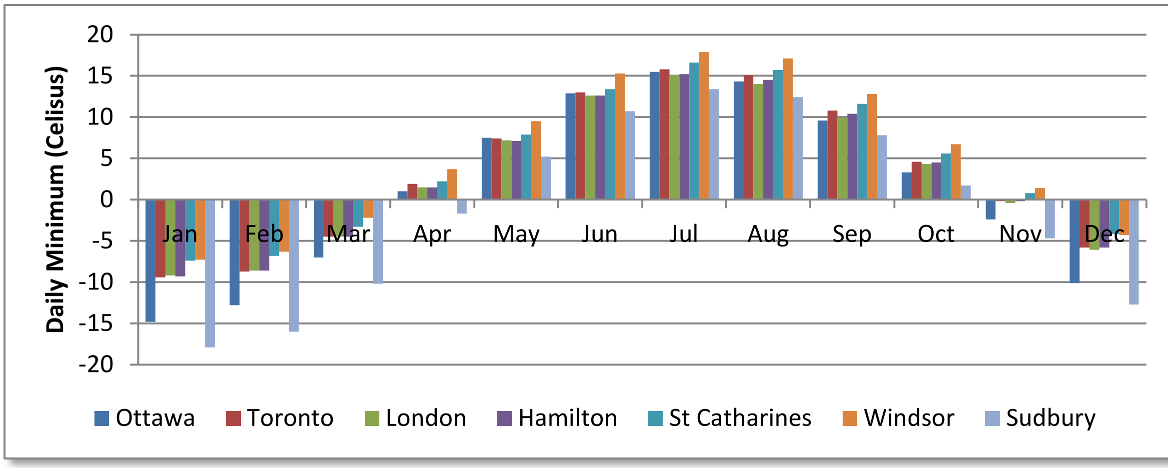


Figure 2.2.4 - Rainfall

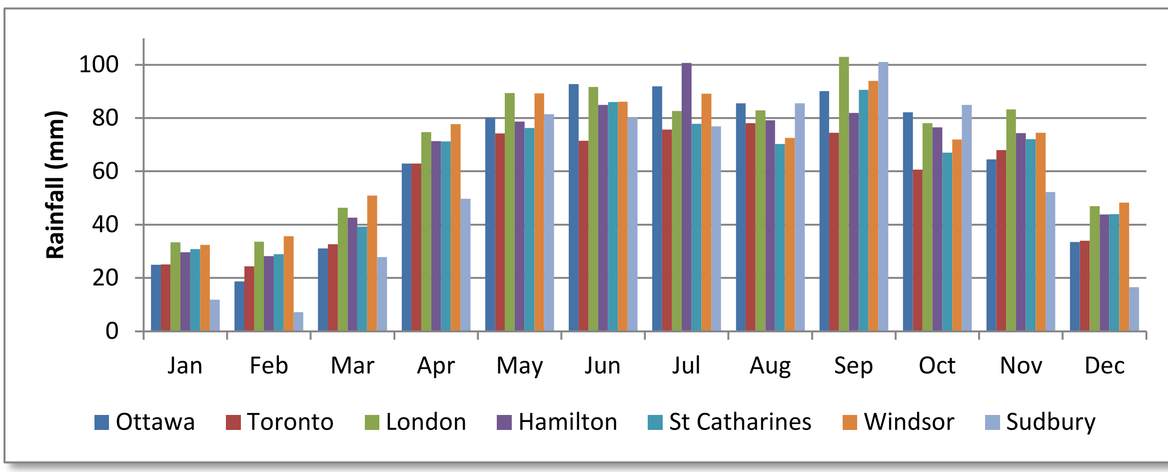


Figure 2.2.5 - Snowfall

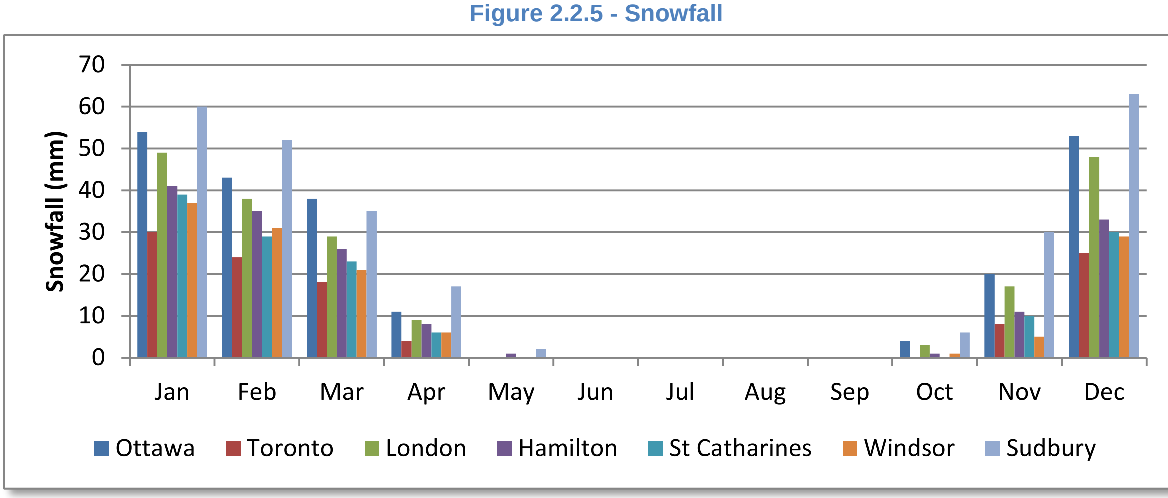
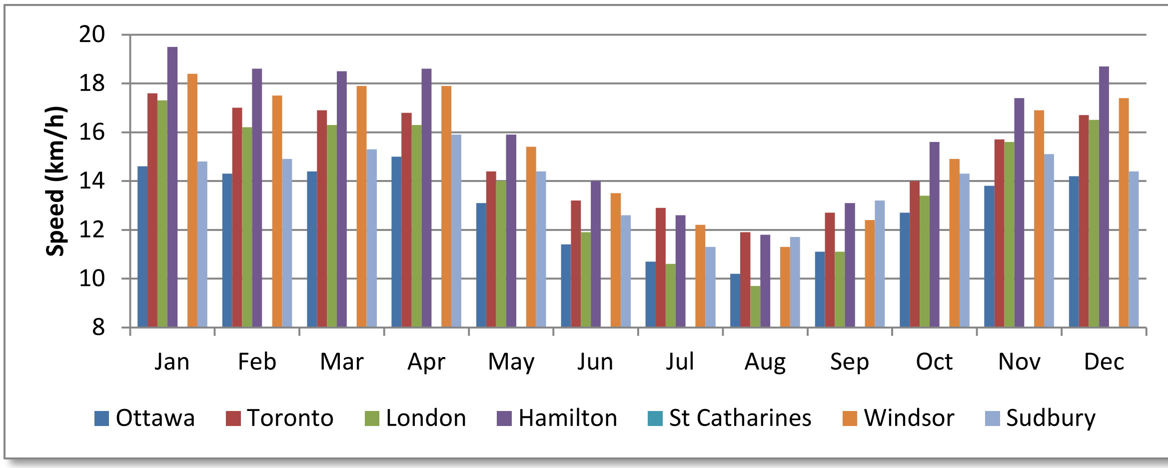


Figure 2.2.6 - Wind Speed



Temperature Profile

The Ottawa region temperature profile requires that equipment operate under a temperature range of -40 to +40 degrees centigrade. Various pieces of equipment that contain inert gasses may not operate reliably at the lower end of this range and thus require extra heaters to ensure reliable operation. Extra heaters on equipment causes design changes and non-standard equipment procurement. The requirement of additional heaters thus impacts capital investment and may require a larger initial investment than that of a similar equipment model in an area with a warmer temperature range.

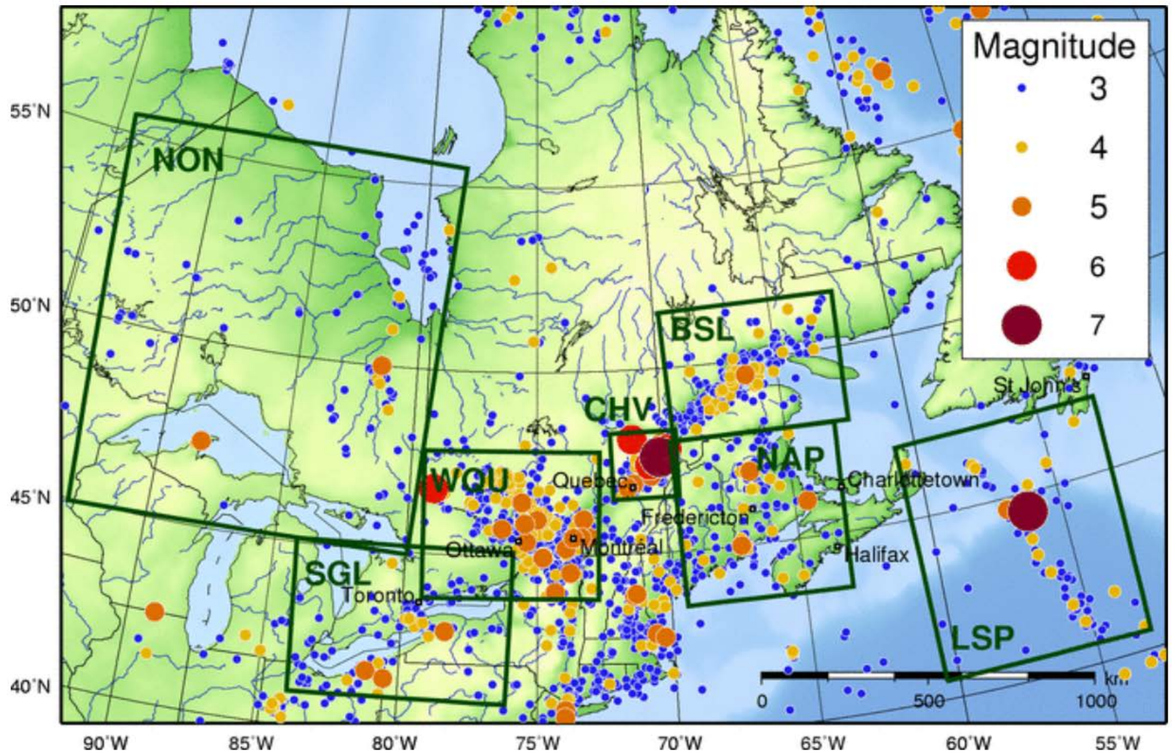
Seismic Zone

Ottawa sits within Zone 4 for Seismic Acceleration (0.16-0.23g) and Zone 2 for Seismic Velocity (0.0-0.11m/s). Ottawa sits within the Western Quebec seismic zone which sees on average one earthquake every five days (Natural Resources Canada).This requires civil footings and foundations to be designed and constructed to withstand these higher seismic levels. Larger foundations and footings means more reinforcing steel (rebar), larger excavations, and more concrete, contributing to increases in capital expenditures.

The seismic zone also requires that additional steel cross bracing is designed and installed on all structures. The additional bracing causes for larger design, fabrication, and installation costs than that of a zone of lower seismic activity.

Figure 2.2.7 depicts the historic level of seismic activity as recorded by the Canadian seismograph network and reported by the Government of Canada on Natural Resource Canada's website.

Figure 2.2.7 - Historic Seismic Activity (Years: 1627-2008)



**Source: Government of Canada, Natural Resources Canada*

Ice Accumulation & Snow Loading

Due to the amount of snowfall and ice accumulation experienced in Ottawa (see Figure 2.2.5), civil structures (structural steel) must be able to withstand a significant amount of ice build-up without impacting structural integrity. This requires that the specific alloys chosen must be of high quality and thus increases the cost of fabrication.

Another impact of the harsh winters is an increased use of road salt which can lead to premature rusting of padmounted and pole mounted equipment located along the road right of way. The salt spray from roadways impacts O&M costs by increasing the need to wash insulators to prevent arcing and flash overs which leads to asset failures as well as an increase in the need to repaint and repair rusted padmounted and pole mounted equipment.

Soil Conditions

The Ottawa area soil conditions generally fall within two categories: till soils with loam to sandy loam texture, and clay soils. There are also extensive bogs within the region consisting of pockets of moist to wet soils. In the west area of the City, soil materials are shallow and there are regions of exposed sedimentary bedrock.

The sandy and clay soil conditions call for increased civil infrastructure (piling) beneath the civil footings to ensure the stability of structures, specifically within substations. The piling necessitates further excavation, resources, material and design, and therefore higher costs. Due to the shallow bedrock there can be increases in costs associated with boring, for example with the installation of poles, ducts or piling to support civil structures.

2.2.2 System Configuration

HOL's diverse system comes from the amalgamation of the 5 former municipal utilities. The system has 6 different distributing voltages that are constructed in a mix of overhead and underground systems. The majority of the underground infrastructure is built in the downtown and integrated suburb areas.

The substations supplying the service area are a mix of HOL and Hydro One Networks Inc. (HONI) owned stations and transformers. Formally, HONI owned all transmission connected transformers supplying HOL owned breakers at the low voltage side to distribute electricity throughout the service area. The current practice for newly built transmission connected stations is for HOL to construct and own all equipment.

Below is a summary of the system configurations:

Table 2.2.2 - Length (km) of Underground & Overhead Systems

Orientation	Total Length (km)
Underground	2,782
Overhead	2,702
Total	5,484

Table 2.2.3 - Number & Length of Circuits by Voltage Level

Voltage Level	Number of Circuits	Total Overhead (km)	Total Underground (km)
4.16 kV	298	664	289
8.32 kV	112	717	504
12.43 kV & 13.2 kV	12 kV – 6 13 kV – 299	431	830
27.6 kV	52	720	1,152
44 kV	17	170	7
Total	784	2702	2782

Table 2.2.4 - Number & Capacity of Transformer Stations

Secondary Voltage Level	# of Station	# of Transformers Owned by HOL	# of Transformers Owned by HONI	Total Transformation (MVA)
4.16 kV	36	103	0	662
8.32 kV	24	39	3	448
12.43 kV	2	3	0	26
13.2 kV	12	2	25	1776
27.6 kV	14	21	4	843
44 kV	3	0	6	416
Total	91	168	38	4170

*Note that this is a sum of top rating (not planning limit) of all in-service units in HOL's service territory

2.2.3 Asset Demographics and Condition

The following section summarizes the demographics and condition assessment for the major asset classes within HOL's system. Asset condition is based upon health index calculations which are unique for each asset class. Where information is lacking, a correlation is implied between condition and age. Further details on the asset demographics can be found in the AMPR.

Table 2.2.5 summarizes the condition and population statistics for the asset classes that are detailed in the following sections. All information is current as of the end of 2013. Note that the cable lengths in the table below represent total kilometers of installed cable (sum of each run of cable, i.e. 3x for three-phase circuits) and differs from the stats provided above which represent circuit kilometers (1x for three-phase circuits).

Table 2.2.5 - Asset Demographics & Condition

Asset Type	Population	Average Age	% in Poor & Critical Condition
Poles	59,450	39	12%
Polemounted Transformers	15,663	30	11%
Kiosk & Padmounted Transformers	15,633	33	4%
Vault Transformers	3,474	34	7%
Distribution Cables (XLPE)	4,128 km	25	17%
Distribution Cables (PILC)	356 km	35	15%
Underground Switchgear	439	15	2%
Station Transformers	170	36	2%
Station Breakers	1,003	36	5%

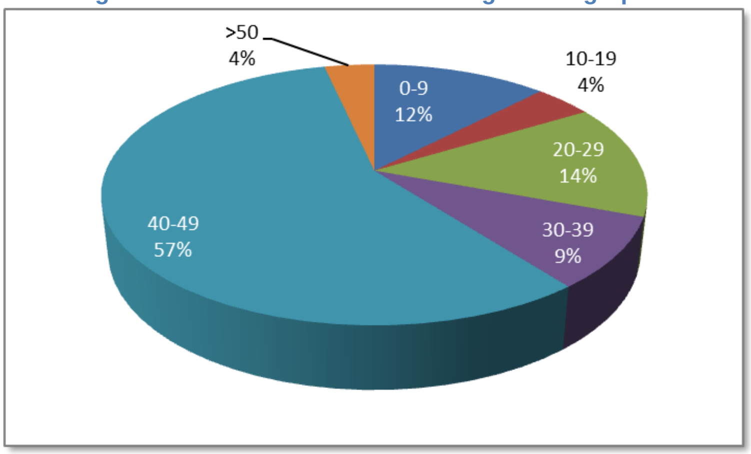
Table 2.2.6 - Asset Management Strategy

Type	Asset	Strategy	Age / Condition Based Replacement
Substation	Transformers	Proactive	Condition
	Switchgear	Proactive	Condition
	Batteries	Proactive	Age
Distribution	Overhead Conductor	Proactively replaced with other projects	N/A
	Poles	Proactive	Condition
	Cable – PILC	Reactive	N/A
	Cable – XLPE	Proactive/Refurbish	Condition
	Cable – Butyl Rubber	Proactive	Condition
	Cable – EPR	Reactive	N/A
	Padmounted & Kiosk Transformers	Reactive	N/A
	Polemounted Transformers	Reactive	N/A
	Vault Transformers	Reactive	N/A
	Underground Switchgear	Proactive	Age
	Underground Civil Structures	Proactive	Condition
	Overhead Distribution Switches and Reclosers	Reactive	N/A

2.2.3.1 Station Transformers

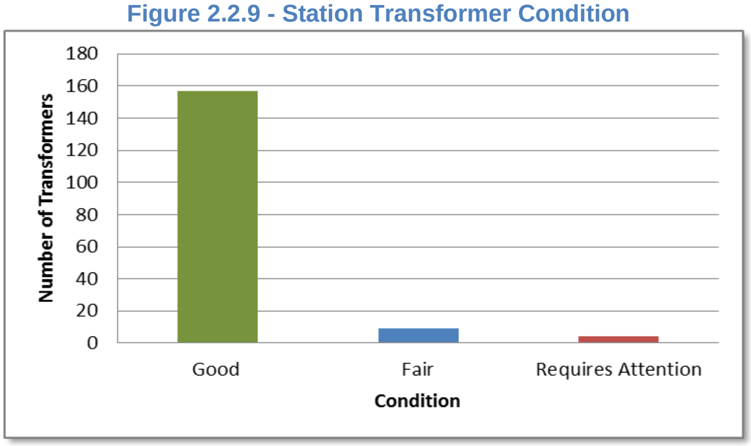
Station transformers are critical pieces of equipment among HOL's groups of assets. They provide voltage transformation from high voltage transmission lines to a lower voltage to distribute electricity throughout the City. HOL has 170 station transformers with different primary voltages: 103 at 13.2kV, 39 at 44kV, 22 at 115kV and 6 at 230kV.

Figure 2.2.8 - Station Transformer Age Demographics



HOL currently tracks the health index of Station Transformers through results from dissolved gas analysis (DGA), oil quality analysis and Doble testing. These various quality tests allow HOL to monitor the concentration of the Key Gases, the rate at which these gases are increasing, and the quality of the mineral oil inside the transformer. Once the gases, rate of change, and oil quality have reached an unacceptable level, the transformer will be scheduled for an out-of-service inspection and potential refurbishment or replacement.

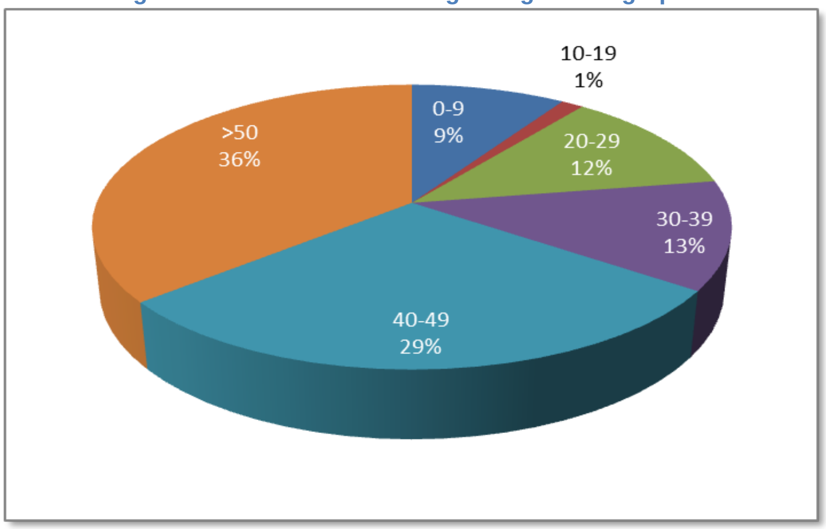
Figure 2.2.9 - Station Transformer Condition



2.2.3.2 Station Switchgear

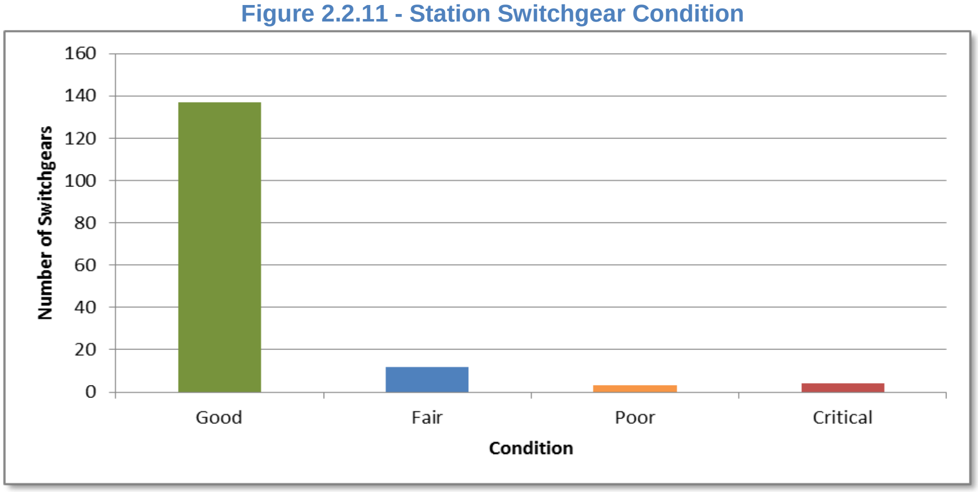
HOL owns and maintains switchgear assemblies in 83 substations. The station switchgear asset class consists of breakers, switches, bus insulation, support structures, protection and control systems, arrestors, control wiring, ventilation and fuses.

Figure 2.2.10 - Station Switchgear Age Demographics



The health index for Station Switchgear takes into account the many functional and supporting parts. A qualitative assessment of the equipment condition, based on subject matter experience, is done on the switches, breakers, bus, insulation, and supporting structures. The equipment is then reviewed for functional obsolesce and the availability of spare parts. The health index is calculated using this information and the age of the equipment.

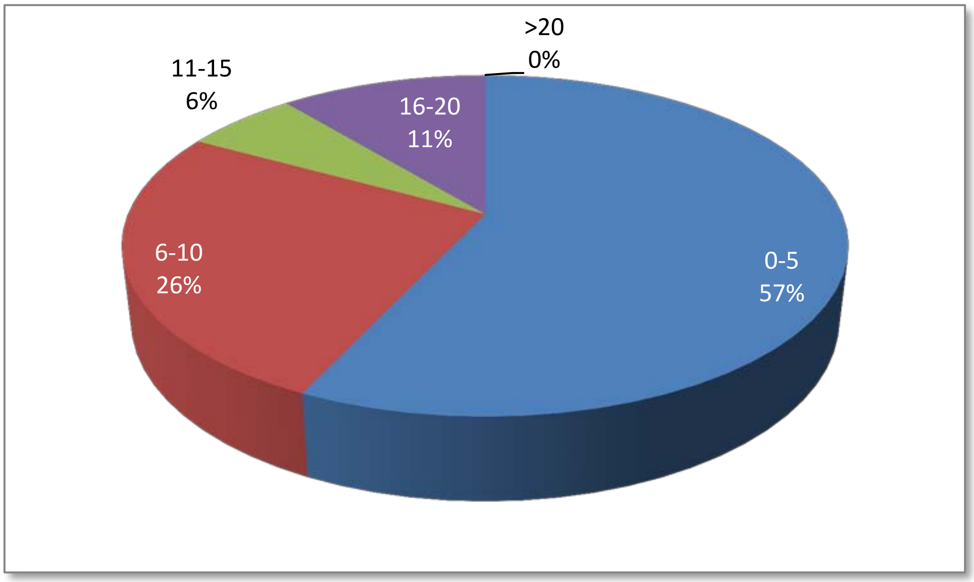
Figure 2.2.11 - Station Switchgear Condition



2.2.3.3 Station Batteries

HOL's station batteries and chargers asset class provide power for operating station breaker trip and closing coils, DC lights and relays when the station service power is lost. HOL has 53 station battery banks that supply 24V, 48V and 125V. The life expectancy of a station battery bank is in the range of 20-25 years.

Figure 2.2.12 - Station Battery Bank Age Demographics



The condition of station batteries is assessed through regular inspections. Routine maintenance is also performed which enables their health to be closely related to their age. The failure consequence for this asset can be significant as all the controls in a substation rely on the DC system to operate in case of power interruption. For this reason HOL replaces 2-3 station battery and charger banks per year to ensure reliable operation.

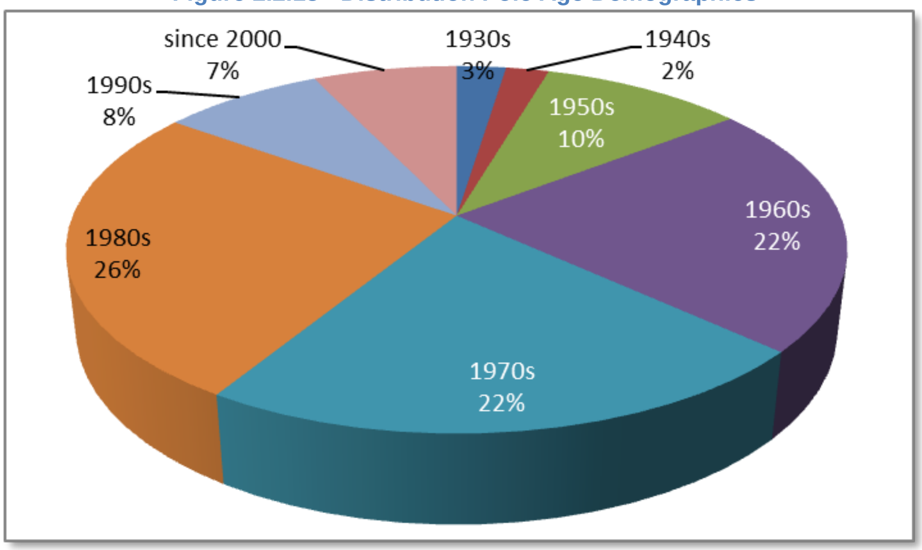
2.2.3.4 Overhead Conductor

HOL owns and operates on over 2900km of overhead conductor. Due to the rarity of overhead conductor failures, HOL does not record or perform inspections. The conductors are replaced during work on pole top equipment or pole replacement projects. This allows for the greatest efficiency. During this time the area is studied to assess whether larger conductors need to be installed.

2.2.3.5 Distribution Poles

HOL owns 47,815 wood poles and 537 non-wood poles and operates on an additional 11,635 wood and 126 non-wood poles which are owned by third parties. Currently, HOL has installation date information for approximately 25% of its poles (41% of those operated on). For poles that do not have available installation information, install data has been estimated using manufacture date, estimated from the adjacent property legal records, or assumed to be equivalent to the average age of the known poles in that region (roughly 41% of asset group).

Figure 2.2.13 - Distribution Pole Age Demographics



The condition of poles is evaluated against a health index developed by HOL. The health index for poles is based on determining the percentage of remaining strength left in the pole. As per Canadian Electrical Code - CSA 22.3, poles should be replaced once they fall below 60% of the required strength. HOL uses the CSA criteria that once a pole's ultimate strength has been reduced to 60% of its original design, it will be considered to be at end of life and scheduled for replacement.

Health Index Inputs:

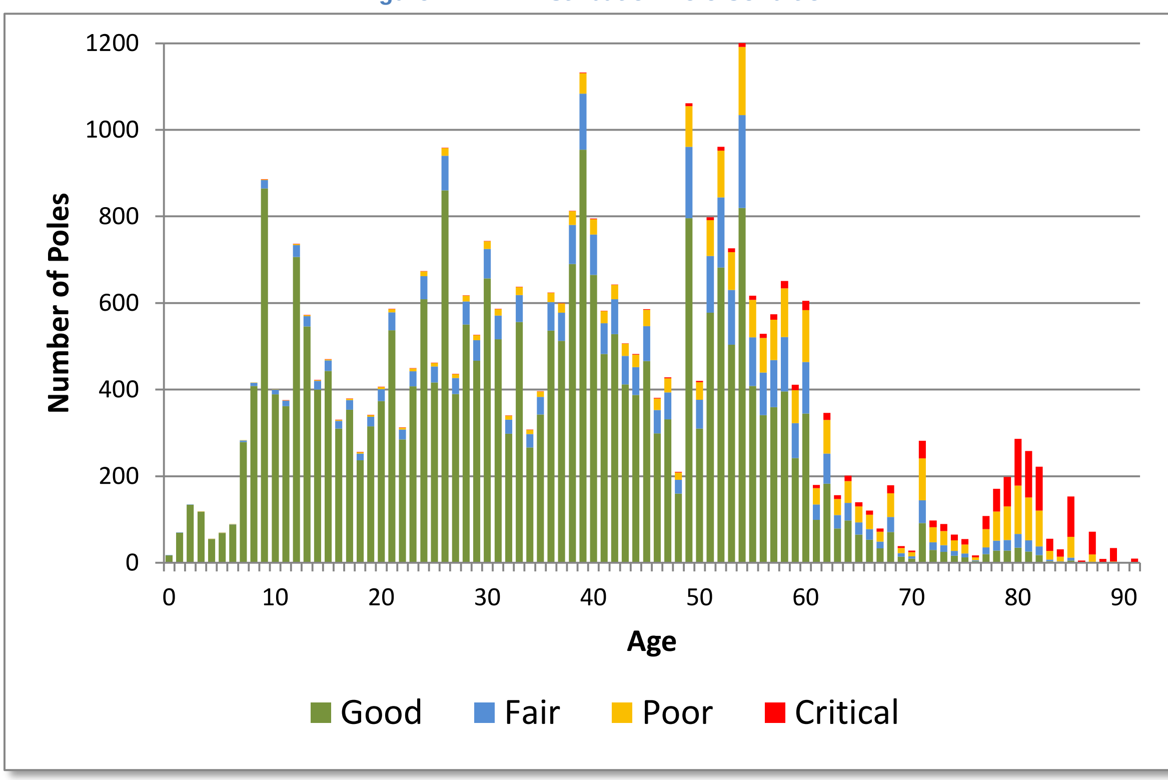
1. Maximum and minimum ground line circumference to determine the extent of surface rot and mechanical damage due to vehicles and snow plows;
2. Width and depth of pocket holes along the pole caused by rot or woodpeckers; and

3. Width of the external shell of a pole, measured from the center, which can be reduced due to internal rot.

HOL has inspected 14,370 poles since 2011, an average of 3,592 poles per year with a continued program inspection target of 4,500 poles per year over a ten year cycle. These inspections are initially done visually and if a pole appears to be in a degraded state a drill test is completed. As mentioned above, if the pole is determined to have a remaining strength below 60% it is replaced. When an area is identified as having numerous poles in a degraded state a pole replacement project is initiated.

Currently, HOL is working to prioritize and replace poles with a known condition of critical or poor from the 14,370 completed inspections, with an intention to continue to the inspection process and continue to replace poles based on the inspection results. Although not all poles have yet been inspected, the information already collected (shown in Figure 2.2.14 below) has been used to project the condition over the population of remaining poles.

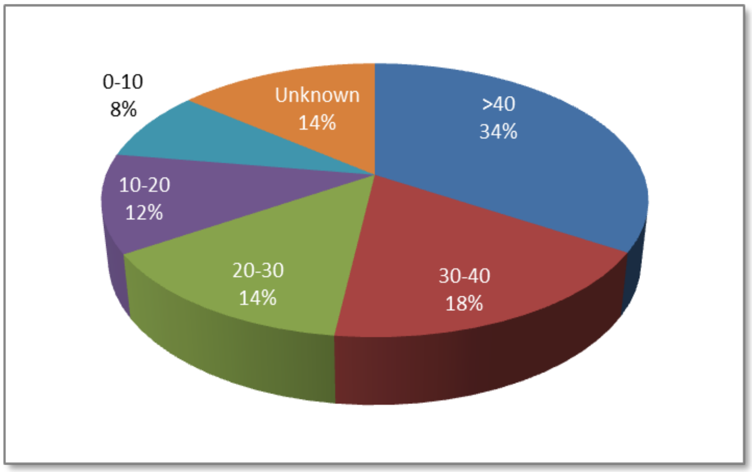
Figure 2.2.14 - Distribution Pole Condition



2.2.3.6 Distribution Cables (PILC)

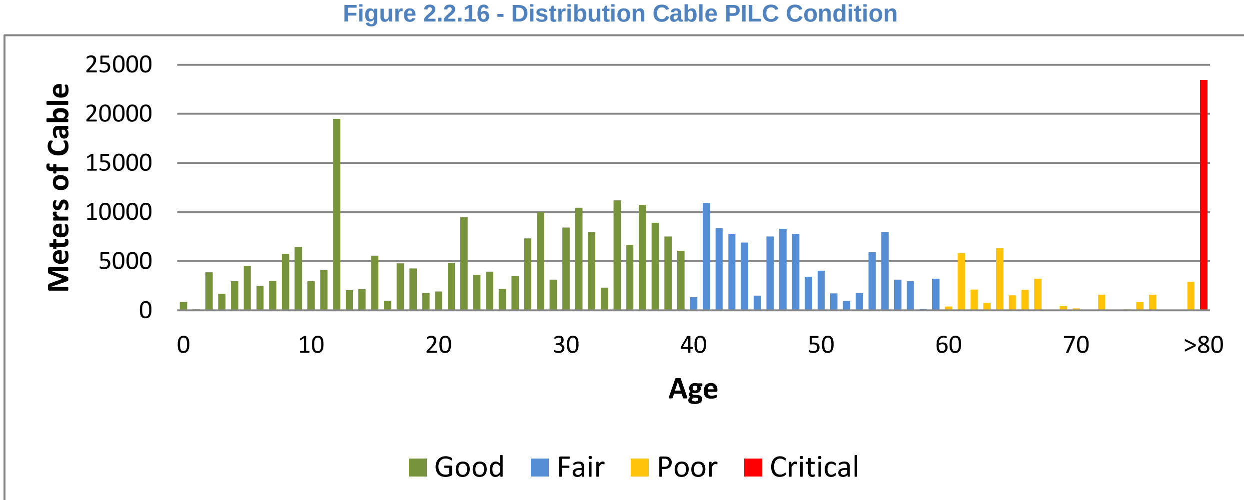
HOL owns and operates 356 km of triple conductor Paper Insulated Lead Cable (PILC). It was primarily installed in the Core of Ottawa on the 13kV system and is some of the oldest cable in the service area. Due to higher material costs, increasing procurement lead times, and the need for specialised tradesmen, HOL is passively phasing out this cable type by installing alternative cable types for new installations.

Figure 2.2.15 - Distribution Cable PILC Age Demographics



The condition assessment for PILC cables is based on age alone. Critical and poor condition cables are considered to be over the ages of 80 (Weibull Analysis) and 60 (Historical Failures), respectively. These assets are considered to be at a higher risk of failure.

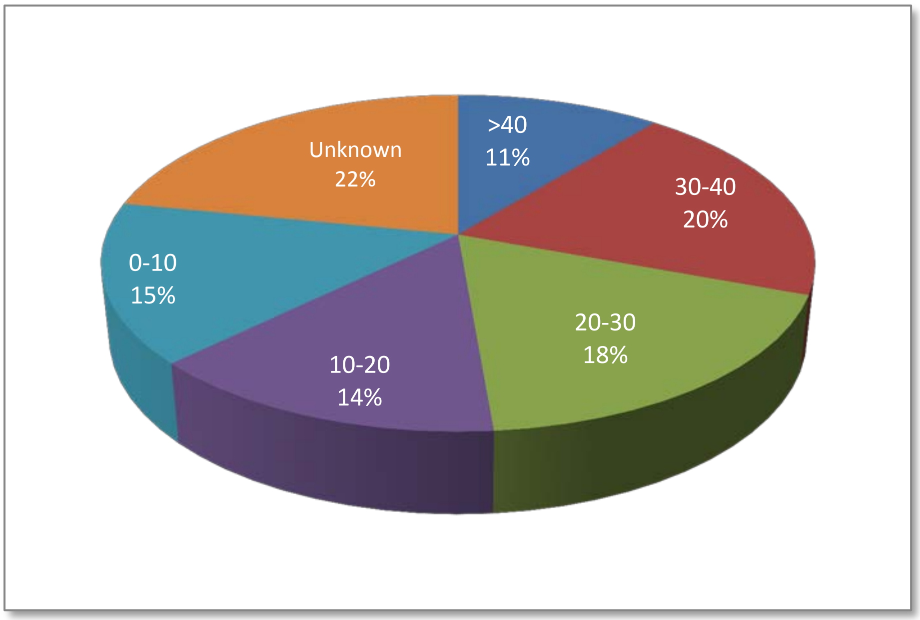
Figure 2.2.16 - Distribution Cable PILC Condition



2.2.3.7 Distribution Cables (Polymer)

HOL owns and operates 4,128 km of single conductor Polymer Cable (Cross-Linked Polyethylene (XLPE), Ethylene Propylene Rubber (EPR) and Butyl Rubber) which is primarily installed in developed suburbs. The installation of this cable uses a mix of concrete encased duct, direct buried duct, and direct buried cable which can add to the cost and labour requirements when replacing under planned and unplanned events.

Figure 2.2.17 - Distribution Polymer Cable Age Demographics

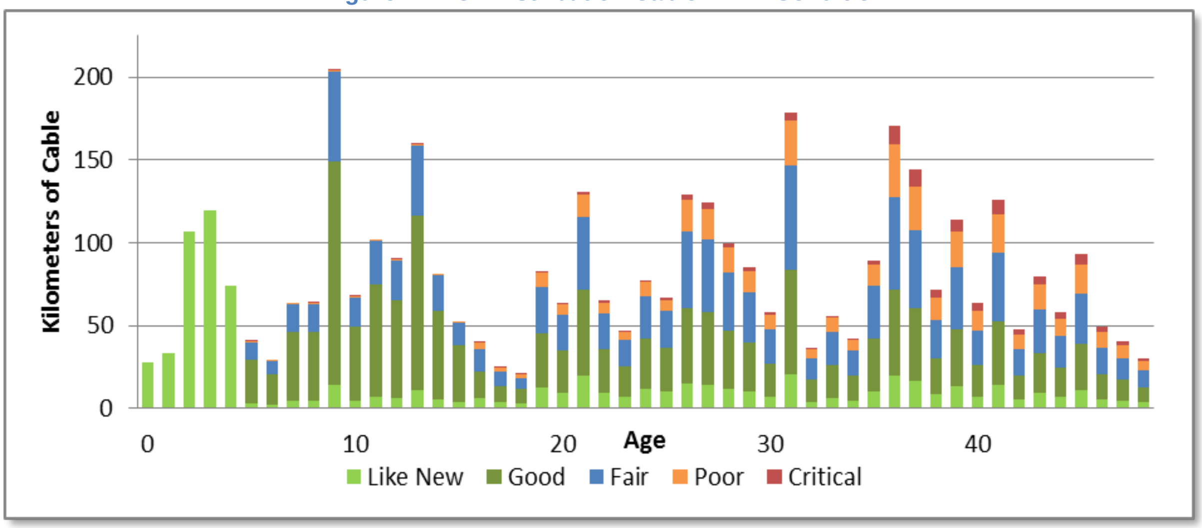


The vast majority of the underground polymer cable is XLPE. Butyl Rubber is in the process of being phased out of HOL's system due to the number of failures. EPR has been newly introduced into the HOL system and only makes up a small portion of underground cable. Therefore, the condition of underground polymer cable uses data collected from tests on XLPE cable.

The condition of distribution XLPE cables are monitored through an underground cable testing program which collects information useful for developing an asset health index. The health index for XLPE is based on the remaining insulation strength of the cable. The tests done on XLPE provide a Quality (Q) Value which indicate the condition of the cable. HOL uses the criteria that once the Q Value reaches a value of 32 or greater, it is considered to in either Bad or Critical condition and should be scheduled for replacement.

The entirety of the XLPE cable population within the HOL system has not yet been tested, however a correlation of the current findings are represented across the entire demographics in the figure below.

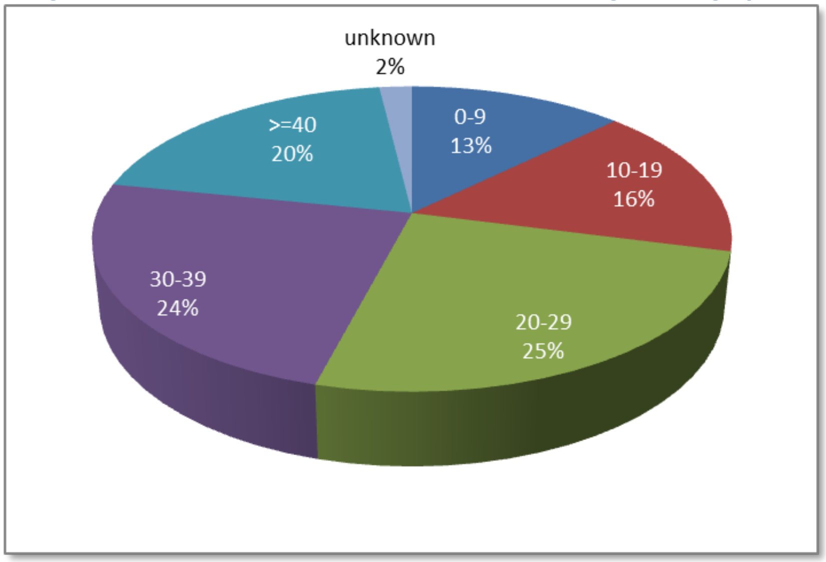
Figure 2.2.18 - Distribution Cable XLPE Condition



2.2.3.8 Kiosk & Padmounted Transformers

HOL owns roughly 1,800 kiosk transformers and 14,000 padmounted transformers. Kiosk style transformers have been in use for longer than padmounted transformers and as a result there is a higher proportion of this style at end of life.

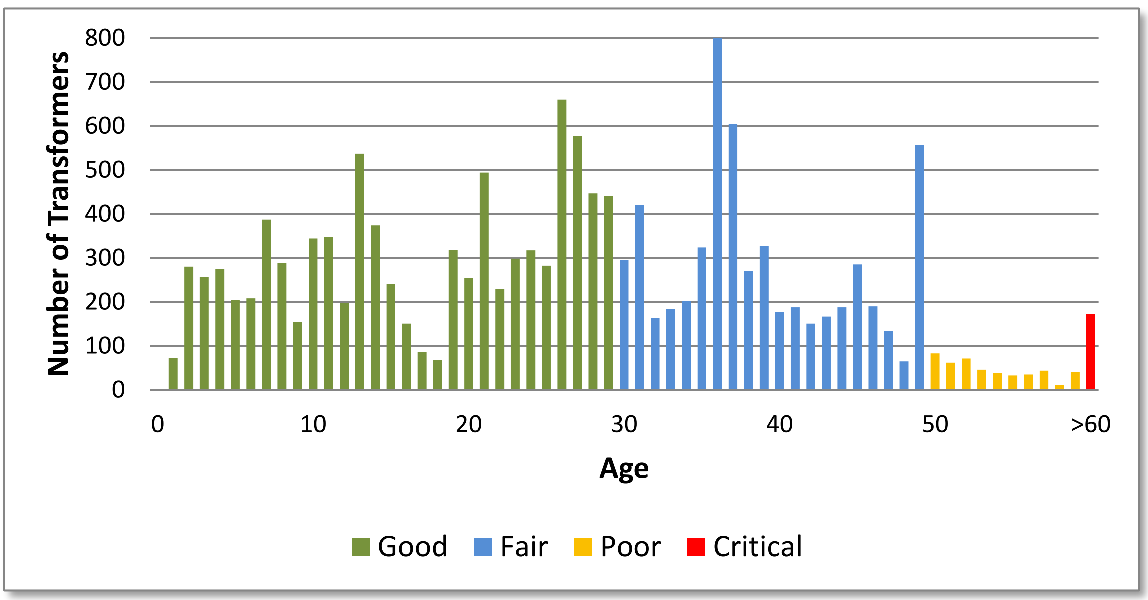
1 **Figure 2.2.19 - Kiosk & Padmounted Transformer Age Demographics**



2

3 The condition assessment for padmounted transformers is based on age alone. Critical and
4 poor condition transformers are considered to be over the ages of 60 (Weibull Analysis) and 50
5 (Historical Failures), respectively. These assets are considered to be at a higher risk of failure.

6 **Figure 2.2.20 - Kiosk & Padmounted Transformer Condition**

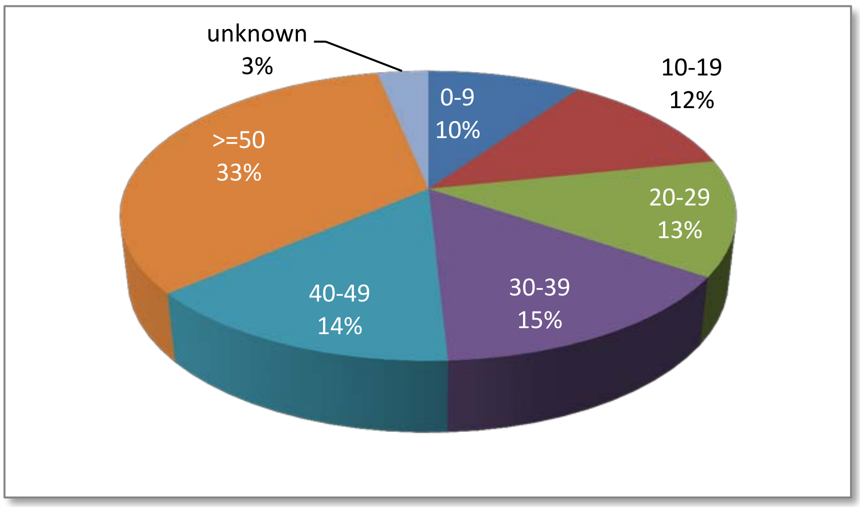


7

2.2.3.9 Polemounted Transformers

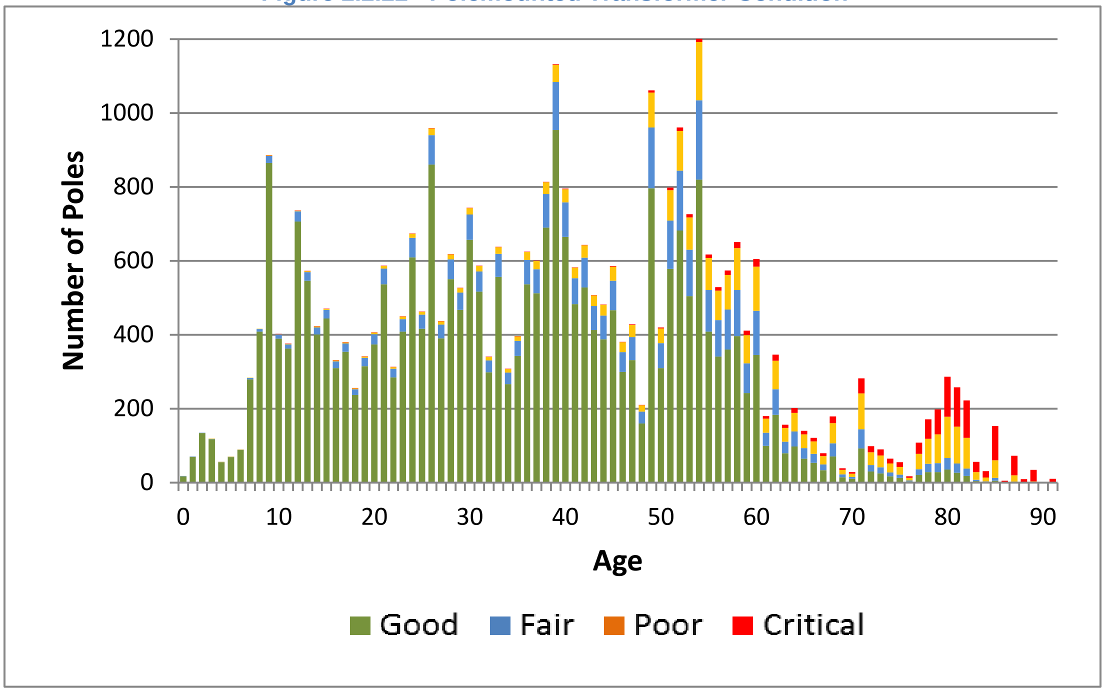
Demographic information for polemounted transformer assets such as purchase date, manufacture date, ratings and manufacturer are stored in HOL's Geographical Information system (GIS). HOL owns and operates 15,663 polemounted transformers. Currently, the installation and manufacture date are not consistently available. As such, where install year is not available it has been approximated based on the purchase year, estimated install year, or based on legal documentation of the surrounding properties.

Figure 2.2.21 - Polemounted Transformer Age Demographics



The condition assessment for polemounted transformers is based on age alone. Critical and poor condition transformers are considered to be over the ages of 90 (Weibull Analysis) and 60 (Historical Failures), respectively. These assets are considered to be at a higher risk of failure.

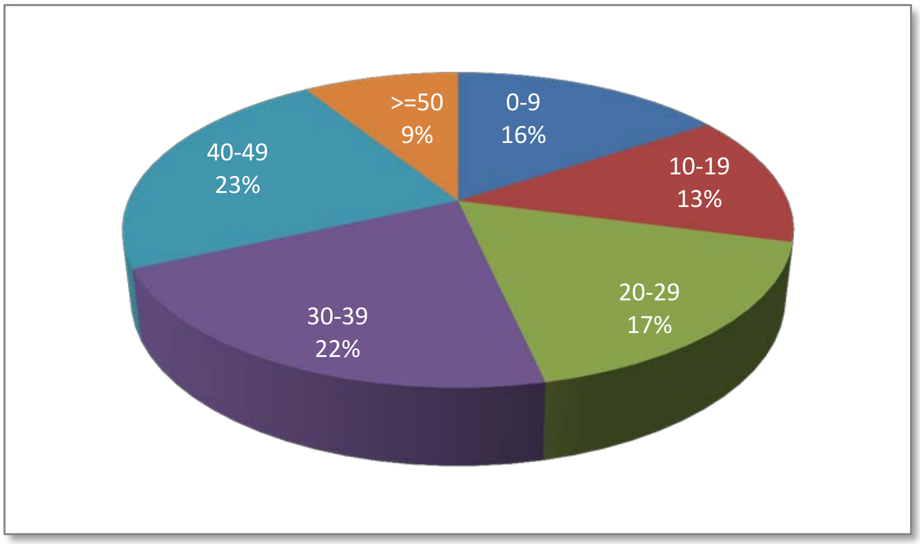
Figure 2.2.22 - Polemounted Transformer Condition



2.2.3.10 Vault Transformers

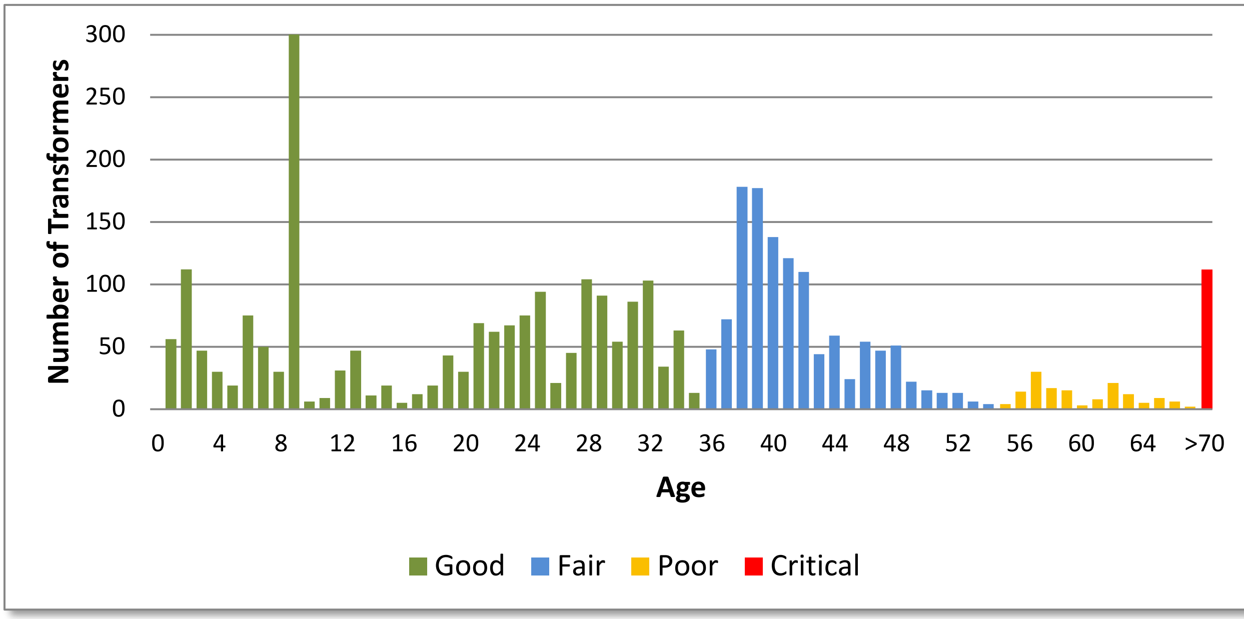
HOL's vault transformers are located in building vaults and typically service a single large customer. Currently HOL owns 3,474 vault transformers.

Figure 2.2.23 - Vault Transformer Age Demographics



The condition assessment for vault transformers is based on age alone. Critical and poor condition transformers are considered to be over the ages of 70 (Weibull Analysis) and 65 (Historical Failures), respectively. These assets are considered to be at a higher risk of failure.

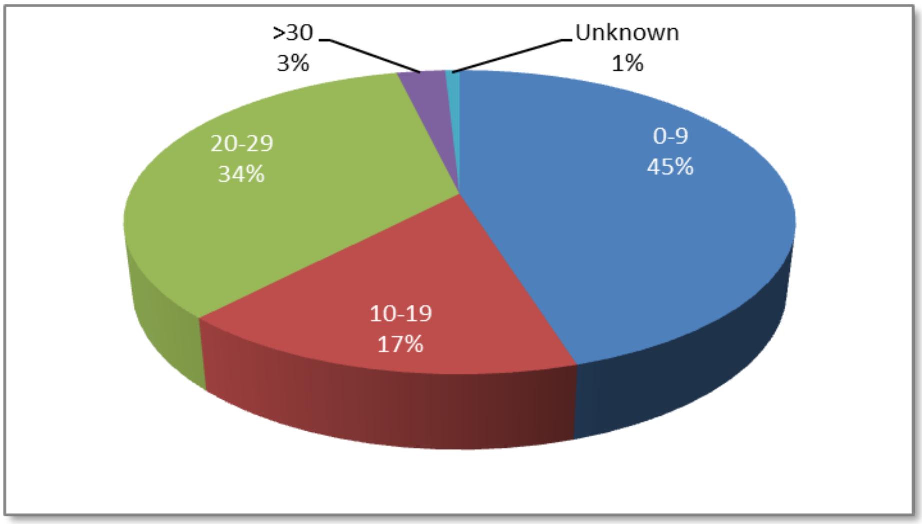
Figure 2.2.24 - Vault Transformer Condition



2.2.3.11 Underground Switchgear

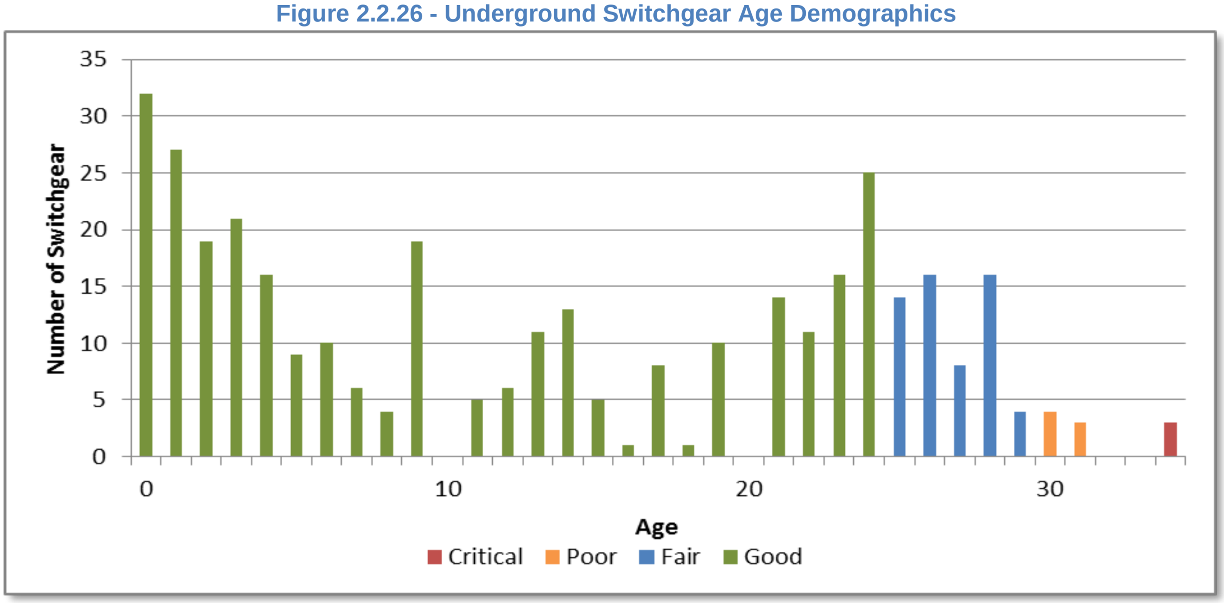
HOL's distribution switchgear asset class consists of 439 pad-mounted, 191 vault installed and 2 submersible types. There are many different configurations and types of switchgear in service due to the amalgamation of the former utilities and their varying policies for servicing customers. HOL is developing policies and procedures for incorporating these different practices in a consistent manner.

Figure 2.2.25 - Underground Switchgear Age Demographics



The condition assessment for underground switchgear is based on age alone. Critical and poor condition switchgears are considered to be over the ages of 35 (Weibull Analysis) and 30 (Historical Failures) respectively. These assets are considered to be at a higher risk of failure.

Figure 2.2.26 - Underground Switchgear Age Demographics



2.2.3.12 Underground Civil Structures

Hydro Ottawa's Underground Civil Structure asset class consists of underground duct banks, hand holes and various types of underground chambers forming a network through which cables may be installed. Distribution underground civil structures are used in areas where underground wiring is required for aesthetics or clearances, to improve reliability, to reduce the time to access and correct faulty wiring, to permit access in congested areas and to allow re-entry or expansion in areas where further excavation would be costly.

The asset class has been divided into two primary groups; Duct Structures and Underground Chambers. While duct structures are run to the unlikely event that they fail, underground chambers are maintained through a replacement and rehabilitation program based on regular condition assessment. Based on the currently available inspection data it is recommended that the program target a minimum of 10 underground chambers per year.

Table 2.2.7 - Civil Structure by Type

Civil Structure Type	Pre 1970	Post 1970	Unknown	Total
Cable Chambers	**760**	**2,017**	**731**	**3,508**
Precast	66	661	159	886
Cast in Place	694	1,284	551	2,529
Unknown/other	-	23	6	29
Pre-Cast Switch Cable Chambers	-	49	15	64
Handholes	**9**	**240**	**115**	**364**
Sidewalk Vaults	**-**	**34**	**-**	**34**
Equipment Pad	**-**	**3,300**	**18,040**	**21,340**
Miscellaneous Pad	-	32	2,164	2,196
Primary Pedestal	-	-	7	7
Secondary Pedestal Pad	-	1,642	2,671	4,313
Service Disconnect Pad	-	38	552	590
Switchgear Pad	-	23	238	261
Transformer Pad	-	1,565	12,408	13,973

2.2.3.13 Overhead Distribution Switches and Reclosers

Hydro Ottawa's distribution overhead switch and recloser asset class consists of all pole mounted load break switches, reclosers, fuse cut-outs and inline switches, with a primary voltage rating up to 44 kV. The primary purpose for this asset class is to provide a means to isolate or re-route a section of overhead line due to a fault condition or planned work.

The overhead switch and recloser program is typically a run-to-failure asset class unless a technical or health and safety issue have been identified.

Table 2.2.8 - Overhead Switch & Recloser Demographics

Switch Type	4.16 kV	8.32 kV	12.43 kV	13.2 kV	27.6 kV	44 kV	Total
Non-Load Break	1,610	2,293	39	1,342	1,467	483	7,234
Load Break	51	137	0	159	446	309	1,102
Cut-Outs	8,333	6,139	41	2,770	3,977	9	21,323
Reclosers	0	19	2	1	35	0	57

2.2.4 Capacity of the Existing System Assets

The following section outlines the degree to which the capacity of the existing system assets is utilized relative to planning criteria, referencing the related objectives as set out in section 1.3.1.4 System Operations Performance.

2.2.4.1 Stations Exceeding Planning Capacity

The planned capacity rating is defined as the sum of either the transformer's 10 day LTR or the allowable top loading rating if there is no published LTR for the remaining transformers following a single contingency loss of the largest element within the substation (N-1 contingency). An N-1 contingency for a station is defined as the loss of the largest transformer within the station. Note that for stations with a single supply and a single transformer, the planning rating is considered to be the rated capacity of the single unit (10 day LTR or allowable top load rating if there is no published LTR).

Station loading must be maintained within the planning capacity to allow for efficient transfer of load during an N-1 contingency reducing the duration of the interruption, while respecting equipment ratings.

Stations loaded above their planning capacity on the system peak day:

Table 2.2.9 - Stations Exceeding Planning Capacity

	Station	2013 System Peak Day Load (MVA)	Planning Capacity (MVA)	Planning Factor (%)
1	Bridlewood MS 28kV	48.9	25.0	196%
2	Rideau Heights DS	19.6	12.5	157%
3	Merivale DS	15.6	10.0	156%
4	Borden Farm DS	12.3	8.0	154%
5	Longfields DS	20.1	15.0	134%
6	Marchwood MS	43.7	33.0	132%
7	Startop MS	15.4	12.0	128%
8	Alexander DS	15.5	12.5	124%
9	Limebank MS	39.0	33.0	118%
10	Bayshore DS	11.6	10.0	116%
11	Centrepointe DS	15.9	14.0	114%
12	Stafford Road DS	15.5	14.0	111%
13	Fallowfield MTS	27.0	25.0	108%
14	Manordale DS	10.1	10.0	101%

2.2.4.2 Stations Approaching Rated Capacity

The rated capacity is defined as the sum of the top rating (LTR or allowable flat rating should an LTR not be published) of all transformers within the station. If the loading on a transformer exceeds this limit it will cause accelerated loss of life.

Transformer loading must be maintained within the rated capacity in order to avoid any accelerated loss of life to the unit.

Stations loaded within 90% of their rated capacity on the system peak day:

Table 2.2.10 - Stations Approaching Rated Capacity

	Station	2013 System Peak Day Load (MVA)	Rated Capacity (MVA)	Capacity Factor (%)
1	Richmond North DS	5.5	5.0	110%
2	Nepean TS	153.6	160.0	96%
3	Hawthorne TS	103.5	110.0	94%

2.2.4.3 Feeders Exceeding Planning Capacity

The planned capacity rating for a feeder takes three factors into consideration.

1. Coordination with lo-set instantaneous protection;
2. Feeder cold load pick up ability; and
3. Short term (8 hour) egress cable overload capabilities

Feeders must be maintained within the planning capacity to allow for efficient load transfer during an N-1 contingency situation, thereby reducing the duration of interruption while respecting equipment ratings.

Table 2.2.11 lists the feeders above 100% of their planning capacity.

1 Table 2.2.11 - Feeders Exceeding Planning Capacity

	Station	Feeder	2013 System Peak Day Load (A)	Rated Capacity (A)	Capacity Factor (%)
1	King Edward TK	404	229	85	269%
2	Rideau Heights DS	180F3	470	300	157%
3	Startop MS	6F10	391	300	130%
4	Bridlewood MS 28kV	BRDF3	399	310	129%
5	Russell TB	5304	326	255	128%
6	Russell TB	TB2JP (TB13)	313	255	123%
7	Parkwood Hills DS	190F5	356	300	119%
8	Stafford Road DS	200F6	341	300	114%
9	Limebank MS	7F2	344	310	111%
10	Jockvale DS	145F1	333	300	111%
11	Uplands MS	Q4801F8	342	310	110%
12	Kanata MTS	624F5	367	340	108%
13	Overbrook TO	TO1UT	273	255	107%
14	Kanata MTS	624F1	361	340	106%
15	Albion TA	2209	268	255	105%
16	Woodroffe TW	TW2UC	264	255	104%
17	Overbrook TO	1801	263	255	103%
18	Lisgar TL	TL7TS (TL19)	261	255	102%
19	Hinchey TH	TH2UL	257	255	101%
20	Carling TM	306	256	255	100%
21	Bilberry TS	77M2	310	310	100%
22	Carling TM	307	254	255	100%

2.2.4.4 Feeders Approaching Rated Capacity

The rated capacity is defined as the egress cable 8 hour loading limit. If the circuits are loaded above this limit for longer than 8 hours it will cause overheating and accelerated loss of life. Feeder loading must be maintained within the rated capacity in order to avoid damaging equipment and causing an accelerated loss of life to the cables.

Table 2.2.12 lists the feeders loaded within 90% of the rated capacity on the system peak day.

Table 2.2.12 - Feeders Approaching Rated Capacity

	Station	Feeder	2013 System Peak Day Load (A)	Rated Capacity (A)	Capacity Factor (%)
1	Rideau Heights DS	180F3	470	475	99%
2	Startop MS	6F10	391	420	93%

2.3 Asset Lifecycle Optimization Policies and Practices

This section documents HOL's asset lifecycle optimization policies and practices. The HOL approach is to maximize the lifecycle of an asset while providing a reliable service using a Plan, Deploy, Maintain, Evaluate, and Retire process (see Figure 2.3.1 - Asset Lifecycle Optimization). HOL optimizes the lifecycle of its assets by tracking and analyzing asset failure rates, historical asset Budget Program costs, and asset demographics. Effective testing, inspections and maintenance (TIM) programs ensure that adequate information is gathered about the assets to properly prioritize asset replacement and refurbishment while balancing operation and maintenance (O&M) costs.

Plan – determine the optimal equipment usage and arrangement based on requirements and develop standards and procedures for installation and maintenance;

Deploy – install the equipment in the field following approved standards;

Maintain – inspect and maintain the equipment following internal standards, manufacturer recommendations and best practice;

Evaluate – review inspection and maintenance records to ensure the equipment continues to perform as required – based on evaluation, continue the Maintain cycle, or move on to Retire;

Retire – once the equipment no longer is able to meet requirements, it is disposed of in a sustainable manner, following environmental and regulatory requirements. Circle back to plan, where once again the equipment requirements will be evaluated before a replacement or re-arrangement is completed.

Figure 2.3.1 - Asset Lifecycle Optimization

HOL prioritizes asset replacement, refurbishment and maintenance by assessing the health condition of an asset. If insufficient data is available for an asset group, HOL will use age alone as the primary determinant of condition. HOL has implemented an Asset Investment Planning and Management software known as Copperleaf C55. One of the functions of this software is to act as a new asset repository, creating better defined health indices and reforming the TIM programs to gather required asset information for improving condition assessment processes.

2.3.1 Asset Replacement and Refurbishment

HOL plans asset replacement and refurbishment projects annually through the Asset Management Process (AMP) (see section 2.1 Asset Management Process Overview). The AMP mostly involves determining investment requirements under the System Renewal investment category of Chapter 5. The intention of the AMP is to document the asset management practices used by HOL as part of an optimized lifecycle strategy for distribution assets. The objectives of the Asset Condition Assessment are to demonstrate that the assets deliver the required functions at the desired level of performance and that this level of performance is sustainable for the foreseeable future while staying within the targeted levels of risk.

The HOL asset lifecycle optimization plan is achieved by forecasting equipment failures using available information regarding equipment demographics, inspection data and historical failure records.

2.3.1.1 Asset Replacement and Refurbishment Policies and Practices

HOL manages its asset replacement and refurbishment through proactive replacement, reactive replacement and refurbishment. HOL strategizes asset replacement and refurbishment through the use of asset failure curves, asset demographics and TIM programs. The asset replacement approach is determined based on the failure consequence of the asset, replacement costs, required lead-time for materials and the available information for that asset group.

HOL's two main drivers for asset refurbishment and replacement are age and condition. Assets with more established TIM programs continue to use health indexing based on condition to prioritize replacement. All other proactive replacement programs use age to prioritize replacement.

HOL is continuing to develop the TIM programs to achieve health indexing for all assets. Asset health indices will allow HOL to create a proactive replacement strategy for all assets, including reactively replaced assets.

2.3.1.1.1 Proactive Replacement

HOL has adopted a practice of proactive replacement for assets that incur higher failure consequences. This can be in the form of additional expenses or affect additional customers when replaced reactively following failure. Therefore, a more planned approach for acquiring and dedicating resources to minimize costs and customer impacts is required. HOL proactive replacement programs and rate of replacement are justified by reviewing historical asset failure rates and creating asset failure curves. Asset failure curves allow HOL to predict future failure rates to forecast replacement rates and costs. An increase in the failure rates may signify the need to increase replacement rates.

Proactive replacement of assets mitigates failure consequence by often minimizes costs, minimizes outage impact and decreases the project duration. HOL is striving to establish more asset information to maximize proactive replacement projects.

The evaluation of the technical life of assets focuses on the failure modes rather than the broader question of asset retirement, and as such does not consider assets retired from service for external reasons, such as capacity upgrades, relocations, and vehicle collisions. The ACA's focus on end of life failure provides appropriate models for forecasting proactive asset replacement requirements, but typically results in higher average age than would be appropriate for asset depreciation.

Asset replacement projects can also be driven by the need to upgrade the system to meet the needs of new developments and intensification or new system operation requirements. Additional replacement projects are developed through the management of assets to minimize health and safety concerns, reduce environmental impact and improve reliability.

HOL develops all details of replacement projects well in advance of construction to ensure all aspects of the projects are known and documented, maximizing efficiency by being fully aware of all risks and potential obstacles up front. The consequence of all projects are assessed for their potential risks and analysed to mitigate known risks. This is done in an attempt to maximize the benefits versus costs ratio. Business cases are prepared to justify the project and select the preferred alternative from various options by comparing costs, associated risks and benefits of each.

HOL has developed a consequence scoring and prioritization process to streamline selecting proactive projects. HOL assesses risk based on five objectives: Health and Safety, Environment, Reliability and Customer Impact, Asset Condition and Regulatory. Each of these categories is given a measure based on a seven step scale from “None” to “Severe”. The scale measure describes the potential consequences of delaying the project. Refer to Section 2.1 for the full description of the process.

While it is preferred for all investments to be selected based on this prioritization, mandated investments will arise typically due to external drivers. When such investments occur they have reasoning clearly documented and are scored so that the impact to objectives is clearly understood and communicated. An example of this type of replacement would be due to equipment recalls, environmental regulation or major safety concerns.

2.3.1.1.2 Reactive Replacement

HOL has developed capital programs that manage assets through reactive replacement. These assets have minimal failure consequence, have spares readily available, and require minimal resources for installation. HOL reactive replacement strategy has been developed based on historical failure rates and considers utility best practices.

2.3.1.1.3 Refurbishment

Asset refurbishment is approached on a per asset case, or through an asset refurbishment program and utilizes results from inspections, manufacturer recommendations, internal standards and/or regulatory requirements as drivers. Asset refurbishment is thoroughly compared to asset replacement to ensure there is financial and/or operational benefit.

Refurbishment of an asset is a life extension investment to offset the planned replacement. HOL determines the best course of action, refurbishment or retirement, by examining:

- Asset remaining useful operating life;
- Life extension forecasted from refurbishment activity;
- Cost of refurbishment as compared to cost of replacement;
- Availability of replacement parts;
- Obsolescence of asset;
- Impact to reliability, refurbishment outage vs. replacement outage;
- Refurbishment warranty; and
- Asset remaining financial life: cost of de-recognition if replaced;

2.3.1.2 Maintenance Planning Criteria

Annual review of the HOL maintenance programs are completed through the Testing, Inspection and Maintenance Planning Process (TIM) and documented in the Annual Planning Report (Attachment B-1(B)) TIM section. The TIM Planning Report was developed to serve as a summary and guide of the current activities, data collection methodologies as well as to identify the gaps in the existing practices. HOL's TIM programs are crucial to ensuring a reliable and sustainable distribution system by ensuring that all assets are effectively meeting requirements. Information from the TIM programs feed back into the ACA to allow for effective life-cycle planning of assets. Currently, there are many different types of testing, inspection and maintenance activities that are used to gain asset information, health information required for the determination of replacement and/or maintenance prioritization in order to increase asset reliability, safety and longevity.

The purpose of the HOL TIM programs is to test, inspect and maintain the equipment and to gather equipment information for use in asset lifecycle planning. HOL retains maintenance records for assets used to optimize asset replacement, refurbishment, and maintenance activities. HOL currently splits the maintenance activities into two groups; distribution maintenance and station maintenance.

Through the TIM Plan the annual O&M spend is tracked by maintenance program to ensure an optimal balance between inspection and maintenance versus replacement is achieved.

2.3.1.2.1 Criteria and Assumptions

HOL maintenance planning criteria and assumptions are asset dependent and rely on either internal standards or regulatory requirements (OEB Distribution System Code Appendix C – Minimum Inspection Requirements). Internal maintenance program requirements follow industry best practises or are formed through HOL historical experience. HOL develops maintenance and replacement programs by comparing their associated benefits and costs: it may be practical to replace an asset if the cost of maintaining the asset outweighs the value of its replacement.

2.3.1.3 Preventive Inspection and Maintenance Programs

HOL TIM program activities include visual or infrared inspection as well as more intrusive testing of equipment condition and operation. The TIM program also includes maintenance activities referring to physical work on equipment. Most of HOL asset maintenance activities are on a cyclic schedule. The cycle period is selected based on manufacturer’s recommendation, regulatory requirement or internal experience and standards.

Table 2.3.1 outlines the inspection and maintenance cycles of each program. The following sections describe the HOL inspection and mainteneance programs, further details can be found in the Testing, Inspection and Maintenance Plan, included in the APR.

1 Table 2.3.1 - Maintenance Programs

	TIM Type	Cycle	Type
Substation	Station IR Scans	Annually	Predictive
	Switchgear Inspections	Annually	Preventative
	Breaker & Recloser	Every 4-6 Years	Preventative
	Station Switches	Annually	Preventative
	SCADA Inspections	Annually	Preventative /Predictive
	Relay	Every 4-6 Years	Preventative
	Station Inspections	Monthly	Predictive/Corrective
	Battery Maintenance	Annually	Predictive
	Transformer Maintenance	Every 3-5 Years	Preventative
	Transformer Doble	Every 3-5 Years	Predictive
	Transformer Oil Analysis	Annually	Predictive
	Transformer Tapchanger Maintenance	Every 3-5 Years	Preventative /Predictive
Distribution	Padmounted Switchgear IR and Visual	Every 3 Years	Predictive/Corrective
	Padmounted XFMR IR and Visual	Every 3 Years	Predictive/Corrective
	O/H IR Inspection	Every 3 Years	Predictive
	Vault Maintenance	Not Defined	All
	Vegetation Management	Every 2 or 3 Years	Preventative /Corrective
	Pole Inspection	Every 10 years	Predictive/Corrective
	Critical Switch Inspection	Every 3 Years	Preventative
	Insulator Washing	Annually	Preventative
	Switchgear CO_2 Washing	Every 3 Years	Preventative
	Cable Inspection	120 segments annually	Predictive
	Manhole Inspections	10 Year	Corrective
	Graffiti Abatement	Routinely	Corrective

2.3.1.3.1 Station Infrared (IR) Inspections

Infrared (IR) inspection on station equipment is completed in conjunction with more specific equipment inspection. The IR inspection checks equipment for hot spots to indicated loose connections, defective equipment, overloading, contamination, short circuits and ground faults. HOL performs IR scanning, internally, on station equipment.

2.3.1.3.2 Station Switchgear Maintenance

Switchgear General Maintenance

Switchgear undergoes inspections, as part of the monthly cycle, that check the switches, over current relays, position indicator, heaters, breaker tools, and breaker and racking mechanism operation.

Breaker Maintenance

The current TIM activities for circuit breakers include: visual inspection and electrical, mechanical, and operational tests. Visual inspection ensures that the breakers are clean, there are no signs of arcing or leaking oil, and there is no damage to the breaker or arc chute. Electrical testing includes performing insulation resistance and contact resistance testing. Mechanical tests include: cleaning the bushing, checking for any leaks around the gaskets, cleaning, lubricating and testing the operating mechanism, checking the contacts, and tightening all bolts, pins, and connections. Operational testing of the breaker checks the operating mechanisms, and ensures the proper operation of the breaker and the charging motor.

Station Recloser Maintenance

Recloser maintenance includes: visual inspection, electrical testing, mechanical testing and dielectric sampling. The visual inspection checks the bushings, contacts and liquid level and includes an IR scan of the recloser and its components. The electrical, mechanical, and operational inspection includes checking mechanical connections, testing insulation resistance and recloser function test to ensure proper operation.

Station Switch Maintenance

Switches undergo visual inspection on a monthly basis. Visual inspection checks for issues with the arc shoots, arc tips, broken insulators, burned insulators, and dirty components. The visual inspection is completed to ensure that the switch has no issues that could indicate a problem with day to day operation.

High Voltage Fuse Maintenance

High voltage fuse inspection involves: IR scans, visual inspection and cleaning and clip pressure inspection. The visual inspection includes: inspecting the fuse holders, insulators and fuse for breaks, cracks, burns, pitting, and indication of flashover and signs of deterioration. The IR inspection checks the fuse holder to ensure the components are under the threshold temperature.

2.3.1.3.3 Supervisory Control and Data Acquisition (SCADA) Maintenance

Supervisory Control and Data Acquisition (SCADA) is a control system that allows for the monitoring and control of compatible electrical equipment in the HOL electrical system. The maintenance performed on SCADA controlled equipment includes visual inspection, checking communication, cleaning, torquing, function testing and ground inspection.

2.3.1.3.4 Relay Maintenance

Relays are currently undergoing complete inspections every 4 to 6 years. Visual inspections are part of the monthly stations inspection and check for obvious equipment deficiencies. Electrical, mechanical and operational inspections identify loose connections, broken studs, burned insulation, dirty contacts, setting configuration and proper operation. IR scans are completed as part of the station annual IR scan and detects equipment operating over the manufacturers temperature specifications.

2.3.1.3.5 Station Visual Inspection

The Station Visual Inspection program is used to assess the condition of the station yard, the station building exterior and interior, the station security, and general equipment condition. The inspections are conducted monthly.

2.3.1.3.6 Battery Maintenance

The station battery and battery charger are inspected by completing voltage measurements and visual inspection of the direct current (DC) supply components. Included in the voltage measurements are recording individual cell voltages, the battery charger normal charging voltage and the battery charger equalization voltage. The voltage of the individual cells will ensure that they are holding their nominal level and will confirm the cell is in good condition. The charging voltages are taken to ensure the battery charger is set up to charge the battery at the manufacturer's recommendations. Visual inspections are completed for the bonding connections, the battery and battery charger as well as all connecting equipment. The visual inspection determines if there are low electrolyte levels and if corrosion exists at the battery terminals.

2.3.1.3.7 Station Transformer Maintenance

Transformer maintenance currently includes: visual inspection, electrical tests, mechanical tests and oil sampling. The visual inspection involves current and voltage readings, temperature readings, liquid level check, physical condition assessment and pressure/vacuum gauge readings.

The visual inspections of current, voltage and temperature readings ensure that the transformers are operating within the acceptable limits. If the levels are measured outside of the specifications, investigation will be required to determine the root cause and remediation plans.

Liquid, pressure and vacuum level readings are checked to ensure that the transformer is not leaking in any way. If the readings are out of the acceptable range, the stations office is contacted to provide immediate support or schedule follow-up action.

2.3.1.3.8 Station Transformer Doble Testing

Doble testing equipment is being used to assess the overall power factor, turns ratio testing, leakage reactance and exciting current of the transformer. These tests are used to detect moisture in the oil or insulation, detect contamination in the transformer bushing, determine the electrical insulation quality, and locate bad connections and winding movement. The Doble equipment provides test results and expected values and thresholds to effectively translate the results. Doble testing, DGA testing and oil quality analysis complement each other to provide clear indication of the overall health of the transformer.

2.3.1.3.9 Station Transformer Oil Analysis Testing

Transformers undergo dissolved gas analysis (DGA) and oil quality analysis annually. The DGA and oil quality analyses are an important diagnostic tool used to monitor the condition of the unit. Emphasis is placed on these tests for detecting insulation breakdown, water in the oil, stressing of the coils, localized overheating and arcing that can lead to failure of the transformer. Currently, HOL sends oil samples to an oil testing laboratory, uses DGA portable equipment and uses DGA online monitoring equipment. The oil testing laboratory uses sophisticated lab equipment that creates a full analysis of the oil sample, compares the results to any previous transformer oil samples, and specifies detailed recommendations for the transformer. If the laboratory processing lead time is too lengthy, HOL will use portable DGA equipment for immediate results. The online DGA equipment is used for continuous monitoring of transformer gas concentrations and can be used to set alarms at specific gas concentration thresholds. DGA online monitoring systems are being installed as part of HOL standards and are capable of sending DGA data to the PI server data historian.

DGA and oil quality tests identify abnormalities within the transformer and provide detailed information to allow for sound decision making for future operation and maintenance of the transformer.

2.3.1.3.10 Tap Changer Maintenance

Oil Filled (Filtered) Tap Changers

Oil filled tap changer TIM activities include recording position of the tap changer, inspecting the physical and mechanical condition, verifying correct auxiliary device operation, verifying correct liquid level in all tanks, performing tests as recommended by the manufacturer, verifying operation of heaters and verifying grounding. An internal inspection is also conducted and includes removing of the oil and cleaning carbon residue and debris from compartment, inspecting the contacts for wear and alignment, tightening all electrical and mechanical connections to calibrated specifications, inspecting the tap changer components for signs of moisture, cracks, electrical tracking or excessive wear and then refilling the tank with filtered oil.

Oil/Vacuum Filled Tap Changers

Oil/vacuum tap changer inspection includes: recording position of the tap changer, inspecting the physical and mechanical condition, verifying correct auxiliary device operation, verifying vacuum level, performing tests as recommended by the manufacturer, verifying operation of heaters, verifying grounding, and inspecting the vacuum bottles for wear or erosion.

2.3.1.3.11 Infrared (IR) and Visual Inspection

HOL performs infrared (IR) and visual inspection for many of its assets. The IR inspections allow crews and contractors to examine equipment operating temperature to detect defective components, poor connections, or overloaded equipment which can indicate the potential for failures. Visual inspections are important to monitor cleanliness, ease of access, obtain updated nomenclature and equipment information, and to assess damage and any potential follow-up activities required.

In order to effectively use the IR scanning information, an equipment health index was created and is used for various pieces of equipment. The condition rating is based on the temperature difference between the reference temperature and the equipment's actual measured temperature. Equipment that is within the critical temperature range has an Outage Management System (OMS) ticket created to schedule immediate repair. It is the responsibility of the area supervisor to schedule the work and close out the ticket when the issue is verified to be resolved.

Padmounted Switchgear

The padmounted switchgear inspection consists of IR scanning and a visual inspection of air-break switchgear. The IR scan detects loose connections, tracking, overloaded equipment, and other heat related problems. Visual inspection includes recording equipment information as well as checking for swollen elbows, exposed electrical hazards, operating hazards, rusting and graffiti.

Padmounted and Kiosk Transformers

The padmounted and kiosk transformer inspections consist of an infrared scan and a visual inspection. Infrared scanning detects loose connections, tracking, equipment overload, and other heat related problems. Visual inspection checks for swollen elbows, exposed electrical hazards, operating hazards and graffiti. Additional patrol inspection is performed as a result of the Graffiti Abatement and Repainting program.

Overhead Equipment

Overhead switches, transformers, lines, and associated attachments are inspected through the IR Scanning Program. The IR Scanning Program consists of performing infrared inspections on overhead equipment from ground level. Equipment that is over a temperature threshold is flagged as requiring further investigation.

2.3.1.3.12 Vault Maintenance

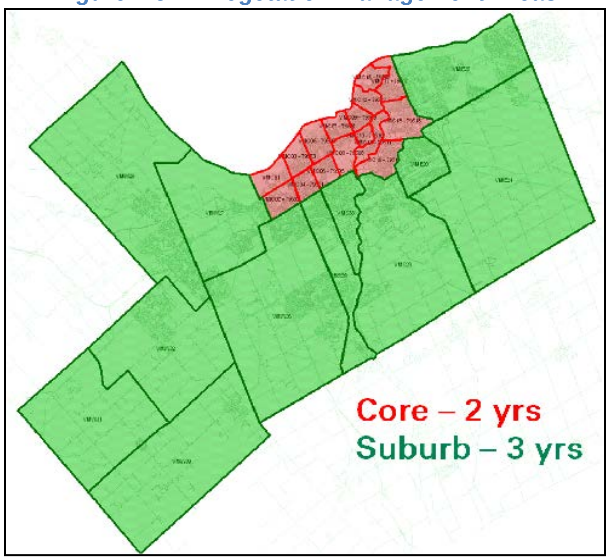
HOL has approximately 1500 vaults in its system, most of which are customer owned. HOL is in the process of creating a vault maintenance program. Customer owned vaults are the customers' responsibility to maintain along with the containing equipment. If no current maintenance is being performed on customer owned vaults, HOL will recommend that maintenance is performed by the customer. In the rare case that a customer does not complete maintenance on their vaults, and there are obvious issues, the vault could be reported to the Electrical Safety Authority (ESA) for follow-up.

Vault maintenance being performed is at the discretion of the customer or the contractor completing the work. Most often vault maintenance includes visual inspection of the civil structure, ventilation fans, and all electrical equipment, cleaning of the switchgear, transformer(s), breakers, the vault floors and any other required equipment, IR scanning of the electrical equipment, torquing connections, inspecting grounding and lighting and any other supplementary maintenance.

2.3.1.3.13 Vegetation Management

Vegetation that encroaches on the distribution lines on any right-of-way is managed to ensure system reliability and public safety. The HOL's service territory is currently divided into regions for vegetation management: 12 suburb and 16 core areas (Figure 2.3.2). Third party arborist contactors are hired to maintain certain vegetation areas annually. Recently, HOL undertook a project to evaluate each of the circuits in the distribution system through physical inspection. This produced a large amount of data regarding tree species to aid in a potential redevelopment of the vegetation management program to improve upon the effectiveness of the program. Also identified during the inspections were a number of circuits with overhanging branches. As a result, HOL is working through a storm hardening activity to remove the overhanging branches in an effort to further improve reliability.

Figure 2.3.2 - Vegetation Management Areas



2.3.1.3.14 Pole Inspections and Testing

One of HOL's largest asset classes is distribution poles and attached hardware. These assets are used to support overhead distribution and sub-transmission conductors throughout the City. Maintaining these assets is essential for a reliable and safe system.

HOL currently performs visual inspection and drill testing on poles. Visual inspections record detailed information about the pole, the attached hardware and any other relevant information. This information is used in conjunction with the drill test to prioritize pole replacement, hardware replacement or to create new designs that will integrate with the present configuration. Drill assessment is a non-destructive testing method using an International Distribution Network (IML) Resistograph drill which measures the density or resistivity of the wood against the drill bit. The drill test provides an overall indication of rot, void, and solid wood thickness that can be used to calculate the remaining strength of the pole.

2.3.1.3.15 Critical Switches Inspection

HOL currently has a critical switch program with the purpose of maintaining and inspecting switches that are deemed a high priority. These switches are selected based on the requirements to interrupt higher loads, supply many customers, or critical customers such as hospitals. The cyclic inspection program will ensure all areas will be visited, and problems detected before they lead to system failures that may:

- Impair the safety of HOL employees or the public at large;
- Impair system reliability and reduce the quality of service to our customer;
- Seriously reduce the life expectancy of the equipment and increase costs; and/or
- Adversely affect the environment.

Currently, the critical switch maintenance includes a visual and mechanical inspection, electrical tests, and comparison of resistance tests with similar connections. The mechanical and visual inspection includes a visual check of the physical appearance of the mechanical and electrical connections, cleaning of the switch, and mechanical operator test. The electrical test includes connection resistance checks, equipment torquing, and Megger checks on each pole and/or control wiring.

2.3.1.3.16 Washing

Insulator Washing

HOL has adopted an extensive insulator washing program with full washing of critical 44 kV, 27.6 kV and 13.2 kV circuits.

Washing is used to clean insulators with contamination build-up. Contamination decreases the insulation strength and causes tracking and flashover. This arcing causes electrical losses but can also lead to pole fires, further equipment damage, and outages to the system. Currently, only porcelain insulators are being washed as part of the program.

The program was revisited in 2013 and the insulator routes were modified based on several criteria. The main selection criteria were system voltage, type of traffic or nearby industry, numbers of recorded pole fires and percentage of porcelain insulators.

The insulator wash is a supplementary activity from those stated in the OEB's Minimum Inspection Requirement document

Padmounted Switchgear CO_2 Wash

All identified air-brake switchgear are Carbon Dioxide (CO_2) washed by contractors to remove contamination, such as road salt or dirt, that contributes to tracking and flashover. To eliminate the contamination's impact on the IR results, the switches are washed prior to performing IR scan. The carbon dioxide is mixed with clean compressed air at the spraying nozzle and safely removes surface contamination from both energized and de-energized internal equipment. CO_2 wash allows switchgear to be cleaned while energized, is environmentally friendly, safe, and will increase system reliability by removing surface contamination that can lead to flashover.

Cable Inspection

Underground cables are patrol inspected during manhole inspections. Select condition testing of XLPE cable is done annually in the winter through a cable testing program with National Research Council of Canada (NRC). Specific cable segments are tested using a polarization / depolarization technique and the results are compared to reference cables. Test locations are determined based on fault history, age and future planned replacement projects. Test results provide input to HOL's cable replacement and cable injection strategy.

2.3.1.3.17 Civil Structure Inspections

The manhole inspection program targets 300 manholes annually as part of a 10 year inspection cycle. Underground chambers are also inspected through regular work activities when crews perform scheduled work in manholes and handholes.

2.3.1.3.18 Graffiti Abatement

The objective of the Graffiti Abatement program is for painting rusted equipment, graffiti removal, refurbishment and removal of eyesores and extending equipment life when necessary. Currently, equipment requiring attention is identified through regular patrol by a contractor. The Graffiti Abatement program was developed in response to the City of Ottawa Graffiti By-Law to ensure HOL keeps its property free of graffiti. It also allows HOL to work cooperatively with the City of Ottawa By-Law department to address criminal acts of graffiti to deter future acts of vandalism.

2.3.2 Asset Life Cycle Risk Management

HOL uses several different TIM programs and activities to provide different approaches to asset failure mitigation; predictive, preventive and corrective maintenance. The HOL maintenance programs may use more than one approach to minimize asset failure and for input into strategic asset management planning.

2.3.2.1 Methods

2.3.2.1.1 Predictive Maintenance

HOL practices predictive maintenance techniques to mitigate asset failure by evaluating testing and inspection information to identify when proactive or corrective maintenance is required to ensure that the equipment continues to meet requirements.

Infrared Scanning

HOL proactively performs infrared (IR) scanning on most equipment as a predictive tool for maintenance. Equipment that undergoes IR scans includes but is not limited to:

- station transformers;
- station switchgear;
- station switches;
- station terminations;
- station batteries;
- overhead conductors and terminations;
- padmounted transformers;
- padmounted switchgear;
- polemounted transformers; and
- supervisory control and data acquisition (SCADA) system equipment

Table 2.3.2 - Infrared Condition Rating

Critical - (>75°C), immediate repair
Major Problem - (>36°C-75°C), repair as soon as possible
Intermediate - (>10°C- 36°C)
Minor - 10°C or less

IR scans are a useful tool to locate overloaded equipment, bad termination, or failed equipment to prioritize maintenance activities to eliminate the potential risk of failure. HOL uses a conditioned rating to prioritize follow-up preventative maintenance (see Table 2.3.2).

Dissolved Gas Analysis

Substation transformers and tap changers undergo dissolved gas analysis (DGA) and oil quality analysis annually. The DGA and oil quality analyses are an important diagnostic tool used to monitor the condition of the equipment. DGA and oil quality tests identify abnormalities within the transformer and tap changer and provide detailed information to allow for sound decision making for future operation and maintenance practices to ensure the equipment continues to run efficiently.

Station Batteries and Chargers

HOL performs testing on substation direct current (DC) systems to assess the condition of the charger and the battery. Testing ensures the charging system is performing as expected and evaluates the individual cell health. The cell health condition predicts any problematic cells in the battery to flag corrective maintenance or replacement before a failure can occur.

Poles

HOL poles are visually and drill tested for condition assessment and as input to develop the health indexing. The visually inspection and drill testing are a predictive approach used to calculate the remaining strength of the pole and any attachments. The remaining strength is used to assess if the pole is adequate, if it needs immediate replacement, or to forecast when replacement will be required. The visual inspection identifies any risks of failure to pole attachments which includes insulators, crossarms, guying or anchoring. Any immediate concerns are dealt with and follow up work is scheduled for resolution.

2.3.2.1.2 Preventive Maintenance

HOL performs preventive maintenance on distribution and station assets. Preventive maintenance is an approach where cyclic testing, inspection, and maintenance results in safe and reliable equipment operation by proactively identifying issues that could lead to future concerns.

Insulator Washing

HOL executes overhead insulator washing to decrease flashovers and potential pole fire due to contamination, such as salt spray, dust or pollution, which can cause tracking. Insulator washing is done in selective areas deemed to be critical based on the following factors: system voltage, type of traffic or nearby industry, numbers of recorded pole fires and percentage of porcelain insulators.

CO_2 Washing

Air-brake switchgear are carbon dioxide (CO_2) washed to remove contamination in order to reduce the probability of tracking and flashover. The carbon dioxide is mixed with clean compressed air at the spraying nozzle and safely removes surface contamination from both energized and de-energized internal equipment. CO_2 washing allows switchgear to be cleaned while energized, is environmentally friendly, safe, and will increase system reliability by removing surface contamination that can lead to flashover.

Vegetation Management

The HOL vegetation management program combines preventive and corrective activities. The preventative work is regular trimming that occurs on a 2 or 3 year cycle depending on region aimed at maintaining proper clearances to lines. This trimming manages the majority of trees in HOL right of ways. The vegetation management program removes tree hazards that are within the encroachment limits to decrease tree related failures and interruptions. Corrective work includes unpredictable vegetation activities and includes customer calls for tree hazards, emerald ash trees affected by the emerald ash borer, and emergent work from storms.

Critical Switch Program

The purpose of HOL's critical switch program is to maintain and inspect switches that are deemed to have a high consequence of failure. These switches are selected based on the requirements to interrupt higher loads, supply many customers, or critical customers such as hospitals. The cyclic inspection program ensures all areas are visited, and problems detected before they lead to system failures that may:

- Impair the safety of HOL employees or the public at large;
- Impair system reliability and reduce the quality of service to our customers;
- Seriously reduce the life expectancy of the equipment and increase costs; and/or
- Adversely affect the environment.

Station Equipment

Substation equipment has a larger failure consequence as compared to distribution equipment based on an increase in number of customer affected by any failure, increased equipment procurement time and higher cost, and as such, has more regular, rigorous and frequent testing, inspection and maintenance activities. The following list details the regular maintenance performed on station equipment.

- The oil from transformers and tap changers is drained to perform an internal visual inspection and the oil is replaced to eliminate any potential contamination;
- Tap changers are cleaned and tested to ensure reliable operation;
- Switchgear is cleaned thoroughly;
- Breakers are tested and calibrated to ensure adequate timing
- Breaker racking mechanisms are cleaned, greased and tested.

During these routine maintenance activities any problematic components identified are proactively replaced.

2.3.2.1.3 Corrective Maintenance

Corrective maintenance activities are identified through visual inspection or by equipment failure indication. HOL uses predictive and preventive maintenance to minimize corrective maintenance which can typically result in longer interruption duration and higher overall costs. Reactive maintenance is commonly performed on equipment with low consequence of failure or due to unpredicted failure.

Corrective maintenance is prioritized in HOL's tracking system (Outage Management System, OMS) depending on the criticality of the work. Issues identified as a reliability, safety or environmental concern are resolved immediately and progress on other issues is tracking through the OMS to ensure completion in a timely manner.

2.3.2.2 Information Collection and Analyses

HOL is currently in the process of maximizing digital collections of maintenance information. Digital collection of information, through the use of ruggedized tablets, optimizes the ability to perform data analyses and allows for more effective implementation of health indexing and project prioritization. HOL is reviewing its asset health index to identify the gaps in the inspections process. Identifying the gaps will allow the maintenance programs to improve and evolve to provide more qualitative results.

The TIM Plan documents HOL's current programs; including the programs schedule, performance indicators, data governance, corrective maintenance activities and program gaps (refer to the Annual Planning Report Testing Information and Maintenance – Data Governance for the information collected by HOL, Attachment B-1(B)).

2.3.2.3 Asset Risk Analysis

HOL risk analysis is completed as part of the Asset Management Process. The risk is calculated using objective weighting and risk scoring (see Section 2.1.2 Asset Management Process Components) that prioritizes activities that address a higher level of risk.

2.3.2.4 Risk Analyses and Prioritizing Capital Expenditures

HOL risk analysis and capital project prioritization is completed as part of the Asset Management Process. The capital expenditures are prioritized to maximize benefit to cost (see Section 2.1.2 Asset Management Process Components).

3 Capital Expenditure Plan

The capital expenditure plan details the system investment decisions which are made through the asset management and capital expenditure planning process. Investments are detailed by investment category, HOL Capital Program and Budget Program for the historic years of 2011 through 2015 and the forecast years of 2016 through 2020.

3.1 Summary

HOL's Capital Expenditures are broken into categories based on the following hierarchy: Investment Category, Capital Program followed by Budget Program, as shown in Table 3.1.1 along with the primary driver. For a description of each driver refer to Table 2.1.1 - Driver Descriptions.

Table 3.1.1 - Capital Expenditure Categories

Investment Category	Capital Program	Budget Program	Primary Driver
System Access	Plant Relocation	Plant Relocation & Upgrade	3rd party requirements
	Residential	Residential Subdivision	Customer service request
	Commercial	New Commercial Development	Customer service request
	System Expansion	System Expansion	Customer service request
	Stations Embedded Generation	Embedded Generation Projects	Customer service request
	Infill & Upgrade	Infill Service (Res & Small Com)	Customer service request
	Damage to Plant	Damage to Plant	Mandated service obligation
	Metering	Suite Meters	Mandated service obligation
System Renewal	Station Assets	Stations Transformer Replacement	Assets at end of service life – failure risk
		Stations Switchgear Replacement	Assets at end of service life – failure risk
		Stations Plant Failure	Assets at end of service life – failure
	Stations	Stations Enhancements	Assets at end of service

	Refurbishment		life – substandard performance
	Distribution Assets	Planned Pole Replacement	Assets at end of service life – failure risk
		Insulator Replacement Program	Assets at end of service life – high performance risk
		Elbow & Insert Replacement	Assets at end of service life – substandard performance
		Distribution Transformer Replacement	Assets at end of service life – failure risk
		Vault Rehab or Removal	Assets at end of service life – failure risk
		Civil Rehabilitation	Assets at end of service life – failure risk
		Cable Replacement	Assets at end of service life – failure risk
		Switchgear New & Rehab	Assets at end of service life – failure risk
		O/H Equipment New & Rehab	Assets at end of service life – failure risk
		Plant Failure	Assets at end of service life – failure
	Metering	Remote Disconnected Smart Meter	Assets at end of service life – substandard performance
System Service	Stations Capacity	Stations New Capacity	Capacity constraint
	Distribution Enhancement	Line Extensions	Capacity constraint
		System Reliability	Reliability
		Distribution Enhancements	System efficiency
		System Voltage Conversion	Capacity constraint
	Automation	Distribution Automation	Reliability
		Substation Automation	System efficiency
		SCADA Upgrades	System efficiency
		RTU Additions	System efficiency
General Plant	Hydro One Payments	Hydro One Payments	System capital investment support

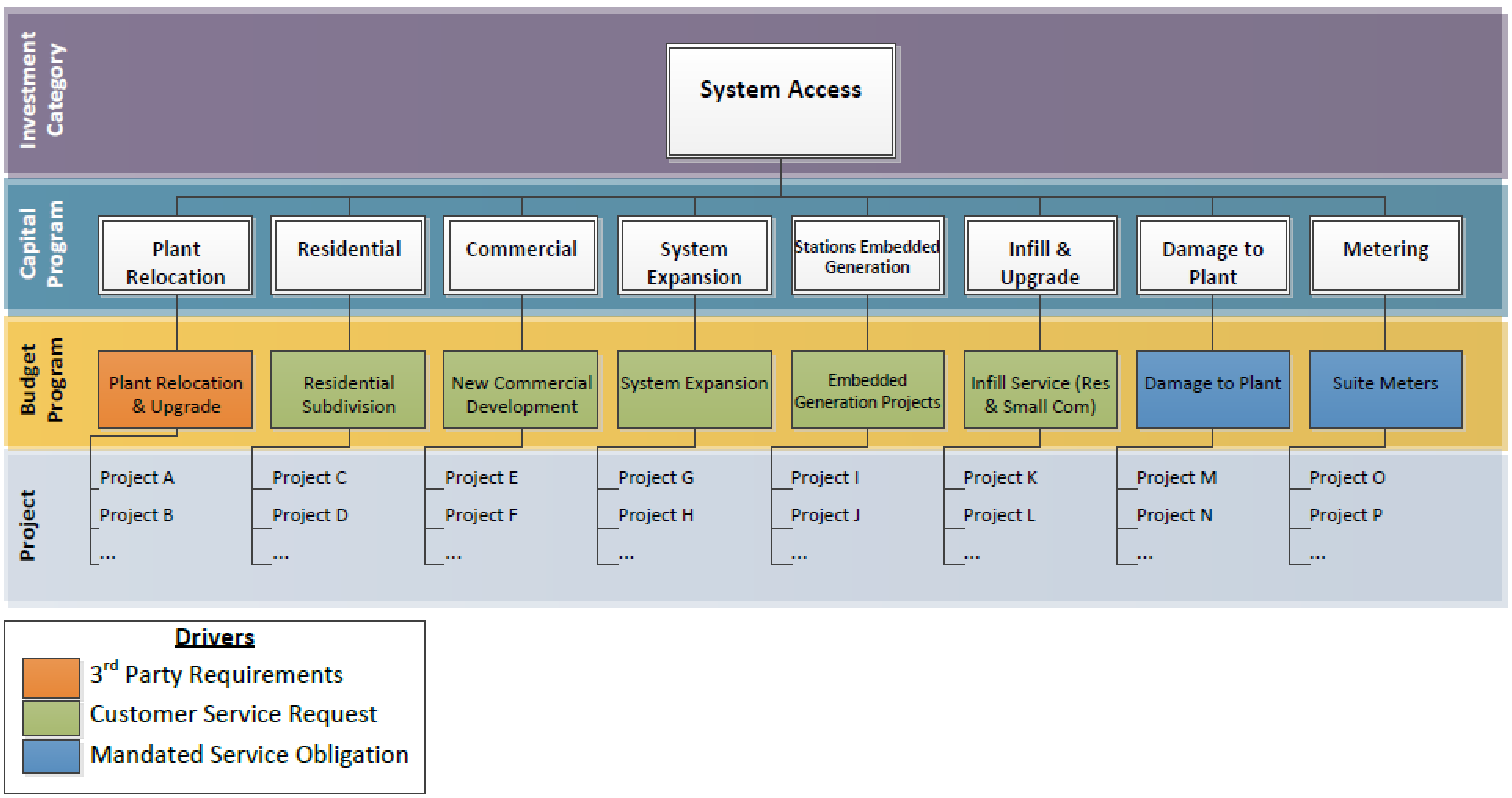
	Facilities Management	Facilities Management	Non-system physical plant
	Fleet Replacement	Fleet Replacement	System capital investment support
	Tools Replacement	Tools Replacement	System maintenance support
	IT Life Cycle & On-going Enhancements	IT Life Cycle & On-going Enhancements	Business operations efficiency
	IT New Initiatives	IT New Initiatives	Business operations efficiency
	ERP System	ERP System	Business operations efficiency
	Customer Service	Customer Service	Business operations efficiency
	Operation Initiatives	Operation Initiatives	Business operations efficiency
	Facilities Implementation Plan	Facilities Implementation Plan	Non-system physical Plant

The following sections outline the descriptions of the Capital Programs and Budget Programs by Investment Category.

3.1.1 System Access

System Access investments, as defined in the Chapter 5, Section 5.1.1 Investment Categories are "modifications (including asset relocation) to a distributor's system a distributor is obligated to perform to provide a customer (including a generator customer) or group of customers with access to electricity services via the distribution system". Figure 3.1.1 shows the System Access financial hierarchy and drivers.

Figure 3.1.1 - System Access Financial Hierarchy and Drivers



1 Table 3.1.2 - System Access Capital Program & Budget Program Descriptions

Capital Program		Budget Program	
Name	**Description**	**Name**	**Description**
Plant Relocation	• Work triggered by road widening, relocation and upgrade of plant during relocation and any plant removal due to conflict; • Typically 50% contributed capital	Plant Relocation & Upgrade	• Relocation or upgrade of HOL owned or joint-use overhead lines or underground; • equipment to permit for safe limits of approach.
Residential	• Connection of new subdivision developments; • Exclusive of work considered under Infill & Upgrade	Residential Subdivision	• To connect new residential subdivisions consisting of townhomes, semi-detached, single, or any combination of housing units; • Includes alternative bid and HOL built subdivisions; • Trunk, primary & secondary distribution infrastructure all considered within scope
Commercial	• To connect new developments with secondary voltage at or above 600V; • Exclusive of work considered under Infill & Upgrade	New Commercial Development	• New developments serviced via padmounted equipment (switchgear and/or transformers) or via a vault
System Expansion	• An addition to the distribution system in response to a request for	System Expansion	• A demand driven addition to a distribution feeder in response to a request for

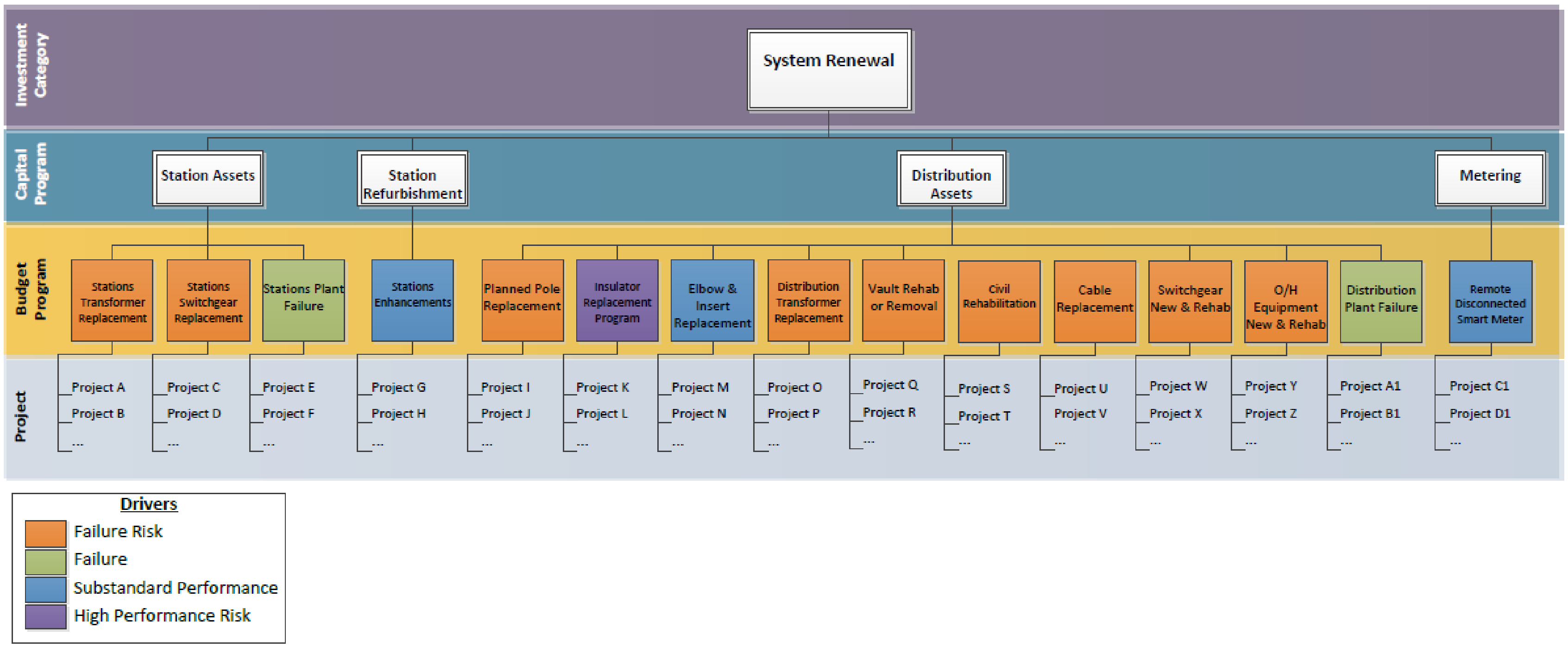
	additional customer connections that otherwise could not be made		additional customer connections; for example a line extension
Stations Embedded Generation	• Projects that HOL undertakes to ensure the system can accept customer embedded generation connections while ensuring reliability of the existing system is maintained	Embedded Generation Projects	• Connection of customer driven embedded generation projects; • Includes metering, service connection and protection and control as required
Infill & Upgrade	• Residential infill and small commercial connections (one-offs); • Excluding those covered under Residential or Commercial; • Appendix G in HOL's Conditions of Service outlines fees, servicing standards, and conditions for infill and upgrade connections to the distribution network	Infill Service (Res & Small Com)	• Infill service or service upgrade for either residential or small commercial developments, i.e. services that do not require padmounted equipment or vault installations
Damage to Plant	• Replacement of harmed assets that has resulted in the loss of functional use or a safety hazard and are caused by a third party	Damage to Plant	• Unplanned replacement of harmed assets as caused by a third party

	(e.g. motor vehicle collision, cable dig-in, etc.); • Asset may be no longer functional or has an aesthetic condition beyond normal wear and tear; • Target 100% recovery of cost from the third party; however, where tracking information is not available, HOL absorbs the cost or may attempt at recovery from its insurer; • Includes damaged distribution or stations assets, excluding metering		
Metering	• Retrofit or installation of suite meters in commercial installations capable of measuring consumption on a per dwelling (as opposed to bulk) basis	Suite Meters	• Retrofit or installation of suite meters (retrofit of bulk meters) for commercial buildings; • Focus of the program is on residential retrofits and new construction in vertically arranged establishments with a minimum of 25 units

3.1.2 System Renewal

System Renewal investments, as defined in Chapter 5, Section 5.1.1 Investment Categories "involve replacing and/or refurbishing system assets to extend the original service life of the assets and thereby maintain the ability of the distributor's distribution system to provide customers with electricity services". Figure 3.1.2 shows the System Renewal financial hierarchy and drivers.

Figure 3.1.2 - System Renewal Financial Hierarchy and Drivers



1

Table 3.1.3 - System Renewal Capital Program & Budget Program Descriptions

Capital Program		Budget Program	
Name	**Description**	**Name**	**Description**
Station Assets	• Sustainment of discreet stations assets based on condition (Health Index) and prioritization (See Section 2.1 Asset Management Process Overview)	Stations Transformer Replacement	• Station transformer refurbishment (life extension), or replacement as guided by the Asset Management Planning process
		Stations Switchgear Replacement	• Stations switchgear and relay refurbishment (life extension), or replacement as guided by the Asset Management Planning process
		Stations Plant Failure	• Unplanned replacement of failed station assets; • In cases where there is no full functional failure (causing an interruption), or immediate safety or environmental concern then work should be planned and prioritized based on crew and resource availability (where work is not considered to be an emergency); • If the equipment has been damaged by a third party then it is considered under Damage to Plant
Stations	• Repairs and/or	Stations	• Repairs, refurbishment and/or

Refurbishment	refurbishment of existing station building or property assets for the purposes life extension or safety/regulatory requirements	Enhancements	replacement of existing station building or property assets
Distribution Assets	• Sustainment of discreet distribution assets based on assessed condition (Health Index) and prioritization (See Section 2.1 Asset Management Process Overview)	Planned Pole Replacement	• Planned replacement or upgrade of HOL owned poles or cross-arms based on condition assessment; • Pole attachments and conductors are considered in scope for replacement along with the poles/cross-arms where they are of the same vintage as the poles
		Insulator Replacement Program	• Replacement or upgrade of HOL owned insulators that have been deemed a safety hazard, operationally inadequate and/or may cause pole fires
		Elbow & Insert Replacement	• Replacement and upgrade of distribution transformer non-vented elbows and/or inserts on the 27.6 kV system due to safety concerns of flash over during operation below $0^{o}C$

		Distribution Transformer Replacement	• Replacement of overhead or underground distribution transformers due to functional, safety or environmental concern (leaks, PCBs, corrosion, failure risk, etc.), or upgrade, including transformer shop testing and commissioning
		Vault Rehab or Rebuild	• Vault rehabilitation due to condition of equipment or removal for consolidation or system betterment; • Includes replacement of Jack-Bus arrangements; • Exclusive of work considered under Plant Relocation & Upgrade
		Civil Rehabilitation	• Rehabilitation or rebuild of underground cable chambers, collars, ducts, and equipment pads due to condition or failure risk; • Includes installation of pads and vault space under pads; • Duct extensions considered under Line Extensions
		Cable Replacement	• Replacement or injection of underground cable based on condition;

			• All cable types considered, i.e. PILC, XLPE, butyl rubber, etc.; • Can include associated distribution transformer replacements based on condition assessment on a case-by-case basis
		Switchgear New & Rehab	• Replacement, refurbishment or upgrade of HOL owned switchgear based on condition
		O/H Equipment New & Rehab	• Installation of new, or the rehabilitation of overhead equipment (i.e. switches, reclosers, cutouts, or arrestors) based on condition or functional requirements (i.e. upgrade to gang operable switches or automated devices)
		Distribution Plant Failure	• Unplanned replacement of failed distribution assets; • In cases where there is no full functional failure (causing an interruption), or immediate safety or environmental concern then work should be planned and prioritized based on crew and resource availability (where work is not considered to be an

			emergency); • If the equipment has been damaged by a third party then it is considered under Damage to Plant
Metering	• Upgrading customer meters for the ability to remotely disconnect and reconnect	Remote Disconnected Smart Meter	• Upgrading customer meters for the ability to remotely disconnect and reconnect

1

3.1.3 System Service

System Service investments, as defined in Chapter 5, Section 5.1.1 Investment Categories are "modifications to a distributor's distribution system to ensure the distribution system continues to meet distributor operational objectives while addressing anticipated future customer electricity service requirements". Figure 3.1.3 shows the System Service financial hierarchy and drivers.

Figure 3.1.3 - System Service Financial Hierarchy and Drivers

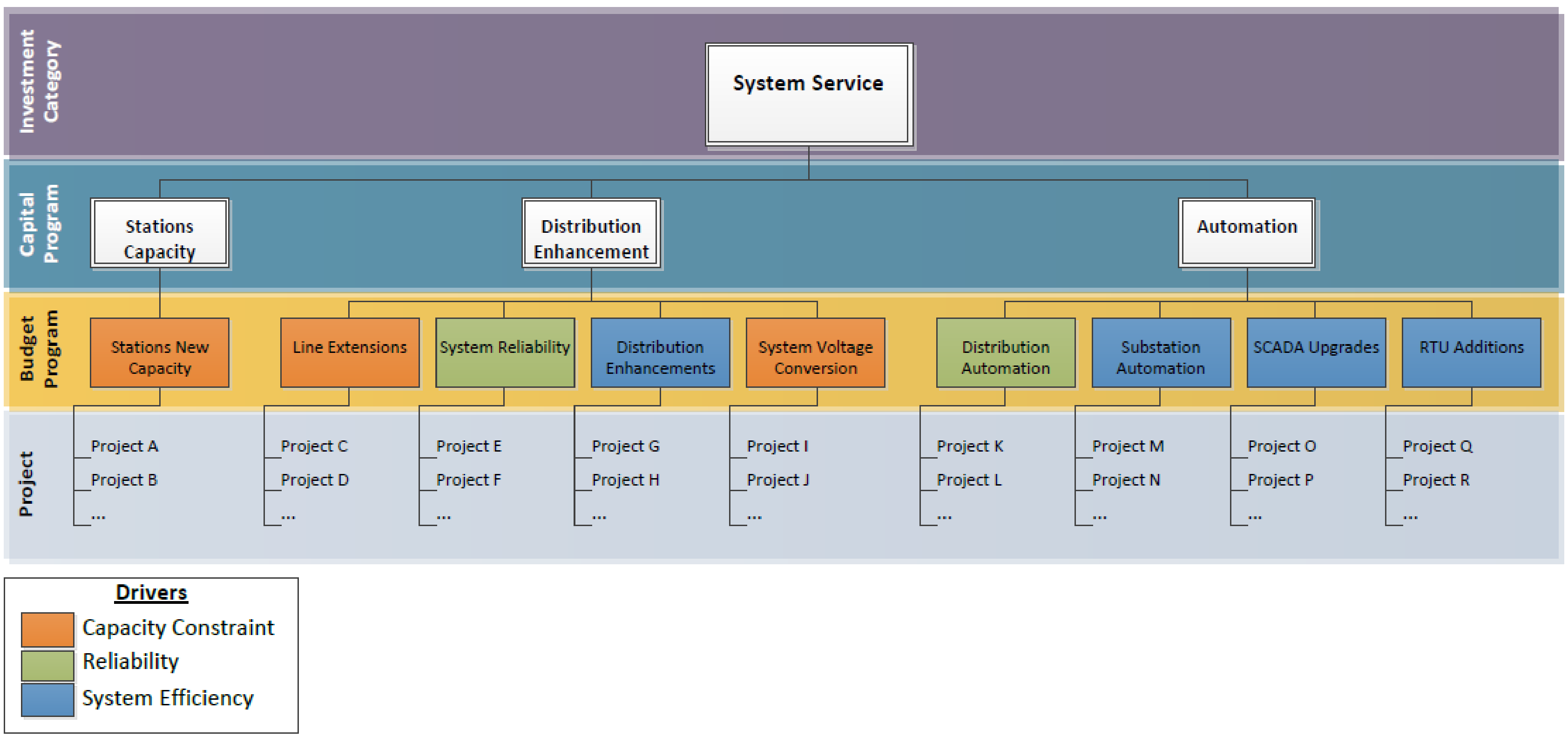


Table 3.1.4 - System Service Capital Program & Budget Program Descriptions

Capital Program		Budget Program	
Name	**Description**	**Name**	**Description**
Stations Capacity	• Increase in station capacity by either increasing existing station transformation or through the construction of new substations; • Identified through the Asset Management Process (see 2.1.2.1.3 System Service) for the purpose of ensuring adequate and reliable supply	Stations New Capacity	• New stations or increased station transformation through transformer upgrades or additions at existing stations as identified through the Capacity Planning process
Distribution Enhancement	• Modification to an existing distribution system that is made for purposes of improving system operating characteristics such as reliability, power quality or for relieving system capacity constraints as identified through the Asset Management Process (see 2.1.2.1.3 System Service)	Line Extension	• Line extensions (overhead or underground) for the purpose of increased capacity, reliability and/or improved power quality as identified through either the Reliability or Capacity planning processes
		System Reliability	• Specific enhancements to particular areas identified as having poor historic system reliability, as identified through the Asset Management

			Process (see 2.1.2.1.3 System Service); • Includes projects to support the betterment of the Worst Performing Feeders (see 1.3.1.1.3 Worst Feeder Analysis)
		Distribution Enhancements	• Modifications to an existing distribution system made for purposes of improving system operating characteristics or operability (e.g. circuit reconfiguration)
		System Voltage Conversion	• Distribution voltage conversion for increased capacity in areas seeing significant growth; • Typically coincide with retirement of existing stations or distribution assets due to condition or failure risk
Automation	• Installation and commissioning of automated equipment for the purposes of communication or operability	Distribution Automation	• Installation of remotely operable or intelligent overhead or underground equipment, i.e. fault current indicators, Vipers, VBMs, SCADA operable switchgear, etc.

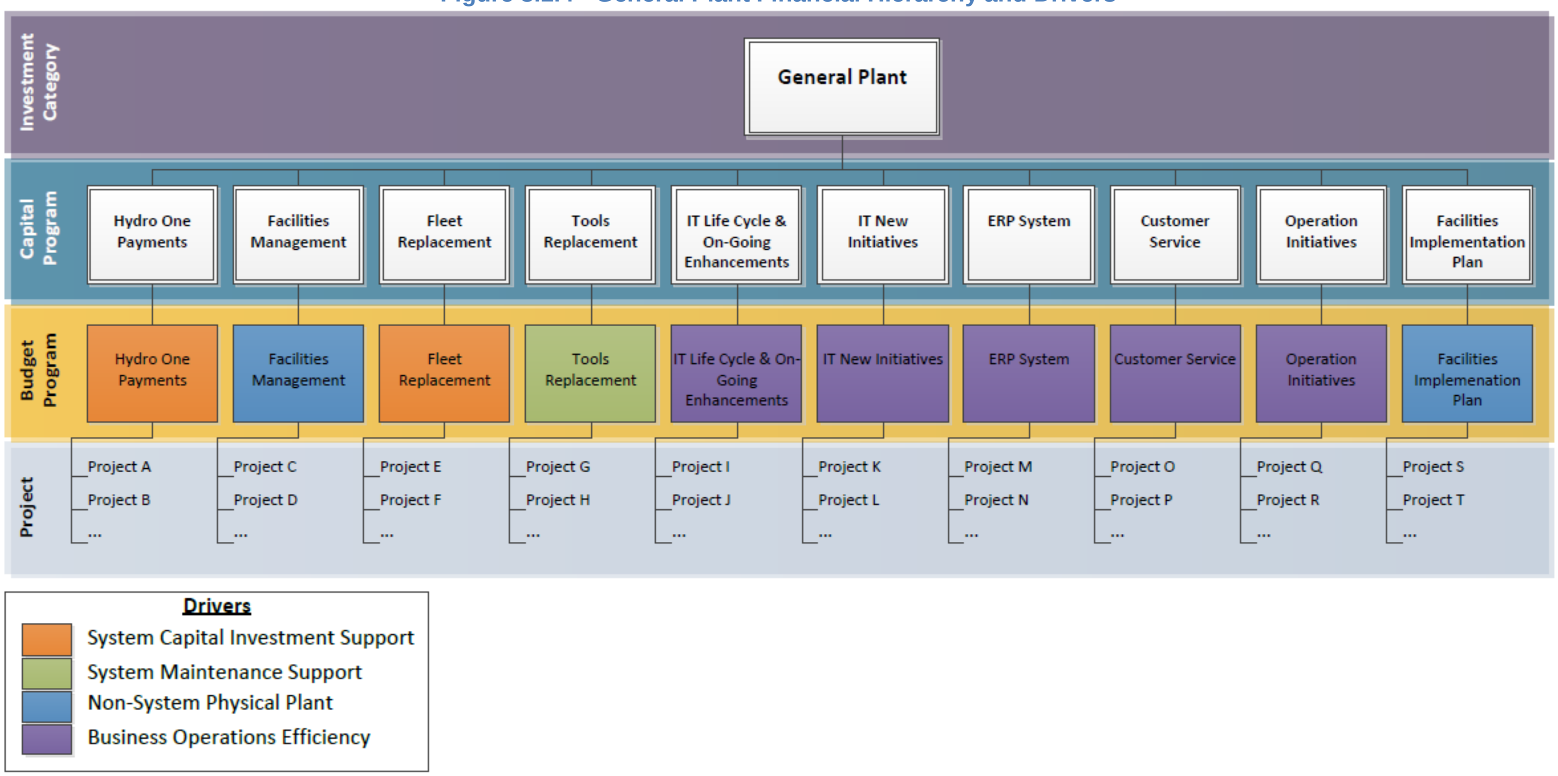
		Substation Automation	• Automation of non-operational information and functionality (not SCADA)
		SCADA Upgrades	• Upgrades to the Supervisory Control and Data Acquisition (SCADA) system; • Both hardware and software upgrades are considered
		RTU Additions	• Upgrading and addition of Remote Terminal Units (RTUs) in the distribution network to improve SCADA functionality

1

3.1.4 General Plant

General Plant investments, as defined in, Chapter 5, Section 5.1.1 Investment Categories are “modifications, replacements or additions to a distributor’s assets that are not part of its distribution system; including land and buildings; tools and equipment; rolling stock and electronic devices and software used to support day to day business and operations activities”. Figure 3.1.4 shows the General Plant financial hierarchy and drivers.

Figure 3.1.4 - General Plant Financial Hierarchy and Drivers



1 Table 3.1.5 - General Plant Capital Program & Budget Program Descriptions

Capital Program		Budget Program	
Name	**Description**	**Name**	**Description**
Hydro One Payments	Capital contributions to intangible assets purchased from Hydro One in conjunction with HOL's major station projects. Generally referred to as CCRA.	Hydro One Payments	Capital contributions to intangible assets purchased from Hydro One in conjunction with HOL's major station projects. Generally referred to as CCRA.
Facilities Management	The program addresses the necessary building improvements for the admin buildings and the operation centres to ensure employees with a safe environment to operate.	Facilities Management	The program addresses the necessary building improvements for the admin buildings and the operation centres to ensure employees with a safe environment to operate.
Fleet Replacement	Acquisition of vehicles to replace end of life vehicles. Program objective is to provide safe, reliable and efficient vehicles to meet the operational requirements.	Fleet Replacement	Acquisition of vehicles to replace end of life vehicles. Program objective is to provide safe, reliable and efficient vehicles to meet the operational requirements.
Tools Replacement	Tools replacements are needed to carry out the distribution maintenance and capital program efficiently and effectively.	Tools Replacement	Tools replacements are needed to carry out the distribution maintenance and capital program efficiently and effectively.
IT Life Cycle & On-Going	The program addresses the renewal and maintenance of	IT Life Cycle & On-Going	The program addresses the renewal and maintenance of

Enhancements	the IT infrastructure including PC replacements, network security, data loss prevention program, network switches upgrade, network file storage, and software licenses.	Enhancements	the IT infrastructure including PC replacements, network security, data loss prevention program, network switches upgrade, network file storage, and software licenses.
IT New Initiatives	The program focuses on initiatives to optimize business operations including Document Management System, Enterprise Architecture Program, and Data Management System	IT New Initiatives	The program focuses on initiatives to optimize business operations including Document Management System, Enterprise Architecture Program, and Data Management System
ERP System	The ERP is a vital technology solution to achieve business outcomes. Hydro utilizes J.D. Edwards (JDE) as its enterprise resource planning system. It is used to manage budgets, procurement, inventory, payroll, job cost, and general ledger functions.	ERP System	The ERP is a vital technology solution to achieve business outcomes. Hydro utilizes J.D. Edwards (JDE) as its enterprise resource planning system. It is used to manage budgets, procurement, inventory, payroll, job cost, and general ledger functions.
Customer Service	The program includes the Customer Care and Billing system, Customer Service Strategy, and Website Enhancements. The	Customer Service	The program includes the Customer Care and Billing system, Customer Service Strategy, and Website Enhancements. The program

	program objective is to add value to the customers.		objective is to add value to the customers.
Operation Initiatives	The program objective is to strengthen the Geospatial Resource Management (GRM) system, enhance reliability services, and increase productivity and organizational effectiveness.	Operation Initiatives	The program objective is to strengthen the Geospatial Resource Management (GRM) system, enhance reliability services, and increase productivity and organizational effectiveness.
Facilities Implementation Plan	The expenditures related to the purchase of two parcels of land upon which HOL will construct its new Eastern Operations & Campus and its Southern Operations centre and warehouse facilities	Facilities Implementation Plan	The expenditures related to the purchase of two parcels of land upon which HOL will construct its new Eastern Operations & Campus and its Southern Operations centre and warehouse facilities

3.1.5 Load and Generation Connection Capability

This section summarizes HOL's capability to connect new load or generation. More details are found in the System Capacity Plan section of the 2014 Annual Planning Report, in Attachment B-1(B).

3.1.5.1 Ability to Connect New Load

HOL regularly assesses the capability and reliability of the distribution system in an effort to maintain adequate and reliable supply to customers. Where gaps are found, appropriate plans for additions and modifications consistent with all regulatory requirements and with due consideration for safety, environment, finance and supply system reliability/security are developed.

In this regard, the supply needs have been assessed to determine if additions and/or modifications are required to maintain an adequate and reliable/secure system capacity.

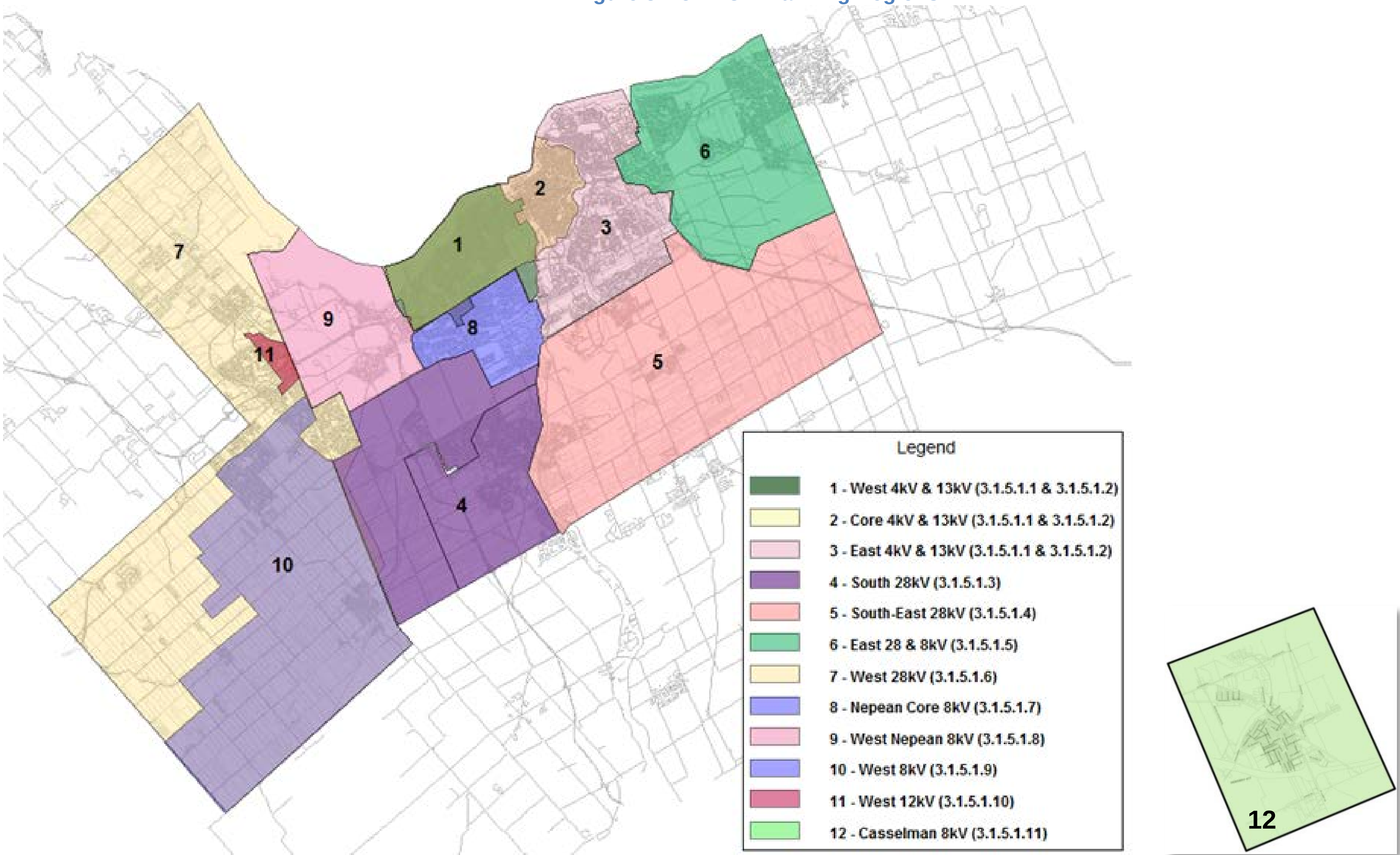
HOL plans system and feeder capacity based on coincident peak loading and single (N-1) contingency. The station and area contingency is considered to be the loss of the largest element, typically either a substation transformer or supply circuit. Under a single contingency, the system is planned to maintain the loading within the remaining equipment's top rating (either 10 day Limited Time Rating (LTR) or allowable flat rating). HOL plans a one-to-one backup arrangement for feeders, this means that circuits have contingency pairs so that for the loss of any one circuit the entire load can be recovered by its back-up thereby reducing the number of switching operations (and time) for recovery of full load. With this arrangement any one circuit must only be loaded to half of its 8 hour emergency rating. Refer to section 1.3.1.4 System Operations Performance for more details on the determination of planning and rated capacities for stations and feeders.

Load for each substation supplying HOL customers is forecasted separately using the previous year's summer coincident peak as the starting point for the forecast. An average annual load growth rate is calculated using the station's historic load levels. This rate is used to predict the baseline load growth over the next twenty years, and reflects typical addition of new customers and the load maturation of existing customers. Additional adjustments are made to the forecast to account for known City of Ottawa and developer plans, forecasted load transfers and other local events that are expected to impact the load forecast. Loading is weather normalized and a one in ten year heat wave adjustment is used as a worst case planning scenario.

Growth in the City is currently being driven by new residential developments in previously rural areas, infill and intensification in many established areas, as well as major projects like the Ottawa Light Rail Transit (OLRT) system.

HOL distribution system is composed of several subsystems, which are segregated by operating voltage, geographical boundaries, and historic political boundaries (see Figure 3.1.5 - HOL Planning Regions). Each of these subsystems undergoes an extensive review annually, as part of the Capacity Planning Process (Section 2.1.2), and a forecast is produced over a twenty year horizon. The following sections details the forecasted subsystem needs.

Figure 3.1.5 - HOL Planning Regions



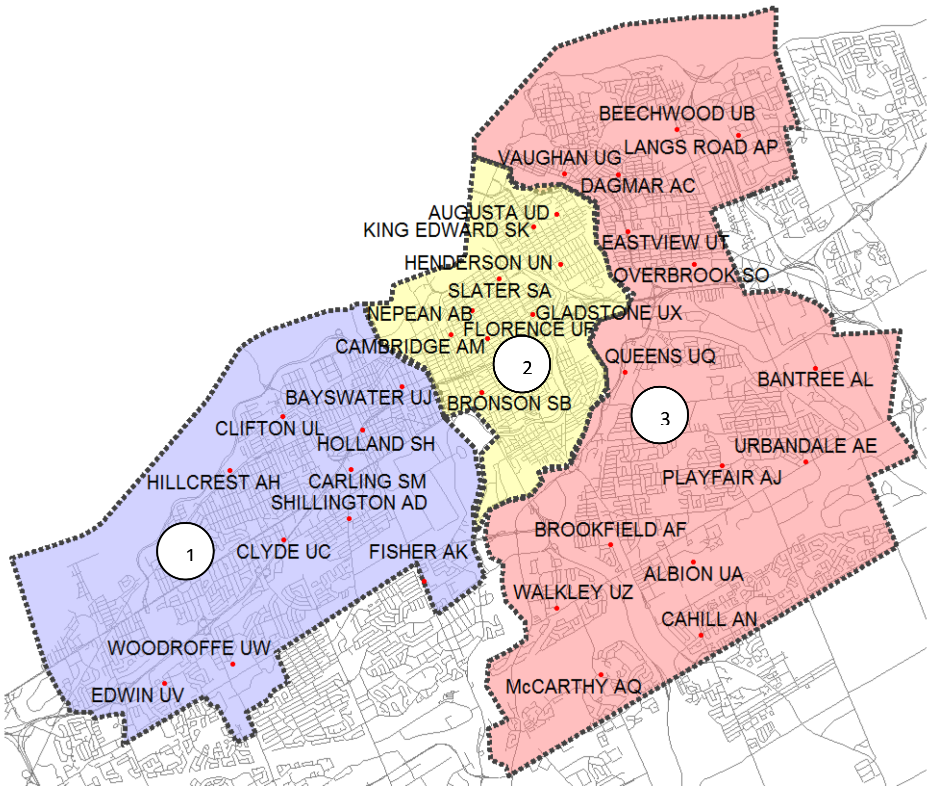
3.1.5.1.1 4 kV System

HOL 4kV supply region (Figure 3.1.6) is comprised of three main areas:

1) The West 4kV supply region covers West of Rochester Street, East of Bayshore Drive, and North of Baseline Road. This region is supplied by the Edwin UV, Shilington AD, Fisher Park AK, Clyde UC, Carling SM, Holland SH, Hillcrest AH, Clifton UL, Bayswater UJ.
2) The Core 4kV supply region covers East of Rochester Street and is bounded West and North of the Rideau River. This region is supplied by the Bronson SB, Nepean AB, Gladstone UX, Augusta UD, Cambridge AM, Slater SA, Henderson UN, Florence UF, Riverdale SR, King Edward SK.
3) The East 4kV supply region covers West of Blair Road, East of the Rideau River, and North of Hunt Club Road. This region is supplied by the Vaughan UG, Bantree AL, Albion UA, Eastview UT, Playfair AJ, Cahill AN, Dagmar AC, Urbandale AE, McCarthy AQ, Beechwood UB, Brookfield AF, Walkley UZ, Queens UQ, Langs Road AP, Overbrook SO, Church AA.

These 4kV substations are supplied from twelve 13kV stations and provide electricity for much of the residential load in the region (See 3.1.5.1.2 13kV System).

Figure 3.1.6 - 4kV Supply Region



Through the Official Plan, the City of Ottawa is promoting new growth by means of intensification. Many new developments are converting from low-rise apartments to larger high density condos and apartment buildings. As a result, most of the 4kV substations are experiencing decreasing loads as customers upgrade their electrical supply and transfer to being supplied directly from the 13kV system.

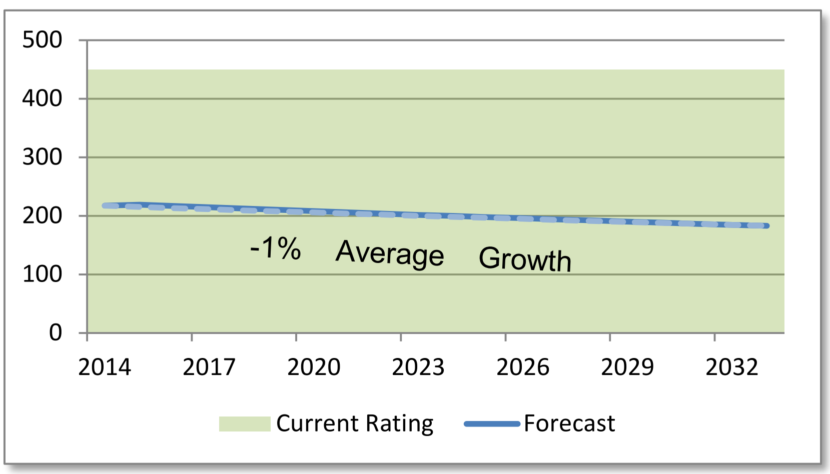
This decrease in load among the stations reduces their financial usefulness due to the fixed maintenance and replacement costs required that is independent of load. In areas that have seen a large transition of their load being supplied by 13kV stations and where the 4kV substation's equipment is nearing end of life, it may be financially advantageous to convert the existing customers to a 13kV supply while decommissioning the 4kV substation.

Currently, HOL is undergoing a voltage conversion project where the 4kV system fed from the substation Woodroffe UW is being decommissioned. The customers that were supplied from this system are being transitioned to the 13kV system fed from Woodroffe TW. This project was mainly driven by the Woodroffe UW assets nearing their end of life, but also due to the decreasing load on the substation. A business case was developed concluding that it made financial sense to undergo the voltage conversion. The end date of this project will be December 2015.

Stations which are forecasted to have diminished asset utilization due to decreased load are identified as potential candidates for voltage conversion projects. Stations for consideration in the short term include: Slater SA and Cahill AN. These stations were identified based on their loading, however, detailed business cases will be required to ultimately determine whether a voltage conversion makes economic sense.

The forecasted 20 year load growth along with planned capacity upgrade projects is shown in Figure 3.1.7.

Figure 3.1.7 - 4kV Load Forecast



Capacity Projects

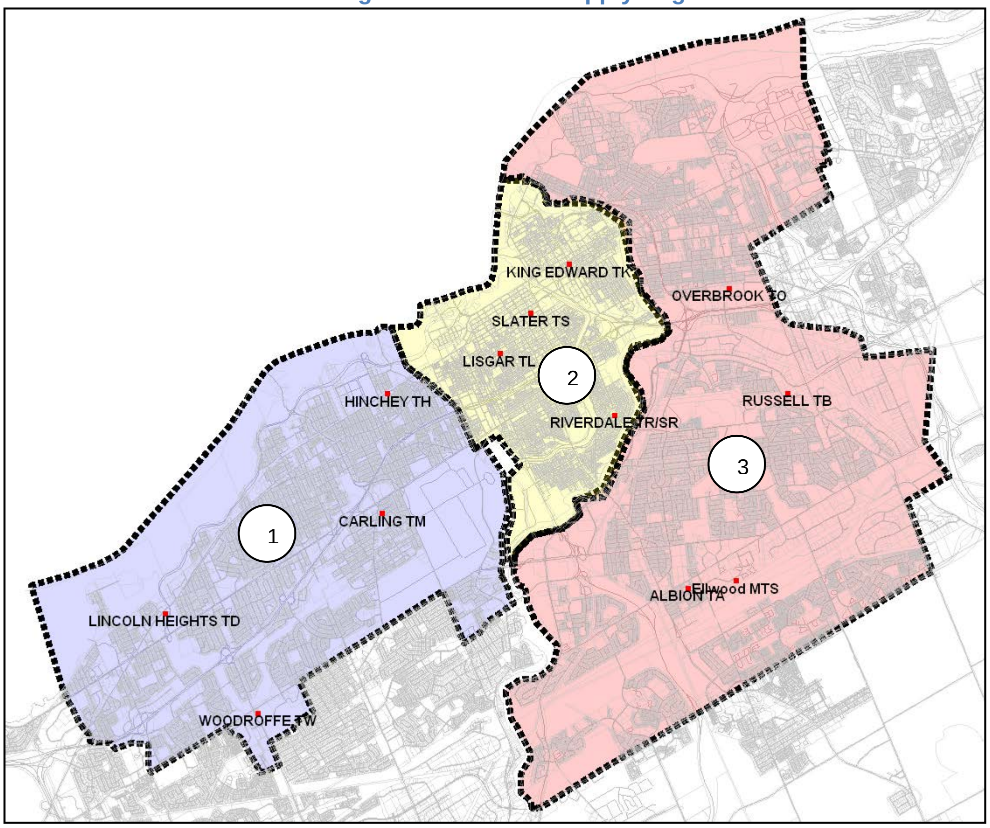
None

3.1.5.1.2 13kV System

The HOL 13kV supply region is composed of 3 main areas, as shown in Figure 3.1.8. These zones correspond to the 4kV system mentioned in 3.1.5.1.1 above. The three areas are:

1. The West 13kV supply region covers from Bayview Yards and west of Preston Street to Bayshore Drive, north of Baseline Road. This region is supplied by Hinchey TH, Carling TM, Woodroffe TW and Lincoln Heights TD. Hinchey TH also supports the Core 13kV supply region.
2. The Core 13kV area follows the Rideau River to the East and covers to LeBreton Flats in the West. This region is supplied by King Edward TK, Slater TS, Lisgar TL, Hinchey TH, and Riverdale TR. Riverdale TR and King Edward TK also support the East and Core 13kV supply regions.
3. The East 13kV supply region includes the eastern portion of the Old City of Ottawa. This region is supplied by the Russell TB, Albion TA, Ellwood TS, Overbrook TO, Riverdale TR and King Edward TK. Riverdale TR and King Edward TK also support the East and Central 13kV supply regions.

Figure 3.1.8 - 13kV Supply Region



Much of the residential load in these regions is not directly supplied from the 13kV system, but rather from a total of thirty-five 4kV substations (see 3.1.5.1.1 4 kV System) which are supplied from the 13kV system.

Through the Official Plan, the City of Ottawa is promoting new growth by means of intensification. This impacts the 13kV system as it covers mostly established areas. Many new developments are trading in low-rise apartments for larger, high density condos. This will reduce the load of the 4kV network through conversion onto the 13kV system.

The majority of the load growth on the 13kV system is from new infrastructure projects and City driven Community Design Plans. More detailed information can be found in Appendix E.

- The West 13kV new loads include the Ottawa Light Rail Transit (OLRT), Tunney's Pasture, Bayview Yards, Centrepointe, Richmond Road, and Preston-Carling Area.

- The Core 13kV is seeing large new loads such as the Ottawa Light Rail Transit (OLRT), the Cliff Street Heating/Cooling Plant (CHCP), Lansdowne Park, LeBreton Flats, Bayview Yards and Transit Oriented Development (TOD).
- The East 13kV new loads include the Ottawa Light Rail Transit (OLRT), the reconstruction of Rockliffe CFB, Transit Oriented Developments (TOD), the Bank Street CDP and the Beechwood CDP.

In the short term, there is a requirement for capacity upgrades and the construction of station interconnections to transfer load at opportune times in order to manage the growth. Longer term planning relating to the IRRP is meant to deal with transmission upgrade plans.

Major capacity infrastructure upgrades on this system include the Hinchey TH Expansion, the Lisgar TL Upgrade, the Overbrook TO upgrade, the King Edward TK upgrade, and the Russell TB upgrade.

Hinchey TH Expansion

The capacity expansion of Hinchey TH substation began in 2012. The two transformers at Hinchey TH will have their tertiary winding brought out and allow for the installation of a new bus. The capacity at Hinchey TH will increase from 42 MVA to 99 MVA and will provide 12 new breaker positions. The project is expected to be completed in 2015. Feeder expansions out of Hinchey TH will also be required to transfer load from Lisgar TL to accommodate new growth. Currently 4 feeder expansions are planned for 2014-2015, more will proceed as necessary.

Hinchey TH is currently limiting generation connection capacity based on its minimum load. This expansion will allow for increased generation capacity by providing the ability to transfer more load to the station, plus, the nature of the power transformers will allow some reverse flow capability.

Lisgar TL Upgrade

To accommodate the new load to the west of downtown, upgrading the capacity at Lisgar TL is required to support Hinchey TH. This project will increase the limited time rating (LTR) capacity from 83 MVA to 133 MVA. HONI is currently working on preparing estimates for this work.

This upgrade will allow for increased generation capacity availability by upgrading the equipment capacity which currently has a thermal restriction for any new generation connections.

Overbrook TO Upgrade

The total transformer capacity at Overbrook TO will be upgraded to 144MVA from 82MVA. The transmission supply to the substation will need to be upgraded to facilitate the increased capacity of this station. This is currently being studied under the IRRP being conducted by HONI, HOL and the OPA (now IESO). This upgrade will be required in or about 2016.

King Edward TK Upgrade

The two transformers at King Edward TK substation are currently mismatched in capacity, limiting the overall available capacity. This project would see the replacement of the undersized transformer thereby increasing the available LTR of the station from 80 MVA to 136 MVA. The increased capacity will relieve Slater TS and support the Light Rail Transit (LRT) project. The timelines for this project may be affected by the on-going IRRP with the OPA (now IESO) and Hydro One. The study is currently reviewing the A4K 115kV transmission line which has been identified as having a thermal overload in N-1 contingency loss of the A5RK. The project need has been identified for 2021.

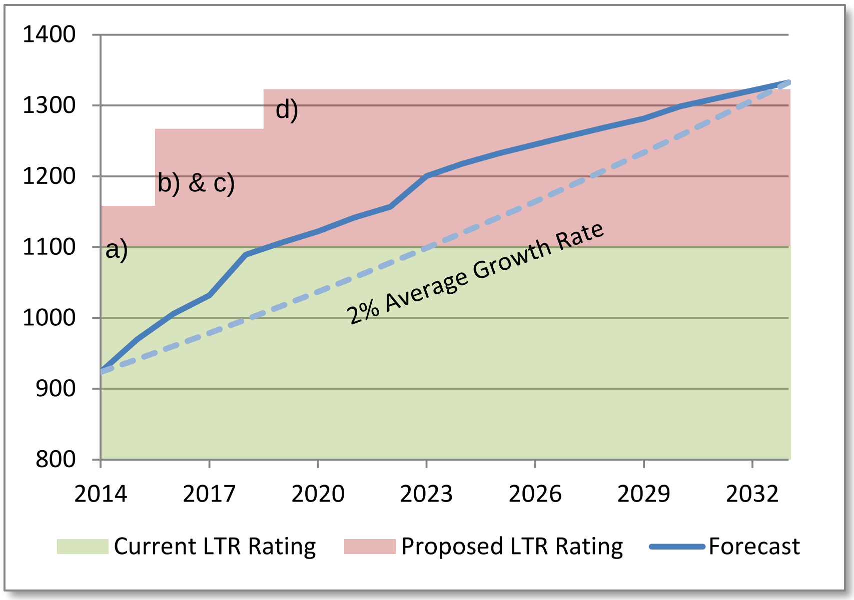
King Edward TK is currently limiting generation connection capacity based on its minimum load. This expansion will allow for increased generation capacity by providing the ability to transfer more load to the station. Also, generation connection capacity can be increased if the power transformers are specified for reverse flow capability.

Russell TB Upgrade

Russell TB will need to be upgraded to 144MVA from the current 77MVA. There are no known transmission limitations that should cause delays in this project and will be required in or about 2024.

The forecasted 20 year load growth along with planned capacity upgrade projects is shown in Figure 3.1.9.

Figure 3.1.9 - 13kV Load Forecast



Capacity Projects

Committed:

(a) *Hinchey TH – 57MVA (2014)*

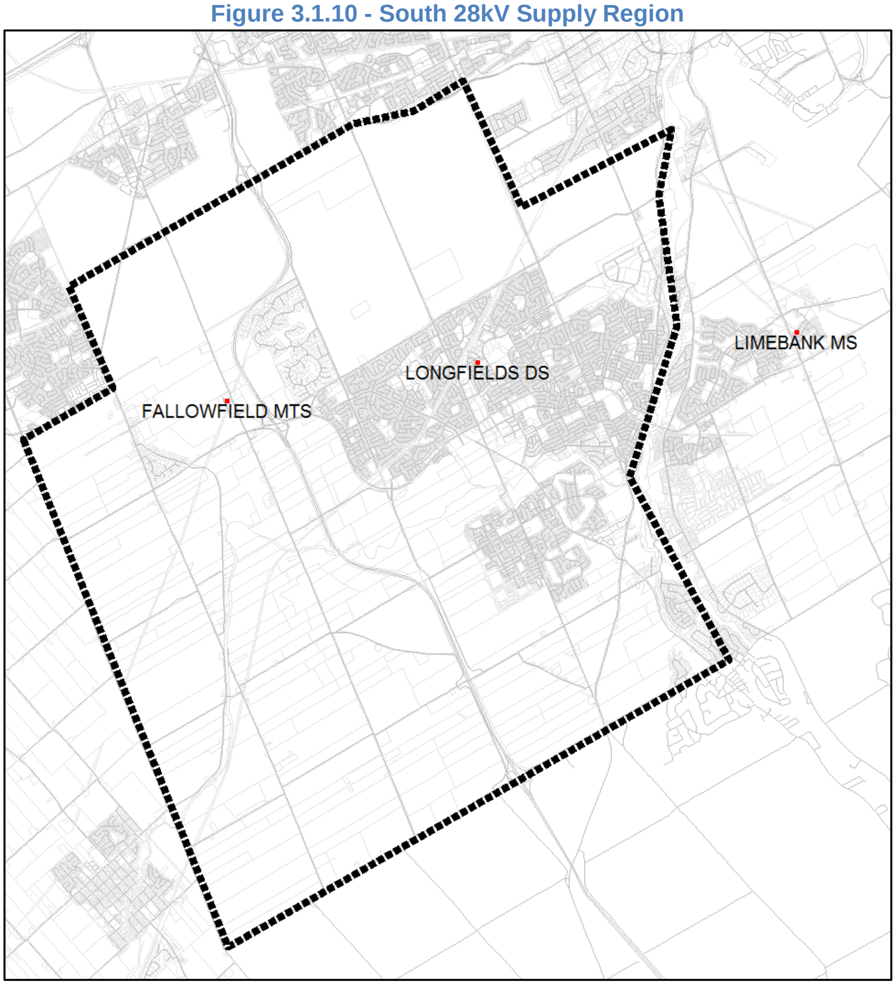
Planned:

(b) *Lisgar TL – 53MVA (2016)*
(c) *Overbrook TO – 55.6MVA (2016)*
(d) *King Edward TK – 56MVA (2019)*
(e) *Slater TS – 50MVA (2025)*

3.1.5.1.3 South 28kV System

The South 28kV supply region includes the southern portions of Nepean. This region is supplied by the Fallowfield DS and Longfields DS 28kV substations as well as two feeders from Limebank MS 28kV substation, located in the South-East supply region. Figure 3.1.10 shows the supply region of the South 28kV System.

Figure 3.1.10 - South 28kV Supply Region



Despite the physical barrier of the Rideau River between Nepean and Gloucester, the Limebank MS station plays an essential role in supplying both sides of the river.

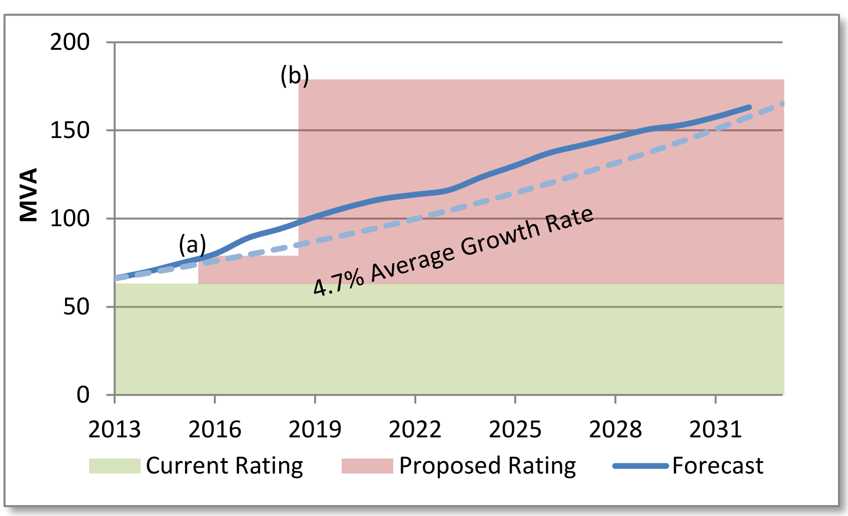
Growth in the south supply region is driven by the ongoing expansion of suburban residential developments, the Nepean Town Centre and the Strandherd Business Park. In addition, rural areas south of the Jock River which are currently fed by the 8KV system will be transferred to the 28kV system as 28kV feeders are introduced in the area to supply new suburban developments.

Overall, the existing south 28kV area is supplied by a strong network of trunk feeders. However, there is the need to expand the system to cover areas seeing growth, as well as strengthen the interconnections to the south of the Jock River. These issues will be addressed by the introduction of a new substation that will support the growth in the Fallowfield DS supply area for the expected load growth.

Based on the projected load growth, an additional station is required to supply the expected load in the South 28kV area. It is planned to build the new station with 2 X 75 MVA transformers with a need date of 2019. The planned new station will solve the overloading issues in normal operating conditions as well as the N-1 contingency situations to the end of the study period. Currently, capacity in this area is being evaluated under the Regional Planning Study which evaluated the various options to meet the capacity needs and resulted in the next step of determining the location of the new station and transmission connection. Details can be found in the project business case found in Attachment B-1(A).

The forecasted 20 year load growth along with planned capacity upgrade projects is shown in Figure 3.1.11.

Figure 3.1.11 - South Nepean 28KV load forecast



Capacity Projects

Planned:

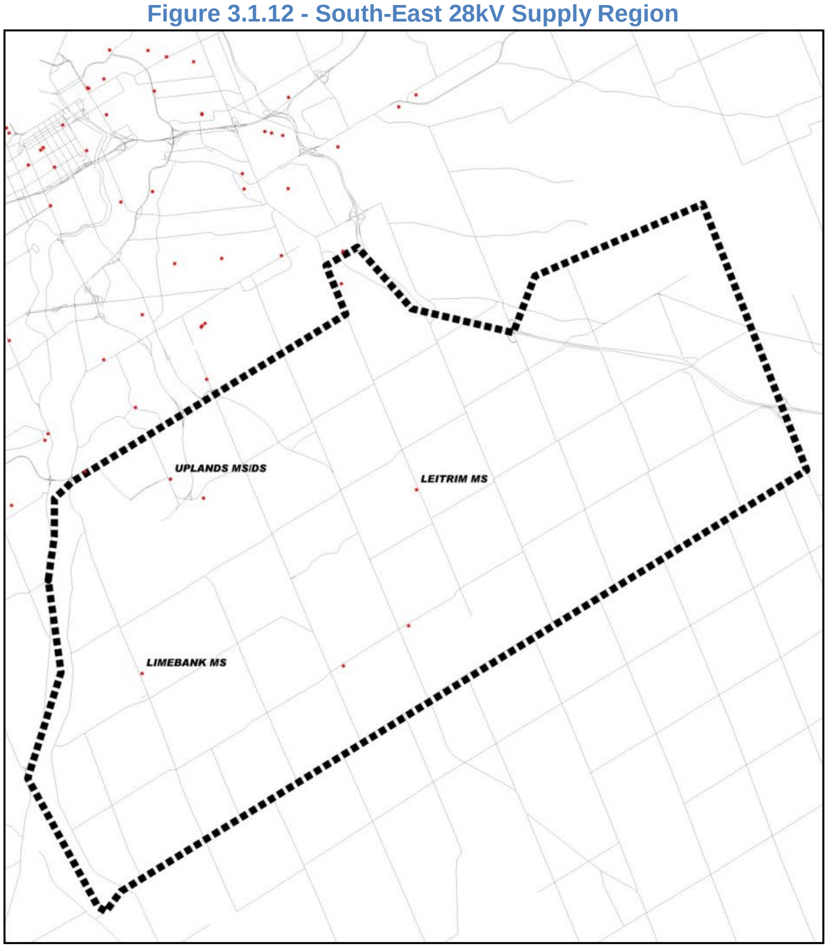
(a) Added Capacity from Limebank-16MVA(2016)

(b) New 28kV Station – 100 MVA (2019)

3.1.5.1.4 South-East 28kV System

The South-East 28kV supply region includes the southern portions of Gloucester. This region is supplied by the Limebank MS, Uplands MS and Leitrim MS 28kV substations, as well as a small pocket supplied by 8kV feeders from the Hydro One owned South Gloucester substation. Despite the physical barrier of the river between Nepean and Gloucester, the Limebank MS station plays an essential role in supplying both sides of the river, creating interdependence between the South 28kV and the South East 28kV systems. Figure 3.1.12 shows the supply region of the South-East 28kV System.

Figure 3.1.12 - South-East 28kV Supply Region



New load growth in this area is driven by commercial development in the land surrounding the airport and residential and mixed-use developments in the Riverside South and Leitrim community areas.

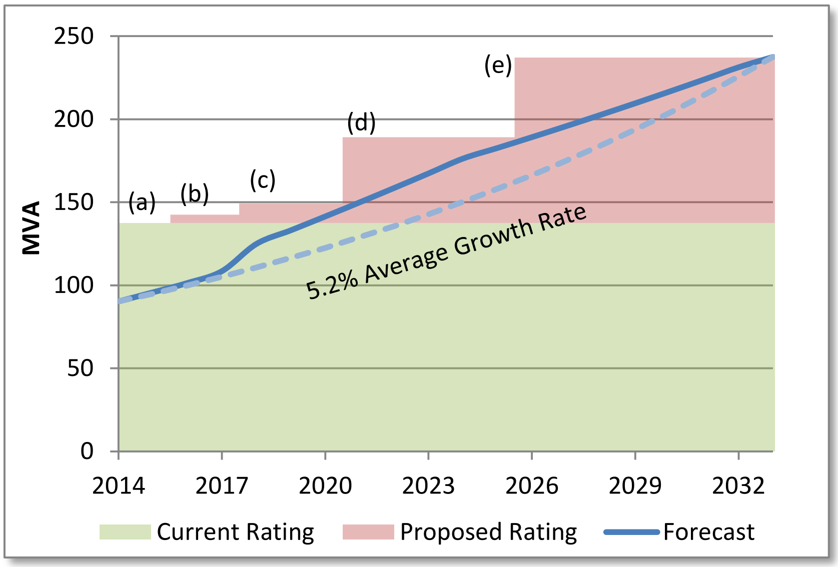
Both Uplands MS and Leitrim MS substations have single supplies and single transformers. With such configurations it is paramount that sufficient distribution circuit ties are maintained to transfer load to adjacent stations under contingency. Circuit ties exist for Uplands MS, although station capacity is currently a limitation to adequately backup capacity for the loss of transformers or supply at Uplands MS.

Regional capacity will require significant increase in order to keep pace with forecasted growth. Upgrades are currently underway at Limebank MS to add a third transformer and make provisions for a fourth transformer, currently projected to be required between 2018 and 2021. In or about 2018, Uplands MS will require an additional transformer to support growth in the region as well. Supply capacity in the region is anticipated to lag growth through the second half of the planning period. The load growth during this period is expected to be met by planned additional upgrades in the South 28kV Region.

While it only results in minor increases to the overall firm capacity in the area, additional transformers are required at both Leitrim MS and Uplands MS in 2016 and 2018 respectively. These units will improve the specific region contingencies and station capacity. As load continues to grow in the Leitrim MS supply area the potential of creating a new transmission connected substation should be evaluated as the existing 44kV supply is limited and it will be costly to add a second 44kV supply.

The forecasted 20 year load growth along with planned capacity upgrade projects is shown in Figure 3.1.13.

Figure 3.1.13 - South East Load Growth



Capacity Projects

Committed:

(a) Limebank MS – 40MVA (2014)

Planned:

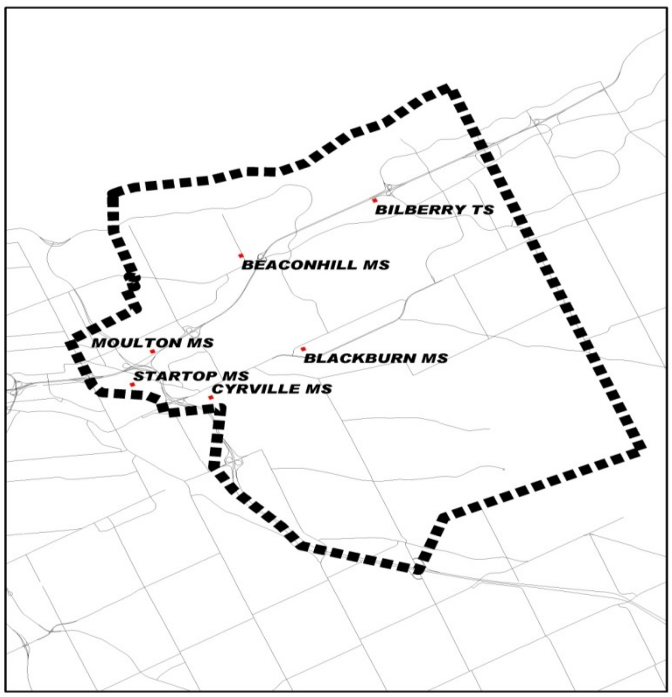
(b) Leitrim (2nd Tx) – 5 MVA (2016)
(c) Uplands (2nd Tx) – 40MVA (2018)
(d) Limebank MS – 46MVA (2021)
(e) South 28kV Support (2026)

1

East 8kV & 28kV System

The East 28kV and 8kV supply area is bounded by the old Gloucester & Ottawa municipal boundary and Highway 417 in the south. Supply to the region includes 28kV transmission connected stations: Cyrville MTS, Bilberry TS and Moulton MS as well as 44kV sub transmission supplied 8kV substations: Startop MS, Blackburn MS and Beaconhill MS. Figure 3.1.14 shows the supply region of the East 28kV and 8kV System.

Figure 3.1.14 - East 28kV and 8kV Supply Region



The East 28/8kV system is seeing two main pockets of growth: the East Urban Community, a combination of residential and mixed-use areas, and Light Rail Transit related load developing in the vicinity of the split between highways 417 and 174.

The 28kV & 8kV trunk network provides acceptable coverage of the region; however, expansion of the Cyrville MTS trunk circuits to the east (currently underway) will be required to supply the south of Orleans as it develops.

From a regional point of view there is sufficient capacity to address forecasted load growth. Minor changes to address localized load growth will be required over the next 20 years.

Startop MS Transformer Upgrades

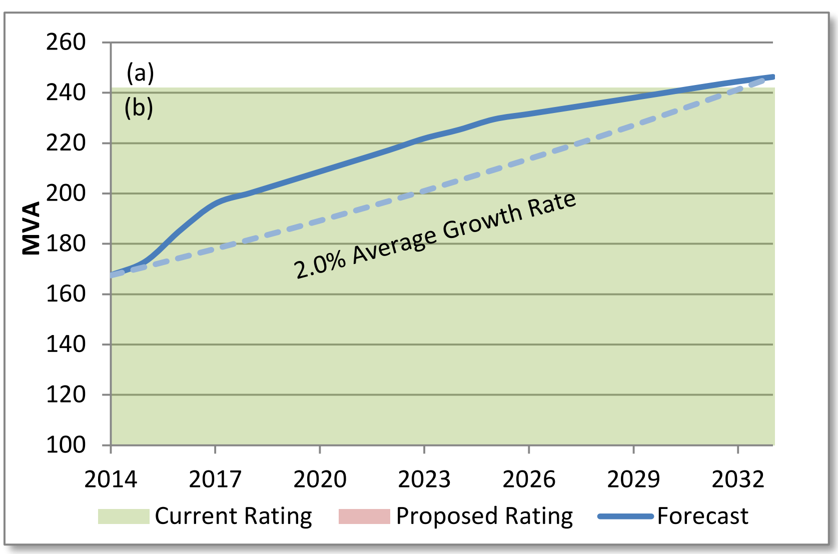
While overall regional capacity is sufficient for future load growth, the local loading on the Startop MS substation is currently above the station rating. Due to the distance between substations this load cannot be effectively supplied from the other 8kV stations in the area. The upgrade of these transformers will be coordinated with primary protection upgrades and automation work occurring on the 44kV subtransmission in the east. The new station transformers will increase the station capacity from 15MVA to 20MVA and will be completed in 2015.

HONI Orleans TS Construction

HONI is constructing a new 28kV station, Orleans TS, in the vicinity of Mer Bleue Road and Innes Road. HOL has requested ownership of a single circuit, providing for 16MVA of capacity. The new Orleans TS feeder will tie into the system currently supplied from the Cyrville F1, reducing the load on Cyrville MTS and possibly Bilberry TS and provide additional redundancy to the area. The new feeder will be tied into the Mer Bleue Road line and open points introduced along Renaud Road and Navan Road. It is anticipated that this circuit will be in service in 2015.

The forecasted 20 year load growth along with planned capacity upgrade projects is shown in Figure 3.1.15.

Figure 3.1.15 - East 8kV & 28kV Load Growth



Capacity Projects

Committed:

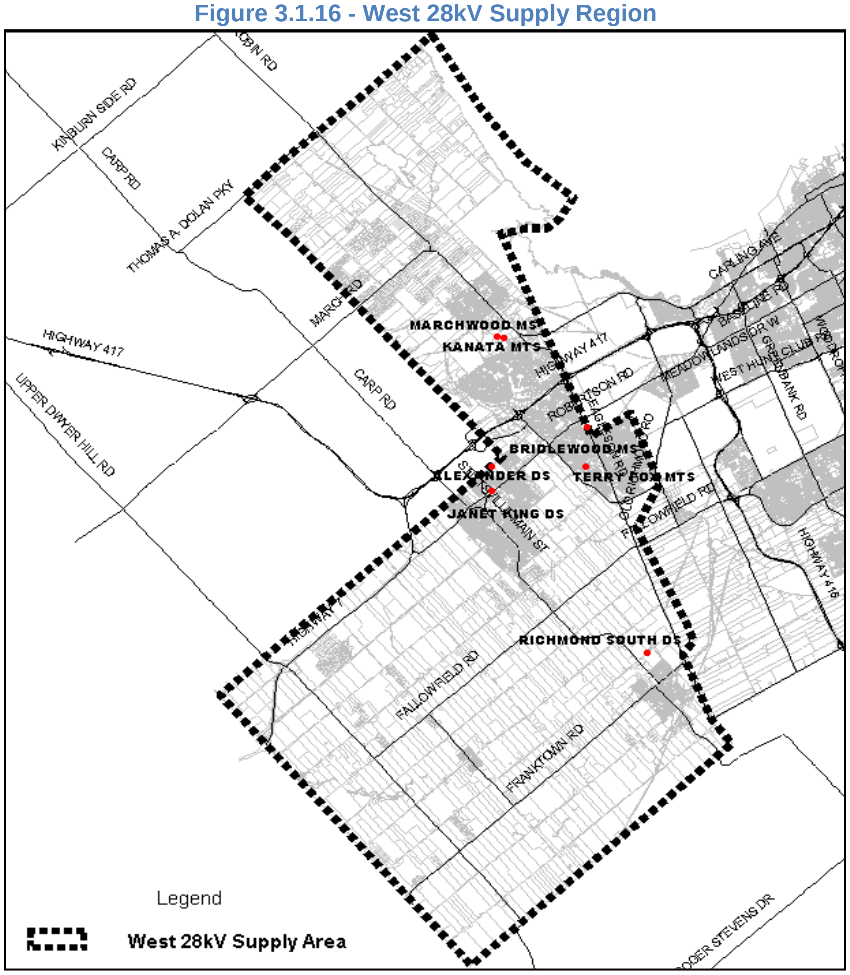
(a) Startop MS – 5MVA (2014)
(b) Orleans TS – 16MVA (2014)

3.1.5.1.5 West 28kV System

The West 28kV supply region includes Kanata and Stittsville. The region is bounded by HOL's service boundary in the west, south and north. Eagleson Road has been utilized as the main boundary to the east, with the exception of the Bridlewood Area. The majority of this service territory is fed at 28kV; however, there are pockets fed at 12kV and 8kV. The 28kV region is supplied by the Kanata MTS, Marchwood MS, Bridlewood MS, Alexander DS, Janet King DS and the Terry Fox MTS 28kV substations.

Figure 3.1.16 shows the supply region of the West 28kV System.

Figure 3.1.16 - West 28kV Supply Region



Growth in the west supply region is driven by the ongoing expansion of suburban residential developments, and associated mixed-use centres.

Projected load growth in the Kanata and Stittsville areas is expected to be supplied from the recent addition to the system, Terry Fox MTS. Terry Fox MTS is located on Michael Cowpland Drive along the 230kV right-of-way and will mainly supply the areas of new growth, and act as a backup for Bridlewood MS and Janet King DS. Terry Fox MTS will also be used to off-load the Stittsville load from the Hydro One owned substation Alexander DS which will allow Hydro One to have available capacity for growth in their service territory.

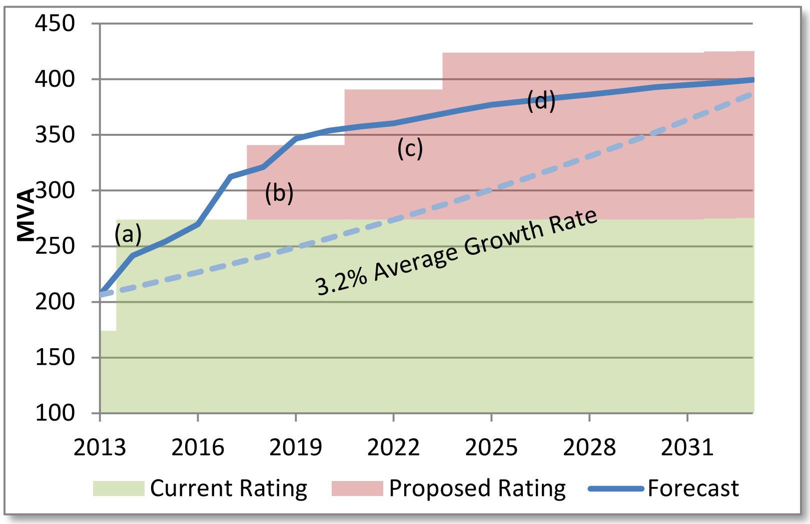
The anticipated growth in the Village of Richmond has prompted the upgrade and voltage conversion of the Richmond South DS substation. Construction is anticipated to begin in 2016 and will increase capacity to accommodate the expected growth and will increase the capacity of Richmond South DS by 1100%.

Overall, the existing west 28kV area is supplied by an adequate network of trunk feeders. There is however the need to expand the system to cover areas seeing growth, as well as to transfer the HOL load off of Alexander DS. Back-up solutions are also required in the south section of the Stittsville community as well as create a backup loop across the south-western part of the region including Richmond. These issues will be addressed by the introduction of six feeders from Terry Fox MTS and the four new feeders planned from Richmond South DS.

There is a need in the short term to increase capacity in the Richmond area as well as increase the transformation at Bridlewood MS and Marchwood MTS to meet the N-1 planning criteria at the station level. Distribution transfer capabilities can however be maintained allowing station transformers to remain below capacity in an N-1 situation delaying the need date for capacity upgrades. Due to the future anticipated capacity demand expected from the Richmond area, Richmond South DS will require an upgrade with voltage conversion to be capable of meeting this demand. The rebuild is planned to replace the existing 8kV transformer with two 28kV 45/60/75 MVA units. Based on the forecasted station growth and the assumed ability to maintain feeder transfer during a station N-1 contingency it is planned to completely rebuild the Bridlewood MS substation by replacing the existing four transformers supplying both 8kV and 28kV, with two 75 MVA units supplying solely 28kV in 2019. In order to maintain supply capacity within the north 28kV supply territory it is planned to replace the 33 MVA transformers at Marchwood MS with 30/40/50 MVA units (with an assumed LTR of 66 – 1.33 x 50) by 2026.

The forecasted 20 year load growth along with planned capacity upgrade projects is shown in Figure 3.1.17.

Figure 3.1.17 - West 28kV Load Growth



Capacity Projects

Committed:

(a) Terry Fox MTS – 100MVA (2014)

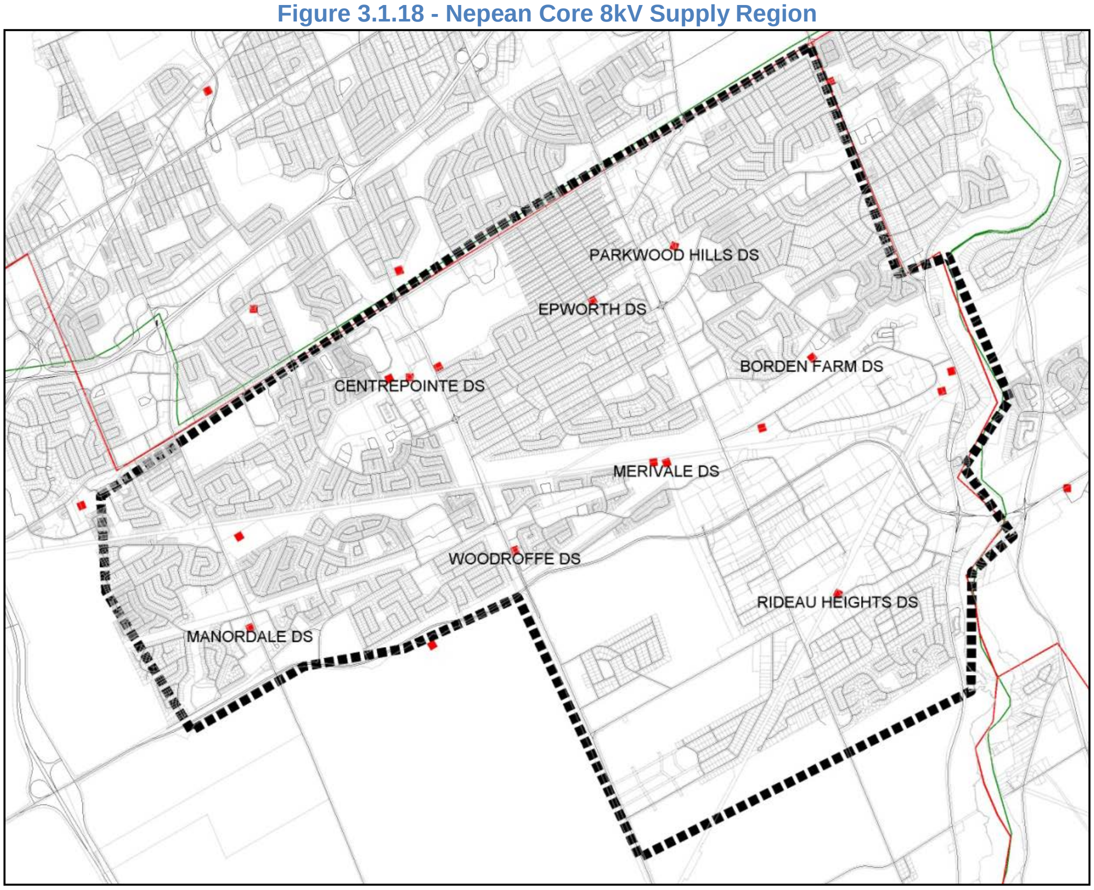
Planned:

(b) Richmond South DS – 67MVA (2016)
(c) Bridlewood MS – 50MVA (2019)
(d) Marchwood MS – 33MVA (2022)

3.1.5.1.6 Nepean Core 8kV System

The Nepean Core 8kV supply region includes the northern portions of Nepean. This region is supplied by the Manordale DS, Centrepointe DS, Woodroffe DS, Epworth DS, Merivale DS, Parkwood Hills DS, Borden Farms DS and Rideau Heights DS 8kV substations. Figure 3.1.18 shows the supply region of the Nepean Core 8kV System.

Figure 3.1.18 - Nepean Core 8kV Supply Region



Growth in the 8kV Nepean supply region is driven by ongoing commercial developments and associated mixed-use centers, two major areas of development are the Nepean Employment Area (located around Hunt Club Road between Merivale Road and Prince of Wales Drive) and Centrepointe that involves the expansion of Algonquin College and the relocation of the existing Transit Station.

The existing 8kV Nepean area is above the capacity limitations. The area of main concern is the Nepean employment area in which the trunk feeders are approaching their capacity limitations and the existing circuit interconnections are limited.

Over the next 20 years, significant growth is expected for the employment area in the Nepean region. The expected growth will push the stations and feeders to their capacity limits. The transformers at Merivale DS and Borden Farm DS are at the end of their useful lifetime, work at Borden Farm is currently in progress and expected to be completed by 2015. By 2021, new 28KV feeders will need to be introduced in this area along Hunt Club Road and Prince of Wales Drive where a high concentration of load is expected. In addition, major circuit reconfiguration and new interconnection ties need to be built in order to maintain a reliable system for this area.

Borden Farm DS Transformers Replacement

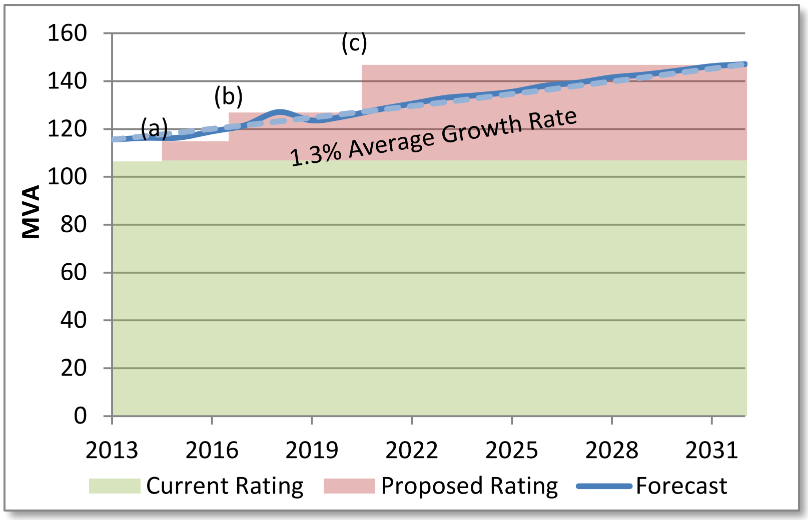
The transformers at this station have reached the end of their life and are in need of immediate replacement. In 2013, a project was started to replace the transformers and it will be completed by 2015. As mentioned in this report, the exiting transformer size would not be able to supply the additional proposed load in the next 8 years. It is recommended that the transformation at the station be upgraded to 2 x 15MVA.

New Merivale DS Station

This station is at the end of its life and it is planned for replacement with design starting in 2015 with completion in 2016. Additional capacity is required in order to service the proposed additional load. It is planned that the transformation be upgraded to 2x20 MVA transformers and four feeders per bus.

The forecasted 20 year load growth along with planned capacity upgrade projects is shown in Figure 3.1.19.

Figure 3.1.19 - Nepean 8kV Load Growth



Capacity Projects

Planned:

(a) Borden Farm DS – 8MVA (2015)

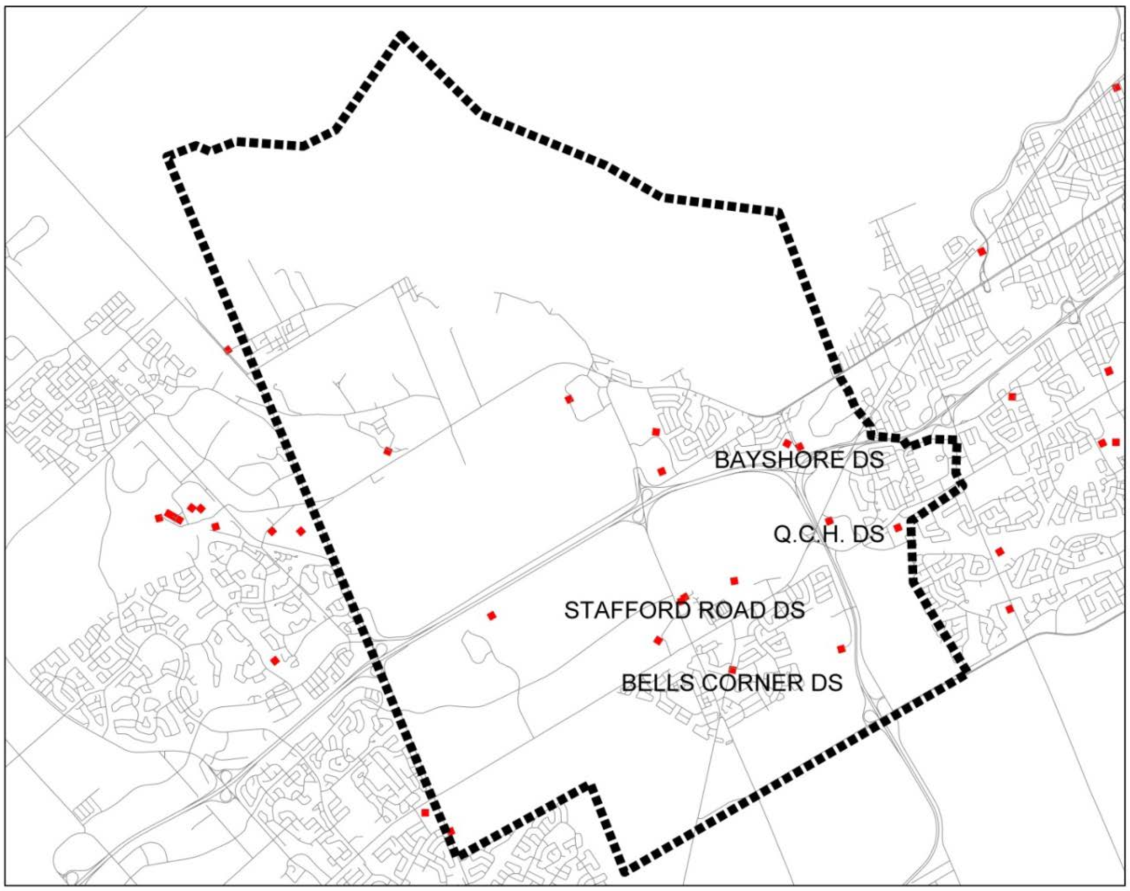
(b) Merivale MS – 12MVA (2017)

(c) New 27KV

West Nepean 8kV System

The West Nepean 8kV supply region includes the north-west portions of Nepean. This region is supplied by the Bayshore DS, QCH DS, Stafford Road DS and Bells Corners DS 8kV substations. Figure 3.1.20 shows the supply region of the West Nepean 8kV System.

Figure 3.1.20 - West Nepean 8kV Supply Region



Growth in the 8kV West Nepean supply region has been very slow in the last couple of years. This trend is expected to continue since no major projects for this area have been identified, except for the Bayshore Mall expansion which is expected to bring an additional demand of 2MVA in the next 1-2 years.

The existing 8kV West Nepean area is below the capacity limitations. No major issues have been identified in this area of Nepean; however, the transformers at these stations are approaching end of life and will need replacement during the duration of this study period.

Over the next 20 years, very little growth is expected for the west area of the Nepean region. The expected growth will not push the stations and feeders to their capacity limits.

Bayshore T1

The T1 transformer at this station will be reaching end of life by 2018. Currently, the transformers at this location do not match in size. It is recommended that the transformation at the station be upgraded to 15MVA. The planned capacity upgrade will improve the supply availability under a contingency scenario.

Bells Corners DS

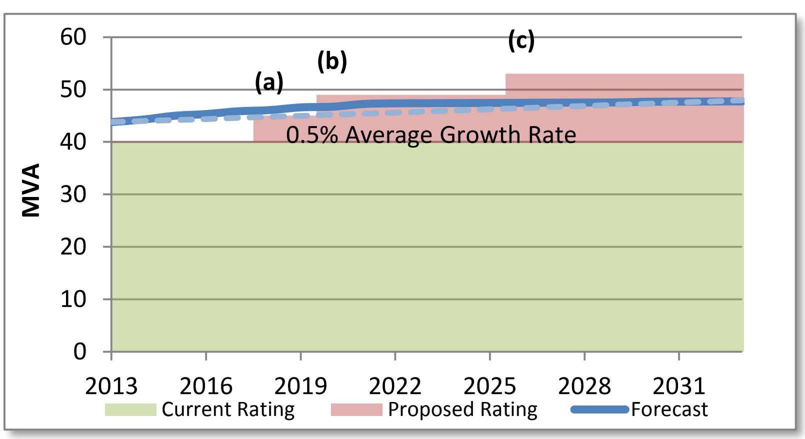
The transformers at this station will be reaching end of life by 2020. It is recommended that the transformation at the station be upgraded to 2 x 12MVA.

QCH DS

The transformers at this station will be reaching end of life by 2026. It is recommended that the transformation at the station be upgraded to 2 x 12MVA.

The forecasted 20 year load growth along with planned capacity upgrade projects is shown in Figure 3.1.21.

Figure 3.1.21 - West Nepean 8kV Load Growth



Capacity Projects

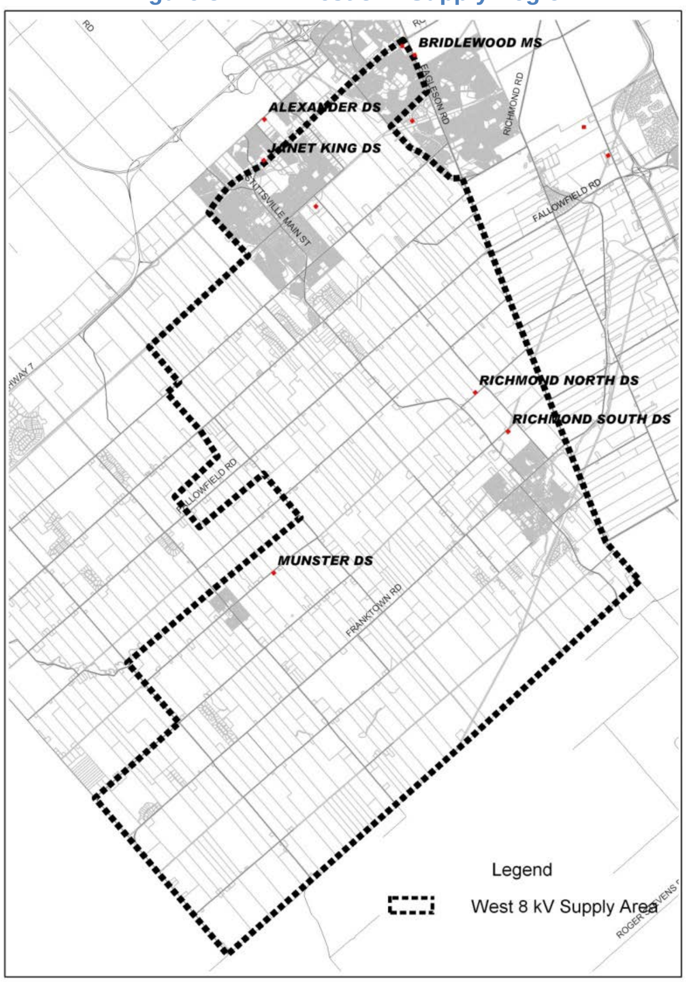
Planned:

- *(a) Bayshore T1 – 5MVA (2018)*
- *(b) Bells Corners DS– 4MVA (2020)*
- *(c) QCH DS – 4MVA (2026)*

3.1.5.1.7 West 8kV System

The West 8kV supply region includes South Kanata, Stittsville, the Village of Richmond and Munster Hamlet. This region is supplied by the Bridlewood MS, Janet King DS, Munster DS, Richmond North DS and Richmond South DS 8kV substations as well as by the 28kV substations Alexander DS, Beckwith DS and Janet King DS through the use of distribution step-down transformers (28kV to 8kV). Figure 3.1.22 shows the supply region of the West 8kV System.

Figure 3.1.22 - West 8kV Supply Region



Growth in the west 8kV supply region is driven primarily by the growth in the Village of Richmond. Based on the Village of Richmond, City of Ottawa plans and available information from other agencies, the key developments which will continue to drive growth in this supply region are all centered in Richmond and detailed in the Village of Richmond Community Design

Plan (CDP). The Village of Richmond CDP outlines the expansion of industrial and commercial areas as well as an increase of 2,850 – 3,950 dwelling units.

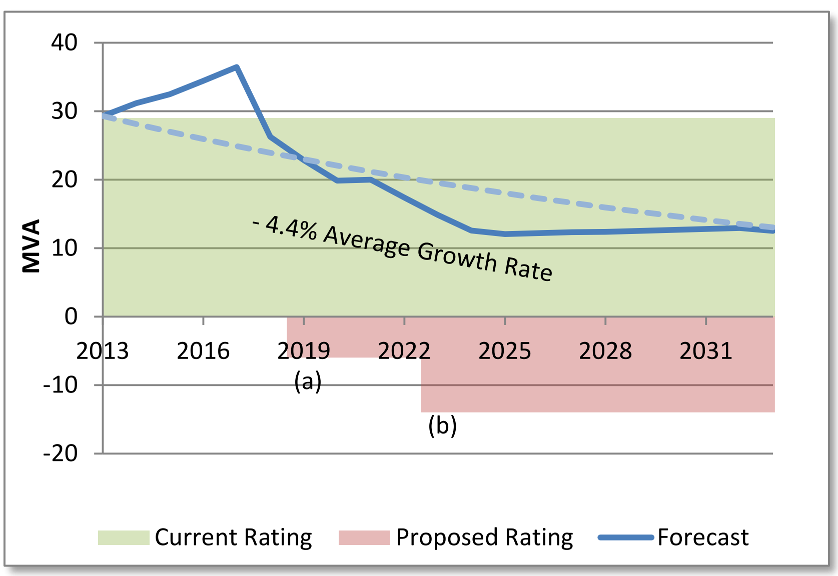
Overall, the existing west 8kV area is supplied by an adequate network of trunk feeders. There is however the need to expand the system to cover areas seeing growth. As there are very few 8kV feeders (9) that span a vast geographic region there are limits to capacity as well as the ability to restore under contingency.

Based on the load growth predicted in the Village of Richmond as well as capacity demand for Trans Canada's Energy East Pumping Station, there is a need in the short term to increase capacity with voltage conversion at Richmond South DS.

Due to aging infrastructure in the Glen Cairn community and at Bridlewood MS substation, reliability has been greatly impacted and has prompted a station rebuild. This project is planned to completely rebuild the substation by replacing the existing four transformers supplying both 8kV and 28kV, with two 75 MVA units supplying solely 28kV in 2019.

The forecasted 20 year load growth along with planned capacity upgrade projects is shown in Figure 3.1.23.

Figure 3.1.23 - West 8kV Load Growth



Capacity Projects

Planned Voltage Conversions:

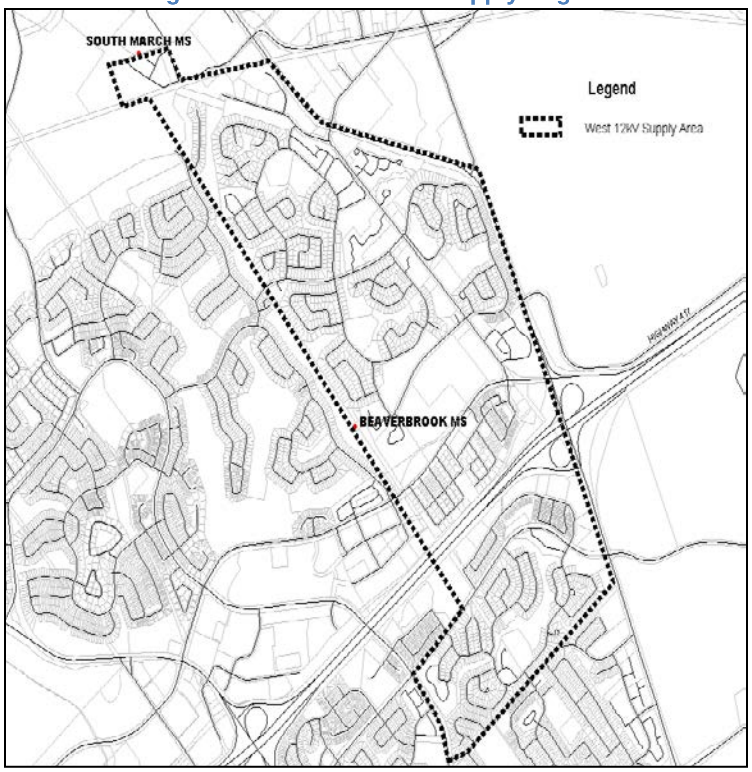
(a) Richmond South DS Reduction of 6 MVA (2016)

(b) Bridlewood MS

3.1.5.1.8 West 12kV System

The West 12kV supply region is located in central Kanata, including the communities of Katimavik and Beaverbrook. This region is supplied by the Beaverbrook MS, and South March MS substations. Figure 3.1.24 shows the supply region of the West 28kV System.

Figure 3.1.24 - West 12kV Supply Region



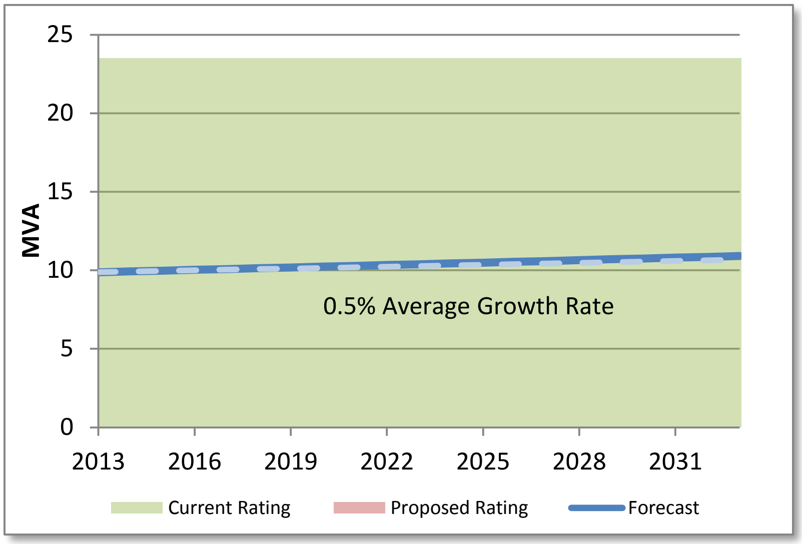
The West 12kV area is bounded by 28kV supplied areas on all sides and is anticipated that all future growth will be supplied from 28kV sources.

Overall, the existing West 12kV area is supplied by an adequate network of trunk feeders and can be recovered in N-1 contingency circumstances.

Based on only infill load growth predicted in the west 12kV supply area, the system will only require regular inspection and maintenance to continue providing the demanded capacity.

The forecasted 20 year load growth along with planned capacity upgrade projects is shown in Figure 3.1.25.

Figure 3.1.25 - West 12kV Load Growth



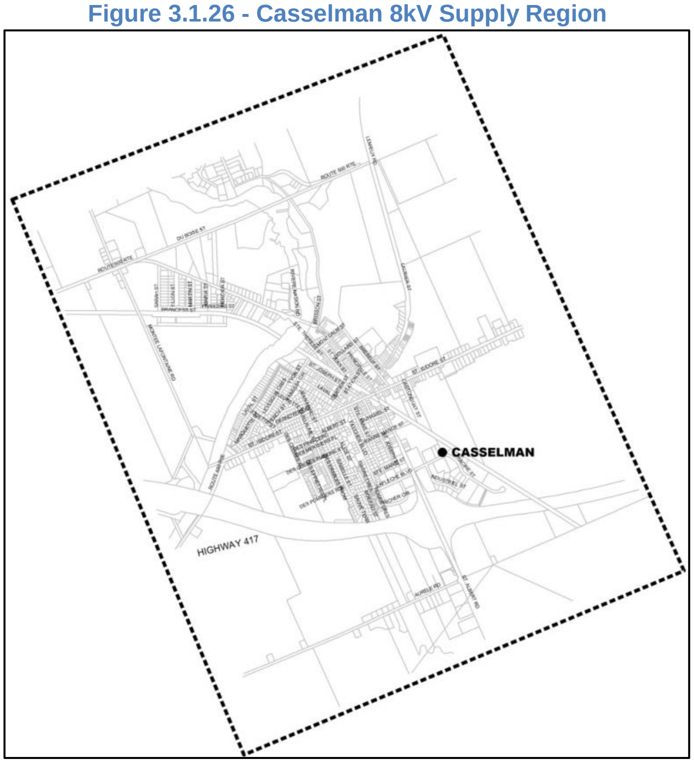
Capacity Projects

None

3.1.5.1.9 Casselman 8kV System

The Village of Casselman is supplied from a single station, Casselman MS at 8.32kV from three circuits. Figure 3.1.26 shows the Casselman supply area.

Figure 3.1.26 - Casselman 8kV Supply Region

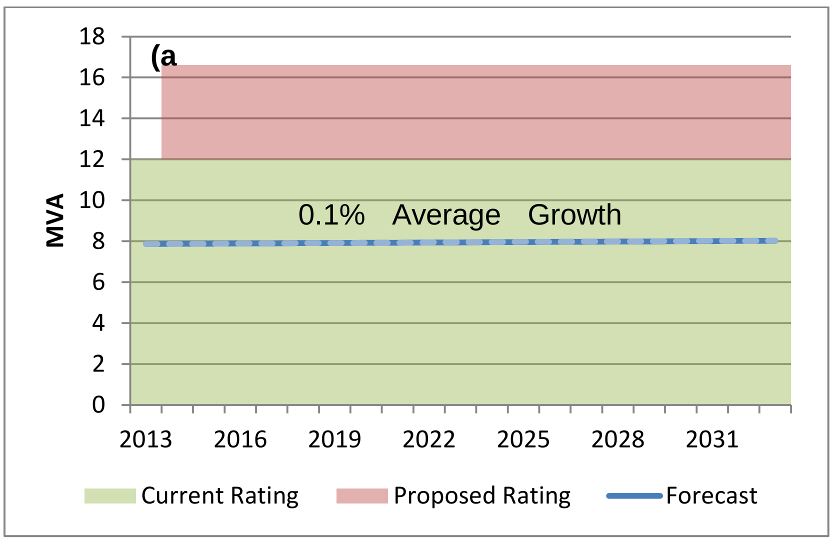


Overall, the Casselman area is supplied by an adequate network of trunk circuitry, however there is no redundancy at the station level since it is a single transformer with a single supply. In order to provide redundancy for contingency situations, a second transformer is planned to improve reliability to the area.

Growth within the Village of Casselman has been slow, and there are no major developments anticipated in the region over the next 20 year forecast period.

The forecasted 20 year load growth along with planned is shown in Figure 3.1.27.

Figure 3.1.27 - Casselman 8kV Load Growth



Capacity Projects

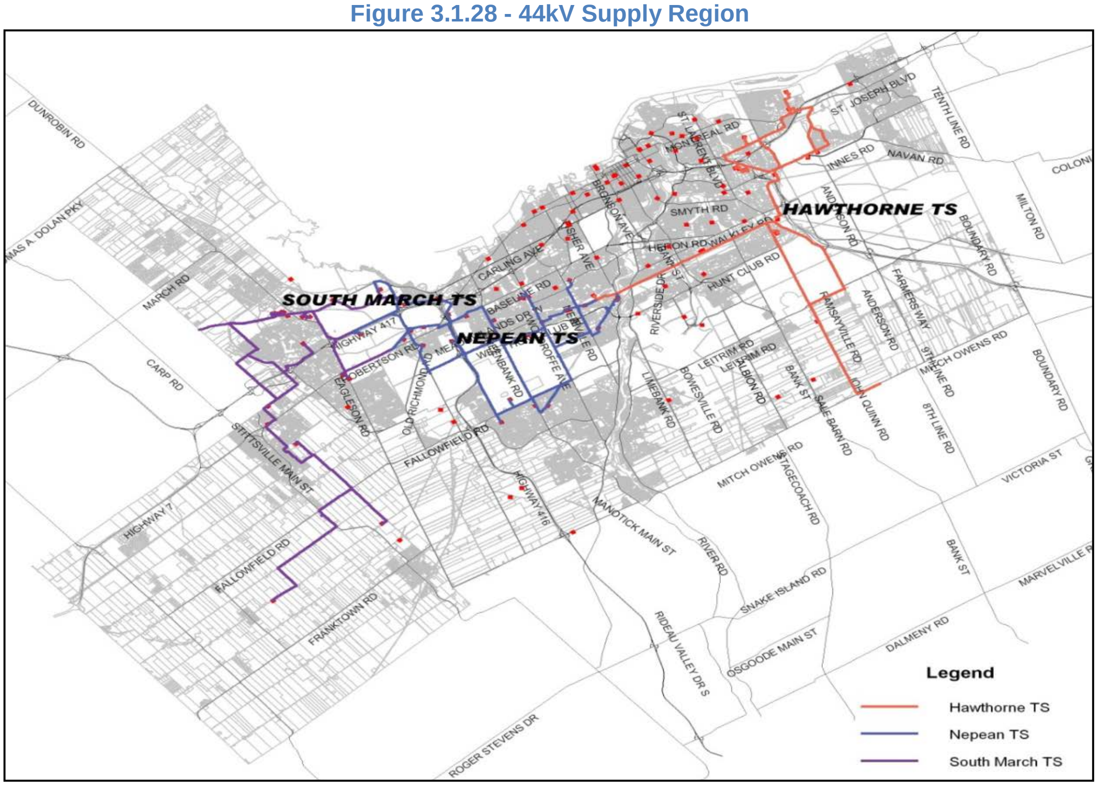
Planned:

(a) Casselman T2 – 5MVA (2014)

3.1.5.1.10 Citywide 44kV System

The 44kV system spans the entire service area and is supplied from three stations: Hawthorne TS, Nepean TS and South March TS. This system supplies a number of large industrial customers as well as 44kV to 28kV and 44kV to 8.32kV HOL substations. Figure 3.1.28 outlines the trunk circuit routing from each of these three stations.

Figure 3.1.28 - 44kV Supply Region



Each station area is essentially independent of the others with limited connections between South March TS and Nepean TS and between Hawthorne TS and Nepean TS.

Based on the vast area that these stations cover and their independent nature, they have been studied as separate stations as opposed to as a single region. Through the Regional Planning Study currently under way with the OPA (now IESO) and HONI, the load forecast for each of the stations has been developed.

In order to improve reliability performance in the East end of the City the loop of feeders from Hawthorne TS will be automated, the details of which can be found in the Reliability Plan Report as part of the 2014 Annual Planning Report, Attachment B-1(B).

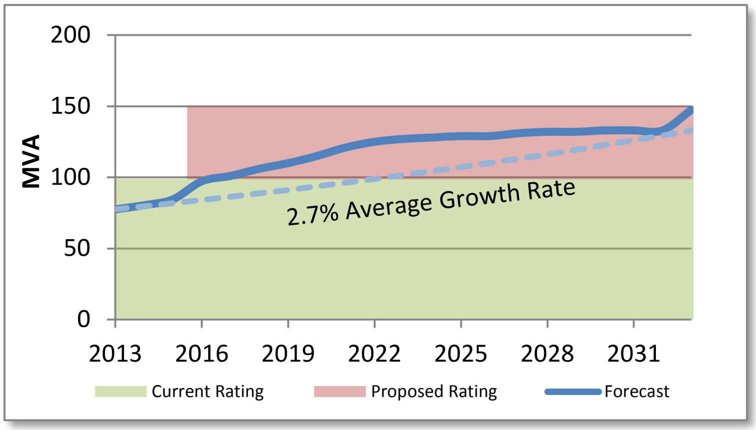
The Nepean TS 44kV system is built in a network configuration and at this time there are no significant issues identified with the distribution arrangement.

The 44kV trunk network from South March TS is adequate, except for the single radial feeder (A9M3) that runs south of Maple Grove Road. The radial section of A9M3 supplies three 44/8kV stations: Janet King DS, Richmond North DS and Munster DS. In order to improve reliability performance the 22M25 out of Nepean TS will be extended into the southern part of the West service territory to serve as a backup to these stations. Construction is anticipated and to begin in 2015 and be operational in 2017.

Additional capacity is required at Hawthorne TS in the near term and at South March TS in the long term, after the end of the study period. HONI is currently replacing the T7 and T8 230kv-44kV transformers with an expected LTR of 152MVA and in service date of 2017. An additional 44kV station is being proposed in the Richmond area which will create dual supplies to some of the rural 44kV supplied substations, create additional feeder ties for contingency operability and will help off-load the heavily loaded feeders from South March TS and Nepean TS.

The forecasted 20 year load growth along with planned capacity upgrade projects for each station are shown in Figure 3.1.29, Figure 3.1.30, and Figure 3.1.31.

Figure 3.1.29 - Hawthorne TS Load Growth

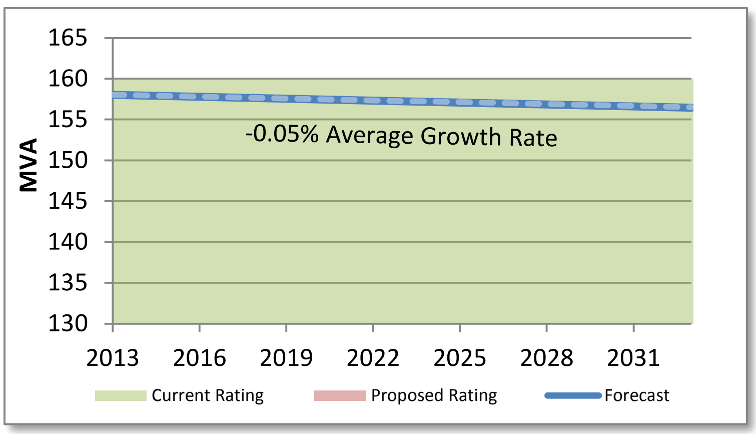


Capacity Projects

Planned:

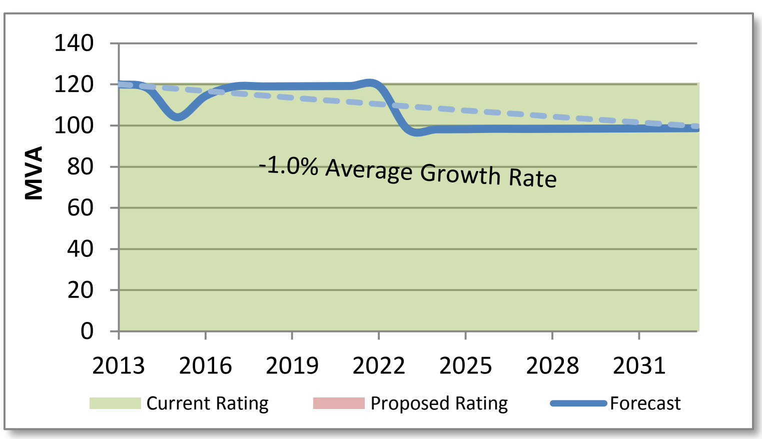
(a) Hawthorne TS – 51MVA (2017)

Figure 3.1.30 - Nepean TS Load Growth



There are no capacity issues forecasted at Nepean TS. The load forecast shows a decreasing trend based on the conversion of 8kV load (fed from 44/8kV stations) to the 28kV system.

Figure 3.1.31 - South March TS Load Growth



There are no capacity issues forecasted at South March TS during the study period. The load forecast shows a decreasing trend based on load transfers to transmission connected stations.

3.1.5.2 Ability to Connect New Generation

System ability to connect distributed generation is limited by several factors such as:

1. **Station Loading** – some station transformers have limited or no capability for reverse power flow. At these stations, total connected generation cannot exceed either 60% of top transformer rating plus minimum loading, or in the most restrictive case where there is no reverse flow capability, generation is limited to the minimum station loading. This limit has been adopted from HONI's evaluation tool for generation connection assessment.
2. **Feeder Thermal Rating** – the feeder ampacity rating must be respected to not overheat the conductors and connected equipment. For distributed generation, the available thermal capacity is the full feeder ampacity rating less contingency loading.
3. **Short Circuit Rating** – connection of distributed generation will increase the available current that flows through the system during faults. The total available current during faults cannot exceed the equipment ratings.
4. **Power Quality** – four concerns arise when connecting distributed generation:
    a. harmonics caused by inverter based generation;
    b. phase imbalance caused by single-phase generators;
    c. voltage instability caused by generators connected at various points along a feeder, or by induction generators requiring reactive power; and
    d. flicker caused by generators intermittently turning on and off – they can affect the voltage on the circuit impacting the quality of supply to HOL customers.
5. **Anti-Islanding** – distributed generation may introduce safety and power quality issues in the event of continued generation after loss of supply from the distribution system. The installation of transfer trips and other anti-islanding methods are used to limit islanding.

The generation connected to both feeders and station must be managed to prevent adverse impact to existing HOL load and generation customers.

As of July 30, 2014, HOL's Service Area was no longer under a transmission constraint due to the short circuit rating of 115kV transmission breakers located at the Hydro One Networks Inc. (HONI) owned Hawthorne TS. As a result, 300MW of generation capacity is now available.

Despite this, some stations remain restricted from any generation connection regardless of size and are discussed in the sections that follow.

Core 13kV

Currently, there are connection restrictions at the Slater TS, and one bus at Lisgar TS. Slater TS is limited due to short circuit levels at the station, whereas Lisgar TS is currently limited by the minimum normal loading on the station bus. Proposed upgrades at Lisgar TS substation will allow loading at this station to increase, which is anticipated to alleviate the current restriction at this location.

HOL has discussed with a few proponents their interest in large size district heating & cooling, hydro-generation, or energy storage within this region. With the coming load growth and planned station upgrades it is anticipated that capacity will be available to accommodate these requests.

East 13kV

There are currently no regional substation restrictions for the connection of distributed generation at the East 13kV substations; however; there are proposed upgrades at King Edward TK substation that may result in a constraint due to an increased fault current from the larger substation transformers.

West 13kV

Presently, the Lincoln Heights TS B1B2 bus pair is restricted to allow connection of only renewable micro-generation due to thermal limitations.

The OPA (now IESO) has approved a 29.35MW large hydro generation facility that will connect to Carling TS with an anticipated in service date of 2017.

As per the manufacturer's recommendation, HONI is presently restricting reverse flow through the existing Hinchey TH transformers to the minimum station load. The planned station upgrade will allow for more loading of Hinchey TS, and reverse flow of 60% of the top transformer rating plus minimum load with the requirement to keep the loading (with and without generation) on the secondary windings balanced.

South 28kV

Currently, the T1 half of Fallowfield MTS is restricted due to thermal limitations as well as a zero reverse flow capability. The T2 side of the station was built with reverse flow capability allowing the connection of generation dependant on remaining capacity available as applications currently exist for large generation to make partial use of this capacity.

South-East 28kV

There are currently no station restrictions for the connection of distributed generation at the South-East 28kV stations.

East 8kV & 28kV

There are currently no station restrictions for the connection of distributed generation at the East 28kV & 8kV stations.

West 28kV

There are currently no station restrictions for the connection of distributed generation at the West 28kV stations. HOL is attending to a proponent with a 4MW IESO energy storage offer-of-contract for transmission grid support. This project will connect to the Terry Fox MTS.

Nepean Core 8kV

There are currently no station restrictions for the connection of distributed generation at the Nepean Core 8kV stations.

West Nepean 8kV

There are currently no station restrictions for the connection of distributed generation at the West Nepean 8kV stations. All these stations are supplied from HONI High Voltage Distribution Stations (HVDSs), either South March TS or Nepean TS.

West 8kV

There are currently no station restrictions for the connection of distributed generation at the West 8kV stations.

West 12kV

There are currently no station restrictions for the connection of distributed generation at the West 12kV stations.

City Wide 44kV

There are currently no station restrictions for the connection of distributed generation at the 44kV Stations.

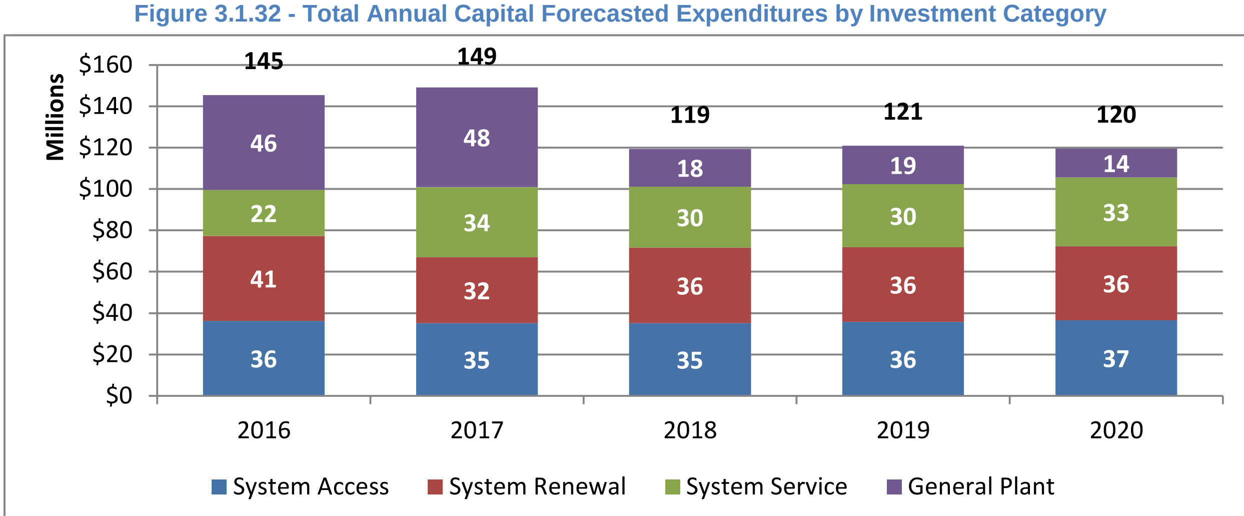
3.1.6 Total Annual Capital Expenditures by Category

HOL's total annual capital forecasted expenditure by investment category is shown in Table 3.1.6 and Figure 3.1.32.

Table 3.1.6 - Total Annual Capital Forecasted Expenditures by Investment Category

Investment Category	$'000				
	2016	2017	2018	2019	2020
System Access (Gross)	36,263	35,156	35,132	35,835	36,551
System Renewal	41,033	31,823	36,491	35,980	35,718
System Service	22,235	33,957	29,518	30,473	33,314
General Plant	45,899	48,138	18,276	18,695	13,954
Grand Total	**145,430**	**149,073**	**119,418**	**120,982**	**119,538**

Figure 3.1.32 - Total Annual Capital Forecasted Expenditures by Investment Category



3.1.7 Capital Expenditures Description by Category

HOL's capital expenditures are driven by the Asset Management planning process which is described in section 2.1 Asset Management Process Overview. The following sections describe, by investment category, how the outputs of the planning process tie into the allocation of the capital budgets.

3.1.7.1 System Access

System Access capital expenditures are driven by HOL's mandate to connect customers to the distribution system and to meet the service obligations of the Distribution System Code. The System Access Budget Programs are: Plant Relocation & Upgrade, Residential Subdivisions, Commercial Development, System Expansion, Embedded Generation, Infill Service (Res & Small Com), and Damage to Plant (see section 3.1.1 for a brief definition of the Budget Programs). System Expansion Demand contributions are determined though the application of the Board's prescribed economic evaluation methodology.

The capital planning process has minimal impact on System Access Capital Expenditures since these expenditures are demand/customer driven and are therefore typically considered to be mandatory.

Forecasted annual spending takes into consideration a number of variables:

- Historic spending levels – trending of each category;
- Known large future developments;
- City plans and projects; and
- Economic indicators

Where efficiencies are identified in combining activities, system renewal or system service projects are considered to allow all work in one area to take place together. System access projects may in some cases require a system renewal or service project to be delayed due to physical restrictions in the work area or system operability restrictions. In these circumstances, the risk to the system is evaluated and an optimal solution is determined with regards to work timing and prioritization.

3.1.7.2 System Renewal

System Renewal investments include sustainment programs that replace or refurbish assets which are nearing or have reached the end of their useful lives. The System Renewal Budget Programs are: Stations Transformer Replacement, Stations Switchgear Replacement, Stations Plant Failure, Stations Enhancements, Pole Replacement, Insulator Replacement, Elbow & Insert Replacement, Distribution Transformer Replacement, Vault Rehab or Removal, Civil Rehabilitation, Cable Replacement, Switchgear New & Rehab, O/H Equipment New & Rehab, and Distribution Plant Failure (see section 3.1.2 for a description of the Budget Programs).

Capital expenditures for System Renewal are sustainment investments that are determined as an output of the Asset Investment Strategy (Section 2.1 Asset Management Process Overview) and are captured annually in the Annual Planning Report (Attachment B-1(B)). The primary planning pieces which impact System Renewal investments are the Asset Management Plan and the Testing, Inspection & Maintenance Plan. The Asset Management Plan provides strategic guidance on replacement and investment forecasts, manages priorities, and identifies process gaps. The Testing, Inspection, and Maintenance Plan outputs data used in the development of asset condition assessment and aims to optimize maintenance practices and therefore, overall asset lifecycle.

Full details on how System Renewal Investments are determined and prioritized can be found in section 2.1 Asset Management Process Overview.

3.1.7.3 System Service

System Service investments include sustainment programs that address capacity, reliability, and power quality issues on the distribution system. The System Service Budget Programs are: Stations New Capacity, Line Extensions, System Reliability, Distribution Enhancements, Distribution Automation, Substation Automation, SCADA Upgrades, and RTU Additions (see section 3.1.3 for a description of the Budget Programs).

Capital expenditures for System Service are investments that are determined as an output of the Asset Investment Strategy (Section 2.1 Asset Management Process Overview) and are captured annually in the Annual Planning Report (Attachment B-1(B)).The primary planning pieces which impact System Renewal are the System Capacity Plan and the Reliability Plan.

The System Capacity Plan identifies milestones for required system upgrades to ensure a reliable supply is maintained. The Reliability Plan provides a platform for thorough review of system reliability and identifies planned works which are designed to directly impact system reliability.

3.1.7.4 General Plant

General Plant investments include payments to Hydro One under Connection & Cost Recovery Agreements, facility and fleet requirements, Information Technology system upgrades, and new initiatives. The General Plant Budget Programs are: Facilities Management, Fleet Replacement, Tools Replacement, IT Life Cycle and On-going Enhancements, IT New Initiatives, ERP System, Customer Service, and Operation Initiatives.

Forecasted annual spending takes into consideration a number of variables:

- Identification of lifecycle optimization, examples including building facilities, vehicles, and tools. The objective is to determine the optimal replacement to minimize overall costs but also maintain a safe work environment;
- Identification of any IT system upgrades required to continue with vendor support and maintain data integrity;
- All new Operation initiatives must align to business plan priorities, help achieve approved performance targets, and support the four key areas of focus (Customer Value, Financial Strength, Organizational Effectiveness, and Corporate Citizenship). Funding must be justified and supported by business case and approved by Executive Management Team (EMT).

3.1.8 Forecasted Material Capital Expenditures

The following section outlines the material capital expenditures, by category, planned over the forecast period, which exceed the materiality threshold of $750k.

3.1.8.1 Committed Investment

Annual budgets for 2015 and 2016 have been prepared and identify projects by Investment Category, Capital Program and Budget Program. Table 3.1.7 and Table 3.1.8 list the projects executing in 2015 and 2016 that exceed the materiality threshold. It should be noted that this number represents the total project cost and therefore may incorporate project expenditures which fall outside of the 2015-2020 window (either before or after). The full justifications of these projects can be found in Attachment B-1(A).

Table 3.1.7 - Material Capital Expenditures for 2015 and 2016 Projects (1/2)

Investment Category	Capital Program	Budget Program	Project	Total Budget $'000
System Renewal	Station Assets	Station Trans. Replace.	Merivale DS Rebuild	17,126
			Bronson T1 & T2 Replacement	3,223
			Longfields T2	4,340
			Albion UA T1, T2 & T3 Replacement	2,970
		Station Switchgear Replacement	Epworth T1 Primary Fuse to Circuit Switcher	1,149
			Woodroffe TW 13kV Switchgear Replacement	7,346
			Borden Farms Switchgear Replacement	7,269
			Bayshore Primary Circuit Switcher	3,782
			Overbrook TO Switchgear Replacement	7,130
			Startop Protection Upgrade	4,768
	Distribution Assets	Pole Replacement	Centretown East Pole Replacement	7,416
			South East Kilborn Area Pole Replacement	1,054
			Riverside South Pole Replacement	4,565
			Grandview Road Pole Replacement	1,086
			Centretown West Pole Replacement	6,681
			Alphabet Ave Pole Replacement	1,224
			Prince of Wales & Greenbank	2,456
		Dist Trans Replace	OH TXF – PCB Regulatory Compliance	1,473
		Civil Rehab.	Civil on Carling from Bronson to Sherwood	2,602
		Cable Replacement	48M4 & 48M5 Cable Replacement	841
			Butyl Rubber Craig Henry	1,604
			Stittsville Main Cable Replacement	2,868
			Blackburn 4F8	1,611
			Butyl Rubber Tanglewood	2,540

Investment Category	Capital Program	Budget Program	Project	Total Budget $'000
		O/H Equipment New & Rehab	SMD-20 Switch Replacement	1,250
		Metering	Remote Disconnect Smart Meters	6,800

1 Table 3.1.8 - Material Capital Expenditures for 2015 and 2016 Projects (3/2)

Investment Category	Capital Program	Budget Program	Project	Total Budget $'000
System Service	Stations Capacity	Stations New Capacity	New South 28kV Substation	21,255
			Hinchey New Switchgear Lineup	11,280
			Lisgar TL Transformer Upgrade	TBD*
			Limebank Transformer Upgrade	8,360
			Leitrim T1	3,050
			Casselman T1	4,740
			Richmond South DS	17,657
	Distribution Enhancements	Line Extension	TM1AH Capacity Upgrade	880
			Alta Vista Tie	1,658
			Orleans TS Feeder	4,546
			Fernbank Rd Line Extension	1,533
			West 44kV Line Extension	6,243
			Springbrook Drive Trunk Extension	2,363
			Abbott Street Trunk	1,023
		System Voltage Conversion	Woodroffe UW Voltage Conversion	15,835
			Prince of Wales Voltage Conversion	1,475
			Rideau Valley Voltage Conversion	1,035
			Richmond Voltage Conversion	8,320
			Goulbourn St Voltage Conversion	802
	Auto-mation	Dist. Auto.	Telecommunications Master Plan	17,000
		SCADA Upgrade	SCADA Replacement	2,800

2 *Note – the budget for Lisgar TL Transformation Upgrade is currently being prepared by Hydro
3 One.

3.1.8.2 2017-2020 Investments

For the 2017-2020 forecasted years, total Budget Program level spending has been projected, as shown in Table 3.1.9, Table 3.1.10, Table 3.1.11, and Table 3.1.12. Note that all programs are shown including those that do not exceed the materiality threshold of $750k. Project specific investments will be identified on an on-going basis, always looking out three years at a time. Project and Budget Program Justifications can be found in Attachment B-1(A).

Table 3.1.9 - Forecasted Capital Expenditures by Budget Program – System Access

Investment Category	Capital Program	Budget Program	$'000			
			2017	2018	2019	2020
System Access	Plant Relocation	Plant Relocation & Upgrade	7,773	7,928	8,087	8,248
	Residential	Residential Subdivision	7,027	7,167	7,311	7,457
	Commercial	New Commercial Dev	13,042	12,576	12,827	13,084
	System Expansion	System Expansion Demand	2,366	2,413	2,462	2,511
	Stations Embedded Gen	Embedded Generation	384	392	400	408
	Infill & Upgrade	Infill Service (Res & Small Com)	3,223	3,288	3,353	3,420
	Damage To Plant	Damage to Plant	1,171	1,195	1,219	1,243
	Metering	Metering – Re-verification	-	-	-	-
		Smart Meters	-	-	-	-
		Suite Metering	170	173	177	180
	Total		**35,156**	**35,132**	**35,835**	**36,551**

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Table 3.1.10 - Forecasted Capital Expenditures by Budget Program – System Service

Investment Category	Capital Program	Budget Program	$'000			
			2017	2018	2019	2020
System Service	Stations Capacity	Stations New Capacity	15,272	10,464	14,441	15,626
	Distribution Enhancements	Line Extensions	6,180	7,132	6,455	6,739
		System Voltage Conversion	4,964	5,729	5,185	5,413
		System Reliability	445	513	464	485
		Dist. Enhancements	694	801	725	757
	Automation	SCADA Upgrades	1,011	556	51	51
		SCADA - RTU Additions	76	87	79	82
		Distribution Automation	4,719	3,548	2,449	3,510
		Stations Automation	597	689	624	651
	Total		33,957	29,518	30,473	33,314

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Table 3.1.11 - Forecasted Capital Expenditures by Budget Program – System Renewal

Investment Category	Capital Program	Budget Program	$'000 2017	2018	2019	2020
System Renewal	Stations Asset	Stations Transformer Replacement	4,620	6,533	8,225	7,965
		Stations Switchgear Replacement	7,088	7,408	6,871	6,114
		Stations Plant Failure	107	107	107	107
	Stations Refurbishment	Stations Enhancements	634	731	662	691
	Distribution Asset	Pole Replacement	6,592	7,608	6,886	7,189
		Insulator Replacement	168	194	176	183
		Elbow & Insert Replacement	190	219	198	207
		Dist. Transformer Replacement	808	933	844	881
		Civil Rehabilitation	636	734	664	694
		Cable Replacement	5,262	6,073	5,496	5,738
		Switchgear New & Rehab	376	434	393	410
		O/H Equipment New & Rehab	902	1,041	942	983
		Plant Failure Capital	2,893	2,893	2,893	2,893
	Metering	Remote Disconnected Smart Meter	1,547	1,584	1,623	1,662
	Total		31,823	36,491	35,980	35,718

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Table 3.1.12 - Forecasted Capital Expenditures by Budget Program – General Plant

Investment Category	Capital Program	Budget Program	$'000			
			2017	2018	2019	2020
General Plant	Buildings – Facilities	Buildings – Facilities	509	408	323	243
	Customer Service	Customer Service	2,361	1,148	6,658	1,139
	ERP System	ERP System	354	350	354	1,061
	Fleet Replacement	Fleet Replacement	1,209	1,452	1,480	1,876
	Info Serv & Tech New Initiatives	Info Serv & Tech New Initiatives	1,166	1,006	1,218	1,203
	IT Life Cycle & Ongoing Enhancement	IT Life Cycle & Ongoing Enhancement	1,737	1,905	2,232	1,816
	Operation Initiatives	Operation Initiatives	452	405	892	1,069
	Tools Replacement	Tools Replacement	521	530	539	548
	Hydro One Payments	Hydro One Payments	5,000	5,000	5,000	5,000
	Facilities Implementation Plan	Facilities Implementation Plan	34,829	6,073	-	-
	Total		48,138	18,276	18,695	13,954

3.1.9 Regional Planning Process

HOL is currently participating in the Integrated Regional Resource Planning process (IRRP) with Hydro One Network Inc., Hydro One Distribution, and the Independent Electricity System Operator (IESO) as described in 1.2.1.1 Integrated Regional Resource Planning Process. The IRRP began in 2011 and continues to be developed by the working group, with the IESO leading the process. The IESO has issued a hand off letter to Hydro One Networks Inc. initiating development work on near and mid-term transmission solutions to meet the identified needs. As per the hand off letter, found in Appendix B, two transmission solutions have been identified that impact HOL's capital expenditure plan: rebuilding of the existing 115 kV single-circuit A6R and upgrading a section of 115 kV S7M. It has been determined that to increase the available capacity of the Hydro One circuit S7M HOL overhead line that passes beneath it must be lowered by 2.5 feet through the crossing. The costs associated with the work is budgeted at approximately $10k and is scheduled for completion in 2015.The plan for the Hydro One circuit A6R upgrade will be developed and implemented by Hydro One Networks Inc. Currently, the date and cost is not known, no estimate has been provided, and there is potential that the costs of this work will fall within HOL's forecast years. As the timeline and costs of this work are beyond the control of HOL, any work will be integrated into the current plan through reprioritization of work following the planning process. HOL will continue to provide updates as more information becomes available.

3.1.10 Customer Engagement Activities

As an overview, this section outlines the activities HOL undertakes to solicit feedback from customers. Some examples of outcomes are provided in section 3.2.4 Customer Engagement

Each year, HOL engages an external research firm to conduct an annual Customer Satisfaction Survey. The survey helps HOL understand the satisfaction levels of HOL customers relative to Ontario comparators. It also reveals how customer perceptions, issues and concerns are evolving over time. The types of questions posed to customers in this annual survey include:

- LDC Knowledge, integrity, involvement and trust;
- Overall Customer Satisfaction scores;
- % of respondents indicating they had a blackout or outage issue in the past 12 months;

- % of respondents indicating they had a Billing problem in the past 12 months;
- What customers think of electricity costs;
- Level of customer engagement;
- Company Image; and
- Customer view of importance to pursue implementation of “SMART Grid”

The survey results factor into the setting of annual performance objectives and the establishment of relative priorities.

In addition to the annual survey described above, HOL also conducts monthly telephone surveys of customers who have recently called HOL’s call center. This survey measures factors such as:

- Call Center level of Satisfaction;
- Level of knowledge of the staff who dealt with the customer;
- Level of courtesy of the staff who dealt with the customer; and
- The ability to deal with the customer’s issue (First Call Resolution)

Use of these two surveys helps to determine if HOL is improving performance, from the customer’s perspective, year over year. Further, these surveys help identify emerging issues which influence planning and resolution priorities. Annual plans are more informed and aligned as a result of customer feedback generated from these two surveys.

3.1.11 System Development Expectations

This section describes how HOL anticipates the system to develop over the next five years, including in relation to load and customer growth, smart grid development and the accommodation of forecasted renewable energy generation projects.

3.1.11.1 Load and Customer Growth

HOL’s system capacity is lagging behind the load growth – currently 15% of substations are above their specified planning rating (see2.2.4 Capacity of the Existing System Assets). Over the next five years, HOL is expecting growth to continue as previous rural areas are changed to urban areas and the City’s plan for intensification continues.

Overall, the City of Ottawa is seeing continued growth, primarily focused in four regions: the downtown core, Nepean & Riverside South, South Kanata & Stittsville and Orleans. This growth is being seen through the development of new mixed retail/residential communities as well as intensification of existing communities and the Light Rail Transit developments. Moving forward, significant investment in capacity for the system, at both the station and distribution level, will be required to catch up to and maintain pace with the demand. In addition, there are a number of distribution expansions which will be required to bring power from the substations to the customer site. These capacity upgrade projects are identified through the Capacity Planning process and the needs are described in Section 3.1.5.1 Ability to Connect New Load.

There are several upgrades of transmission interties within the City which may be necessary over the next 20 years to maintain adequate and reliable supply from the bulk system. HOL is currently involved in an IRRP (section 1.2.1.1 Integrated Regional Resource Planning Process) that is evaluating the transmission capacity and infrastructure requirements in the Ottawa region. The final report is expected by Q1 2015. Preliminary findings indicate required upgrades to address the following needs:

- Post-contingency thermal overload of the 115 kV double circuits in Downtown Ottawa M4G and M5G ;
- Additional station capacity needed in Downtown Ottawa area;
- Additional supply capacity needed in the south of Nepean area to support the growth;
- Post-contingnecy thermal overload of one Merivale autotransformer; and
- The need for bulk transfer capability between Hawthorne and Merivale.

3.1.11.2 Smart Grid Development

HOL's Smart Grid Development is detailed in the Grid Transformation Action Plan (GTAP) report, found in Attachment B-1(C).

The term "Smart Grid" means different things to different people depending on their perspective and knowledge of the power system. One statement that captures the essence of Smart Grid is the following:

"The integration and application of real-time monitoring, advanced sensing, communications, analytics, and control, enabling the dynamic flow of both energy and information to accommodate existing and new forms of supply, delivery, and use in a secure, reliable and efficient electric power system, from generation source to end-user."

In addition to the challenge of distributed generation, consumers are very aware of the increasing cost of electricity and are demanding greater control over their usage. At the same time they expect a high level of electricity supply reliability.

Governments are also keenly aware that demand control can play a significant role towards reducing overall cost in delivering electricity service in the future. The Grid Transformation Action Plan report is the first step in preparing HOL for the future Smart Grid.

Refusing to make progress in developing a smarter grid is not an option. At the same time HOL must not be reckless in the transformation plans. Being on the bleeding edge of technology is not something that many of our customers would value for HOL. A middle of the road approach of making prudent investments in proven technology will enable us to bring greatest returns to our customers.

HOL has identified a number of fundamental building blocks for the Smart Grid that requires study to ensure they will meet our future needs. Communication Infrastructure, data capture, storage and sharing, IT systems and cyber security are some of the fundamentals that are required to ensure a solid foundation for future projects.

HOL treats "Smart Grid" development activities within the regular processes to identify capital expenditures. It is anticipated that more focus will be placed on automation, including a robust communication infrastructure, in the coming years to allow for more efficient system operability and transparency.

3.1.11.3 Accommodation of forecasted renewable energy generation projects

HOL is predicting a continued interest in the installation of REG within the service territory, over the five year forecast period. Based on the current ability of the system to connect new REG (Section 3.1.5.2), there are no constraints at the anticipated connecting stations for the forecasted connections. For more detailed information on accommodation of forecasted renewable energy projects in the next five years, please refer to 3.3 System Capability Assessment for Renewable Energy Generation.

3.1.12 Impact of Customer Preferences, Technology, and Innovation on Total Capital Cost

HOL uses the information gathered from customer engagement activities (section 3.2.4) to help meet customer preferences through the use of technology and innovation. The use of smart switches and enhanced communication systems to improve restoration times are two examples of the use of technology.

3.1.12.1 Response to customer preferences

See section 3.2.4 Customer Engagement.

3.1.12.2 Technology Based Opportunities

Over the next five years, HOL will continue implementing grid technologies to improve the reliability and efficiency of the distribution system. Ongoing targeted installation of automated devices is planned. Currently, targeted projects are the East 44kV automation, which will deploy automatic restoration to this sub-transmission loop that supplies 3% of HOLs' customers. In addition, automation plans are being deployed in the quickly growing South Nepean/Barrhaven area, as well as targeted annual installation to address the Worst Performing Feeders (1.3.2.1.3 Worst Feeder Analysis). Continued investment in the communication infrastructure will be essential to support current automation plans while maintaining the flexibility to integrate the technologies of tomorrow.

Starting in 2015, with a completion of installation in 2018, HOL's Supervisory Control and Data Acquisition (SCADA) is being upgraded. SCADA supports system reliability by providing system operators with real-time access to system status and control, reducing time required to identify service disruptions, locate system faults, and operate the system to restore customers. As more and more distribution assets are connected to the SCADA system, the Operator's situational awareness improves, resulting in a more focused and effective restoration effort.

In early 2014, HOL initiated a pilot project to deploy a small WiMAX network using the 1800 – 1830MHz band that has been reserved by Industry Canada for use in the management of the electricity system. It is the goal of this project to evaluate the technology for use in distribution automation as well as SCADA and metering applications. While the WiMAX network will not provide the throughput of 3G/LTE systems, it does provide lower latency and a cost structure that will be more compatible with a utility budgetary framework.

HOL continues to evaluate the best mix of technologies to support increased communications across both distribution and substation equipment. Over the course of 2014, HOL engaged a leading utility communications consulting firm to develop a telecommunications master plan. This plan (completed in August of 2014) provides a complete picture of the core Wide Area Network which will accommodate all HOL communications needs. With this plan completed, a detailed investment roadmap has been crafted which describes the necessary investments and outcomes over the next 10 years. These investments will bring the HOL communications infrastructure from a disparate patchwork of costly services to a single cost efficient, secure, reliable, and effective communications network. By building a private communications infrastructure, HOL will reduce the ongoing burden of third-party service charges while at the same time providing connectivity and capacity exactly where it is needed.

3.1.12.3 Innovative Processes, Services, Business Models, or Technologies

In 2014, HOL acquired Copperleaf C55, an industry-leading and established Asset Investment Planning tool. This planning tool will enable the development of a strategic framework, improved asset analytics, investment decision optimization, and performance management. Copperleaf C55 will achieve the objectives of value creation through better decision making, improved efficiency in the planning process, and meeting the standards set by the OEB's performance-based Renewed Regulatory Framework. Implementation of Copperleaf C55 was completed in December 2014.

3.2 Capital Expenditure Planning Process Overview

The Capital Expenditure Planning Process Overview section outlines HOL's planning objectives, how non-distribution alternatives for relieving capacity and operational constraints are evaluated, a description of how HOL identifies, selects, prioritizes and paces investments, and the mechanisms used to engage customers.

3.2.1 Capital Expenditure Planning Objectives

HOL's capital expenditure Planning Objectives are as follows:

- To align with HOL's Corporate Strategic Objectives as outlined in Section 1.0.1: Customer Value, Financial Strength, Organizational Effectiveness, and Corporate Citizenship;
- To optimize projects by ranking investment criteria and comparing project benefits;
- To ensure that investments are financially viable in terms of the approved budget and required resources;
- To provide high quality customer service by evaluating customer value and striving to increase reliability;
- To maximize cost efficiency by considering timing, resource allocation and contingency scenarios;
- To analyze previous investments to improve future investment decisions; and
- To pace expenditures to minimize rate impact.

These objectives align with HOL's Asset Management Objectives in that the Planning Objectives define the selection and prioritization process for project investments. The Asset Management Objectives are: Health & Safety, Asset Management, Reliability & Customer Impact, Environment and Regulatory Compliance. They are detailed in section 2.1.1 Asset Management Objectives. Whereas HOL's Asset Management Objectives provide a focus on identifying the asset needs and enhancing the distribution system, the capital planning objectives aim to maximize the outcome of the invested capital, based on the available budget.

Both the Planning Objectives and the Asset Management Objectives revolve around HOL's primary area of focus: delivering customer value. As a company that provides an essential service to the public, the ability to deliver value to its customers is critical to HOL's. The fundamentals of customer value in the electricity business are quality and cost — delivering a reliable service, while operating efficiently and effectively to minimize rate impact. HOL is consistently among the top performers in Ontario in both these areas, but the customer's place within the electricity system is also evolving. Customers are no longer just consumers of electricity, but also generators of electricity and managers of energy conservation, thereby making them integral and active participants in the management of the electricity system.

In order to meet and exceed the diverse expectations of the customer base, HOL is focussing on service quality and responsiveness, assisting customers in managing their energy consumption and electricity costs, and maintaining/improving overall system reliability.

HOL's approach includes:

- A focus on detailed customer knowledge to guide the company in understanding, anticipating and responding to customer needs;
- The revision of the conditions of service —operating practices, levels of service and connection policies — to be more customer-centric; and
- The effective and innovative use of technology and communication to enhance the customer experience, and provide solutions to help customers conserve energy and manage costs.

HOL also focuses on accommodating and implementing proposals for customer distribution generation projects. This includes solar generation projects under the Feed-In-Tariff (FIT) or microFIT programs. HOL works with the customer in the preparation of their connection proposal, ensuring that the equipment and design meets all required standards and regulations. A Connection Impact Assessment is completed by HOL as a formal response to the proposal, verifying that connection at the proposed location is viable and that the proposed generation will not negatively impact the grid.

3.2.2 Non-Distribution System Alternatives

HOL does not have a policy governing the treatment of non-distribution system alternatives to relieve capacity or operational constraints. HOL is currently involved in an Integrated Regional

Resource Planning process (IRRP) as developed by the IESO and updated by the OEB. The IRRP process develops and analyzes forecasts of demand growth for a 20-year time frame, determines supply adequacy in accordance with the Ontario Resource and Transmission Assessment Criteria (ORTAC), and develops regionally integrated solutions to address needs that are identified. These include: conservation, demand management, distributed generation, large-scale generation, transmission, and distribution. HOL continues to work with Hydro One, and the IESO in developing optimal solutions to the transmission and bulk system needs within the Ottawa area. Refer to section 1.2.1.1 Integrated Regional Resource Planning Process for more details.

3.2.3 Prioritization Process, Tools and Methods

HOL's process, tools, and methods used to identify and prioritize projects are described in 2.1.2 Asset Management Process Components.

The pace at which HOL plans project execution is dependent on three criteria:

- Customer service requests;
- Rate impact to customers; and
- System requirements – safety, reliability & capacity

Investments are scheduled and paced according to customer requirements and are coordinated to meet regulatory requirements based on crew availability.

The annual planning process as part of the Annual Planning Report (see Attachment B-1(B)), identifies a gap between the forecasted investment required for the distribution system, and the funding currently identified. That gap exists to some degree due to resource constraints including operational and capacity, and affordability constraints. The pattern of increased capital investment has placed pressure on rate impacts and financing capability. A balance must be found that ensures sufficient investment in the distribution system to enhance reliability and improve productivity and customer service, while achieving the deemed funding level through rates. Projects and new initiatives must be reviewed and prioritized to ensure the most essential investments with the greatest value to the customers are funded on a timely basis, within all the constraints.

3.2.4 Customer Engagement

HOL undertakes various customer engagement activities of which the following relate directly to the implementation of the Distribution System Plan.

Annual Customer Satisfaction Survey

Each year, HOL conducts a customer satisfaction survey which solicits customer feedback on the utility and the various services the utility provides. In 2014, 805 telephone interviews were conducted with a wide range of questions covering such topics as: system reliability performance, investment to improve reliability, acceptable length of outages, design of the system (overhead versus underground) and willingness to pay more for system enhancements.

Key results of the survey, including percentage of responses:

- Provides consistent, reliable electricity – 90%
- Not willing to pay for further improvements – 51%
- Willingness to pay at least something to better their electricity system – 43%
- Acceptable duration of an outage during extreme conditions:
  - None, the power should not go out – 7%
  - Less than 2 hours – 11%
  - 2 to 4 hours – 17%
  - 12 to 18 hours – 7%
  - 1 day – 10%
  - 1 to1.5 days – 5%
  - 1.6 to2 days – 5%
  - More than 2 days – 4%

Based on the survey results, HOL customers indicated that reliability be maintained or improved, at minimal or no increased cost. As a result, HOL has created a capital plan that paces investments in order to minimize rate impacts, while continuously improving efficiencies and productivity with respect to distribution planning and implementation. HOL is continuing to improve capital project prioritization, specifically in the areas of data collection and risk management.

Customer Consultations on Major Projects

HOL regularly consults customers with regards to major projects that will potentially impact customer property or neighbourhoods, such as cable replacement or distribution transformer replacement.

The consultation process first involves informing the potentially impacted customers of the pending work, followed by a customer open house aimed at creating open dialog. During the open houses, HOL staff informs customers on the scope, schedule and the general process to be undertaken to perform the work. It is also a venue for customers to provide their feedback and voice their concerns that staff can then immediately address. The open house strategy was developed based on feedback received from customers in the past and have since proven to enable a productive and successful project for both the customers and HOL. HOL believes, and it has been proven from these sessions that strong and open communication is essential with our customers. Customers have commented that they appreciate these consultation sessions as they provide a forum for discussion and airing their concerns, while allowing HOL to inform them of project needs and the concept of reliability.

Participation with Electrical Contractor Association

HOL actively communicates with the Electricity Contractor Association (ECA) of Ottawa to ensure strong communications between HOL and the numerous contractors that work in Ottawa. This need was identified by the ECA as part of the customer persona activity that HOL initiated in 2013. As a result, HOL now ensures any and all questions are answered and actively communicates new information to the ECA. Topics such as changes to the Conditions of Service are explained and discussed to ensure clear understanding of requirements. Feedback received in this continuous manner allows HOL planners to better understand future needs, timing of developments and issues and concerns around design standards and planning practices.

HOL Website

Customers are solicited for their direct feedback on HOL's corporate website, as well as, on the secured customer portal known as "My Hydro Link". Customers can send in their complaints and inquiries, the resolution of which, are tracked and managed by a complaint management application. The use of complaint management software helps identify complaint trends and opportunities for improvement. As an example, one of HOL's previously rural areas was developed into a dense residential community. The rural area previously made use of a protection scheme known as fuse saving, which allowed a distribution circuit to experience momentary outages rather than longer sustained outages caused by factors such as animal contacts. As a result, long outages were avoided, but identifying the exact location and cause of the outage was more difficult. Based on customer feedback, HOL learned that these customers preferred experiencing a longer outage in order to determine the associated root causes and put in place location specific risk mitigation measures, such as animal guards. This highlighted that customers in different areas have different preferences and tolerances for dealing with outages. Regarding this particular issue, a dedicated feeder more suited for the now urban area was installed in late 2014 to provide improved reliability.

3.2.5 Prioritization of REG Investments

HOL prioritizes Renewable Energy Generation (REG) investments based on customer requests and follows regulated timelines for response and connection.

HOL strives to integrate all proposed residential and commercial customer generation projects into the grid. Several projects are proposed every year (see Table 3.3.1 for connected and committed generation) and HOL works with project managers and the customer to integrate the proposed generation into the distribution system. The process for accepting these projects involves: analyzing the generation capacity of the connecting feeder and interface transformer; verifying that the relevant station transformer can accept reverse flow; ensuring that the short circuit changes and voltage fluctuations will cause no material impacts on either the distribution or transmission grid; and reviewing the proposed single line diagram, electrical protection scheme and site plan for adherence to all HOL, ESA and OPA (now IESO) standards and requirements (Refer to 3.1.5.2 Ability to Connect New Generation). In the event that the proposed generation connection is not possible, HOL works with the customer to provide a solution. This solution may involve expanding the distribution system to meet customer needs or relocating the project to a more fitting property. Where work on the distribution system is required for the connection, the project is coordinated to ensure regulatory timelines are met while optimizing crew time.

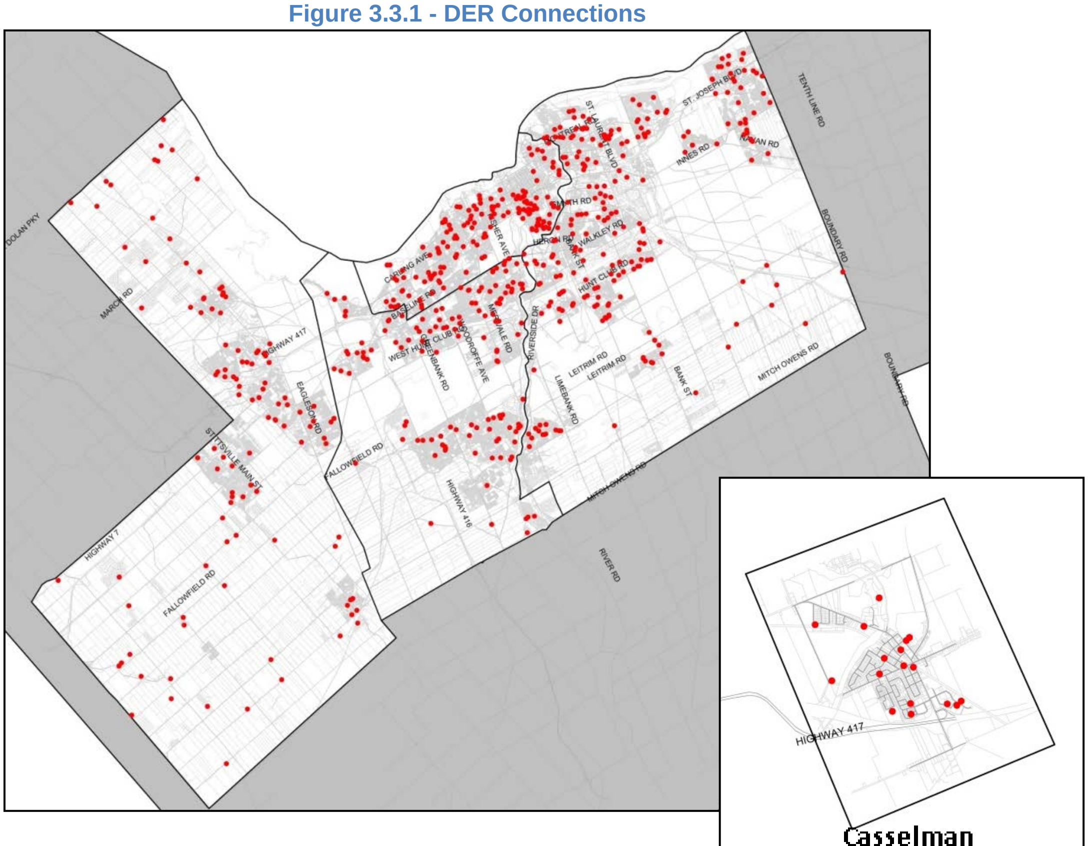
3.3 System Capability Assessment for Renewable Energy Generation

This section describes HOL's system capability to accommodate all Distributed Energy Resources (DER) including its the sub-set of Renewable Energy Generation (REG).

HOL is required by the Distribution System Code to assess generator connection requests of all fuel types, not just those defined as "renewable" in the Electricity Act, regardless of contract or program categories.

HOL currently has a number of connected generation facilities within the service area. These facilities have been connected and continue to be connected under various programs such as the OPA (now IESO) programs (FIT, HCI, PSUI-CDM, RESOP, HESOP), Net-Metering and Load Displacement. HOL also conducts system evaluations to accommodate a much broader group of generation connections classified as Distributed Energy Resources (DER), like large energy storage such as batteries and co-generation plants. The existing DER connections within HOL's service territory are shown in Figure 3.3.1.

Figure 3.3.1 - DER Connections



By the end of 2014 it is anticipated that HOL will have 678 DER connections of various sizes. The detail on number and total kilowatts of DERs connected by size and program are provided in Table 3.3.1.

Table 3.3.1 - 2014 DER Connections

Program / DSC Category	Large kW (qty)	Medium kW (qty)	Small kW (qty)	Micro kW (qty)	Total kW (qty)
Non-Renewable					
Load Displacement		9,249 (5)			**9,249 (5)**
Renewable					
FIT	-	-	10,792 (88)	-	**10,792 (88)**
HIC	-	18,080 (4)	500 (1)	-	**18,580 (5)**
Load Displacement	-	-	70 (1)	6 (3)	**76 (4)**
microFIT	-	-	-	4,619 (569)	**4,619 (569)**
Net-metered	-	-	-	18 (4)	**18 (4)**
RES 1		6,378 (1)			**6,378 (1)**
RESOP	-	10,700 (2)	-	-	**10,700 (2)**
Stand Alone	-	2,736 (1)	-	-	**2,736 (1)**
Total	**-**	**47,143 (13)**	**11,362 (90)**	**4,643 (576)**	**63,148 (679)**

Where the generation categories are defined in the Ontario Energy Board Distribution System Code (August 21, 2014), section 1.2 Definitions as:

Micro-embedded generation facility: name-plate rated capacity of 10kW or less

Small embedded generation facility: is not a micro-embedded generation facility with a name-plate rated capacity of 500kW or less in the case of a facility connected to a less than 15kV line and 1 MW or less in the case of a facility connected to a 15kV or greater line

Medium embedded generation facility: name-plate rated capacity of 10 MW or less and is more than 500kW in the case of a facility connected to a less than 15kV line and more than 1 MW in the case of a facility connected to a 15kV or greater line

Large embedded generation facility: name-plate rated capacity of more than 10MW

3.3.1 Applications Over 10kW

By the end of 2014, HOL will have a total of 102 connected DERs over 10kW, totalling 64.3 MW peak nameplate capacity. See Table 3.3.1, columns Large, Medium and Small.

3.3.2 Renewable Generation Forecast

Interest in generation projects within HOL's service territory has been steady over the historic years, and is anticipated to continue into the future. The trend has shown an increasing interest in Net-Metering and Load Displacement projects of various fuel types.

HOL has performed initial consultations or is currently (November 2014) completing assessments for:

- 69.35 MW of hydro-electric generation;
- 38 MW of co-generation (natural gas);
- 18.3 MW of solar photovoltaic ; and
- 16 MW of synthetic gas generation.

HOL is aware of 33 potential new projects under final FIT3 OPA evaluation totalling 8.68 MW of nameplate capacity. Currently, no existing restrictions are in place at the requested substation that would prevent connection.

Forecasts for DER connections are provided in Table 3.3.2 and are based on initial consultations and executed CIAs received and completed to date (November 2014). The initial consultations include those made with demonstrated higher level of intent under Net-Metering, Load-Displacement, IESO Energy Storage Procurement Request for Proposal (RFP) (one 4 MW applicant has been approved), and the OPA (now IESO) programs such as the PSUI, FIT 3, or Large FIT RFP. The executed CIAs have been for applicants under the OPA (now IESO) HESOP or PSUI program.

Table 3.3.2 - Forecasted DER Connections

Type	2015 (kW)	2016 (kW)	2017 (kW)	2018 (kW)	2019 (kW)	2020 (kW)
Co-Generation	9,723	3,250	-	-	25,000	-
Hydro-Electric	-	-	29,350	-	-	40,000
Solar PV	6,302	12,000	-	-	-	-
Synthetic Gas	-	-	16,000	-	-	-
Total	16,025	15,250	45,350	0	25,000	40,000

Capacity of the System to Connect DER as shown in Table 3.3.3 (last update December 5th, 2014) illustrates the capacity availability to connect Distributed Energy Resources at each HOL owned High Voltage Distribution Stations (HVDS). Note that if an HVDS has an open bus-tie switch capacity is provided per bus, and where the bus-tie is normally closed, it is provided by bus pair.

Overall, where HOL station limitations exist, they are limited by thermal capacity and not short circuit capacity, with the exception of Ellwood MTS and Nepean Epworth DS. When transformers are identified as having reverse flow capability, by manufacturer specification, (Bridlewood Q and Fallowfield Q) the limiting factor is the transformer capacity plus minimum station load. Otherwise, the limiting factor is simply the station minimum load.

Typically, more capacity at the stations is available for inverter based generation as opposed to spinning generation for two reasons:

- When reverse flow is the limiting factor, the minimum station load is higher between the 10AM to 3PM – the same period the solar generation nameplate capacity will likely be reached and the facility nameplate in capacity calculation is considered; and
- Short circuit contribution of inverter based generators is by rule of thumb 1.2 times the full load current and for spinning generation is considered to be 5 times the full load current.

The column label Connected & Committed represents all non-standby DER (renewable and non-renewable), that is already connected to the grid, committed for connection due to having an IESO or OPA contract, or HOL has issued a CIA and tentatively allocated, allocated, or reserved capacity.

Table 3.3.3 - Capacity for Generation at HOL HVDS

Station	Bus	Connected & Committed (kW)	Remaining Generation Capacity (kW)		Limiting Factor
			Equivalent Inverter Based Generation	Equivalent Spinning Generation	
Bridlewood MTS	B1	515	3,009	3,009	Minimum load
	Q	454	7,031	6,670	Transformation + Minimum load
Centrepointe DS	B1	45	1,730	736	Minimum load
	B2	30	882	167	Minimum load
Cyrville MTS	JQ	339	2,389	1,625	Minimum load
Ellwood MTS	JQ	335	1,905	457	Short Circuit
Fallowfield DS	J	9,131	0	2,454	Minimum load
	Q	9,224	11,614	5,292	Transformation + Minimum load
Kanata MTS	B1B2	1,124	18,475	17,317	Minimum load
Limebank MS	B1	87	3,485	2,408	Minimum load
	B2	468	6,238	4,616	Minimum load
Manordale DS	B1	23	1,493	639	Minimum load
	B2	34	1,808	823	Minimum load
Marchwood MS	J	865	7,420	5,425	Minimum load
	Q	295	7,519	6,654	Minimum load
Merivale MS	B1	84	1,667	644	Minimum load
	B2	22	1,878	1,385	Minimum load
Moulton MS	B1	80	5,638	3,729	Minimum load
	B2	-	4,614	4,099	Minimum load
Nepean Epworth DS	B	20	1,201	288	Short Circuit
	Q	12	2,398	1,112	Minimum load
Richmond South DS	B	300	1,628	866	Minimum load
Terry Fox MTS	J	4,105	0	1,929	Minimum load
	Q	24	2,450	1,959	Minimum load
Uplands MS	Z	228	9,219	8,388	Minimum load

Notes:

- Total Connected and Committed includes a reserve for future micro-generation projects;
- Committed projects are those that have an OPA Offer-of-Contract, received a CIA or have received and paid for a DER connection.

3.3.3 Constraints

Constraints to capacity for the connection of DER can occur due to legacy station power transformers not being able to accommodate reverse power flows as well as the short circuit capability of the station protection devices. To increase the short circuit limitations of the equipment, replacement is required with devices with higher ratings. Some station transformers have been operating for over 50 years and were intended to pass electricity only one way: from the transmission grid to the distribution system. At best, many of these units can allow connection of generation capacity up to the minimum of supplied load thereby not allowing electricity to flow back through the transformer and into the transmission grid. To eliminate this constraint, minimum load on the station transformer can be increased or the station transformer(s) can be replaced with newer, reverse flow capable units. As part of HOL's asset management plan, new or upgraded transformers being installed are standardized to allow for reverse flow in order to help eliminate the constraint through normal business practices.

There are currently six stations within HOL's service area that are either restricted or constrained for the connection of DER:

Slater TS

- HONI owned station
- Restricted due to short circuit handling capability being exceeded
- HOL is currently unaware of any plans to alleviate the restriction

Lisgar TS

- HONI owned station
- JY bus-pair is restricted due to thermal capacity being exhausted
- As a result of the IRPP Lisgar TS was identified for transformer replacement which will include transformers with reverse flow capability.

Hinchey TH

- HONI owned station
- Constrained by the legacy station transformers – no reverse flow capability
- HONI will be completing transformer replacements and station upgrade in 2016

- HONI has assured HOL that the newer transformers will be capable of some reverse flow

Lincoln Heights TD

- HONI owned station
- B bus-pair is constrained due to thermal capacity being exhausted for all but micro-generation projects
- HOL is currently unaware of any plans to alleviate the restriction

Fallowfield DS

- The J bus (half the station) is restricted to any further generation connection due to reverse flow limitations
- Remaining capacity has been reserved for an existing large generation customer that is currently undergoing the connection process
- Continued load growth at Fallowfield DS will increase the capacity available at the station
- Note that only half of the station is constrained as the second transformer was installed in 2013 and therefore has reverse flow capabilities, whereas the other, older unit does not.

Leitrim MS

- HOL owned single transformer station
- The station is thermally and short circuit constrained
- There is a 10 MW solar farm connected to this station
- Starting in 2015 HOL is undertaking station upgrades which will alleviate these constraints with the addition of a second transformer

3.3.4 Constraints for an Embedded Distributor

HOL does not have any embedded distributors within the service territory.

3.4 Capital Expenditure Summary

This section provides the overview of HOL's total capital expenditures for the period from 2011 through 2020, along with discussions on yearly and trend variances.

3.4.1 Capital Spending Overview

Overall capital expenditures are outlined in Table 3.4.1, showing the budget and actuals for the years 2011 through 2020.

HOL plans and budgets work by Capital Program (see section 3.1); therefore, the variances described in the following sections will be explained in terms of these Capital Programs.

The tables outlined in the following sections list the capital expenditures for the period 2011 through 2020. At the time of writing (November 2014) the final numbers for 2014 actuals are not available and have therefore been based on Q2 forecast: 6 months of actual costs and 6 months of forecasted costs. For the 2015 costs, no actual expenditures have been included in this report.

Table 3.4.1 - Capital Expenditure Summary

Category	Historical (Previous Plan & Actual)														
	2011			2012			2013			2014 Q2*			2015		
	Plan	Act.	Var	Plan	Act.	Var	Plan	Act.	Var	Plan	Act.	Var	Plan	Act.	Var
	$M		%	$M		%	$M		%	$M		%	$M		%
System Access	30.2	31.6	5%	34.5	30.9	-2%	36.9	37.7	-11%	40.7	39.0	-8%	35.3	-	-
System Renewal	26.7	27.8	4%	27.4	29.6	10%	23.4	29.5	8%	32.8	37.0	-7%	40.0	-	-
System Service	25.5	26.7	5%	21.5	21.4	20%	25.1	23.9	-1%	23.1	21.8	-10%	20.8	-	-
General Plant	20.6	10.2	-50%	35.9	27.2	-24%	43.6	40.5	-24%	22.8	18.7	-11%	20.9	-	-
Total	**103.1**	**96.3**	**-7%**	**119.3**	**109.0**	**-9%**	**129.0**	**131.6**	**9%**	**119.4**	**116.5**	**-9%**	**117.0**	**-**	**-**
System O & M	N/A	N/A	N/A	N/A	24.9	N/A	N/A	25.2	N/A	N/A	27.1	N/A	29.5	N/A	N/A

*Note that 2014 Actuals are based on Q2 forecast

Table 3.4.2 - Capital Expenditure Forecasted Spend

Category	Forecast (Planned)				
	2016 (test)	2017	2018	2019	2020
	$M	$M	$M	$M	$M
System Access	36.3	35.2	35.1	35.8	36.6
System Renewal	41.0	31.8	36.5	36.0	35.7
System Service	22.2	34.0	29.5	30.5	33.3
General Plant	45.9	48.1	18.3	18.7	14.0
Total	**145.4**	**149.1**	**119.4**	**121.0**	**119.5**
System O & M	30.9	N/A	N/A	N/A	N/A

3.4.2 System Access

System Access investments are "modifications (including asset relocation) to a distributor's distribution system that a distributor is obligated to perform to provide a customer (including a generation customer) or group of customers with access to electricity services via the distribution system" as *per Section 5.1.1 of Chapter 5*.

Spending in the System Access Capital Programs is focused around:

- Relocation of existing plant due to third party agency (the cities of Ottawa and Casselman, Ministry of Transportation of Ontario, National Capital Commission) infrastructure projects;
- Costs associated with the connection of new residential and commercial customers;
- Expansion of HOL's distribution system to meet a specific customer or developer's needs;
- Connection of new generation customers under various provincial programs such as microFIT, FIT and RESOP;
- Connection of one-off residential and small commercial infill connection requests that do not fall under the dedicated Residential and Commercial Capital Programs;
- Replacement of damaged assets caused by a third party; and
- New and replacement meter installations.

Details of these Capital Programs have been outlined in section 3.1.1.

3.4.2.1 Historic Expenditures

The following section outlines HOL's System Access Capital Programs and projects from 2011 through 2020 and discusses the variance in spending over the 10 years. As mentioned in section 3.1.1 System Access.

System Access expenditures are mandated by legislation. While HOL strives to ensure the expenses in this Investment Category are completed as efficiently as possible, HOL does not control the timing of projects. While every attempt is made to predict and budget the expenses, the actual implementation is not within HOL's control. Budgeting is based off of historical spending and known large projects or changes in legislative requirements (e.g. Green Energy Act).

Table 3.4.3 - System Access Expenditure Summary

Investment Category / Capital Program	2011		2012		2013		2014		2015
	Act.	Var.	Act.	Var.	Act.	Var.	Act.*	Var.	Plan
	$'000	%	$'000	%	$'000	%	$'000	%	$'000
System Access	**31,635**	**5%**	**30,868**	**-11%**	**37,675**	**2%**	**39,010**	**-4%**	**35,275**
Plant Relocation	7,743	39%	5,942	-24%	10,005	-13%	9,437	-19%	7,814
Residential	7,247	35%	6,278	34%	6,573	37%	5,985	-1%	6,720
Commercial	9,159	25%	11,892	99%	10,634	47%	9,342	-1%	12,279
System Expansion	3,276	-28%	1,675	-86%	5,710	-30%	10,144	8%	3,727
Stations Embedded Generation	190	204%	1,181	2680%	64	-81%	277	2%	376
Infill & Upgrade	3,081	-1%	2,731	-10%	3,178	-3%	2,857	-2%	3,075
Damage To Plant	826	-5%	798	4%	1,349	64%	840	-2%	1,120
Metering	112	-97%	370	-31%	160	-81%	130	-3%	163

Historical spending in System Access has steadily increased from 2011 through 2014. While some Capital Programs have remained consistent, others have seen considerable growth causing the overall trend to show a steady increase in spending in the category. While attempts are made to budget for both the historical trending and known major projects in System Access, variances from the budget do occur on a regular basis, and are typically offset by the other Capital Programs within this category.

Plant Relocation

HOL has seen a steady increase in the spending for Plant Relocation mainly due to the City of Ottawa's Light Rail Transit project (LRT). This project was budgeted based off of the City of Ottawa's LRT project schedule, which has seen a number of revisions and project changes over the course of HOL's involvement. The changes in project plan have been due to decisions made by the City of Ottawa and not HOL, but these changes have impacted both the timing and scope of work required.

Residential

Historically, residential subdivisions in HOL's territory have followed a 7-10 year rolling trend that has been consistent with the provincial and national averages since amalgamation, with the noted exception of 2011. Ottawa's territory trending has been slightly higher than the provincial and national average. As of 2012, and into 2013, subdivision development is in a flat line state and will likely continue until 2014 when the City of Ottawa finalizes its review of the Official Plan regarding development lands. There has also been a shift in development housing trends over this timeline due to intensification policies: there are more blocks within subdivisions being used for high density housing (Stacked Townhomes) on private streets.

Commercial

New Commercial Development has remained strong in Ottawa in recent years, including 2013 as actual costs are expected to exceed the budget by approximately 5 million dollars due to developer demand. The recent economic downturn in Canada has had little effect on Ottawa as it is largely government and high tech based. 2014 is expected to remain fairly consistent with 2013 results, new commercial development is still increasing as a result of developer demand.

System Expansion

The actual costs for system expansion have varied over the 5 year time frame as requests have been made to HOL. The budgets for system expansion are based on historical trends and expected projects. HOL works with the relevant City of Ottawa departments, as outlined in section 3.1.11.1, to ensure that the forecasts are in line with the City of Ottawa. The timing of these projects, and therefore the actual costs are driven by the third parties and not controlled by HOL. HOL works with the third parties to determine realistic estimates for timing; however, delays do occur due to external reasons and cannot always be controlled by HOL.

Embedded Generation

Costs associated with distributed generation connections have shown a steady increase since 2011 with the exception of 2012. Work associated with OPA's (now IESO) FIT program and the

Green Energy Act had been fairly low at the start of the program but has been steadily increasing with all projects associated with FIT 1.0 to be completed in 2015 which has caused the increase in spend in 2013 and 2014. HOL has not received any projects under the FIT 2.0 release. A large RESOP project for the Green Soldiers 10MW solar farm was located just beyond HOL's service territory and included the construction of a new 27.6kV overhead pole line and communication tower at Leitrim MS station to allow for protection upgrades. In order to serve the customer, a service area amendment was completed with Hydro One. This project represented a cost of $1.2M in 2011 and 2012 which is more than all other distributed generation projects from 2011 to 2015 combined.

Infill & Upgrade

Infill services remain strong due to the City's Official Plan which encourages urban infill developments. HOL anticipated that the demand for these installations would remain strong through 2015. The actual cost for infill services has remained consistent over the 5 year time frame as Ottawa has been isolated from any slowing of the home market. The budgets for infill services are based on historical trends and expected projects. HOL works with the relevant City of Ottawa departments, as outlined in section 3.1.11.1, to ensure that our forecasts are in line with the City of Ottawa. The timing of these projects, and therefore the actual costs are driven by the third parties and are not controlled by HOL. HOL works with the third parties to determine realistic estimates for timing, however delays do occur due to external reasons and cannot always be controlled by HOL.

Damage to Plant

Due to the largely unknown and variable nature of the Damage to Plant Capital Program historical trends are used as the basis for budgeting and forecasting. Since 2007, Damage to Plant expenditures have remained relatively stable year over year. The vast majority of damages consistently occur to overhead and underground transformers, and to wooden poles. The impact of increasing material and labour costs has offset gains made in reducing volumes and/or severity of incidents. As such, 2014 & 2015 volumes and costs are expected to remain consistent with prior years.

Metering

The work consists of recertification of meters to ensure their accuracy and extend either the meter's serviceable life or that of a representative sample of meters through compliance sampling. This work all but disappeared through the smart meter installation years from 2006-2011 and into 2012. Metering has been proactively pre-inspecting compliance sample lots to attest to their quality and in 2014 compliance sample testing will be conducted on those meters installed in 2006 to extend their life beyond the initial seal period of 10 years. HOL does this in advance of the 2016 seal expiry period to flatten out production as one third of the whole system meter population was installed with contractors in the fall of 2006, representing 96,000 meters.

3.4.2.2 Forecast Trend

Table 3.4.4 - System Access Forecasted Spend

Investment Category / Capital Program	Forecast (Planned) $'000				
	2016	2017	2018	2019	2020
System Access	**36,263**	**35,156**	**35,132**	**35,835**	**36,551**
Plant Relocation	7,620	7,773	7,928	8,087	8,248
Residential	6,889	7,027	7,167	7,311	7,457
Commercial	13,423	13,042	12,576	12,827	13,084
System Expansion	3,479	2,366	2,413	2,462	2,511
Stations Embedded Generation	377	384	392	400	408
Infill & Upgrade	3,160	3,223	3,288	3,353	3,420
Damage To Plant	1,148	1,171	1,195	1,219	1,243
Metering	167	170	173	177	180

The forecasted spending in the System Access category is expected to remain at consistent levels through to 2020. HOL expects that the economy in Ottawa will remain steady over the next five years, and work associated with the System Access Category will remain at the levels seen since from 2011 through 2015.

- Plant Relocation costs are expected to remain at the elevated costs seen since 2013 as a result of the LRT project. This project has represented a large increase in the relocation costs for HOL. While the first phase of LRT is expected to be completed in

2018, the City of Ottawa has expressed plans to continue directly into the second phase of the project. This combined with a continued focus on infrastructure investments by the City and other agencies HOL expects the spending to remain at the current levels through to 2020 and beyond.

- With the continued strength of the Ottawa community, HOL is expecting that the customer connection needs in Residential, Commercial and Infill & Upgrade Capital Programs will remain consistent with the levels from 2011 through 2015.
- System Expansion is expected return to historical values seen in 2011 and2012. With the completion of the Phase 1 of the City of Ottawa's LRT project expected in 2018, HOL plans on completing the required work for this project in 2016. Following that, for future phases, there are no details of the requirements for HOL, and as a result no costs have been budgeted past 2016.
- Stations Embedded Generation is expected to remain at the consistent levels experienced in 2014 and 2015. With the transmission constraints removed from the Ottawa area by Hydro One, it is expected that the level of interest for these connections will remain at the current levels.

3.4.3 System Renewal

System Renewal investments "involve replacing and/or refurbishing system assets to extend the original service life of the assets and thereby maintain the ability of the distributor's distribution system to provide customers with electricity services" as per Section *5.1.1* of Chapter 5. Projects outlined in the System Renewal Investment Category have been identified as part of HOL's Asset Management Process.

Spending in the System Renewal Capital Programs is outlined in section 3.1.2 and are focused around:

- Replacement of end of life and obsolete station equipment such as power transformers, switchgear and protection devices;
- Refurbishment of station building structures and facility systems;
- Replacement of end of life distribution assets such as poles, distribution transformers, cables and switches;

- Replacement of in service failed assets through the Plant Failure Capital Program; and
- Upgrades to end of life meters and meter technology.

3.4.3.1 Historic Expenditures

The following section outlines the capital expenditures in the System Renewal category from 2011 through 2020. Projects contained in the in System Renewal and System Service categories are determined through HOL's capital expenditure planning process outlined in section 3.2. variances in this category are tracked and approved though HOL's change order request process. This process documents changes in project plans or costs associated with each individual project. This process allows HOL to track and adjust the progress of the sustainment project to ensure that spending is completed as close as possible to the planned budget. Any large variance in the plan can be identified and allow for adjustment of the plan to keep the asset management plan on track.

Table 3.4.5 - System Renewal Historical Spend

Investment Category / Capital Program	2011		2012		2013		2014		2015
	Act.	Var.	Act.	Var.	Act.	Var.	Act.*	Var.	Plan
	$'000	%	$'000	%	$'000	%	$'000	%	$'000
System Renewal	**27,778**	**4%**	**29,628**	**8%**	**29,540**	**26%**	**36,997**	**13%**	**40,048**
Stations Asset	5,097	-9%	8,475	10%	9,154	48%	14,493	11%	17,200
Stations Enhancement	2,046	-7%	1,067	-66%	906	-38%	825	-16%	679
Distribution Asset	20,512	9%	19,701	22%	18,992	23%	21,263	16%	21,756
Metering	122	37%	385	-6%	488	33%	416	1%	412

Historical spending in the System Renewal has fluctuated over the past five years, but overall has seen an increase in the spending trend, as in the other capital categories. Both of the largest Capital Programs (Station Assets and Distribution Asset) are for the replacement of existing aging infrastructure. The need for these projects has been outlined in section 2.3 Asset Lifecycle Optimization Policies and Practices.

Stations Asset

The investments in Stations Asset have seen a marked increase year over year in the past 5 years. While attempts to maintain overall spending on major station projects (Stations Capacity, Transformer Replacement and Switchgear Replacement) consistent year over year, it is not possible to smooth the spending over all years of the Capital Programs. The individual projects are budgeted in an attempt to maximize the efficiency of the project and can cause the timing of costs required for these multiyear projects to fluctuate.

Stations Enhancement

The investments in Stations Enhancements have seen a reduction from 2011 to 2013 with the completion of the Stations Transformer Cooling Fan and Porcelain Insulator projects. The spending levels in 2014 and 2015 are planned remain consistent trough to 2020.

Distribution Asset

The spending in Distribution Assets has shown a more consistent increase over the 5 years. Spending in the Capital Program has continued to focus on Pole and Cable Replacement Projects along with the Plant Failure projects.

Spending in System Renewal in 2011 was within 4% of the budgeted amount, but some variances did occur in various Capital Programs.

- Stations Asset was 9% below original budget due to contractor and vendor delays causing spending on two Station Switchgear Replacement projects (Richmond North DS and Bridlewood Breaker Refurbishment) to be delayed and pushed these costs forward one year into 2012.
- Distribution Assets was 9% off of budget, however under this Capital Program there were a number of larger variances over and under the planned budget. In the pole replacement program a number of projects were completed under the estimated amount which caused a decrease in the expenditures compared to the budget. The Pole Replacement, Elbow and Insert Replacement and Distribution Transformer replacement

programs were faced with contractor and labour restrictions that caused some of the work to be pushed into 2012.

- Offsetting these decreases in spend in System Renewal in 2011 was the spending in Plant Failure which saw a year end cost 141% above the original budget. Spending on Plant Failure is due to assets that are not replaced proactively before they reach their functional end of life and fail while in service. As outlined in section 2 Asset Management Process, many of the HOL's assets are reaching end of life. Even though HOL is increasing spend on proactive asset replacement to offset the anticipated equipment reaching end of life and levelize replacement spend, HOL continues to experience failure of in service equipment. The spending of $5.1M has been seen in 2011 through 2014; however, HOL has continued to budget at a lower amount. HOL focuses on replacing assets in a proactive manner through planned projects as outlined in our Asset Management Process in Section 2.1. This focus on proactive replacement is expected to reduce the required spend on plant failure. The lower budget also allows planning for an adequate amount of sustainment work for our crews to meet available labour hours, allowing for readjustment if there is an increase in the Plant Failure work that cannot be handled within the capital budget or labour and contractor availability. The level of plant failure spend is continuously monitored throughout the year and the capital budgeted projects are adjusted accordingly.

Spending in 2012 was 8% over budget for the System Renewal category.

- Stations Assets spending was 10% above budget mainly due to increased spending in stations transformers. Scope Increases associated with the transformer replacement at Clyde UC and Barrhaven DS were the main reasons for the Capital Program tracking over the original budget. Increased civil construction costs at Clyde US were caused by unforeseen removal of legacy underground structures and increased safety requirements. It was determined that the Barrhaven DS project could be done more efficiently if the timing of the project was condensed, which pulled costs into 2012 that were originally planned for 2013.
- Costs associated to the Stations Refurbishment Capital Program for protection and equipment upgrades associated to the Green Energy Act (GEA) were originally

budgeted to the System Renewal Investment Category. The budgeting was done early on in the GEA implementation when the true requirements of the program were not yet known. It was later determined that the upgrades required at the stations were already part of HOL's Stations Asset Capital Program and the costs therefore would not be required.

- Distribution Asset spending was over the original budget by 22% and again was mainly due to spending in the Plant Failure Capital Program, for similar reasons as those discussed for 2011.

System Renewal spending in 2013 was 26% above the original budget; this was offset by under spending in both General Plant and System Service. Sustainment (System Renewal and System Service) as defined by HOL was 11% over the original budget as a whole.

- Stations Assets was over spent by 48% in 2013 mostly due to increased spending in the Stations Transformer Replacement Budget Program. Carry over associated with the Clyde UC transformer replacement project was the main contributing factor. This was a direct result of the increased scope that was highlighted in the 2012 spending. For the Beechwood UB transformer project, the feeder reconfiguration project that was identified for future years was added to the station project scope. This combined with higher contractor costs than anticipated also contributed to the increased spending in the Stations Replacement Budget Program.
- Distribution Asset spending was over the original budget by 23% and similarly to 2011 and 2012, was mainly due to spending in the Distribution Plant Failure Budget Program. The reasons for this are the same that were discussed for 2011. Spending was in line with the values that have been experienced from 2011 through 2014.

2014 spending in the System Renewal Investment Category is expected to be 13% over the original budget. This is based off of the 6 months of actuals and 6 months of forecasted expenditures. Sustainment (System Renewal and System Service) as defined by HOL was only 5% over the original budget as a whole.

- The majority of the forecasted spending variance is due to spending in Station Plant Failure in the Stations Asset Capital Program which is expected to be 11% over the original budget. The one station transformer at Leitrim MS was required to be replaced due to failure, as identified through dissolved gas analysis. This replacement is expected to continue into 2015.
- Distribution Asset spending was over the original budget by 16% and similarly to 2011 through 2013, was primarily due to spending in the Plant Failure Budget Program. The reasons for this are the same as those discussed for 2011. Spending was in line with the values that have been experienced for the past three years.

3.4.3.2 Forecast Trend

Table 3.4.6 - System Renewal Forecasted Spend

Investment Category / Capital Program	Forecast (Planned) $'000				
	2016	2017	2018	2019	2020
System Renewal	**41,033**	**31,823**	**36,491**	**35,980**	**35,718**
Stations Asset	16,338	11,815	14,048	15,203	14,186
Stations Enhancement	597	634	731	662	691
Distribution Asset	23,683	17,828	20,128	18,492	19,179
Metering	415	1,547	1,584	1,623	1,662

Overall, when combined, spending in System Renewal and System Service is expected to increase at 3% annually from 2016 through 2020. The main driving factor for fluctuations in the category spend over the 5 years is due to timing of the major station projects. The decrease in spend in 2017 is due to the increased spending in the Stations New Capacity Budget Program in order to maintain overall sustainment spending consistent year over year. A continued focus will be seen through to 2020 and beyond on replacements of the critical assets as outlined in section 2.2.3 Asset Demographics and Condition. HOL will continue to replace major station and distribution assets on a focused basis as has previously been the case.

- Station transformers and switchgear will remain consistent with the spending levels seen since 2011;

- Distribution asset including poles, cable and switches will also remain consistent. A large civil infrastructure project along Carling Avenue is planned for 2016 which will see a one year increase in HOL's Civil Rehabilitation Budget Program.
- An increased focus on spending for the Remote Disconnect Smart Meter Budget Program is planned for 2017 and will continue through to 2020.

3.4.4 System Service

System Service investments are "modifications to a distributor's distribution system to ensure the distribution system continues to meet distributor operational objectives while addressing anticipated future electricity service requirements" as per Section *5.1.1* of Chapter 5.

Spending in the System Service Investment Category is focused around:

- Stations Capacity Upgrades covers the building of new or rebuilding of stations for the addition of transformation capacity or supply;
- Distribution Enhancements includes a range of system betterment projects. Included in this Capital Program are Line Extensions and System Voltage Conversions projects; and
- HOL's Automation Capital Program which include upgrades to the SCADA systems and installation of automated switches in the distribution and devices in stations.

3.4.4.1 Historic Expenditures

The following section outlines the capital spending in the System Service category from 2011 through 2020. Projects contained in the in System Renewal and System Service categories are determined through HOL's capital expenditure planning process outlined in section 3.2. Variances in this category are tracked and approved though HOL's change order request process. This process documents changes in project plans or costs associated with each individual project. This process allows HOL to track and adjust the progress of the sustainment project to ensure that spending is completed as close as possible to the planned budget. Any large variance in the plan can be identified and allow for adjustment of the plan to keep the asset management plan on track.

Table 3.4.7 - System Service Historical Spend

Investment Category / Capital Program	2011		2012		2013		2014		2015
	Act.	Var.	Act.	Var.	Act.	Var.	Act.*	Var.	Plan
	$'000	%	$'000	%	$'000	%	$'000	%	$'000
System Service	**26,716**	**5%**	**21,362**	**-1%**	**23,917**	**-5%**	**21,753**	**-6%**	**20,806**
Stations Capacity	19,170	16%	11,838	-2%	13,198	-13%	6,223	30%	2,187
Distribution Enhancements	6,226	-12%	8,375	23%	10,319	13%	14,961	-16%	15,176
Automation	1,320	-33%	1,150	-58%	400	-52%	569	3%	3,444

Historical spending in the System Service category has fluctuated within each Capital Program over the past five years, but overall has shown a steady trend. The largest contributor to the costs in System Service category can be attributed to Stations Capacity and Distribution Enhancements Capital Programs. These programs are designed to build out the distribution system to efficiently serve the customer at the best possible value. The need for these projects has been outlined in 3.1.3 System Service.

Stations Capacity

The investments in Stations Capacity has decreased over the past five years which is due to the completion of three major station builds at Ellwood MTS, Beacon Hill DS and Terry Fox MTS. These projects are in addition to the expansion of a number of other stations through the installation of additional transformers. While attempts to maintain overall spending on major station projects (Stations Capacity, Transformer Replacement and Switchgear Replacement) consistent year over year, it is not possible to smooth the spending over all years of the Budget Programs. The individual projects are budgeted in an attempt to maximize the efficiency of the project and can cause the timing of costs required for these multiyear projects to fluctuate.

Distribution Enhancements

The spending in Distribution Enhancements has increased gradually since 2011. The largest increase has been seen because of increased spending in the Voltage Conversion Budget Program which has been focused in the Woodroffe TS, Kilborn DS and South Nepean areas. Line Extensions have fluctuated over the 5 years since 2011, but the majority of these projects are tied to the timing of the completion of Station New Capacity projects. Details on these projects can be found in section 3.5 Justifying Capital Expenditures.

Automation

The Automation Capital Program have decreased in 2013 and 2014 as automation switch installations have become part of our normal course of business. 2015 is the first year of HOL Telecom Plan implementation. The details of this project are outlined in Attachment B-1(A). This project will continue to 2024.

Spending in System Service in 2011 was 6% below the budgeted amount, but some larger variances did occur in various Capital Programs.

- Distribution Enhancements was 12% under the budgeted amount for 2011, with the majority of the variances being in the Line Extensions Budget Program. The variance in this Budget Program was due to both efficiencies in construction and a portion of the work being pushed into 2012.
- The Automation Capital Program spending was below budget due to the cancelation of one project in the SCADA Upgrade Budget Program. The MyOASIS project was canceled after a detailed review revealed that it was not going to deliver the desired outcomes.

2012 System Service spending was very close to budget at 1% below the budgeted amount of $21M.

- Distribution Enhancements was 23% over the original budget in 2012 due to carry over of projects from 2011 in the Line Extension Budget Program and an increase in the scope for the voltage conversion project at Upland DS.
- The Automation Capital Program spending was below budget due to delays on the SCADA Upgrade Budget Program and delays of control boxes for automated distribution switches.

2013 System Service spending was again close to budget at 5% below the original amount.

- Progress payments for the new Switchgear at Limebank MTS and contractor delays for the construction of the expanded Casselman DS led to the spending in Station Capacity to be 13% below the original budgeted amount of $15M.
- The reasoning for the increase in the spending for Distribution Enhancements was due to an increase in the scope for the Woodroffe Voltage Conversion project. Some of this increase was offset by the delays in three line extension projects. Delays in the City of Ottawa's Strandherd Bridge project delayed the installation of new feeder ties across the Rideau River and Work along the Alta Vista Transit Corridor was delayed to 2014 due to HOL budget and resource constraints.

The forecasted spending for 2014 is expected to be in line with the budget with a 6% variance from the budget.

- Stations Capacity spending is forecasted to be over budget. The majority of these costs are due to the carryover of in spending from Hinchey TH from 2013. An increased scope in the Casselman DS project to upgrade the second bank has also led to a large increase in the Stations Capacity Capital Program.
- A number of Line Extension projects have been delayed due to coordination with the City of Ottawa's LRT project. The planned work for the LRT has caused a delay to the completion of a number of projects to ensure HOL work coincides with the City's plans.

3.4.4.2 Forecast Trend

Table 3.4.8 - System Service Forecasted Spend

Investment Category / Capital Program	Forecast (Planned) $'000				
	2016	2017	2018	2019	2020
System Service	**22,235**	**33,957**	**29,518**	**30,473**	**33,314**
Stations Capacity	5,676	15,272	10,464	14,441	15,626
Distribution Enhancements	11,290	12,282	14,175	12,829	13,394
Automation	5,269	6,403	4,880	3,202	4,295

Overall, when combined, spending in System Renewal and System Service is expected to increase at 3% annually from 2016 through 2020. The main driving factor for fluctuations in the category spend over the 5 years is due to timing of the major station projects. Spending in the System Service category is expected to increase in 2017 and continue at the elevated levels through 2020. The requirement for the Stations Capacity and Distribution Enhancement Capital Programs has been outlined in section 3.1.3

HOL will continue to build and enhance our stations while developing distribution feeders and ties as we have been since before 2011 including:

- Station capacity upgrades including the rebuild of Richmond South DS, building of a new transmission station in the south region to supply the growing City along with additional transmission upgrades to improve reliability;
- Build new and extend feeders to connect the new capacity with the customers and load, while focusing on removing stations and their associated distribution assets through targeted voltage conversions;
- Continuation of the Telecom Plan project started in 2015 through 2020 with completion in 2024. The details of this project are outlined in Attachment B-1(A).

3.4.5 General Plant

General Plant investments are "modifications, replacements or additions to a distributor's assets that are not part of its distribution system; including land and buildings; tools and equipment; rolling stock and electronic devices and software used to support day to day business and operations activities" as *per Section 5.1.1* of Chapter 5.

In General Plant, there are two major funding requirements:

1) Life cycle funding requirements for fleet replacement, facilities, tools, and information technology asset replacement have also been forecast to 2020. The investments are essential to meet the operational needs.
2) New technology initiatives have been identified in the 2015 to 2020 planning horizon. The business case for each initiative have been reviewed and approved by the Executive Management Team. Examples include mobile workforce management software, asset planning software, JD Edwards system upgrades, and automated power outage system upgrades. Each of these initiatives is required to maintain the integrity of

our data, to facilitate productivity improvements through automation, and/or to position HOL for the next phase of smart grid transformation in the planning horizon.

The following section outlines the capital spends in the General Plant from 2011 through 2020.

3.4.5.1 Historic Expenditures

The following section outlines HOL's System General programs from 2011 through 2020 and discusses the variance in spending over the 10 years. Expenditures and variances are tracked regularly by HOL's management team and are adjusted to align with any changes in the Corporate Strategic Objectives.

Table 3.4.9 - General Plant Expenditure Summary

Investment Category / Capital Program	2011		2012		2013		2014 Q2*		2015
	Act.	Var.	Act.	Var.	Act.	Var.	Act.		Plan
	$'000	%	$'000	%	$'000	%	$'000		$'000
General Plant	**10,215**	**-50%**	**27,190**	**-24%**	**40,484**	**-7%**	**18,742**		**20,850**
Buildings - Facilities	767	-51%	380	-60%	380	-52%	426		688
Customer Service	3,818	-65%	10,365	0%	13,389	2%	5,839		2,450
ERP System	950	-29%	933	-28%	478	-24%	329		1,547
Fleet Replacement	2,024	-15%	2,542	-5%	3,056	-26%	1,441		1,537
IT New Initiatives	296	-55%	578	-19%	57	-95%	1,584		2,111
IT Life Cycle & Ongoing Enhancement	1,122	-43%	2,440	19%	3,076	33%	2,821		1,970
Operations Initiatives	356	-44%	683	54%	242	-67%	3,011		2,756
Tools Replacement	580	-17%	568	-18%	539	-19%	386		512
Hydro One Payments	-	-	1,116	N/A	6,358	11%	2,453		2,347
Facilities Implementation Plan	302	-20%	7,586	-54%	12,909	-10%	453	-91%	4,933

*Note that 2014 Actuals are based on Q2 forecast

Historical spending in the General Plant investments has seen a marked increase from 2011 through 2015 from the implementation of HOL's Facilities Implementation Plan which is outlined below. Outside of this program the spending has remained consistent over the past 5 years with the exception of 2011 and 2013. Spending in 2011 was significantly below budget due to timing of cost of service application and the pending rate approval. All General Plant capital spending was cut to a bare bone. 2013 saw an increase in spending in the Customer Service Capital Program which is outlined below. Overall the General Plant Investment Category has had little variance to budget with the exception of the Facilities Implementation Plan which has been under budget for the past years. The details of these variances are outlined below.

Buildings – Facilities

Spending in the Building – Facilities Capital Program have been pared back due to the implementation of the Facilities Implementation Plan.

Customer Service

The largest contributor to the costs in General Plant was attributed to the Customer Care and Billing System (CC&B) Upgrade started in late 2010, went live in 2014. The Customer Information System was going to reach end of life in 2013 and no longer supported by its vendor. Therefore the company invested on the upgrade of the new system to ensure billing is properly supported. Spending variance from budget was due to timing of project milestones and delivery.

ERP System

Spending in the ERP System Capital Program remained relatively consistent over the past 5 years. There is an increase in spending in the ERP Capital Program in 2015. The Enterprise Architecture Program is a multi-year project to connect all the individual software applications and improve operational effectiveness and the JDE Application Upgrade will begin (details can be found in Attachment B-1(A)). In the past three years, the spending for ERP System was below budget due to internal resource issue. Several key enhancements are reprioritized for the upcoming ERP Upgrade.

Fleet Replacement

Life cycle replacements were steady with a slight increase in 2013. The spending in 2014 and 2015 reduced due to the vehicle end of life schedule caught up with the increase in 2013. Some vans and trucks ordered in 2013 were delivered in 2014, therefore 2013 spending was below budget.

IT New Initiatives

This program focuses on initiatives to optimize business operations including Document Management System, Enterprise Architecture Program, and Data Management System. The introduction of Document Management System to ensure documents for legal, business, health, safety, environmental are managed in accordance with legislative compliance and ISO requirement. The Asset Planning software is to improve capital planning process and ensure the most optimized capital investment decisions are made for the company and the customers. The project is expected to be complete in 2015. Historical spending was below budget due to internal resources redeployed for other IT Life Cycle & Ongoing Enhancement projects.

IT Life Cycle & Ongoing Enhancements

The IT Life Cycle & Ongoing Enhancements Capital Program has a slight increase over the past 5 years. 2012 and 2013 spending exceeded budget due timing of spending i.e. 2011 projects implemented in 2012. Also some of the new initiative components were embedded into the ongoing enhancements. Combined the two programs, the spending was in line with budget projection.

Operations Initiatives

Operations Initiatives have remained constant from 2011 through to 2013. The spending is planned to increase in 2014 and 2015 with the focus on the next productivity initiative –Mobile Workforce Management software (project details can be found in Attachment B-1(A)). 2011 spending was low due to the Radio System Replacement project budgeted in 2011, but completed in 2012. 2013 variance is mainly explained by a planned GIS (OMS-AMI Meter Ping) project cancellation due to some technical issues with AMI communication infrastructure.

Tools Replacement

The Tools Replacement Capital Program has remained relatively unchanged over the past 5 years with spending being at a consistent level under the budget.

Hydro One Payments

Starting in 2012, capital contributions to intangible assets purchased from Hydro One in conjunction with HOL's major station projects accounted for under the General Plant account. Prior to 2012, costs associated with these investments were tracked under the separate System Renewal or System Service budgets. These budget amounts and timelines for these projects are based off of the original signed contracts between Hydro One and HOL, but timing can move these payments out of the budgeted year. The only payment in 2012 was for HOL's Hinchey TH project which was originally budgeted under Stations Capacity in the System Service category.

2014 spending was well under the budget. This was due to the delay of two projects. The Lisgar TL upgrade payment was delayed into 2015, only the study agreement payment was completed in 2014. The original schedule from Hydro One was to complete Orleans TS in 2014 and this has now been updated to spring 2015, which has delayed the final milestone payment until that time.

Facilities Implementation Plan

The expenditures related to the purchase of two parcels of land upon which HOL will construct its new Eastern Operations & Campus and its Southern Operations centre and warehouse facilities. An amount for the purchase of land for the construction of new facilities was included in HOL's 2012 rate base used to calculate distribution rates resulting from its last cost of service rate case (EB-2011-0054). Details of the spending are outlined in Table 3.4.10.

Table 3.4.10 - Facilities Implementation Plan Historic Spend

Facility		$'000				
		2011 Act.	2012 Act.	2013 Act.	2014 Q2* Act.	2015 Plan
East Ops & Campus	Land	-	250	10,002	21	-
	Building	234	492	287	432	3,835
South Ops	Land	-	6,704	2,537	-	-
	Building	68	140	83	-	1,098
Total		302	7,586	12,909	453	4,933

The 2011-2014 budget to actual variances are the result of delays in the schedule for the purchase of land and construction of Hydro Ottawa's new facilities. More specifically, the 2011 variance is the result of underspending on the services provided by Hydro Ottawa's real estate advisors. Spending in 2012 and 2013 was significantly lower than forecasted due to delays in the project. Actual spend reflects the purchase of the two land parcels whereas the budget had also set aside monies for the construction of the facilities.

3.4.5.2 Forecast Trend

Table 3.4.11 - General Plant Forecasted Spend

Investment Category / Capital Program	Forecast (Planned) $'000				
	2016	2017	2018	2019	2020
General Plant	**45,899**	**48,138**	**18,276**	**18,695**	**13,954**
Buildings - Facilities	688	509	408	323	243
Customer Service	3,740	2,361	1,148	6,658	1,139
ERP System	5,043	354	350	354	1,061
Fleet Replacement	1,455	1,209	1,452	1,480	1,876
IT New Initiatives	2,127	1,166	1,006	1,218	1,203
IT Life Cycle & Ongoing Enhancement	1,424	1,737	1,905	2,232	1,816
Operations Initiatives	1,074	452	405	892	1,069
Tools Replacement	512	521	530	539	548
Hydro One Payments	4,575	5,000	5,000	5,000	5,000
Facilities Implementation Plan	25,262	34,829	6,073	-	-

Over the period 2016-2020 Hydro Ottawa General Plant investments will be addressing Operational Effectiveness and Customer Value. Life cycle investments remain flat while there are increases in spending in the Customer Service Capital Program in 2019, details of this change is outlined in the Materials Investments section 3.6.

The forecasted trend for Hydro One Payments is expected to remain consistent over the next 5 years. This will represent an increase from the $3M average from 2012 through 2015 due to the increased amount of work associated and existing agreements. The actual expenditures forecasted are expected to change as agreements with HONI are finalized, and therefore it remains difficult to determine the expected costs for new projects or true-up payments.

New agreements are expected to be signed for a number of transmission connected stations and jointly owned HOL/Hydro One stations through 2020. Below is a list of projects that have been identified to start by the end of 2016 that will have new agreements with Hydro One issued. These projects may or may not require a capital contribution by HOL, and this will only be known once Hydro One completes the evaluation of the projects and a contract is signed, timelines of which have not yet been determined.

- Merivale DS Rebuild;
- Woodroffe TW 13kV Switchgear Replacement ;
- Overbrook TO Switchgear Replacement;
- New South 28kV Substation;
- Lisgar TL transformer Upgrade;
- Richmond South DS Rebuild; and
- 2nd 230kV Supply to Terry fox MTS

There has been an increase in the number of agreements signed with Hydro One over the last five years and as a result HOL has obligations under these agreements to complete true-up reviews on five year increments. These reviews may require that payments be made for any short fall of revenue generated by Hydro One as a result of the forecasted load from HOL not materializing. While HOL does attempt to maintain the loading committed to in the CCRA agreements, shortfalls do occur. Table 3.1.11 outlines the existing CCRA contracts that have true-up reviews over the 2016-2020 timeframe.

Table 3.4.12 - Hydro One CCRA True-up Dates

Station	2016	2017	2018	2019	2020
Hawthorne 115kV Lines Upgrade					X
Cyrville MTS				X	
Ellwood MTS					X
Terry Fox MTS			X		
Orleans TS					X
Hawthorne TS					X
Overbrooke TS	X				
Limebank MS					X

Spending in the Facilities Implementation Plan is set to be completed by 2018. Table 3.4.13 below sets out HOL's forecasted expenditure for its new Eastern Operations & Campus and its Southern operation/warehouse centre facilities. The capital expenditure for the construction of the new facilities is a once in a generation investment. This investment was identified almost fifteen years ago at amalgamation as necessary to consolidate administrative functions; to better locate the operation centres; to modernize the work environment and to provide for future growth. HOL's existing facilities are between 45 and 60 years old and were designed and built in an era and are now beyond their end of life. These costs can be broken down by the two proposed projects.

Table 3.4.13 - Facilities Implementation Plan Forecasted Spend

Facility		Forecast (Planned) $'000				
		2016	2017	2018	2019	2020
East Ops & Campus	Land	-	-	-	-	-
	Building	19,642	25,818	6,073	-	-
South Ops	Land	-	-	-	-	-
	Building	5,620	9,011	-	-	-
Total		25,262	34,829	6,073	-	-

3.4.5.3 Y Factor Treatment

HOL proposes to recover the costs associated with the construction of new head office and operations buildings via a Y factor. Y factors are mechanisms available under incentive regulation to accommodate revenue requirement pass throughs. HOL proposes to use a Y factor to pass along the costs associated with the construction of the administrative and operational buildings to ratepayers in the years that said costs are incurred. HOL proposes to use the Y factor rather than embed the full costs into revenue requirement because HOL does not know at this point in time a) the precise amount of costs that is to be recovered; b) when (ie. the year) said costs will be incurred and hence recoverable. HOL proposes to record the expenses incurred with the construction of its new facilities in a Y Factor Account.

3.4.5.4 Proceeds of Sale of Existing Facilities

Following the move to its new facilities, HOL's existing Albion Street, Merivale Road and Bank Street facilities will be marketed for sale. At this time, HOL does not know the final sale price for the land and buildings at each location nor the year in which the sale will occur.

HOL proposes to credit ratepayers with the entire value of the after tax proceeds of sale for the buildings and for 50% of the after tax proceeds for the sale of the lands. The 50% share of the after tax proceeds for the sale of the lands recognizes that land is an undepreciated asset. HOL is proposing to establish a deferral account to record the after tax proceeds from the sale of the buildings and lands and will bring forward the deferral account for clearance in a future proceeding once the buildings and lands have been sold.

3.5 Justifying Capital Expenditures

The following section provides the data, information and analysis to support the forecasted capital expenditures as proposed by HOL.

3.5.1 Overall Plan

The Overall Plan section provides comparative data from the historic period of 2011-2015 and the forecast period of 2016-2020 by Investment Category and by primary driver.

3.5.1.1 Historic Expenditures by Category

Table 3.5.1 and Figure 3.5.1 depict the expenditures by investment category over the historic period of 2011-2015 and the projected expenditures for the forecast period of 2016-2020.

Table 3.5.1 - Expenditures by Investment Category in $'000

Investment Category	$'000											
	Historical						Forecast					
	2011	2012	2013	*2014	**2015	Avg.	2016	2017	2018	2019	2020	Avg.
System Access	31,635	30,868	37,675	39,010	35,275	34,892	36,263	35,156	35,132	35,835	36,551	35,787
System Renewal	27,778	29,628	29,540	36,997	40,048	32,798	41,033	31,823	36,491	35,980	35,718	36,209
System Service	26,716	21,362	23,937	21,753	20,806	22,915	22,235	33,957	29,518	30,473	33,314	29,899
General Plant	10,215	27,191	40,484	18,743	20,850	23,497	45,899	48,138	18,276	18,695	13,954	28,992
Grand Total	96,343	109,049	131,635	116,503	116,979	114,102	145,430	149,073	119,418	120,982	119,538	130,888

Note: *2014 actuals are based on the Q2 forecast **2015 based on budget

Figure 3.5.1 - Expenditures by Investment Category

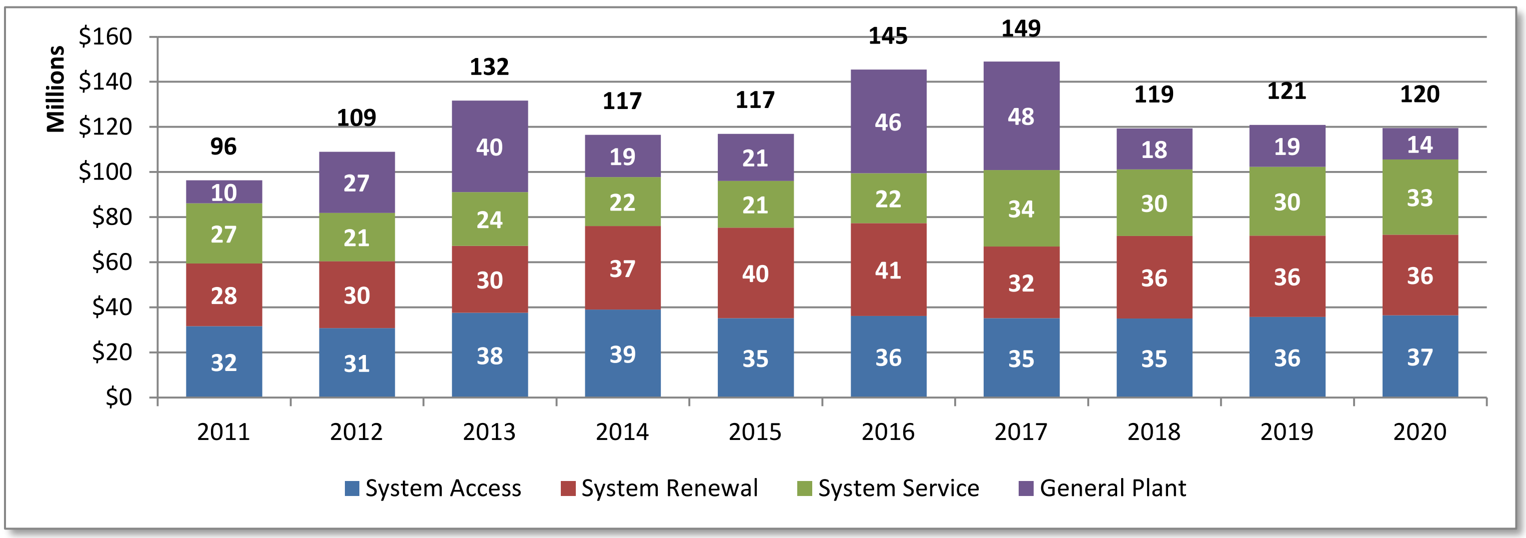
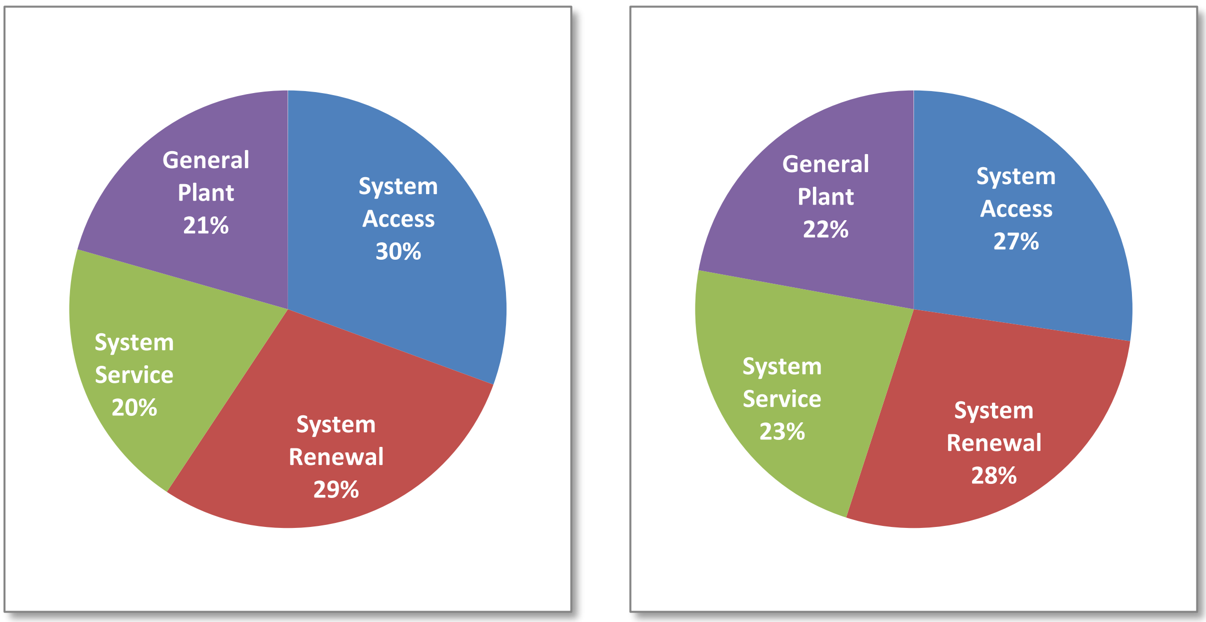


Figure 3.5.2 shows the average percent contribution of annual expenditure to each of the Investment Categories over the historic period of 2011-2015 compared to the forecast period of 2016-2020.

Figure 3.5.2 - Average Expenditure Distribution by Investment Category

Historic Years: 2011-2015 **Forecast Years: 2016-2020**



3.5.1.2 Impact on O&M Costs

Impacts to operation and maintenance costs vary by Investment Category, as described below.

System Access

System Access projects can introduce new assets to the system resulting in an increase of equipment requiring maintenance, and additional potential failure points within the grid. These projects can also involve expanding the communication infrastructure, and as a result could incur ongoing licencing fees.

System Service

System Service investments represent the costs associated with growing the distribution system, thereby increasing the number of assets to maintain and introducing additional potential failure points within the system. These projects can also involve expanding the communication infrastructure, and as a result could incur ongoing licencing fees.

System Renewal

System Renewal Investments target the replacement of ageing infrastructure. As an asset ages, the costs associated with maintenance increases as the activities become more onerous. When an asset is replaced, maintenance is still required, but typically involves less time and resources, resulting in lower O&M expenses in comparison. As well, as an asset ages and its condition deteriorates to the point of failure, there are resulting O&M costs associated with the emergency work required to respond and restore power. Through pro-active replacement, these additional costs can be avoided.

As HOL replaces assets, new technologies are introduced. There are benefits to such improvements, such as reduced crew travel time, but other costs such as communication licencing, software licencing, increased communication infrastructure and a need for device specific training can increase O&M costs.

3.5.1.3 Drivers by Investment Categories

The drivers by investment category are expected to remain constant from the historic period moving through the forecast period and have been summarized in Table 3.5.2. For the definitions of the drivers refer to Section 2.1.1 Asset Management Objectives.

Table 3.5.2 - Drivers by Investment Category

Investment Category	Driver(s)
System Access	• 3rd Party Requirements • Customer Service Request • Mandated Service Obligation
System Renewal	• Assets at end of Service Life o Failure Risk o Failure o High Performance Risk o Substandard Performance
System Service	• Capacity Constraint • Reliability

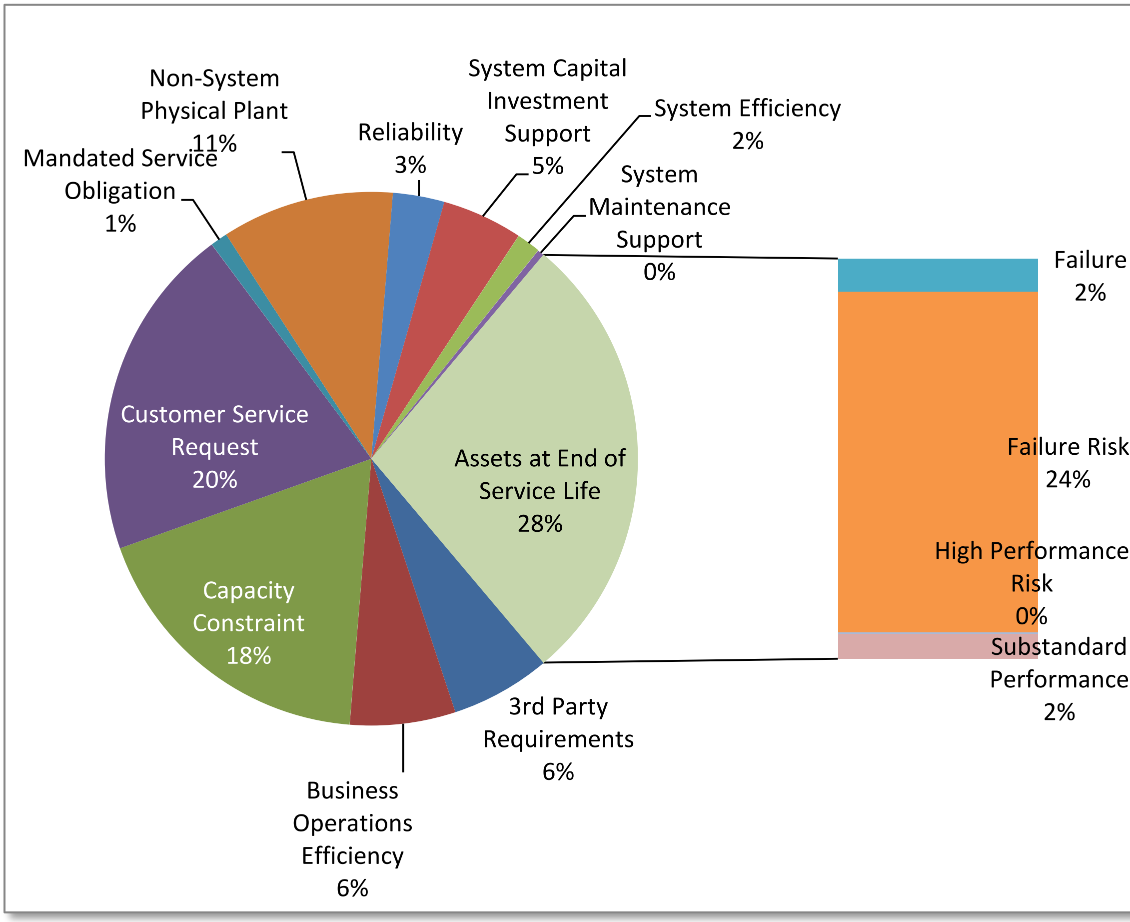
	• System Efficiency
General Plant	• System Capital Investment Support • System Maintenance Support • Business Operations Efficiency • Non-System Physical Plant

Table 3.5.3 shows the forecasted expenditures by driver and Figure 3.5.3 shows the distribution by driver of the total expenditures over the forecast period.

1 **Table 3.5.3 - Forecasted Expenditures by Driver**

Investment Category	Driver	$'000									
		2011A	2012A	2013A	2104A	2015	2016	2017	2018	2019	2020
System Access	3rd Party Requirements	6,542	14,998	17,242	13,583	10,833	7,620	7,773	7,928	8,087	8,248
	Customer Service Request	767	380	380	426	688	27,328	26,042	25,836	26,352	26,880
	Mandated Service Obligation	2,024	3,658	9,414	3,894	3,885	1,315	1,341	1,368	1,395	1,423
System Renewal	Failure	580	568	539	386	512	3,000	3,000	3,000	3,000	3,000
	Failure Risk	302	7,586	12,909	453	4,933	36,732	26,284	30,763	30,321	29,975
	High Performance Risk	7,743	5,942	10,005	9,437	7,814	-	168	194	176	183
	Substandard Performance	22,207	23,031	25,661	28,410	26,178	1,301	2,370	2,534	2,483	2,560
System Service	Capacity Constraint	1,684	1,895	2,008	1,163	1,283	15,955	26,416	23,325	26,082	27,778
	Reliability	6,146	5,186	5,322	6,493	2,991	4,282	5,164	4,061	2,913	3,995
	System Efficiency	16,648	22,078	22,494	28,889	35,219	1,998	2,377	2,133	1,478	1,541
General Plant	Business Operations Efficiency	403	150	303	326	319	13,407	6,070	4,814	11,352	6,288
	Non-System Physical Plant	3,066	2,214	1,421	1,514	1,519	688	509	408	323	243
	System Capital Investment Support	24,496	19,081	22,436	20,018	16,004	6,030	6,209	6,452	6,480	6,876
	System Maintenance Support	856	1,010	394	921	3,305	512	521	530	539	548
	Non-System Physical Plant	1,363	1,272	1,107	814	1,498	25,262	34,829	6,073	-	-
Total		94,829	109,050	131,635	116,727	116,979	145,430	149,073	119,418	120,982	119,538

Figure 3.5.3 - Contribution to Total Forecasted (2016-2020) Expenditures by Driver



3.5.1.4 System Capability Assessment

Over the period 2016-2020 HOL will be addressing three stations that currently have restrictions for the connection of REG within the capital expenditures: Lisgar TL by contributing to the transformer upgrade being completed by HONI, Hinchey TH by contributing to the transformer upgrade being completed by HONI, and Leitrim MS by adding a second transformer at the station. Further details of the system capability assessment for REG connections can be found in section 3.3. As well, whenever station transformers are identified for replacement through the Asset Management Process (2 Asset Management Process) due to either reaching their end of life or capacity constraints, the new units will have reverse flow capabilities specified to eliminate the potential restriction to the connection of REG.

3.5.2 Material Investments

This section describes HOL's Budget Programs and projects specifically those that meet the materiality threshold of $750k in each of the four investment categories (System Access, System Renewal, System Service, and General Plant) for the forecast years of 2016 through 2020.

3.5.2.1 System Access

System Access investments are "modifications (including asset relocation) to a distributor's distribution system a distributor is obligated to perform to provide a customer (including a generation customer) or group of customers with access to electricity services via the distribution system" as *per Section 5.1.1* of Chapter 5.Table 3.5.4 details HOL's full expenditures by Capital Program within System Access from 2016 through 2020.

Table 3.5.4 - System Access Forecast Expenditure by Capital Program

Capital Program	Budget Program	$'000				
		2016	2017	2018	2019	2020
Plant Relocation	Plant Relocation & Upgrade	7,620	7,773	7,928	8,087	8,248
Residential	Residential Subdivision	6,889	7,027	7,167	7,311	7,457
Commercial	New Commercial Development	13,423	13,042	12,576	12,827	13,084
System Expansion	System Expansion Demand	3,479	2,366	2,413	2,462	2,511
Stations Embedded Generation	Embedded Generation	377	384	392	400	408
Infill & Upgrade	Infill Service (Res & Small Com)	3,160	3,223	3,288	3,353	3,420
Damage To Plant	Damage to Plant	1,148	1,171	1,195	1,219	1,243
Metering	Suite Metering	167	170	173	177	180
Total		36,263	35,156	35,132	35,835	36,551

3.5.2.1.1 Plant Relocation

The HOL Plant Relocation Capital program is in response to the Ontario Energy Board's *Distribution System Code (August 21, 2014)* (DSC), *section 3.4 – Relocation of Plant*, *3.4.1*, which states that "When requested to relocate distribution plant, a distributor shall exercise its rights and discharge its obligations in accordance with existing legislation such as the *Public Service Works on Highways Act*, regulations, formal agreements, easements and common law. In the absence of existing arrangements, a distributor is not obligated to relocate the plant. However, the distributor shall resolve the issue in a fair and reasonable manner. Resolution in a fair and reasonable manner shall include a response to the requesting party that explains the feasibility or infeasibility of the relocation and a fair and reasonable charge for relocation based on cost recovery principles."

3.5.2.1.2 Residential, Commercial, System Expansion and Infill & Upgrade

HOL's Residential, Commercial, System Expansion, and Infill & Upgrade Capital Programs are driven by the requirements as set out in the DSC, s*ection 6 – Distributors' Responsibilities, 6.1 – Responsibilities to Load Customers, 6.1.1,* which states that "A distributor shall make every reasonable effort to respond promptly to a customer's request for connection. In any event a distributor shall respond to a customer's written request for a customer connection within 15 calendar days. A distributor shall make an offer to connect within 60 calendar days of receipt of the written request, unless other necessary information is required from the load customer before the offer can be made".

3.5.2.1.3 Stations Embedded Generation

The HOL Stations Embedded Generation Capital Program is driven by the DSC requirement from s*ection 6.2 – Responsibilities to Generators, 6.2.4* that states "Subject to all applicable laws, a distributor shall make all reasonable efforts in accordance with the provisions of section 6.2 to promptly connect to its distribution system a generation facility which is subject of an application for connection".

3.5.2.1.4 Damage to Plant

HOL's Damage to Plant Capital Program covers costs associated with damage to HOL owned plant which is caused by a third party. HOL targets 100% recovery of the costs from the third party; however, where tracking information is not available, HOL absorbs the cost or may attempt at recovery from the insurer.

3.5.2.1.5 Metering

The HOL Metering Capital Program is driven by the DSC requirement from *section 5.1 – Provision of Meters and Metering Services, 5.1.1* that states "A distributor shall provide, install and maintain a meter installation for retail settlement and billing purposes for each customer connected to the distributor's distribution system…".

HOL forecasts expenditures within System Access using a number of factors:

- Analysis of historic trends;
- Forecasted economic and population statistics;
- Known developments; and
- City of Ottawa plans;

Details from City of Ottawa plans used in the forecasting of expenditures are explained below.

City of Ottawa Official Plan

All information within this section has been obtained from the City of Ottawa Official Plan, Section2 – Strategic Directions, Figure 2.2.

Table 3.5.5 - Project Growth in Population, Households & Employment, City of Ottawa, 2006 to 2031

Population				
Area	**2006**	**2011**	**2021**	**2031**
Inside the Greenbelt	533,000	540,000	562,000	591,000
Outside Greenbelt, Urban	252,000	291,000	367,000	432,000
Rural	86,000	91,000	102,000	113,000
Total	**871,000**	**923,000**	**1,031,000**	**1,136,000**

Households				
Area	**2006**	**2011**	**2021**	**2031**
Inside the Greenbelt	228,000	237,000	258,000	278,000
Outside Greenbelt,	88,000	106,000	140,000	168,000

Urban				
Rural	30,000	32,000	38,000	43,000
Total	**346,000**	**376,000**	**436,000**	**489,000**

Employment				
Area	**2006**	**2011**	**2021**	**2031**
Inside the Greenbelt	432,000	457,000	482,000	506,000
Outside Greenbelt, Urban	72,000	95,000	128,000	162,000
Rural	25,000	26,000	30,000	35,000
Total	**530,000**	**578,000**	**640,000**	**703,000**

Table 3.5.5 shows that growth within the City of Ottawa is expected to continue into the future and that the total average annual growth rates from 2011 to 2021 are:

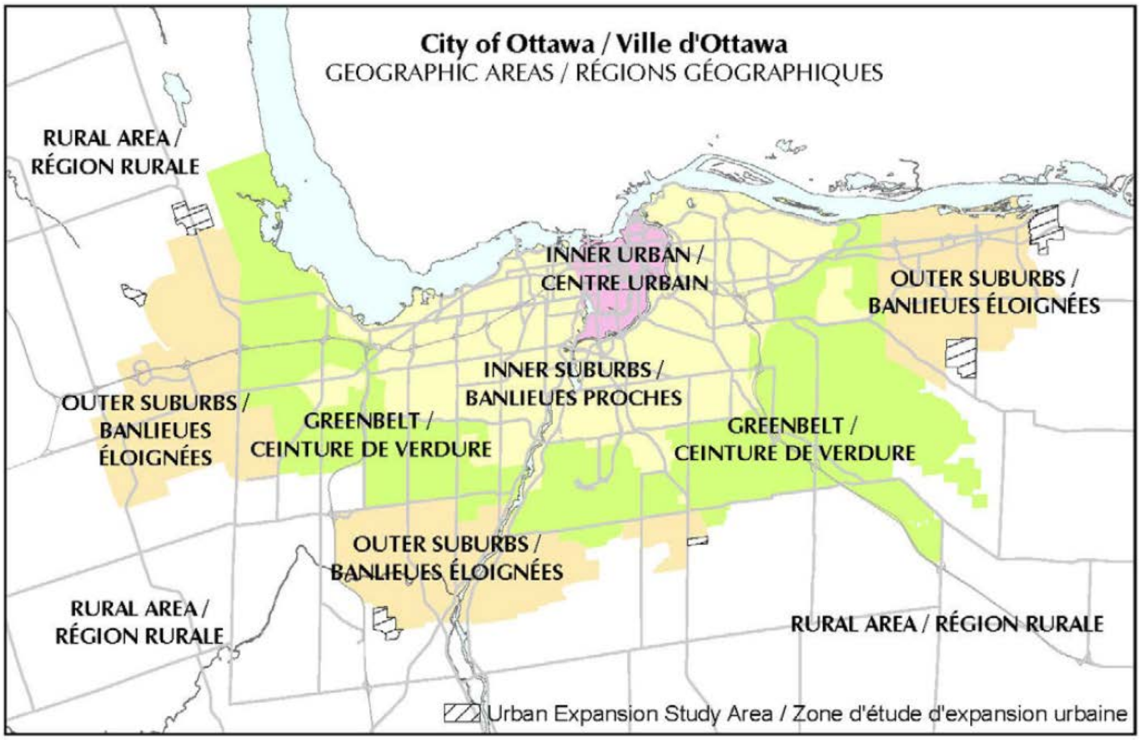
- Population – 1.11%
- Households – 1.49%
- Employment – 1.02%

Therefore, HOL expects the continuing trend of requests for connection of residential subdivisions and the associated mixed-use centres, along with employment centres.

City of Ottawa Transportation Master Plan

The City of Ottawa's Transportation Master Plan identifies the transportation facilities and services that are required to meet the needs of the growing City. HOL utilizes this information to help forecast customer connection requests and to plan the sustainment of the distribution system. The following figure and table depict the increasing requirements by region, within the City of Ottawa out to 2031.

Figure 3.5.4 - Location of Inner Area, Inner Suburbs & Outer Suburbs - City of Ottawa



**Source: City of Ottawa Transportation Master Plan, 2013 – Exhibit 2.1*

Table 3.5.6 - Population & Employment: 2011 Actual & 2031 Projections

Area	Population			Employment		
	2011	2031	Growth and distribution	2011	2031	Growth & distribution
Inner Area	97,200	116,400	19,200 (9%)	170,600	201,800	31,200 (23%)
Inner Suburbs	432,500	459,300	26,800 (13%)	287,400	355,300	67,900 (49%)
Kanata/ Stittsville	105,200	162,000	56,800 (27%)	51,300	62,500	11,200 (8%)
Barrhaven	71,200	107,400	36,200 (17%)	11,100	21,800	10,700 (8%)
Riverside South/Leitrim	15,900	35,800	19,900 (9%)	4,000	7,800	3,800 (3%)
Orléans	108,200	143,400	35,200 (16%)	20,600	33,000	12,400 (9%)
Rural Ottawa	91,400	111,700	20,300 (9%)	20,000	20,900	900 (1%)
Total	***922,000***	***1,135,900***	***213,900 (100%)***	***564,900***	***703,200***	***138,100 (100%)***

**Source: City of Ottawa Transportation Master Plan, 2013 – Exhibit 2.10*

Within the Transportation Master Plan, the City of Ottawa has developed an "Affordable Road Network" planned out to 2031. This "Affordable Road Network" is the prioritized City projects based on the expected funding levels, and as such, is the most reasonable list of projects to base future road work projections which is used to forecast Plant Relocation spending levels.

The "Affordable Road Network" projects have been broken out by phases, and are listed in Table 3.5.7, showing only those projects planned until 2025, and graphically in Figure 3.5.5.

1 **Table 3.5.7 - City of Ottawa Affordable Road Network - Projects by Phase**

Currently Under Construction		
Sector	**Project**	**Description**
Southeast	Alta Vista Transportation Corridor	New two-lane road between Riverside Drive and the Ottawa Hospital
Southwest	Greenbank Road	Widening from two to four lanes between Malvern Drive and Strandherd Drive
Southeast	Hunt Club Road Extension	Eastward extension of Hunt Club road to Highway 417
East	St. Joseph Boulevard	Widening from two to four lanes between Old Tenth Line Road and Trim Road
Southwest	Strandherd-Earl Armstrong Bridge	New bridge crossing between Strandherd Drive and Earl Armstrong Road
East	Trim Road	Widening from two to four lanes between North Service Road and Innes Road

2

Phase 1: 2014-2019		
Sector	**Project**	**Description**
Southeast	Airport Parkway (1)	Widen from two to four lanes between Brookfield Road and Hunt Club Road
East	Blackburn Hamlet Bypass Extension (1)	New four-lane road between Orléans Boulevard and Navan Road
East	Brian Coburn Boulevard Extension	New two-lane road (ultimately four-lane) between Navan Road and Mer Bleue Road
West	Campeau Drive	New four-lane road between Didsbury Road and Huntmar Drive
Rural	Country Club Road	New two-lane road between eastern terminus of Golf Club Way and Jenkinson Road
West	Earl Grey Drive Underpass	New underpass of Terry Fox Drive
Southwest	Greenbank Road Extension	New four-lane road between Cambrian Road and Jockvale Road
West	Old Richmond/West Hunt Club	Widen Old Richmond Road/ West Hunt Club Road from two to four lanes between Hope Side and Highway 416
West	Stittsville North-South Arterial (1)	New two-lane road between Fernbank Road and Abbott Street
West	Klondike Road	Urbanize existing two-lane rural cross section between March Road and Sandhill Road
East	Mer Bleue Road	Widen from two to four lanes between Brian Coburn Boulevard and Renaud Road
West	Palladium Drive Realignment	Realign in vicinity of Huntmar Road to new north-south arterial
Southwest	Strandherd Drive (1)	Widen from two to four lanes between Fallowfield Road and Maravista Drive

3

Phase 2: 2020-2025		
Sector	**Project**	**Description**
Southeast	Bank Street	Widen from two to four lanes between Earl Armstrong Road extension and south of Leitrim
East	Blackburn Hamlet Bypass Extension (2)	New four-lane road between Innes Road and Orléans Boulevard
West	Carp Road	Widen from two to four lanes between Highway 417 and Hazeldean Road
Southwest	Chapman Mills Drive	New four-lane road between Strandherd Drive and Longfields Drive
West	Eagleson Road	Widen from two to four lanes between Cadence Gate and Hope Side Road
Southwest	Jockvale Road	Widen from two to four lanes between Cambrian Road and Prince of Wales Drive
West	Kanata Avenue	Widen from two to four lanes between Highway 417 and Campeau Drive
West	Stittsville North-South Arterial (2)	New four-lane road between Palladium Drive (at Huntmar) and Abbott Street
Southeast	Lester Road	Widen from two to four lanes between Airport Parkway and Bank Street
Southwest	Strandherd Drive (2)	Widen from two to four lanes between Maravista Drive and Jockvale Road
East	Tenth Line Road	Widen from two to four lanes between Harvest Valley Road and Wall Road

**Source City of Ottawa Transportation Master Plan, 2013 – Exhibit 7.2*

City of Ottawa Community Design Plans

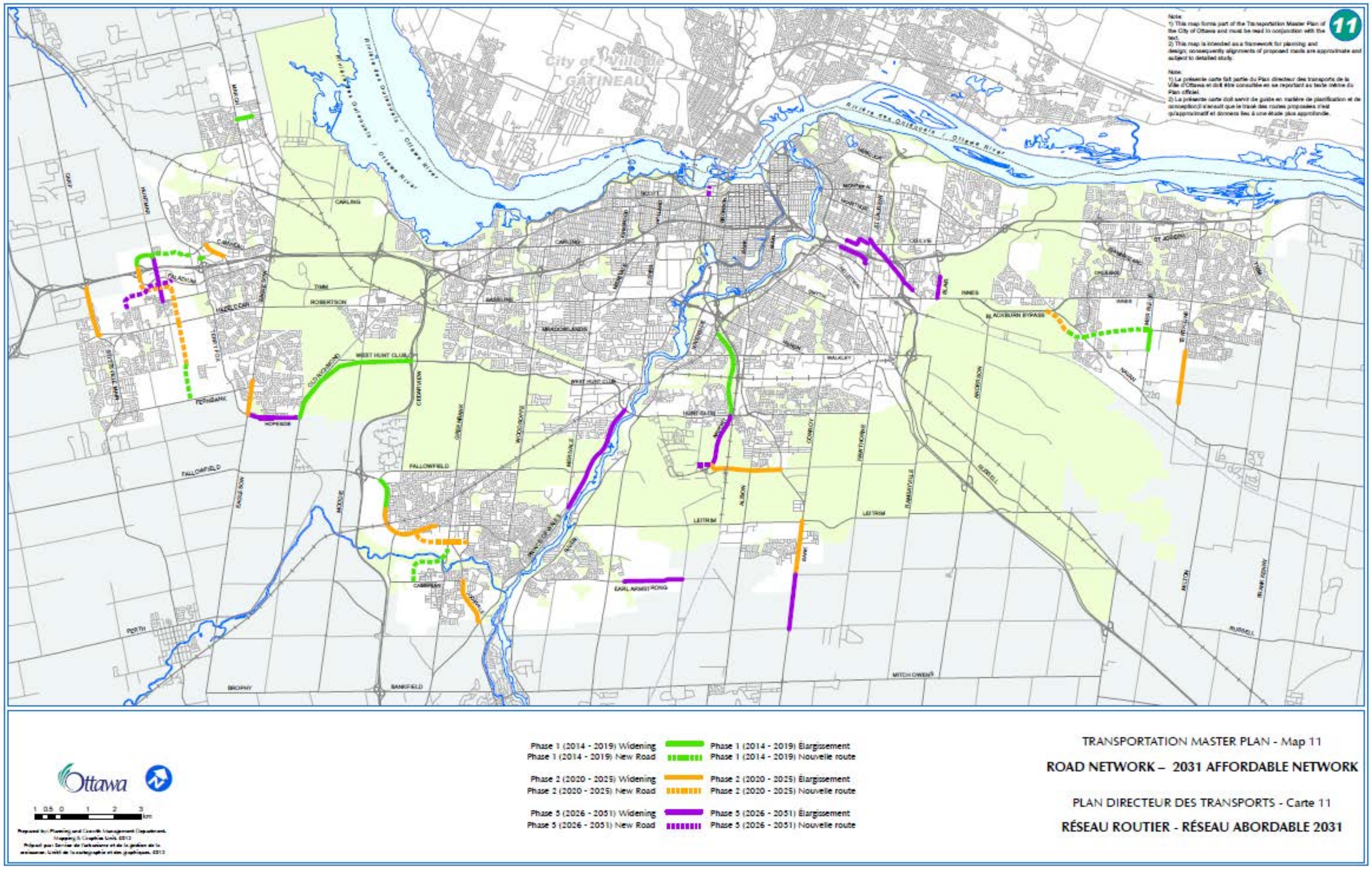
HOL also references published Community Design Plans from the City of Ottawa to forecast future residential and mixed-use centres.

Currently, there are 32 Community Design Plans published on the City of Ottawa's website which describe a mix of development types. A summary of the CDPs can be found in Table 3.5.8 and is based upon information provided within each study. Further details from the City of Ottawa CDPs have been captured in Appendix E.

1 Table 3.5.8 - City of Ottawa Community Design Plans Summary

Study	Study Area (ha)	GFA (ha)	No. Res. Units	Land Use Type
Barrhaven South CDP	500	188.9	6,862	Mixed-Use
Bank Street CDP	101			Mixed-Use
Bayview Station District CDP	29.5	55		Mixed-Use
Bayview/Somerset Area Secondary Study	89.7		1,590	Mixed-Use
Beechwood CDP	22		819	Mixed-Use
Cardinal Creek Village Concept Plan	208	95	3,500	Mixed-Use
Carp Road Corridor CDP	2475		0	Commercial
Village of Carp CDP	49.5		543	Mixed-Use
Village of Constance Bay Community Plan	114		204	Mixed-Use
Downtown Ottawa Urban Design Strategy				
East Urban Community (Phase 1 Area) CDP	570		3,498	Mixed-Use
East Urban Community (Phase 2 Area) CDP	240		1,726	Mixed-Use
Escarpment Area District Plan				Mixed-Use
Fernbank CDP	674	310	11,000	Mixed-Use
Greely CDP	1276		729	Mixed-Use
Leitrim CDP	500	362.3	5,300	Mixed-Use
Mer Bleue CDP	160	113.7	3,000	Mixed-Use
Kanata West Concept Plan	887		5,000	Mixed-Use
North Gower CDP	278	208	520	Mixed-Use
Old Ottawa East CDP	158		2,250	Mixed-Use
Orleans Industrial Park Study	316	18.7	0	Commercial
Queensway Terrace North	140			
Richmond Road/Westboro CDP	270		3,970	Mixed-Use
Richmond Road/Westboro Transpo Plan				
Riverside South CDP	1800	1450	18,300	Mixed-Use
Scott Street CDP	57.7		1,500	Mixed-Use
South Nepean Town Centre CDP	165	35	11,000	Mixed-Use
St. Joseph Boulevard Corridor Study	67.3			Mixed-Use
Uptown Rideau CDP	21			Mixed-Use
Transit-Oriented Development (TOD) Plans				
Village of Richmond CDP	879			Residential
Wellington Street West CDP	232		950	Mixed-Use

Figure 3.5.5 - City of Ottawa Transportation Master Plan, 2013-2031 Affordable Network



**Source: City of Ottawa Transportation Master Plan – Map 11*

3.5.2.2 System Renewal

System Renewal investments "involve replacing and/or refurbishing system assets to extend the original service life of the assets and thereby maintain the ability of the distributor's distribution system to provide customers with electricity services" as per Section *5.1.1* of Chapter 5.

The following section details HOL's System Renewal Budget Programs and projects from 2016 through 2020 that meet the materiality threshold of $750k. Table 3.5.9 shows the full Budget Program expenditures over the forecast period.

Table 3.5.9 - System Renewal Forecast Expenditure by Program

Capital Program	Budget Program	$'000				
		2016	2017	2018	2019	2020
Stations Asset	Stations Transformer Replacement	10,729	4,620	6,533	8,225	7,965
	Stations Switchgear Replacement	5,424	7,088	7,408	6,871	6,114
	Stations Plant Failure	185	107	107	107	107
Stations Refurbishment	Stations Enhancements	597	634	731	662	691
Distribution Asset	Pole Replacement	8,641	6,592	7,608	6,886	7,189
	Insulator Replacement	-	168	194	176	183
	Elbow & Insert Replacement	289	190	219	198	207
	Dist. Transformer Replacement	804	808	933	844	881
	Civil Rehabilitation	3,153	636	734	664	694
	Cable Replacement	5,974	5,262	6,073	5,496	5,738
	Switchgear New & Rehab	1,222	376	434	393	410
	O/H Equipment New & Rehab	785	902	1,041	942	983
	Plant Failure Capital	2,815	2,893	2,893	2,893	2,893
Metering	Remote Disconnected Smart Meter	415	1,547	1,584	1,623	1,662
Total		**41,033**	**31,823**	**36,491**	**35,980**	**35,718**

3.5.2.2.1 Stations Transformer Replacement

Details on the Stations Transformer Replacement Budget Program can be found in Attachment B-1(A).

3.5.2.2.2 Stations Switchgear Replacement

Details on the Stations Switchgear Replacement Budget Program can be found in Attachment B-1(A).

3.5.2.2.3 Stations Plant Failure

The Station Plant Failure Budget Program is set up to capture costs associated with station assets that have failed or that have substandard performance and are no longer meeting the requirements and require immediate refurbishment to extend the service life or replacement.

3.5.2.2.4 Stations Enhancements

Costs associated with the Stations Enhancement Budget Program cover the replacement of non-distribution equipment such as, building assets, station batteries, and cable racking when they have reached end of functional life. For building assets the costs are associated with sustaining civil, electrical, mechanical, structural and security/life safety assets, such as, work on roof, windows, doors, fencing and security equipment.

3.5.2.2.5 Pole Replacement

Details on the Pole Replacement Budget Program can be found in Attachment B-1(A).

3.5.2.2.6 Insulator Replacement

The Insulator Replacement Budget Program is designed for the replacement of overhead insulators typically when they have been deemed to have a high performance risk, or categorized as having a high probability of failure. Currently, there are four types of insulators that have been identified for proactive replacement:

- “WART” type porcelain post insulators;
- Canadian Porcelain pin type 28/46kV insulators;
- Horizontally installed porcelain pin type insulators; and
- Ohio Brass porcelain insulators on standoff brackets.

3.5.2.2.7 Elbow & Insert Replacement

The Elbow & Insert Replacement Budget Program was initiated for the replacement of 28kV non-vented elbows and inserts on distribution transformers to eliminate the safety hazard associated with switching below 0^{o}C. Annually, a specific neighbourhood, or region, is identified to undergo full replacements, creating great efficiencies for labour utilization and future system operability.

3.5.2.2.8 Distribution Transformer Replacement

Details on the Distribution Transformer Replacement Budget Program can be found in Attachment B-1(A).

3.5.2.2.9 Civil Rehabilitation

Details on the Civil Rehabilitation Budget Program can be found in Attachment B-1(A).

3.5.2.2.10 Cable Replacement

Details on the Cable Replacement Budget Program can be found in Attachment B-1(A).

3.5.2.2.11 Switchgear New & Rehabilitation

Details on the Switchgear New & Rehabilitation Budget Program can be found in Attachment B-1(A).

3.5.2.2.12 Overhead Equipment New & Rehabilitation

Details on the Overhead Equipment New & Rehabilitation Budget Program can be found in Attachment B-1(A).

3.5.2.2.13 Distribution Plant Failure

The Distribution Plant Failure Budget Program is set up to capture costs associated with distribution assets that have failed or that have substandard performance and are no longer meeting the requirements and require immediate refurbishment to extend the service life or replacement.

3.5.2.2.14 Remote Disconnected Smart Meter

Details on the Remote Disconnected Smart Meter Budget Program can be found in Attachment B-1(A).

3.5.2.3 System Service

System Renewal investments are "modifications to a distributor's distribution system to ensure the distribution system continues to meet distributor operational objectives while addressing anticipated future electricity service requirements" as per Section *5.1.1 Investment Categories* of the *OEB Filing Requirements for Electricity Distribution Rate Applications*, published July 17th, 2013.

The following section details HOL's System Service Budget Programs and projects from 2016 through 2020 that meet the materiality threshold of $750k.Table 3.5.10 shows the full Budget Program expenditures over the forecast period.

Table 3.5.10 - System Service Forecast Expenditure by Budget Program

Capital Program	Budget Program	$'000				
		2016	2017	2018	2019	2020
Stations Capacity	Stations New Capacity	5,676	15,272	10,464	14,441	15,626
Distribution Enhancements	Line Extensions	7,522	6,180	7,132	6,455	6,739
	System Voltage Conversion	2,758	4,964	5,729	5,185	5,413
	System Reliability	329	445	513	464	485
	Dist. Enhancements	682	694	801	725	757
Automation	SCADA Upgrades	1,011	1,011	556	51	51
	SCADA - RTU Additions	169	76	87	79	82
	Distribution Automation	3,953	4,719	3,548	2,449	3,510
	Stations Automation	136	597	689	624	651
Total		**22,235**	**33,957**	**29,518**	**30,473**	**33,314**

3.5.2.3.1 Stations New Capacity

The expenditures under the Stations New Capacity Budget Program are identified and prioritized through the Asset Management Process (Section 2.1, and more specifically through the Capacity Planning process). The 20-year outlook for capacity requirements are detailed in 3.1.5.1 Ability to Connect New Load.

3.5.2.3.2 Line Extensions

The expenditures under the Line Extensions Budget Program are identified and prioritized through the Asset Management Process (Section 2.1, and more specifically through the Capacity Planning process). The 20-year outlook for capacity requirements are detailed in 3.1.4.1 Ability to Connect New Load.

3.5.2.3.3 System Voltage Conversion

The expenditures under the System Voltage Conversion Budget Program are identified and prioritized through the Asset Management Process (Section 2.1, and more specifically through the Capacity Planning process). The 20-year outlook for capacity requirements are detailed in 3.1.4.1 Ability to Connect New Load.

3.5.2.3.4 System Reliability

The expenditures under the System Reliability Budget Program are identified and prioritized through the Asset Management Process (Section 2.1, and more specifically through the Reliability Planning process) and include projects identified through evaluation of the Worst Feeders (section 1.3.1.1.3).

3.5.2.3.5 Distribution Enhancements

Distribution Enhancement projects are targeted at making improvements to the existing distribution system in terms of reliability and/or operability and are typically targeted towards areas or equipment that are deemed problematic.

3.5.2.3.6 SCADA Upgrades

The SCADA Upgrades Budget Program covers expenditures related to upgrading and/or renewing SCADA equipment that has reached end of life or has become obsolescent.

3.5.2.3.7 SCADA RTU Additions

The SCADA RTU Budget Program covers expenditures related to upgrading and/or renewing SCADA remote terminal units that have reached end of life or has become obsolescent.

3.5.2.3.8 Distribution Automation

The expenditures under Distribution Automation are aimed at making the distribution system "smarter" and improving reliability and operability through the installation of remotely operable devices and sensors.

3.5.2.3.9 Substation Automation

The expenditures under Substation Automation are aimed at increasing visibility into the distribution system and improving reliability and operability through increasing remote operability and reporting/alarms.

3.5.2.4 General Plant

General Plant investments are "modifications, replacements or additions to a distributor's assets that are not part of its distribution system; including land and buildings; tools and equipment; rolling stock and electronic devices and software used to support day to day business and operations activities" as per Section *5.1.1* of Chapter 5.

Over the period 2016-2020 HOL's General Plant investments will be addressing Operational effectiveness and Customer value. Life cycle investments remain flat. The major initiatives include:

- Facilities Implementation Plan;
- CC&B Enhancements;
- Outage Communication System;
- JDE Application Upgrade;
- Fleet Replacement;
- Enterprise Architecture Program; and
- Mobile Workforce Management.

Further details of these initiatives can be found in Attachment B-1(A).

1 **Table 3.5.11 - General Plant Expenditures by Capital Program**

Capital Program	$'000				
	2016	2017	2018	2019	2020
Hydro One Payments	4,575	5,000	5,000	5,000	5,000
Buildings – Facilities	688	509	408	323	243
Customer Service	3,740	2,361	1,148	6,658	1,139
ERP System	5,043	354	350	354	1,061
Fleet Replacement	1,455	1,209	1,452	1,480	1,876
IT New Initiatives	2,127	1,166	1,006	1,218	1,203
IT Life Cycle & Ongoing Enhancement	1,424	1,737	1,905	2,232	1,816
Operation Initiatives	1,074	452	405	892	1,069
Tools Replacement	512	521	530	539	548
Total	**20,637**	**13,309**	**12,203**	**18,695**	**13,954**

2

3.6 Material Investments

The details on the Budget Programs and projects that meet the materiality threshold of $750k have been included in a separate document which can be found in Attachment B-1(A).

Appendix A

Integrated Regional Resource Planning – Load Forecast

Medium Planning Forecast

Updated July 31, 2014

Weather Correction Values			2010	2011	2012	2013
Source: Hydro One		Norm	0.944	0.91	0.942	0.930
		Extrem	1.001	0.970	0.999	0.987

Latest Forecast

Group	Reference	Historical (Actuals) 2006	2007	2008	2009	2010	2011	2012	Weather Corrected 2012	Preliminary 2013	Source	10-Day LTRs? (MVA)	10-Day LTRs (MW)	Forecast 2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Downtown A	CARLING	84	80	78	80	86	79	80	76	80	H1	103	93	80	81	82	83	84	85	86	86	87	88	93	94	95	96	96	97	98	99	99	100
	LINCOLNHTS	45	45	41	42	48	46	45	43	39	H1	79	71	45	45	45	45	45	45	44	44	44	44	49	49	49	49	49	48	48	48	48	48
	WOODROFFE	37	33	32	32	34	36	34	32	32	H1	102	92	33	39	39	40	41	42	42	43	43	44	53	53	54	54	55	55	56	56	56	57
Downtown - A Total		167	159	150	153	168	161	159	150	151			256	159	165	166	168	170	172	173	173	175	176	196	196	198	199	200	200	202	203	203	204
Downtown B	HINCHEY	42	46	43	44	48	46	44	42	47	H1	86	77	44	44	47	50	52	56	58	60	62	64	67	69	71	73	75	77	79	81	83	85
	SLATER	113	110	116	121	113	108	99	93	112	H1	131	118	100	101	102	103	104	105	104	103	103	103	103	102	102	102	101	101	101	101	100	100
	LISGAR	59	64	56	59	66	61	61	58	62	H1	82	74	61	61	74	78	81	85	85	85	86	86	87	87	88	89	90	90	90	90	90	89
	KINGEDWARD	76	79	71	71	85	84	78	74	76	H1	79	71	77	76	77	79	81	83	83	84	84	85	86	86	87	87	86	86	86	85	86	86
Downtown - B Total		290	299	286	294	312	300	283	266	297			340	282	283	301	309	318	329	330	331	336	339	343	344	348	350	352	353	356	357	359	360
Downtown C	RUSSELL TS	61	60	58	73	79	82	61	58	68	H1	77	69	61	61	61	63	65	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
	OVERBROOK	77	74	74	76	80	75	78	74	77	H1	144	130	80	81	85	87	89	95	97	98	103	104	105	105	106	107	107	108	109	109	110	110
	ALBION	108	100	95	100	109	104	99	93	67	H1	98	88	71	71	72	72	73	73	73	73	74	74	74	74	75	75	75	76	76	76	77	77
	ELLWOOD	0	0	0	0	0	0	0	0	32	H.O.	65	59	27	27	27	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
	RIVERDALE	84	83	77	68	73	70	92	87	84	H1	117	105	94	97	99	102	105	117	118	119	121	122	124	124	125	126	126	127	128	128	129	129
Downtown - C Total		331	317	304	317	342	331	330	311	328			451	334	337	344	352	361	387	388	389	397	401	404	404	407	409	410	411	414	416	417	418
Downtown TOTAL		788	775	741	764	822	792	772	727	777				774	785	811	829	849	888	891	894	907	916	942	945	953	958	963	965	971	976	980	982

Latest Forecast with consideration of HOL's transfer capability

Group	Reference	Historical (Actuals) 2006	2007	2008	2009	2010	2011	2012	Weather Corrected 2012	Preliminary 2013	Source	10-Day LTRs? (MVA)	10-Day LTRs (MW)	Forecast 2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Downtown A	CARLING	84	80	78	80	86	79	80	76	80	H1	103	93	80	81	82	83	84	85	86	86	87	88	93	94	95	96	96	97	98	99	99	100
	LINCOLNHTS	45	45	41	42	48	46	45	43	39	H1	79	71	45	45	45	45	45	45	44	44	44	44	49	49	49	49	49	48	48	48	48	48
	WOODROFFE	37	33	32	32	34	36	34	32	32	H1	102	92	33	39	39	40	41	42	42	43	43	44	53	53	54	54	55	55	56	56	56	57
Downtown - A Total		167	159	150	153	168	161	159	150	151			256	159	165	166	168	170	172	173	173	175	176	196	196	198	199	200	200	202	203	203	204
Downtown B	*HINCHEY*	42	46	43	44	48	46	44	42	47	H1	86	77	*44*	*44*	*58*	*60*	*62*	*66*	*68*	*70*	*72*	*75*	*67*	*69*	*71*	*73*	*75*	*77*	*79*	*81*	*83*	*85*
	SLATER	113	110	116	121	113	108	99	93	112	H1	131	118	*100*	*105*	*106*	*113*	*114*	*116*	*115*	*114*	*114*	*113*	*113*	*112*	*112*	*112*	*112*	*111*	*111*	*111*	*110*	*110*
	LISGAR	59	64	56	59	66	61	61	58	62	H1	120	108	*61*	*61*	*64*	*67*	*71*	*74*	*74*	*75*	*75*	*76*	*87*	*87*	*88*	*89*	*90*	*90*	*90*	*90*	*90*	*89*
	KINGEDWARD	76	79	71	71	85	84	78	74	76	H1	79	71	*77*	*69*	*70*	*67*	*69*	*75*	*75*	*75*	*76*	*76*	*77*	*77*	*78*	*78*	*77*	*77*	*77*	*77*	*78*	*77*
Downtown - B Total		290	299	286	294	312	300	283	266	297			374	282	280	298	307	316	330	332	333	337	340	344	346	350	352	354	355	357	359	361	361
Downtown C	RUSSELL TS	61	60	58	73	79	82	61	58	68	H1	77	69	61	61	61	63	65	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
	OVERBROOK	77	74	74	76	80	75	78	74	77	H1	144	130	*80*	*81*	*85*	*91*	*94*	*100*	*101*	*102*	*108*	*109*	*110*	*110*	*111*	*111*	*112*	*113*	*113*	*114*	*114*	*115*
	ALBION	108	100	95	100	109	104	99	93	67	H1	98	88	71	71	72	72	73	73	73	73	74	74	74	74	75	75	75	76	76	76	77	77
	ELLWOOD	0	0	0	0	0	0	0	0	32	H.O.	65	59	27	27	27	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
	RIVERDALE	84	83	77	68	73	70	92	87	84	H1	117	105	*94*	*100*	*102*	*99*	*102*	*111*	*112*	*112*	*114*	*116*	*118*	*118*	*119*	*120*	*120*	*120*	*121*	*122*	*123*	*123*
Downtown - C Total		331	317	304	317	342	331	330	311	328			451	334	340	347	353	362	385	387	388	396	400	403	403	406	408	409	410	412	414	416	417
Downtown TOTAL		788	775	741	764	822	792	772	727	777				774	785	811	829	849	888	891	894	907	916	942	945	953	958	963	965	971	976	980	982

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Group	Reference	Historical (Actuals)							Weather Corrected	Prelimin	Source	10-Day LTRs?	10-Day LTRs	Forecast																			
		2006	2007	2008	2009	2010	2011	2012	2012	2013		(MVA)	(MW?)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Ottawa - East	MOULTON	42	40	39	39	36	34	31	29	23	H.O.	33+33	34	31	31	31	32	32	32	32	32	32	32	33	33	33	33	33	33	33	33	34	34
	CYRVILLE	0	0	0	0	6	17	21	19	19	H.O.	65	59	27	24	24	30	35	35	37	38	40	41	42	42	44	44	44	44	44	44	44	44
	BILBERYCREEK - H.O.	63	61	56	56	64	54	53	50	55	H1	94	85	53	53	53	54	54	54	54	54	54	54	54	54	55	55	55	55	55	55	55	55
	BILBERYCREEK - H1	34	35	22	24	39	26	26	25	28	H1	94	85	30	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ORLEANS	0	0	0	0	0	0	0	0	0	H1	113	102	0	5	86	90	92	92	94	96	96	98	99	100	100	102	103	105	105	107	107	109
Ottawa - East Total		140	135	117	119	145	132	131	124	124			279	141	144	195	205	212	214	217	219	222	225	228	229	232	233	234	236	237	240	240	242

Group	Reference	Historical (Actuals)							Weather Corrected	Prelimin	Source	10-Day LTRs?	10-Day LTRs	Forecast																			
		2006	2007	2008	2009	2010	2011	2012	2012	2013		(MVA)	(MW?)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Kanata	MARCHWOOD	34	36	21	36	27	46	42	40	40	H.O.	33+33	34	34	33	34	34	34	35	34	34	34	34	35	35	34	35	35	34	35	35	35	35
	KANATA	58	54	62	54	73	49	50	47	55	H.O.	61	54	46	47	46	47	47	47	47	46	47	47	47	47	48	47	48	47	48	48	48	48
	BRIDLEWOOD	29	34	33	30	35	39	32	30	26	H.O.	33+8	37	24	22	22	22	23	22	22	22	23	39	39	40	39	39	39	39	39	39	39	39
	TERRY FOX	0	0	0	0	0	0	0	0	0	H.O.	100	90	0	25	39	50	78	83	65	65	64	64	63	64	63	63	62	62	61	61	60	60
Kanata Total		121	124	116	120	135	134	125	118	121			215	104	127	141	153	181	186	169	166	168	184	185	185	185	184	184	183	183	182	182	182

Group	Reference	Historical (Actuals)							Weather Corrected	Prelimin	Source	10-Day LTRs?	10-Day LTRs	Forecast																			
		2006	2007	2008	2009	2010	2011	2012	2012	2013		(MVA)	(MW?)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Kanata - South	SOUTHMARCH - H.O.	38	34	33	36	39	34	42	40	39	H1	121	109	43	43	43	43	43	43	42	42	42	27	26	26	26	26	26	26	26	26	26	25
	SOUTHMARCH- H1	59	56	52	56	54	56	61	57	58	H1	121	109	61	68	73	67	72	76	80	84	89	92	96	76	78	78	77	77	78	78	78	78
	RICHMOND	6	3	4	4	4	4	4	4	4	H.O.	6	5	6	8	9	10	11	13	31	34	36	35	36	37	37	37	38	38	39	39	38	38
Kanata - South Total		103	93	88	96	98	95	108	101	102			114	110	119	125	120	126	132	154	160	167	154	159	139	141	141	141	142	143	143	142	141

Group	Reference	Historical (Actuals)							Weather Corrected	Prelimin	Source	10-Day LTRs?	10-Day LTRs	Forecast																			
		2006	2007	2008	2009	2010	2011	2012	2012	2013		(MVA)	(MW?)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Nepean South	FALLOWFIELD	27	20	23	21	26	27	30	28	29	H.O.	25+25	26	29	31	36	39	38	41	49	51	54	55	58	59	61	66	67	70	71	74	76	79
	LIMEBANK	46	45	24	29	40	41	40	38	33	H.O.	33+33	68	42	43	44	47	49	52	54	56	59	61	64	67	70	73	76	79	82	85	89	88
	UPLANDS	6	9	25	28	26	23	23	21	22	H.O.	33	30	24	25	25	26	26	27	27	27	27	28	28	28	29	29	29	30	30	30	30	30
Nepean - South Total		79	75	72	78	93	91	93	87	84			124	95	99	105	111	114	119	129	134	140	144	150	154	160	168	173	179	183	189	195	198

Appendix B

Integrated Regional Resource Planning – Near-Term Needs Hand Off Letter

ONTARIO POWER AUTHORITY

120 Adelaide Street West
Suite 1600
Toronto, Ontario M5H 1T1

T 416-967-7474
F 416-967-1947
www.powerauthority.on.ca

June 27, 2014

Mr. Bing Young
Director, System Planning
Hydro One Networks Inc.
483 Bay Street
Toronto, Ontario M5G 2P5

Ottawa Area Regional Planning – Initiating Study or Development Work on Near and Mid-Term Transmission Solutions

Dear Bing,

The purpose of this letter is to:

- Hand off from the Ontario Power Authority (OPA) the lead responsibility for the planning process associated with the near-term transmission components of the Ottawa Region Integrated Regional Resource Planning (IRRP) process to Hydro One, and
- Request Hydro One Networks to initiate the development of wires solutions or implement the near-term transmission component of the integrated plan to meet the near- and medium-term reliability needs of the Ottawa Area.

This is consistent with the regional planning process endorsed by the Ontario Energy Board (OEB) as part of its Renewed Regulator Framework for Electricity.

The Ottawa Area Working Group (Working Group), consisting of staff from the OPA, the Independent Electricity System Operator (IESO), Hydro One and Hydro Ottawa, has been conducting an Integrated Regional Resource Planning (IRRP) process for the Ottawa Area since 2011. The IRRP process develops and analyzes forecasts of demand growth for a 20-year time frame, determines supply adequacy in accordance with the Ontario Resource and Transmission Assessment Criteria (ORTAC) and develops integrated solutions to address any needs that are identified.

While the IRRP process is not yet complete, a number of supply capacity and reliability issues in the near (within 5 year) and mid (5 to 10 years) term have been identified as not meeting the ORTAC planning standards in the Ottawa area. Furthermore, because of feasibility and the nature of the identified reliability issues, it has also been determined that wires solutions are the only reasonable means of addressing the identified needs. In such a situation, the Ontario Energy Board's (OEB) endorsed regional planning process provides for a "hand off" letter from the OPA to the lead transmitter, in this case Hydro One Networks, to initiate the development of wires solutions. This will permit Hydro One to develop and implement wires solutions to address the near-term needs in a timely fashion and commence early work associated with these solutions for their Regional Infrastructure Plan for the Ottawa area in advance of the completion of the IRRP.

Summarized below are four near-term needs along with proposed wires solutions identified for the Ottawa area by the Working Group for implementation by Hydro One.

1. Improve the reliability performance of Almonte TS and Terry Fox MTS by installing an in-line circuit breaker at Almonte TS on 230 kV circuit M29C between Cherrywood TS and Merivale TS. This work was identified early in the IRRP and is currently underway with a scheduled in-service date of Q2 2015.

2. Provide additional 230/115 kV autotransformation capacity at Hawthorne TS so as to relieve overloading of the existing autotransformers T5 and T6 there. The preferred alternative is to replace these lower rated units with standard 250 MVA units. The increased capacity is required now.

3. Provide increased supply capability for the downtown Ottawa 115 kV network to relieve overloading of the 115 kV circuit A4K from increased demand on this system. The preferred alternative is to rebuild the existing 115 kV single-circuit A6R to a double-circuit and extend it to Overbrooke TS. The need date is 2017.

4. Upgrade a section of 115 kV circuit S7M (the tap to Fallowfield TS) to increase its supply capability in order to supply a large customer load connecting to this circuit in the south Nepean area. The need date is 2019 or earlier.

In addition to the above, Hydro One has advised that the transformers and protection facilities at Bilberry Creek TS are approaching their end of life. Based on a 2020 end of life date for these facilities, a transmission and distribution development plan is required to supply the load served by Bilberry Creek TS either by refurbishing the station or alternately decommissioning the station and serving the load from other stations in the area.

The Working Group has identified these projects to address near- and mid-term needs. However, more detailed study and development work is required before these projects can be implemented. Continued development of these projects is best accomplished by Hydro One leading this effort as a lead transmitter and working with any relevant LDCs, guided by the information and requirements provided below from the IRRP process.

To facilitate the development of the wires solution, the OPA will provide Hydro One with the following information:

- Relevant system base cases
- Demand forecasts
- Conservation and distributed generation forecasts
- Any other relevant information

We look forward to receiving information, results, recommendations and deliverables related to these four near and mid-term projects for the Ottawa area, as part of the Ottawa Working Group activities and continue to work with and support Hydro One on the implementation of these projects.

Best Regards,

R.F. Chow

Bob Chow
Director, Transmission Integration
Power System Planning Division
Ontario Power Authority

CC Working Group members:

Hydro Ottawa
Jim Pegg
Jenna Van Vliet
Morgan Barnes

Hydro One Distribution
Ashley Lebel
Donald Lau

Hydro One Networks
Farooq Qureshy
Jean Morneau
Konrad Witkowski
Jayde Suleman

IESO
Peter Drury

OPA
Kai Fung
Yvonne Huang
Tracy Garner
Luisa Da Rocha

CC Others:

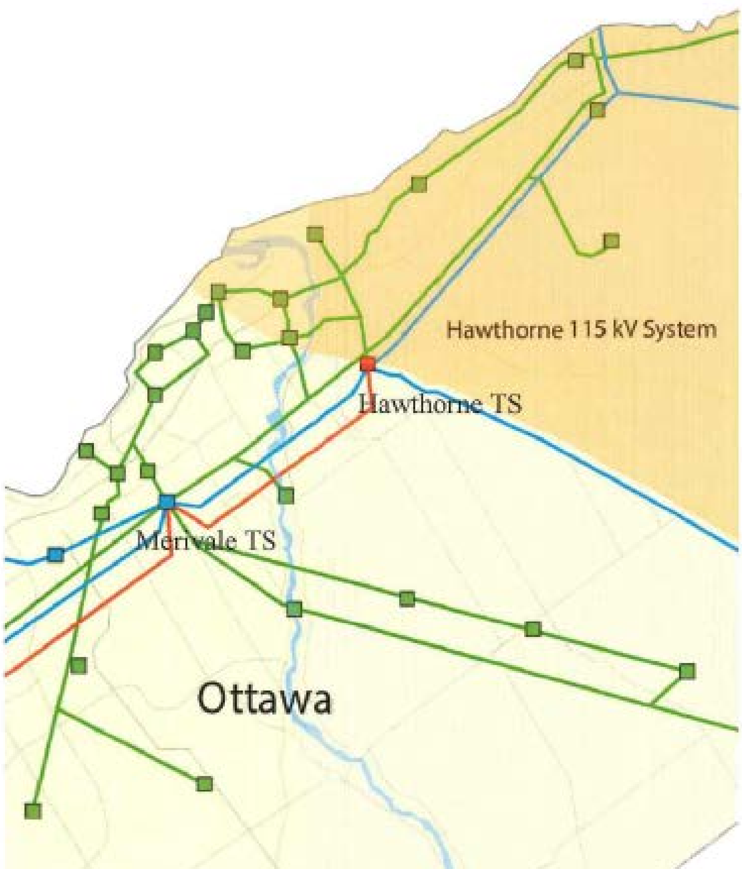
OPA
Amir Shalaby
Nancy Marconi
Joe Toneguzzo
Nicole Hopper

IESO
Mark Wilson
Mike Falvo
Mauro Facca

Attachment 1 – Project Objectives and Scope

Project 1: Hawthorne 115 kV System Autotransformer Upgrade

The 115 kV network in Ottawa area is connected to the 230 kV system through two autotransformer stations, Hawthorne TS, which serves the east half of the Ottawa area and Merivale TS, which serves the west half. The purpose of this project is to increase the 230/115 kV transfer capability at Hawthorne TS in order to meet the forecast load demand in the area while providing a level of reliability consistent with the IESO's ORTAC reliability standards.



There are currently four 230/115 kV autotransformers at Hawthorne TS. They supply about 630 MW of demand in east Ottawa. The 230/115 kV transformation capability at Hawthorne TS is limited by two of the existing autotransformers, T5 and T6. These two autotransformers are smaller in size, each with a rating of 225 MVA, while the other two autotransformers are rated at 250 MVA. Even at today's load level, planning studies done for this IRRP indicate that, following an outage of one of the autotransformers at Hawthorne TS, overload would result on the remaining T5 or T6 transformer under peak demand conditions. Orleans TS, which comes in service in 2015 and transfer some load from the 115 kV to the 230 kV system, does not provide enough relief for the overloaded autotransformers. After that, continued load growth on the Hawthorne 115 kV system will worsen the overload.

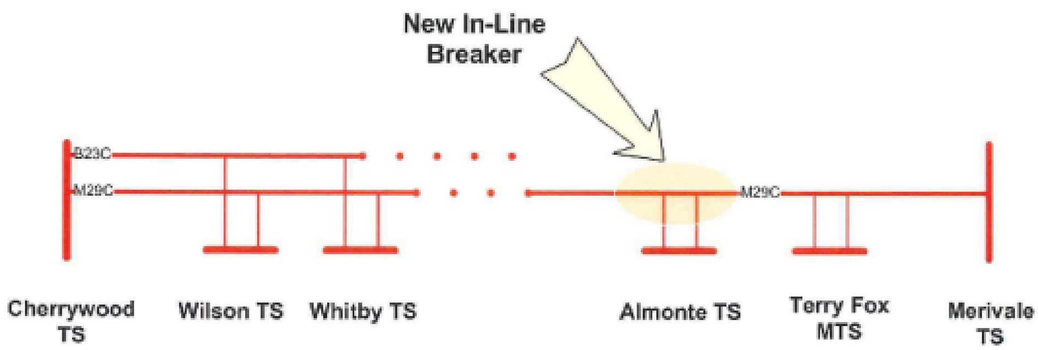
Since the overloading problem exists with today's load level, local generation option, which requires longer lead time, is not considered viable to address this need. Options of additional CDM were considered. However, significant demand reduction on the 115 kV system in the area will be required to provide sufficient relief for the overloaded autotransformers. 200 MW demand reduction can only provide roughly 10-year of relief on T5 and T6. On the other hand, both T5 and T6 are approaching 60-year-old in next few years. Replacement of these equipments is likely necessary in the near-term. Therefore, with support from the Working Group, the OPA recommends replacing the T5 and T6 autotransformers with 250 MVA units, with an estimated cost of $14 million. The estimated in-service date is 2017.

Project 2: Almonte in-line Breaker

Circuit M29C is a 320km long line that links Merivale TS in Ottawa to Cherrywood TS in Pickering. The line supplies two DESNs in the GTA, Wilson TS and Whitby TS; and two in Eastern Ontario, Almonte TS and Terry Fox MTS.

While Whitby TS and Wilson TS have a second 230kV supply from circuit B23C, both Almonte and Terry Fox MTS are on single line supply from circuit M29C. Any outage on the circuit - occuring about 7-10 times per year - means a complete interruption of supply to load customers at these two stations.

The Working Group identified the need for a breaker at Almonte early in the IRRP study and Hydro One is currently proceeding with the installation of a 230 kV breaker. This project will improve the reliability of the transmission supply to Terry Fox MTS and Almonte TS by eliminating the exposure of these stations to lightning related outages west of Almonte TS and is expected to reduce the probability of transmission-line related outages at these stations by about 80%.



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The Working Group noted that the breaker option does not protect against outages occurring on M29C on the Merivale side of the breaker. However, it does provide substantial improvement in reliability that can be achieved relatively quickly. It does not preclude development of other options that may be considered in the context of a long-term plan for the Nepean/Kanata area.

The reliability problem is due to the system configuration in this area, and is not driven by load growth. Therefore, additional CDM and local generation were not considered viable options to meet this need. This project is scheduled to be in service by Q2-2015, with an estimated cost of under $5 million.

Project 3: Downtown Transmission Line Rebuild

Downtown Ottawa is supplied by two 115 kV systems as shown in the figure below:

- from Merivale TS in the west through M4G and M5G
- from Hawthorne TS in the east through A4K, A5RK, A6R and A3RM

With forecasted load growth in the downtown area, the main section of A4K, from Hawthorne TS to Blackburn JCT, will exceed planning criteria starting 2017. Upon the contingency of losing the companion circuit A5RK, A4K will experience thermal overload.

This transmission line refurbishment project involves rebuilding a section of A5RK, between Overbrook TS and the junction with A6R, from a single circuit to a double-circuit line, and reconfiguring the supply to Overbrook TS to relieve the A4K circuit.

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The Working Group also discussed upgrading the main section of A4K to increase the supply capability of this circuit. However, this would involve upgrading a section that is proximately 8 km in length. In addition, due to the ampacity rating of the existing main section of A4K, upgrading may not provide significant incremental supply capacity to the area. For these reasons, the Working Group did not pursue the option of upgrading A4K.

Other non-wire options were considered. A 29 MW new hydroelectric facility was recently contracted through the OPA's Hydroelectric Standard Offer Program (HESOP). This is a run-of-the-river facility and hence based on planning assumption for run-of-the-river hydroelectric, very little capacity of the facility will be available during peak load condition. In addition, this HESOP facility has the milestone date for commercial operation of 2022. As the overload on A4K starts to arise in 2017, local generation option with this HESOP facility is not considered viable.

Additional CDM, such as Demand Response (DR) was also considered. However, to entirely address this need, over 30 MW of demand reduction will be required in the next 10 years and over 40 MW will be needed by 2032. Since the transmission option involves only refurbishing a short section of an existing line (less than 2 km in length), it would have a lower cost as compare to CDM options.

Therefore, with the support from the Working Group, the OPA recommends that Hydro One initiate work on the project. The cost of this project is currently estimated between $5 million and $6 million. Detailed project costs and in-service date will be determined as part of this work.

Project 4: S7M Upgrade

S7M is a 115 kV single circuit originated from Merivale TS. It supplies the Nepean / Kanata area in the west Ottawa. With forecasted load growth in the Nepean south area, the S7M tap to Fallowfield DS is expected to exceed its thermal capacity by 2019. This includes a large customer of Hydro Ottawa with bulk load of 20 MW who has recently requested connection at Richmond DS which is also supplied by the S7M tap, south of Fallowfield DS.

While the Working Group continues to develop options for additional supply to the Nepean south area for the longer-term, upgrading the existing S7M tap to Fallowfield DS is needed in the near-term in order to accommodate the connection of the bulk load customer. With the support from the Working Group, the OPA recommends that Hydro One work with Hydro Ottawa to determine the optimal upgrade configuration and proceed with the development work to upgrade the S7M circuit between STR 673 N JCT and Fallowfield DS.

Development of Transmission Options for Addressing the End-of-Life at Bilberry Creek TS

Bilberry Creek TS is a medium size 115 kV stepdown station located in East Ottawa. It was built in 1964 and is currently supplying about 80 MW of Hydro One Distribution and Hydro Ottawa customer load. Hydro One Transmission, who owns the station, informed the Working Group

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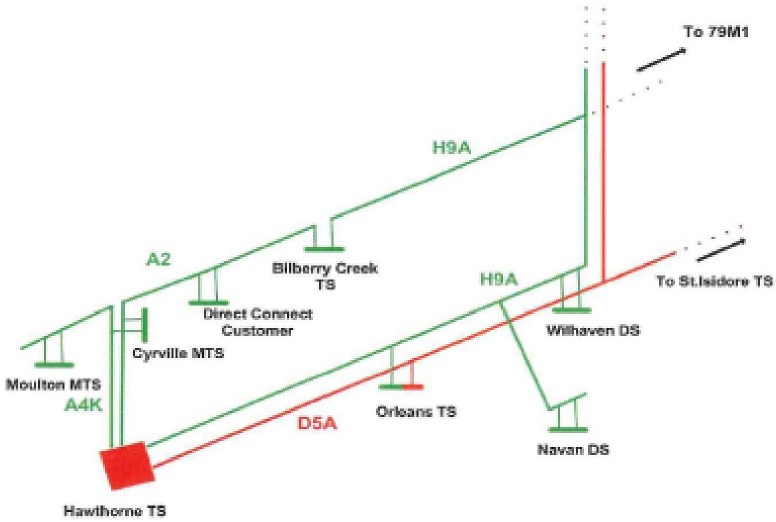
that the two transformers and the associated protection system at this station are near their end-of-life. For planning purpose, the end-of-life date is 2020. A decision is needed now to either refurbish the station and maintain the 115 kV system in the area, or decommission the station and transfer its load to other stations in the area by 2020.

Below is a figure showing the current supply arrangement for the East Ottawa / Orleans area.



The primary issue is to replace an end-of-life facility and is not related to load growth. Therefore, other options such as CDM and local generation are not viable to address this need. However, these other options will be considered as part of the integrated solutions for the area in the long-term, after the decision on addressing Bilberry Creek TS end-of-life is made. At this time, more detailed cost and technical information is required by the Working Group in order to make that decision. The Working Group agrees that the study work be handed-off to Hydro One at this time so that more detailed studies can be carried out by Hydro One.

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Appendix C

IESO Letter of Comment – REG Investments Plan

IESO Letter of Comment

Hydro Ottawa Limited

Renewable Energy Generation Investments Plan

Date: January 20, 2015

Independent Electricity System Operator

Introduction

On March 28, 2013, the Ontario Energy Board ("the OEB" or "Board") issued its Filing Requirements for Electricity Transmission and Distribution Applications; Chapter 5 – Consolidated Distribution System Plan Filing Requirements (EB-2010-0377). Chapter 5 implements the Board's policy direction on 'an integrated approach to distribution network planning', outlined in the Board's October 18, 2012 Report of the Board - A Renewed Regulatory Framework for Electricity Distributors: A Performance Based Approach.

As outlined in the Chapter 5 filing requirements, the Board expects that the Ontario Power Authority [1] ("OPA") comment letter will include:

- the applications it has received from renewable generators through the FIT program for connection in the distributor's service area;
- whether the distributor has consulted with the OPA, or participated in planning meetings with the OPA;
- the potential need for co-ordination with other distributors and/or transmitters or others on implementing elements of the REG investments; and
- whether the REG investments proposed in the DS Plan are consistent with any Regional Infrastructure Plan.

Hydro Ottawa Limited – Distribution System Plan

On October 23, 2014 Hydro Ottawa Limited ("HOL") provided its Renewable Energy Generation Investments Information ("Plan") to the Ontario Power Authority as part of its 5-year Distribution System Plan. The IESO has reviewed HOL's Plan and has provided its comments below.

OPA FIT/microFIT Applications Received

Hydro Ottawa Limited indicates that presently it has connected 569 microFIT projects totalling 4,619 kW, and 88 FIT projects, totalling 10,792 kW. According to the IESO's information, as of November 2014, the OPA had offered contracts to 573 microFIT projects totalling 4,611 kW of capacity. The OPA contracted a total of 95 FIT projects, 88 of which have reached commercial operation or the Notice to Proceed stage ("NTP"). The remaining seven contracts have not yet reached NTP. The renewable energy generation connections information in HOL's Plan is therefore consistent with that of the IESO.

Additional Renewable Generation Procurement

Hydro Ottawa Limited also indicates that it has connected five facilities, with a total capacity of 18,580 kW, which were contracted as part of the Hydroelectric Contract Initiative; one facility, with a capacity of 6,378 kW, which was contracted as part of the RES I procurement; and two facilities, with a

[1] On January 1, 2015, the Ontario Power Authority ("OPA") merged with the Independent Electricity System Operator ("IESO") to create a new organization that will combine the OPA and IESO mandates. The new organization is called the Independent Electricity System Operator.

Independent Electricity System Operator
1600 – 120 Adelaide Street West, Toronto, ON M5H 1T1
t 416 967-7474 f 416 967-1947 toll free 1-800-797-9604 customer.relations@ieso.ca www.ieso.ca

capacity of 10,700 kW, which were contracted as part of the RESOP procurement. This information is consistent with the IESO's records of previous OPA procurement programs.

In addition, Hydro Ottawa has noted that it has additional renewable and non-renewable generation connected to the distribution system (in the form of load displacement, net-metered and stand alone projects) which is not related to previous OPA procurement programs and which therefore cannot be verified by the IESO.

Consultation / Participation in Planning Meetings; Coordination with Distributors / Transmitters / Others; Consistency with Regional Plans

Hydro Ottawa Limited has been active in the Greater Ottawa regional planning process which has been ongoing since 2011. This regional planning process has now been merged into the Ontario Energy Board's regional planning process and is part of "Group 1" of the Board's 21 Ontario regions. The Integrated Regional Resource Plan ("IRRP") for this region is due to be completed in April, 2015.

Hydro Ottawa Limited identified six stations within their service territory that are restricted or constrained for additional renewable generation connection, four of which are owned by Hydro One, and two of which are owned by Hydro Ottawa. For Fallowfield DS, Hydro Ottawa has indicated that load growth in the area will be a mitigating factor, allowing additional renewable generation connections to the portion of the station which is currently constrained. For Leitrim MS, Hydro Ottawa has indicated the planned station investment which will remove the constraint.

The IESO looks forward to continuing to work with Hydro Ottawa Limited to complete an Integrated Regional Resource Plan for the Ottawa area, and appreciates the opportunity to comment on the information provided as part of its Distribution System Plan at this time.

Independent Electricity System Operator
1600 – 120 Adelaide Street West, Toronto, ON M5H 1T1
t 416 967-7474 f 416 967-1947 toll free 1-800-797-9604 customer.relations@ieso.ca www.ieso.ca

Appendix D

Worst Feeder Evaluation Methodology

HydroOttawa	TITLE: Worst Feeder Analysis	
RECOMMENDED: **Jenna Van Vliet**	NO:	REV: **0**
APPROVED:		
REV. DATE: **2011-08-30**		

Worst Feeder Analysis

See Hydro Ottawa's Intranet site
for the latest revisions

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REVISION SHEET

Revision	Description of Change	Date	Initial
0	Original Document	2011-08-30	jvv

TABLE OF CONTENTS **PAGE**

1. Introduction

The basis for the evaluation of the Worst Feeders is to track and highlight priority areas that are consistently seeing issues, to then identify solutions to improve the reliability performance.

2. References

Canadian Electricity Association

3. Scope

This document describes the methodology used to determine and track the worst performing feeders on an annual basis. It does not describe methods used to improve feeder reliability.

4. Definitions

Interruption: The loss of service to one or more customers.

Loss of Supply: Customer interruptions due to problems in the bulk electricity supply system.

Momentary Interruption: An interruption with a duration of less than 1 minute.

Scheduled Outage: Customer interruptions due to the disconnection at a selected time for the purpose of construction or preventive maintenance.

4. Definitions

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5. Worst Feeder Evaluation

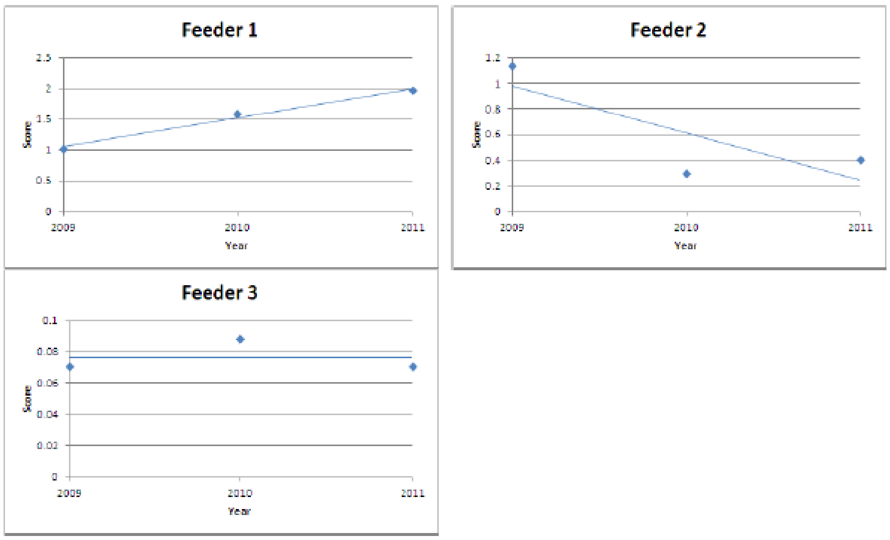
In order for HOL to be able to directly impact the reliability performance, only the causes for outages that can be reduced or eliminated by HOL intervention are included in the Worst Feeder Evaluation. This means that outages caused by Loss of Supply and Scheduled Outages are not included in the evaluation.

Four metrics are used in the evaluation process: the number of customers interrupted, customer hours of interruption, the number of interruptions a feeder sees annually and the number of momentary interruptions a feeder sees annually. The worst feeders are defined by those with: the highest number of customers interrupted (SAIFI), the highest number of customer hours interrupted (SAIDI), the highest number of interruptions (FEMI) and the highest number of momentary interruptions (MAIFI). In the evaluation, the metrics are each given a weighting according to their impact on a feeder's overall reliability. The number of customers interrupted, the number of customer hours of interruption and the number of interruptions are all equally weighted by a factor of 1, while the number of momentary interruptions is given a weighting of ½. This weighting is based on the fact that not all of the reclosing devices in the system are monitored and therefore we currently do not report on MAIFI.

To calculate each metric, the maximum number of customers, the total number of customer hours, the number of outages and momentary outages seen has to be determined for each feeder in the system for the previous 3 years. The 3-year average for the four categories, for each feeder, is then calculated based on the 3 year period. From the 3-year average, a per-unit value is then calculated. To calculate the per-unit value for the 3-year average of the maximum number of customers and the total number of customer hours, the 3-year average values are divided by 30,000. The 30,000 is based on an assumption that no feeder should contribute more than 10% towards the corporate target of 1.0 for both the 3-Year average SAIDI and SAIFI values with a total customer count of 300,000. The 3-year average number of outages is divided by 10, since HOL reports on $FEMI_{10}$, to determine the per-unit value for each feeder. The 3-year average number of momentaries is divided by 25, since no feeder has seen more than 25 momentary outages annually to date. This number may be adjusted as a specific target for momentary outages is chosen. To attain the overall feeder rating the four per unit values are multiplied by their associated weighting (1 for customers interrupted, 1 for customer hours, 1 for number of outages and ½ for number of momentaries) and then summed.

The score of each feeder gives a picture of the feeder's performance over the last three year period, but does not take into consideration whether the feeder's reliability has been improving or deteriorating. To determine whether the feeder's reliability is improving the feeder's Score (weighted per-unit ranking as outlined above) is evaluated over the previous three year period. When the Score is plotted for the three year period, if the overall trend is increasing (positive slope) then the feeder's reliability has been deteriorating, if the overall trend is decreasing (negative slope) then the feeder's reliability has been improving and if the slope is relatively flat, then the reliability has remained consistent. See Figure 1 below, Feeder 1 has deteriorating reliability, Feeder 2 has improving reliability and Feeder 3 has had relatively consistent reliability.

Figure 1: Feeder Score



To incorporate whether the feeder's reliability is improving or deteriorating, the linear slope of the Score for the previous three years is calculated. This is accomplished by determining the Least Squares Fit to the Score for the three year period. The formula assumed is shown below.

$$m = \frac{\sum x \cdot y - 3\overline{x}\,\overline{y}}{\sum x^2 - 3\overline{x}^2}$$

Where, $m =$ Slope – Least Squares Fit
$x =$ Year
$y =$ Score

The slopes for Feeder 1, Feeder 2, and Feeder 3 from the charts above are calculated below.

$$m_{Feeder1} = \frac{[(2009 \cdot 1.02) + (2010 \cdot 1.59) + (2011 \cdot 1.97] - 3[(2009 + 2010 + 2011)/3] \cdot [(1.02 + 1.59 + 1.97)/3]}{(2009^2 + 2010^2 + 2011^2) - 3(2009 + 2010 + 2011)/3)^2}$$

$$m_{Feeder1} = \frac{9206.75 - 9205.80}{12120302 - 12120300}$$

$$m_{Feeder1} = \frac{0.95}{2.00}$$

$$m_{Feeder1} = 0.48$$

$$m_{Feeder2} = \frac{[(2009 \cdot 1.13) + (2010 \cdot 0.30) + (2011 \cdot 0.41)] - 3[(2009 + 2010 + 2011)/3] \cdot [(1.13 + 0.30 + 0.41)/3]}{(2009^2 + 2010^2 + 2011^2) - 3(2009 + 2010 + 2011)/3)^2}$$
$$m_{Feeder2} = \frac{9970.25 - 9971.89}{2.00}$$
$$m_{Feeder2} = \frac{-0.72}{2.00}$$
$$m_{Feeder2} = -0.36$$

$$m_{Feeder3} = \frac{[(2009 \cdot 0.07) + (2010 \cdot 0.09) + (2011 \cdot 0.07)] - 3[(2009 + 2010 + 2011)/3] \cdot [(0.07 + 0.09 + 0.07)/3]]}{(2009^2 + 2010^2 + 2011^2) - 3(2009 + 2010 + 2011)/3)^2}$$
$$m_{Feeder3} = \frac{14095.99 - 14095.73}{2.00}$$
$$m_{Feeder3} = \frac{0.00}{2.00}$$
$$m_{Feeder3} = 0.00$$

The slopes are then unitized based on a scale from -1 to +1. This implies that the feeder with the fastest improving reliability will have a Trend closest 0, while the feeder with the quickest deterioration will have a trend closest to 1 and feeders who's reliability has remained consistent will sit near 0.5. The unitizing is done with the following equation.

$$Trend = \frac{m - Min(m)}{Max(m) - Min(m)}$$
$$Trend = \frac{m - (-1)}{1 - (-1)}$$
$$Trend = \frac{m + 1}{2}$$

The Trends for Feeder 1, Feeder 2 and Feeder 3 are calculated below.

$$Trend_{Feeder1} = \frac{0.48 + 1}{2}$$
$$Trend_{Feeder1} = 0.74$$

$$Trend_{Feeder2} = \frac{-0.36 + 1}{2}$$
$$Trend_{Feeder2} = 0.32$$

$$Trend_{Feeder3} = \frac{0.00 + 1}{2}$$
$$Trend_{Feeder3} = 0.50$$

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To determine the overall Rank for each feeder the Trend is multiplied by the Score. The Rank for the feeders is then sorted from highest to lowest score, which sorts the feeders from worst reliability performer to best.

To visually inspect the Worst Feeders, a plot of Trend versus Score can be used. See the example in Figure 2 on the following page.

Since Trend is the unitized slope value, between 0 and 1, a Trend between 0 and 0.5 implies a negative slope, or improving reliability, and a Trend between 0.5 and 1 implies a positive slope, or deteriorating reliability. It can be seen in Figure 2 that the majority of the feeders fall within a Score from 0 and 0.5 (Approx. 95%) and a Trend around 0.5. It can therefore be interpreted that the feeders that need to be evaluated can be determined by eliminating the feeders with a Score below 0.5, and a Trend below 0.5 See Figure 3.

Figure 2: Feeder Rank - Overall

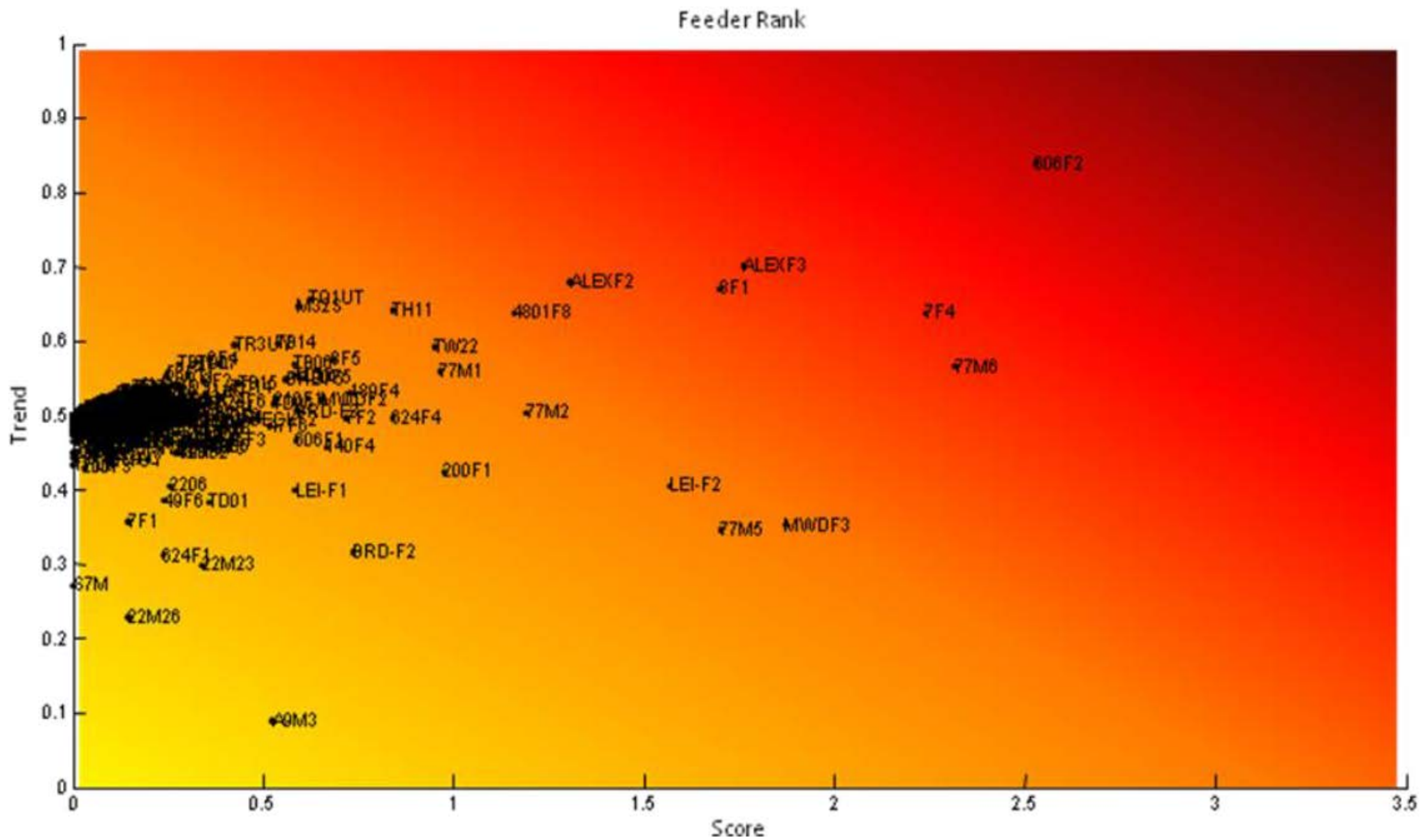

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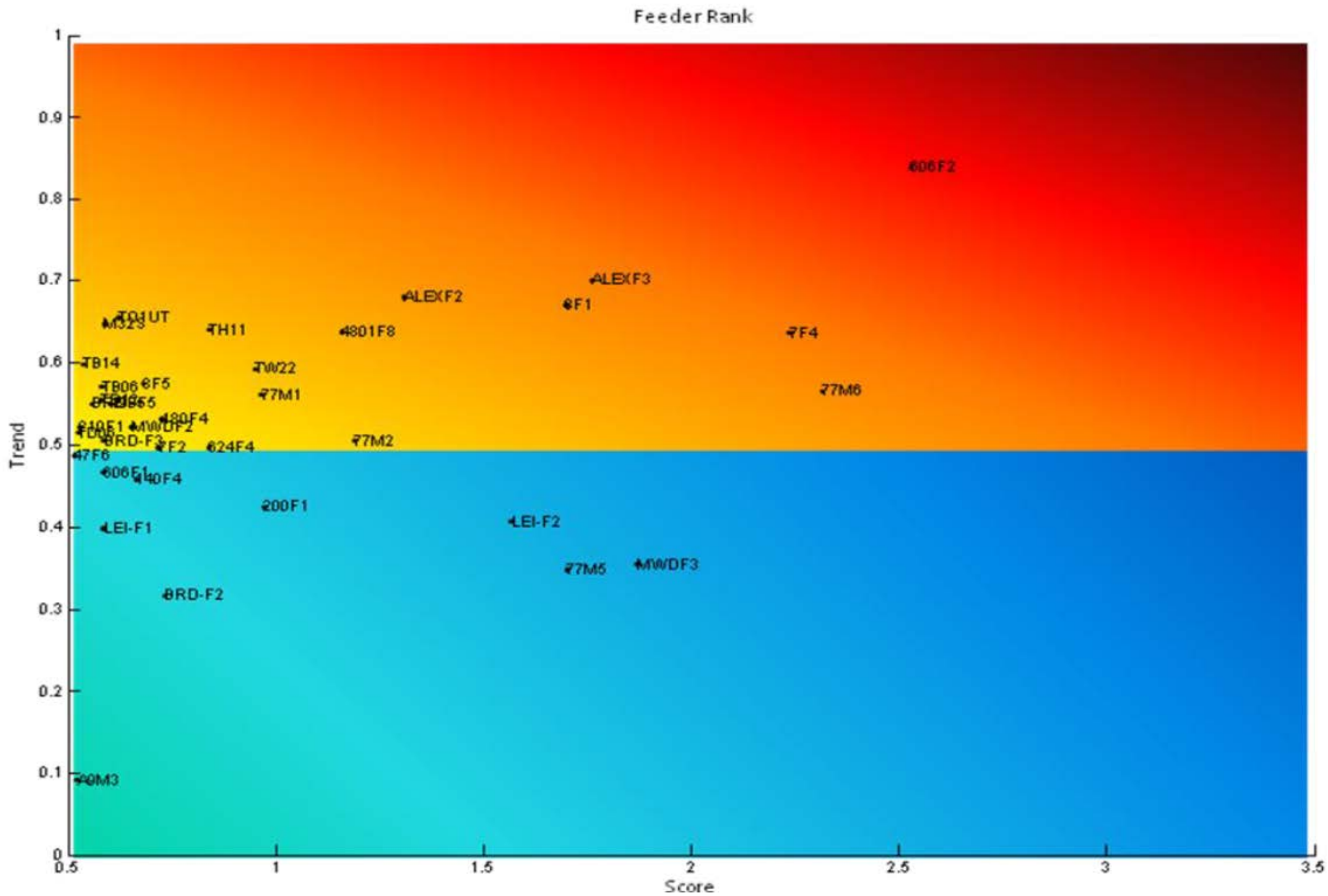
Figure 3: Feeder Rank – Feeders Requiring Evaluation



6. Worst Feeder Evaluation Process

The following section outlines the steps to determine the Worst Feeder List.
See Table 1 for the referenced rows and columns for steps 1-4.

1. Determine the Number of Outages, the Number of Momentary Outages, Maximum Customers Interrupted, and the Total Customer Hours of Interruptions for all feeders.
   - Fill in the information for Columns C, D, E & H, I, J & M, N, O & R, S, T
2. Calculate the 3-year average for the Number of Outages, the Number of Momentary Outages, Maximum Customers Interrupted, and the Total Customer Hours of Interruptions for all feeders.
   - (Value Year 1 + Value Year 2 + Value Year 3) / 3
   - Calculate columns F & K & P & U
   - Ex: *F1 = (C1+D1+E1)/3*
3. Calculate the per unit values for the Number of Outages, the Number of Momentary Outages, Maximum Customers Interrupted, and the Total Customer Hours of Interruption for all feeders.
   - 3 Year Average / Maximum Allowable Value
   - Maximum Allowable Value:
     i. Number of Outages: 10
     ii. Number of Momentary Outages: 25
     iii. Maximum Customers Interrupted: 30,000
     iv. Total Customer Hours of Interruption: 30,000
   - Calculate Columns G & L & Q & V
   - Ex: *G1 = F1/Max Allowable Value)*
4. Calculate the Score for all feeders
   - (Per Unit Number of Outages) + 0.5*(Per Unit Number of Momentary Outages) + (Per Unit Maximum Customers Interrupted) + (Per Unit Customer Hours of Interruptions)
   - Calculate Column B

- Ex: *B1 = G1 + 0.5*L1 + Q1 + V1*

See Table 2 for the referenced rows and columns for steps 5-8.

5. Calculate the slope for each feeder using the Least Squares Fit Method.

   - $m = \frac{\sum x \cdot y - 3\overline{xy}}{\sum x^2 - 3\overline{x}^2}$ Where, m = slope, x = year and y = score

   - Calculate Column E

   - Ex: *E1 =(SUMPRODUCT(C1:E1,C2:E2)-3*AVERAGE(C1:E1)*AVERAGE(C2:E2))/(SUMSQ(C1:E1)-3*AVERAGE(C1:E1)^2)*

6. Calculate the Trend for each feeder, unitizing to a scale of -1 to +1.

   - $Trend = \frac{m - Min(m)}{Max(m) - Min(m)}$
     $Trend = \frac{m-(-1)}{1-(-1)}$
     $Trend = \frac{m+1}{2}$

   - Calculate Column F

   - Ex: *F1 =(E1+1)/2*

7. Calculate the Rank for each feeder.

   - $Rank = Score \ \ x \ Trend$

   - Calculate Column G

   - Ex: *G2 = D2*F2*

8. Arrange the Rank in descending order, for largest to smallest.

   - Arrange Column G in descending order – This arranges the feeders from worst performer to best performer.

Table 1: 2010 Feeder Score

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Score	Number of Interruptions					Number of Momentary Interruptions					Customer Hours					Maximum Customers				
	Feeder	2010	2008	2009	2010	Average	Per Unit	2008	2009	2010	Average	Per Unit	2008	2009	2010	Average	Per Unit	2008	2009	2010	Average	Per Unit
1	Worst Feeder 1	2.91	35	24	12	23.67	2.37	2	1	4	2.33	0.09	12317	13439	1755	9170.33	0.31	6796	7562	2835	5731.00	0.19
2	Worst Feeder 2	1.59	5	8	5	6.00	0.60	11	4	1	5.33	0.21	9295	13457	18374	13708.67	0.46	5245	12572	20522	12779.67	0.43
3	Worst Feeder 3	2.06	13	18	8	13.00	1.30	6	7	3	5.33	0.21	1261	20479	453	7397.67	0.25	4483	31754	239	12158.67	0.41
4	Worst Feeder 4	1.86	15	14	13	14.00	1.40	1	16	12	9.67	0.39	1447	4469	983	2299.67	0.08	838	10366	5627	5610.33	0.19
5	Worst Feeder 5	1.61	14	12	18	14.67	1.47	1	1	0	0.67	0.03	648	7671	661	2993.33	0.10	233	1840	956	1009.67	0.03
6	Worst Feeder 6	1.77	11	14	15	13.33	1.33	6	0	0	2.00	0.08	8883	1903	8468	6418.00	0.21	11497	2467	2676	5546.67	0.18
7	Worst Feeder 7	1.40	8	8	7	7.67	0.77	1	0	6	2.33	0.09	7140	9270	15841	10750.33	0.36	3482	5795	11161	6812.67	0.23
8	Worst Feeder 8	1.13	8	9	6	7.67	0.77	2	3	2	2.33	0.09	1204	2032	6514	3250.00	0.11	4638	4719	8978	6111.67	0.20
9	Worst Feeder 9	0.99	7	14	6	9.00	0.90	1	0	0	0.33	0.01	279	3376	667	1440.67	0.05	140	2342	535	1005.67	0.03
10	Worst Feeder 10	2.10	32	7	8	15.67	1.57	1	2	0	1.00	0.04	17456	3894	1680	7676.67	0.26	17890	4262	749	7633.67	0.25

Table 2: 2010 Feeder Slope, Trend & Rank

	A	B	C	D	E	F	G
		Score			Slope	Trend	Rank
	Feeder	2008	2009	2010	2010	2010	2010
1	Worst Feeder 1	2.50	2.80	2.91	0.21	0.60	1.76
2	Worst Feeder 2	0.62	1.02	1.59	0.48	0.74	1.18
3	Worst Feeder 3	1.79	2.16	2.06	0.14	0.57	1.17
4	Worst Feeder 4	1.44	1.79	1.86	0.21	0.60	1.12
5	Worst Feeder 5	1.10	1.33	1.61	0.26	0.63	1.02
6	Worst Feeder 6	1.75	1.84	1.77	0.01	0.51	0.90
7	Worst Feeder 7	1.06	1.00	1.40	0.17	0.58	0.82
8	Worst Feeder 8	0.55	0.88	1.13	0.29	0.64	0.72
9	Worst Feeder 9	0.70	0.91	0.99	0.14	0.57	0.57
10	Worst Feeder 10	3.02	2.52	2.10	-0.46	0.27	0.56

7. Worst Feeder Trending

In order to determine whether or not improvements are being seen on the worst feeders from one year to the next – as a feeder may appear in the top ten for a few years as the rating is based on a 3-year average – trending from year to year must be evaluated.

For three years following the first time a feeder is seen on the Top Ten listing the slope is tracked to determine whether or not the reliability performance is improving. Three years is used since any improvements to the feeder will be implemented in the following budget year, then results can be tracked for the next two years.

As described above, if the overall linear trend is decreasing for the following three years, then improvements are being seen on the feeder, if the overall trend is increasing or remaining constant, then further evaluation, and possible intervention is required.

Appendix E

City of Ottawa Community Design Plan Summary

Hydro Ottawa Limited

Community Design Plans

Approved by City Council for Implementation

Annie Williams

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This document contains a summary of all Community Design Plans approved by the City of Ottawa as of October 2014. The purpose of this report is to demonstrate the expected growth in the city over the next few years. Some projects may already be underway while others are planned for the long term. This report is specifically focused on the consequences of City expansion projects to Hydro Ottawa's electrical distribution system.

Each CDP summary states the boundaries of the study area, any relevant transportation projects within the study area that may affect Hydro Ottawa's assets, and a brief description of the development proposed for the area. Full CDP documents are available on the City of Ottawa's website at http://ottawa.ca/en/city-hall/planning-and-development/community-plans-and-design-guidelines/community-plans-and-studi-0.

It is expected that there will be more than 214MW of load growth in the City of Ottawa over the next 20 years. Hydro Ottawa's distribution system does not currently have the capacity to supply these additional loads in some areas. System expansion and relocation will need to occur alongside these City plans and additional station capacity is being considered.

Table of Contents

CDP Summary

Study	Study Area (ha)	GFA (ha)	No. Res. Units	Land Use Type	Expected Load (MW)	MVA (PF=0.9)
Barrhaven South CDP	500	188.9	6,862	Mixed-Use	14,253	15,837
Bank Street CDP	101			Mixed-Use	0	0
Bayview Station District CDP	29.5	55		Mixed-Use	4,146	4,607
Bayview/Somerset Area Secondary Study	89.7		1,590	Mixed-Use	3	4
Beechwood CDP	22		819	Mixed-Use	2	2
Cardinal Creek Village Concept Plan	208	95	3,500	Mixed-Use	7,168	7,965
Carp Road Corridor CDP	2475		0	Commercial	0	0
Village of Carp CDP	49.5		543	Mixed-Use	1	1
Village of Constance Bay Community Plan	114		204	Mixed-Use	0	0
Downtown Ottawa Urban Design Strategy					0	0
East Urban Community (Phase 1 Area) CDP	570		3,498	Mixed-Use	7	8
East Urban Community (Phase 2 Area) CDP	240		1,726	Mixed-Use	3	4
Escarpment Area District Plan				Mixed-Use	0	0
Fernbank CDP	674	310	11,000	Mixed-Use	23,390	25,989
Greely CDP	1276		729	Mixed-Use	1	2
Leitrim CDP	500	362.3	5,300	Mixed-Use	27,321	30,356
Mer Bleue CDP	160	113.7	3,000	Mixed-Use	8,577	9,530
Kanata West Concept Plan	887		5,000	Mixed-Use	10	11
North Gower CDP	278	208	520	Mixed-Use	15,680	17,422
Old Ottawa East CDP	158		2,250	Mixed-Use	5	5
Orleans Industrial Park Study	316	18.7	0	Commercial	1,410	1,566
Queensway Terrace North	140				0	0
Richmond Road/Westboro CDP	270		3,970	Mixed-Use	8	9
Richmond Road/Westboro Transpo Plan					0	0
Riverside South CDP	1800	1450	18,300	Mixed-Use	109,338	121,486
Scott Street CDP	57.7		1,500	Mixed-Use	3	3
South Nepean Town Centre CDP	165	35	11,000	Mixed-Use	2,660	2,956
St. Joseph Boulevard Corridor Study	67.3			Mixed-Use	0	0
Uptown Rideau CDP	21			Mixed-Use	0	0
Transit-Oriented Development (TOD) Plans					0	0
Village of Richmond CDP	879			Residential	0	0
Wellington Street West CDP	232		950	Mixed-Use	2	2

*Expected load should be greater than shown in table due to lack of information

Barrhaven South CDP

Boundaries: Jock River, Highway 416, Barnsdale Rd, Jockvale Rd & Greenbank Rd
Transportation projects: Relocation and widening of Greenbank Rd (also upgrade to 4-lanes south of Cambrian Rd), New 4-lane structure over Jock River, Cambrian Rd widening

The area currently contains a few farms and rural residential homes. The plan is to create a complete residential community that contains a full range of housing choices and a broad complement of support services and facilities. This will include residential housing, commercial buildings, community centres and schools.

Bank Street CDP

Boundaries: Bank St - Rideau River to Ledbury Park (ie. Riverside Dr to CN Rail Line)
Transportation Projects: 2 Transitway stations + LRT station within walking distance, 3 Intersection modifications

The current land uses along Bank St are predominantly commercial, with some residential, office and industrial uses. The Bank St corridor will become a vibrant mixed use area with diverse housing, shops and services. The goal is to transform the area from a retail strip into a central spine for a new higher-density community.

Bayview Station District CDP

Boundaries: Revolves around Bayview Station, Bayview Rd, Albert St, City Centre Ave, Somerset St W
Transportation Projects: LRT station, Existing O-Train line to become major LRT route (BRT to LRT)

A large portion of the study area is publicly owned, such as the rail corridor and the Tom Brown Arena. The area also contains some smaller-scale residential and commercial properties. The focus is on transit-oriented development in the area around Bayview Station. It will include residential buildings, mixed-use commercial and small scale industrial buildings. The CDP notes that existing underground utilities do not follow municipal rights-of-way and development will need to consider avoiding or relocating these services. It is not specified whether these utilities include Hydro.

Bayview/Somerset Area Secondary Study

Boundaries: Lebreton Flats to Tunney's Pasture, Bayview Road, Canadian Pacific Railway, Transitway, Ottawa River Parkway
Transportation Projects: Traffic circle at Burnside/Bayview

The site is currently occupied by a number of City operations such as snow disposal. Bayview Road will become the community's main street, and there will be a mix of medium density housing forms as well as retail space. It should be noted that many properties in the study area have soil contamination.

Beechwood CDP

Boundaries: Beechwood Ave - St. Patrick St Bridge to Beechwood Cemetery
Transportation Projects: No Relevant Projects

Beechwood Avenue currently has a wide variety of shops. The public prefers low-rise or medium-rise building heights. It is mentioned that hydro poles and wires should be removed, if possible. It is anticipated that there will be a new grocery store, other small stores, residential buildings and urban plazas.

Cardinal Creek Village Concept Plan

Boundaries: Ottawa Road 174 & Ottawa River, Cardinal Creek, Frank Kenny Rd/Ted Kelly Ln
Transportation Projects: Rapid Transit Corridor may be extended into study area

These lands currently have large lot rural residential, institutional and nursery/landscape uses. 50% of the area is pasture. The intent is to create a complete residential community with a full range of housing choices that is complemented and supported by appropriate community facilities such as parks and schools, while providing opportunities to work and shop in close proximity to the residential neighbourhoods. A 'center' to the village was considered an important community-defining element of the plan and accordingly, the intersection of the proposed north-south major collector road and Old Montreal Road was identified as a central area. In this location, a variety of land uses (such as local commercial uses, higher density residential uses and a neighbourhood park) have been provided to create an active, interesting and diverse 'Village Core'. The 'Village Core' will be supported by the creation of a traditional main street character along Old Montreal Road, and will support potential future transit service along this road. Hydro Ottawa has confirmed that there is plant in reasonable proximity to the study area.

Carp Road Corridor CDP

Boundaries: Carp Rd - Rothbourne Rd to March Rd
Transportation Projects: Carp Rd widening to 4 lanes (Stittsville boundary to Richardson Side Rd)

The Carp Road Corridor currently contains country lot residential subdivisions, a golf course, commercial and agricultural properties. The objective is to promote the corridor as a rural employment area which is an attractive base for a wide range of industrial and commercial uses.

Village of Carp CDP

Boundaries: Carp River, Carp Hills
Transportation Projects: Former CN Rail line protected as corridor for future public transit

There are 2 areas being discussed: the Village Core and the residential areas. The Village Core contains heritage buildings, and will be the primary focus of Carp's economic activity. The predominant uses in the Core will be commercial, recreational and institutional, with residential uses being encouraged as part of a mixed-use development. Commercial and retail uses will not be permitted in the residential areas.

Village of Constance Bay Community Plan

Boundaries: Ottawa River
Transportation Projects: Road links from Allbirch to Kilmaurs Side Rd (to provide 2nd access into area)

There is limited potential for growth, but the Village will grow slowly over the next 20 years in two ways: new subdivision in the undeveloped land, and the conversion of cottages to permanent homes. Constance Bay will be a residential-focused area, with some commercial development in the Village. This includes a new shopping area, medical centre and day care.

Downtown Ottawa Urban Design Strategy

Boundaries: Ottawa's Downtown Core
Transportation Projects: This document encompasses many upcoming transportation projects

Over the next 20 years, this design strategy will help set the stage for a renewed physical environment for the downtown core. This is a strategic document that can be used by several parties as a tool to guide future development projects in the downtown area. The strategy sets the proper priorities on improvements for realization over the 20-year time frame.

East Urban Community (Phase 1 Area) CDP

Boundaries: Mer Bleue Rd, Former Canadian Pacific Railway line, NCC Greenbelt, Hydro corridor
Transportation Projects: Alignment of the future Blackburn Hamlet By-pass Extension, Navan Rd and Mer Bleue Rd widening to 4-lane divided arterials, Belcourt Boulevard Extension, 2 LRT stations

There are existing structures in the study area, but the land is largely undeveloped. The Orleans projected population is expected to increase steadily over the next 15 years to approximately 20,000 more people. More housing is needed for this additional population. There are several Official Plan (OP) targets for residential development that should be met, such as: achieve a density of 29 units/net ha for singles, semis and towns, requirement of 10% apartments, at least 30% multiples, and maximum 60% singles and semi-detached dwellings. There are 2 proposed transit stations and a Mixed Use Centre (700-850 units).

East Urban Community (Phase 2 Area) CDP

Boundaries: Former Canadian Pacific Railway line, Mer Bleue Rd, Renaud Rd, Phase 1 boundary
Transportation Projects: Mer Bleue Rd realignment, Future VIA Rail high-speed passenger train

The majority of the study area is currently covered with open pasture or wooded areas. Existing structures are predominantly residential dwellings, with some small commercial uses. The East Urban Community's designation as a Developing Community in the City of Ottawa Official Plan sets the requirement for the completion of a CDP for the lands. There will be more residential housing, commercial sites, 3 elementary schools, and a fire station. It should be noted that there are multiple statements in the CDP regarding burying hydro lines along particular roads.

Escarpment Area District Plan

Boundaries: Lebreton Flats, Garden of the Provinces, Bay Street, Laurier Avenue
Transportation Projects: New roads (no impact on existing/proposed transit system)

Over the next 15 years, the Escarpment District will develop into a diverse and attractive downtown community. This will include new residential developments (various types – ex. high rise buildings), commercial buildings, and an Ottawa Technical High School. It is noted that hydro services are located adjacent to the study area, and that Hydro Ottawa will be contacted in advance of site plan approval to confirm the adequacy and availability to service the proposed development.

Fernbank CDP

Boundaries: Stittsville, Carp River, Terry Fox Dr, South of Hazeldean Rd to Fernbank Rd
Transportation Projects: Widening of Hazeldean Rd, Terry Fox Dr, Kanata West road network, Extension of Western Transitway, Extension of rapid transit corridor & north-south arterial

The study area currently contains rural and agricultural uses, including 2 transmission corridors. Development will include residential and commercial uses. It has been noted that Hydro Ottawa has confirmed that there is plant in reasonable proximity of the study area, and that there is adequate supply to service the Fernbank community.

Greely CDP

Boundaries: Mitch Owens, Sale Barn, Fox Valley, Snake Island Rd
Transportation Projects: Updated Road Network

The objectives of this CDP are to provide more residential dwellings, and to develop the Village Core, which will include residential, commercial and institutional uses. There will be a shopping centre. Note that the CDP mentions an expansion of utility services which will be installed efficiently to minimize disruptions.

Leitrim CDP

Boundaries: Leitrim Rd, Bank St, Albion Rd
Transportation Projects: Future LRT Station (North-South LRT Corridor) and Park & Ride Lot, 4-lane Bank St & Albion Rd, 2-lane Leitrim Rd & Earl Armstrong Dr Extension

The majority of Leitrim is presently undeveloped, but there are existing commercial, institutional, industrial and residential uses throughout the area. The plan involves adding 3 mixed use centres along Bank Street to accommodate commercial, institutional, residential and service uses. There will be 4 elementary schools, higher density residential uses and 10 residential neighbourhoods.

Mer Bleue CDP

Boundaries: Hydro Corridor, Mer Bleue Rd, Tenth Line Rd, Southern Urban Boundary
Transportation Projects: East-West Transit Expansion along northern boundary (Stations at Mer Bleue & Tenth Line), Blackburn Hamlet By-pass Extension, Innes Rd Widening 4-lanes

The CDP area is part of the Orleans Expansion Area. There are currently residential and rural uses, developing commercial uses and a HONI corridor. The plan will potentially involve 2 new schools, as well as residential, commercial and mixed-use development. The CDP notes that private utilities shall be permitted in all land use designations, utilities must confirm the ability to provide service prior to development, and developers should consult with utilities early on.

Kanata West Concept Plan

Boundaries: Highway 417, former: Township of West Carleton, Township of Goulbourn, City of Kanata
Transportation Projects: Transit Corridor Extension (Kanata Town Centre to CTC), Highway 417 widening 6/8 lanes, Terry Fox Dr Widening (Upgrade Interchange), Hazeldean Rd Widening, Eagleson Rd Widening, Construct Castlefrank Rd Interchange
Existing uses within the area are limited, but include the Canadian Tire Centre (CTC) and related offices, the City of Ottawa Works Yards, the Wesleyan Church of Canada, and some residential dwellings. The concept plan involves creating office uses, housing, retail, institutional and entertainment uses. The Mixed Use area is the heart of this new community with 3 integrated land use concepts – the Community Core Zone, the Major Facilities Zone, and the Institutional/Corporate Campus Zone. There will also be a Prestige Business Park, and 2 residential areas. The plan notes that the proposed development area is split between HONI and HOL, and it states that HONI will act as the lead representing both utility companies. It is stated that there is adequate capacity to serve initial loads, and new sources will be brought into the area as loads exceed capacity.

North Gower CDP

Boundaries: Centered on crossing of 3 roads: Prince of Wales, Roger Stevens, Fourth Line
Transportation Projects: Multi-Use Pathway Plan (including new sidewalks), Future Local Road Network

North Gower is a vibrant farming community in a rural setting. There are currently some small commercial uses in the Village Centre. The goal of the CDP is to provide a variety of business to support the community, and to provide more housing for residents. There will be added commercial uses. It is noted that some residents would like overhead lines buried within the Village Centre. They would like to see upgraded street lighting for safety purposes, along certain streets such as Prince of Wales, Roger Stevens and Fourth Line. They would also like to see lighting throughout new subdivisions and on the bridges.

Old Ottawa East CDP

Boundaries: Rideau River, Rideau Canal, Riverdale, Highway
Transportation Projects: Widen Sidewalks (Main St, Lees Ave), Roundabout at Main/Riverdale Intersection, Narrow Main St from 4 to 3 lanes

The study area primarily focuses on Main Street, along which there are some clusters of retail uses. A large percentage of the land is occupied by institutions and there is a large portion of residential space.

The plan involves intensifying lots in a mixed-use format, adding residential and commercial uses, and enhancing a mixed-use centre precinct at the east end of Lees Ave (near Ottawa University campus). The CDP notes that priority will be given to the burial of overhead wires in some locations.

Orleans Industrial Park Study

Boundaries: Innes Rd, Hydro Corridor, Pagé Rd, Tenth Line Rd
Transportation Projects: Innes Rd Expansion 4-lanes, Widening of Mer Bleue Rd & Tenth Line Rd

The study area currently contains residential and commercial uses. There is a HONI Transmission Corridor on the south border of the study area. Proposed development includes a 45 m^2 commercial development and an 18.7 ha snow disposal facility. The industrial park will be modified without disturbing the surrounding residential areas.

Queensway Terrace North

Boundaries: Carling Ave, Transitway, Queensway, Pinecrest Rd
Transportation Projects: No Relevant Projects
This study was undertaken in response to increasing community concerns over the number of residential triplex conversions within the area, which are not in compliance with Zoning By-law 1998. The goal of this study was to conduct a review of the likely forms, locations and appropriate levels of intensification, the ability of existing infrastructure to accommodate growth, and the potential impact of evolving City Council intensification policies on this neighbourhood. The results of this study do not appear to directly affect Hydro Ottawa or any of its assets.

Richmond Road/Westboro CDP

Boundaries: Ottawa River, Island Park Dr, Byron Ave, Ottawa River Parkway Extension
Transportation Projects: Potential Transitway Station in New Orchard Area

This CDP was undertaken because neighbouring residential communities were concerned with several rezoning applications for substantial increases in maximum building height. They viewed increased building heights as being incompatible with the existing character of Richmond Road. The study area currently contains a mix of residential housing types, retail, office, institutional, commercial and industrial uses. The study area has been divided into several sectors. Between all of them, there will be new residential communities with commercial mixed-use buildings, offices, institutional and industrial development. The CDP also mentions the installation of pedestrian-oriented street lighting, and the possibility of placing overhead wires underground.

Richmond Road/Westboro Transportation Management Plan

Boundaries: Ottawa River, Island Park Dr, Byron Ave, Ottawa River Parkway Extension
Transportation Projects: Making Transit More Accessible, Improve Sidewalks, Bike Lanes

The purpose of this plan is to promote a shift to more sustainable modes of transportation in the Richmond Road/Westboro community over the next 15 years. The peak period auto modal share must decrease by 13% to avoid the need for additional roadway capacity. This plan includes designating bike lanes, sidewalk improvement projects, and making public transit more accessible.

Riverside South CDP

Boundaries: Ottawa Macdonald-Cartier International Airport, Rideau River
Transportation Projects: Rapid Transit Corridor + Stations

The northwest portion of the site is currently developed as a residential subdivision, and the CDP focuses on the surrounding area east of the river. This plan involves development of a rapid transit corridor, residential areas and an employment area. The subdivision will be expanded to include a variety of uses and housing types.

Scott Street CDP

Boundaries: Northwestern Ave, Bayview Rd, West Wellington St, North of Burnside Ave
Transportation Projects: Confederation LRT to Tunney's Pasture, Extend Sir Frederick Banting north to connect to Sir John A. Macdonald Parkway, Extend Goldenrod Driveway

This CDP is intended to guide future change in the area surrounding the Tunney's Pasture Transit Station. This involves 4 established neighbourhoods: Mechanicsville, Hintonburg, Wellington Village and Champlain Park. Development will include commercial uses, residential uses, institutional and cultural uses. Apartment neighbourhoods will be expanded. The CDP acknowledges that there is an existing hydro substation on Scott Street, and there are no changes proposed for the zoning of these sites.

South Nepean Town Centre CDP

Boundaries: Strandherd Dr, Jock River
Transportation Projects: 2 Rapid Transit Routes, LRT & BRT Alignments

The Town Centre is intended to be a compact, mixed-use, walkable, pedestrian-scaled, and transit-supportive community. It will include a shopping district, retail, office and residential uses.

St. Joseph Boulevard Corridor Study

Boundaries: Montreal Rd in Vanier, Rideau in downtown Ottawa, Wellington St in front of Parliament
Transportation Projects: ---

St. Joseph Boulevard is one of the City's major arterial roads, and is classified as a commercial strip. The purpose of this study is to create a lively, vibrant and diverse district with a mix of places to live, work, shop and play. The study area is divided into 4 basic districts: industrial, neighbourhood commercial, main street, and residential hinterland. Development will involve industrial uses, commercial, office and community uses. There will also be more residential uses, retail uses and government facilities. The Study mentions that there are overhead utility poles along St. Joseph Boulevard and both sides of the street, as well as crossing the road. The City currently has no plans to bury the utility lines, but sees underground hydro service as a long term goal.

Uptown Rideau CDP

Boundaries: Rideau St (between King Edward Ave, Cummings Bridge)
Transportation Projects: Sidewalk Widening (eliminate OH hydro plant)

There are currently a mix of retail/office uses and retail/residential uses along the street. The goal is to transform the street into a green, pedestrian streetscape of the highest quality in a compact urban setting, framed with 3-6 storey buildings on both sides of the street. The mainstreet will serve a mix of residential, commercial, institutional, and entertainment functions. The community would like the hydro poles and overhead wires to be removed, as a first priority. This should be done in conjunction with street reconstruction.

Transit-Oriented Development (TOD) Plans

Ottawa's Light Rail Transit (LRT) project runs east-west from Tunney's Pasture in the west to Blair Road in the east. The LRT system includes 12.5 km of new rail, 13 stations and a tunnel through the downtown core. Ten of the stations are a conversion or reconstruction of existing bus rapid transit stations to accommodate light rail and the other three stations are new underground stations in the downtown area. The final design phase and construction will be undertaken over the next few years with system opening day scheduled for 2018.

In anticipation of land development pressure in proximity to the LRT stations, City Council has established priority areas for the creation of transit-oriented development (TOD) plans. The TOD plans set the stage for future transit-supportive, or "intensified", land development by adding in appropriate locations opportunities for additional land use types and densities. The first three TOD studies for land surrounding the "Train", "St. Laurent" and "Cyrville" future LRT stations were approved by City Council on November 14, 2012.

The following concerning Hydro Services is noted:
The main findings and recommended upgrades are as follows:

- *Substation spare capacity is currently limited, especially at Overbrook, Russell, and Moulton.*
- *Overbrook, Russell, and Moulton are already planned to be enlarged by Hydro-Ottawa.*
- *Circuit capacity will have to be upgraded by addition of new lines, especially Russell, and to a lesser extent, Riverdale and Moulton.*

Assuming a slightly lower build-out rate of 25% of eventual build-out within 20 years, the Hydro Ottawa substation build-out plans are not significantly altered. It may only delay the trigger points where additional circuit capacity must be added for development loading. Most of the developer related circuit build-out costs are triggered within the first 10 years using initially proposed build-out rates plans.

Village of Richmond CDP

Boundaries: South of Kanata on either side of Jock River
Transportation Plans: Sidewalk Widening

This CDP involves redeveloping the shopping centre in the village, new residential buildings and possibly small commercial buildings. The plan mentions moving buildings closer to the street while adhering to overhead setbacks. The plan seems to be more visually oriented, rather than large expansion.

Wellington Street West CDP

Boundaries: Wellington St (Holland Ave, Parkdale Ave, Spencer St)
Transportation Plans: Road Reconstruction Project (surface and sub-surface infrastructure)

This CDP contains the following goals: to enhance the existing mix of land uses, to establish a clear network of people spaces, to strengthen the traditional built form and spaces through respect and innovation, to capture the opportunities of mainstreet gateways and nodes, to encourage views and vistas, to link the varied character areas together as a unified corridor, and to promote a pedestrian and transit friendly environment. The plan involves adding more residential and commercial uses.