Water Supply Master Plan Update Final Report

FINAL REPORT

Prepared for:
Region of Waterloo

Prepared by:
Stantec Consulting Ltd.

March 2015

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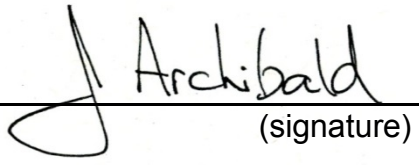
Reviewed by  (signature)

Jim Archibald, P.Eng.

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Abbreviations

The following section provides the definitions for the acronyms used in this report.

Acronym	Definition
2007 Strategy	2007 Water Supply Strategy
A.Mun.s	Area Municipalities
ASR	Aquifer Storage and Recovery System
BPS	Booster Pumping Station
CAM	Indicates Cambridge Pressure Zone
Cambridge	City of Cambridge
Class EA	Class Environmental Assessment
CV	Control Valve
DWWP	Drinking Water Works Permit
EA	Environmental Assessment
ESL	East Side Lands
ET	Elevated Tank
GHG	Greenhouse Gas
HGL	Hydraulic Grade Line
IUS	Integrated Urban System
KIT	Indicates Kitchener Pressure Zone
Kitchener	City of Kitchener
L/s	Litres per second
LTWS	Long-term Water Strategy
MLD	Million Litres per Day
MOE	Ministry of the Environment
MTV	Motorized Throttle Valve
MV	Motorized Valve
MWTP	Mannheim Water Treatment Plant
PCC	Public Consultation Centre
PTTW	Permit to Take Water

Acronym	Definition
PRV	Pressure Reducing/Relief Valve
PS	Pump Station
Region	Region of Waterloo
ROP	Region Official Plan
RSC	Required Surplus Capacity
STELM	St. Jacobs and Elmira
SCADA	Supervisory Control and Data Acquisition
TCE	Trichloroethylene
Tech Memo	Technical Memorandum
TP	Treatment Plant
WAT	Indicates a Waterloo Pressure Zone
Waterloo	City of Waterloo
Woolwich	City of Woolwich
WSS	Water Supply System
WSDOMP	Water Supply and Distribution Operations Master Plan
WSMP Update	Water Supply Master Plan Update (2011)
WTP	Water Treatment Plant

Executive Summary

Introduction and Objectives of the Water Supply Master Plan Update

This Final Report represents the updated Water Supply Master Plan (WSMP Update) (2011) for the Region of Waterloo. The WSMP Update will guide medium to long-term (10 to 40 years) water supply planning for the Region of Waterloo's Integrated Urban System (IUS) to ensure the availability of a sustainable water supply.

The objectives of this recent update process were to:

- Understand recent IUS water demand patterns and use this information to update the most recent water demand projection;
- Confirm the capacity and identify constraints of all existing and planned water sources feeding into the IUS;
- Optimize existing and planned water sources in the IUS; and
- Formulate a preferred strategy for the WSMP for the 30-40 year planning horizon, with emphasis on the next 10 to 20 years in relation to the examination of existing water sources.

Drivers for the WSMP Update

This WSMP Update was initiated in response to the declining trend of IUS average and peak water demands as compared to the projections in the previous WSMP (2007 Strategy). The reduction in system water demands is due in part to water conservation and efficiency efforts, intensification and economic factors and has been sustained over the last several years. The decrease in the peak flows has shifted the focus from meeting maximum week demands to meeting average day demands as a more critical factor for long-term water supply management. In addition to the decrease in demands, groundwater pumping rates have also been reviewed and revised in light of recent studies undertaken as part of the Clean Water Act. This has resulted in slightly lower average day sustainable pumping rates for some well fields than what was originally permitted.

The planning and policy framework of the WSMP Update was considered and several key studies completed concurrently were incorporated in this Update. These include the Water Supply and Distribution Operations Master Plan (WSDOMP), Water Efficiency Master Plan (WEMP), Tier 3 Water Supply Assessment (Tier 3 Assessment), and various water supply source Class Environmental Assessments (EAs).

WSMP Update Methodology

The WSMP Update (2011) was carried out by Stantec Consulting Ltd. (Stantec) working closely with the Region of Waterloo's (Region) Water Services Division. A Stakeholder Group was established to provide guidance to the Project Team and included representatives from local Area Municipalities, relevant governmental agencies, and staff from various Regional departments. The WSMP Update comprised of five (5) workshops with various stakeholders and five (5) technical memoranda (Tech Memos) to generate this Final Report. The WSMP Update included consultation with the public, agencies, and stakeholders as well as one set of three Public Consultation Centres to present and receive feedback on the preliminary strategy.

Water Demand Update

Based on the declining per capita demand trends, demand forecasting was updated for the newly observed demand trends up to 2031 in detail for each pressure zone and from 2031 to 2051 for the entire IUS. System demands were estimated based on population forecasts and per capita water use trends anticipated to represent probable future demands. The result was a revised projection for the average and maximum day demands forecasted for the Region up to 2051. The forecasted IUS demands at major intervals are presented in Table ES-1.

Table ES-1: IUS Average and Maximum Day Demand Actuals and Projections

Year	Average Day		Maximum Day	
	L/s	MLD	L/s	MLD
2012	1,659	143	2,127	184
2031	1,868	161	2,461	212
2051	2,276	197	2,991	258

Analysis of Projected Demands vs. Existing Supplies

In light of the policy framework and recent studies, a thorough review of supply rates, treatment systems, and the availability of water in the context of the distribution system and water demands was undertaken to identify opportunities for supply optimization and new groundwater supplies. The total sustainable supply capacity available today to the IUS, which includes only existing permitted supply sources as of 2013, is summarized in Table ES-2.

Table ES-2: Existing (2013) IUS Supply Sources and Capacity

Source	Average Day		Maximum Day	
	L/s	MLD	L/s	MLD
Groundwater	1440	120	2095	181
Surface Water	795	73	795	69
Aquifer Storage and Recovery (ASR)	0	0	231	20
TOTAL	193 MLD		270 MLD	

Note: Supply rates are provided as treated water available, which has accounted for applicable treatment losses.

The "Required Surplus Capacity" (RSC) is a new strategic supply management parameter introduced in this WSMP Update. Setting RSC to a sufficient amount for average day supply will significantly reduce the potential for water shortages. The surplus capacity serves to safeguard supply for average day demands in light of operating needs (supplies offline for maintenance, etc.), unexpected outages, and the uncertainty of the sustainable supply rate estimations. Based on maintaining a supply surplus of approximately 20% above the forecasted average day demands, there is a supply-demand gap in the IUS of approximately 39 MLD by 2051.

Since the supply sources in Table ES-2 are distributed geographically throughout the Region, the available supply was reviewed in the context of the distribution network and the location of water demands. This was done to ensure that enough water is sustainably available to the IUS as a whole and on the local scale within each pressure zone in the IUS.

Evaluation of Supply Alternatives

The objective of the supply alternatives' evaluation was to generate supply recommendations to ensure sufficient supply in each pressure zone and to close the projected supply gap of approximately 39 MLD by 2051. Supply alternatives to meet future demands were developed based on the 2007 Strategy recommendations, insights gained from Tasks 1 through 4 of the WSMP Update, and the recommendations in the WSDOMP Draft Final Report (March 2014). The generated alternatives were evaluated, and top ranked alternatives created the preliminary preferred Supply Alternatives presented to the public for review at the consultation centres.

Updated Water Supply Master Plan Strategy

Based on the updated demand projections, updated supply rates, and evaluation of supply alternatives, the WSMP Updated Strategy includes the following measures:

1. Address Constraints in Supply and Distribution:

    - Addressing constraints in distribution of supply by removing bottlenecks, planning for intensification, and improving energy efficiency. This is supported by the WSDOMP (March 2014).

2. Increase Groundwater, as needed, to maintain sustainable average day capacity at least 20% above projected demand:

    - Constructing new groundwater facilities, including Waterloo North WTP and the Central Grand River/Maple Grove WTP, as required to increase supply. An approximate increase of 317 L/s (27.5 MLD); and,

    - Constructing improvements to existing Cambridge water treatment plants (Turnbull TP and Pinebush TP) and wells (G4/G4A, G5/G5A, Hespeler wells) to optimize the quantity of water produced. An approximate increase of 263 L/s (22.8 MLD)).

3. Continue to improve water efficiency and conservation efforts to reduce demands.

4. Peaking and capacity increases to address peak demands, such as implementing Phase II of the Region's ASR system to manage peak water demands which occur in dry summer months (approximately 266 L/s (23 MLD)), and performing hydrogeological assessments on constrained well fields.

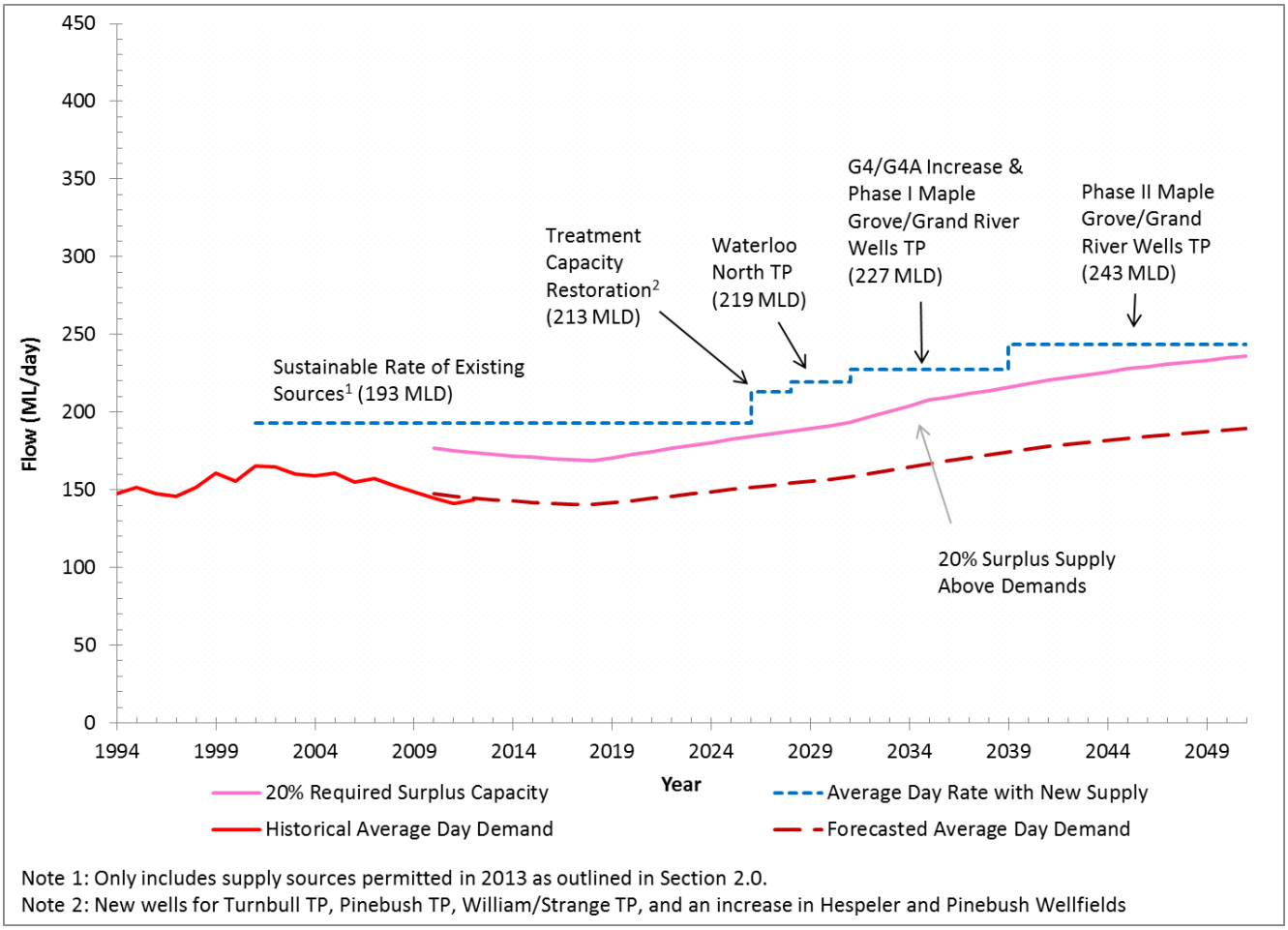
5. Updating the WSMP regularly (approximately every 5 years).

6. Deferring the Great Lake Supply beyond 2051 and consider water reuse for long-term water supply planning.

Where the 2007 Strategy included the construction of the Great Lake supply, the decreasing trend in demands has renewed the focus on improving the efficiency of water distribution in the IUS and addressing localized surpluses and shortages of water. It was determined that there are enough water supplies available in the Region to meet demands with some investments in source capacity restoration of facilities, new groundwater facilities, and distribution optimization up to 2051. The Great Lake Supply along with Water Reuse are considered as a potential long-term solution beyond 2051. Figures ES-1 and ES-2 show the proposed schedule of implementation for the recommended Supply Alternatives that result in an increase in total supply. Figures ES-1 and ES-2 also demonstrate that the proposed Supply Alternatives maintain the Required Surplus Capacity for average day demands and also meet the needs for peak demands.

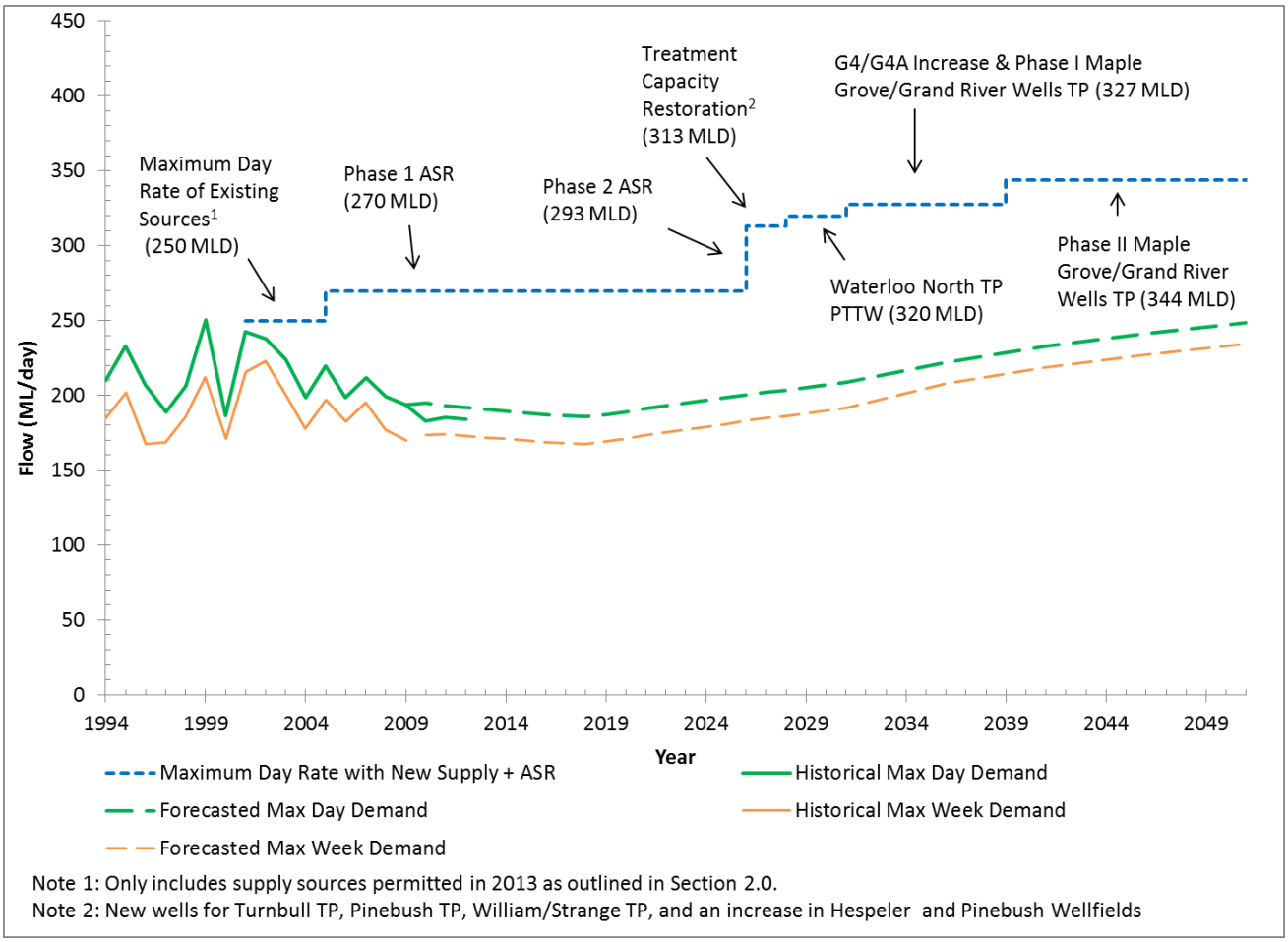
The total estimated capital budget up to 2031 (20 year window) to implement the preferred supply alternatives is $54.6 million (2014 $s).

Figure ES-1: Average Day Supply-Demand Configuration to 2051 with Implemented Supply Alternatives and 20% Required Surplus Capacity



Note 1: Only includes supply sources permitted in 2013 as outlined in Section 2.0.
Note 2: New wells for Turnbull TP, Pinebush TP, William/Strange TP, and an increase in Hespeler and Pinebush Wellfields

Figure ES-2: Maximum Day and Maximum Week Supply-Demand for the IUS to 2051 with Implemented Supply Alternatives



Note 1: Only includes supply sources permitted in 2013 as outlined in Section 2.0.
Note 2: New wells for Turnbull TP, Pinebush TP, William/Strange TP, and an increase in Hespeler and Pinebush Wellfields

1.0 Introduction

The Regional Municipality of Waterloo (Region) is responsible for supplying drinking water throughout the Tri-Cities and surrounding area through the integrated urban system (IUS) and various individual rural systems. The IUS includes the Cities of Cambridge, Kitchener, Waterloo, and Towns of St. Jacobs and Elmira, as well as a number of smaller communities in parts of Woolwich, Wilmot and North Dumfries Townships. The IUS draws groundwater from 75 production wells as well as surface water from the Grand River. Numerous regional treatment, disinfection and pumping works ensure that high quality water is delivered through the distribution system to meet the demands of the communities. Water distribution to individual customers is the responsibility of the aforementioned Cities and Townships.

This Final Report represents the Water Supply Master Plan Update (WSMP Update) (2011) for the Region. The WSMP Update was initiated to update the 2007 Water Supply Strategy (2007 Strategy) to reflect the trend of declining water demands in the Region and to review supply versus demand on a local scale. The primary objective of the project was the optimization of existing and planned water supply sources for the medium-term planning horizon (10 to 20 years) and to determine the water supply required for the long-term planning horizon (30 to 40 years) in order to meet demands and maintain a factor of safety in supply capacity.

The WSMP Update project was planned and implemented in accordance to the Municipal Class Environmental Assessment process for Master Plans (Municipal Engineers Association, June 2000, as amended in 2007 and 2011). The project was organized to consist of a Region Project Team, Consultant Project Team and a Stakeholder Group. The WSMP Update was completed by accomplishing nine major tasks including:

- Task 1: Start-up and Data Collection.
- Task 2: Demand Projections to 2051 (Technical Memorandum 1).
- Task 3: Water Sources/Treatment Facilities (Technical Memoranda 2 and 3).
- Task 4: Zone-Wise Supply Demand Analysis (Technical Memorandum 4).
- Task 5: Opportunities/Constraints Analysis (Technical Memorandum 5).
- Task 7: Master Plan Formulation, Presentation and Reporting (Final Report).
- Task 9: Project Management of the Update Project.

Outcomes of Tasks 1 through 5 were used to develop the updated Water Supply Strategy. Task 6: Optimized Operations Report and Task 8: Operator Level Guidance Document were both deferred to be completed as separate projects after the completion of the WSMP Update.

Public consultation occurred throughout the project and included notification to relevant stakeholders and agencies at project commencement, Public Consultation Centres (PCC),

workshops with stakeholders, and notification of the 30-day public review period for the Final Report (Task 7).

The purpose of the Final Report for the WSMP Update is to summarize the master planning process, the outcome of the above tasks, and provide the preferred Water Supply Strategy. This report is organized into nine (9) sections.

- Section 1.0 provides an introduction to the project, the structure of the Report, and project objectives.
- Section 2.0 provides an overview of the Integrated Urban System (IUS) and supply sources, summarizing Task 3.
- Section 3.0 provides background information on the main drivers for the update, including regulatory and policy changes and studies related to the WSMP Update, such as the Water Supply and Distribution Operations Master Plan (WSDOMP).
- Section 4.0 includes the WSMP Update process and methodology of the update.
- Section 5.0 provides an overview of the various public, agency and stakeholder consultations which occurred throughout the WSMP Update.
- Section 6.0 provides an overview of the water demand forecast updates, summarizing Task 2.
- Section 7.0 includes the analysis of projected demands versus the water supply sources and the distribution system completed for Tasks 2 and 4.
- Section 8.0 includes the methodology for generating and evaluating the supply alternatives for the WSMP Update completed for Task 5.
- Section 9.0 presents the Updated WSMP Strategy components and estimates on implementation costs and timing, summarizing the outcome of Task 5.

1.1 Problem Opportunity Statement Objectives of the WSMP Update

The purpose of the Region's WSMP Update is to provide guidance on planning and implementation of capital projects and water management programs for the medium- to long-term planning window to ensure adequate water supply to the IUS. The current WSMP Update (2011) is an update to the 2007 Water Supply Strategy (2007 Strategy). The primary focus of the 2007 Strategy was to assess the effect of planning, technical and regulatory changes since the 2000 WSMP and any resultant impact on the timing of a lake-based water supply system. The WSMP Update was initiated to review the impact of recent decreasing trends in demands observed since the 2007 Strategy and evaluate the supply of individual sources compared to demand on a local scale over the medium- to long-term horizon. The objectives of this recent WSMP update process were to:

- Understand recent IUS water demand patterns and use this information to update the most recent water demand projection.
- Confirm the capacity and identify constraints of all existing and planned water sources feeding into the IUS.
- Optimize existing and planned water sources in the IUS.
- Formulate a preferred strategy for the WSMP Update for the 30 to 40 year planning horizon, with emphasis on the next 10 to 20 years in relation to the examination of existing water sources.

2.0 Background

2.1 The Integrated Urban System (IUS)

The existing Integrated Urban System (IUS) services the Area Municipalities (A.Mun.s) of Kitchener, Waterloo, and Cambridge (Tri-Cities) as well as towns and settlement areas within the surrounding Townships, including Woolwich (Elmira, St. Jacobs, and Breslau), Wilmot (Mannheim and Shingletown), and North Dumfries (Lloyd Brown). The Region also services 16 smaller rural communities located in the four Townships. These communities are supplied by smaller communal systems independent of the IUS. The focus of the WSMP Update is limited to the IUS.

Potable water in the IUS is delivered to the customer through a two-tier system. The Region provides wholesale water to each A.Mun. in the IUS. The Region owns and operates the water treatment plants, groundwater wells, pumping stations, reservoirs, and trunk watermains. A.Mun.s are responsible for the distribution of water to customers in their respective municipality and own and maintain the local distribution watermains.

Water supply in the IUS originates from two sources: groundwater and surface water. Groundwater supply from production wells located throughout the Region represents approximately 75% of the total supply during typical conditions. Surface water is drawn from the Grand River and treated at the Mannheim Water Treatment Plant (MWTP) and represents approximately 25% of the total supply during typical conditions. The total capacity of groundwater to surface water supplies is closer to 65% and 35%, respectively. The IUS supply and distribution system is complex, including one surface water treatment plant, aquifer storage and recovery (ASR) wells, 75 production wells, 5 groundwater treatment plants, servicing multiple A.Mun.s in 24 pressure zones. Figure 2-1 provides an overview of the wells and treatment facilities in the IUS. Information on the supply capacity of the various water supply facilities is discussed further in Section 2.2 and the water demands for each A.Mun. pressure zone will be discussed in more detail in Sections 6.0 and 7.0.

Stantec

TOWNSHIP OF WELLESLEY

TOWNSHIP OF WOOLWICH

CITY OF WATERLOO

CITY OF KITCHENER

CITY OF CAMBRIDGE

TOWNSHIP OF WILMOT

TOWNSHIP OF NORTH DUMFRIES

Elmira East

Elmira

St Jacobs

Market

Kit 4A

Wat 4

Bridgeport

Breslau North

Breslau South

Wat 5

Wat Zone 6

Wat 7

St Agatha

Erb Street Supply

Kit Zone 6

Kit 5

Kit 4

Kit 2E

Kit 2EA

Kit 2W

Cam 2W

Cam 2E

Cam 1W

Cam 1

Cam 3

Cam 1A

Mannheim 5

Mannheim

Shingletown

Mannheim Supply

Lloyd Brown

N

5 km

1:125,000

Test Well		
Key	Number of Wells Represented	Names
1	1	Laurel Tank Well
2	1	W5A
3	1	H5A
4	1	H4A
5	1	H3A
6	1	FSTP1-10
7	1	G5A
8	2	P10A,10B
9	1	PBTW1-05
10	1	PBPW1-06
11	1	CMPW1-06
12	1	CMPW2-06
13	1	G4A
14	2	K-SS-TW1-11,13

Facility		
Key	Name	Status
A	Laurel Tank & Lakeshore West PS	Existing
B	Waterloo North TP	Proposed
C	William Street PS	Existing
D	Strange Street TP	Existing
E	Erb Street Reservoir	Existing
F	Zone 6 Reservoir	Existing
G	Greenbrook TP	Existing
H	Maple Grove TP	Proposed
I	Parkway TP	Existing
J	Pinebush ET & TP	Existing
K	Hidden Valley Reservoir & PS	Existing
L	Freeport ET	Existing
M	Rahmans Reservoir & PS	Existing
N	Mannheim WTP & PSs	Existing
O	Strasburg TP	Existing
P	Turnbull TP & Reservoir	Existing
Q	Shades Mill TP	Existing
R	Middleton TP	Existing
S	St Andrews ET & PS	Existing
T	South Cambridge Reservoir & PS	Existing
U	Inverness ET	Existing
V	Howard ET & PS	Existing
W	Elmira West ET	Existing
X	St Jacobs Reservoir & PS	Existing

Well		
Key	Number of Wells Represented	Names
1	1	K42A
2	1	K41
3	1	W10
4	5	W1C,1B,2,3,15
5	6	K70-75
6	1	H5
7	3	K80-82
8	4	K11A,13,18,19
9	1	K10A
10	1	W6A,6B
11	2	W7,8
12	1	H4
13	5	K1A,2A,4B,5A,8
14	1	H3
15	1	P16
16	3	K31-33
17	3	P10,11,17
18	2	P9,15
19	1	G5
20	4	K91-94
21	1	K21
22	6	ASR
23	2	K25,29
24	1	G6
25	2	K22A,23
26	1	G16
27	1	G17
28	1	G18
29	1	P6
30	2	K34,36
31	2	K50,51
32	1	K24
33	1	K26
34	2	G38,39
35	2	G7,8
36	1	G4
37	1	G9
38	5	G1-3,1A,14
39	1	G15

Pressure Zone
Road
Municipality
Waterbody

Coordinate System: NAD 1983 UTM Zone 17N
Produced using data under license with the Regional Municipality of Waterloo and the Ontario Ministry of Natural Resources.

Project:
Regional Municipality of Waterloo Water Supply Master Plan Update

Title:
IUS Water Supply Sources - Existing and Planned

Figure Number: **2-1**

Project Number: **161111001**

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Revised: 2014-11-21 By: kbuchanan

2.2 Existing and Planned Water Supplies and Capacity

This section will provide an overview of the supply sources and facilities. For more detailed descriptions, reference can be made to Tech Memos 2 and 3 in Appendix B and C respectively.

The Region's water supply to the IUS is obtained from three primary sources, as follows:

- Groundwater
- Surface water (Grand River)
- Aquifer Storage and Recovery (ASR) at the Mannheim Water Treatment Plant

The following definitions have been established for the WSMP Update to describe different pumping rates associated with these sources.

Average Day Rate: The recommended average day pumping rate limits are based on the Tier 3 Assessment (refer to Section 3.3.4) which considered the influence of pumping from nearby wells or well fields and potential impacts to environmental features as well as the long-term sustainability of the supply under drought conditions and changing land uses. The average pumping rate is calculated by dividing the total volume pumped in a given year by the number of days in a year (365 days) which assumes in a given year the well is pumped every day for 24 hours per day.

Maximum Day Rate: The maximum day rate is the maximum pumping rate that can be sustained from a well based on Permit to Take Water (PTTW), well performance or aquifer yield constraints. The maximum day pumping rate is defined as that which could be supplied 24 hours a day, 365 days a year and does not consider potential interference with adjacent wells or well fields. This provides a conservative estimate of the maximum day capacity as pumping at these higher rates is generally restricted to short periods of time.

Peak Pumping Rate: The pumping rate that can be obtained from a well for a short duration based on PTTW constraints and/or well performance or aquifer yield. Only certain sources have permitted peaking capacity, for example ASR, Mannheim East Peaking (K90s), and Middleton wells.

Pertaining to surface water taking, the withdrawal rate (average, maximum and peaking) is governed by the Permit to Take Water (PTTW) and the capacity of the treatment plant.

In some cases, the Tier 3 Assessment recommended limits were lower than the average day rate limit which was originally permitted. The total sustainable supply capacity available today to the IUS is summarized in Table 2-1.

Table 2-1: Existing (2013) IUS Supply Sources and Capacity

Source	Average Day		Maximum Day	
	L/s	MLD	L/s	MLD
Groundwater	1,440	120	2,095	181
Surface Water	795	73	795	69
ASR	0	0	231	20
TOTAL	193 MLD		270 MLD	

Note: Supply rates are provided as treated water available, which has accounted for treatment losses (approximately 5%), where applicable.

The supply sources in Table 2-1 are distributed geographically throughout the Region, as was demonstrated in Figure 2-1. The analysis of the IUS supply determines if there are gaps between sustainable supply capacity and demands for the IUS as a whole and on the local scale within each IUS pressure zone.

The locations of water supply facilities in the IUS which are designated as planned facilities are also provided in Figure 2-1. Planned supply facilities include new sources that have been identified through previous Class Environmental Assessments (EAs) and hydrogeological studies to either replace existing wells or provide additional supply capacity, and are in various stages of construction and permitting. The timing of implementation of these planned projected will be updated in this WSMP. Details of the various water sources in Figure 2-1 are presented in the following sections arranged by source type (groundwater, surface water, ASR).

2.2.1 Groundwater

Groundwater makes up approximately 75% of the water supplied to the IUS during typical operating conditions. Groundwater sources are located throughout the IUS and include: 1) individual wells that are disinfected by ultraviolet (UV) reactors, chlorination or chloramination and supply directly to the distribution system, and, 2) a collection of wells that flow to a centralized treatment and storage facility and then discharge to the distribution system. In the following sections, divided by area municipality, an overview of the groundwater treatment facilities is provided. This overview outlines the respective pressure zone, treatment processes, and rated capacity for existing and planned groundwater sources.

2.2.1.1 Cambridge Groundwater

Cambridge is primarily supplied by groundwater sources located within Cambridge. Groundwater treatment facilities in Cambridge include:

- Middleton Treatment Plant (TP)
- Shades Mills TP
- Pinebush TP
- Turnbull TP

Cambridge groundwater system wells include:

- G4/G4A, G9, G6, G5/G5A, P6, P16, H3/H3A, H4/H4A, and H5/H5A

Cambridge facilities use chlorination for secondary disinfection, whereas the rest of the IUS utilizes chloramination for secondary disinfection. Mixing of chloraminated and chlorinated water creates aesthetic problems related to taste and odour, and therefore is minimized where possible.

There are five (5) existing and one (1) planned pressure zones in Cambridge, including CAM 1, CAM 1W (proposed 2016), CAM 1A, CAM 2E, CAM 2W, and CAM 3. CAM 1 is centrally located in Cambridge and contains Middleton TP, which is the largest capacity groundwater facility in the IUS. As a result of Middleton TP's capacity, it is capable and at times relied upon for transferring water to all but one pressure zone within the Cambridge portion of the IUS. The Lloyd Brown subdivision in the Township of North Dumfries is supplied via a connection to pressure zone CAM 3.

Table 2-2 provides a summary of the existing groundwater supply sources in Cambridge including: the zone in which it is located, the average and maximum treated water rates carried in this WSMP Update, and the status of the source.

Table 2-2: Cambridge Groundwater Facilities and Treated Water Currently Available by Pressure Zone and Well Field

Pressure Zone and Well Supply System (WSS)	Details of Wells	Average Day Water Available (L/s) NOTE 1	Maximum Day Water Available (L/s) NOTE 1	Status NOTE 2
Cambridge				
CAM 1: Middleton and Willard NOTE 3	Middleton TP G1, G1A, G2, G3, G14, G15	270.0	397.0	Existing
CAM 1: Shades Mill	Shades TP G7, G8, G38, G39	71.0	110.8	Existing
CAM 1: Elgin Street NOTE 4	G9	0.0	24.0	Existing; Recommended as Standby Supply
CAM 3: Blair Road	G4/G4A	20.0	20.0	Existing
CAM 1: Pinebush	P9	15.0	15.0	Existing
	P15	15.0	15.0	Existing
	G5/G5A	15.0	25.0	Existing
	Pinebush TP P10, P11, P17	53.0	61.5	Existing
CAM 2E: Clemens Mill (Turnbull)	G6	10.0	15.0	Existing
	Turnbull TP G16, G17, G18	70.1	92.8	Existing
CAM 2E: Hespeler	H3	10.0	10.0	Existing
	H4/H4A	15.0	24.0	Existing
	H5	10.0	15.0	Existing
CAM 1: Dunbar NOTE 4	P6	0	10	Existing; Recommended as Standby Supply
CAM 2W: Fountain Street NOTE 4 /Maple Grove	P16	0	23	Existing; Recommended as Standby Supply
Existing Cambridge Groundwater		574.0	801.1	Presently constructed and permitted regular supply capacity.

Note 1: The average day water available is the recommended Tier 3 Assessment limit, and both the average and maximum day rates represent the amount of water supplied to the system after applicable treatment losses.
Note 2: Existing supplies are constructed and permitted, and are currently capable of supplying to the IUS.
Note 3: Middleton TP has a peaking rate of 455 L/s, however only the maximum groundwater taking rate was included in the maximum day treated water available.
Note 4: Based on Tier 3 Assessment, average day rates for P6, G9 and P16 were included as standby supply sources only and are not included in the total existing supply capacity for Cambridge.

The planned supply sources for Cambridge are presented in Table 2-3. The planned wells are those that will replace and/or enhance supply from the given well field. The supply rates are derived from hydrogeological studies, and actual supply capacities may be constrained by infrastructure or permitting. In the case of replacement wells, only additional supply capacity is presented. The planned projects exist in varying stages of completion, as is outlined in Table 2-3. Refer to Tech Memo 3: Groundwater Supply Capacity Assessment (Appendix C) for more details on Tables 2-2 and 2-3.

Table 2-3: Planned Cambridge Groundwater Supplies by Pressure Zone and Well Field

Pressure Zone and Well Supply System (WSS)	Details of Wells	Average Day Supply (L/s) NOTE 1	Maximum Day Supply (L/s) NOTE 1	Purpose and Status
Cambridge				
CAM 3: Blair Road	G4A	35.0	35.0	G4A to replace G4. Constructed; requires permitting (Class EA, and Permit to Take Water (PTTW) and Drinking Water License (DWL) amendments for additional capacity)
CAM 1: Pinebush	G5A	18.0	18.0	Constructed; requires permitting (PTTW and DWL amendments for additional capacity).
	Pinebush TP: P10A+P10B, TW1-10 , PBPW1-06, PBTW1-05	181.5	177.5	P10A, P10B to replace P10. Constructed; requires permitting (amendments to PTTW and DWL). TW1-10, PBPW1-06, and PBTW1-05 to provide additional capacity. Not Constructed; requires permitting (Class EA, PTTW, Pinebush TP DWL amendment).

Pressure Zone and Well Supply System (WSS)	Details of Wells	Average Day Supply (L/s) NOTE 1	Maximum Day Supply (L/s) NOTE 1	Purpose and Status
Cambridge				
CAM 2E: Clemens Mill (Turnbull)	Turnbull TP: CMPW1-06, CMPW2-06	60	60	Additional capacity. Not constructed; requires permitting (Class EA, PTTW, Turnbull TP DWL amendment).
CAM 2E: Hespeler	H3A	5.0	5.0	To replace H3. Constructed; requires permitting (DWL).
	H4A	30.0	21.0	To replace H4. Constructed; requires permitting (Class EA and permitting amendments for additional capacity).
	H5A	30.0	30.0	To replace H5. Constructed; requires permitting (DWL).
CAM 2W: Fountain Street/Maple Grove	Maple Grove TP: Combined P16 + FSTP1-10	60.0	60.0	Additional capacity. Not Constructed; requires permitting (PTTW and DWL). Class EA ongoing.
Approximate Planned Cambridge Groundwater Supply Capacity		434.5	421.5	To replace and augment supply capacity as needed.

Note 1: Rates presented do not include treatment losses. In most cases, further testing and monitoring is required to confirm the long-term supply capacity of planned wells.

2.2.1.2 Kitchener and Wilmot Groundwater

Groundwater in Kitchener is supplied by treatment facilities located throughout the city and water from Mannheim Water Treatment Plant (MWTP). Kitchener's groundwater TPs include:

- Greenbrook TP
- Strange Street TP
- Parkway TP
- K34/K36 (Strasburg) TP

Water sources pumped to IUS from Mannheim WTP:

- Surface water from the Grand River
- Groundwater in the Mannheim Aquifer (K20s, K90s, K50s)

Treated surface water from the MWTP is blended at the Mannheim Reservoir with groundwater from a series of wells (ratio of surface water to groundwater is approximately 2:1). Three pump stations distribute water to the IUS. Surface water supply will also be discussed further in Section 2.2.2.

There are eight (8) pressure zones in Kitchener, including Kit 2E, KIT 2EA, KIT 2W, KIT 4, KIT 4A, KIT 5, KIT 6 and Bridgeport. KIT 4 is the largest and central to the IUS and responsible for transferring water to many pressure zones within the IUS. The Mannheim Supply, which represents the collection of wells and the Mannheim surface water treatment plant, is a significant supply source to Kitchener and the IUS. Wilmot is supplied by groundwater wells which also convey water to the Mannheim Supply. The 1978 Wilmot Agreement between the Region and the Township of Wilmot governs the amount of supply which is directed to the IUS from Wilmot. In the case of the K50 wells, the transfer to IUS is restricted to 87 L/s, with the rest available to supply the Wilmot communities of Baden and New Hamburg.

Table 2-4 provides a summary of the existing groundwater supply sources in Kitchener and Wilmot including: the zone in which it is located, the average and maximum treated water rates carried in this WSMP Update, and the status of the source.

Table 2-4: Kitchener and Wilmot Groundwater Facilities and Treated Water Currently Available by Pressure Zone and Well Field

Pressure Zone and Well Supply System (WSS)	Details of Wells	Average Day Water Available (L/s) NOTE 1	Maximum Day Water Available (L/s) NOTE 1	Status NOTE 2
Kitchener and Wilmot				
KIT 4: Strange Street	Strange Street TP: K10A (K10), K11A (K11), K13, K18, K19	66.3	144.8	Existing
KIT 4: Greenbrook	Greenbrook TP: K1A (K1), K2A (K2), K4B, K5A, K8	85.2	189.3	Existing
KIT 4: Parkway	Parkway TP: K31, K32, K33	90.0	125.0	Existing
KIT 4: Strasburg	K34/K36 TP: K34, K36	30.3	49.2	Existing
Mannheim Supply: Mannheim East	K21, K25, K29	100.0	115.0	Existing
Mannheim Supply: Mannheim East Peaking	K91, K92, K93, K94	110.0	110.0	Existing
Mannheim Supply: Wilmot Centre	K50, K51	87.0	87.0	Existing
Mannheim Supply: Mannheim West	K22A, K23, K24, K26	105.0	166.0	Existing
Existing Kitchener and Wilmot Groundwater		673.8	1217.3	Presently constructed and permitted regular supply capacity.

Note 1: The average day water available is the recommended Tier 3 Assessment limit, and both the average and maximum day rates represent the amount of water supplied to the system after applicable treatment losses.
Note 2: Existing supplies are constructed and permitted, and are currently capable of supplying to the IUS.

The planned supply sources for Kitchener/Wilmot are presented in Table 2-5. The planned wells are those that will replace and/or enhance supply from the given well field. The supply rates are derived from hydrogeological studies, and actual supply capacities may be constrained by infrastructure or permitting. In the case of replacement wells, only additional supply capacity is presented. The planned projects exist in varying stages of completion, as is outlined in Table 2-5. Refer to Tech Memo 3: Groundwater Supply Capacity Assessment (Appendix C) for more details on Tables 2-4 and 2-5.

Table 2-5: Planned Kitchener and Wilmot Groundwater Supplies by Pressure Zone and Well Field

Pressure Zone and Well Supply System (WSS)	Details of Wells	Average Day Supply (L/s) NOTE 1	Maximum Day Supply (L/s) NOTE 1	Purpose and Status
Kitchener and Wilmot				
KIT 4: Strange Street	Test Well (K-SS-TW1-11 or K-SS-TW1-13)	60.0	60.0	Increase supply capacity and/or replacement for K13. Not constructed; requires permitting (Class EA, PTTW, Strange St TP DWL amendment).
KIT 4: Lancaster	K41 (grandfathered)	23.0	23.0	Additional capacity. Grand River Wells and Lancaster Wells are constructed; however they have been on standby for a number of years as the supply capacity has not been required. Will require studies and/or updated permitting to be brought online.
	K42A	27.0	27.0	
KIT 4: Grand River Wells	Future Sources: Woolner (K80, K81, K82)	115.0	115.0	
	Standby Sources: Forwell (K70, K71), Pompei (K72, K73, K74, K75)	81.0	81.0	
Approximate Planned Kitchener and Wilmot Groundwater Supply Capacity		306.0	306.0	To replace and augment supply capacity as needed.

Note 1: Rates presented do not include treatment losses. In most cases, further testing and monitoring is required to confirm the long-term supply capacity of planned wells.

2.2.1.3 Waterloo

Waterloo is supplied by groundwater sources and water from the MWTP. The groundwater treatment facilities in Waterloo currently include:

- William Street PS
- Erb Street Supply

Waterloo groundwater system wells include:

- W10

There are six (6) pressure zones in Waterloo, including WAT 4, WAT 4B, WAT 4C, WAT 5, WAT 6, and WAT 7. WAT 4 is the largest and most central zone in Waterloo and transfers water to other pressure zones in Waterloo and Woolwich. WAT 4 is supplied primarily by transfers from MWTP and the William Street wells. The Erb Street Supply is a significant supply source on the northwest side of Waterloo.

Table 2-6 provides a summary of the existing groundwater supply sources in Waterloo including: the zone in which it is located, the average and maximum treated water rates carried in this WSMP Update, and the status of the source.

Table 2-6: Waterloo Groundwater Facilities and Treated Water Currently Available by Pressure Zone and Well Field

Pressure Zone and Well Supply System (WSS)	Details of Wells	Average Day Water Available (L/s) NOTE 1	Maximum Day Water Available (L/s) NOTE 1	Status NOTE 2
Waterloo				
WAT 4: William Street	W1B, W1C, W2, W2A	47.3	71	Existing
WAT 5: System Well	W10	15.0	15.0	Existing
Erb Supply: Erb Street	W6-A, W6-B, W7, W8	130.0	245.0	Existing
Existing Waterloo Groundwater		192.3	331.0	Presently constructed and permitted regular supply capacity.

Note 1: The average day water available is the recommended Tier 3 Assessment limit, and both the average and maximum day rates represent the amount of water supplied to the system after applicable treatment losses.
Note 2: Existing supplies are constructed and permitted, and are currently capable of supplying to the IUS.

The planned supply sources for Waterloo are presented in Table 2-7. The planned wells are those that will replace and/or enhance supply from the given well field. The supply rates are derived from hydrogeological studies, and actual supply capacities may be constrained by infrastructure or permitting. In the case of replacement wells, only additional supply capacity is presented. The planned projects exist in varying stages of completion, as is outlined in Table 2-7. Refer to Tech Memo 3: Groundwater Supply Capacity Assessment (Appendix C) for more details on Tables 2-6 and 2-7.

Table 2-7: Planned Waterloo Groundwater Supplies by Pressure Zone and Well Field

Pressure Zone and Well Supply System (WSS)	Details of Wells	Average Day Supply (L/s) NOTE 1	Maximum Day Supply (L/s) NOTE 1	Purpose and Status
Waterloo				
WAT 4: William Street	W3, W15	19	19	Additional supply capacity. Constructed; requires permitting (DWL, PTTW). Class EA ongoing.
WAT 4: Waterloo North	W5A	75.7	75.7	Additional supply capacity. Not constructed and requires permitting (PTTW, DWL). Anticipated Class EA amendment.
	Laurel Tank Well			
Approximate Planned Waterloo Groundwater Supply Capacity		192.3	331.0	To replace and augment supply capacity as needed.

Note 1: Rates presented do not include treatment losses. In most cases, further testing and monitoring is required to confirm the long-term supply capacity of planned wells.

2.2.2 Surface Water (Grand River)

Surface water makes up approximately 25% of the water supplied to the IUS under typical operating conditions and under maximum taking from the Grand River, represents approximately 35% of present supply capacity. Water is pumped from the Grand River at the Hidden Valley Pumping Station in southeast Kitchener and pumped to the Mannheim Water Treatment Plant (MWTP) located in western Kitchener for treatment and distribution.

The MWTP is a conventional water treatment process which includes flocculation, sedimentation, filtration, UV disinfection, ozonation, chlorination for primary disinfection, and chloramination for secondary disinfection.

Treated water from the MWTP is blended with groundwater from a series of wells at the Mannheim Reservoir where three pump stations distribute water based on the target HGLs. The Mannheim Zone 4 PS, Mannheim Zone 5 PS, and Mannheim Zone 6 PS supply water to zones KIT 4 and WAT 4, KIT 5, and KIT 6/WAT 6, respectively. The MWTP is a significant source within the IUS as it can supply to all the area municipalities.

The MWTP is capable of supplying approximately 795 L/s (68.7 MLD) to the IUS, though it typically operates at an average rate of 500 L/s (43 MLD). Table 2-8 outlines the basic supply parameters for the MWTP.

Table 2-8: Overview of MWTP Water Supply

Descriptor	Supply	
	L/s	MLD
MWTP year-round permitted taking from Grand River (PTTW)	841	72.7
Rated capacity of MWTP (DWL)	840	72.6
Treated water available to IUS	795	68.7
Typical production rate at MWTP[NOTE1]	500	43.2

Note 1: Historical operating rate for MWTP is 416 L/s based on average operational data from 2007 to 2010.

To assess the capacity available to the IUS for long-term planning purposes, the maximum treated water capacity (795 L/s) was used as the supply capacity available from MWTP.

2.2.3 Aquifer Storage and Recovery (ASR)

The Aquifer Storage and Recovery (ASR) system is located at the MWTP site and allows for more flexibility to meet peak demands in the IUS. An aquifer is a below-ground geological formation that contains a large amount of water (groundwater). ASR technology is used to store treated water from the MWTP when there is a surplus and draw it back up when demands increase. For example, during the fall, winter and spring the Grand River is running high and demand in the IUS is low. Surplus water from the MWTP (either from the Mannheim Reservoir or downstream of the UV reactor) is injected into the aquifer for storage. During the summer months when water demand is typically at its highest, water is recovered and enters the MWTP process upstream of chlorination at the clearwells, and distributed to the IUS as described above for the MWTP. Water quality of recovered ASR water is similar to that of groundwater.

Phase I of the ASR system includes six (6) ASR wells at the MWTP, four (4) for recharge and recovery (ASR1, ASR2, ASR3, and ASR4) and two (2) for recovery only (RCW1 and RCW2). Phase I has been online since 2005 and has a sustainable peaking capacity of 231 L/s (20 MLD).

The planned Phase II of the ASR system is intended to increase peaking capacity by approximately 266 L/s (23 MLD) to a total ASR capacity of 497 L/s (43 MLD). Implementation of the Phase II ASR will require permitting, design and construction of wells and piping.

3.0 Drivers for the Update

The key factors driving the WSMP Update which impact the 2007 Strategy recommendations include:

1) The declining demands observed in the IUS as compared to the projections.

2) The decrease in peak demands.

3) The revision of the sustainable average day groundwater pumping rates.

Several key studies undertaken since the 2007 Strategy and alongside this WSMP Update have been incorporated into this WSMP Update. These include:

- The Water Supply and Distribution Operations Master Plan (WSDOMP).
- The Tier 3 Water Supply Assessment (Tier 3 Assessment).
- The Water Efficiency Master Plan (WEMP).
- Various water supply source Class Environmental Assessments (EAs).

Building from the 2007 Strategy, these studies have been considered in the WSMP Update as part of the analysis of IUS-wide demand forecasting, proposed distribution configuration, water supply rates, and potential water supply alternatives. These drivers and studies are described in more detail in the following sections.

3.1 Changes from Planning, Technical, and Regulatory Perspective

The most significant change since the completion of the 2007 Strategy, necessitating an update of the WSMP, was the decrease in actual demands compared to projected demands. Improved water conservation and efficiency programs, urban core intensification, and economic factors are the key factors that have contributed to this declining demand trend.

The 2007 Strategy and Water Efficiency Master Plan are discussed further in Section 3.3.1 and 3.3.3 and the decreasing trend in demand is discussed further in Section 6.0 in the review of the water demand forecast update.

Since the completion of the 2007 Strategy, a local area water budget and risk assessment (Tier 3 Assessment) was identified as necessary and initiated for the Region's IUS under the Clean Water Act (2006). This assessment reviewed the existing and planned pumping rates of groundwater in order to determine the sustainable average day rates, i.e. rates that do not deplete aquifers over time, thereby updating the achievable water supply pumping rates previously determined for the IUS. The Tier 3 Assessment is discussed in Section 3.3.4. Along with the decrease in demands, the Tier 3 Assessment has resulted in a shift of

focus for capital planning from meeting maximum demands to meeting both average day demands and maximum demands. This change is discussed in Section 6.2.

Other key planning studies undertaken since the 2007 Strategy and alongside this WSMP Update include the WSDOMP and various water supply and watermain infrastructure Environmental Assessment (EA) studies. These are discussed in the Sections 3.3.2 and 3.3.5 and emphasize the focus of improving the efficiency of transferring water in the IUS to meet local demands and address localized surpluses and shortages of water.

Additional notable changes in legislation, regulations and policies are highlighted in Section 3.2. Identifying applicable initiatives and determining the impact on the proposed projects was a focus of the 2007 Strategy. In the current update, recent amendments to these initiatives were reviewed and key items were discussed in more detail to outline the potential implications to the proposed projects of this WSMP Update.

3.2 Regulatory and Policy Framework

An evaluation of the regulatory and policy framework was a large component of the 2007 Strategy. While not a focus of this WSMP Update, the major proposed legislation, regulations, and policy initiatives identified in the 2007 Strategy as well as any new and relevant initiatives were reviewed to identify any potential applicability to the proposed projects for the WSMP Updated Strategy.

These initiatives were grouped into the categories of: planning, water, environmental, and other (which includes consultation with First Nations). Table 3-1 provides an overview of the initiatives presented in the 2007 Strategy.

Table 3-1: List of Legislation, Regulations, and Policy Initiatives

Category	Legislation, Regulation or Policy Initiative	Last Update
Planning	1. Provincial Policy Statement, 2005	N/A
	2. Places to Grow Act, 2005	N/A
	3. Growth Plan for the Greater Golden Horseshoe, 2006	Second amendment in 2013
	4. Planning Act, 1990	N/A
	5. Planning and Conservation Land Statute Law Amendment Act - Bill 51 (Royal Assent, October 19, 2006)	N/A
	6. Conservation Lands Act, 1990	Last amendment 2009

Category	Legislation, Regulation or Policy Initiative	Last Update
	7. Greenbelt Act, 2005	Last amendment 2009
	8. Greenbelt Plan, 2005	N/A
	9. Niagara Escarpment Planning and Development Act, 1990	Revised in 2012
	10. Niagara Escarpment Plan	Last revised December 2006
Water	1. Great Lakes - St. Lawrence River Basin Sustainable Water Resources Agreement, Boundary Waters Treaty, U.S. - Canada Great Lakes Water Quality Agreement, Great Lakes Charter	Updated 2012 and renamed: "Agreement Between the United States of America and Canada on Great Lakes Water Quality"
	2. Ontario Water Resources Act	N/A
	3. Safe Drinking Water Act, 2002	Last amendment 2011
	4. Clean Water Act - Bill 43, October 2006	Last amendment 2012
	5. Sustainable Water and Sewage Systems Act, 2002	N/A
	6. Watertight (Ministry of Public Infrastructure Renewal Expert Panel)	N/A
	7. Ontario Water Opportunities Act, 2010	N/A
Environment	1. Ontario Environmental Assessment Act	Last amendment 2010
	2. Canadian Environmental Assessment Act	Last amendment 2013
	3. Canada-Ontario Agreement on Environmental Assessment Cooperation	N/A
	4. Municipal Class Environmental Assessment, 2000	Second amendment in 2011
	5. Fisheries Act	Last amendment 2013
	6. Species at Risk Act	Last amendment 2013
	7. Canadian Transportation Act	Last amendment 2013
	8. Navigable Waters Protection Act	Last amendment 2009

Category	Legislation, Regulation or Policy Initiative	Last Update
	9. National Energy Board Act	Last amendment 2013
Other	1. Draft Guidelines for Ministries on Consultation with Aboriginal Peoples Related to Aboriginal Rights and Treaties	Published as Draft 2013
	2. Public Transportation and Highways Improvement Act	Last amendment 2008

Two important initiatives to highlight are the Growth Plan for the Greater Golden Horseshoe (GGH) (2006, second amendment 2013) and the new Water Opportunities Act (2010) in Ontario, which are discussed in the sections below.

3.2.1 Growth Plan for the Greater Golden Horseshoe, 2006

The Growth Plan is important to the WSMP because it outlines population and employment growth projections for various municipalities in the GGH, including the Region of Waterloo. The population and employment forecasts are a key component of the Growth Plan for the GGH as these forecasts are to be adopted within the municipalities' official plans.

The second amendment of the Growth Plan (June 2013) updates and extends the population and growth forecasts from 2031 to 2041. This was done because the GGH is one of the fastest growing regions in North America in which immigration continues to be the most important component of population growth. The GGH is also experiencing higher fertility rates and longer life expectancy than previously anticipated when the 2006 Growth Plan forecasts were released. This is forecasted to result in higher household sizes than previously anticipated. Extending the forecasts to 2041 will ensure an appropriate timeframe for infrastructure and long-term planning.

In 2018 municipalities in the GGH will be required to update official plans with the second amendment population and employment forecasts. An update to the official plan will therefore require an update to the demand forecasting for the next update to the WSMP.

3.2.2 Water Opportunity Act, 2010

The Water Opportunity Act (WOA) (2010) recognizes water as an opportunity for economic growth and as an important resource that must be managed sustainably. The WOA is relevant to the WSMP (current and future versions) as it fosters innovation in the water sector in Ontario, aims to support and streamline the process for integrating new and sustainable technologies into municipalities, and encourages technologies which extend the life of municipal infrastructure, all of which enable the continued growth of the Region.

3.3 Related Studies

3.3.1 Previous Water Supply Master Plans

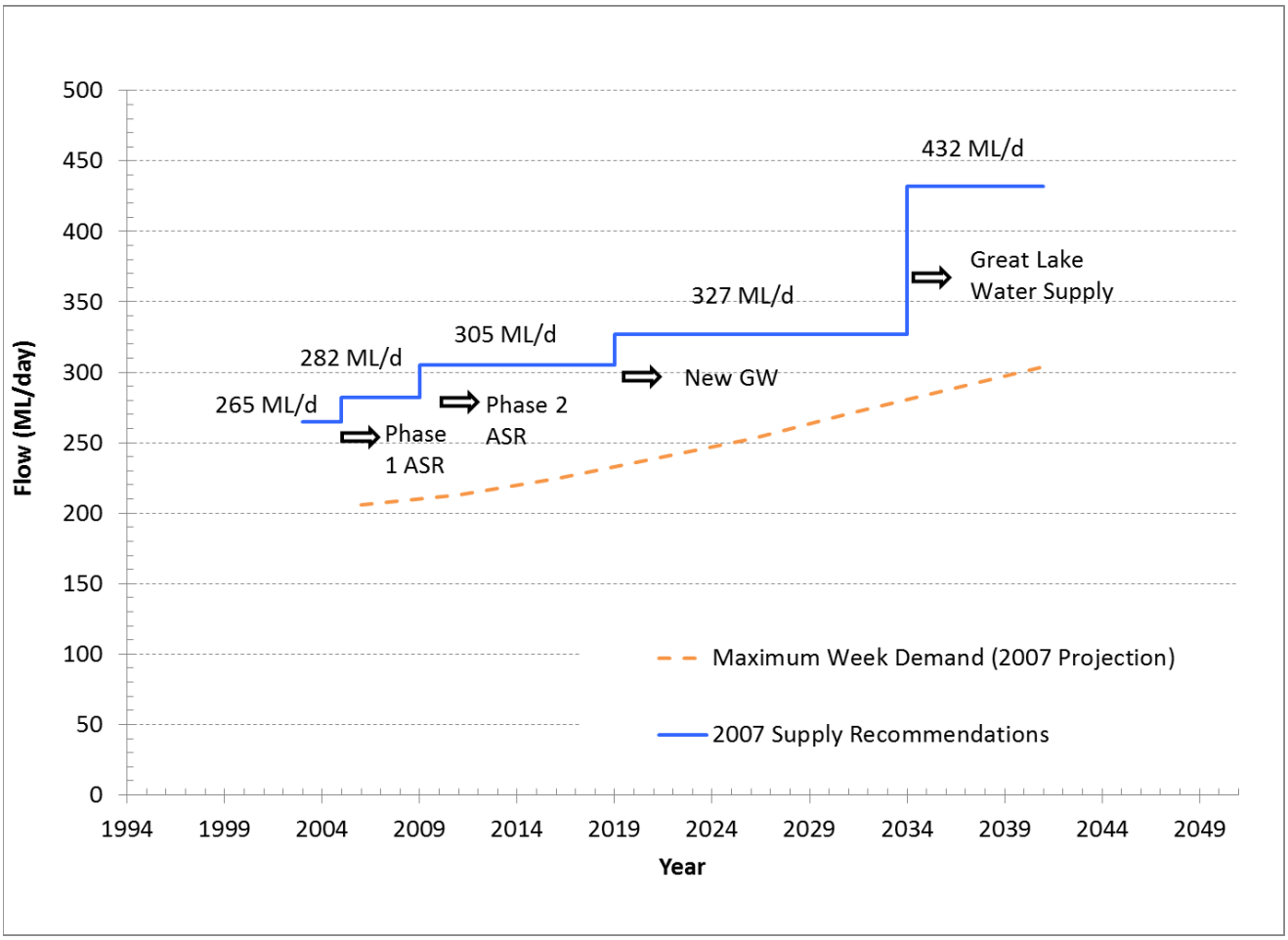
The Region's WSMP was adopted in 2000 (2000 WSMP) and established a long-term water supply strategy for the IUS to the year 2041. The 2000 WSMP was updated by the Water Supply Strategy Update which was completed in 2007. The primary focus of the 2007 Strategy was to assess the effect of planning, technical and regulatory changes since the 2000 WSMP and any resultant impact on the timing of a lake-based water supply system. For example, the 2007 Strategy reevaluated and confirmed short and long-term water supply sources to accommodate projected population growth in the Region based on the *Places To Grow: Growth Plan for the Greater Golden Horseshoe* (Ministry of Public Infrastructure Renewal, 2006) and addressed regulatory changes. The 2007 Strategy confirmed that the philosophy and staging in the 2000 WSMP was still relevant.

Components of the 2007 Strategy recommendations included:

- Continued and improved management of existing supplies (source protection activities and restoring facilities to their rated capacity).
- Implement Phase II ASR (23 MLD).
- Develop additional well supplies (23 MLD identified).
- Construct Great Lake Supply.
- Continued water efficiency efforts and lawn watering restrictions (as identified in the Water Efficiency Master Plan).

Based on projected population growth and supply demands, the 2007 Strategy forecasted that water supply demands would grow by almost 100 ML/day between 2007 and 2040 and would exceed the available local supply capacity by 2034. As a result, the need for a Great Lake water supply was identified to meet water demands beyond 2034. Figure 3-1 shows the 2007 projected demand and recommended supply projects for the 2007 Strategy.

Figure 3-1: 2007 Water Supply Strategy Update Demand Projections and Supply Recommendations



Since the adoption of the 2007 Strategy there have been a number of factors that have significantly changed demand requirements, including a decreasing trend in the per capita demand in comparison to that used in the 2007 Strategy, and reduction in peak flows due to new outdoor water use by-laws. The decreases in demands were also seen in other municipalities across Canada and can be attributed to water conservation and water efficiency efforts, economic changes, and intensification. The updates to Figure 3-1 will be described in more detail in Section 6.0: Water Demand Forecasting Update.

3.3.2 Water Supply and Distribution Operations Master Plan (2011)

The Water Supply and Distribution Operations Master Plan (WSDOMP) was initiated just before the WSMP Update in 2011 to identify opportunities and develop both medium- and long-term strategies to optimize the operating efficiency of the IUS distribution system. The WSDOMP Draft Final Report was completed in the spring of 2014. This work expanded on the 2009 Tri-City Water Distribution Master Plan (2009 WDMP), which conducted a high-level examination of the IUS distribution system identifying opportunities for improvement. Area studies which resulted from the 2009 WDMP recommendations included southwest

areas of the City of Kitchener and the City of Cambridge, and the eastern area of the City of Kitchener including lands located on the eastern side of the Grand River referred to as the "East Side Lands" (ESL).

The focus of the WSDOMP was to optimize the current distribution operations with considerations for greenhouse gas emissions and energy consumption. This was in part due to the new Green Energy and Green Economy Act (GEGEA, 2009) and Ontario Regulation 452/09 (2009) enacted under the Environmental Protection Act which requires large emitters to report emissions on an annual basis. Though the water supply industry is exempt, the Ontario government may develop a voluntary reporting program for which water supply would be included in the future. Environmental sustainability is also a core value to the Region, as outlined in the Strategic Plan (2011-2014) which identified the reduction of Green House Gases (GHGs) as a priority, and developing an Energy Reduction Plan for Water and Wastewater facilities as a strategic objective. The end goal for the project was to develop a cost-effective system that is sustainable for long-term population growth within the Region.

As part of the WSDOMP, demand projections and new infrastructure were updated in the Region's hydraulic network model, and a Water System 2009 Green House Gas (GHG) Emission Inventory Survey (GHG Inventory) was completed. Constraints and alternative solutions were identified, and through consultation with the Region, upgrades were recommended for the IUS. Area Municipalities serviced by the IUS include the City of Cambridge, City of Kitchener, City of Waterloo, and Township of Woolwich. Additional recommendations were made as part of the WSDOMP to address localized constraints in the system. The WSMP Update may modify selected outcomes of the WSDOMP, as new information was generated in the WSMP Update that was beyond the scope of the WSDOMP. An overview of modifications that impact the overall configuration within the Area Municipalities is provided below.

3.3.2.1 City of Cambridge Reconfiguration

Recommendations proposed in the WSDOMP that impact the overall configuration of the distribution system in Cambridge include:

- Divide pressure zone CAM 1 into CAM 1 and CAM 1W:
    - CAM 1W to be supplied by chloraminated water from CAM 1 via a new chloramination station as well as CAM 2W and KIT 2W via existing PRVs. CAM 1 will continue to be supplied with chlorinated water.
    - P6 decommissioned due to the upgrades required for supply in chloraminated zone and low capacity of the well (6 L/s); supply infrastructure better invested elsewhere.

- Improve floating storage for CAM 1:
    - Turnbull converted to pumped storage and reconfigured to also supply CAM 1.
    - Construct a new and larger CAM 1 tank (10,000 m^3) to replace St. Andrews Standpipes and PS to CAM 3.
    - Rahmans Reservoir is to be repurposed to service CAM 2E rather than CAM 1.

- Consolidate sources and restore capacity for CAM 2E:
    - Consolidate Rahmans PS, Pinebush TP, and Well G5/G5A and redirect to CAM 2E.
    - Consolidate Hespeler (H3/H3A, H4/H4A, and H5/H5A) system wells to one new facility.

- Increase Supply for CAM 2W and East Side Lands:
    - Install in-line booster pump station from CAM 2E to CAM 2W.
    - Construct new Maple Grove Treatment Plant (wells P16 and FSTP1-10).

- New watermain infrastructure to increase capacity for CAM 3.

- Consolidate pressure zones in the area of the East Side Lands:
    - Consolidate a small area from the existing KIT 4 pressure zone, Breslau South, CAM 2W, and KIT 2E and strengthen distribution system and looping (as this involves multiple Area Municipalities, metering will be maintained).

3.3.2.2 City of Kitchener Reconfiguration

Recommendations proposed in the WSDOMP that impact the overall configuration of the distribution system in Kitchener include:

- Connect pressure transducers to SCADA and update operating strategy.

- Install control valves on feedermains (existing and planned):
    - Victoria St watermain at KIT 4/ WAT 4, planned KIT 4 hydro-corridor watermain, planned secondary KIT 4/WAT 4 connection.

- Reconfigurations at Mannheim WTP:
    - Redirect water from Mannheim West Wells (K22A, K23, K24, K26) in Mannheim Village to Mannheim WTP for centralized treatment, storage and

distribution to IUS with Village service via the IUS. Eliminate individual well treatment.
    - WAT 4 dedicated discharge from Mannheim Zone 4 PS (if required).

3.3.2.3 City of Waterloo Reconfiguration

Recommendations proposed in the WSDOMP that impact the overall configuration of the distribution system in Waterloo include:

- Redirecting William Street (W1B, W3, W1C, W2, W2A) raw water to Strange Street TP in Kitchener.
- Facility capacity restoration at Erb Street wells.
- Construct a new facility, referred to for the purposes of the Master Plan as the Waterloo North (Laurel) TP, to consolidate, provide treatment, and distribute water from the new Waterloo North wells (W5A and Laurel Tank).

3.3.2.4 Township of Woolwich Reconfiguration

Recommendations proposed in the WSDOMP that impact the overall configuration of the distribution system in Woolwich include:

- Realign the Elmira/Elmira East pressure zone boundary and create a direct feed from the Howard Tanks to the new Elmira East zone; decommission existing PRV stations between Elmira pressure zones.
- Adjustments to the St Jacobs PRV to increase the hydraulic grade line (HGL) in St Jacobs.
- New watermain connection for emergency conditions between Breslau South and Breslau North.

The infrastructure upgrades outlined for each Area Municipality have been accepted at this time, and Class Environmental Assessments will be carried out for the projects requiring approvals. These accepted and finalized recommendations were considered as planned projects for the WSMP Update analysis.

3.3.3 Water Efficiency Master Plan

The Region has been actively promoting water efficiency programs since the early 1970s, and in 1998 Council approved the first Water Efficiency Master Plan (WEMP) which established the goal of reducing water consumption by 1.5 million gallons per day by 2009. Initiatives of the current WEMP include general public education, outdoor water use by-law, toilet replacement, industrial, commercial and institutional (IC&I), municipal leak reduction,

and research and development. The Region has been a leader in water conservation with pioneering programs such as the Toilet Replacement Program, the Rain Barrel Distribution Program and the current Water Efficient Technology (W.E.T.) Program for Business.

With the successful implementation of programs under the current WEMP, the Region Water Services completed an update to the plan for the period 2015 - 2025. The WEMP 2015 – 2025, approved by Council on June 4, 2014, outlines continuing and new program directions and targets for the water efficiency program. The key targets to be achieved by 2025 are to:

- Reduce cumulative drinking water usage by 1,370 million litres (ML) per year;
- Decrease detached and semi-detached residential water use from 202 to 165 litres per capita per day;
- Maintain the system peaking factor (ratio of maximum day demand to average day demand) at 1.28 or below;
- Avoid the release of a cumulative 7,700 tonnes of greenhouse gases; and
- Defer a Great Lakes displacement pipeline indefinitely.

Reduction through efficiency and conservation, fostered by programs undertaken by the Region, has been demonstrated to be more cost effective than developing new supply sources.

3.3.4 Tier 3 Water Budget and Local Area Risk Assessment

As required under the Clean Water Act (2006), the Region is undertaking a Tier 3 Water Budget and Local Area Risk Assessment (Tier 3 Assessment) for portions of the Region identified as being under potentially moderate to significant stress from a water quantity perspective, based on the watershed-scale water budget completed for the Grand River Watershed (AquaResource, 2009). The overall goal of the Tier 3 Assessment is to evaluate the sustainability of the water supply system from a quantity perspective, and to identify potential threats to that sustainability. The Tier 3 Assessment used an advanced computer groundwater model to evaluate the long-term sustainability of the well fields under normal and drought climatic conditions, in response to changing land use conditions, and potential impacts to environmentally sensitive areas such as cold water creeks. The results from the Tier 3 Assessment were used to determine the sustainable long-term average day pumping rates for the WSMP Update.

3.3.5 Relevant Class Environmental Assessments

The IUS Groundwater Study was undertaken from 2005 to 2007 and focused on developing an additional 23 MLD from new wells and under-utilized wells within the Region’s existing well fields. This study resulted in the following recent and ongoing Municipal Class Environmental Assessments (Class EA) undertaken by the Region.

Table 3-2: Relevant Completed and On-going Class Environmental Assessments

Class EA	Description	Status
Cambridge East Class EA (2009-2014)	The Cambridge East Class EA (Golder Associates, ongoing) investigated new supply wells to restore capacity at Shades Mill TP, Turnbull TP, and Pinebush TP. Test wells included locations at Witmer Park, the Portuguese Club, Cedarbrook Court, Can-Amera Parkway, and Clyde Park. Additionally, a deeper well (Well P10A) was investigated at Well P10, which supplies water to the Pinebush TP.	This study is in progress.
Fountain Street and Maple Grove Area Water Supply Class EA (2009 – 2014)	The Fountain Street and Maple Grove Area Water Supply Class EA (MTE, 2014) evaluated a new treatment facility, referred to as Maple Grove, to provide treatment for P16 and test well FSTP1-10. Recommendations of the Class EA include combining the two sources for centralized treatment at the FSTP1-10 site.	This study has been completed and the Notice of Completion was advertised in April 2014.
Waterloo North Water Supply System Class EA (2010 – 2011)	The Waterloo North Water Supply System Class EA (AECOM, 2011) evaluated alternatives for a treatment of new wells identified in north Waterloo (W5A and Laurel Tank wells). The preferred alternative for the Class EA is a new treatment facility, referred to as the Waterloo North (Laurel) TP, which is to have a maximum supply capacity of 80 L/s. The recommendations of this study were considered in both the WSDOMP and this WSMP Update.	This study has been completed.
Strange Street WSS Class EA (2010 – 2012)	The Strange Street Class EA (Stantec, 2012) reviewed the Strange Street WSS to confirm the sustainable supply and evaluate the need for treatment and watermain upgrades. The supply capacity was evaluated based on the existing wells and the need for new wells. The preferred solution includes raw watermain replacement on Belmont Avenue, replacing K13, developing a new supply well if needed, replacing high-lift pumps to increase capacity, and providing centralized treatment for iron and manganese removal and chlorination.	This project has been completed and the new watermain along Belmont has been installed, however, the treatment and supply expansion upgrades have been put on hold pending the outcome of the William St and Strange St. WSS Class EA.

Class EA	Description	Status
Erb Street WSS Class EA (2010 – 2013)	The Erb Street Water Supply System (WSS) Class EA (Stantec, 2013) assessed current well capacity, identified the need for rehabilitation or new well capacity, examined of treatment needs, and reviewed well field operation for optimization. Erb Street WSS is located along Erbs Road in the Township of Wilmot between the City of Waterloo (City) and the community of St. Agatha. There are four production wells that are part of the Erb Street Well Field: W6A, W6B, W7 and W8. The Erb Street WSS has sufficient infrastructure in place to provide the required 170 L/s design flow rate. Minor electrical and control modifications are suggested to improve reliability, redundancy, and reduce the energy usage at the well houses. The water produced from the wells is good quality. The blended water quality meets the aesthetic objective for both metals, and iron is low in the source water.	This project has been completed. All the updates recommended are Schedule A activities under the Municipal Class EA and are pre-approved. Some upgrades have already been completed by the Region.
Conestoga Plains Water Supply System Class EA (2013 - Present)	The Conestoga Plains EA (CIMA, 2013) was initiated to confirm the feasibility of servicing West Montrose from the Conestoga Plains system. It was recommended in the prior West Montrose EA that a permanent connection be made, as the Conestoga Plains system currently operates well below its existing rates capacity and has adequate water quality. In the next stages of this study, water supply options will be subjected to more detailed evaluation considering technical and natural environment impacts, social and community impacts, and cost impacts. One of the water supply options under consideration is a supply connection to the IUS.	This study is in progress.
William Street and Strange Street Water Supply Systems Class EA and Preliminary Design (2014– present)	The primary purpose of the William St. and Strange St. Class EA (XCG Consultants Ltd., ongoing) is to review the William Street WSS and examine alternatives including routing the William St. water to Strange St. WSS for treatment and distribution, based on the WSDOMP Draft Final Report (March, 2014) recommendation. This project was recently commenced (Spring 2014) and completion of the Class EA and preliminary design is anticipated in the Spring of 2016.	This study is in progress.

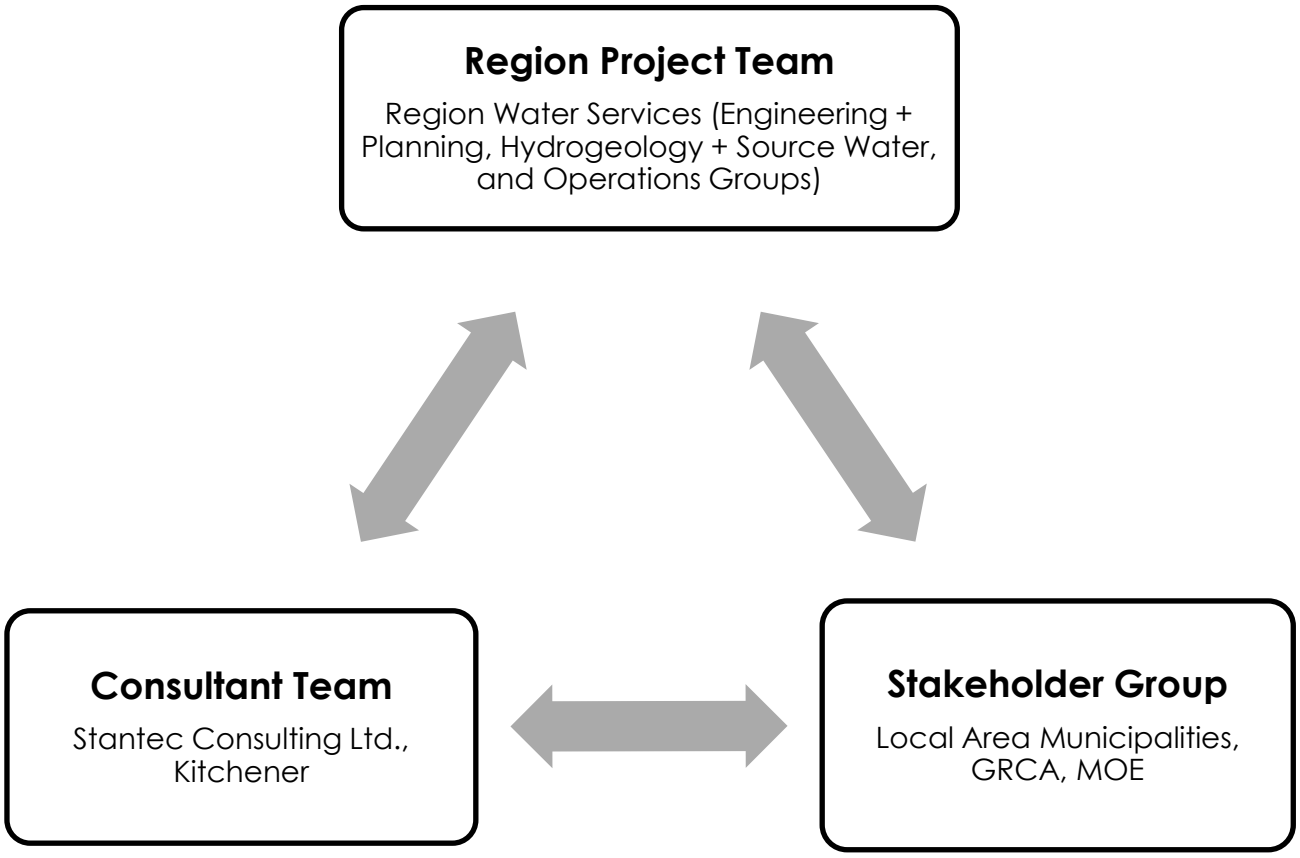
4.0 Water Supply Master Plan Update Methodology

The WSMP Update was carried out by Stantec working under the direction of the Region's Water Services Division. Stantec worked closely with Regional staff as part of the Project Team by arranging regular meetings and receiving technical guidance and feedback on deliverables. A Stakeholder Group was also established to provide guidance to the Project Team. The project organization and the overall approach used to complete the WSMP Update are described in the following subsections.

4.1 Project Organization

Overall project organization is presented in Figure 4-1. Roles and participants in each committee are presented in the following subsections.

Figure 4-1: Project Organization



4.1.1 Region Project Team and Consultant Team

The Region Project Team provided technical oversight and project management for the WSMP Update in coordination with the Consultant Team. This included attending meetings, facilitating the transfer of Region data to the Consultant Team, and guidance, revisions and feedback on technical memoranda and public consultation material. The Region Project Team was also responsible for reviewing and running advertisements for the various MP Notices in local newspapers and updating the Region website.

The Consultant Team worked closely with the Project Team Project Manager with regular meetings and communication. The Consultant team performed the research, analysis and reporting for review by the Region. The Consultant Team compiled the draft stakeholder lists, notices, advertisements and public consultation materials for the Region to review and mailed out the Notices to the Stakeholder list.

4.1.2 Stakeholder Group

A Stakeholder Group was established at the project initiation as a joint effort between the Region Project Team and Consultant Team. The purpose of the Stakeholder Group was to provide guidance and feedback to the MP process. The Stakeholder Group comprised of:

- Representatives from local Area Municipalities, including the Cities of Cambridge, Kitchener, Waterloo and the Township of Woolwich.

- Representatives from other agencies with a direct interest in the WSMP Update, including the Ministry of the Environment (MOE) and the Grand River Conservation Authority (GRCA).

- Staff from various Regional groups from Transportation and Environmental Services (TES), including Water Services Engineering and Planning, Water Services Operations, Water Efficiency, Design and Construction, and Hydrogeology and Source Water.

Refer to Section 5.2 for more information on the Stakeholder Group meetings. Many of the members of the Stakeholder Group were also participants in one or more of the Workshops undertaken in the early stages of the WSMP Update process (refer to Section 4.2.1).

4.2 Approach

The WSMP Update project was planned and implemented in accordance with the Municipal Class Environmental Assessment (EA) process for Master Plans (Municipal Engineers Association, June 2000, as amended in 2007 and 2011). The completion of the WSMP Update satisfies the requirements of Phases 1 and 2 of the Class EA process. An overview of the master planning process is provided in Appendix G. Table 4-1 is an outline of the major milestones for the WSMP Update.

Table 4-1: WSMP Update Class EA Process with Milestones

Phase 1 (July 2011 to December 2011)	
Date	Deliverable
July 2011	Notice of Commencement
September 2011	Stakeholder Workshops: • No. 1 Operations • No. 2 Hydrogeology • No. 3 Planning • No. 4 Well Flows • No. 5 Water Source Review
December 2011	Stakeholder Meeting
Phase 2 (January 2012 to December 2014)	
Date	Deliverable
April 2012	Tech Memo No. 1: Verify and Update Demand Forecasting
May 2012	Tech Memo No. 3: Groundwater Capacity Assessment
August 2012	Tech Memo No. 2: Supply Source Treatment and Infrastructure
January 2013	Tech Memo No. 4: Pressure Zone-Wise Supply Demand Analysis
July 2013	Tech Memo No. 5: Opportunities/Constraints Analysis and Evaluation of Supply Alternatives
September 2013	Stakeholder Meeting
November 2013	Notice of Public Consultation Meeting (PCC)
December 2013	PCC
April 2014	Draft Final Report
November 2014	Final Report & Notice of Completion
December 2014	Public Review

4.2.1 Workshops and Technical Memoranda

The WSMP Update consisted of five (5) workshops with various stakeholders and five (5) technical memoranda (Tech Memos) to generate this Final Report. The workshops included:

- Workshop No. 1: Operations
- Workshop No. 2: Hydrogeology
- Workshop No. 3: Planning
- Workshop No. 4: Well Flows
- Workshop No. 5: Water Source Review

Three information gathering workshops were conducted to collect background information for the WSMP Update. The information from the first three workshops was used to prepare Tech Memos 2 and 3. An iterative approach was taken for Workshops No. 4 and 5 and Tech Memos 4 and 5. Tech Memos were initiated prior to the workshops. The material was reviewed with the participants in a facilitated workshop forum to gather information and gain consensus on key issues. The Tech Memos were then updated from the insights gained from the workshops and reviewed by the Project Team.

Outside of the workshops, several key project meetings were held with the Project Team and various Stakeholders over the project duration to gain consensus on approach. For example, several meetings were held with the Project Team and Region Stakeholders during the development of the evaluation methodology and the development of supply alternatives. The workshops and the tech memos are summarized below.

4.2.1.1 Workshops

Workshop No. 1 (Operations) was held for the Region Operations staff on September 22, 2011 to gather information on water source rates and capacities and operational issues or constraints related to the various water supply facilities and identify opportunities to strengthen pressure zone supply configuration. The workshop was structured to provide an overview of the supply sources (current and new) and a discussion of operational issues and constraints for each water facility, including operating strategies, regulatory constraints, water quality concerns, and operational difficulties (i.e. well pumps drawing sand from around the well casing). The second half of the workshop reviewed the zone supply and demand configurations, and well field and well operation opportunities were discussed, for vulnerable pressure zones, growth areas and for the integration of new sources.

The agenda, presentation material from Workshop No. 1, and notes summarizing the outcomes are provided in Appendix F. Results from Workshop No. 1 are included in Tech Memo 2.

Workshop No. 2 (Hydrogeology) was held for the Region Hydrogeology and Source Water Group staff on September 12, 2011 to gather information and confirm data sources and methodology. The objectives of Workshop No. 2 were to define all water sources to be considered in this WSMP Update, determine condition and potential supply capacity for key

wells and well fields, identify well fields where more detailed analysis was required, and identify potential constraints to supplies due to hydrogeological, well performance, or water quality issues. The workshop was structured to first review the methodology for determining supply capacity for wells. Then, the participants were provided with preliminary analysis results for each major well field in the IUS and asked for feedback on specific questions.

The agenda, presentation material from Workshop No.2, and notes summarizing the outcomes are provided in Appendix F. Results from Workshop No. 2 are included in Tech Memo 3. Key findings presented in Tech Memo 3 are presented in Section 2.0.

Workshop No. 3 (Planning) was held for the Region Water Services Engineering and Planning group on September 26, 2011 to gather information and to confirm rates and operational challenges of different wells and facilities from the engineering and planning perspective. The first portion of the workshop was structured to review and discuss: 1) water supply sources and supply versus demand; and operational, planning, and 2) engineering (Design & Construction) issues or constraints. The second portion of the workshop was designed as a preliminary discussion on water supply operations opportunities including: zone pressure supply configurations, well field and well operation opportunities related to vulnerable pressure zones, growth areas, and integration of new sources.

The agenda, presentation material from Workshop No. 3, and notes summarizing the outcomes are provided in Appendix F. Results from Workshop No. 3 are included in Tech Memo 2.

Workshop No. 4 (Well Flows) was held for Region Stakeholders and the Project Team including staff from the Hydrogeology and Source Water and Engineering and Planning groups on May 30, 2012 to confirm the well rates and provide context on the concepts simultaneously developed in the WSDOMP. The workshop endeavored to keep the stakeholders up to date to ensure meaningful feedback could be given on the WSMP Update as it progressed alongside the WSDOMP. The workshop was structured first to review the WSDOMP concepts then review the proposed well rates for each of the well fields and facilities.

The agenda, presentation material from Workshop No. 4, and notes summarizing the outcomes of Workshop No. 4 are provided in Appendix F. Results from Workshop No. 4 were included in Tech Memo 3, which was subsequently updated based on Tier 3 Assessment results. Key findings presented in Tech Memo 3 are presented in Section 2.0.

Workshop No. 5 (Water Source Review) was held for Region Stakeholders and the Project Team including staff from the Hydrogeology and Source Water and Engineering and Planning groups on February 28, 2013. The objective was to review the IUS demand projections, updates from groundwater modelling (Tier 3 Assessment) to refine well rates, groundwater optimization concepts, and preliminary supply alternatives for each area municipality for the WSMP Update. The workshop was structured to provide updates on the above concepts with on-going input from the stakeholders. The ideas presented were

refined based on input from attendees in order to develop groundwater optimization criteria for evaluating source water alternatives, completed as part of Task 5.

The agenda, presentation material, list of participants, and notes summarizing the outcomes from Workshop No. 5 are provided in Appendix F. Results from Workshop No. 5 are included in Tech Memo 4 and 5. Key findings presented in Tech Memo 4 and 5 are presented in Section 7.0.

The methodology for ranking wells and supply alternatives was discussed in subsequent meetings with the Project Team. The ranking of the supply alternatives was used to develop the WSMP Updated Strategy (Section 9.0).

4.2.1.2 Technical Memos

Five tech memos were prepared for the WSMP Update. A brief description of each tech memo is provided below.

Tech Memo No. 1 satisfies Task 2 of the WSMP Update and summarizes on the demand forecasts. Tech Memo No. 1 verifies demands up to 2031 and develops a demand forecast from 2031 to 2051. Methodology for demand forecasting for both time periods is provided. Key results from Tech Memo No. 1 are presented in Section 6.0. Tech Memo No. 1 is provided in Appendix A.

Tech Memo No. 2 and **Tech Memo No. 3** satisfy Task 3 of the WSMP Update. The primary objective of Task 3 is to develop a thorough understanding of the existing and future supply sources for the Region. **Tech Memo No. 2** is a summary of treatment facilities in the IUS. Background information was gathered through a review of previous and ongoing studies and a series of workshops, as discussed in the previous section. Tech Memo No. 2 included a summary of supply sources by municipality and pressure zone, and details related to supply infrastructure including treatment processes, energy consumption, on-going maintenance, etc. and presented a preliminary assessment of the IUS water supply sources. Tech Memo No. 2 is provided in Appendix B. **Tech Memo No. 3** is a groundwater supply capacity assessment and summarizes the groundwater wells in the IUS. Tech Memo No. 3 was prepared to identify constraints related to the existing production wells that currently supply the IUS and potential new production wells that have been recently completed as part of groundwater supply investigations and Class EAs. Key results from Tech Memos No. 2 and No. 3 are presented in Section 7.0. Tech Memo No. 3 is provided in Appendix C.

Tech Memo No. 4 satisfies Task 4 of the WSMP Update and provides a summary of supply-demand analysis for each pressure zone in the IUS. All information collected in the previous tasks was combined to conduct a supply-demand analysis for each pressure zone in the IUS. This memo also introduced the concept of a “Required Surplus Capacity” of supply, and identification of inter-pressure zone transfers based on the Region’s current plans. Results from Tech Memo No. 4 contributed to developing supply alternatives in Task 5 and key results are presented in Section 7.3 and 7.4. Tech Memo No. 4 is provided in Appendix D.

Tech Memo No. 5 satisfies Task 5 of the WSMP Update and outlines the preliminary preferred alternatives for water supply capacity improvements. Tech Memo 5 provides the summary of the methodology for developing and evaluating supply alternatives for the IUS in the medium and long-term and provides a proposed schedule for implementation. Results from the Draft Tech Memo No. 5 were used to develop the Public Consultation Material and the key results are presented in Section 7.0. Tech Memo No. 5 is provided in Appendix E.

4.2.2 Public, Agency and Stakeholder Consultation

The WSMP Update included consultation with the public, agencies (GRCA, MOE) and stakeholders through the issuance of the Notice of Commencement, the continually growing stakeholder contact list, Stakeholder Meetings, and three (3) public consultation centres (PCCs) to present the results of the WSMP Update and receive comments to incorporate. Refer to Section 5.0 for a more detailed discussion of the consultation process.

5.0 Public, Agency and Stakeholder Consultation

5.1 Overview of Public and Agency Consultation Program

The public and agency consultation of the WSMP Update followed the Class Environmental Master Planning Process and included the following:

- Public and Agency Notifications
- Project Mailing List
- Stakeholder Meetings
- Internal Project Workshops
- Public Consultation Centres

A master list of project stakeholders was developed to make up the Project Mailing List. This list was added to over the course of the project. A Notice of Commencement was mailed out July 26, 2011 to the stakeholders on the project mailing list and was advertised in local newspapers and on the Region website starting on July 8, 2011 (Section 5.3.1).

Stakeholder meetings were held internally throughout the project duration to provide guidance at critical stages of the MP. Stakeholder Meetings were held on December 15, 2011 and September 26, 2013 (Section 5.2).

Five internal Region workshops were held on the following dates: September 12, 2011, September 22, 2011, September 26, 2011, May 30, 2012, February 28, 2013 (Section 4.2.1).

The Notice of Public Consultation Centres (PCCs) ran in local newspapers and on the Region website starting on November 28, 2013 (Section 5.5). All project notices included description of the project and contact information of the project team to enable members of the public to request further information and ask questions.

Further details on the public and agency consultation for this project are provided in the following sections, Sections 5.2 to 5.5. Additional materials on the public and agency consultation are included in Appendix G.

5.2 Stakeholder Meetings

The Stakeholder Group was consulted to provide overall guidance and direction to the project team undertaking this WSMP Update. The members of the Stakeholder Group were discussed in Section 4.1.2. Stakeholders were consulted for two purposes during the WSMP Update, as outlined in Table 5-1. Agendas and minutes for each meeting are provided in Appendix F.

Table 5-1: Stakeholder Meetings Summary

Meeting Date	Purpose of Meeting
December 15, 2011	• Present the project and background information on the 2007 Strategy • Present the primary trigger for this WSMP Update, which was to update the 2007 Strategy to reflect recent demand trends • Provide a progress overview to date of the project • Discuss the water demand forecast for the Region IUS
September 5, 25, 26, 2013	• Review the draft content for the Public Consultation Centre (PCC) boards • Distill concepts and messaging to address the changes in approach and outcome of this WSMP Update compared to the 2007 Strategy

5.3 Public and Agency Notifications

5.3.1 Notice of Commencement

A Notice of Commencement was advertised in the KW Record, the Waterloo Chronicle, Cambridge Times and Woolwich Observer on their respective issue dates in July 2011. The Notice of Commencement was also posted on the Region website during the week of July 8, 2011. The advertisement and letter are provided in Appendix G.

Federal, provincial and municipal agencies and other local stakeholders were also notified by letter dated July 26, 2011. The list of agency and stakeholder contacts and the Notice of Commencement letter is provided in Appendix G.

Two environmental organizations (Cambridge Environmental Advisory Committee and Great Lakes United) responded to the published newspaper Notice of Commencement and requested that they be added to the project mailing list. Community Group and Agency responses to the Notice of Commencement advertisement and letter are summarized in Table 5-2 and included in Appendix G.

Table 5-2: Comments in Response to Notice of Commencement

Organization	Name	Date Received	Comment
Response to Advertisement Notice of Commencement			
Great Lakes United	John Jackson	July 24, 2011	• Requested to be added to the contact list
Cambridge Advisory Committee	April Souwand	July 26, 2011	• Requested level of involvement is to provide comments and attend PCCs.
Response to Notice of Commencement Letter			
Enbridge Gas	Russell McLean	July 26, 2011	• For the engineering work which will derive from this study, please send copies of plan as per normal procedure to locate gas mains.
Grand River Conservation Authority	James Etienne (primary contact) and Samantha Lawson (secondary contact)	July 27, 2011	• Acknowledged receipt of Notice of Commencement and expressed interest in participating in the study and integrating the results with the GRCA 2012 Water Management Plan Update. • Concern noted for tributaries of the Grand, Nith, Conestogo, and Speed River. Noted areas within the Study Area that are subject to O. Reg 150/06 and provincially significant wetlands (as defined by the MNR). • Recommended that MNR be contacted directly for Environmental Site Assessments
Ministry of the Environment	Barbara Slattery	July 27, 2011	• Noted importance of keeping the public informed and MOE requirement for detailed documentation of the public consultation process. • Noted that all other applicable agencies should be kept informed and have input. • MOE has requested participation once projects have been identified to ensure agreement with their schedule and subsequent EA requirements. • Aboriginal agencies must be contacted and updated contact information is provided at http://www.ene.gov.on.ca/en/eaab/aboriginal-resources.php

Organization	Name	Date Received	Comment
City of Kitchener	Grant Murphy and Alain Pinard	August 3, 2011	• Noted road occupancy permits required on local roads in the City of Kitchener and Site plan approvals for pumping and treatment facilities. • Requested level of involvement is to be kept informed on the project status, schedule, and to provide comments as study progresses. • Preferred method of contact is mail or email
Kitchener-Wilmot Hydro	Shaun Wang	August 11, 2011	• Interest in project for increase in power demand, service upgrades, and transformer replacements. • Contact information to be updated so mail is addressed to the attention of "System Planning Engineer: Kitchener Wilmot-Hydro"
Aboriginal Affairs and Northern Development Canada (AANDC)	M Shafiul Alam	August 19, 2011	• In an emailed letter, provided a list of resources regarding the AANDC • Requested for contact list to be updated to send EA notifications to the Environment Unit. • Contact list updated accordingly to remove existing AANDC contacts and add new contact.
City of Waterloo	Denise McGoldrick	August 26, 2011	• Comment sheet faxed. • Interest in long-term water supply plans, as the Region is sole supplier of water to the City of Waterloo
Grand River Environmental Network	John Jackson	September 16, 2011	• Emailed a letter outlining the concern for the accuracy of the Region's Water Efficiency Master Plan based on recent activity, request for revision to the "Request for Consultant Services", and commented that the 30-day review period is inadequate involvement of the public.
Ministry of Natural Resources (MNR)	Ken Cornelisse	September 26, 2011	• In email, requested to participate as an agency representative. • Expressed concern for water taking and the potential impact on natural heritage features. • Noted that MNR approvals will be project specific and examples include approval under the Public Lands Act and Endangered Species Act.

Organization	Name	Date Received	Comment
Ministry of Aboriginal Affairs	Heather Levecque	October 11, 2011	• Mailed letter noting potential aboriginal groups that may be impacted by the study and provided the associated contact information.

5.3.2 Notice of Public Consultation Centres (PCCs)

The Public Consultation Centres (PCCs) were advertised for two weeks in advance of the events in the following newspapers:

- Cambridge Times November 29 and December 6, 2013
- Elmira Independent November 28 and December 5, 2013
- Kitchener Post November 29 and December 6, 2013
- The Record November 29 and December 6, 2013

The Notice of PCC advertisement which appeared in the above newspapers is included in Appendix G. A Notice of PCC was also sent to those on the project mailing list, including those organizations which were added since the project commencement.

5.3.3 Notice of Completion

A Notice of Completion, indicating the completion of the WSMP Update and the availability of the Draft Final Report for public review and comment, was advertised in advance of the public review and was published in the following newspapers:

- Kitchener Post November 28, 2014
- Waterloo Chronicle November 26, 2014
- Cambridge Times November 28 and November 25, 2014
- New Hamburg Independent November 28, 2014
- Elmira Independent November 28, 2014

A Notice of Completion was mailed out to all those on the project mailing list. The Notice of Completion advertisement which appeared in the above newspapers and letter which was mailed out to the project list are included in Appendix G.

The public review period ran from November 28, 2014 to January 19, 2014, slightly longer than the required 30 day review in order to account for the holiday season. The comments submitted to the Region in response to the Notice of Completion and public review are summarized in Table 5-3, and the public comments and the Region's responses are available in Appendix G.

Table 5-3: Comments in Response to Notice of Completion

Organization	Name	Date Received	Comment
Response to Notice of Completion and Public Review			
City of Cambridge	Deborah Ingraham	November 28, 2014	• Request to update Chief Administrative Officer to Mr. Gary Dyke
City of Cambridge, Planning and Development Department	Judy Boudreau	November 28, 2014	• Request to update Commissioner of Planning and Development to Mr. Hardy W. Bromberg • Request to update Senior Environmental Planner for the Cambridge Environmental Advisory Committee to Mr. Beau Wansbrough
Canadian Heritage Rivers System	Johanne Ranger	November 28, 2014	• Request to update contact information to Johanne Ranger
Former Puslinch Resident	John Hueton	November 28, 2014	• Requested a hardcopy of the Final Report for public review
City of Kitchener	Rita Delaney	December 5, 2014	• Request to update City of Kitchener City Clerk to Christine Tarling
Township of Puslinch	Donna Tremblay	December 5, 2014	• Requested a representative of the Region attend a Puslinch Council meeting to provide a summary with respect to the update and in particular the effect on Puslinch Residents
Harden Environmental Services Ltd.	Stan Denhoed	December 15, 2014	• As the Senior Hydrogeologist for the Township of Puslinch, the Township, as an adjacent municipality to the Region, expressed reservations about increased taking from the east side of Cambridge related to environmental impacts and drawdown of private wells in the Township of Puslinch. • The Township of Puslinch will plan to review and comment on the specific details regarding these wells in the Environmental Assessment for the Cambridge East wells, planned for Spring 2015.
Township of Puslinch	Karen Landry	January 15, 2015	• The Township expressed reservations about increased water taking from the east side of Cambridge, as identified in the Final Report the Cambridge East Facilities Capacity Restoration, in regards to the potential impact

Organization	Name	Date Received	Comment
			on the natural environment and the potential impact on the wellhead protection areas in the Township. • Included correspondence related to questions and concerns raised in 2006, at which time pumping tests completed resulted in drawdown of private wells. Indicated intentions for further involvement in the public consultation process of the Cambridge East Class EA process. • The Township understands that the Tier 3 water quantity modelling results were incorporated into the WSMP Update and that the results will also be used to update the Region's wellhead protection areas. The Township requests this information to assist with understanding the Cambridge East Facilities Capacity Restoration project. • The Township requests being recognized and included as a stakeholder for the WSMP and the Cambridge East Class Environmental Assessment.
Farmer, St. Agatha	Norbert Dietrich	January 20, 2015	• Expressed concern of the potential impacts of municipal wells on private wells for farming operations, including the minimum safe distance for agricultural operations. • Requested clarification on the continued reliance on groundwater versus the Lake Erie Pipeline in terms of costs and projected population growth. • Requested clarification on the groundwater contamination risk from landfills. • Requested clarification on the water allocation considerations for industrial uses, including how 'wet' versus 'dry' industries were incorporated in future employment water demands.

5.4 Public Consultation Centres (PCCs)

One round of three Public Consultation Centres (PCCs) was held in each of Cambridge, Kitchener and Waterloo. The PCCs provided an opportunity for the public and stakeholders to review the results of the work completed to date, including the preliminary preferred WSMP Updated Strategy, discuss with the Region Project Team and Consultant Project Team, and to obtain comments and feedback which the Project Team took into consideration prior to the completion of the WSMP Update. The PCCs were held on the dates and locations provided in Table 5-4. The Notice of PCC was advertised as outlined in Section 5.3.2

Table 5-4: WSMP Update PCC Locations and Dates

Date	Time	Location
December 10, 2013	5:30 – 7:30 PM	K-W Bilingual School, 600 Erb Street, Waterloo
December 11, 2013	5:00 – 7:00 PM	1st Floor, Region Headquarters, 150 Fredrick St., Kitchener
December 12, 2013	5:30 – 7:30 PM	St. Benedict Catholic Secondary School, 50 Saginaw Parkway, Cambridge

The Regional Project Team staff and Consultant Team staff were available to answer questions and direct the public to the sign-in and comment sheets. A handout describing the project was available and a printout of the PCC boards on display was supplied to attendees. Ten (10) people attended the three (3) PCCs and the PCC board materials were posted on the project website (see the Region of Waterloo Project website for more information). The PCC materials are included in Appendix G.

There was one submission of comments received from an environmental organization, the Grand River Environmental Network (GREN). This comment is summarized in Table 5-5 and the submission from GREN and the Region's response letter are available in Appendix G.

Table 5-5: Comments in Response to PCC

Organization	Name	Date Received	Comment
Response to PCC			

Grand River Environmental Network	John Jackson	February 25, 2014	• Grand River Environmental Network (GREN) prepared a letter of comments based on the December PCC boards which was emailed to project staff.
			• GREN supports:
			  ○ The deferment of a Lake Erie pipeline until after 2051, instead focusing on the "long-term sustainable water available in the Region"
			  ○ Water withdrawals and treatment as close to the place where it is used
			  ○ Water taken only from existing and new groundwater wells that don't interfere with agricultural uses
			• GREN suggests changing terminology from "continue" to "enhance" when referring to water efficiency programs and updating WSMP regularly (about every 5 years)
			• Include impact from more aggressive water efficiency plans on Regional capital and operating budgets
			• Clarify what the "Current Average Day Demand Forecast" is based on. More background information to assess this forecast.
			• What is the data on current water usage and projected water usage per sector (residential, industrial, commercial, institutional, and agricultural)
			• What is the impact on operating expenditures of the projected reduction in capital budget?
			• Where is the potential for industrial, commercial and institutional water conservation?
			• Must ensure other Regional Programs (such as road salt reduction, increased onsite infiltration, restore natural flows) support the WSMP, and that these programs are assessed to ensure they are up to date and properly implemented
			• Overall, GREN is pleased with the overall vision and goals of the WSMP and looks forward to supporting the plan

6.0 Water Demand Forecast Update

A major driver for the WSMP Update was the trend of declining demands, on both a per capita basis and general usage by ICI (e.g. the Schneider's meat processing plant closing in Kitchener), experienced in the Region IUS and the resultant deviation from the 2007 Strategy demand projections.

As part of the WSMP Update (2011), forecasted demands were adapted up to 2031, and developed from 2031 to 2051. Details regarding the background information and methodology for the demands up to 2031 are provided in the *Water Supply and Distribution Operations Master Plan (WSDOMP): Water Demand Forecasting* (Stantec, September 2011). Details for the demands from 2031 to 2051 are provided in *Tech Memo No. 1 – Verify and Update Water Demand Forecasting* (Stantec, 2012) provided in Appendix A.

6.1 Background to Current Conditions

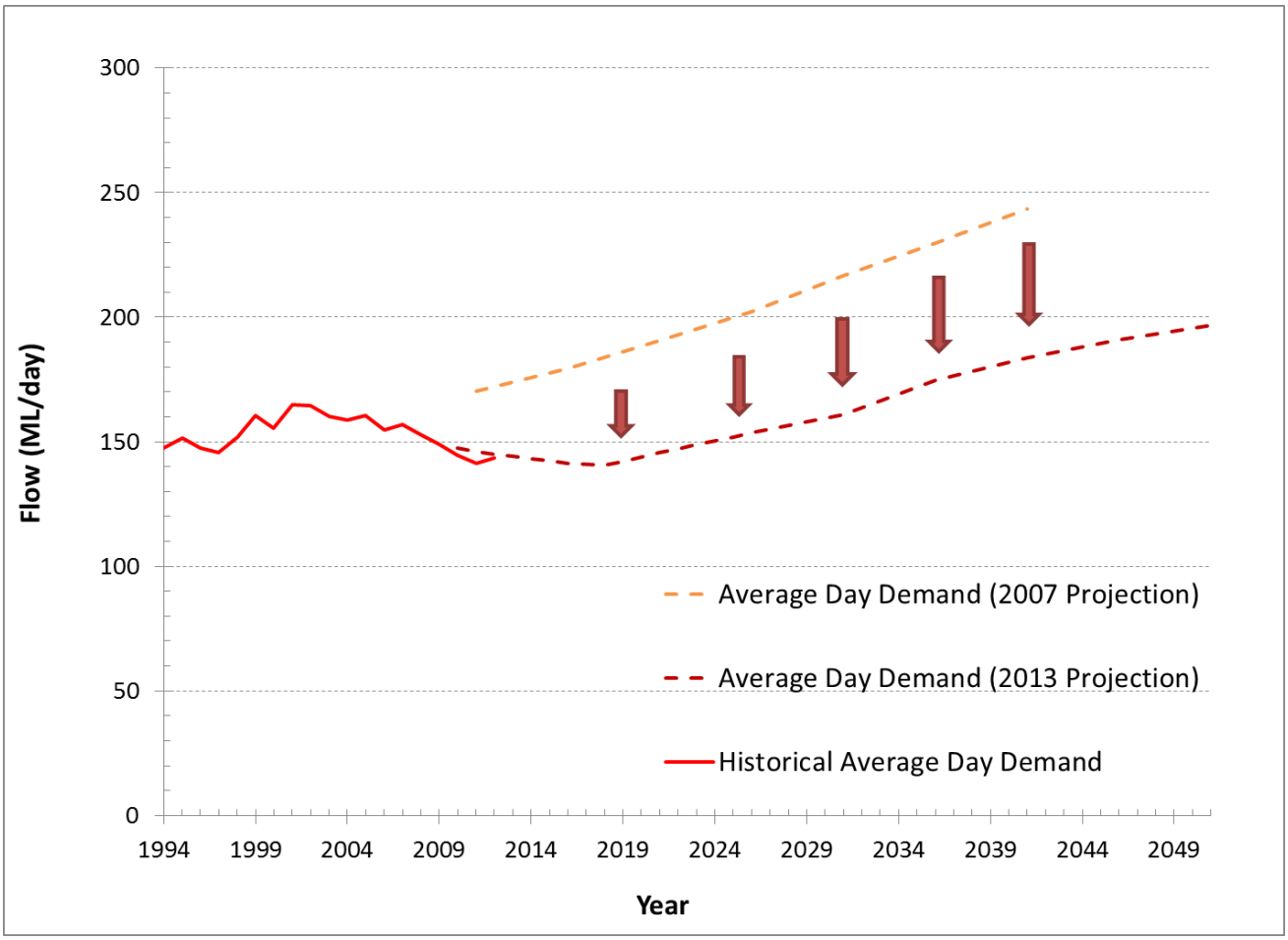
Based on historical trends, the projected demands presented in the 2007 Strategy were forecasted to increase. In the year after the completion of the 2007 Strategy it became evident that there was a new declining water demand trend. The decline is attributed to a number of factors: water conservation and water efficiency efforts, intensification, and economic factors. Environment Canada indicates this decreasing trend is also evident in other Municipalities across Canada [Footnote 1].

During the WSDOMP development, revised forecasted demands were developed up to 2031. System demands were estimated based on population forecasts, employment forecasts, and per capita water use trends anticipated to represent probable future demands.

The 2007 Strategy used maximum week demands for assessing the IUS supply needs, whereas this WSMP Update uses average day demands as a more critical factor for long-term supply management. Peak supply, with maximum week demand as a basis, has historically guided the water supply planning process. Maximum week demands are represented by the highest average of seven days in a given year, and typically occur in the summer. This WSMP Update focuses instead on average day demands due to the combination of 1) a decrease in the max day factor (ratio of the maximum day demand to the average day demand) and 2) the greater constraint on average day rates due to the findings of the Tier 3 Assessment (Section 3.3.4). While the IUS system must be capable of meeting maximum day, maximum week, and fire flow demands, the WSMP Update added long-term average day demands as a key parameter for supply management. Using average day demand projections as the basis for comparison, Figure 6-1 demonstrates the decrease in average day demands from the 2007 Strategy forecasts compared to the average day demand forecast used in the WSMP Update (2011).

Footnote [1] Environment Canada. 2011. *2011 Municipal Water Use Report – Municipal Water Use 2009 Statistics.* Retrieved from: http://www.ec.gc.ca/doc/publications/eau-water/COM1454/survey2-eng.htm.

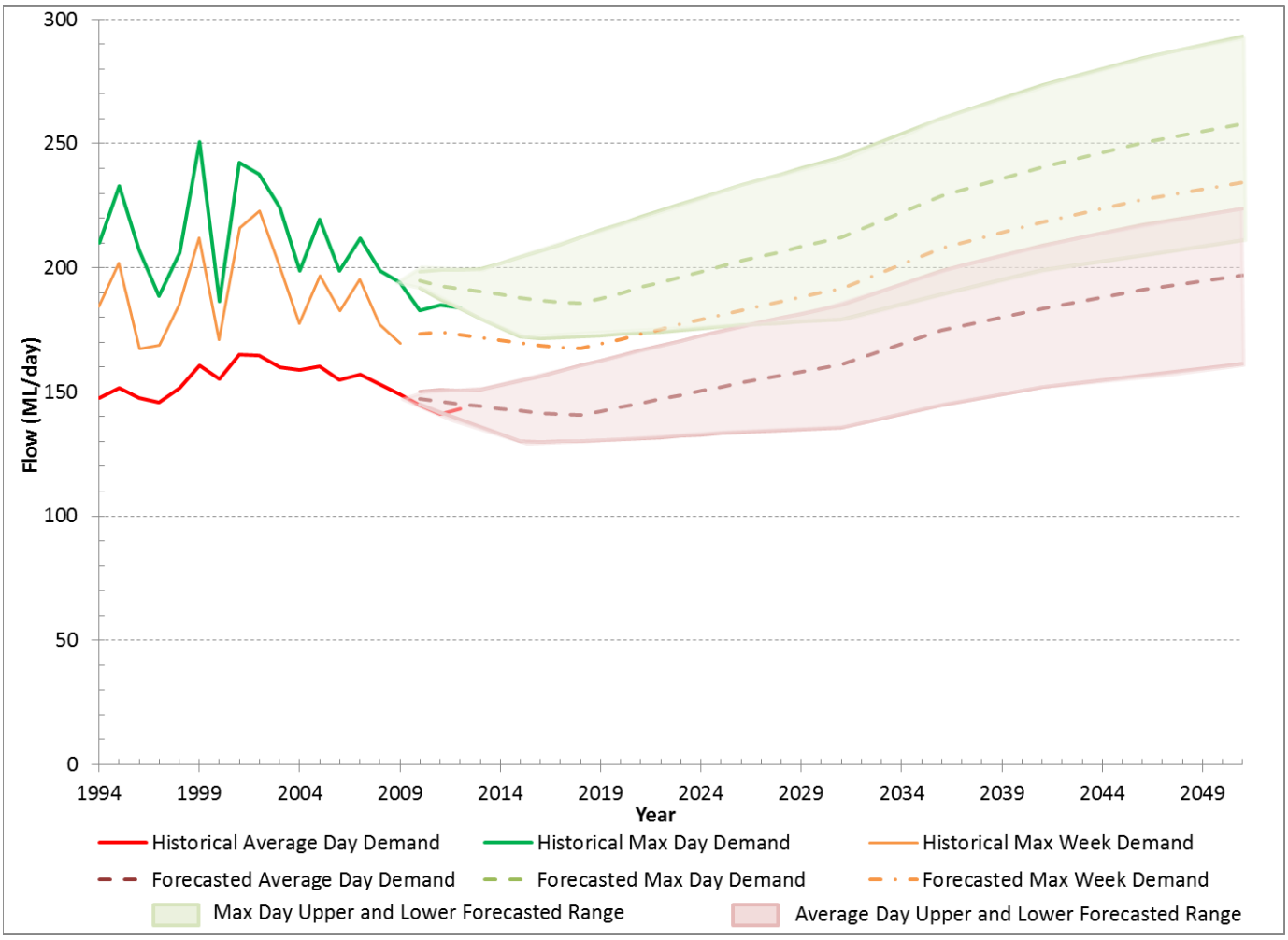
Figure 6-1: Decrease from 2007 Strategy Average Day Demand Forecast to WSMP Update (2011) Average Day Demand Forecast



6.2 Forecasted Demands

Population in the Region is forecasted to increase by approximately 32% from 2012 to 2051. System demands were estimated for the Region based on forecasts for residential demand, ICI demand, max day and max week demand factors, and unaccounted for water (UFW) assumptions presented in Tech Memo No. 1 (Appendix A). Multiple scenarios were evaluated to develop a range in probable future demands for average and maximum day demands. Figure 6-2 presents the average, maximum day, and maximum week historical system demands up to 2012 and forecasted system demands starting from 2010. The shaded areas fanning the forecasted demands represent the upper limit and lower limit demand scenarios that were considered representative of probable future demands.

Figure 6-2: Historical and WSMP Update (2011) Forecasted Average, Maximum Week and Maximum Day Demands, including uncertainty



From Figure 6-2 it can be noted that the actual average and maximum day demands are trending below the forecast demands in 2010 to 2012. However, some degree of variation is inevitable when predicting future conditions (including year to year variations in growth rates, economy, rate of implementation of water efficiency measures, seasonal effects, etc.) and the demand forecast lines should be considered as a prediction of long-term trend only. Therefore, for the purposes of the WSMP Update project, it is recommended that the forecasted demands (dashed lines) be used as the preferred trend in considering the future demand scenarios.

6.3 Summary of System Demands

For the analysis of supply versus demand, the 2031 demands were evaluated as the medium-term planning horizon (20 years from the start date of the project). Table 6-1 provides a breakdown of the demands for each pressure zone in the IUS projected for 2031.

Table 6-1: Pressure Zone Average Annual Demands in 2031

IUS Pressure Zone	Zone Demand 2031 (L/s)
Cambridge	
CAM 1	138
CAM 1A	35
CAM 3	42
CAM 2E	181
CAM 1W	87
CAM 2W	48
Total Demand for Cambridge Zones	530
Kitchener	
KIT 4	550
KIT 2E	34
KIT 2EA	6
KIT 2W	56
KIT 5	110
KIT/WAT Zone 6	105
KIT 4A	4
Bridgeport	6
Mannheim Village	3
Total Demand for Kitchener Zones	874
Waterloo	
WAT 4	287
WAT 5 (includes WAT 4B & WAT 4C)	99
WAT 7	9
Total Demand for Waterloo Zones	395

IUS Pressure Zone	Zone Demand 2031 (L/s)
Woolwich	
Breslau North	9
Breslau South	11
Market	2
St Jacobs	6
Elmira	31
Elmira East	9
Total Demand for Township of Woolwich Zones	68
IUS Total	1868

The description of supply sources and the distribution network to meet the updated demands (up to 2031 for each zone and up to 2051 for the entire IUS) is addressed in the following Section 7.0.

7.0 Analysis of Projected Demands versus Existing Supplies

This section will provide an overview of the supply facilities in more detail and compare supply and demand on an IUS-wide and Area Municipality/pressure zone basis. For more detailed descriptions, Tech Memos 4 and 5 are provided in Appendix D and E respectively.

7.1 Required Surplus Capacity

The “Required Surplus Capacity” (RSC) is a new strategic supply management parameter introduced in this WSMP Update. The RSC represents the amount of water continuously available in excess of the projected average day demands. It is different from a peaking supply which serves as a short-term measure for meeting daily and seasonal spikes in water demands. The Required Surplus Capacity is intended to provide reasonable capacity to meet average day demands and ensure redundant water capacity to meet long-term demands.

Setting RSC to a sufficient amount for average day supply is important as it will help ensure the Region does not experience water shortages. The surplus capacity serves to safeguard supply for average day demands in light of operating needs (supplies offline for maintenance, construction, upgrades, replacements, etc.), unexpected outages, and the uncertainty of the sustainable supply rate estimations. For example, a recent incident (mid-2014) at the Greenbrook TP has resulted in a loss of approximately 85 L/s of average day capacity (142 L/s of maximum treatment capacity) in central Kitchener (KIT 4) and the plant is expected to be offline until early 2015.

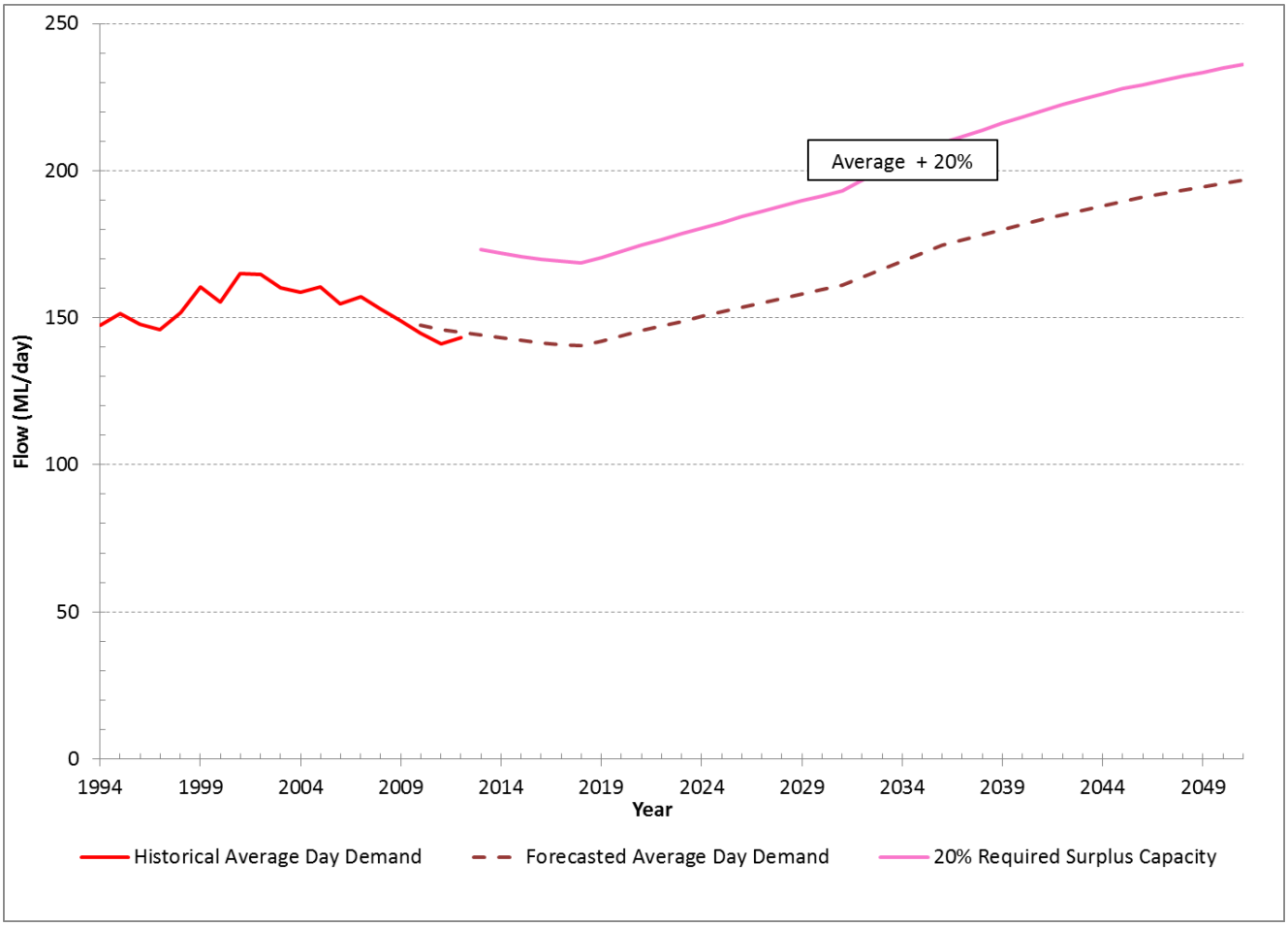
The surplus supply capacity also allows for actual demands (variations from the forecasted demands) to be met given the extended timeframe required for a new source to be fully operational. For example, the RSC will provide capacity for short- to medium-term increases in demands due to 1) more rapid growth trends than identified by the Official Plans or 2) higher than expected demand by a new industrial or commercial user. The buffer the RSC provides is essential since accelerating a new supply capacity project is not necessarily feasible given the requirements of the Municipal Class EA process and the multi-year process for design and construction of a new water supply facility.

The RSC was determined by considering potential scenarios for long-term outages at critical supply sources, a review of the historical surplus capacity, and the insights from Region staff based on their collective experience with the IUS.

The MWTP is the single most significant supply source to the IUS due to the quantity produced and capability to service Area Municipalities throughout the IUS. Through consensus, the recommended RSC is 20% above forecasted demands. This capacity is equivalent to the long-term loss of one treatment train of the surface water treatment at the MWTP. This was considered a reasonable surplus, as an RSC which is too conservative may result in excessive system redundancy and unused capacity (reduced cost effectiveness).

Figure 7-1 graphically presents the required surplus capacity of 20% target of supply above average annual demands. Maintaining supply capacity at the 20% surplus, versus simply maintaining supply above the demand projection, will be important to address potential water supply capacity shortages in the event of facility outages (as evidenced by the loss of Greenbrook TP for an extended period).

Figure 7-1: Required Surplus Capacity of 20% above Average Day Demands



7.2 Supply-Demand Gap Analysis

A comparison of overall forecasted demands versus supply capacity for the IUS was completed to assess the need for new ground water supplies. In 2031, IUS average day demands were forecasted to be 1,868 L/s (161 MLD) (Refer to Section 6.3). Supply capacity of the IUS in 2031, assuming only existing sources are included and that those sources maintain their current level of efficiency, is calculated to be approximately 2,235 L/s (193 MLD).

Comparing the total forecasted demands to the total supply capacity of the IUS showed that there is sufficient supply to meet demands based on the assumptions presented. This analysis accounted for the required transfers between pressure zones and planned

reconfigurations up to 2031. Table 7-1 highlights that, beyond being able to meet the projected demand requirements for average day in 2031, there is approximately 20% surplus of supply available in excess of demands, which meets the recommended RSC.

Table 7-1: Summary of 2031 IUS Supply (Surface Water and Groundwater)

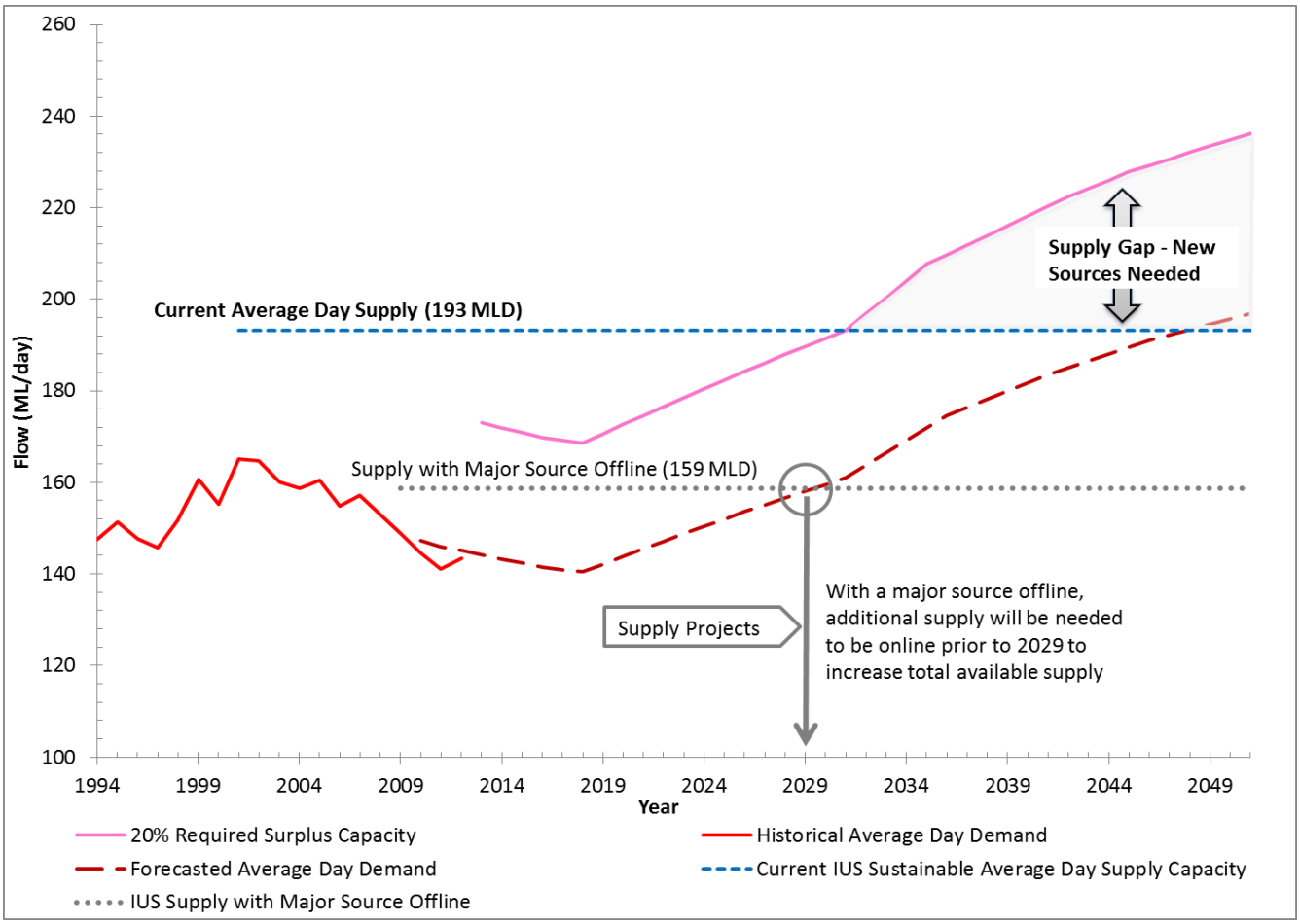
2031 Configuration	Available Average Day Supply[1] (L/s)	IUS Average Day Demands (L/s)	Surplus Capacity
Groundwater Sources	1440	1868	**20%**
Surface Water Sources	795		
TOTAL	**2,235 (193 MLD)**	**1,868 (161 MLD)**	

Note 1: Groundwater sources outlined in Section 2.2.1 and surface water source is outlined in Section 2.2.2.

It can be noted that the average day available supply capacity in Table 7-1 includes only existing, permitted wells or wells that are grandfathered (not requiring permits). Non-permitted wells include those groundwater sources that are being tested and developed for potential future use, but do not yet have a PTTW.

Figure 7-2 illustrates the current average day supply and demand capacity with the 20% RSC up to 2051, graphically showing the supply-demand gap and the year (2029) in which new supplies must be online in order to meet the RSC.

Figure 7-2: Average Day Supply and Demand with No Additional Supply Beyond 2013 Permitted, Existing Supply Sources with 20% RSC



From Figure 7-2 it is evident that there is a projected surplus of supply available within the IUS with existing water supplies out to 2051; however, the 20% buffer is not maintained for the duration of this period. A supply gap begins in approximately 2031 assuming all supplies are available, and a minimum of 39 MLD will be required by 2051 to close this gap while maintaining the RSC.

In Figure 7-2, the lower supply line represents the decrease in supply of 50% of the MWTP capacity, as described in Section 7.1. To provide redundancy for the longer term loss of as supply source as large as the 50% of the MWTP, it is recommended that additional supply projects be initiated at least five to six years in advance of being required (2029) to allow for the Class EA process and design and construction of a new facility.

Figure 7-3 presents the available maximum day supply versus projected demand for the IUS up to 2051.

Figure 7-3: Maximum Day Supply and with No Additional Supply Beyond 2013 Permitted Sources

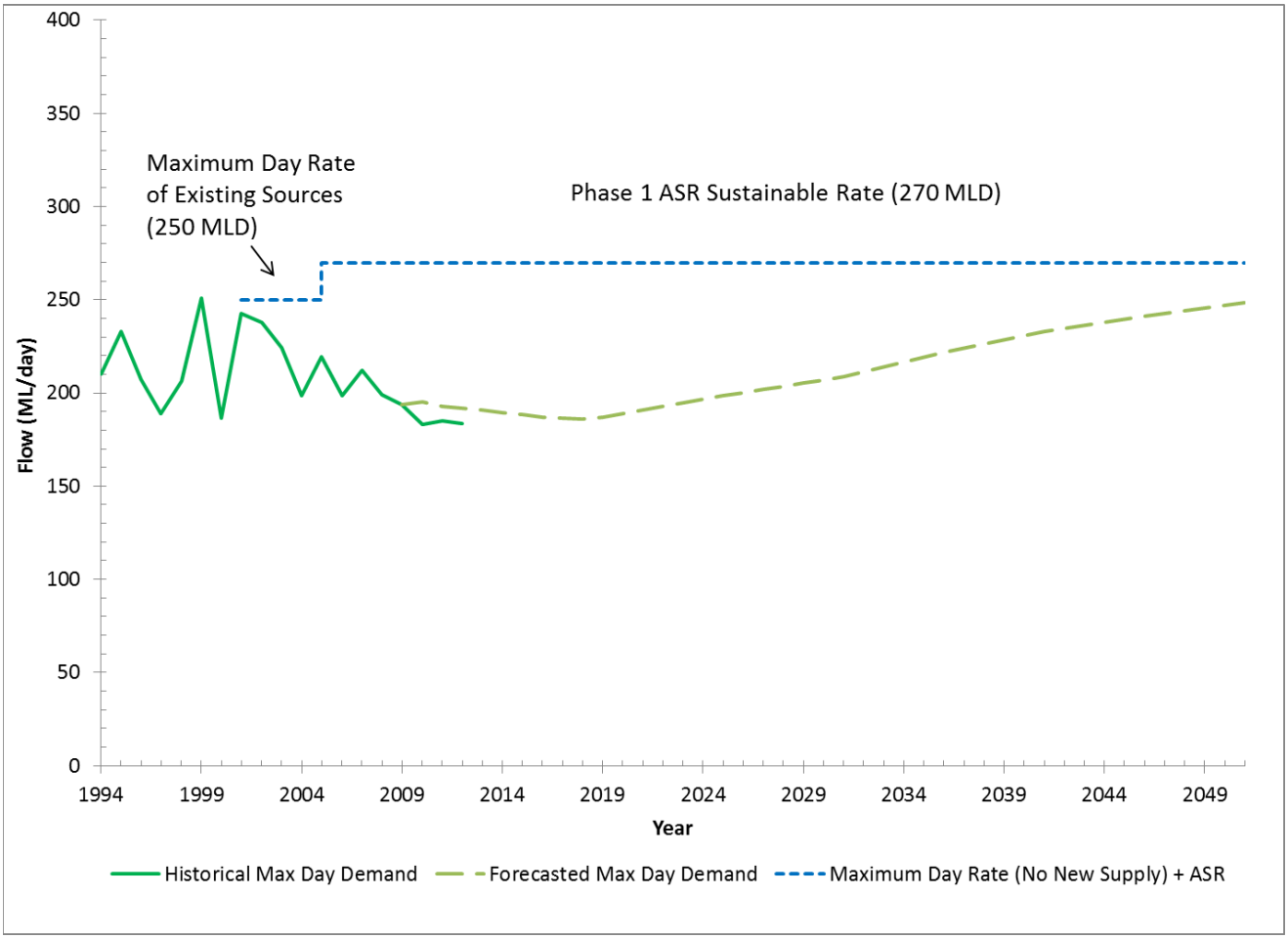


Figure 7-3 indicates that the existing supply sources considered in this WSMP Update are capable of meeting the projected maximum day demands for the IUS system up to 2051, but are not capable of meeting the projected average day demands for the IUS up to 2051.

Therefore, as the overall supply capacity is governed by average day taking from sources, a minimum of 39 MLD will be required to close the supply gap by 2051 to maintain the 20% RSC for average day conditions.

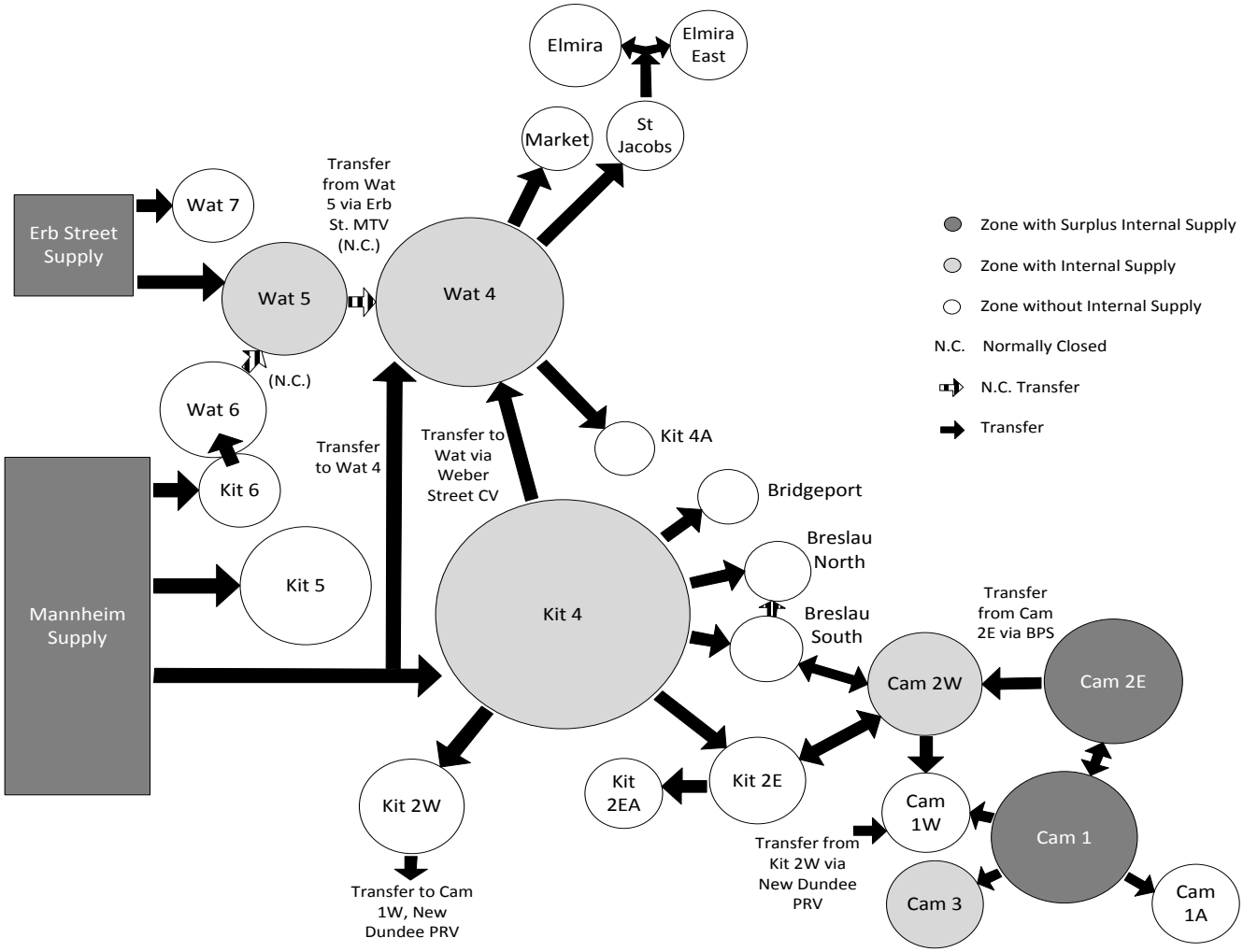
7.3 Localized Zone-Wise Supply versus Demand

The supply infrastructure and distribution network is considered in the analysis of availability of supply as it represents the ability of the supply sources to service various areas of the IUS. For example, sources in Cambridge are not currently configured to service the Cities of Kitchener or Waterloo. As such, the WSMP Update considered the localized surpluses and shortages of water and how to efficiently, reliably and sustainably transport water to various parts of the distribution system to meet water demands.

Figure 7-4 is a schematic of the IUS and the proposed transfers between various pressure zones recommended in the WSDOMP Draft Final Report (March 2014) for 2031. Water can be transferred between zones at select locations by pumping, pressure reducing valves and control valves depending on the operating pressure of adjacent zones.

In Figure 7-4, the size of the zone represents the approximate magnitude of the demand relative to other zones, the shades of grey indicate the existence of water supply sources located within the zone, and the black arrows indicate the direction of water transfers between adjacent zones. Figure 7-4 outlines schematically how local demands are met and how supply sources are dispersed throughout the IUS.

Figure 7-4: Region of Waterloo IUS Supply-Demand Configuration for 2031



As can be seen from Figure 7-4, the majority of outlying zones do not have supply sources and depend on transfers from larger, more central zones. Mannheim Supply represents the groundwater supplies from the Township of Wilmot and the surface water from the MWTP and ASR. The Mannheim Supply, Erb Street Supply, Cambridge Zones 1 and 2E are areas where, under typical conditions, there is supply in excess of the zone demand and water is available to be transferred to adjacent zones.

Comparing existing supply sources to the 2031 zonal demands, there is a marginal surplus capacity in 2031. However, as demands increase there is a need to bring on new supply sources in strategic locations to maintain the RSC of 20% of supply above demands and maintain the system based on a preferred operating strategy. A zone-wise analysis was performed as part of Task 4 and was taken into consideration when developing and evaluating the supply alternatives to maintain the RSC.

More details on supply and supply transfers on a zonal level are provided in Tech Memo 4 which outlines the pressure zone-wise supply and demand conditions for the present day (refer to Appendix D). Tech Memo 5 describes the IUS for conditions based on the recommendations in the WSDOMP Draft Final Report (2014) and provides details of average day and maximum day pumping rate versus zone demand for each individual production well (refer to Table A-1 in Appendix E).

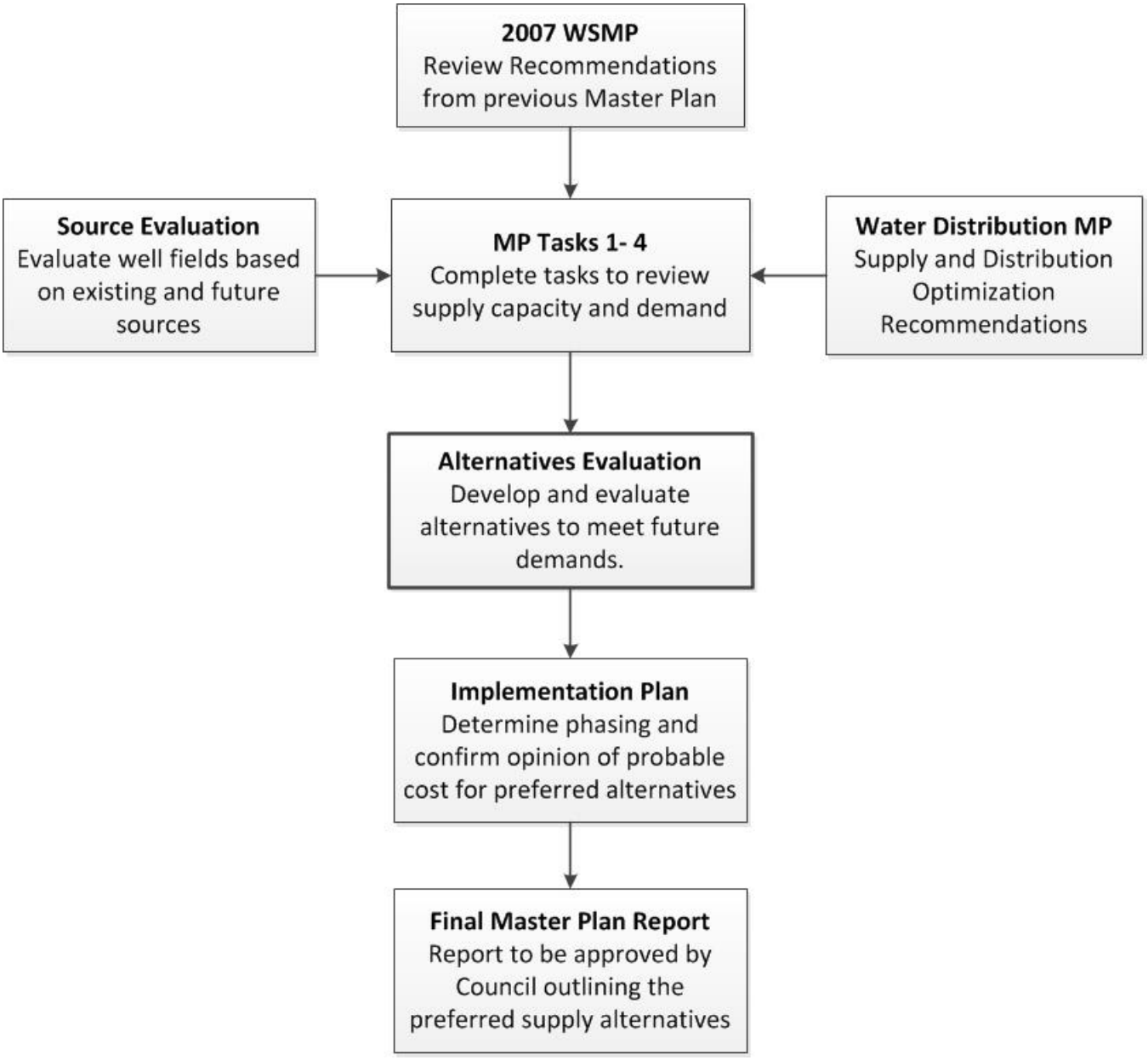
8.0 Methodology for Evaluation of Alternatives

The methodology for evaluating supply alternatives for the WSMP Update was developed as part of Task 5. The objective of the evaluation was to generate supply recommendations to maintain sufficient average day supply in each pressure zone and to close the projected supply gap of approximately 39 MLD by 2051. A groundwater source evaluation was completed at the outset of the process to identify local constraints and opportunities associated with the supply wells and well fields. This evaluation was used to assess individual facilities.

In parallel with the groundwater source evaluation, the supply alternatives evaluation was completed. Supply alternatives to meet future demands were developed based on the 2007 Strategy recommendations, insights gained from Tasks 1 through 4 of the WSMP Update and the source evaluation, and the recommendations in the WSDOMP Draft Final Report (March 2014). The generated alternatives were evaluated, and top ranked alternatives represent the preliminary preferred Supply Alternatives presented to the public for review at the Public Consultation Centres described previously.

Figure 8-1 provides an overview of the methodology for the generation and evaluation of the supply alternatives, and the outcomes of the evaluations.

Figure 8-1: Overview of Evaluation Methodology



The following sections summarize the methodology used for the groundwater source (8.1) and water supply alternatives (8.2) evaluations. The recommended Supply Alternatives and opinion of probable costs are presented in Section 9.0.

8.1 Groundwater Source Evaluation Process

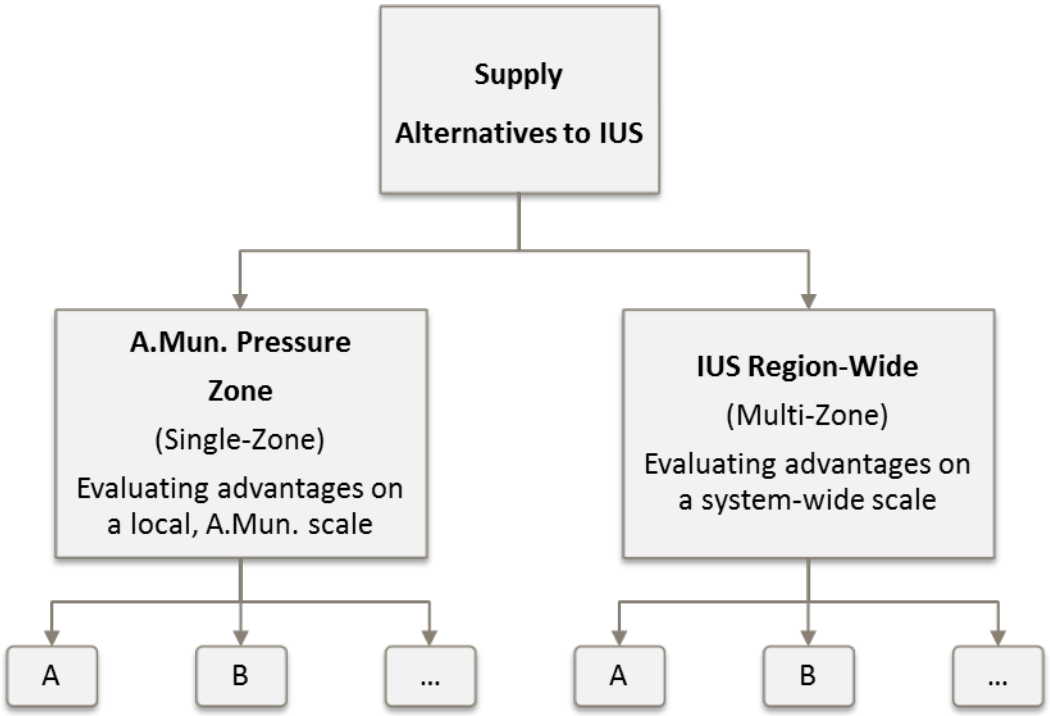
The purpose of the groundwater source evaluation was to provide insight into identifying and prioritizing well field or individual well projects required to optimize the water supply system. In this evaluation the potential to increase or decrease production and develop new supply sources was considered in optimizing the water supply system. The overall rankings

determined as part of the source evaluation were used to help identify and evaluate water supply alternatives. More details on the source evaluation and the results of the source water evaluation are provided in Tech Memo No. 5 (refer to Appendix E).

8.2 Water Supply Alternatives Evaluation Process

Due to the complexity of the IUS distribution system, it was necessary to provide an evaluation of supply alternatives on an Area Municipality (A.Mun.) pressure zone basis and on multi-zone or IUS-wide basis (refer to Figure 8-2 below). This approach was taken to consider advantages of supply alternatives that were both local and system-wide.

Figure 8-2: Generation and Evaluation of Supply Alternatives based on Local Zonal and Region-Wide Considerations



As previously mentioned, water supply alternatives were developed based on insights from the previous WSMP Update Tasks, the 2007 Strategy, and the recommendations of the WSDOMP. The recommendations of the WSDOMP to be implemented by 2031 were considered baseline scenarios (the “No Change” option) for the WSMP Update alternatives.

The alternatives were evaluated based on seven (7) criteria: treatment complexity, production cost, labour cost, capital cost, location, energy efficiency, and security of supply. Alternatives were assigned a rank of 1 through 4 or 1 through 3 for each criterion, a higher rank representing a good score and a lower rank representing a poor score. A weight of 1 -

2 was assigned to each criterion based on significance of the criteria to determine an overall rank for each alternative. The criteria and weighting were developed through consultation and consensus with Region staff. Table 8-1 summarizes the evaluation criteria used for alternatives.

Table 8-1: Alternatives Evaluation Criteria

Criteria	Weight	Rank
Treatment Complexity	1	1-4
Production Cost	1	1-4
Labour Cost	2	1-4
Capital Cost	2	1-4
Location (Connectivity)	1	1-4
Energy Efficiency	2	1-3
Security of Supply	1	1-4

The overall rank for each Area Municipality Zonal Alternative was calculated by summing the individual ranks for each criterion which were multiplied by the respective weighting. This scoring resulted in a maximum possible overall scoring of 38.

As a result of the broader scope of the IUS Region-Wide Alternatives analysis, an additional evaluation criterion and multiplier is incorporated for the multi-zone alternatives. The additional evaluation criterion is Supply Rate and the multiplier is the Regional Score Modifier. The Supply Rate is a significant consideration when evaluating supply to the IUS for long-term planning purposes; therefore, more weight was added to this parameter compared to the zonal alternatives. Table 8-2 presents the relative rank and weighting for the supply rate criterion. The supply rates of the IUS Region-Wide supply alternatives are arranged from lowest to highest and ranked on a scale of 1 to 4 respectively.

Table 8-2: Average Day Supply Rate for Alternative Future Supply Sources

Criteria	Weight	Relative Rank
Supply Rate (L/s)	2	1 - 4

The Regional Score Modifier emphasizes the regional considerations for water demand in the IUS. Three Regional Modifiers were identified: supply sources in Waterloo, supply sources configured to serve two or more area municipalities (A.Mun.s) (i.e., Kitchener, Cambridge), and supply sources configured to serve one A.Mun. (i.e. Cambridge, Woolwich). These represent a multiplier of 3 to 1, respectively. Table 8-3 provides an explanation of the Regional Modifiers.

Table 8-3: Regional Score Modifier for Future Region-Wide Supply Sources

Location Descriptor	Regional Score Modifier	Justification
Waterloo	3	Waterloo does not have sufficient supply sources within its municipal borders to meet demand and thus alternatives for sources in Waterloo were assigned a Regional Modifier of 3 which would favorably increase the overall alternative ranking. Additionally, reduction in transfer capacity to service Waterloo allows water from sources in Kitchener to be utilized in both Kitchener and Cambridge and enhances the robustness of the overall IUS.
Location of supply source which serves two or more A.Mun.s	2	Supply sources which are more centrally located and configured to supply to more than one A.Mun., such as sources located in Kitchener and potentially Cambridge, were assigned a Regional Modifier of 2 which would neutralize the overall alternative ranking.
Location of supply source which serves one A.Mun.	1	Supply sources which only have the potential to supply to one A.Mun., due to location, configuration of distribution network, or energy efficiency considerations were assigned a Regional Modifier score of 1, which would reduce the overall ranking.

For each IUS Region-Wide Alternative, the Regional Score Modifier was multiplied by the summed weighted rank of the criteria, which included: treatment complexity, production cost, labour cost, capital cost, location, energy efficiency, security of supply, and supply rate. This resulted in a maximum possible overall scoring of 138. Additional details on the Supply Alternatives evaluation and the results of the evaluations are provided in Tech Memo No. 5 (refer to Appendix E).

9.0 Water Supply Master Plan Updated Strategy

9.1 Updated Strategy up to 2031 and 2051

Some aspects of the 2007 Strategy, with minor modifications, continue to be recommended in this WSMP Update. However, not all recommendations are included; notably the Great Lake Supply has been delayed beyond the planning window of this WSMP Update. The major recommendations of the updated WSMP Strategy for the next 20 and 40 year periods include:

1. Address Constraints in Supply and Distribution:
    - Addressing constraints in distribution of supply by removing bottlenecks, planning for intensification, and improving energy efficiency.
2. Increase groundwater supply capacity, as needed, to maintain sustainable average day capacity at least 20% above projected average demand:
    - Constructing new groundwater facilities, including Waterloo North WTP and the Central Grand River/Maple Grove WTP, as required to increase supply.
    - Constructing improvements to existing Cambridge water treatment plants and wells to optimize the quantity of water produced.
3. Continue to improve water efficiency and conservation efforts to reduce demand growth.
4. Peaking and capacity increases to address peak demands, such as implementing Phase II of the Region's ASR system to manage peak water demands, which occur in dry summer months.
5. Updating the WSMP regularly (approximately every 5 years).
6. Beyond 2051, deferring the Great Lake Supply and consideration for water reuse for long-term water supply capacity planning.

Details on the recommendations of the updated strategy are included in the following sections.

9.2 Components of Updated Strategy

The components of the updated WSMP Update Strategy are detailed in the following sections. The implementation schedule and phasing is presented in Section 9.3 and the Opinion of Probable Cost is presented in Section 9.4.

9.2.1 Address Constraints in Zonal Supply and Distribution

Many of the preferred Area Municipality Zonal Supply Alternatives of the WSMP Update improve supply to a given area through reconfigurations of the flow of water in the IUS and removal of bottlenecks. The existing infrastructure and recommendations of the WSDOMP (March 2014) to be implemented by 2031 were considered baseline scenarios for the WSMP Update Alternatives.

The Zonal Supply Alternatives were evaluated according to the methodology outlined in Section 8.0 and are ranked in terms of priority per pressure zone. Recommendations for zonal supply and distribution are presented in Table 9-1. The rankings in Table 9-1 indicate a phased approach where more than one supply alternative is recommended, with the proposed timing of implementation presented.

The phasing and proposed implementation of the zonal supply alternatives will be discussed in Section 9.3. Generally, lower ranked supply alternatives have not been included in the 20 year WSMP Update planning window but should be considered for supply capacity enhancement beyond the planning window in future WSMP updates. Refer to Tech Memo 5 in Appendix E for details on the scoring of supply alternatives.

Table 9-1: Zonal Supply and Distribution Optimizations by Area Municipality

Pressure Zone	Description of Ranked Recommended Alternatives	Timing of Implementation	
Cambridge		Before 2031	After 2031
CAM 1 and CAM 1A	1. No Change (Continue with Optimized Supply Infrastructure as per WSDOMP). CAM 1 supplies CAM 1A. Supply in CAM 1 includes: Turnbull PS to CAM 1, G9 on standby, Shades Mill, and Middleton online as primary supply source. The distribution system of CAM 1A is strengthened in WSDOMP optimizations.	✓	-
CAM 1W	1. No Change (Continue with Optimized Supply Infrastructure as per WSDOMP). This includes: Primary CAM 1 connection, supplemented by CAM 2W, KIT 2W connections, P6 decommissioned. This supply configuration increases robustness of supply and is cost effective.	✓	-

Pressure Zone	Description of Ranked Recommended Alternatives	Timing of Implementation	
CAM 2W	1. No Change (Continue with Optimized Supply Infrastructure as per WSDOMP). This includes: planned CAM 2E in-line Booster Pumping Station (BPS) to CAM 2W. The BPS increases security of supply and makes use of excess supply in CAM 2E reducing pressure on KIT 4 supplies.	✓	-
	2. If required, proposed Maple Grove TP to be re-evaluated and expansion to commence before 2031.	✓	-
CAM 2E	1. Capacity restoration of treatment facilities, described in Section 9.2.2.2	-	-
CAM 3	1. Expand capacity of G4 and new G4A by 35 L/s. Supply to this zone also includes the new St. Andrews PS, and improvements to distribution network. The internal supply source (G4/G4A) creates sufficient supply capacity and security while reducing demands on CAM 1.	✓	-
Kitchener and Wilmot		Before 2031	After 2031
KIT 2EA, KIT 2E, KIT 2W, & KIT 4	1. No Change (Continue with Optimized Supply Infrastructure as per WSDOMP).	✓	-
KIT 2W	1. No Change (Continue with Optimized Supply Infrastructure as per WSDOMP). This includes incorporating K34/K36 (Strasburg) TP as direct supply to both KIT 2W and KIT 4. This results in minimal capital costs, and increases security of supply for KIT 2W and CAM 1W.	✓	-
Mannheim Peaking	1. No Change (Continue with Optimized Supply Infrastructure as per WSDOMP). This includes the extension of the PTTW for the peaking K90 wells to 365 days (no change in capacity). This configuration increases flexibility and security of peaking capacity without increase flow rates or enduring significant capital costs.	✓	-
	2. Implement ASR Phase II, based on maximum day demands (refer to Section 9.2.4.1). Timing dependent on peak demand needs.	✓	-

Pressure Zone	Description of Ranked Recommended Alternatives	Timing of Implementation	
Waterloo and Woolwich		Before 2031	After 2031
WAT 4	1. No Change (Continue with Optimized Supply Infrastructure as per WSDOMP). This includes consolidating raw water from Williams Street at Strange Street TP for treatment, and return to WAT 4 via proposed KIT 4/WAT 4 connection at Weber Street. This also includes the proposed Waterloo North TP (See Section 9.2.2.). This reconfiguration takes advantage of an existing facility, is centrally located, reduces treatment complexity, and reduces capital costs.	✓	-
	2. When required, a new supply source located in Woolwich to offset demands on WAT 4 is to be re-evaluated	-	✓
WAT 5 & 7	1. No Change (Continue with Optimized Supply Infrastructure as per WSDOMP). This includes supply transfer from Erb Street Supply and W10 in WAT 5.	✓	-
	2. Transfer from WAT 6 via new Pressure Reducing Valve (PRV), when required. This is a lower cost option and an alternate backup supply from MWTP.	✓	-
	3. Transfer from Waterloo North TP via new Pump Station (PS), if required	-	✓
WAT 6	1. No Change (Continue with Optimized Supply Infrastructure as per WSDOMP).	✓	-

As can be seen from Table 9-1, in addition to the distribution optimizations, there is also an increase in supply to IUS pressure zones CAM 3 (35 L/s) and KIT 4/WAT 4 (30 L/s) by 65 L/s (5.6 MLD). Despite this, the majority of the zonal recommendations outline no change from the WSDOMP (March 2014), as these measures were evaluated to be sufficient for meeting zonal supply for the WSMP Update planning period up to 2031.

9.2.2 Increase Groundwater Supply to IUS as Needed

The IUS Supply Alternatives were generated and evaluated according to the methodology outlined in Section 8.0. Alternatives identified that increasing groundwater supply in the IUS can be achieved by:

1. Drilling new wells and creating new treatment facilities.
2. Drilling new wells and restoring capacity of existing treatment facilities.
3. Restoring existing wells and creating new treatment facilities.

Proposed groundwater facilities which were evaluated and selected to increase supply to the IUS include Waterloo North TP and a Central Grand River and Maple Grove TP. Proposed restoration to Cambridge East TPs and wells (Turnbull, Pinebush and Hespeler) were also evaluated to be significant in terms of its ability to increase supply to the IUS. These proposed and restored facilities have the potential to strategically increase supply to the IUS due to their location and the interconnectedness of the IUS distribution system. Servicing Waterloo and the East Side Lands (ESL) (CAM 2W, KIT 2E, and Breslau) is the priority for increases in supply capacity. Refer to Tech Memo 5 in Appendix E for details on the scoring of supply alternatives.

Proceeding with the Waterloo North TP, the Cambridge East TP capacity restoration, the Central TP for the Grand River and Maple Grove wells, and the preferred and planned zonal supply increases will add approximately 581 L/s (50 MLD) of capacity to the IUS for average day scenarios, which is sufficient for the Region's projected needs up to 2051.

9.2.2.1 Waterloo North TP

Waterloo North TP involves the addition of two new wells, W5A and Laurel Tank, and a new treatment facility near the Laurel Tank in north Waterloo. Waterloo North TP was top ranked because of the need for additional water supply in Waterloo to ensure security of supply. There is no need for extensive supply source development in the next 15 to 20 years; therefore it is recommended that a staged approach for the two wells be investigated as part of an amended Class EA to better match the projected water demands. In order to contribute to the security of supply for Waterloo and considering water quality, it is recommended the Laurel Tank Well be developed initially as minimal treatment will be required for supply. W5A, with more advanced treatment requirements for sulphates, could then follow at a later date as determined by the amended Class EA.

9.2.2.2 Cambridge East Treatment Facilities Capacity Restoration

Cambridge East treatment facilities are currently operating under-capacity due to the decline in reliable well supply capacity. Constructing improvements to the existing Cambridge East water treatment plants and wells, including the Pinebush TP, Turnbull TP, Hespeler wells, and Pinebush wells, will increase the quantity of water produced in the IUS. The restoration of Cambridge East facilities and wells is recommended due to the location of the pressure zone CAM 2E relative to supply growth in Cambridge and the East Side Lands (ESL) and the lower cost associated with making use of existing facilities and infrastructure versus bring new treatment facilities online.

The permitted maximum capacity for each of Turnbull TP and Pinebush TPs is 120 L/s. Restoration of capacity at both TPs by the addition of new wells will permit restoration of operation to the maximum of 120 L/s as the current wells are not capable of meeting the permitted capacity at either facility. The new test wells which are considered for capacity restoration for Turnbull and Pinebush TPs are outlined in Section 2.2.1.1.

New system wells for Cambridge East are located in the Hespeler and Pinebush well fields. The new Hespeler wells are located adjacent to the existing wells. Increases in the

Hespeler wells will result in approximately 65 L/s in addition to the existing average day capacity based on the updated pumping rates of permitted wells (Section 2.2.1.1). Reconfigurations recommended from the WSDOMP Draft Final Report (March 2014) for the Pinebush well field include consolidation of system wells (G5, P9, and P15) and the Pinebush TP at the Rahmans PS. The addition of system well G5A located adjacent to G5 will result in an additional 18 L/s for this consolidated facility.

The treatment capacity restoration of Cambridge Facilities is appropriate for the Region to implement in the medium-term, prior to 2031.

9.2.2.3 Central Grand River and Maple Grove TP

A central facility for Grand River and Maple Grove wells involves the restoration of the Grand River Wells (K70s and K80s) and the Maple Grove wells (P16 and FSTP1-10) and a new treatment facility. It is recommended because it has a strategic location that can supply multiple areas of the IUS and it has the highest potential combined yield of the new groundwater supply alternatives (242 L/s treated water for average and maximum day conditions).

Combining treatment for Maple Grove and Grand River wells would reduce long-term operating costs and positions a new supply facility in a strategic location to potentially service KIT 4 and the East Side Lands (ESL), which includes KIT 2E, CAM 2W, and Breslau, as needed. The location of the proposed facility would be dependent upon a number of factors, including future growth needs. As there is not a need for a large increase in supply capacity until beyond 2031, this supply project is recommended to be phased as demands increase in the ESL.

9.2.3 Continue with Water Efficiency and Conservation Programs

The Region has been a leader in water conservation historically and as a result of the programs' success there has been a noticeable impact on decreasing water demands across the IUS. Public input from the PCCs indicated that the public feels strongly about the importance of the water efficiency programs (Section 5.4).

The WSMP Update recommends that the Region continue to implement and update the Water Efficiency Master Plan (WEMP) which outlines water efficiency and conservation targets and programs. The efficiency and conservation programs undertaken by the Region have been demonstrated to be more cost effective than developing new supply sources.

The expected benefits of the WEMP include the delay of the need for new supplies by decreasing water demand, reduction of water and wastewater operating costs, and reduction of greenhouse gas emissions. As such, the WEMP has been, and will continue to be, an important part of Regional water supply planning process.

9.2.4 Capacity Increases to Meet Peaking Demands

9.2.4.1 Implement ASR to Meet Peak Demands as Needed

Phase II of ASR is a planned project from the 2007 Strategy to address peak demands in dry summer months. It involves optimizing the Phase I ASR wells and expanding the ASR well field to result in a capacity increase of up to 23 MLD (Refer to Section 2.2.3). This would include one additional ASR injection well and four additional recovery wells. Phase II was re-evaluated in the WSMP Update and while it has been retained as a supply alternative, its timeline for implementation has been delayed to 2026 based on the reduced requirement for increased peak capacity.

9.2.4.2 Groundwater Supply Increases for Constrained Supplies

There are several groundwater facilities and wells that need to be examined for restoration of capacity at this time (as a result of Tier 3 modeling). These facilities are noted in this section for their potential to supply additional groundwater to the IUS. Recent analyses on sustainable yields (outlined in Section 2.0) for these well fields and groundwater facilities have indicated that pumping rates are below the facility permitted rate (DWL or PTTW) and result in a surplus of unused treatment capacity (except for the Lancaster Wells which have no treatment). As such, there is a potential opportunity to increase groundwater supply from these facilities by optimizing supply from existing sources and/or consideration of new sources, provided that there are no negative impacts on aquifers or surface water features. These facilities include:

- Strange Street/William Street TP
- Greenbrook TP
- Lancaster Wells
- Parkway/Strasburg (34/36) TPs

Note, due to the ongoing Environmental Assessment for the Strange Street/William Street TP, an additional 28.5 L/s is recommended to be incorporated from existing wells for the treatment plant upgrades (included in the total presented in Section 9.2.2). Similar to the Cambridge East TPs, substantial savings may be achieved through optimizing the potential capacity of these well fields and treatment facilities as rehabilitation and hydrogeological monitoring are less costly than developing new treatment facilities. Hence, it is recommended that additional hydrogeological monitoring and studies be undertaken to assess the sustainability and feasibility of restoring capacity at these groundwater treatment facilities and system wells.

9.3 Preliminary Phasing and Schedule of Implementation

The ranking of the preferred Supply Alternatives was used to guide the phasing of implementation on a zonal, area municipality and IUS basis. The WSDOMP (March 2014) was also used as a guide for the implementation timing for the Zonal Alternatives. With the updated supply rates and demand projections, the “Required Surplus Capacity (RSC)” concept developed in Section 7.3.1 was used as a guide to determine the need and

approximate timing of new water supply capital projects and optimizations. New sources and supply optimizations will be implemented as needed to maintain a 20% surplus capacity of the average sustainable flow rate above the forecasted average day demand rate. Though the surplus capacity is based on average day rates, the maximum day supply capacity can be met with a margin of surplus. The major supply recommendations are summarized by time period in Figures 9-1 through 9-4, and are summarized in Table 9-2.

Many of the preferred Area Municipality Zonal Supply Alternatives presented in Table 9-2 improve supply to a given area through reconfigurations of the flow of water in the IUS and optimization of bottlenecks. The preferred Zonal and IUS Region-Wide Supply Alternatives that result in an increase in supply to the IUS are shown in Figures 9-5 and 9-6 at the proposed time of implementation. As is demonstrated in Figures 9-5 and 9-6, this schedule of implementation of the proposed Supply Alternatives maintains the RSC for average day demands and also meets the needs for peak demands.

Stantec

Supply Option		
Key	Description	Implementation
A	New PRV Connection Between Wat 6 and Wat 5	5-10 years
B	Optimize Operations of K90s	5-10 years
C	Optimize Kit 2W Supply	5-10 years
D	Supply from Cam 1W and Kitchener	5-10 years

Well		
Key	Number of Wells Represented	Names
20	4	K91-94
30	2	K34,36

Facility		
Key	Name	Status
N	Mannheim WTP & PSs	Existing
O	Strasburg TP	Existing

Supply Option
Well
Test Well
Facility
Pressure Zone
Municipality
Road
Waterbody

Project:
Regional Municipality of Waterloo
Water Supply Master Plan Update

Title:
Supply Increase Recommended Solutions (5-10 years)

Figure Number:
9-1

Project Number:
161111001

5 km
1:125,000

Coordinate System: NAD 1983 UTM Zone 17N
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Revised: 2014-11-21 By: kbuchanan

TOWNSHIP OF WELLESLEY
TOWNSHIP OF WOOLWICH
TOWNSHIP OF WILMOT
TOWNSHIP OF NORTH DUMFRIES
CITY OF WATERLOO
CITY OF KITCHENER
CITY OF CAMBRIDGE
Elmira
Elmira East
St Jacobs
Market
Wat 4
Kit 4A
Bridgeport
Breslau North
Breslau South
Wat 5
Wat Zone 6
Wat 7
St Agatha
Kit Zone 6
Kit 5
Kit 4
Kit 2E
Kit 2EA
Kit 2W
Cam 2W
Cam 2E
Cam 1W
Cam 1
Cam 3
Cam 1A
Mannheim 5
Mannheim
Shingletown
Lloyd Brown
A
B
C
D
20
N
O
30

Stantec

TOWNSHIP OF WELLESLEY

TOWNSHIP OF WOOLWICH

Elmira East

Elmira

St Jacobs

Market

Kit 4A

Wat 4

CITY OF WATERLOO

Bridgeport

Breslau North

Breslau South

Wat 5

Wat Zone 6

Wat 7

St Agatha

Kit Zone 6

Kit 5

Mannheim 5

TOWNSHIP OF WILMOT

Shingletown

Mannheim

CITY OF KITCHENER

Kit 4

Kit 2E

Kit 2EA

Kit 2W

Kit 4

CITY OF CAMBRIDGE

Cam 2W

Cam 2E

Cam 1W

Cam 1

Cam 3

Cam 1A

Lloyd Brown

TOWNSHIP OF NORTH DUMFRIES

A B C D E F G H

Supply Option		
Key	Description	Implementation
A	New PRV Connection Between Wat 6 and Wat 5	5-10 years
B	Optimize Operations of K90s	5-10 years
C	Optimize Kit 2W Supply	5-10 years
D	Supply from Cam 1W and Kitchener	5-10 years
E	Combine William and Strange Street Water	10-15 years
F	Implement ASR Phase II	10-15 years
G	Supply to Cam 2W from Cam 2E	10-15 years
H	Cambridge East Treatment Facilities Capacity Restoration	10-15 years

Facility		
Key	Name	Status
C	William Street PS	Existing
D	Strange Street TP	Existing
J	Pinebush ET & TP	Existing
M	Rahmans Reservoir & PS	Existing
N	Mannheim WTP & PSs	Existing
P	Turnbull TP & Reservoir	Existing

Well		
Key	Number of Wells Represented	Names
4	5	W1C,1B,2,3,15
6	1	H5
8	4	K11A,13,18,19
9	1	K10A
12	1	H4
14	1	H3
17	3	P10,11,17
18	2	P9,15
19	1	G5
22	6	ASR
24	1	G6
26	1	G16
27	1	G17
28	1	G18

Test Well		
Key	Number of Wells Represented	Names
3	1	H5A
4	1	H4A
5	1	H3A
7	1	G5A
8	2	P10A,10B
9	1	PBTW1-05
10	1	PBPW1-06
11	1	CMPW1-06
12	1	CMPW2-06
14	2	K-SS-TW1-11,13

Supply Option
Supply Option (Prev. Plan Phase)
Well
Test Well
Facility
Pressure Zone
Municipality
Road
Waterbody

Coordinate System: NAD 1983 UTM Zone 17N
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5 km
1:125,000

Project:
Regional Municipality of Waterloo Water Supply Master Plan Update

Title:
Supply Increase Recommended Solutions (10-15 years)

Figure Number: **9-2**
Project Number: **161111001**

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Revised: 2014-11-21 By: kbuchanan

Stantec

TOWNSHIP OF WELLESLEY

TOWNSHIP OF WOOLWICH

TOWNSHIP OF WILMOT

CITY OF WATERLOO

CITY OF KITCHENER

CITY OF CAMBRIDGE

TOWNSHIP OF NORTH DUMFRIES

Elmira East

Elmira

St Jacobs

Market

Kit 4A

Wat 4

Bridgeport

Breslau North

Breslau South

Wat 5

Wat Zone 6

Wat 7

St Agatha

Kit Zone 6

Kit 5

Kit 4

Kit 2E

Kit 2EA

Kit 2W

Cam 2W

Cam 2E

Cam 1W

Mannheim 5

Mannheim

Shingletown

Lloyd Brown

Cam 1

Cam 3

Cam 1A

1336

Supply Option		
Key	Description	Implementation
A	New PRV Connection Between Wat 6 and Wat 5	5-10 years
B	Optimize Operations of K90s	5-10 years
C	Optimize Kit 2W Supply	5-10 years
D	Supply from Cam 1W and Kitchener	5-10 years
E	Combine William and Strange Street Water	10-15 years
F	Implement ASR Phase II	10-15 years
G	Supply to Cam 2W from Cam 2E	10-15 years
H	Cambridge East Treatment Facilities Capacity Restoration	10-15 years
I	Waterloo North TP	15-20 years
J	G4/G4A Increase	15-20 years

Well

Key	Number of Wells Represented	Names
36	1	G4

Test Well

Key	Number of Wells Represented	Names
1	1	Laurel Tank Well
2	1	W5A (as required)
13	1	G4A

Facility

Key	Name	Status
B	Waterloo North TP	Proposed

Supply Option
Supply Option (Prev. Plan Phase)
Well
Test Well
Facility
Pressure Zone
Municipality
Road
Waterbody

Coordinate System: NAD 1983 UTM Zone 17N
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5 km
1:125,000

Project:
Regional Municipality of Waterloo Water Supply Master Plan Update

Title:
Supply Increase Recommended Solutions (15-20 years)

Figure Number: **9-3**

Project Number: **161111001**

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Revised: 2014-11-21 By: kbuchanan

Stantec

TOWNSHIP OF WELLESLEY

TOWNSHIP OF WOOLWICH

TOWNSHIP OF WILMOT

CITY OF WATERLOO

CITY OF KITCHENER

CITY OF CAMBRIDGE

TOWNSHIP OF NORTH DUMFRIES

Elmira East

Elmira

St Jacobs

Market

Kit 4A

Wat 4

Wat 5

Wat Zone 6

Wat 7

St Agatha

Kit Zone 6

Kit 5

Kit 4

Mannheim 5

Mannheim

Shingletown

Kit 4

Kit 2W

Kit 2EA

Kit 2E

Bridgeport

Breslau North

Breslau South

Cam 2W

Cam 2E

Cam 1W

Cam 1

Cam 3

Cam 1A

Lloyd Brown

A

B

C

D

E

F

G

H

I

J

K

5

7

6

15

Supply Option		
Key	Description	Implementation
A	New PRV Connection Between Wat 6 and Wat 5	5-10 years
B	Optimize Operations of K90s	5-10 years
C	Optimize Kit 2W Supply	5-10 years
D	Supply from Cam 1W and Kitchener	5-10 years
E	Combine William and Strange Street Water	10-15 years
F	Implement ASR Phase II	10-15 years
G	Supply to Cam 2W from Cam 2E	10-15 years
H	Cambridge East Treatment Facilities Capacity Restoration	10-15 years
I	Waterloo North TP	15-20 years
J	G4/G4A Increase	15-20 years
K	Central Grand/Maple Grove Treatment Facility	20+ years

Well		
Key	Number of Wells Represented	Names
5	6	K70-75
7	3	K80-82
15	1	P16

Test Well		
Key	Number of Wells Represented	Names
6	1	FSTP1-10

Facility		
Key	Name	Status
H	Maple Grove TP	Proposed

Supply Option
Supply Option (Prev. Plan Phase)
Well
Test Well
Facility
Pressure Zone
Municipality
Road
Waterbody

Coordinate System: NAD 1983 UTM Zone 17N
Produced using data under license with the Regional Municipality of Waterloo and the Ontario Ministry of Natural Resources.

5 km
1:125,000

Project:
Regional Municipality of Waterloo Water Supply Master Plan Update

Title:
Supply Increase Recommended Solutions (20+ years)

Figure Number: **9-4**

Project Number: **161111001**

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Revised: 2014-11-21 By: kbuchanan

Table 9-2: Summary of Timing of Implementation for WSMP Update Supply Recommendations

Preferred Supply Alternatives to Increase IUS Supply			2013 to 2015	2016 to 2020	2021 to 2025	2026 to 2030	2031 to 2035	2036 to 2040	2041 to 2045
IUS-Wide	Medium-term Supply	Waterloo North TP		Phased	2028				
		Cambridge East Treatment Facilities Capacity Restoration			2026	-->			
		Hydrogeological Studies on Constrained Well Fields		2021					
	Longer-Term Supply	Grand River Wells and Maple Grove Well Combined Treatment Plant				Phased	2039	--------->	
		Water Conservation and Efficiency Measures			Ongoing				

Preferred Supply Alternatives to Address Zonal Supply and Distribution			2013 to 2015	2016 to 2020	2021 to 2025	2026 to 2030	2031 to 2035	2036 to 2040	2041 to 2045
Cambridge	CAM 1W	Supply from CAM 1 and Kitchener		2020					
	CAM 2W	Supply from New Pump Station (CAM 2E BPS)			2026	---->			
	CAM 3	Expand Capacity of G4/G4A			2031				
Kitchener	KIT 2W	K34/K36 (Strasburg) TP direct supply to KIT 2W and KIT 4		2022					
	Mannheim WTP Peaking	Optimize Peaking/Permitting Operation for K90 Wells	2018						
		ASR Phase II			2026	--------->			
Waterloo	WAT 4 - Maintain Supply	William St Wells Treated and Distributed from Strange St System		2023					
	WAT 5	New PRV Connection from Zone 6 (Mannheim WTP)		2021					

Notes:

Dotted line indicates delayed implementation should circumstances change (i.e. water demand change)

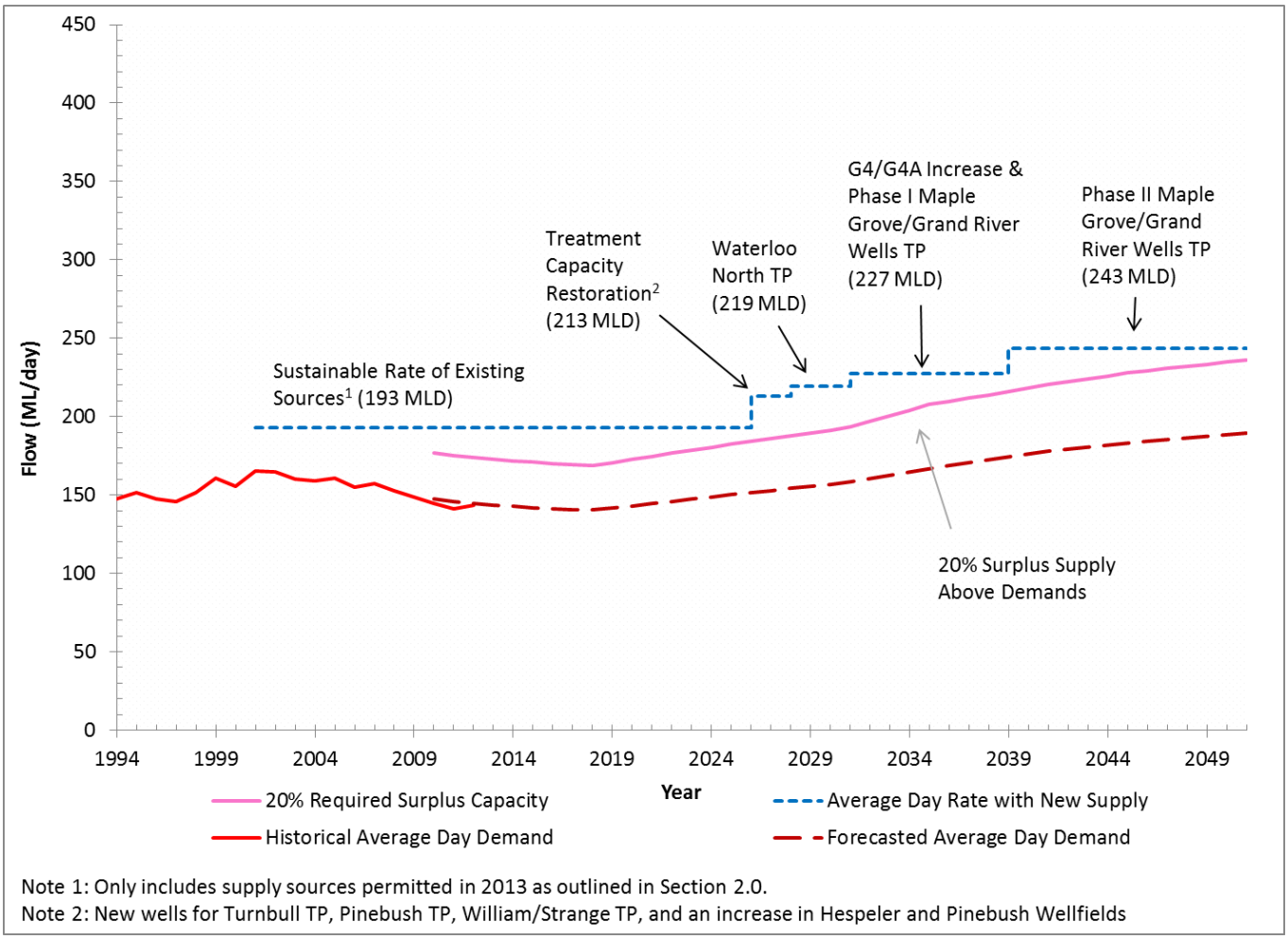
Legend:

Reconfiguring/Optimizing Existing Supplies

Additional Water Supply

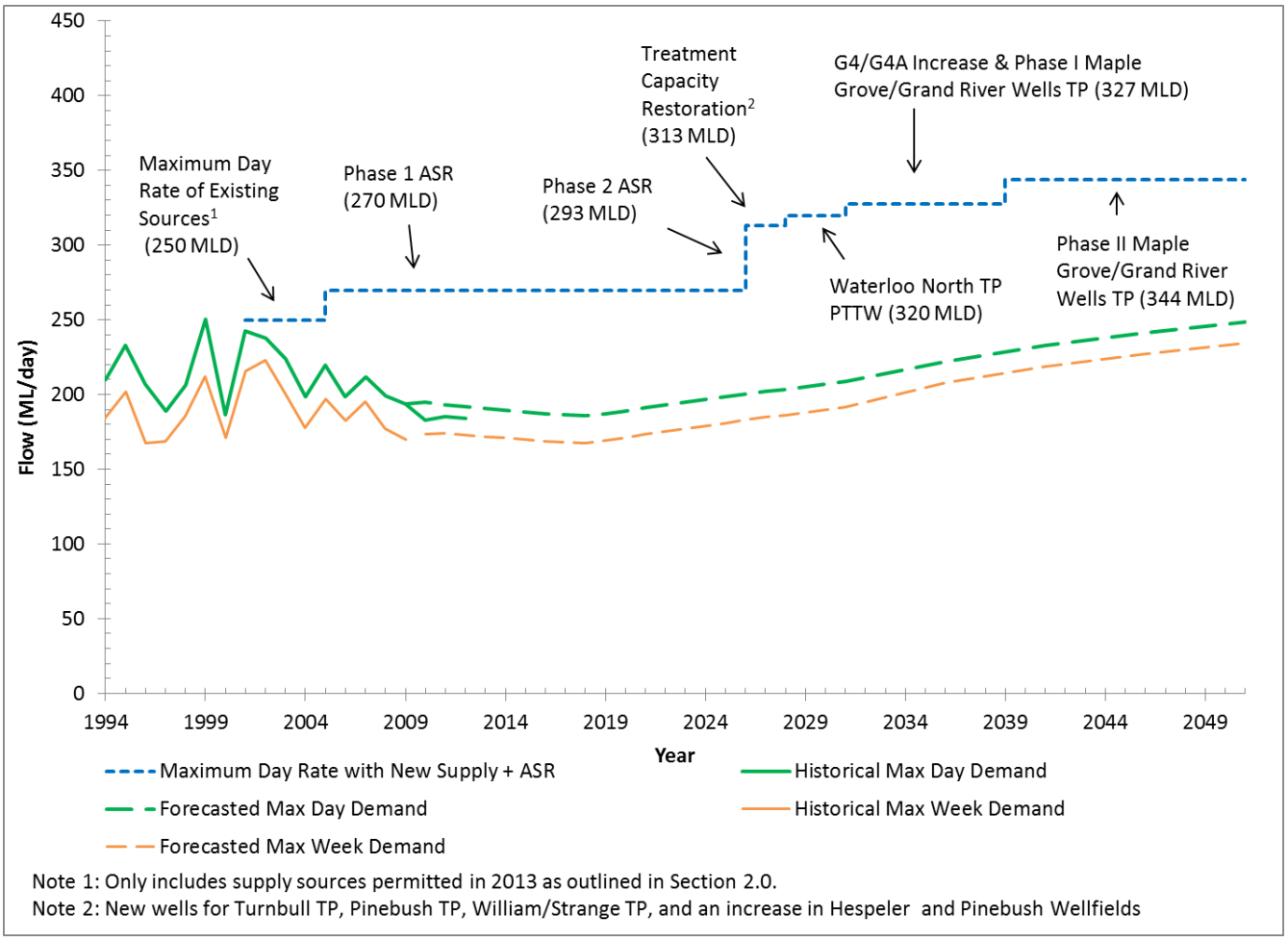
Start EA/Predesign — Commissioning of Facilities

Figure 9-5: Average Day Supply-Demand Configuration to 2051 with Implemented Supply Alternatives and 20% Required Surplus Capacity



Note 1: Only includes supply sources permitted in 2013 as outlined in Section 2.0.
Note 2: New wells for Turnbull TP, Pinebush TP, William/Strange TP, and an increase in Hespeler and Pinebush Wellfields

Figure 9-6: Maximum Day Supply-Demand for the IUS to 2051 with Implemented Supply Alternatives



Presented in Table 9-2 is the preliminary implementation schedule for the preferred Supply Alternatives. The scheduling accounts for the approximate amount of time required to develop the various supply alternatives, including studies, design, permits, construction, and commissioning.

9.4 Opinion of Probable Costs

The opinion of probable cost for the WSMP Update recommended program up to 2031 is presented Table 9-3. Alongside the costs is the implementation schedule and information on the overlap with the WSDOMP (March 2014) and other projects. The costs presented in Table 9-3 are in 2014 dollars and include capital, engineering (design and construction services), and contingency. These costs represent high-level estimates and further design work is required to refine cost estimates. Further details on cost are provided in Appendix H.

Table 9-3: Summary of Opinion of Probable Cost for WSMP Update Supply Recommendations

Preferred Supply Alternative		Opinion of Probable Cost			2013 to 2015	2016 to 2020	2021 to 2025	2026 to 2030	2031 to 2035	2036 to 2040	2041 to 2045
		Captured in WDMP	>20 Year Planning Window	20 Year Planning Window							
IUS Medium-term Supply	Waterloo North Treatment Plant	X		$ 9,900,000							
	Cambridge East Treatment Facilities Capacity Restoration	X		$ 4,400,000							
	Hydrogeological Studies on Constrained Well Fields	X		$ 2,000,000							
IUS Longer-Term Supply	Grand River Wells and Maple Grove Well Combined TP[1]		X	$ 5,700,000 ($ 37,100,000)							
	Water Conservation and Efficiency Measures			On-going							
CAM 1W	Supply from CAM 1 and Kitchener[2]	X		$ 900,000							
CAM 2W	Supply from New Pump Station (CAM 2E BPS)	X		$ 3,000,000							
CAM 3	Expand Capacity of G4/G4A			$ 400,000							
KIT 2W	K34/K36 (Strasburg) TP direct supply to KIT 2W and KIT 4	X		$ 2,700,000							
Mannheim WTP Peaking	Optimize Peaking/Permitting Operation for K90 Wells	X		In Progress							
	ASR Phase II			$ 11,200,000							
WAT 4	William St Wells Treated and Distributed from Strange St TP	X		$ 13,900,000							
WAT 5	Additional Transfer From Zone 6 (Mannheim WTP)	X		$ 500,000							
	TOTAL (20 Year Window)			**$ 54,600,000**							
	TOTAL (Incl. Grand River Wells)			**$ 91,700,000**							

Notes:

1 - The first phase of the Grand/Maple Grove TP project is within the 20 year window.
2 - Assumes no booster pumps are required.
3 - Dotted line indicates delayed implementation should circumstances change (i.e. water demand change)

Legend:

Reconfiguring/Optimizing Existing Supplies
Additional Water Supply
Start EA/Predesign
Commissioning of Facilities

9.5 Future Updates

It is recommended that the Region review and update the WSMP every five years to ensure the assumptions regarding water demand and supply are still valid. Other triggers which may necessitate a WSMP update at an earlier date include:

- Major changes in environmental policy and regulations.
- Major changes in planning policy.
- Major changes in original assumptions (i.e. change in water demand patterns).
- Significant new environmental effects.
- Major changes in proposed timing and/or scope of projects recommended within the Master Plan.

Updates to the WSMP are important to ensure that any longer-term supply options that are necessary can be analyzed in the context of the IUS supply and distribution system, and budgeted and scheduled for accordingly.

9.5.1 Other Long-term Considerations

9.5.1.1 Defer Great Lake Supply Beyond 2050

Due to demand changes, the Great Lake Water Supply System is not necessary for the planning window of the WSMP Update and therefore was not evaluated. It is recommended to re-evaluate this option in a future WSMP iteration, if deemed necessary at that time.

9.5.1.2 Water Reuse as Potential Long-Term Option

Water reuse is a water efficiency approach and is a long-term alternative to potentially consider for the post-2051 planning window. Water reuse involves reclaiming and treating used water (stormwater, greywater, wastewater) to a desired quality to be used again for the same or different application. It can be applied to many different scales within the Region, from centralized to decentralized treatment and use. The applications can also range from existing drinking water applications (direct reuse) to non-potable applications, such as landscape and agricultural irrigation. Generally, reclaimed water is highly treated and meets or exceeds discharge water quality standards. Water reuse and recycling in industry is well established around the world (Los Angeles, CA and Australia), and industry in the Region already practices some forms of water reuse (Toyota recovers waste process water for reuse and Brick Brewing reuses process water for cooling) [Footnote 2].

Footnote [2] Case Studies: http://www.regionofwaterloo.ca/en/aboutTheEnvironment/Conservation2.asp