Executive Summary

ES-1 Background

In 2007, the City of Guelph (City) completed the Water Supply Master Plan (WSMP) project to ensure that the City's water supply continues to meet current and future demands. The 2014 WSMP Update covered a 25-year period from 2013 to 2038 to make it consistent with the current needs of the City. The purpose of the current WSMP Update is to review and revise the 2014 WSMP covering a 30-year period from 2021 to 2051 to align with the Provincial Growth Plan, **A Place to Grow: Growth Plan for the Greater Golden Horseshoe** (amended in August 2020), and the update to the City's Official Plan (in progress). This update will build upon the previous work, review the 2014 WSMP recommendations as well as examine new water supply alternatives in accordance with the Class Environmental Assessment (EA) process for Municipal Water projects, resulting in the listing of recommended water supply projects, including phased implementation schedules and recommended Class EA schedules. Class EA approvals for Schedule "B" and "C" projects can then be conducted by using the Master Plan as a starting point.

ES-2 Challenge and Opportunity Statement

Phase 1 of the Class EA planning process requires the proponent of an undertaking to first document factors leading to the conclusion that the improvement or change is needed, and ultimately, develop a clear statement of the identified problems, deficiencies or opportunities to be investigated. The Challenge and Opportunity Statement for the 2021 WSMP Update was developed through engagement and consultation with the public and stakeholders in the first round of consultation.

> *The City of Guelph is committed to managing population growth as it continues to develop strategies for ensuring adequate water supply. The goal is to develop a reliable and sustainable supply of water to meet the current and future needs of all residential, industrial, commercial and institutional customers.*
>
> *The 2014 WSMP confirmed that the existing water supply capacity will not meet future demands and set out a strategy for*

meeting future demand. It is, therefore, prudent to undertake an update to the water demand forecast, the existing water system capacity and the status of ongoing projects, in order to review the plan and make adjustments as required.

The proposed implementation strategy must deliver, through to 2051, an adequate amount of water in a safe and cost-effective manner and ensure that environmental sustainability is not compromised.

ES-3 Population and Water Demand Projections

ES-3.1 Population Projections

Population projections are required to determine future water supply requirements. The projections developed for the WSMP Update include the serviced population and employment population within the City. This later category includes the population representative of industrial, commercial and institutional (ICI) land use. The combined total population forms the basis for developing existing and future water demands. Two future population and employment growth scenarios were considered when developing the demand forecasts for the WSMP Update, including the "reference" and "low" growth scenarios from the Province of Ontario's August 28th, 2020 report **A Place to Grow: Growth Plan for the Greater Golden Horseshoe** (P2G). The "reference" growth rate represents the expected rate and was ultimately used to identify the 2051 water supply demand projections. The population projections from 2021 to 2051, in five-year increments are presented in **Table ES-1**.

Table ES-1: Projected "Reference" Growth Population and Employment Rates

Year	Population	Employment
2021	145,777	84,359
2026	155,314	89,633
2031	164,852	94,906
2036	174,389	100,180
2041	183,926	105,453
2046	193,463	110,727
2051	203,000	116,000

ES-4 Water Demand Projections

Design Basis for Average Day Demands

The basis for projecting demands from the residential and ICI sectors, as well as non-revenue water[1] (NRW), was to apply historical per capita demands to population projections, i.e., representative of per capita demands without the influence of future conservation, efficiency and demand management efforts. This baseline was used to measure the effect of potential future programs and their associated costs against the costs and efforts to provide new water supply.

The baseline demand for the residential and ICI sectors considered historical customer demand and analysis of recent trends from the 2010-2019 period. It was evaluated that, while per capita water production and demand rates in litres per capita per day[2] (Lcd) have declined since 2010, the rate of decline was lower between 2015 to 2019 than it was from 2010 to 2015. The per capita NRW rates fluctuated through the review period; however, the 2019 rates are very similar to the rates in 2010. This observation suggests that future per capita customer water demand declines associated with conservation, efficiency and demand management programming and natural water savings may be more difficult to achieve moving forward.

To be conservative when projecting water demand rates to 2051, the average per capita residential, employment, and NRW demand rates between 2015 and 2019 were applied to the years 2020 to 2051. This means that the projected demands assume that further reductions in Lcd customer demands will not occur. The values used in the projection analysis are as follows:

- Average per capita residential demand rate: 167 Lcd
- Average per capita employment demand rate: 191 Lcd
- Average per capita NRW demand rate: 61 Lcd

1. Non-Revenue Water - The difference in water consumed by customers as measured directly through utility billings and that which is pumped at water facilities to the water distribution system. This includes water that is lost from the distribution system through leakage, flows used in fire fighting, watermain flushing and other losses.
2. Litres per capita per day – the amount of water each person in the City uses on a daily basis.

Design Basis for Maximum Day Demand

The Maximum Day Factor (MDF) for a water system is generally defined as the ratio between the water production rate on the highest single production day each year (maximum day) and the average day production rate for the entire year, after removing extreme anomalous events. The average MDF in Guelph between 2010 and 2019 was 1.24 and the highest ratio of 1.34 occurred in 2011. To be conservative, a MDF of 1.34 was used when projecting future maximum day water demands in Guelph.

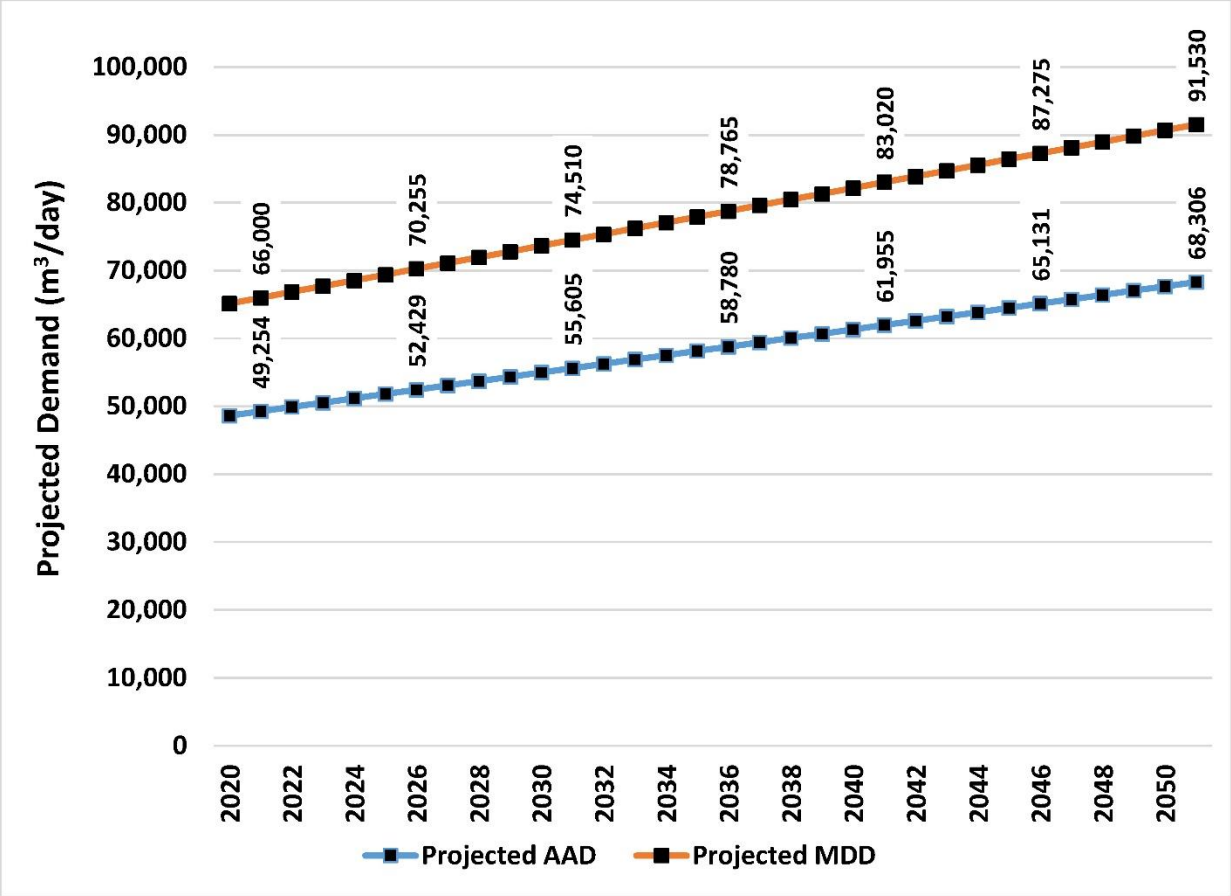
Projected 2051 Water Supply Requirements

Table ES-2 and **Figure ES-1** present the projected average annual day and maximum day water demand from 2021 to 2051, based on the design per capita demands. These estimates represent the projected total demand rates on an average annual and maximum day for each year in the planning period (i.e., combined residential, ICI and NRW demands).

Table ES-2: Total Projected Average Annual Day and Maximum Day Water Demands – Reference Growth Scenario

Demand	2021	2026	2031	2036	2041	2046	2051
Average Annual Day Demand (AAD) (m^3/day)	49,254	52,429	55,605	58,780	61,955	65,131	68,306
Maximum Day Demand (MDD) using MDF of 1.34 (m^3/day)	66,000	70,255	74,510	78,765	83,020	87,275	91,530

Figure ES-1: Total Projected Average Annual Day and Maximum Day Water Demands – Reference Growth Scenario



ES-5 Existing Water Supply System Capacity Assessment

The City relies almost exclusively on groundwater to meet customer water demands. The groundwater supply system comprises 25 drilled wells screened within overburden and shallow and deep bedrock aquifers, as well as one groundwater collection system.

A detailed assessment of the capacity of the existing water supply system was completed to determine: the current maximum capacity for each individual groundwater supply source; any constraints to operating at the maximum; the total sustainable capacity of the groundwater supply system; and, an evaluation of potential risks to system operation and the vulnerability of the identified sustainable capacity from a hydrogeological and operational perspective (i.e., the Security of Supply).

Evaluation of the system was completed with reference to the four quadrants of the City for the purposes of assessment: Southeast, Southwest, Northeast and Northwest. Historical records (from 1997 through 2019) for each groundwater supply source and quadrant provided the daily pumping total, the monthly average of the daily pumping total, observed groundwater elevation, the Ministry of the Environment, Conservation and Parks (MECP) permitted rate and maximum pumping elevations. Based on a review of these data, the capacity of each supply well and the collector system was re-evaluated relative to the 2014 WSMP.

The identified maximum capacity of the existing system is interpreted to be approximately 79,422 m^3/day. This estimate reflects normal operating conditions (i.e., non-drought conditions), and recognizes interference effects amongst the groundwater supply sources, as well as other interferences such as that from dewatering of the Dolime Quarry. This represents a decrease of 4,414 m^3/day, relative to the maximum system capacity reported within the 2014 WSMP. The results are presented in **Table ES-3**, along with an explanation of the capacity values that have changed from the 2014 assessment.

Table ES-3: Updated Capacity Assessment Summary – City of Guelph Groundwater Supply Active Sources

City Quadrant	Groundwater Supply Source	2014 WSMP (m^3/day)	WSMP Update (m^3/day)	Comments on Updated Capacity
Southeast	Arkell Well 1	2,000	2,000	Unchanged
Southeast	Arkell Well 6	28,800	28,800	Unchanged
Southeast	Arkell Well 7	-[b]	-[b]	Unchanged
Southeast	Arkell Well 8	-	-	Unchanged
Southeast	Arkell Well 14	-	-	Unchanged
Southeast	Arkell Well 15	-	-	Unchanged
Southeast	Glen Collector	6,900	5,100	Decreased to reflect available capacity with artificial recharge system inactive
Southeast	Burke Well	6,500	6,500	Unchanged
Southeast	Carter Well 1	5,500[c]	5,184[c]	Decreased by 316 m^3/day based on uncertainty of potential effects on Torrance Creek
Southeast	Carter Well 2	-[c]	-[c]	-

City Quadrant	Groundwater Supply Source	2014 WSMP (m^3/day)	WSMP Update (m^3/day)	Comments on Updated Capacity
Southwest	Membro/Rocco	6,000	5,200	Decreased by 800 m^3/day based on preliminary OTP results
Southwest	Water Street Well	2,700	1,901	Decreased by 799 m^3/day based on well field testing that evaluated mutual interference with Membro site
Southwest	Dean Well	1,500	1,500	Unchanged
Southwest	University Well	2,500	2,500	Unchanged
Southwest	Downey Well	5,236	5,237	Unchanged
Northeast	Park Well 1	8,000[d]	8,000[d]	Unchanged
Northeast	Park Well 2	-[d]	-[d]	
Northeast	Emma Well	2,800	2,800	Unchanged
Northeast	Helmar Well	1,500	800	Decreased by 700 m^3/day based on performance record, rehabilitation results and interference drawdown.
Northwest	Paisley Well	1,400	1,400	Unchanged
Northwest	Calico Well	1,400	1,400	Unchanged[a]
Northwest	Queensdale Well	1,100	1,100	Unchanged
Total	**-**	**83,836**	**79,422**	**-**

Notes:
a) Capacity is total for site (Membro Well and Membro Replacement Well)
b) 28,800 m^3/day is the total daily capacity of the Arkell bedrock wells (Wells 6,7, 8, 14, and 15).
c) Total daily capacity of Carter Well 1 and 3.
d) 8,000 m^3/day is the total daily capacity of Park Well 1 and 2.
e) Capacity increased by 1 m^3/day to match PTTW No. 8468-BCVQAN
f) Well is currently off-line due to casing failure, assigned value represents capacity for the site.

The security of supply assessment considered a series of potential risks to the system including drought conditions, loss of a well (i.e., a contamination event, equipment failure, structural failure, etc.), regulatory permitting changes, and risks to the well facilities and distribution system. These results indicate that that City should continue on-going monitoring of available system capacity, with the objective of maintaining a system redundancy of 15%. With respect to the existing system, 15% of the existing available water supply system capacity should continue to be reserved for servicing of existing customers (i.e., not available for future growth).

ES-6 Water Supply Alternatives

The 2014 WSMP implementation plan set out a strategy for the City to investigate and execute the necessary steps to optimize existing and develop new water supplies, with a focus on local sustainability. As part of the initial WSMP, City Council provided direction in 2003 "That the focus of the WSMP establish a sustainable water supply to regulate future growth". Public response to the 2007 WSMP helped shape the definition of local sustainability to refer to available local water supplies, which included local groundwater and surface water sources.

The utmost importance was placed on water conservation and as a result, the City has become a renowned leader in water conservation, efficiency and demand management in Canada. The City's Official Plan calls for the WSMP to "develop programs and policies to conserve water and to reduce requirements for additional water supply and treatment, including the implementation of the Water Conservation Efficiency Strategy". It is the aim of this update to document demand reductions achieved to date, and to determine feasible reduction strategies and goals moving forward for comparison to other water supply alternatives.

Public feedback in 2007 and 2014 indicated that the City first examine groundwater supply opportunities within the City's boundaries in order to minimize potential effects on its neighbours. As a result, the City has since implemented a number of programs and studies to maintain and optimize existing supply facilities within the City and in areas of existing municipal well supply infrastructure, including (since 2014):

- Completed construction of new well facilities (Arkell 14 and 15) and completed the Arkell Adaptive Management Plan and Operational Testing Program;
- Upgrades to the Arkell artificial groundwater recharge system;
- Completed upgrades to the existing Burke Well facility, including iron and manganese treatment;
- Class EA for a Clythe Well water treatment facility (existing, off-line well);
- Replacement well on the Membro site, referred to as the Membro Replacement Well or the Rocco Well; and

- Through mediation with the Dolime Quarry owner, identified a potential solution to address the City's concerns about how operations at the quarry could affect local groundwater.

Also included in the short- to mid-term implementation strategy was the initiation of various hydrogeological investigations inside the City and just outside the City's boundaries to explore the potential for new water supplies in these areas. These include the Guelph South Groundwater Supply Investigation (on-going) and the Southwest Guelph Water Supply Class EA to evaluate additional water supply sources within southwest Guelph, including a long-term Operational Testing Program at the Dolime Quarry and surrounding existing municipal wells (on-going).

In addition to the above initiatives, the City has completed the following regional studies and plans to ensure the protection and long-term sustainability of the existing water supply system:

- The Guelph and Guelph/Eramosa Township Tier Three Water Budget and Local Area Risk Assessment (Tier Three Study) was completed to evaluate the sustainability of the City's water supply system from a quantity perspective and to identify potential threats to that sustainability (Matrix Solutions Inc., 2017). This study and the Tier Three Groundwater Flow model (Tier Three Model) of Guelph's municipal aquifer system (in and outside the City) provide invaluable insights into reviewing the current water supply system and its reliability now and into the future. It is also referenced herein in determining the feasibility of new water supplies from both a potential capacity and environmental effect perspective.
- A Threats Management Strategy was developed to address the results of the Tier Three Study and guide the development of associated water quantity policies.
- The Grand River Source Protection Plan was developed within a watershed context to identify and evaluate potential water quality threats to the municipal supply system. This process also included the development of policies to protect existing and future drinking water sources from unwanted impacts and harmful contaminants. At this time, the City is currently working on updates to the plan

and development of policies to address the potential water quantity impacts.

The objective of the WSMP Update is to continue to ensure that the City can provide an adequate, safe and sustainable supply of water to meet the current and future needs of all customers over the next 30 years (i.e., to 2051). The water supply demand forecast, and the existing water supply system capacity assessment concluded that under a "do nothing" scenario with continued growth, in 2051, the City would require an additional water supply capacity of approximately 26,000 m^3/day to satisfy maximum day demand with an additional 15% allowance for security of supply.

The following alternatives are evaluated with respect to their capability to contribute to the total water supply solution. It is acknowledged that each does not address the challenge and opportunity statement as a stand-alone alternative. Therefore, each alternative is discussed and evaluated on its own merit as part of the total solution.

ES-6.1 Water Conservation, Efficiency and Demand Management

Based on past success and public support, it is anticipated that water conservation, efficiency and demand management will continue to form part of the preferred sustainable water supply solution (via reductions in water demand) in the future. Four scenarios are developed to consider the potential reductions associated with various combinations of initiatives in order to set a reasonable and publicly supported reduction target, as follows:

Scenario 1: No further reductions - ceasing non-provincially mandated water efficiency measures (baseline scenario)

Scenario 2: Potential reduction through maintaining a level of programming similar to the current water conservation, efficiency and demand management program

Scenario 3: Potential reduction through a focus on high water use customers

Scenario 4: Potential reduction through a focus on the current level of programming *and* water reuse initiatives

A summary of potential reclaimed water supply capacity and costs associated with each scenario is included in **Table ES-4**. Also included in this table is a blended scenario that was recommended through the assessment of alternatives step. This scenario considers the modification of programming through the planning period (2021 to 2051) in response to successfully achieving demand reductions under Scenario 2 in the short-term and subsequently shifting the focus of programming as described in Scenarios 3 and 4 in the mid- and long-term, respectively.

Table ES-4: Summary of Potential Savings and Program Cost Estimates for Each Scenario

Scenario	Projected Reduction in Average Annual Day Demand (m^3/day)	Estimated Program Cost (million $)	Estimated Average Annual Cost ($)	Capital Cost per m^3/day ($)	Life Cycle Cost* – Cost per m^3 avoided ($)
1	-	-	-	-	-
2	4,424	11.41	380,000	2,600	0.53
3	2,220	4.73	157,670	2,100	0.44
4	4,952	15.04	501,333	3,000	0.62
5^	3,683	8.99	299,792	2,400	0.50

Notes: * Life cycle cost is the cost per m^3 of avoided capacity over a 20-year period.
^Blended scenario.

The above water conservation, efficiency and demand management scenarios were developed and reviewed to demonstrate the range of potential savings and associated costs of various combinations of programs, for discussion through public consultation. Implementation of the scenarios would be further developed through future updates to the City's Water Efficiency Strategy.

ES-6.2 Expand Existing Groundwater Supply System

The approach undertaken in investigating opportunities for optimizing the City's existing groundwater supplies and developing new sources followed direction provided through the previous WSMP consultation processes (2007 and 2014 update). Public response clearly indicated that the City should consider groundwater opportunities within its municipal boundaries prior to exploring beyond. As noted in the 2014 WSMP, the development of new water supply sources in the surrounding Townships (Guelph/Eramosa and Puslinch) would require concurrence of both the respective Township and the

County of Wellington. In this update, consistent with previous plans, potential groundwater sources outside of the City boundaries are limited to a distance of approximately 5 km. This parameter was initially determined with consideration to limiting potential effects on surrounding municipalities, as well as the practicality of connecting to the City's existing water distribution system.

The first step in the evaluation of groundwater sources was to review the potential sources on a City quadrant basis and identify those that could potentially provide additional capacity. The potential groundwater opportunities for expansion of the existing supply system are grouped into the alternatives below, following the order established in the 2014 WSMP:

- Alternative 2A - Optimize existing municipal sources
- Alternative 2B - Restore off-line municipal sources
- Alternative 2C/D - Develop municipal test wells (includes Dolime Quarry)
- Alternative 2E - Develop new sources inside City
- Alternative 2F - Install new Aquifer Storage and Recovery wells inside City to optimize excess Arkell Collector system volumes
- Alternative 2G - Develop new wells outside City

A summary of potential new water supplies within each Alternative is provided below.

Optimize Existing Municipal Sources

An extensive assessment of existing municipal production wells was undertaken to determine sustainable concurrent water takings from all supplies, and to identify wells where upgrades and/or modifications could be considered to improve the well performance, water quality and general security of the source. The only well identified as possibly having more capacity available as compared to its current Permit to Take Water (PTTW) is the Downey Well which could potentially pump at a rate 5,700 m^3/day. The potential for increasing the capacity of the Downey Well will be reviewed within the ongoing Southwest Guelph Water Supply Class EA.

Restore Off-line Municipal Sources

This alternative includes wells that are permitted by MECP but where the City has discontinued their use due to concerns regarding existing water quality issues. In general, these wells require upgrades for water quality treatment and to provide the required disinfection contact time. The primary method for evaluating the potential sustainable capacity associated with each source was use of the Tier Three Model. The following sections outline the potential additional capacity available from off-line sources within each City quadrant.

Southeast Quadrant – Lower Road Collector

A review of historical collector production indicates that the Lower Road Collector produced between 600 and 6,000 m^3/day. The collector has been off-line for two decades and would require a full re-build to return to service. The Tier Three Model assessment indicated that a re-built collector could add 4,000 m^3/day to the current minimum collector output.

Coordination with the on-going Water and Wastewater Servicing Master Plan indicates that the City's F.M. Woods Ultraviolet (UV) system has sufficient capacity for the total flows from Arkell. Limitations, that may be partially addressed through infrastructure upgrades, have been identified for flow rates associated with the combined maximum capacity of the Arkell wells and collector PTTW maximum flows (C3, 2018).

The Arkell Collectors are located near the Eramosa River and Eramosa River Blue Springs Creek Provincially Significant Wetland complex. As this is a previously permitted water source and an increase to the PTTW maximum[3] for the system is not being proposed, it is not anticipated that future operation of the Lower Road Collector would cause an impact to the natural environment. As the system has been offline since 2000, a review of existing conditions would be required to confirm this interpretation.

Northeast Quadrant - Clythe Well

The modelling assessment estimated a sustainable capacity for the Clythe Well with consideration of potential effects on the natural environment. The

3. The Glen and Lower Road Collectors are included on a single PTTW with a maximum permitted flow rate of 25,000 m3/day.

well is located near Clythe Creek and the Clythe Creek Provincially Significant Wetland (PSW) and under long-term pumping conditions the modelling assessment indicated the potential for a greater than 10% baseflow reduction to Clythe Creek. Although the creek has historically been identified as a coldwater feature, current temperature monitoring suggests that the middle and lower reaches of the creek, in the vicinity of this well, are no longer coldwater. With respect to the modelling results, the Tier Three Study (Matrix, 2017) noted that insufficient data were available to calibrate the model to shallow conditions locally. As such, the results presented herein should be considered preliminary and further evaluated along with future field data. Evaluation of the Clythe Well alternative cost is based on the upper range of the steady-state modelled capacity of 1,180 m^3/day and the field-tested rate of 3,370 m^3/day (**Table ES-5**).

Northwest Quadrant - Sacco and Smallfield Wells

The modelling assessment estimated a sustainable additional capacity for the NWQ of 1,275 m^3/day, which would include pumping from Sacco, Smallfield and Hauser. Testing completed by the City in 2009 (Stantec, 2009) has demonstrated a capacity of 1,150 m^3/day for the Sacco Well and 1,408 m^3/day for the Smallfield Well. Additional capacity developed from these wells would contribute to system redundancy. Evaluation of the costs associated with re-instating these wells is based on the full potential capacity of 2,560 m^3/day (**Table ES-5**).

The Smallfield Well and to a lesser extent, the Sacco Well are impacted by Volatile Organic Contaminants (VOCs) within the aquifer. There has been a lack of action remediating these sources, going back to 1994 when the issue first affected the wells. As such, there remains great uncertainty and risk for the City in the design of a treatment system with respect to the maximum raw water contaminant concentrations, the concentration trend with time, the duration of treatment, and the potential liability of pulling contaminated groundwater across areas which are not yet impacted. To that end, the City is proposing to defer re-instating these already permitted water supply sources through the update of the WSMP until such time as the sources of groundwater contamination in the area have been remediated. However, these wells should remain as part of the WSMP as future drinking water sources (i.e., post-2051, or until source remediation occurs).

Develop Existing Municipal Test Wells

An extensive review and assessment of existing municipal test wells was undertaken to determine potential well yields and water quality treatment requirements. The following sections outline the potential additional capacity available from test wells within each City quadrant.

Southwest Quadrant - Steffler, Ironwood, and Guelph South

The Tier Three Model assessment concluded that these wells could contribute an additional capacity of 4,500 m^3/day to the overall system capacity under current quarry dewatering conditions. These wells have demonstrated individual well capacities above this combined capacity of 3,600, 8,000, and 4,320 m^3/day for Steffler, Ironwood and Guelph South, respectively. Therefore, additional capacity developed from these wells would contribute to system redundancy. Baseflow reduction of >10% was simulated using the Tier Three Model for Hanlon and Irish Creeks, although there is uncertainty with the results for Irish Creek due to its proximity to the model boundary. These test wells will be further assessed through a detailed Operational Testing Program being completed for the Southwest Guelph Water Supply Class EA, including monitoring of surface water features for baseflow reductions. The cost estimates for these test wells are presented in and are based on the noted individual well capacities of 3,600, 8,000, and 4,320 m^3/day for Steffler, Ironwood and Guelph South, respectively (**Table ES-5**).

Dolime Quarry

Significant dewatering occurs within the Dolime Quarry on an on-going basis to maintain the water level within the quarry pond (i.e., to prevent flooding of the quarry). Recent dewatering rates, as reported by the quarry owners (River Valley Developments Inc.), have typically ranged from 8,000 to 11,000 m^3/day. The agreement in place between the City and RVD includes, in part, the City assuming control of water management, thereby controlling the groundwater elevation within the quarry at a level below the surrounding area, resulting in groundwater inflow to the quarry pond (via a hydraulic gradient). This strategy will be evaluated as a potential alternative within the on-going Southwest Guelph Water Supply Class EA. Through this process, the City will determine the pumped flow from the quarry necessary to protect the water supply and, subject to the technical assessment process,

the Class EA may consider the feasibility of an additional alternative of capturing groundwater directly from the quarry as a potential future source. The groundwater modelling assessment reported daily groundwater discharge to the quarry that ranged from approximately 3,400 to 6,100 m^3/day. Acknowledging the uncertainty in assigning a potential volume that could be available from the quarry under Pond Level Management, a conservative range of 1,000 to 3,000 m^3/day was carried forward for costing and evaluation purposes. The cost estimate for the Dolime Quarry water treatment facility, provided in **Table ES-5**, is based on a capacity of 3,000 m^3/day. The cost for a full-scale water treatment facility is high and will be refined through the Southwest Guelph Water Supply Class EA and associated Operational Testing Program.

Northeast Quadrant - Logan and Fleming

The Tier Three Model assessment concluded that these wells could contribute an additional capacity of 4,180 m^3/day, similar to the 2014 WSMP result of 4,700 m^3/day. The City has initiated a project to reconstruct the Logan Test Well to target the Gasport aquifer by drilling out the existing borehole to below the Vinemount Member (regional aquitard) and installing a new casing. This project will include an assessment of potential effects on surrounding private wells and the natural environment. Consultation with Guelph/Eramosa Township will be required to develop the Logan supply. The cost estimate presented in **Table ES-5** is based on a capacity of 4,700 m^3/day.

Northwest Quadrant - Hauser

The modelling assessment estimated a sustainable additional capacity for the NWQ of 1,275 m^3/day, which would include pumping from Sacco, Smallfield and Hauser. The estimated capacity of a well at this site is approximately 900 m^3/day; however, this requires significant study for verification. Additional studies would be required to determine if water quality impacts would occur from long-term pumping due to known contaminated sites in the Smallfield Well area located 2.2 km to the northeast. Future work should also focus on potential effects on the local natural environment, which includes Ellis/ Chilligo Creek and the Ellis Creek PSW Complex. The cost estimate is presented in **Table ES-5** and reflects a capacity of 900 m^3/day.

Develop New Sources Inside City

Two locations in the SEQ and one location in the NWQ for potential new wells were evaluated on a preliminary basis but were not carried forward to the detailed evaluation of alternatives. The modelling output suggested that any new wells would reduce the capacity of existing municipal wells, resulting in little to no net capacity increase.

Install new ASR wells inside City for Excess Arkell Flows

This alternative consists of capturing and treating a portion of the excess flow available from the Arkell collector systems, when it is not required to meet customer demands, and storing it underground in aquifers for recovery when demands are higher. This option is referred to as an aquifer storage recovery (ASR) system. Based on the completed modelling assessment, the estimated excess flow available from the collectors for ASR, on a monthly basis, was 451,000 m^3. The aquifer injection and recovery system was simulated with six ASR wells located within the Guelph Innovation District Lands. The modelling output suggests that the ASR wells should be operated at 60% of the target withdrawal rates tested in the model, while the existing municipal wells are operated at baseline rates (i.e., system total of 53,551 m^3/day). These were the rates identified to accomplish withdrawal at the ASR wells, while allowing the existing municipal wells to continue operating sustainably.

The modelling output further indicated that with optimization of ASR well locations, higher volumes could be extracted. Further evaluation to optimize the efficiency of the system is recommended should the City wish to pursue ASR as a future water supply option. It is recommended that additional work focus on the potential to site ASR wells that maximize the ability for existing municipal wells to form part of this alternative, thereby greatly reducing the associated cost.

With an optimized strategy, a net zero injection/ withdrawal water balance would be achieved and significant interference effects on existing groundwater dependent natural features or users are not anticipated.

The total potential additional system capacity from the Arkell ASR is 1,170 m^3/day (in consideration of the 60% withdrawal constraint). With optimization of both the artificial recharge system and the injection/

withdrawal strategy, it is anticipated that additional capacity is possible. The cost estimate for capital works for preliminary investigations, and design, land acquisition where required, construction of new wells, dechlorination and rechlorination systems, and approvals is provided in **Table ES-5**. The total cost presented is very high in comparison to other water supply alternatives and illustrates the need to further develop this alternative through an optimization strategy that maximizes the capacity available through ASR, minimizes the number of new ASR wells required for the system and utilizes existing municipal supply wells as part of the injection/withdrawal process.

Develop New Sources Outside City

Guelph Southeast

A potential test well area, located southeast of the City (east of Victoria Road, on Maltby Road) within the Mill Creek catchment area was modelled in the completed assessment. The estimated available sustainable capacity of a modelled groundwater supply well in this general area is 1,600 m^3/day on an average basis with a low potential for effects on baseflow within Mill Creek. The cost estimate for the Guelph Southeast Well is included in **Table ES-5** and is based on the modelled capacity value of 1,600 m^3/day.

Guelph North

A second potential test well area, located north of the City (the western limit of Conservation Road) within the Marden Creek catchment area was modelled in the completed assessment. The estimated available sustainable capacity of a modelled groundwater supply well in this general area is 2,935 m^3/day on an average basis. A baseflow reduction greater than 10% was modelled for Marden Creek.

Future work associated with the Guelph Southeast and North locations would require a detailed assessment of potential effects on surrounding private wells and the natural environment after specific potential well locations are identified. As these well areas are located outside of the City, there is a higher density of active private wells. New property would be required for test wells and future well facilities. Consultation and collaboration with Puslinch Township (Southeast) and Guelph/Eramosa Township (North) would be required in advance of initiating these projects.

The cost estimate for this alternative is included in **Table ES-5** and is based on a capacity of 2,935 m^3/day.

Summary

Table ES-5 summarizes, for all groundwater alternatives, the cost estimate for capital works for preliminary investigations, design, land acquisition (where required), construction of new wells and treatment systems, and approvals. In addition to the capital costs, operating and maintenance costs were also estimated including labour and energy costs.

Table ES-5: Summary of Potential Capacity and Cost Estimates for Each Groundwater Alternative

Alternative Name	Alternative Category	Potential Capacity Range (m^3/day)	Estimated Cost	Cost per m^3/day
Clythe Well	Off-line source	1,180 – 3,370	$6,781,000	$2,012
Smallfield/Sacco Wells	Off-line source	850 – 2,560	$13,116,000	$5,127
Lower Road Collector	Off-line source	4,000	$13,874,000	$3,469
Fleming/ Logan Well	Test well	4,180 – 4,700	$10,103,000	$2,150
Guelph South Well	Test well	2,250 – 4,320	$4,800,000	$1,111
Steffler Well	Test well	2,250 – 3,600	$6,194,000	$1,721
Ironwood Well	Test well	2,250 – 8,000	$5,125,000	$640
Hauser Well	Test well	425 - 900	$5,832,000	$6,480
Dolime	Test well	1,000 - 3,000	$18,976,440	$6,325
Arkell ASR	ASR	1,170	$25,284,000	$21,610
Guelph SE	Well outside City	1,600	$6,862,000	$4,289
Guelph N	Well outside City	2,935	$12,841,000	$4,375

ES-6.3 Establish New Local Surface Water Supply

Two local surface water sources were assessed as potential supply on a continuous or seasonal basis, including the Speed River (at Guelph Lake) and the Eramosa River (at the Arkell Spring Grounds). Surface water must either be treated to provide a continuous flow into the distribution system, or alternatively, volumes of water can be used within an ASR system, as described for the Arkell site. The supply capacity available from this source on a continuous basis is equal to the volume taken from surface water when available and treated and injected, and then removed over the period of a full year.

For both continuous flow and ASR approaches, construction of a water treatment plant (WTP) is required to fully treat the surface water to meet Ontario Drinking Water Quality Standards. In the first option, the WTP is sized to treat a continuous input to the plant with direct discharge to the City's distribution system. In the second option, the WTP would be required to treat varying flows ranging from the continuous flow requirement to the maximum design capacity based on high seasonal river flows.

To evaluate potential quantity available through this alternative, the Grand River Conservation Authority (GRCA) provided their expert opinion on this managed watershed. It was determined that only the Guelph Lake option provided a reasonable surface water alternative for continuous and seasonal flows. Through this evaluation, a base level water taking was established which would be available year-round, while maintaining minimum river flows and minimizing potential environmental effects associated with reducing total river flows. The GRCA also reviewed historical records to establish reliability of taking additional volumes during times of higher river flows.

Historical water quality information for the Speed River was referenced to determine treatment processes required to achieve drinking water quality. Conventional treatment is proposed with treatment for taste and odour on a seasonal basis, as necessary. The proposed WTP has been sized to accommodate the following alternatives at Guelph Lake:

- continuous taking of 150 L/s (12,960 m^3/day) – Municipal Base Taking
- maximum taking of 300 L/s (25,920 m^3/day) – ASR option

The total increase in potential quantity available from surface water treatment and ASR systems based on after treatment flows is 25,825 m^3/day (i.e., a continuous taking from Guelph Lake of 150 L/s and a step taking of 300 L/s with a 5% loss at the WTP). This can be viewed as two alternatives, the first being a continuous surface WTP, and the second an expansion to the WTP and development of the ASR well system. Similar to the Arkell ASR evaluation, the modelling output suggests that the ASR wells should be operated at 60% of the target withdrawal rates tested in the model. Further evaluation to optimize the efficiency of the system is recommended should the City wish to pursue ASR as a future water supply option.

Table ES-6 summarizes the cost estimate for implementation of the two surface water alternatives.

Table ES-6: Cost Estimate for Guelph Lake Surface Water Alternatives

Item Description	WTP	WTP + ASR
Potential Capacity (m^3/day)*	**12,312**	**25,825**
Estimated Cost	**$51,322,000**	**$57,283,000**
Cost per m^3/day	**$4,168**	**$4,239^**

Notes: * Values assume that 5% of raw water is lost during treatment process.
^ Cost to increase WTP capacity from 12,312 to 25,825

ES-7 Environmental Assessment Process

Evaluation criteria were developed based on the environmental components that address the broad definition of the environment described in the Environmental Assessment Act, as summarized in **Table ES-7**. The criteria were refined through the project consultation and engagement process.

Table ES-7: Evaluation Criteria Components Summary

Component	Criteria
Effect on Indigenous values, culture, and Traditional use	■ An evaluation of the effect on Indigenous values, culture, and Traditional use. Key themes shared with the Project Team that help guide the evaluation include: – valuing and respecting the agency of water – understanding the spirit and personhood of water, – good stewardship of the connected ecosystem including protection of water's pureness, – consideration of First Nations, Métis and Inuit Peoples culture and worldview in aspects of the evaluation.
Technical Considerations	■ Constructability ■ Potential productivity and reliability ■ Water treatment requirements ■ Approval requirements
Natural Environmental	■ Effect of construction and operation on aquatic and terrestrial species and habitat ■ Effect on surface water quantity and quality
Built Environment	■ Effect on existing and/or planned residences, businesses, community, institutional or recreational facilities ■ Effect on private and municipal wells

Component	Criteria
Social/Cultural Environment	■ Ability to meet municipal and provincial growth targets ■ Public acceptance ■ Effect of noise/vibration on sensitive receptors ■ Effect on cultural heritage landscapes and built heritage resources ■ Effect on potential archaeological resources
Legal/Jurisdictional Considerations	■ Location inside versus outside of City boundaries
Financial Considerations	■ Estimated capital costs; capital cost per capacity ■ Estimated operation and maintenance costs ■ Life cycle cost (per volume produced)

Each potential alternative was assessed using a consistent approach and evaluation criteria along with specific indicators for each. The evaluation was qualitative – not a numerical ranking system – and considered the suitability of the identified alternative solutions and strategies based on significant advantages and disadvantages. The summary evaluation tables (included within the report) provide an overall recommendation for each of the alternatives which can be compared to the other alternatives. This provides a means to rank the alternatives to allow for incorporation into an implementation plan to meet the water supply requirement to 2051. The alternatives are listed in **Table ES-8** in order of the priority as determined by the summary outputs:

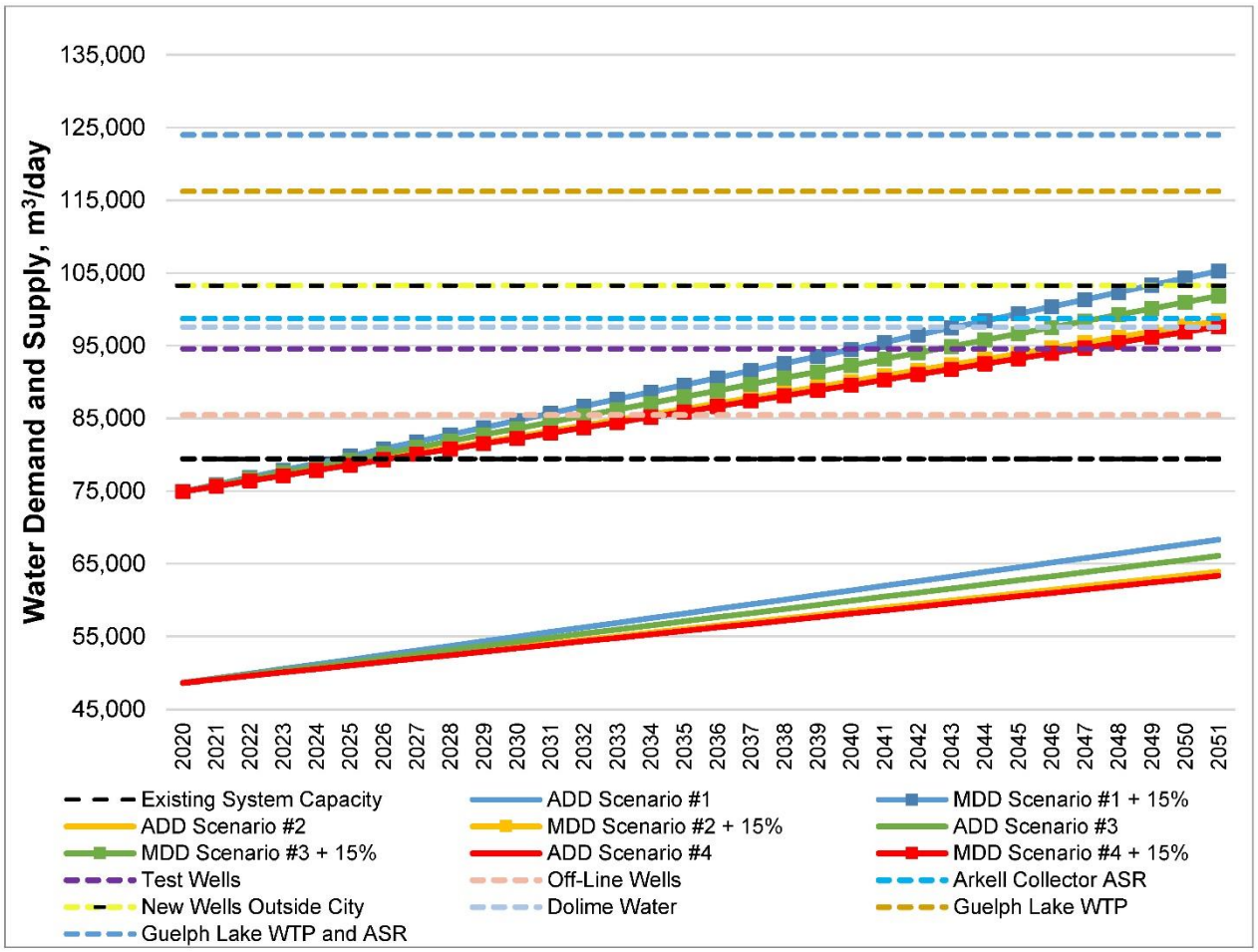
Table ES-8: Summary of Evaluation Outputs

Alternative	Result	Comments
1A – Conservation, Efficiency & Demand Management	Part of preferred solution – high priority	Strong public support for continued programming; strategy must be adjusted through planning period in response to performance; target reduction explored further through financial analysis
2B – Groundwater: Restore Off-line Municipal Wells	Part of preferred solution – high priority	Support for restoring capacity within the City; order of implementation to be determined by the City with consideration for regulatory, treatment, financial constraints. Timeline for Smallfield/Sacco wells uncertain, not currently feasible.
2C/D – Groundwater:	Part of preferred solution – high priority	Support for pursuing test wells within City/on City property; order of implementation to be determined by the

Alternative	Result	Comments
Develop Municipal Test Wells		City with consideration for regulatory, treatment, financial constraints. Assessment of groundwater quality within NWQ required prior to pursuing Hauser site.
2F – Groundwater: Arkell Collectors & ASR Wells	Part of preferred solution – medium priority	ASR alternative requires additional feasibility investigation with respect to Eramosa River PTTW optimization; water volumes available via collector systems; optimization of ASR configuration; option of changing existing well permits to allow for flexible takings
2G – Groundwater: Develop New Wells Outside City	Part of preferred solution – low priority	Incorporates Townships' staff and public response to maximize water takings inside the City before pursuing wells in the Townships
3A – Surface water: Guelph Lake Water Treatment Plant	Part of preferred solution – low priority	While this alternative is not required to provide water supply within the study period (with continued conservation, efficiency and demand management programming) the City will track timeline to determine 10-year lead-in required prior to implementation; Speed River/Guelph Lake water taking requires GRCA policy approvals
3B – Surface water: Guelph Lake Water Treatment Plant & ASR Wells	Part of preferred solution – low priority	While this alternative is not required to provide water supply within the study period (with continued conservation, efficiency and demand management programming) the City will track timeline to determine 10-year lead-in required prior to implementation; Speed River/Guelph Lake water taking requires GRCA policy approvals
Limit Growth	Not preferred	This alternative does not meet the Study Challenge and Opportunity Statement and contravenes the Provincial growth targets
Do Nothing	Not preferred	This alternative does not meet the Study Challenge and Opportunity Statement and contravenes the Provincial growth targets

Figure ES-2 compares the implementation of all of the water supply alternatives to the water demand curve with and without conservation programming to 2051. It can be seen that with conservation programming, new wells outside of the City and the Guelph Lake surface water alternative may not be required prior to 2051. As there is uncertainty about the water supply capacity that each potential source will yield, as the City progresses with implementation of the projects, the water supply deficit will subsequently be evaluated, and the implementation plan will be revised as necessary. This process may result in additional projects falling outside of the planning period.

Figure ES-2: Water Demand Projection with All Water Supply Alternatives



ES-8 Engagement and Consultation

Community input is an essential part of the WSMP Update process. People care about where their water comes from, and they want to see a safe and sustainable supply maintained for present and future generations, and Guelph residents, agencies, stakeholders and Indigenous Peoples were engaged throughout the project. The following provides an overview of the main consultation and engagement activities completed for the project:

- newspaper advertising and electronic mailing to inform people about the start of the WSMP Update;
- a project website to provide useful information, including links to the previous 2014 WSMP Update, contact information and invitations to online and in-person engagement opportunities;
- Online engagement through the City's online community engagement site, Have Your Say Guelph, linked through the project website and promoted via the electronic mailing list, social media and a monthly Have Your Say newsletter;
- One meeting with Mississaugas of the Credit First Nation to provide an overview of the on-going water-related City Master Plans;
- One meeting with Six Nations of the Grand River to provide an overview of the on-going water-related City Master Plans;
- An inclusive and diverse **Community Liaison Group** (CLG) was established to advise and provide feedback to the project team throughout the process. The group met formally on three occasions;
- Two **Municipal / Agency Workshops** provided crucial inputs from a government and approval agency perspective;
- Two public **Open Houses** were held during the course of the study (one in-person and one virtual), giving community members an opportunity to discuss the project with the Study Team and provide comments;
- Presentations and discussion related to the WSMP Update were included at two meetings of the Water Conservation and Efficiency Public Advisory Committee;

- Presentations were made at Puslinch Township and Guelph/Eramosa Township Council meetings at their request; and
- Co-ordination other related master plan updates (i.e., Water and Wastewater Servicing Master Plan, Wastewater and Biosolids Master Plan, Stormwater Master Plan and the Municipal Comprehensive Review / Official Plan Update).

The feedback received through the various engagement tools and activities indicates that there is a continued interest from community members and stakeholders about water supply in Guelph. Several themes emerged related to the key engagement topics of this phase, including:

- prioritizing conservation;
- protecting the natural environment;
- managing growth and development;
- controlling groundwater impacts from large water users;
- concerns about source protection areas and land use constraints particularly with respect to impacts on the Townships;
- concerns about potential well interference effects with existing wells particularly with respect to impacts on the Townships;
- prioritizing supply within the City before considering sources within Township(s);
- considering potential climate change impacts on water supply;
- questions about the Dolime Revitalization Plan and how it fits into the WSMP
- monitoring emerging contaminants;
- limiting impacts to aquatic and terrestrial wildlife; and
- valuing the agency of water.

There are Indigenous Peoples—First Nations, Métis and Inuit Peoples–living in Guelph who have worked with the City and contributed to the development of the WSMP Update. Specifically, through the Community Liaison Group, Indigenous Peoples shared their perspectives on the spirit of water and the importance of respecting the agency of water.

Overall, the community has played an important role in providing feedback to the project team and contributing various perspectives on water supply planning. The main points of discussion at the Community Open Houses were water conservation programming, the impact of major water users on the water system, protecting the natural environment, source water protection (including revitalization of the Dolime Quarry), climate change and water quality. The quality of questions and the engagement of those present at the Community Open Houses was a positive indicator of the interest in water supply issues within the City and the surrounding area.

The additional consultation offered and provided to the Townships at their request resulted in additional feedback that focused on the alternatives outside of the City. Township representatives raised concerns regarding source protection issues and potential constraints on land uses resulting from new water supplies. These meetings provide a good starting point for future discussions around the potential for new wells to be located just outside the City's boundaries in the neighbouring Townships.

ES-9 Implementation Recommendations

ES-9.1 Financial Evaluation Approach

Based on the evaluation outputs for each of the alternatives, a priority was established for the proposed water supply projects that determines how the City will proceed to develop its water supply over time to meet future needs. This implementation strategy is to ensure that there will always be sufficient supply including an additional allowance for security of supply in place prior to approving growth.

The timeline for this plan is dependent on the water conservation scenarios. A financial evaluation was carried out to determine the optimal water conservation scenario when viewed in the context of cost, impact on demand and the resulting timeline and costs for all of the water supply projects.

The financial evaluation takes into consideration the following:

- Timeline and costs associated with each alternative – including technical investigations, water quality analysis, environmental impact studies, land acquisition, preliminary and detailed design,

and construction and commissioning. The timeline allowed in advance of water supply availability is as follows:

  - Groundwater – 5 year timeline
  - Arkell Collector ASR wells – 8 year timeline
  - Surface Water – 10 year timeline

- The exception to the above is that the investigative phase for the test wells and inside-City groundwater options is scheduled to occur early in the implementation timeline so that the City has sufficient information to determine whether the alternative is feasible, to identify any constraints, and to confirm capacity and treatment requirements prior to the next WSMP Update. For the proposed wells outside the City, budget is allocated in the short- to mid-term for additional modeling work to update and substantiate the estimated capacities and potential effects related to the Guelph North and Guelph Southeast alternatives for use in future WSMP Updates.
- An assumed order of groundwater projects is based on the prioritization of alternatives identified in the alternatives evaluation. It is important to note that the assumptions made in the prioritization of projects were for the purpose of determining the requirement for new supplies against the demand curve in comparison to varying conservation scenarios. Most of these projects would be in investigation and design phases concurrently and the schedule for each would be a function of constraints and ease of implementation.
- The schedule for implementation is such that new water supply projects will be brought online when required capacity reaches 90% of system capacity to ensure sufficient capacity for proposed development commitments, and industrial/ commercial applications, as well as to respond to large increases in demand by current customers, in particular major industries or ICI consumers. This flexibility is important to address growth needs or demands that do not follow the planned demand projection.

ES-9.2 Recommended Water Conservation Strategy

Five water conservation, efficiency and demand management scenarios were developed to represent a range of possible target reductions and associated costs. These programs are forecasted to range in cost from $0/year to approximately $501,333/year, and reduce average day water demand by 0 m^3/day to 4,952 m^3/day (Table ES-9). This includes a blended scenario that envisions implementing the current level of programming in the short-term (approximately years 0-10), adjusting the focus to high demand and/or inefficient customers in the mid-term (approximately years 11-20) and incorporating water reuse in the long-term (approximately years 21-30). Each of the water conservation scenarios explored (except Scenario 1) will delay the need to implement proposed projects for increasing the water supply, assuming that conservation is successfully implemented to achieve the desired targets.

Table ES-9: Water Conservation Scenarios

Scenario	Reduction in Average Day Demand (m^3/day)	Est. Total Program Cost (Non-Discounted; million $)
1	-	-
2	4,424	11.41
3	2,220	4.73
4	4,952	15.04
5	3,683	8.99

The analysis compares the forecasted impacts of the five scenarios on: the demand for potable water, the timing of the City's proposed water supply projects, and the City's capital spending and operating expenditure on water supply projects and water conservation.

The forecasted timing of proposed water supply projects under the different scenarios is presented in **Table ES-10**. Included in each project expenditure is the preceding timeline for work and associated costs outlined in the assumptions.

Table ES-10: Timing of Proposed Water Supply Projects Under Different Conservation Scenarios

Order of Implementation	Project Name	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Project 1	Clythe Well	2023	2023	2023	2023	2023
Project 2*	Ironwood/ Steffler Well	2027	2027	2027	2027	2027
Project 3*	Guelph South Well	2028	2030	2028	2030	2030
Project 4*	Dolime Quarry	2031	2032	2031	2032	2032
Project 5	Fleming/ Logan	2033	2036	2034	2037	2036
Project 6	Lower Road Collector	2037	2042	2038	2042	2040
Project 7	Arkell Collector ASR Wells	2041	2047	2044	2047	2045
Project 8	Hauser test well	2042	2049	2045	2049	2047
Project 9	Guelph North	2043	2049	2046	2050	2048
Project 10	Guelph Southeast	2046	Post-2051	2048	Post-2051	Post-2051
Project 11	Guelph Lake WTP	2048	Post-2051	2051	Post-2051	Post-2051
Project 12	Smallfield/ Sacco Wells	Post-2051	Post-2051	Post-2051	Post-2051	Post-2051
Project 13	Guelph Lake WTP and ASR wells	Post-2051	Post-2051	Post-2051	Post-2051	Post-2051

Notes: *Project implementation subject to outcome of on-going Southwest Guelph Water Supply EA

The timing of the water supply projects is dependent on the City's overall demand for water and is different under each scenario.

ES-9.3 Preferred Water Supply Alternative

The preferred water supply alternative consists of the blended conservation scenario as well as Projects 1 through 9 listed in **Table ES-11**. These are all groundwater projects included in the preferred alternatives in the evaluation process, consisting of existing municipal off-line wells, existing municipal test wells, Dolime Pond Level Management, Arkell ASR, and a new well

(Guelph North) outside of the City. A recommended implementation strategy for all required projects is provided in detail in the full report.

Table ES-11: Preferred Water Supply Alternatives

Alternative	Timeline	Projects
1A – Conservation, Efficiency & Demand Management	Throughout	■ Blended Conservation Scenario
2B – Groundwater: Restore Off-line Municipal Wells	Short-term	■ Clythe Well (completion in 2023)
2B – Groundwater: Restore Off-line Municipal Wells	Mid-term	■ Lower Road Collector (completion in 2037)
2C/D – Groundwater: Develop Municipal Test Wells	Short-term	■ Ironwood/Steffler (completion in 2027) ■ Guelph South (completion in 2028) ■ Dolime Quarry (pumping station component completed to align with Ironwood/ Steffler) ■ Logan/ Fleming (completion in 2030)
2C/D – Groundwater: Develop Municipal Test Wells	Long-term	■ Hauser (completion in 2047)
2F – Groundwater: Arkell Collectors & ASR Wells	Long-term	■ Arkell ASR (completion in 2045)
2G – Groundwater: Develop New Wells Outside City	Long-term	■ Guelph North (completion in 2048)

It will be important for the City to closely track the success of the water conservation and efficiency program to ensure that the predicted reductions are being achieved, and to be able to trigger the initial phases of supply projects noting the lengthy lead-in time to complete all of the necessary investigations, approvals and design such that the water is available when needed. This is particularly important for the mid- and long-term projects as there are five supply facilities scheduled to come online in the 2022 to 2031 portion of the timeline. The City may decide to take a more conservative approach to complete more of the preliminary steps in advance to allow for a shorter final implementation time required for final construction and commissioning once triggered. This would also assist in identifying project issues early, and also securing land requirements.

ES-9.4 Recommendations

A series of recommendations are provided in the full report and a subset are provided here as an overview.

General Program Recommendations

- As each new supply source is developed, it is recommended that the total water budget be re-evaluated as compared to the conditions at the time of assessment to ensure that additional groundwater extraction does not result in adverse environmental or well interference effects.
- As each new water supply project is developed, it is recommended that additional surface water and groundwater monitoring programs be put in place to monitor for potential environmental effects to adapt the water takings to mitigate impacts, if necessary. Since water taking effects may extend outside of the City, collaboration with the GRCA and the Townships may be required to implement programs outside of the City.
- Groundwater modelling is recommended as an important tool to assess potential cumulative effects and environmental effects. It is recommended that the City's groundwater flow model be continuously updated and maintained for application in the various WSMP projects.
- A basic premise of the WSMP Update is that the existing supply system is protected, and the City does not lose supply through contamination events or as a result of other non-municipal water takings. Therefore, it is important that the City enhance/maintain its source protection programs, particularly with respect to contaminated sites and to support, and in some cases, sponsor source protection programs outside of the City to provide equal protections. In addition, it is recommended that the preferred solution (i.e., future drinking water sources) in this WSMP Update be incorporated into the City's Source Protection Program for protection of water quantity of future drinking sources as required by the purpose of the Clean Water Act and the objective of the Source Protection Plan.
- In comparison to the 2014 WSMP Update, capital and unit costs for the development of new groundwater supplies have increased, for a variety of reasons. Pandemic-related, supply-chain issues have been identified in developing cost estimates but there is uncertainty if some of the

increased material and service costs will persist into the future. With Guelph City Council's direction of growth paying for the cost of growth, it is recommended that cost estimates in the WSMP Update be updated as part of Class EA projects once additional design details are available and with each subsequent WSMP Update (approximate frequency of five years).

- It is recommended, as part of feasibility studies or the Class EA process, that each potential new source of water supply require additional field work and environmental impact assessments, particularly with respect to water budget and sustainability issues.
- Through the WSMP Community Engagement Plan, the Project Team heard concerns from adjacent municipalities on source protection and land use constraints as well as potential impacts to domestic wells from well interference. It is recommended that future programs have a focus on enhanced engagement and development of intergovernmental relations with the goal to promote more regional water resources management, to support water supply needs for all affected municipalities and to address attendant environmental effects with the support of provincial agencies (i.e., Ministry of the Environment, Conservation and Parks) to meet provincial growth targets.
- It is recommended that the City build on the existing Drinking Water Quality Management System process by developing a risk management plan that includes mitigation and response strategies. This will include current risks to the existing groundwater-based system and may be expanded upon to include additional risks relevant to future water supplies, whether groundwater or surface water based.
- The feasibility of both the Arkell and Guelph Lake ASR alternatives should be further developed, and this process should include an optimization study to evaluate the placement of ASR wells that best utilize the existing municipal supply wells to efficiently recover injected water.

Water Supply Planning Recommendations

- Build on the current process and guidelines for review of applications from new large volume users (e.g., industry), which considers a balance of employment and water use. Future projections are based on allocated

amounts dedicated to the residential and ICI sectors, where the volume for ICI relates to a specified employment number. If high volume water users are not coupled with high employment, water demand projections will need to be revisited to establish a revised schedule for new water supply without jeopardizing the needs of planned growth.

- Investigate more robust policies for supply capacity allocation for both new and existing customers that take into account the relatively large capital expenses and lengthy timelines required to fully commission new water supply facilities. These policies would ensure maximum value to the City for supply capacity allocated to both new and existing customers.
- Complete an update of the 2016 Water Efficiency Strategy, commencing as early as 2022, based on the blended water conservation (Scenario 5), efficiency and demand management scenarios presented through the WSMP. This will include evaluation of non-potable reuse options in alignment with the City's other water-related Master Plans.
- Continue, and refine as necessary, the tracking system that closely monitors sectoral demand management (i.e., conservation and efficiency programs) and optimization successes and review whether results are in-line with the forecasted demand for the preferred scenario and are achieving the goals of the Water Efficiency Strategy. Trends must be monitored with a long-term view recognizing that the effect of some direct programs may be more immediate, resulting in short-term deviations from the forecast.
- Consider time limits on development commitments such that water capacity is not 'held' for long periods of time. Review possible mechanisms to synchronize approvals of significant capacity increases with the proposed timing of new supplies in accordance with the master planning schedule.
- Assess the Development Charges planning process for the ability to provide flexibility in funding in relation to COVID cost increases.
- Review land acquisition requirements for all projects, both short- and long-term, to ensure future flexibility when implementing alternatives. Consider delegation of authority to staff to execute strategic land procurement requirements for future water supply provided property

values fall within 20% of study estimates, subject to the approval of the DCAO and City solicitor.

Supply Capacity Management Recommendations

- Water Services should conduct annual reviews of each component of the water supply system to determine the supply capacity and to identify any changes in the capacity from previous years or any constraints in delivering the optimal supply capacity.
- Based on the annual reviews of water supply capacity, Water Services should develop programs and implement maintenance and upgrades to the water supply system so that the system can deliver its optimal supply capacity.
- To protect water quantity and to mitigate potential impacts on quantity from other water takings, the City should consider implementing a municipal by-law to prohibit new private groundwater supply wells in the City as well as other areas where municipal water services are present.