Grand Valley Water and Wastewater Master Plan 2019 Class Environmental Assessment
Project File Report

Town of Grand Valley

R.J. Burnside & Associates Limited
292 Speedvale Avenue West Unit 20
Guelph ON N1H 1C4 CANADA

March 2019
300040938.0000

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Record of Revisions

Revision	Date	Description
1	March 7, 2019	Submission to the Town of Grand Valley

R.J. Burnside & Associates Limited

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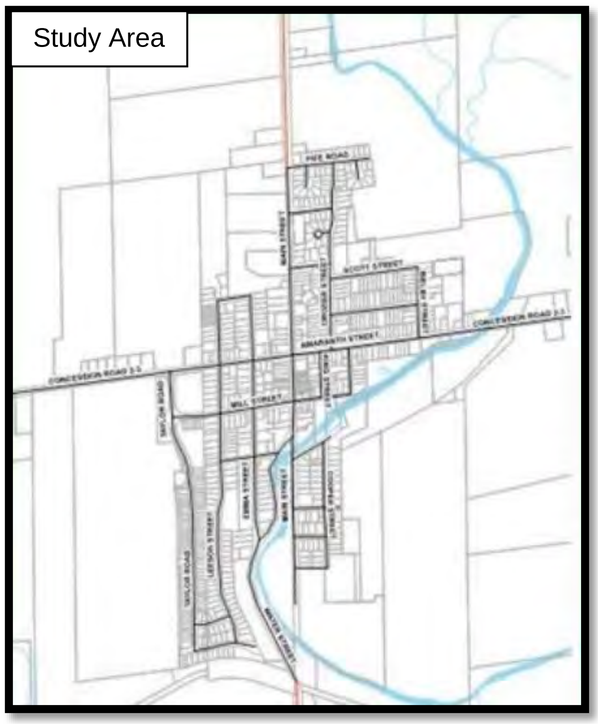
NOTICE OF STUDY COMPLETION
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT
Grand Valley Water and Wastewater Master Plan

The Study



The Town of Grand Valley (Town) retained R.J. Burnside & Associates Limited (Burnside) to complete a Master Plan Class Environmental Assessment to identify and evaluate alternative solutions to meet existing and future water and wastewater demands. Prior to 2014, The Town had an urban population of approximately 1,500 and constructed infrastructure to accommodate the mature state urban population in its Official Plan, which was 2,950. In 2014, approval was given to change the Official Plan such that the mature state urban population increased to 6,145. This amendment was premised on the certainty that services could be provided to the new future population, but no infrastructure plans were put in place. The Town completed a Master Plan to address the problem of how Grand Valley can provide water and wastewater infrastructure to meet the demands in the community as it achieves the growth that is approved in the Official Plan. The approximate extent of the study area is shown on the map. The preferred solution for wastewater infrastructure is rerating the existing Water Population Control Plant (WPCP) and constructing an equalization tank to act as an interim solution that can be implemented in the short-term, followed by the completion of a Schedule C Environmental Assessment, design, tender and construction of a WPCP expansion. The preferred solution of water infrastructure is the construction of two new groundwater wells (one installed in the short-term and the second installed in the future), and the construction of an elevated water storage tower.

The Process

The Study followed the requirements of Phases 1 and 2 of the *Municipal Class Environmental Assessment* process described in the Municipal Engineers Association guide (October 2000, as amended in 2007, 2011, & 2015), which is an approved process under the *Ontario Environmental Assessment Act*.

The Class EA process included consultation with the public, stakeholders and review agencies. A Notice of Study Commencement inviting public input was published on July 24, 2017. A Public Information Center (PIC) was held on November 1, 2017. Various studies were completed to assess potential environmental, social, cultural and economic effects of the proposed alternatives. These included natural environment assessments, tree inventory and impact assessments, wildlife assessments and an assimilative capacity study. Alternative solutions were evaluated for the areas within the Official Plan boundary. Alternative design concepts and evaluation factors were updated based on consultation with review agencies, First Nation communities and stakeholders. Natural environmental and social mitigation measures were established based on potential adverse impacts.

Master Plan Report

A Master Plan Report has been prepared to document the planning and decision-making process for this study. By this notice, the Master Plan is being placed on the public record and is available for a 30-day review period starting March 21st, 2019 and ending April 19th, 2019 in accordance with the requirements of the Municipal Class EA. An electronic copy of the Master Plan is available for viewing on the Town's website, and hard copies are available at the following locations:

Town of Grand Valley
5 Main Street North
Grand Valley, ON L9W 5S6
Mon-Fri: 8:30 am – 4:30 pm

Phone: (519) 928-5652

Grand Valley Public Library
4 Amaranth Street E
Grand Valley, ON L9W 5L2
Mon and Fri: 10:00 am – 6:00 pm
Tues – Thurs: 10:00 am – 8:00 pm
Sat: 10:00 am – 4:00 pm
Phone: (519) 928-5622

Please provide your written comments on the Master Plan by contacting either of the following Project Team members (contact details below) by April 19th, 2019.

Jane Wilson, C.A.O.
Clerk-Treasurer
Town of Grand Valley
5 Main Street North
Grand Valley, ON L9W 5S6
Phone: (519) 928-5652 ext. 224
Email: jwilson@townofgrandvalley.ca

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If concerns arise regarding this project which cannot be resolved through discussion with the Town, the person or party with the concern may submit a written request to the Minister of the Environment, Conservation and Parks to make an order for the project to comply with Part II of the Environmental Assessment Act (referred to as a Part II Order), which addresses Individual Environmental Assessments. Part II Order Requests must be submitted using a standard form available on the Provincial Forms Repository website (http://www.forms.ssb.gov.on.ca/). The form can be found by searching either "Part II Order" or "012-2206E" (the form ID number) on the Repository's main page. The completed form for Part II Order Request must be received by the Minister (addresses are provided on the bottom of the form) by 4:30 pm on April 19th, 2019. A copy of the completed form for Part II Order Request should also be sent the Director, Environmental Approvals Branch and to the Town of Grand Valley project team by this time and date. If no request is received by April 19th, 2019, the Town intends to proceed with detailed design and construction as outlined in the PFR subject to Provincial agency approval and Municipal priorities and budgets.

Project and notice information will be made accessible upon request in accordance with the Accessibility Standard for Information and Communication under the *Accessibility for Ontarians with Disabilities Act, 2005.*

Information will be collected and maintained to meet the requirements of the *Environmental Assessment Act* and for the purpose of creating a record that will be available to the general public as described in Section 37 of the *Freedom of Information and Protection of Privacy Act*. All comments and personal information such as name, address, telephone number and property location will become part of the public record that is available to the general public unless you request that your personal information remain confidential. For more information, please contact the Ministry's Freedom of Information and Privacy Coordinator at 416-327-1434.

This notice issued March 21st and March 28th, 2019.

Executive Summary

R.J. Burnside & Associates Limited (Burnside) was retained by the Town of Grand Valley (Town) to develop a Master Plan Class Environmental Assessment to identify and evaluate alternative solutions to meet existing and future water and wastewater demands.

The Grand Valley water and wastewater infrastructure will require upgrades to accommodate future planned development. The Master Plan Class EA will review alternative solutions for water supply, water storage and wastewater treatment to ensure future demands are met.

The alternative solutions considered included:

Water Supply – Do Nothing, New Groundwater Source, New Surface Water Source, and Utilize an Existing Municipal System

Water Storage – Do Nothing, Elevated Water Storage and Grade Level Water Storage (including Standpipe and In-Ground Reservoir)

Wastewater Treatment – Do Nothing, Rerate the Existing Water Pollution Control Plant and Construct and Equalization Tank, Expand the Existing Water Pollution Control Plant, and Utilize an Existing Municipal System

Public Consultation

A Master Plan requires completion of Phase 1 and 2 of the Municipal Class Environmental Assessment process. There are three points of contact required for a Master Plan Class EA, two of which are mandatory.

- The first point of contact is the Notice of Commencement which was placed on the Town’s website on July 24, 2017. During this time, a letter/email was also sent to agencies that may have an interest in the project to notify them of commencement as well.
- The second point of contact is the mandatory Public Information Centre which was held at the Grand Valley District Community Centre on November 1, 2017. An advertisement for the Public Information Centre was published in the Orangeville Banner and the Orangeville Citizen on October 19 and 26 and was published in the Wellington Advertiser on October 20 and 27.
- The final point of contact is completed through the mandatory submission of the Notice of Completion.

Preferred Alternative Solution

Each alternative solution was evaluated using the following criteria: natural environment, social/cultural environment, financial factors and technical factors. The detailed evaluations are contained in the Project File Report. The preferred alternatives and their estimated timeline for implementation/construction are summarized in the table below:

Preferred Alternative	Class EA Requirement	Estimated Timeline	Cost Estimate
Wastewater			
Rerating of existing WPCP to 1,555 m^3/day and construction of a wastewater equalization tank at the existing WPCP site	Schedule B Class EA This Master Plan EA satisfies all Class EA requirements for this project.	2019/2020	$2,550,000
Complete Schedule C EA for the expansion of the existing WPCP to design, tender and build expansion to existing WPCP including upgrades to Emma St SPS.	Schedule C Class EA Phase 3 and 4 will be required	2021 to 2029	$11 – 14 Million
Two new sewage pumping stations (southeast and northeast quadrants of Town)	Schedule B Class EA This Master Plan EA satisfies all Class EA requirements for this project.	Per Development Process	Per Development Process
Water			
New groundwater production well and water treatment pumphouse at the park site	Schedule B Class EA This Master Plan EA satisfies all Class EA requirements for this project.	2020	$2,400,000
New elevated water storage in the form of a water tower within the WPCP boundary	Schedule B Class EA This Master Plan EA satisfies all Class EA requirements for this project.	2021	$3,590,000
Additional groundwater production well at the park site and connection to park site water treatment pumphouse	Schedule B Class EA This Master Plan EA satisfies all Class EA requirements for this project.	2024	$370,000

The future expansion of the WPCP to 2,131 m^3/d will require completion of a Schedule C Class EA (Phases 3 and 4) before design work can begin. All other projects listed as a preferred alternative are a Schedule B activity and therefore, this Master Plan satisfies all Class EA requirements for these projects.

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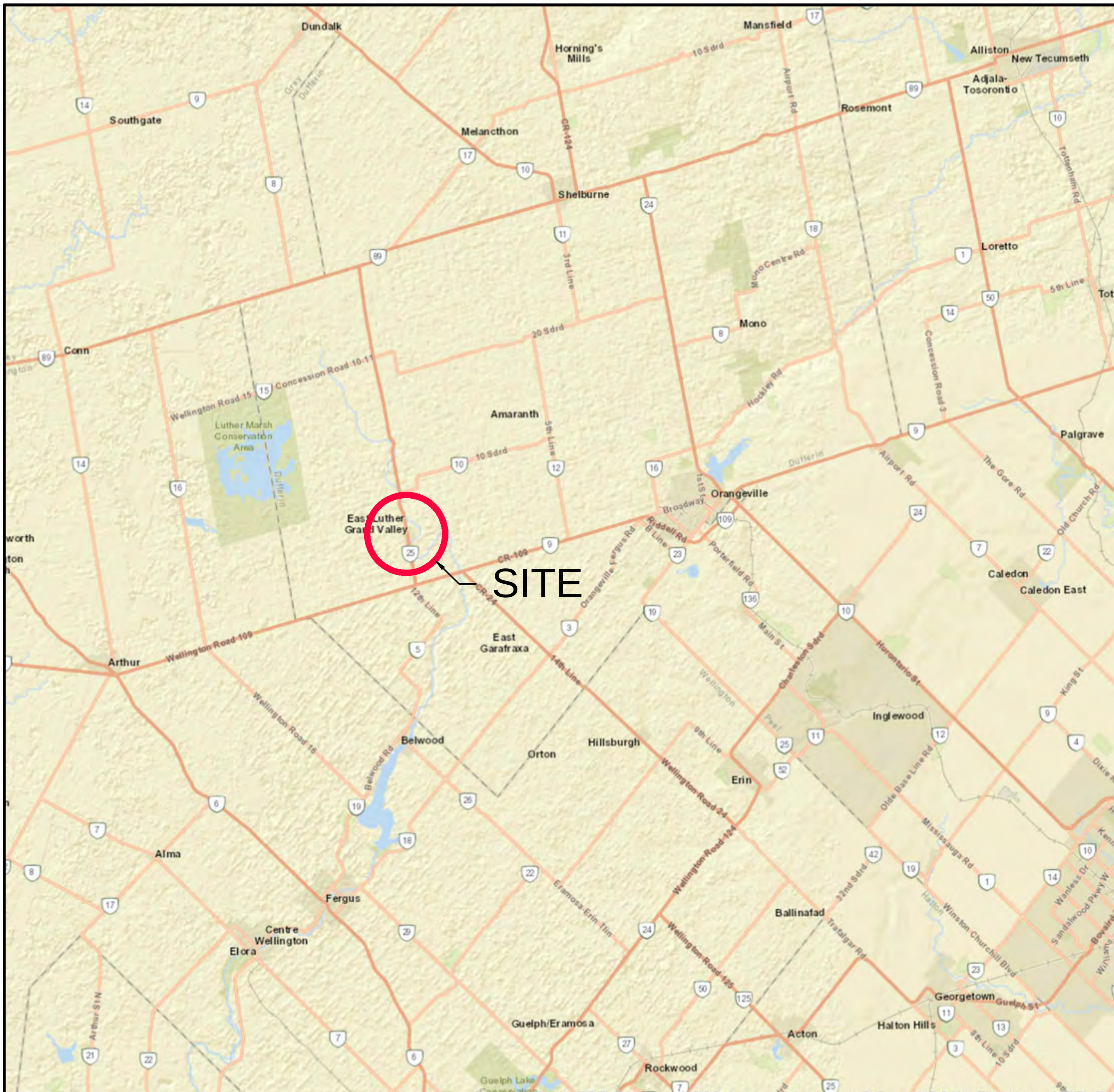
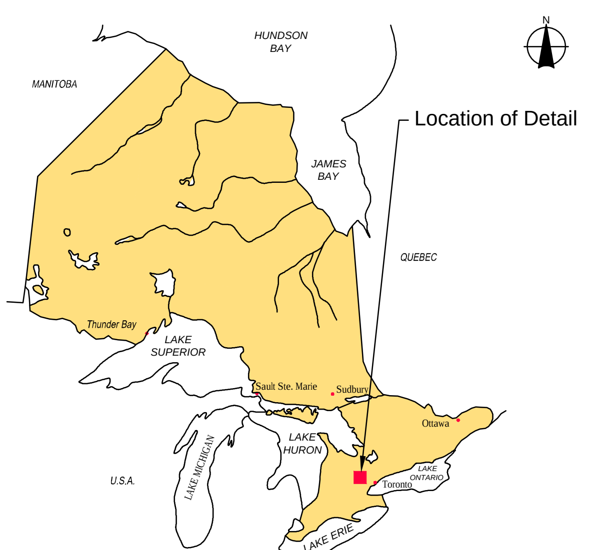
Appendices

1.0 Introduction

The Town of Grand Valley (Town) has authorized R.J. Burnside & Associates Limited (Burnside) to complete a Master Plan in compliance with the Municipal Class Environmental Assessment (MEA, 2000, as amended 2007, 2011 and 2015) process to identify and evaluate alternative solutions to meet future water supply and sewage servicing demands in the Town of Grand Valley.

The Town of Grand Valley is located west of the Town of Orangeville in the south west part of Dufferin County. The location of the Town is shown on Figure 1. This Master Plan Class EA will review and evaluate various water supply and storage upgrades as well as wastewater treatment capacity options for the Grand Valley study area with respect to existing and future population projections and potential impacts on the natural, social, financial and technical environments.





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TOWN OF GRAND VALLEY

Figure Title

GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT

SITE LOCATION MAP

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2.0 Problem/Opportunity Statement

Prior to 2014, the Town of Grand Valley had an urban population of approximately 1,500 and had constructed infrastructure to accommodate the mature state urban population in its Official Plan, which was 2,950. In 2014, approval was given to change the Official Plan such that the mature state urban population increased to 6,145. This amendment was premised on the certainty that services could be provided to the new future population, but no infrastructure plans were put in place. The Town of Grand Valley is undertaking this Master Plan Class EA to address the problem of how Grand Valley can provide water and wastewater infrastructure to meet the demands in the community as it achieves the growth that is approved in its Official Plan.

3.0 Existing Grand Valley Drinking Water System

The Grand Valley Water Supply System is classified as a Large Municipal Residential Drinking Water System under Ontario Regulation (O.Reg.) 170/03. The water supply system is owned by the Town of Grand Valley and is operated by Dufferin Water Co. Ltd. The system relies on four (4) groundwater wells to provide drinking water to the community, three of which are currently in service.

More detailed descriptions for the drinking water system components are provided in the following subsections.

3.1 Water Supply (Groundwater Wells)

3.1.1 Permitted Takings and Water Supply Capacity

The water supply system consists of two wellfields, the Cooper Street Wells and the Melody Homes Wells. Of the four wells, two (PW1 and PW2) are located at the Cooper Street Pumphouse and two (PW3 and PW4) are located at the Melody Lane Pumphouse. However, PW4 is currently being used as a monitoring well. The water supply wells are operated under Permit to Take Water (PTTW) No. 1551-874JGB issued in 2010.

The wells at the Cooper Street Pumphouse are not permitted to operate at the same time and therefore run on a duty/standby alternating basis providing a maximum capacity of 2,290 m^3/day. Normal pump operation for the system includes the Melody Lane well (PW3) operating concurrently with either of the Cooper Street wells (PW1 or PW2). This provides a maximum system capacity of 2,944 m^3/day. Firm capacity which refers to the supply capacity when the largest well is out of service, is therefore 1,963 m^3/day.

Table 1 below provides a summary of the water supply capacities currently available in Grand Valley.

Table 1: Water Supply Summary

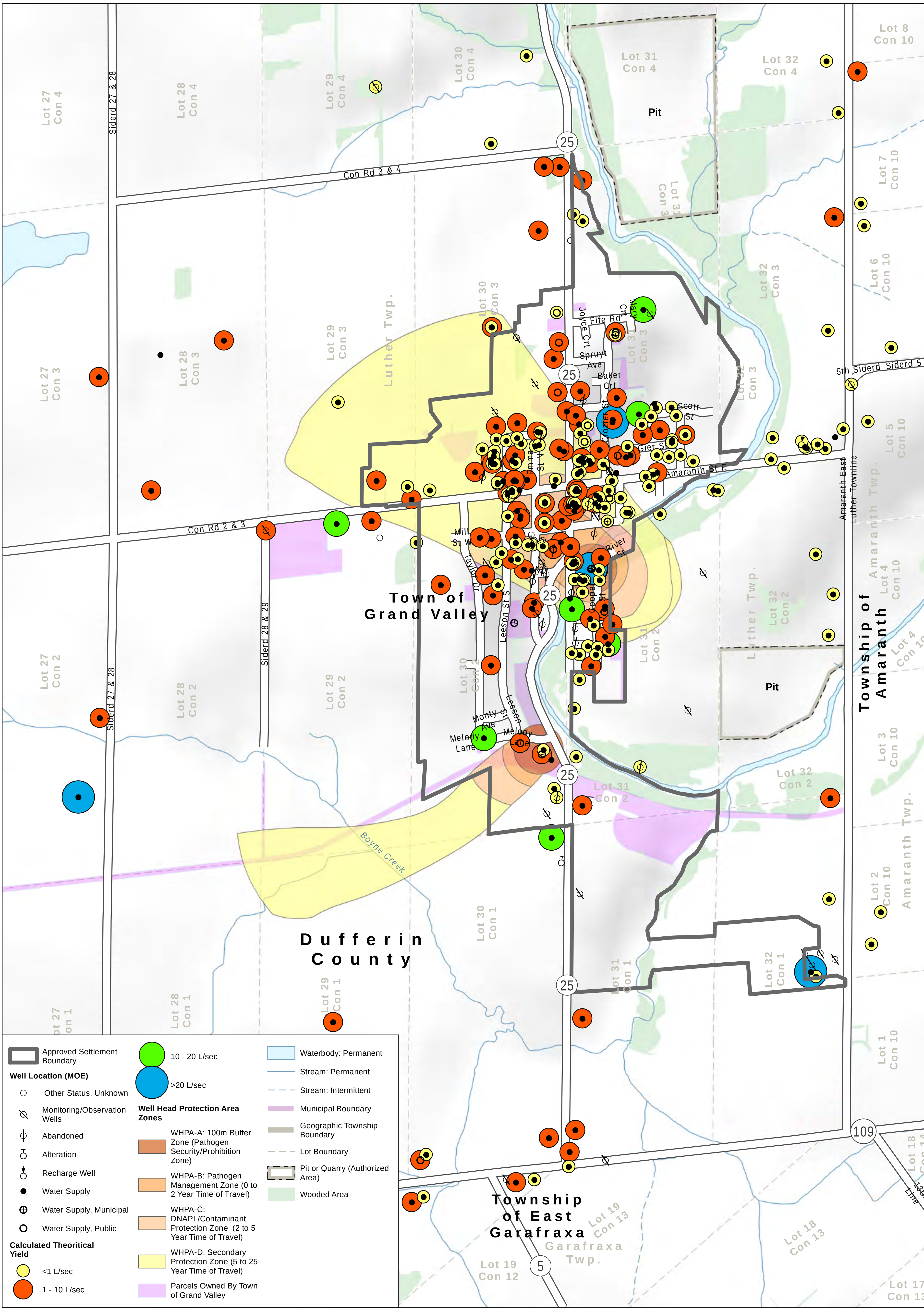
Pumphouse	Well	PTTW (m^3/d)	Maximum Capacity (m^3/d)	Firm Capacity (m^3/d)
Cooper Street	PW1	2,290	2,290	
	PW2	1,309		1,309
Melody Lane	PW3	654	654	654
		Total	**2,944**	**1,963**

3.1.2 Well Head Protection Areas

Wellhead Protection Areas (WHPA) for the Grand Valley water supply wells were delineated as part of a study completed by Golder Associates in 2010. The capture zones were developed for PW1, PW2 and PW3. Since PW4 is permanently off-line, a capture zone was not delineated for the well (Golder Associates, 2010). At the time of the study, Golder Associates did not consider the 25-year growth projections so pumping rates used to create the WHPAs were selected based on historic average pumping rates with PW1/PW2 being modelled at 300 m^3/day and PW3 modelled at 133 m^3/day. The location and orientation of the WHPAs are shown on Figure 2.

The capture zone for PW1 and PW2 extends approximately 1,322 m in a northwest direction covering a total area of 112.5 ha. The capture zone for PW3 extends southwest with a total area of 35.4 ha. The WHPAs were included in the Approved Assessment Report (Lake Erie Region Source Protection Committee (SPC), 2015) for the Grand River Source Protection Area and policies from the Source Protection Plan are applicable within these areas.

Water level monitoring at many locations is completed by Burnside as a condition of the PTTW. Water levels in monitoring wells within the WHPA respond to pumping of the municipal wells.



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Map Title

GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT
LOCATION AND ORIENTATION OF WELL HEAD PROTECTION AREAS

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3.1.3 Water Quality of Existing Well Fields

Historical water quality data for the existing water supply wells were reviewed as part of the Threats Assessment and Issues Evaluation (Burnside, 2010) completed for the Town to support the Grand Valley Assessment Report (LESPR, 2015). The review included samples taken between 1991 and 2000 and annual water quality reports for 2005 and 2009 with results being compared to the Ontario Drinking Water Quality Standards and Guidelines (ODWQS).

Historical water quality data for the Grand Valley wells indicate that the water is typically very hard and often exceeds the ODWQS standard. Hardness concentrations measured between 1991 and 2000 ranged between 217 mg/L and 850 mg/L which are above the Operational Guideline of the ODWQS which ranges from 80-100 mg/L (Burnside, 2001a). This level is typical of drinking water obtained from a dolostone bedrock source and is not considered a condition that threatens the use of the groundwater as a safe drinking water source. Hardness is an aesthetic objective in the ODWQS.

The Grand Valley supply wells also have naturally occurring elevated fluoride which ranges from 0.02 mg/L to 1.8 mg/L and often exceeds the ODWQS Maximum Acceptable Concentration (MAC) of 1.5 mg/L. Adverse effects of fluoride between 1.5 mg/L and 2.4 mg/L are only cosmetic in nature (dental mottling in a small portion of the population). The Ministry of Environment, Conservation and Parks (MECP) recommends that public awareness concerning other fluoride sources is raised when naturally occurring fluoride levels are between 1.5 mg/L and 2.4 mg/L. Since fluoride is naturally occurring and a non-health related parameter it is not a concern for use of the groundwater as a drinking water supply.

Elevated sodium concentrations were identified in the Grand Valley wells with levels ranging from 4 mg/L to 36 mg/L. The ODWQS MAC for sodium is 200 mg/L, however the local Medical Officer of Health should be notified when sodium concentrations exceed 20 mg/L. No increasing trends in sodium were identified in the Issues Evaluation completed by Burnside in 2010.

3.2 Water Storage (Water Tower)

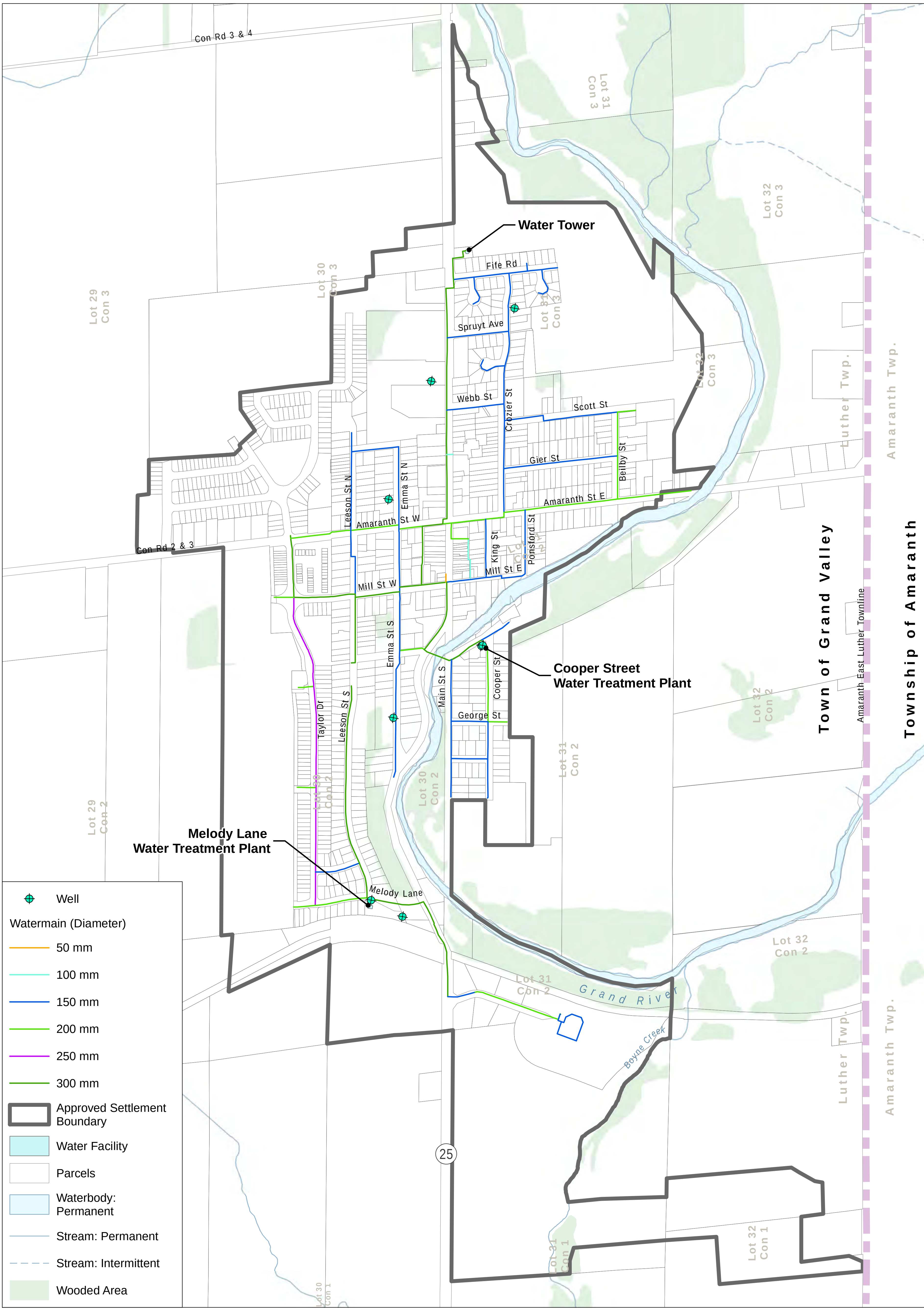
The existing water distribution system includes water storage in the form of a water tower. The tank is composite construction, including a precast concrete shaft and steel tank. The elevated water tower supplements the well supply during periods of high demand. The existing water tower is located on the north end of the system off County Road 25, north of Fife Road. The tower has a storage capacity of 1,600 m^3 and a high-water level elevation of 519.3 m.

3.3 Water Distribution System

The existing distribution system provides water service to Grand Valley through watermain ranging in diameter from 150 mm to 300 mm. The system has been certified under a Class 2 Water Distribution facility and operator class.

The water distribution analysis will be updated to reflect existing and future demand scenarios up to the year 2031 based on the Official Plan and intended development areas.

Figure 3 illustrates the distribution system and location of the water treatment pumphouses.



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Map Title

GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT
EXISTING GRAND VALLEY WATER SUPPLY AND DISTRIBUTION SYSTEM

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TOWN OF GRAND VALLEY

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4.0 Existing Grand Valley Wastewater System

The existing Grand Valley Wastewater System is comprised of a gravity sewer collection, two sewage pumping stations, and a conventional Wastewater Pollution Control Plant (WPCP).

More detailed descriptions of the system components are provided below in the following subsections.

4.1 Wastewater Collection and Conveyance

Wastewater collected by the gravity sewer system combines at a main sewage pumping station (SPS) located on Emma Street. The Emma St. SPS is designed for an instantaneous peak flow of 7,680 m^3/d. This instantaneous peak flow includes a significant allowance for the historically high wet weather flows recorded. The forcemain from the Emma St. SPS to the WPCP consists of 1.1 km of 250 mm diameter polyethylene pipe. There is also a small SPS on Amaranth St that pumps wastewater into main gravity system.

Figure 4 illustrates the existing collection system, the location of the Emma St. SPS and the location of the WPCP.

4.2 Wastewater Treatment

The Grand Valley WPCP provides treatment for wastewater generated within the Town. The WPCP is a tertiary activated sludge treatment plant operating as an extended aeration process and combines filtration and UV disinfection with direct discharge to the Grand River. The quality and quantity of effluent currently discharged by the existing WPCP is regulated by the MECP Certificate of Approval (C of A) No. 9706-7KWQ57, issued on February 2, 2009 (see Appendix A).

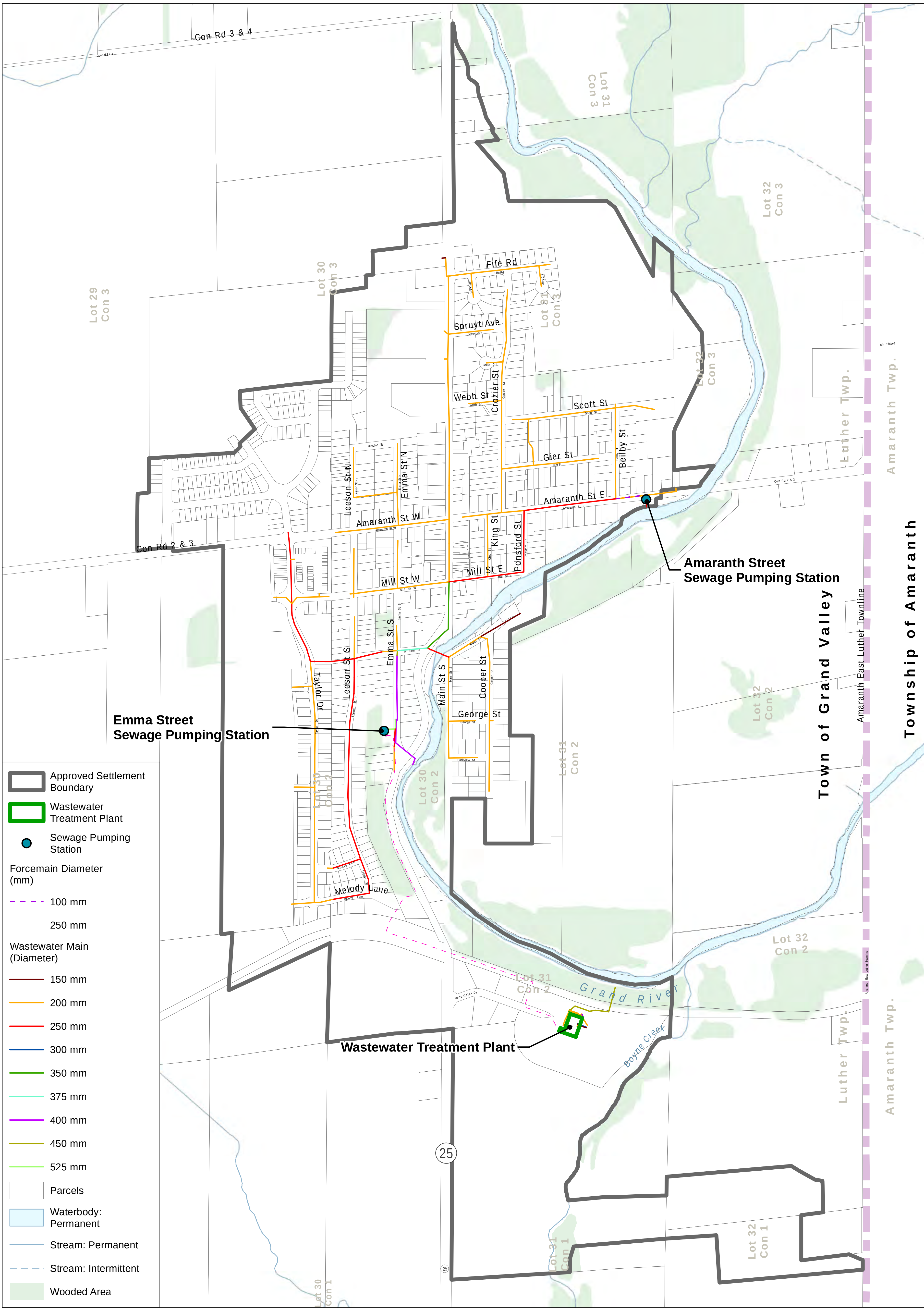
The Grand Valley WPCP has a rated average day capacity of 1,244 m^3/d and is currently operated by Ontario Clean Water Agency (OCWA). The most recent records at the WPCP indicate that the plant operates at a current annual average day flow of approximately 700 m^3/d with maximum day flows ranging between 1,100 m^3/d to 4,671 m^3/d and peak wet weather instantaneous flows up to approximately 6,000 m^3/day.

The unit processes at the plant, including the contemplated expansion of the existing equalization storage, will be evaluated in terms of the short and long-term servicing requirements of the Town.

4.3 Measures to Mitigate High Wastewater Flows

The Town of Grand Valley has experienced high volumes of inflow to its sanitary sewer system dating back to the time of its original construction. Numerous studies have been conducted to determine the source of extraneous flows with the results typically pointing towards private properties. An ongoing CCTV program is used to find and repair issues arising on infrastructure owned and controlled by the Town.

Flows originating on private properties are more problematic because of the need to access and alter property that is not controlled by the Town. These repairs are also very expensive. The Town has found that forced disconnections are only a short-term fix because property owners tend to reconnect the illegal connections after Town inspections are finalized. This has led to a realization that the best solution involves not only a disconnection, but also the provision of an alternate outlet for nuisance foundation flows. In 2017, the Town commenced a 15-year program that involves digging up streets; installing full storm sewers with private services; entering private property and connecting house foundations to the new storm sewer; repairing the sanitary service as necessary, and then reinstating the lawns, gardens, walkways, driveways and roads that have been disturbed. This capital program monopolizes the Town’s annual budget and proceeding at a rate that is manageable will take many years before the results are quantifiable.



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TOWN OF GRAND VALLEY

Map Title

GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT
EXISTING GRAND VALLEY WASTEWATER COLLECTION AND TREATMENT SYSTEM

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5.0 Population Projections

To determine the future water and wastewater needs for Grand Valley, the current and future population must be analysed and projected. Most of the demand within the community is currently from domestic (residential) use, however, new commercial lands are included in future development plans in the south-east portion of Grand Valley. Development of the future population and demand scenarios has been based on the known planned development areas within Grand Valley limits, which are shown in Figure 5.

5.1 Existing Population

The existing population is an important factor for determining the projected demands for the Town. Table 2 summarizes the existing population data of the area serviced by the existing water supply system as well as the wastewater collection and treatment system from 2011 to 2016.

Table 2: Existing Population

Year	Population	Occupancy Permits		Private Dwellings Occupied by Usual Residents	Source
		Singles	Multi Res		
2011	1,481			579	Population and Dwelling Units from Stat Canada
2012	1,494	4	0	583	Occupancy Permits Issued Provided by Town
2013	1,535	13	0	596	Occupancy Permits Issued summarized in email from Town Planner dated May 5, 2015
2014	1,646	32	4	632	Occupancy Permits Issued summarized in email from Town Planner dated May 5, 2015
2015	1,799	39	11	682	Occupancy Permits Spreadsheet provided by Town Planner on March 14, 2017
2016	2,004	65	0	747	Occupancy Permits Spreadsheet provided by Town Planner on March 14, 2017

Year	Population	Occupancy Permits		Private Dwellings Occupied by Usual Residents	Source
		Singles	Multi Res		
2017	2,228	71	0	818	Occupancy Dates provided by CAO on January 22, 2018

5.2 Future Population

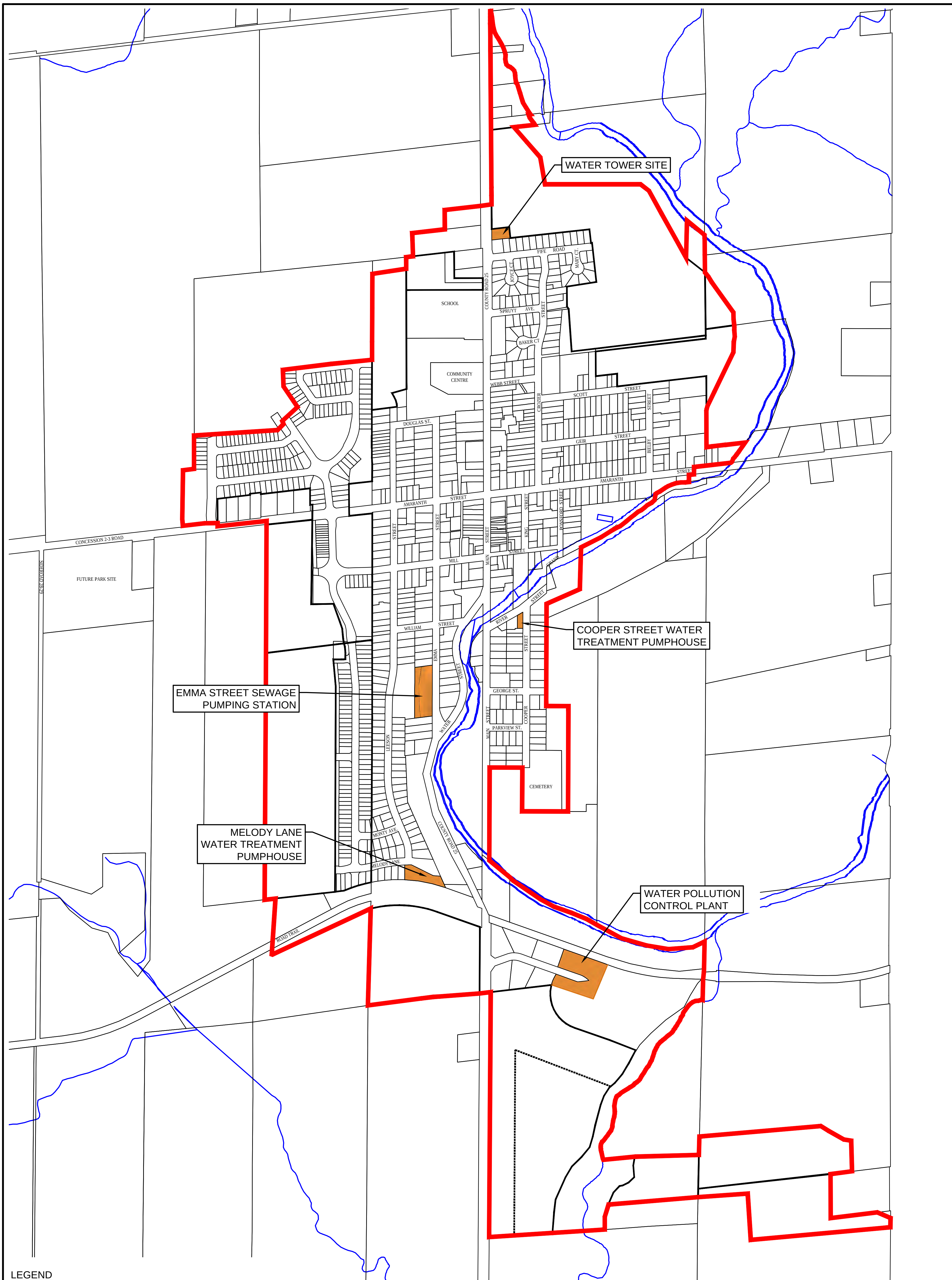
For design considerations, it is typical to design for the ultimate service area requirements. As a result of the 2014 Provincial Growth Plan for Dufferin County, the design population for Grand Valley was increased from 2,950 to 6,145 people.

These population projections are based on the recently accepted population forecast as per the revised Grand Valley Official Plan Land Needs Assessment Summary (December 13, 2013) and the recently adopted revised Official Plan (March 2017). According to the Land Needs Assessment Summary the various populations are presented in Table 3. The population is expected to increase by 4,442 persons between 2011 and 2031. Approximately 426 persons will be accommodated through intensification of existing built up areas, 89 persons are expected in rural (un-serviced areas) leaving 3,927 persons to be accommodated through Greenfield developments. We have assumed that 100 of the existing 695 jobs are within the urban boundary. In the future, 485 jobs will be created in the urban boundary. The total projected Greenfield service population is the combination of 485 jobs and 3,927 persons. Between 2011 and 2016, 522 people have moved into Greenfield developments leaving 3,405 persons to be accommodated.

Table 3: Existing and Proposed Populations within the Urban Boundary

Item	Jobs	Population	Total
Existing 2016 – Urban Serviced Population	100(1)	2,004	2,104
Intensification	0	426	426
Greenfield Development	485	3,715(2)	4,200(2)
Total People and Jobs in 2031	**585**	**6,145**	**6,730**

Notes
(1) Assumed
(2) The population and total numbers include the original population provided for Greenfield Development as well as the additional 310 people identified as part of Additional Lands. This has subsequently been approved by the Ontario Municipal Board.



LEGEND

APPROVED SETTLEMENT BOUNDARY

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Figure Title

GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT

PROJECT AREA - GRAND VALLEY SETTLEMENT BOUNDARY LIMITS

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6.0 Historical and Projected Water Demands

6.1 Historical Water Demands

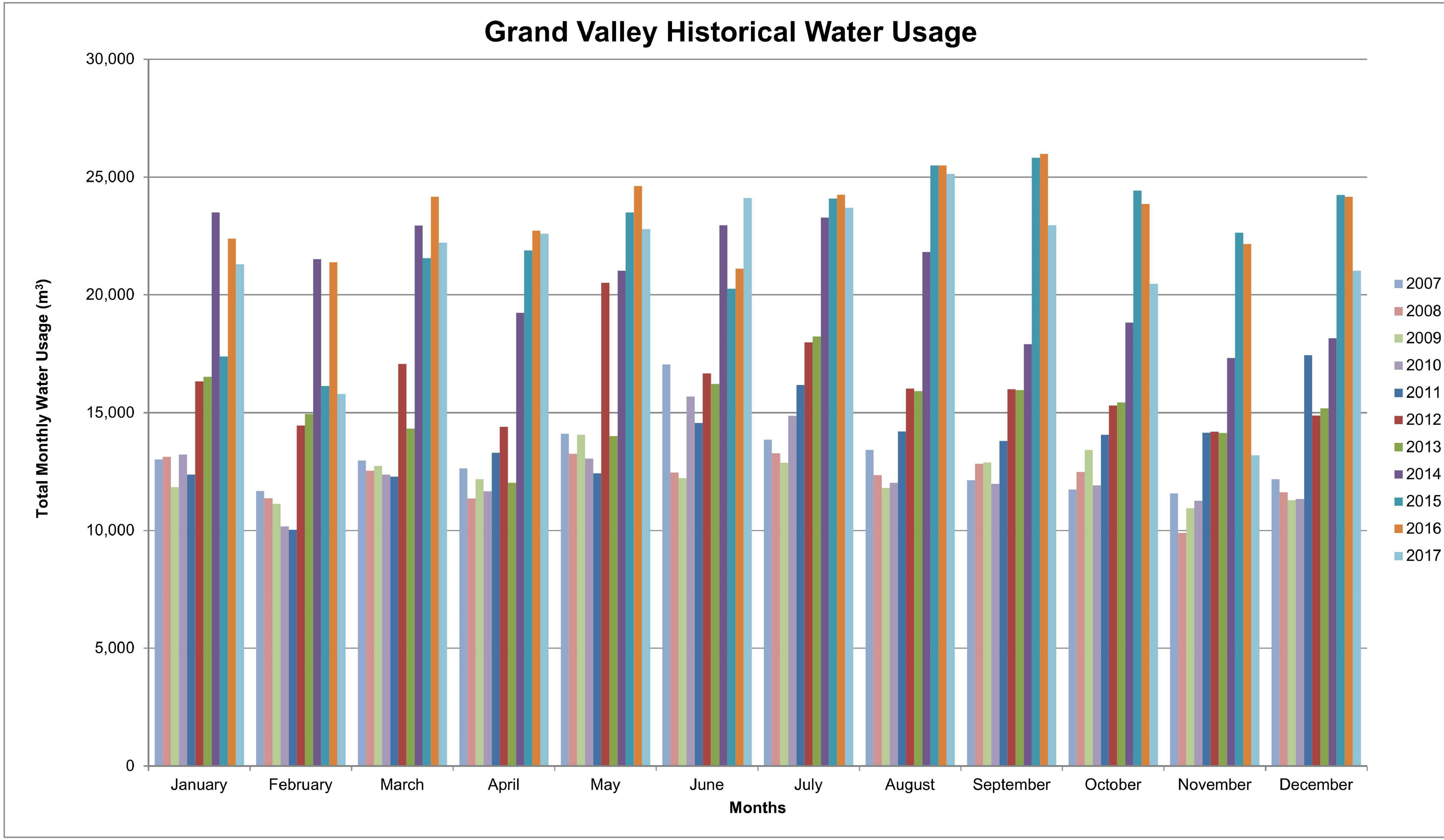
The historical water usage records from 2007 to 2017 were reviewed to determine the existing historical water use. The existing water use is summarized in the following table while the total monthly water usage is illustrated in Figure 6.

Table 4: Historical Water Use

Year	Average Daily Flow (m^3/d)	Maximum Day Demand (m^3/d)	Max Day Demand Factor	Population Serviced	Per Capita Average Day Demand (L/cap/d)
2007	428	736	1.7	1,481	289
2008	409	759	1.9	1,481	276
2009	405	1,505	3.7	1,481	273
2010	410	1,583	3.9	1,481	277
2011	452	742	1.6	1,481	305
2012	530	1,589	3.0	1,494	354
2013	501	844	1.7	1,535	327
2014	681	1,765	2.6	1,646	414
2015	733	1,753	2.4	1,799	407
2016	772	1,734	2.2	2,004	385
2017	738(1)	1,046(1)	1.4	2,228	331

(1) The average and maximum day flows were based on data that was verified and scrubbed by the system Operator providing a more accurate value.

The per capita demand estimates for the years above, except for 2014 and 2015, are around the middle of the design range specified in the MECP Guidelines (270 to 450 L/cap/day). The maximum day factor (ratio of the maximum day demand within the year vs. the average daily demand) for the 2009 to 2014 period was approximately 2.3. This factor is less that the recommended MECP design guideline of 2.5 for similar populations.



BURNSIDE

Figure Title

GRAND VALLEY MASTER PLAN
ENVIRONMENTAL ASSESSMENT
HISTORICAL WATER USAGE

Client	Drawn	Checked	Date	Figure No.
TOWN OF GRAND VALLEY	CD	JP	February 2019	**6**
	Scale: N.T.S.		Project No.: 300040938.0000	

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6.2 Projected Water Demands

For projection purposes, an average daily water demand of 331 L/cap/day and 90 L/job/day were utilized based on the review of the historical data. While flows may appear to have increased during the latter years of data provided, this is attributed to a process that consumed potable water at the WPCP that was undetected for several years. The maximum day factor for the existing population was selected based on historical data as stated in Section 6.1; however, the maximum day factors for the projected populations were selected based on the population according to the MECP guidelines. Peak hour demands for the existing population are unknown and therefore the MECP design guideline for the peak hour factor was utilized based on the total projected population. Table 5 summarizes future water demand projections for Grand Valley.

The demand projected above does include some non-residential water demand. As previously mentioned, the historical data used to determine the per capita and maximum daily demands included the existing non-residential flows.

Table 5: Water Demand Projections

	Population	Jobs	Average Daily Demand (m^3/d)	Max Day Factor	Max Day Demand (m^3/d)	Peak Hour Factor (5)	Peak Hour Demand (m^3/d)
Existing	2,004	100	731(1)	2.3(3)	1,682	3.38	2,472
Mature State Serviced Population	6,145	585	2,087(2)	2.0(4)	4,173	3.00	6,260

Notes:
(1) 365 L/cap/day was utilized for existing based on historical data (inclusive of non-residential flows)
(2) 331 L/cap/day was utilized for residential demand and 90 L/cap/day was utilized for non-residential demand
(3) A max day factor of 2.3 was utilized based on historical data
(4) The max day factor for the projected populations are based on MECP guidelines
(5) The actual peak hour demands for the existing population are unknown and forecasts are based on MECP guidelines.

7.0 Current and Future Water Supply and Storage Requirements

7.1 Supply Requirements

For water systems which include water storage, such as the one in Grand Valley, the source of supply, the wells in this case, should have a capacity that is equivalent to at least the projected maximum day demand. In addition, the MECP Guidelines recommend that the water system be designed such that it can meet the maximum day demand with the largest well out of service, which is referred to as the system's firm capacity. As previously stated in Table 1, Wells PW1, PW2, and PW3 are equipped and permitted to provide 2,290 m^3/d (26.5 L/s), 1,309 m^3/d (15.2 L/s), and 654 m^3/d (7.6 L/s) respectively. However, with only PW1 or PW2 operating at a time the maximum capacity is 2,944 m^3/d (34.0 L/s). As identified below in Table 6, the existing system can provide firm capacity for the population currently being serviced. For future demands, the wells cannot meet the demand; therefore, additional water supply sources will be required to expand the existing well pumping capacity. Specifically, the Town will require an increase in firm capacity of 2,210 m^3/d, likely provided by two additional wells.

Table 6: Projected Max Day Demand Compared to Rated Well Supply

	Population	Max Day Demand (m^3/d)	Are Wells Able to Meet the Demand?	Are Well Able to Provide Firm Capacity?
Existing	2,004	1,682	Yes	Yes
Mature State Population	6,145	4,173	No	No (1)

Notes:
(1) Maximum Day Demand is greater than 1,963 m^3/d which is the firm capacity of the existing well supply system.

7.2 Storage Requirements

Storage reservoirs provide operating, emergency and fire storage for water systems, so that the well supply does not have to directly provide these flows to the distribution system. The MECP Guidelines require the provision of storage sufficient to supply the required fire flow volume and meet the peak demands of the system. The calculation for required storage is based on the ABC formula:

Storage = A + B + C

where: *A = Fire Storage - Required fire flow volume (L)*
B = Equalization Storage - 25 % of maximum day volume (L)
C = Emergency Storage - 25 % of sum of A and B

Using the MECP Guidelines, the required fire flow volume (A) is determined by the equivalent population. Based on Table 8-1 in the MECP Guidelines, A is calculated from the following:

- Existing (based on equivalent population of 2,104): 95 L/s for 2 hours; and
- Year 2031 (based on equivalent population of 6,730): 159 L/s for 3 hours.

Table 7 summarizes the storage requirements for the existing and future scenarios.

Table 7: Existing and Future Storage Requirements

	Existing	**Year 2031**
A. Fire Storage (m^3)	684	1,717
B. Equalization Storage (m^3)	421	1,043
C. Emergency Storage (m^3)	276	690
Minimum Required Storage (m^3)	**1,381**	**3,451**
Existing Storage (m^3)	1,600	1,600
Required Additional Storage (m^3)	**None**	**1,851**

Under existing conditions, the total maximum daily demand is 1,682 m^3/day. The MECP Guidelines require a fire flow of 95 L/s for 2 hours for an equivalent population of 2,104. The minimum storage requirement under these conditions is 1,381 m^3 which is less than the available storage of 1,600 m^3. Therefore, the existing reservoir can still provide adequate storage for the existing demands.

Under future conditions in the year 2031, the total maximum daily demand is 4,173 m^3/day. The MECP Guidelines require a fire flow of 159 L/s for 3 hours for an equivalent population of 6,730 persons. The minimum storage requirement under these conditions is 3,451 m^3 which is greater than the available storage of 1,600 m^3. To meet the MECP Guidelines, an additional 1,851 m^3 of storage will be required.

8.0 Distribution System Analysis

8.1 Hydraulic Analysis of the Future Water Distribution System

A hydraulic analysis was completed for the future water distribution system using the Grand Valley WaterCAD V8i Model from the Grand Valley Master Servicing Plan Update completed by Burnside in May 2014 (see Appendix B). The computer model of the Grand Valley water system was verified and updated to reflect future water demand scenarios identified in this Servicing Master Plan. Water models determine water pressures and available fire flow throughout the system under different water demand scenarios and identifies where system upgrades are required. The user can then input changes that improve the results. These inputs could include watermain sizing, provision of water storage and looping of the distribution mains. This hydraulic analysis was completed under the different future water demand scenarios described below for three of the potential water storage sites (Location 1 - within the Wastewater Treatment Plant Buffer, Location 2 – behind the Melody Lane Pumphouse and Location 3 – Amaranth East Luther Townline) and the resulting water pressures and available fire flow were compared.

The water model was run under four different demand or use scenarios, using calculated demands for the 2031 population:

- Average Day Demand (ADD), Towers Full, Supply Pumps Off;
- Maximum Day Demand (MDD), Towers Full, Supply Pumps On;
- Peak Hour Demand (PHD), Equalization Spent, Supply Pumps On; and
- Maximum Day Demand plus fire flow (MDD + fire), Equalization and Fire Storage Spent, Supply Pumps On.

Under periods of average and maximum day demands the recommended pressures range from 350 to 480 kPa as outlined by the MECP (past MECP Guidelines recommended a range of 345 to 550 kPa). Pressures more than 480 kPa are permitted; however, are not to exceed 690 kPa to avoid damage to household plumbing. During periods of peak hour demand, pressures are to be in the recommended range of 275 kPa (40 psi) to 480 kPa (70 psi), and during a fire event (or other emergency) the pressure is required to remain more than 138 kPa (20 psi).

Areas where the resulting pressure is greater than 480 kPa may require pressure reducing valves, and areas where the pressure is lower than 350 kPa would require boosting.

Future growth has been allocated within the approved settlement boundary. Watermain sizing in the future growth areas was completed with the intention of minimizing watermain diameter size, while ensuring watermains are sufficiently sized to allow the proposed development areas to meet the pressure and fire flow requirements outlined by the MECP. Watermains were modelled using MECP recommended C factors.

8.2 Allocation of Demands

The future average day, maximum day and peak hour water demands in the model are based on the mature state service population water demand projections shown in Table 8.

The anticipated water demands were calculated for each development area based on the allocation of equivalent persons per development. Proposed trunk mains were added throughout the development areas and the watermain was looped where reasonable. The demand for each development area was added to the node(s) on the trunk main for each development. For the proposed development arrangement, the area of intensification (426 persons) is located on Scott Street, as agreed upon with the Town Planner.

The identified flow allowance per job of 90 L/job/day when distributed across the lands identified as employment or mixed-use results in a very small demand per unit area (<2 m^3/ha) which would be much less than the MECP allowances referenced in the Town's engineering standards. For analysis of the pipe network, we have assumed demands consistent with the residential development parcels.

8.3 Modelling Results

The modelling results for each scenario under the calculated 2031 demands are summarized in Table 8. A copy of the WaterCAD modelling results is provided as Appendix B.

Table 8: Future Scenario Water Model Results

Demand Scenario(1)	Minimum System Pressure (kPa)		Maximum System Pressure (kPa)	
	Existing System(2)	Future Development Area(3)	Existing System(2)	Future Development Area(3)
Average Day Demand	369	384	653	585
Maximum Day Demand	369	385	654	585
Peak Hour Demand	326	340	611	541

Notes:
(1) Results summary considers all water tower locations
(2) Existing System results are Junctions J-1 to J-97
(3) Future Development Area results are Junction J-99 to J-155

Almost all the planned developments are within the ideal range of elevations, which results in adequate system pressures in all the future demand scenarios. The exception is Davison Bus (Development K), which lies just outside the ideal range and may require pressure reduction.

It should be noted that a considerable portion of the existing system has water pressure in excess of the current MECP recommended maximum of 480 kPa. These pressures are more in line with the guidelines in place around the time the existing water tower was constructed. Pressures more than the MECP recommendation are permissible; however, they need to remain below 690 kPa as this is the maximum permissible pressure for household plumbing fixtures. The existing system meets this criterion.

When including fire flow in the model, a fire flow requirement of 79 L/s was used as per the standard for Grand Valley. This value was used in the 2014 Grand Valley Master Servicing Plan Update as well as previous iterations of the model (2010) and is typical level of service for a single fire in an area of residential development. All proposed developments can meet the fire flow requirements of 79.0 L/s available, while maintaining 138 kPa (20 psi) throughout the distribution system. The majority of the existing system is also able to meet the fire flow requirements of 79.0 L/s, while maintaining 138 kPa (20 psi) throughout the distribution system. The exception is a section of the distribution system in the northeast around Fife Road and Mary Court that is serviced by 150 mm, dead-end watermains. The minimum available fire flow within the system is 56 L/s on Mary Court. Future looping off Fife Road would improve the available fire flow.

A 300 mm diameter watermain, as modelled, is able to provide a fire flow of 79 L/s to service the Zietsma (Area E) and Collini lands (Area F) in the southeast of the settlement boundary, without additional elevated water storage. However, the storage is required to provide for an adequate duration of firefighting. Three potential water tower locations have been identified; Location 1 is within the Wastewater Treatment Plant Buffer, Location 2 is behind the Melody Lane Pumphouse and Location 3 is along Amaranth East Luther Townline. The water tower is assumed to have similar characteristics to the existing tower with a slightly larger capacity, height and diameter. The high-water level will be the same as the existing tower (519.3 m). Each of the potential water tower options was modelled for the different demand scenarios and the results were compared. For the ADD, MDD and PHD scenarios, the pressure results for all potential water tower locations are the same or differ by 1 kPa. For the MDD with Fire Scenario, all calculated residual pressures are at or greater than the minimum system pressure of 138 kPa (20 psi). Generally, the calculated residual pressure results for Location 1 and Location 3 are the same. The calculated residual pressure results for Location 2 increase very slightly at most of the node locations. The available fire flows calculated ranged from 57.9 L/s (by Mary Court) to over 100 L/s. The available fire flows increase very slightly at some of the node locations when the water tower at Location 2 is used. It should be noted that with the proposed water tower at Location 3, a smaller 250 mm diameter watermain would be able to provide sufficient fire flows to the southeastern development areas but if the water tower is built at either Locations 1 and 2 a 300 mm diameter watermain needs to be installed to be able provide sufficient fire flows to the southeastern development areas. Using a smaller 250 mm diameter watermain to the southeastern development areas and the water tower at Location 3, does not affect the available fire flow results in the other portions of Town.

9.0 Historical and Projected Wastewater Demands

9.1 Historical Wastewater Demands

The reported flows since the opening of the WPCP and the existing wastewater flows are summarized in Table 9 and Table 10.

Table 9: Reported Flows since WPCP Opening

	Emma St. SPS Flow (Input) - m^3/day	Final Effluent Flow (Output) - m^3/day	OCWA Annual Report - m^3/day
2012	701	642	718
2013	1,321	821	815
2014	832	775	772
2015	466	710	473
2016	552	619	553
2017	786	823(1)	823

Notes:
(1) Final effluent flow referenced from existing SCADA records from January to September 2017

Table 9 compares the total influent and effluent flow for the existing WPCP over the course of a year with data from OCWA's annual reports.

As observed in Table 9 there is a large discrepancy in flows from what enters the WPCP from the Emma St. SPS and what is being discharged from the WPCP to the Grand River. From 2012 - 2015 there were problems with the Emma St SPS flowmeter not reading accurately due to grit build up and velocity readings which caused the flowmeter to not calculate flows accurately. Also, at the WPCP at the headworks building, a solenoid valve was found by OCWA to be stuck open washing the screen which increased the total effluent flow being discharged to the river.

Table 10: Existing Wastewater Flows

Year	Precipitation[3] (mm)	Average Day Demand (m^3/day)[4]	Per Capita Demand (L/cap/d)[6]	Maximum Daily Flow (m^3/d)[7]	Population
2011[1]	598	523[(E)]	353		1,481
2012[2]	780	718[(E)]	481	2,601	1,494
2013	1,105	815[(E)]	531	2,254	1,535
2014	989	772[(E)]	469	4,671[8]	1,646
2015	866	473[(I)]	263	1,123	1,799
2016[2]	1,032	553[(I)]	276	2,597	2,004
2017	707	823[(E) (5)]	410	3,234	2,004[9]

Notes:
(1) 2011 days in year are from July 1, 2011 to December 31, 2011
(2) Leap year
(3) Precipitation values were referenced from Fergus Shand Dam Data
(4) (E) represents Effluent Flow and (I) represents Influent Flow
(5) Flow referenced from SCADA records from January to September as stated in Table 9, not the OCWA Annual Report
(6) Density of 3.15 and 2.75 persons per dwelling for single dwellings and multi-residential dwellings, respectively.
(7) Unless otherwise indicated, the flows are based on the flow measurements taken at the effluent flow meter over the review period of 2012- 2016
(8) Based on Emma St. SPS Flow Measurements
(9) Used serviced population from 2016 since full year of data was not available*

As observed in Table 10 particularly in 2013 and 2016, an increase in total annual rainfall results in higher flows entering the WPCP which results in a higher per capita flow.

9.2 Future Wastewater Treatment Requirements

Since the only accurate flow data we have available is from 2016 – 2017 Table 11 summarizes the average day flow and per capita demand for those two years.

Table 11: Historical Wastewater Flows

	Average Daily Flow (m^3/day)	Per Capita Demand for Future Development (L/cap/d)
2-year average (2016 - 2017)	688	343
1-year average (2017)	823	410

For projection purposes, a per capita wastewater demand of 343 L/cap/day (including infiltration) was utilized for residential flow rates based on the historical data and 90 L/job/day was utilized for non-residential flow rates.

To ensure the wastewater demand was projected properly, the percent of population to jobs in 2016 was calculated. Based on the current population and jobs presented in Table 12, the jobs take up approximately 4.8 percent of the demand. Applying this percentage to the 2031 total projected population results in approximately 323 jobs rather than 585. Therefore, 323 jobs were accounted for under the per capita residential demand and the demand for the remaining 262 jobs was calculated at a per capita flow of 90 L/job/day. This resulted in an overall future wastewater demand of 2,131 m^3/d.

With the Grand Valley WPCP currently rated for an average capacity of 1,244 m^3/d, an additional 887 m^3/d of wastewater treatment capacity is required to accommodate the population and jobs projected for 2031.

Table 13 provides a summary of future wastewater demand projected for Grand Valley.

Table 12: Current and Projected Job Percentage

Year	Population	Jobs	Total	Percentage of Jobs	Adjusted Jobs based on 2016 Percentage	Remaining Jobs
2016	2,004	100	2,104	4.8%	…	…
2031	6,145	585	6,730	8.7%	323	262

Table 13: Projected Wastewater Demands

Year	Population	Jobs	Per Capita Demand		Average Daily Demand (m^3/d)
			Residential (L/cap/d)	Non-Residential (L/job/d)	
2031	6,145	262	343	90	2,131

10.0 Master Plan Class Environmental Assessment Process

The planning of long term projects that integrate infrastructure requirements for existing and future land use are subject to the *Environmental Assessment Act*, R.S.O. 1990, and requires the proponent to complete a Master Plan Class EA.

The Master Plan process is similar to the MCEA process developed by the Municipal Engineers Association (MEA); however, they typically recommend and examine a number of related projects that are within the same geographic area and have intended completion over a similar time frame while incorporating Environmental Assessment planning principles. They examine infrastructure system(s) and outline a framework for future development and land use planning rather than addressing the planning and design process on a project by project basis.

The Master Plan approach recognizes the benefits of examining a project with common elements such as geography or function. It allows for a broad overview to be presented through which individual or specific projects can be identified. During this process any individual projects that require additional information under the standard MCEA process can be completed.

A Master Plan is typically subject to approval by the Municipality for which it was prepared. Prior to review, a Master Plan Report is prepared and submitted for public, agency, and client review. Following a public consultation and approval that Master Plan will be subject to periodic review to determine if updates are required.

At a minimum the first two MCEA requirements are addressed under the Master Plan process. The required phases are as follows:

- Phase 1 – Identify the problem (deficiency) or opportunity; and
- Phase 2 – Identify alternative solutions to address the problem or opportunity by taking into consideration the existing environment, and establish the preferred solution considering public and review agency input.

Since a Master Plan typically consists of a set of projects, the projects can be individually categorized as Schedule ‘A+’, Schedule ‘A’, Schedule ‘B’, or Schedule ‘C’ under the MCEA process. When the Master Plan is implemented, each individual project will be subject to the MCEA requirements for its specific category. Therefore, additional requirements for project specific issues that are beyond the scope of the Master Plan Class EA process may be necessary for implementation.

A small description of the Class EA categories is provided below:

Schedule A+ Projects that fall within this category are pre-approved; however, the public is notified prior to project implementation. Projects that are typically classified under this schedule are completed within existing buildings, utility corridors, and right-of-ways within minimal impact to the surrounding environment.

Schedule A Similar to the Schedule A+ category, Schedule A projects are also pre-approved. These projects typically include normal or emergency operation and maintenance activities, are limited in scale and have minimal impact to the surrounding environment.

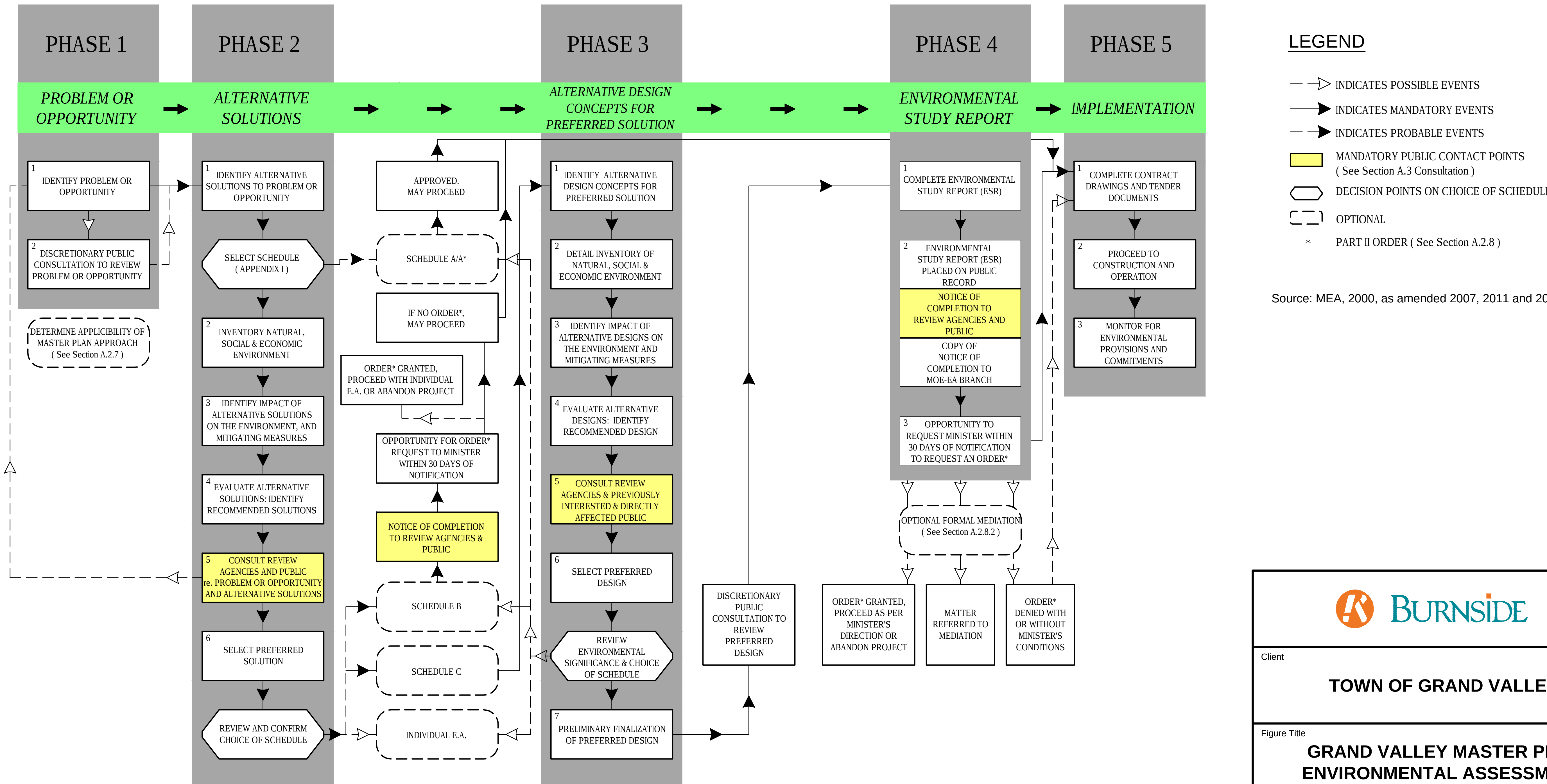
Schedule B Projects under this category generally include improvements and minor expansions to existing facilities. There is some potential that the surrounding environment may be adversely impacted. Therefore, the proponent must go through a screening process to consult and notify any parties that may be affected.

Schedule C The construction of new facilities and major expansions to existing facilities fall within this category. They have the potential for significant environmental impacts and must proceed through the environmental assessment planning process outlined in the Class EA.

The MCEA prepared a flow chart to illustrate the requirements at each phase of the MCEA process. A copy of the flow chart, as seen in Figure 7, has been included below. Under the Master Plan and MCEA process, any member of the public or agency can request that the Minister of the Environment order a MCEA project to become subject to an Individual Environmental Assessment. This is known as a Part II Order (or “bump-up”) request and is made in certain circumstances where concerns are unresolved during the MCEA planning process.

MUNICIPAL CLASS EA PLANNING AND DESIGN PROCESS

NOTE: This flow chart is to be read in conjunction with Part A of the Municipal Class EA



Source: MEA, 2000, as amended 2007, 2011 and 2015

BURNSIDE

Client

TOWN OF GRAND VALLEY

Figure Title

GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT

CLASS ENVIRONMENTAL ASSESSMENT PROCESS

Drawn	Checked	Date	Figure No.
JP	CD	February 2019	7
Scale		Project No.	
N.T.S.		300040938.0000	

File Name: 040938 Grand Valley EA CLASS EA PROCESS.dwg Date Plotted: January 23, 2019 - 9:38 AM

10.1 Public Consultation

10.1.1 Introduction

Public consultation is a key component of the Master Plan Class EA process. Active engagement with all potentially affected parties including government agencies, community members, special interest groups, and Aboriginal communities ensures a transparent and responsible planning process.

To ensure public and agency consultation, a Consultation and Communication Plan was developed at the onset of the study and followed throughout. The objectives of the Consultation and Communication Plan were to:

- Identify potentially affected stakeholders and Aboriginal communities;
- Inform stakeholders and Aboriginal communities of project status and components;
- Obtain input from stakeholders and Aboriginal communities during all phases of the Study; and
- Integrate information received into the planning and decision-making processes.

10.1.2 Consultation Activities Overview

A wide range of stakeholders were identified and contacted at the onset of the Study and during the Master Plan Class EA process including relevant review agencies and organizations, who may be affected or have interest in the study. These stakeholders were contacted through direct distribution of notices and on the Town's website. Aboriginal communities that may have an interest in the project were also contacted at the onset of the Study.

Table 14 summarizes the consultation activities undertaken as part of this Study. Details pertaining to the consultation are provided in the following sections:

Table 14: Summary of Consultation Activities

EA Phase 1: Notice of Study Commencement		
July 24, 2017	Letter and Notice of Commencement	Potentially Interested Organizations, Review agencies and Aboriginal communities / organizations
EA Phase 2: Public Information Centre		
October 16, 2017	Notice of PIC	Potentially Interested Organizations, Review agencies and Aboriginal communities / organizations
October 19 and 26, 2017	Newspaper Notices	Orangeville Banner and Orangeville Citizen

October 20 and 27, 2017	Newspaper Notices	Wellington Advertiser
November 1, 2017	PIC	All interested persons
EA Phase 2: Notice of Study Completion and Filing of PFR		
	Newspaper Notices	Orangeville Banner, Orangeville Citizen, and Wellington Advertiser
	File PFR	Public Record

10.1.2.1 Project Contact List

At the initiation of the project, the Project Team completed a screening to identify the stakeholders that were anticipated to have a higher level of engagement in the Study (i.e., expected to comment on the Project, may have significant concerns about the Project or may request additional engagement). These parties were identified in the Project Contact List which includes relevant Federal and Provincial government agencies, local government officials, and special interest groups (Appendix C). Those who expressed interest in the Master Plan throughout the planning process were also included on the project mailing list.

The Project Contact List served as the primary tool to track comments, questions and issues from emails, phone calls and letters and also demonstrated how the comments, questions and issues were considered in the EA process.

10.1.2.2 Notice of Study Commencement

Agencies, which may have interest in the proposed project, received a Notice of Study Commencement. These agencies were asked to comment on the following: their required level of involvement in this Master Plan, how this Master Plan might affect their mandated areas of responsibility, and how their concerns or comments could be addressed. Notice of Study Commencement

The Notice of Study Commencement (NOCm) was placed on the Town's website on July 24, 2017. This Notice advised the Study commencement, outlined a brief introduction to the study and its purpose and invited further comments or concerns relating to the project. Contact information for the Project Managers was provided so the public could request additional information if desired. The NOCm sent to agencies are provided in Appendix D.

10.1.2.3 Public Information Centre

A Public Information Centre (PIC) was held on November 1, 2017. The Notice of Public Information Centre (PIC) was placed in the Orangeville Banner and the Orangeville Citizen on October 19 and 26, 2017, and in the Wellington Advertiser on October 20 and 27, 2017. The Notice was also mailed to regulatory agencies, Aboriginal communities, and other interested parties on the Project Contact List, as well as posted on the Town's website on October 20 and 27, 2017. Copies of the newspaper advertisements are provided in Appendix D. The Notice provided a brief introduction to the study and encouraged interested individuals to attend the PIC or contact the Project Team directly for more information.

The PIC was held in the Grand River Room (Upper Hall) at the Grand Valley District Community Centre, at 90 Main Street North, Grand Valley, from 6:00 p.m. to 8:00 p.m. on November 1, 2017.

Attendees were greeted upon arrival, encouraged to sign-in, and offered a comment form to provide comments on the project and alternative solutions. A copy of the sign-in sheet from the PIC has been included in Appendix E.

Display boards describing the Master Plan EA process, the project and alternatives being considered were placed around the room to facilitate discussion. The PIC was arranged as an open house style session where participants were given the opportunity to review the display boards and representatives from the Project Team consisting of the Town of Grand Valley and consultant staff (Burnside) were available to answer questions, discuss the project, and offer detailed explanation to the interested members of the public on a one-on-one basis or in small groups. A copy of the display boards is provided in Appendix E.

It should be noted that since the PIC in November 2017, costs have been updated to include inflation and increasing costs of materials (steel etc.).

10.1.2.4 Notice of Completion

At the completion of the Master Plan Class EA, the report is filed and placed on public record for 30 days following a Notice of Study Completion. Concerns regarding a project should be brought to the attention of the Town within the 30-day review period after the Notice of Completion has been issued. If the concern is not resolved through discussion with the Town, a person/party may submit a written request to the Minister of Environment, Conservation and Parks to make an order for the project to comply with Part II of the Environmental Assessment (referred to as a "Part II Order"), which addresses individual environmental assessments. Submissions must be received within the 30-day review period with a copy forwarded to the proponent.

Requests for Part II Orders should address the following issues:

- Environmental impacts of the project and their significance;
- The adequacy of the planning process;
- The availability of other alternatives to the project;
- The adequacy of the public consultation program and the opportunities for public participation;

- The involvement of the person/party in the planning of the project;
- The nature of the specific concerns which remain unresolved;
- Details of any discussions held between the person/party and the proponent;
- The benefits of requiring the proponent to undertake an individual environmental assessment; and
- Any other important matters considered relevant.

In considering a request for Part II Orders, the Minister shall consider the following issues:

- Extent and nature of public concern;
- Potential for significant adverse environmental effects;
- Need for broader consideration of alternatives by the proponent;
- Considerations of urgency;
- Participation of the requester in the planning process;
- Nature of the request; and
- The degree to which public consultation and dispute resolution have taken place.

10.1.2.5 Summary of Public Comments/Issues and Resolutions

Table 15 summarizes the comments that have been received from agencies/stakeholders and private residents. Copy of correspondence is included in Appendix F.

Table 15: Summary of Comments from Agencies/Stakeholders

Date (y/m/d)	Agency/ Stakeholder	Summary of Comments	Response Provided/Action Taken
Agencies			
17/09/21	Grand River Conservation Authority (GRCA)	Noted natural heritage and natural hazard features in the Study Area. Requested to be kept apprised of the study.	GRCA circulated on all notices.
17/09/25	Ministry of Environment, Conservation and Parks (MECP)	Provided a list of Aboriginal communities who have been identified as potentially affected by the proposed project.	All communities on the MECP's list have been contacted regarding the Master Plan.
17/10/30	Ministry of Agriculture, Food	Indicated that future development related to this project not be located	Response letter provided on May 11, 2018. None of the

Date (y/m/d)	Agency/ Stakeholder	Summary of Comments	Response Provided/Action Taken
	and Rural Affairs (OMAFRA)	on prime agricultural lands as identified in the Town of Grand Valley Official Plan.	preferred sites are located on prime agricultural lands. Future development associated with the Town's growth will be approved through separate approval processes.
17/09/14	Ministry of Tourism, Culture and Sport (MTCS)	Advised that archaeological resources, built heritage and cultural heritage landscapes should be considered in the Master Plan.	A Stage 1 Archaeological Assessment was completed and submitted to MTCS.
Stakeholders			
17/08/03	Thomasfield Homes Limited	Suggested that the Master Plan should include a water supply and wastewater system that encompasses the full planning horizon contemplated by the Growth Plan up to 2041.	A response was provided prior to the submission of this report.
17/11/15	Thomasfield Homes Limited	Requested that the population projection be extended from 2031 to 2036 or 2041 to allow for additional capacity to be secured without an Environment Assessment.	A response was provided prior to the submission of this report.
Aboriginal Communities			
17/10/05	Historic Saugeen Metis (HSC)	Advised that the study area is beyond the geographical area of HSC traditional territory.	None Required.

Date (y/m/d)	Agency/ Stakeholder	Summary of Comments	Response Provided/Action Taken
17/08/15	Saugeen Ojibway Nation (SON)	Requested a meeting to discuss the project and how the SON would like to be consulted.	A response email, including an invitation to the PIC and/or a separate meeting, was sent on October 26, 2017. SON was contacted via email on May 16, 2018 to confirm whether a meeting was required.
17/11/29	Rama First Nation	Notice has been forwarded to Karry Sandy McKenzie, Williams Treaties First Nation Process Coordinator/Negotiator. Ms. Williams will take any necessary actions if required.	No further action required.

10.2 The Project File Report

In accordance with the Master Plan Class EA process, this Project File Report identifies the following:

- The existing technical, natural, social and economic environment;
- Alternative solutions to the proposed project;
- Potential impacts of the alternative solutions on the existing environment and appropriate mitigation measures;
- An evaluation of the alternatives;
- The consultation process undertaken throughout the project; and
- The selection of the preferred alternative.

11.0 Water Supply and Storage Alternatives

Water supply alternatives are discussed in Section 11.1 and water storage alternatives are discussed in Section 11.2. These alternative solutions have been proposed to address the problem/opportunity statement identified in Section 2.0.

11.1 Water Supply Alternatives

11.1.1 Alternative 1 - Do Nothing

This is a mandatory alternative for consideration under the Master Plan Class EA process and serves as a reference point for comparing other alternative solutions. The “Do Nothing” alternative means no action is taken in addressing the problem/opportunity statement. This would result in no additional water supply sources being introduced into the existing Grand Valley water supply configuration. Therefore, this alternative does not address the problem/opportunity statement as it also does not accommodate planned growth or conform to local planning provisions. A restriction to the natural growth of a community will result in several negative socio-economic impacts.

11.1.2 Alternative 2 - New Groundwater Source

The current maximum and firm capacity of the existing well field are 2,944 m^3/d and 1,963 m^3/d respectively which accounts for two wells running concurrently. As stated previously, both the maximum and firm capacities of the existing wells will not meet the future demands of the system.

To ensure that adequate water capacity is supplied to the Town, new groundwater sources are one alternative to consider in addition to the three existing wells (two located at Cooper Street PW1 and PW2, and one at Melody Lane PW3). There are many factors that influence the siting of a new well. According to Ontario Regulation 903 (Wells Regulation), a new water supply must comply with minimum separation distances from potential sources of contamination, must be accessible at all times, and must be at a higher elevation than the surrounding area. The site must also show a high yield and must not be located within the zone of influence of nearby wells. Previous testing of PW2 resulted in widespread well interference. On-going water level monitoring indicates that many of the monitoring wells are affected by the pumping at Cooper Street. As a result, it was considered important to locate potential well sites outside the area of influence of the existing municipal wells.

Based on these requirements, three locations were selected. There is the potential that two of the proposed well locations will be required to meet future demands.

All the municipal wells in Grand Valley are completed in the bedrock and a review of well records in the area indicates that domestic wells are also completed in the bedrock. The overburden in the area is typically about 30 m (100 ft) thick. The depth to water bearing zones in the bedrock are quite variable, but it is best practice to advance a test well through the limestone bedrock to the underlying shale. As a result, this alternative was evaluated with a 15 cm (6 inch) test well drilled and a short-term test completed to provide a preliminary estimate of the yield.

Figure 8 illustrates the alternative site locations.

Alternative 2A Location: Park Site - Intersection of Sideroad 28 & 29 and Concession Road 2 & 3

This well site is located at the intersection of Sideroad 28 & 29 and Concession Road 2 & 3. The site is located a substantial distance away from the existing wells and is within proximity of the Thomasfield subdivisions located at the west end of Amaranth Street. An existing monitoring well (EL-MW-2) is located at the northwest corner on this site and is monitored as part of the Town's monitoring program. The well shows no response to pumping of the municipal wells.

Alternative 2B Location: Existing Water Tower - 173363 County Road No. 25

The second proposed well site is located adjacent to the existing water tower near the intersection of Fife Road and Main Street North (County Road 25). This location provides an ideal connection into the existing distribution system as it is located within proximity to the existing water tower.

Alternative 2C Location: Fire Hall – 173145 County Road No. 25

The third proposed well site is located on the fire hall property. This proposed location has the closest proximity to the existing Melody Lane Water Plant; however, it is not located within the zone of influence of the Melody Lane well. This location also has an on-site septic system servicing the Fire Hall. If this site is selected for the new groundwater well and pumphouse, a municipal sanitary collection will need to be considered along with the decommissioning of the existing on-site septic system to minimize the potential for contamination.

11.1.3 Alternative 3 - New Surface Water Source

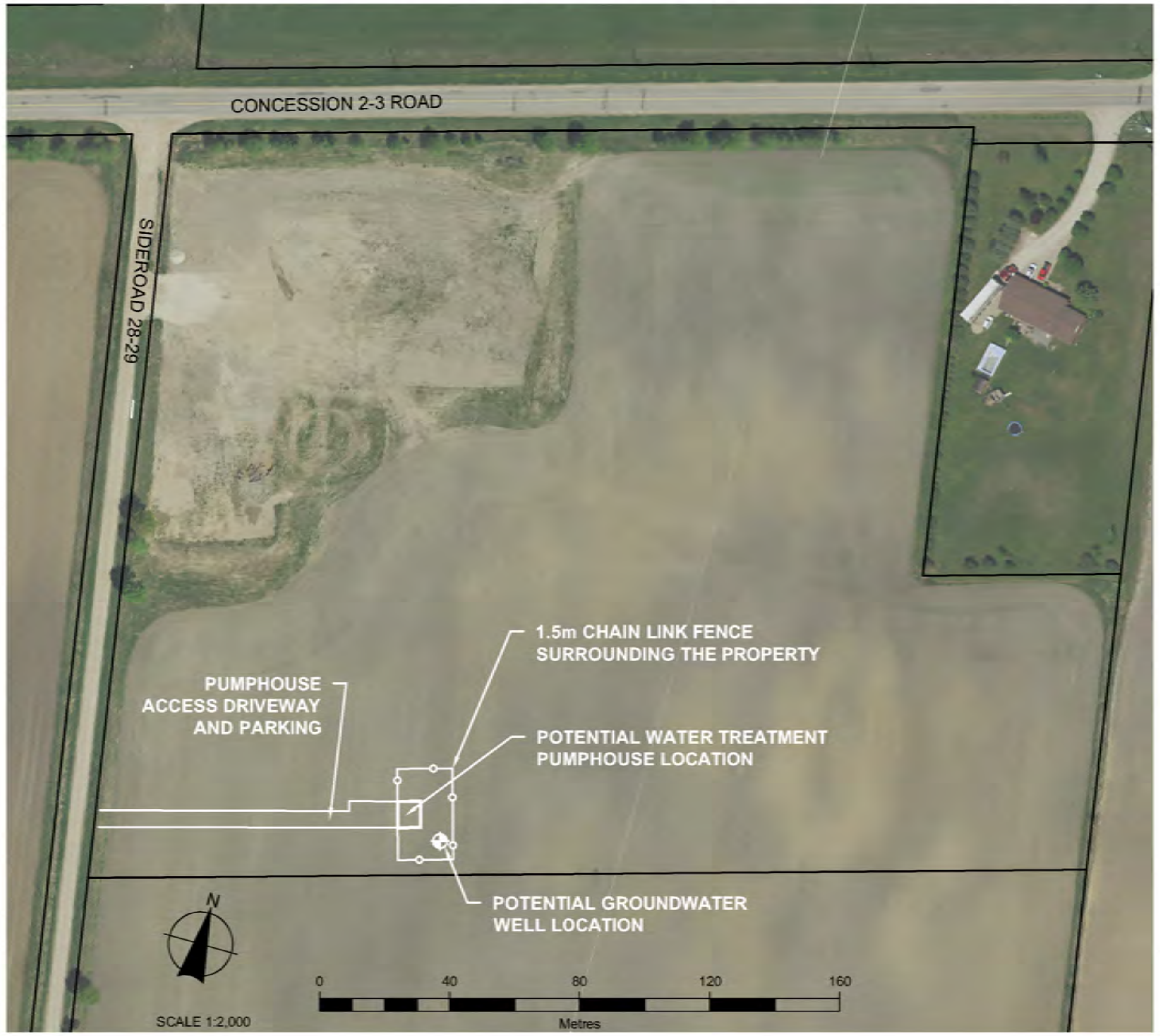
The Town of Grand Valley is within proximity to the Grand River. The Grand River is used by many communities as a surface water source for drinking water. This alternative would involve the installation of a new surface water treatment plant as well as a surface water intake to draw water from the Grand River which can be very costly to construct.

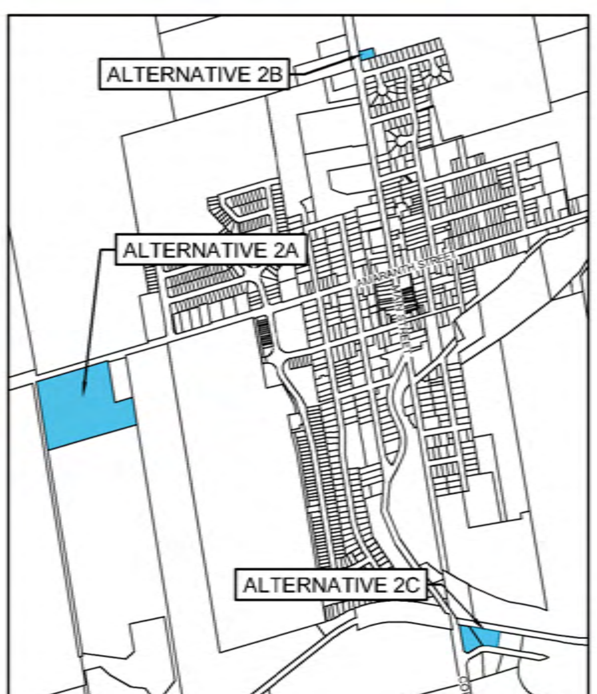
In addition to the new plant and intake, it is anticipated that seasonal water quality fluctuations will occur impacting the treatment process.

11.1.4 Alternative 4 – Use of Surplus from an Existing Municipal System

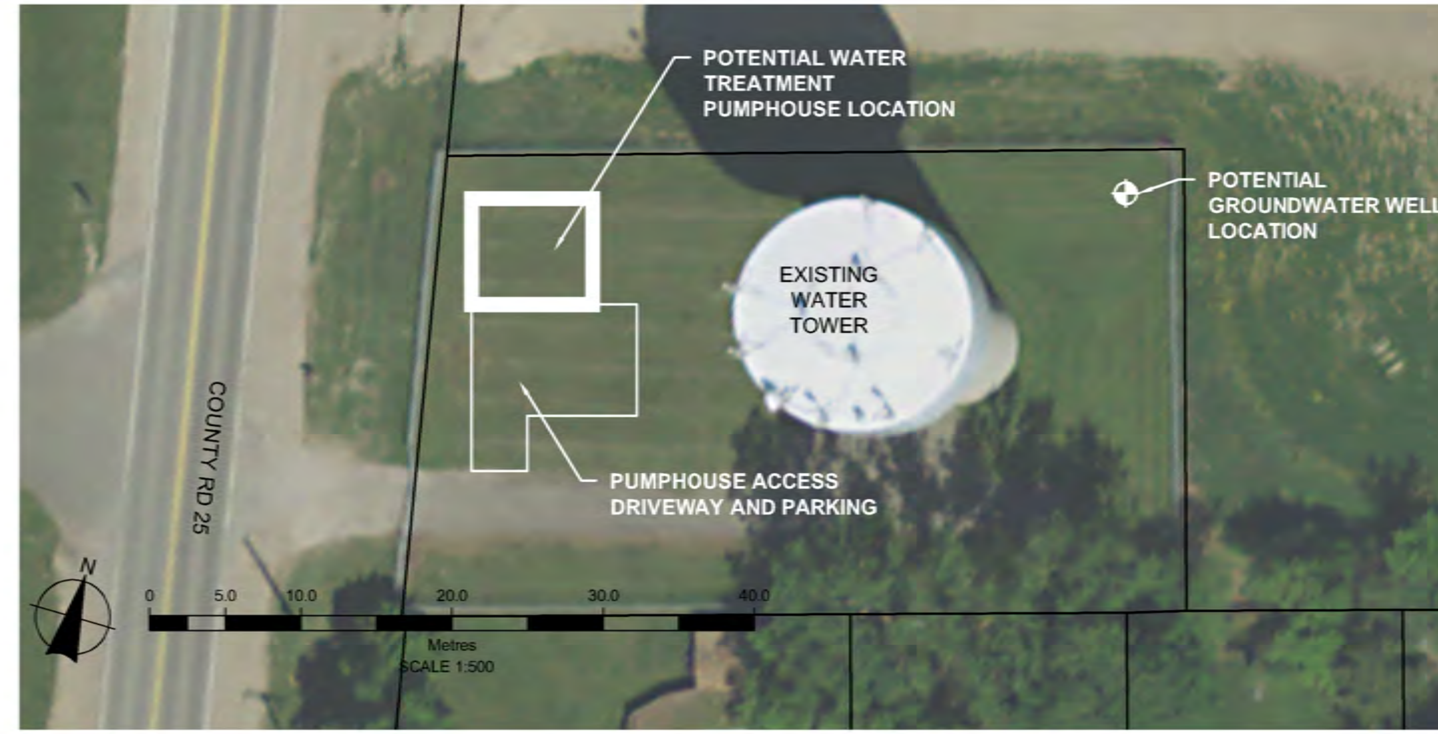
This alternative consists of connecting the Town's water distribution system to a nearby municipal water supply system. Due to Grand Valley's rural location, there is only one potential water supply system within the vicinity that the Town could utilize as a water source. The nearby community of Waldemar has a small municipal system; however, a connection to this system is not feasible as its capacity currently does not meet the servicing requirements specified in Waldemar's Official Plan.

WATER SUPPLY ALTERNATIVE 2A LOCATION - PARK SITE

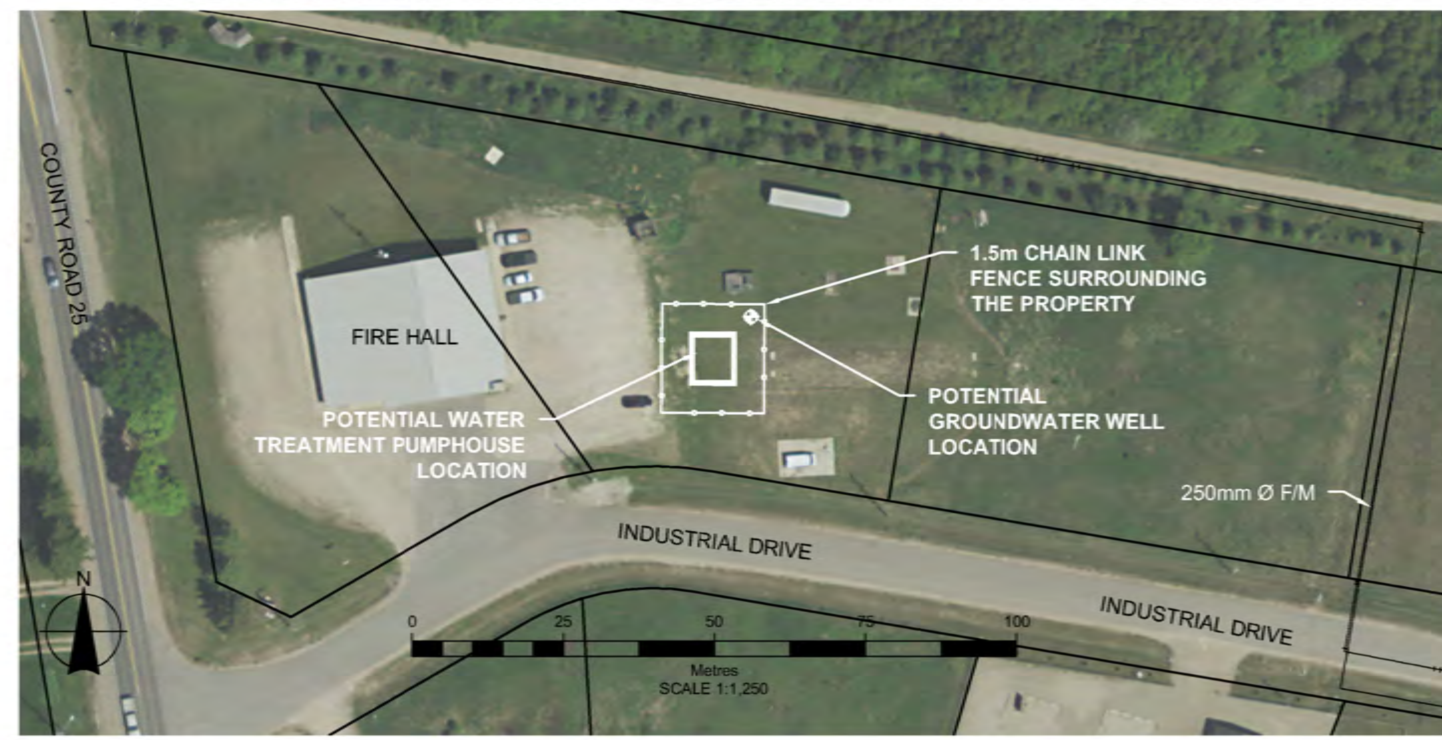




WATER SUPPLY ALTERNATIVE 2B LOCATION - EXISTING WATER TOWER SITE



WATER SUPPLY ALTERNATIVE 2C LOCATION - FIRE HALL SITE



BURNSIDE	Figure Title **GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT** WATER SUPPLY GROUNDWATER SOURCES SITES 2A, 2B & 2C
Client **TOWN OF GRAND VALLEY**	Drawn: CD · Checked: JP · Date: February 2019 · Figure No. **8** Scale: AS NOTED · Project No. 300040938.0000

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11.2 Water Storage Alternatives

As identified in Section 7.2, the available municipal water storage is not adequate to satisfy MECP Guidelines for storage volumes based on existing and future demands. The existing system has available storage of 1,600 m^3 and would require an additional storage of 1,851 m^3 to meet future storage requirements.

During fire events the balance of the distribution system is required to be maintained at a pressure more than 138 kPa (20 psi) while maintaining the maximum day demand. Alternatives will be reviewed with available fire flows compared.

11.2.1 Alternative 1 – Do Nothing

This is a mandatory alternative for consideration under the Master Plan Class EA process and serves as a reference point for comparing other alternative solutions. The "Do Nothing" alternative means no action is taken in addressing the problem statement and this would result in not providing any additional water storage in Grand Valley. Therefore, this alternative does not address the problem/opportunity statement as it does not conform to local planning provisions and will not provide sufficient water storage for future growth. A restriction to the natural growth of a community will result in several negative socio-economic impacts.

11.2.2 Alternative 2 – Elevated Water Storage

Elevated water storage facilities store water at a sufficient elevation to create the necessary pressure and flow by gravity to meet peak hour and fire flow demands. The shaft of the tower provides the height to maintain the appropriate pressures. Water is not stored in the shaft of the tower.

The Town of Grand Valley already has an elevated water storage tank in the form of a water tower. If an additional elevated water storage tank was introduced there would be minimal disturbance to the distribution system's hydraulic profile provided the tank operates at the same elevation. If the storage tank were to be operated at a different elevation, the existing pressure zones within the Town may be affected, increasing the complexity of the hydraulic profile and reducing operational efficiency.

Alternative 2A Location – Within Water Pollution Control Plant Buffer

The first proposed elevated water storage site is located within the buffer of the WPCP. Since the area surrounding the WPCP cannot be utilized for other types of development, utilizing it for water storage is ideal. It also places the water tower within proximity to the intended employment lands, such as the Moco, Zietsma, and Collini developments, where fire flow requirements will be higher. The elevation of this site is lower than the other two locations, however the differential is not substantial enough to limit placement viability.

Alternative 2B Location – Behind Melody Lane Pumphouse

The second proposed site is located behind the Melody Lane water treatment pumphouse. This area has a relatively high elevation and provides proximity to areas requiring high flow, as well as accessibility to the existing site.

Alternative 2C Location – Amaranth – East Luther Townline

The third proposed elevated water storage location is located on Amaranth-East Luther Townline at the border of Luther Township. This location is a significant distance from the intended development; however, it does provide the potential for Amaranth Township/Waldemar to connect into the distribution system in the future if desired.

11.2.3 Alternative 3 – Grade Level Reservoir

A grade level facility can be constructed from concrete, welded steel, or bolted steel and requires a high lift pumping station for distribution. An example of a grade level facility is a standpipe or an in-ground reservoir. A standpipe is normally situated on grade where a reservoir is either installed underground and covered with earth, or partially buried and mounded with earth.

Grade level facilities would be sized to provide peak hour demands and under emergency conditions, maximum day plus fire demand. The standpipe or reservoir would be filled directly from the well pumps as needed and controlled by the level in the storage facility.

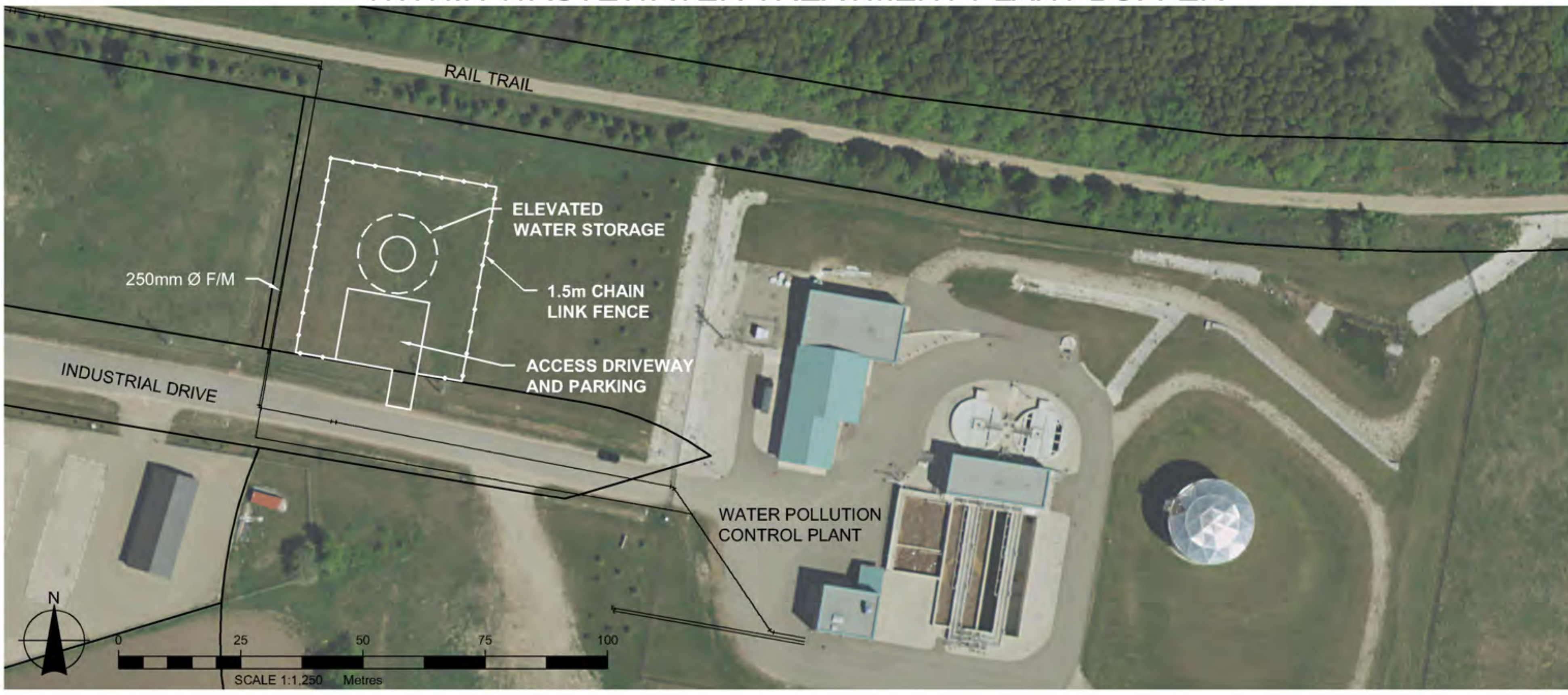
There are situations where a standpipe can be situated at a high enough elevation to maintain appropriate pressures without being pumped. Any additional height required to maintain appropriate pressures is provided by increasing the height of the standpipe. However, if the standpipe height is increased, a portion of the total water volume is considered dead storage as it does not contribute to the total useable storage volume. There is also potential for low water turnover resulting in low chlorine residuals and potential taste and odour problems due to stagnation. A re-chlorination facility is sometimes required.

Also, the hydraulics of the water supply and distribution system may be impacted if a standpipe is introduced in addition to the existing water tower. Storage at different elevations may increase the complexity of the hydraulic profile reducing operational efficiency. This may ultimately lead to addition upgrades or alterations to the system in addition to the storage facility.

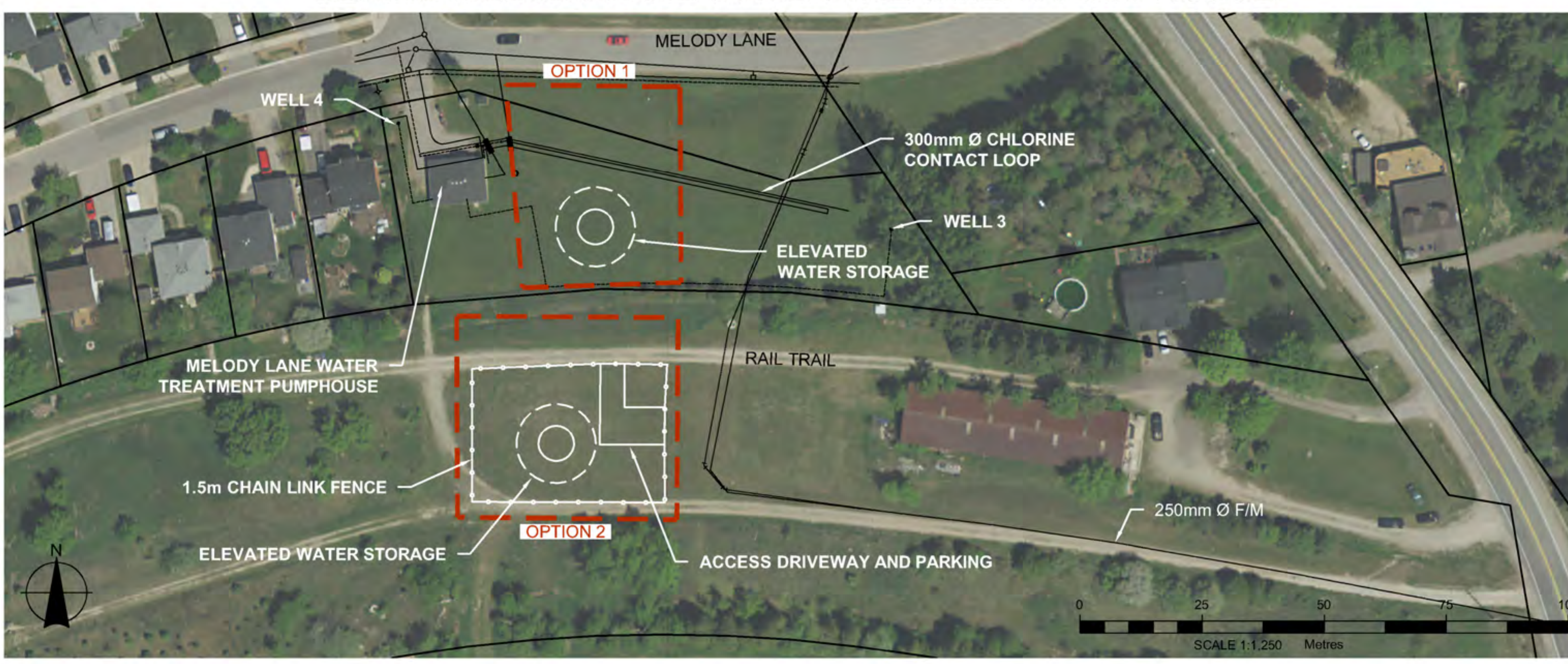
Alternative 3 Location – Park Site

The potential placement location for a grade level reservoir is located at the Park Site adjacent to the proposed well pumphouse near the edge of the property. By placing ground level storage at this location, the new groundwater source (if selected as a viable location) could pump into the standpipe prior to distribution.

ELEVATED WATER STORAGE - ALTERNATIVE 2A LOCATION WITHIN WASTEWATER TREATMENT PLANT BUFFER



ELEVATED WATER STORAGE - ALTERNATIVE 2B LOCATIONS BEHIND MELODY LANE WATER TREATMENT PUMPHOUSE



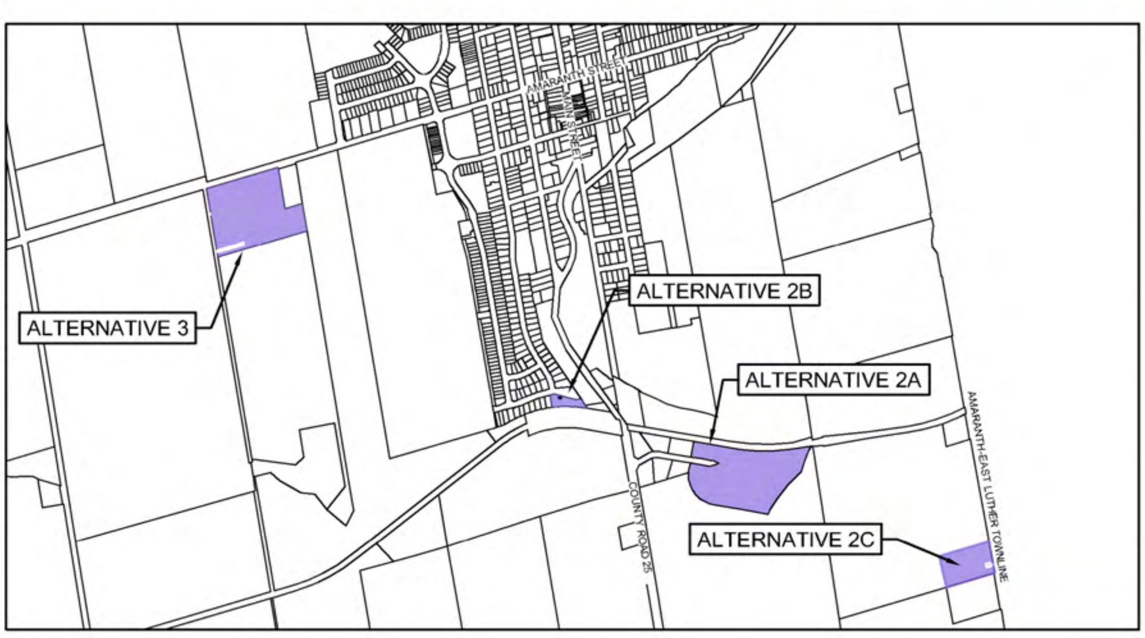


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Figure Title

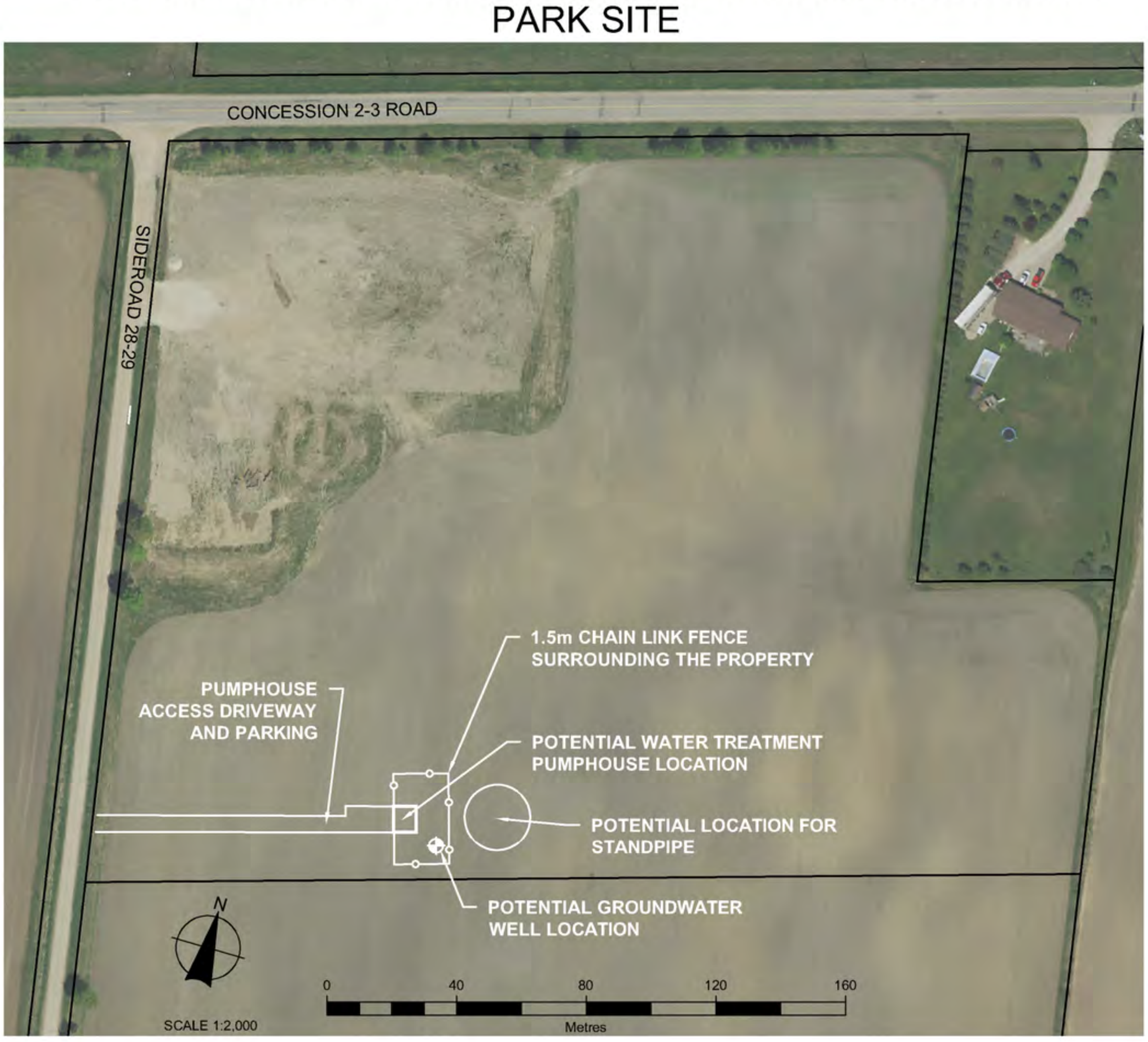
GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT

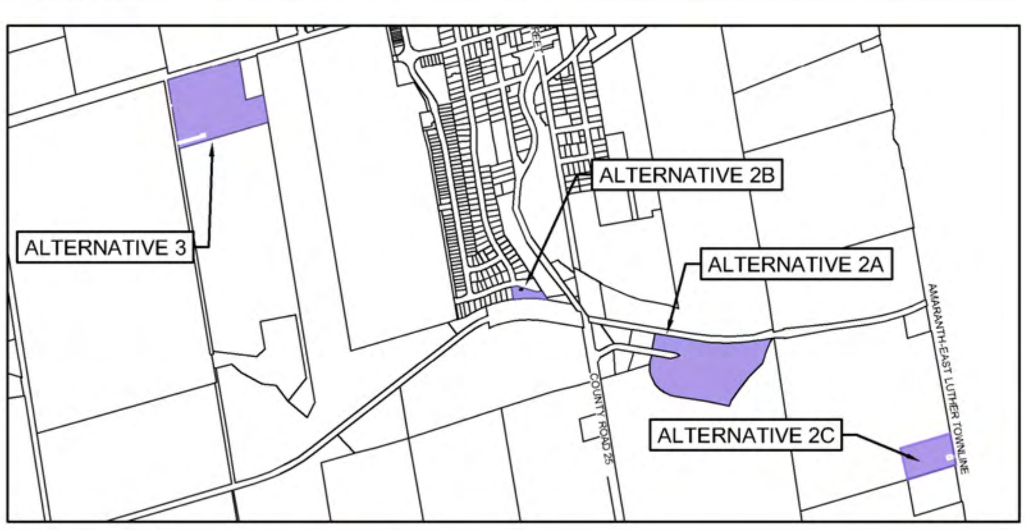
ELEVATED WATER STORAGE ALTERNATIVE 2A & 2B

Client	Drawn	Checked	Date	Figure No.
TOWN OF GRAND VALLEY	CD	JP	February 2019	9
	Scale: AS NOTED		Project No.: 300040938.0000	

ELEVATED WATER STORAGE - ALTERNATIVE 2C LOCATION
AMARANTH - GRAND VALLEY TOWNLINE

ELEVATED WATER STORAGE - ALTERNATIVE 3 LOCATION
PARK SITE





BURNSIDE	Figure Title: **GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT** ELEVATED WATER STORAGE ALTERNATIVE 2C & 3			
Client: **TOWN OF GRAND VALLEY**	Drawn: CD	Checked: JP	Date: February 2019	Figure No.: **10**
	Scale: AS NOTED		Project No.: 300040938.0000	

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11.3 Wastewater Treatment Alternatives

11.3.1 Alternative 1 – Do Nothing

This is a mandatory alternative for consideration under the Master Plan Class EA process and serves as a reference point for comparing other alternative solutions. The "Do Nothing" alternative means no action is taken in addressing the problem statement and this would result in not providing any additional water treatment capacity in Grand Valley. Therefore, this alternative does not address the problem/opportunity statement as it also does not accommodate planned growth or conform to local planning provisions. A restriction to the natural growth of a community will result in several negative socio-economic impacts.

11.3.2 Alternative 2 – Rerate the Existing WPCP

This alternative includes providing additional wastewater treatment capacity in Grand Valley by rerating the existing WPCP. By rerating the plant there is the potential that additional capacity can be acquired through unit process upgrades rather than expanding the entire plant. However, there is a potential that the future wastewater capacity demand will not be met entirely by a Plant rerating.

XCG Environmental Engineers and Scientists (XCG) was retained by the Town to complete a Re-Rating Feasibility Study of the WPCP in 2016. Based on the capacity assessment completed at the WPCP and the projection of future wastewater flows, the capacity of the overall facility is limited by the peak flow treatment capacity. XCG recommended the installation of additional equalization storage to assist in the reduction of peak flows prior to a Plant rerating. Based on two modelling scenarios, the additional equalization volume required to reduce peak flows ranged between 1,500 m^3 and 2,100 m^3.

A copy of the *Grand Valley WPCP Re-Rating Feasibility Study: Summary of Capacity Assessment and Re-Rating Potential* Report completed by XCG in January 2017 is included in Appendix G for reference.

Two locations for the additional equalization storage tank have been outlined below:

Alternative 2A Location - Emma Street Sewage Pumping Station

There appears to be sufficient space available at the existing Emma St. SPS site to construct additional equalization storage in the form of a tank. By placing the tank at this location, peak wastewater flows can be reduced prior to being conveyed to the WPCP. The excess flow would be diverted from the pumping station into the storage tank and release during times of low flow, as to not overwhelm the system.

Additionally, by placing the equalization tank at this location, the projected peak wastewater flows that require conveyance through the SPS to the WPCP would be reduced. The equalization tank would reduce the peak flows below the existing rated capacity of the raw influent pumps, minimizing the potential need for pump and forcemain upgrades.

Figure 11 illustrates the placement of the equalization tank within the Emma Street SPS property; however, the proposed placement will need to be confirmed during the detailed design phase should this alternative be selected and implemented.

Alternative 2B Location - Existing Water Pollution Control Plant

The additional equalization storage can also be placed at the WPCP. By placing the tank at this location, wastewater would be diverted either before or after the headworks. The excess wastewater would then be released during times of normal operation as to not overwhelm the system. The exact placement location of the tank would have to be confirmed during the detailed design phase of the project.

Placing the tank at this location will likely require additional work outside of tank construction and interconnection with the existing WPCP. The projected peak flows for the collection system currently exceed the rated pumping capacity at the Emma St. SPS. By installing the equalization tank at the WPCP, the peak flows from the SPS will not be reduced. A detailed evaluation of the pumping capacity and forcemain hydraulics would need to accompany the tank design and installation.

Figure 11 illustrates the placement of the equalization tank within the WPCP property; however, the proposed placement will need to be confirmed during the detailed design phase should this alternative be selected and implemented.

11.3.3 Alternative 3 – Expansion of Existing WPCP

This alternative would involve upgrading and expanding the existing WPCP to accommodate flows from existing and future development in the Town of Grand Valley up to the Official Plan population. The existing facility would need to be upgraded to an average day capacity of 2,131 m^3/d.

In addition to the expansion of the existing WPCP, the effluent requirements will need to be reviewed to ensure the receiving water requirements are maintained. The effluent criteria currently required for disposal into the Grand River will need to be maintained or improved depending on the Plant expansion design.

11.3.4 Alternative 4 - Connection to an Existing Municipal System

This alternative consists of connecting the Town's wastewater collection system to a nearby municipal treatment plant. Due to Grand Valley's rural location, the closest wastewater treatment plant is located approximately 21 km east in the Town of Orangeville. Therefore, this wastewater treatment alternative is not feasible for Grand Valley as it would be very costly to connect the two systems.

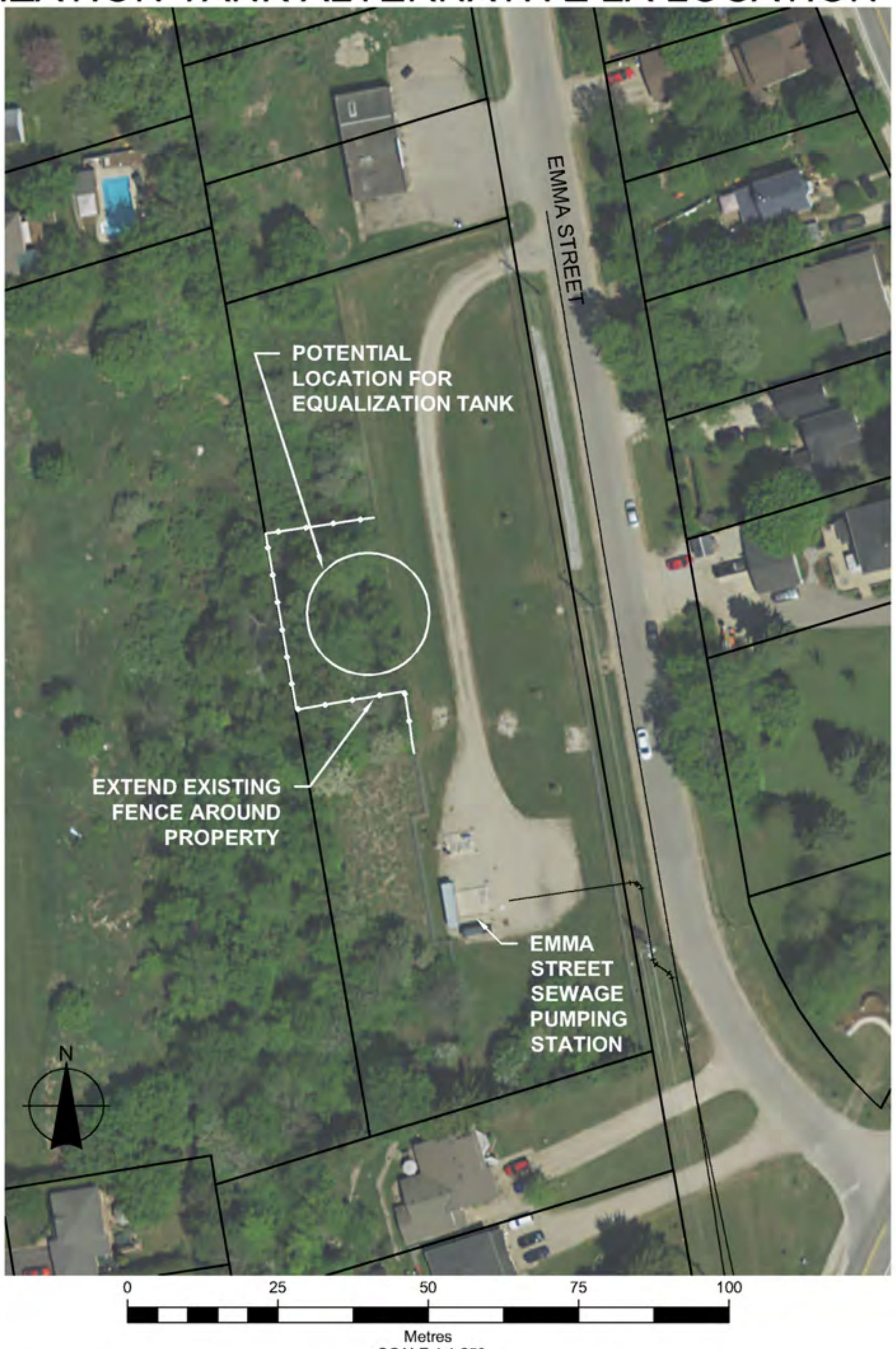
11.4 Wastewater Collection Requirements

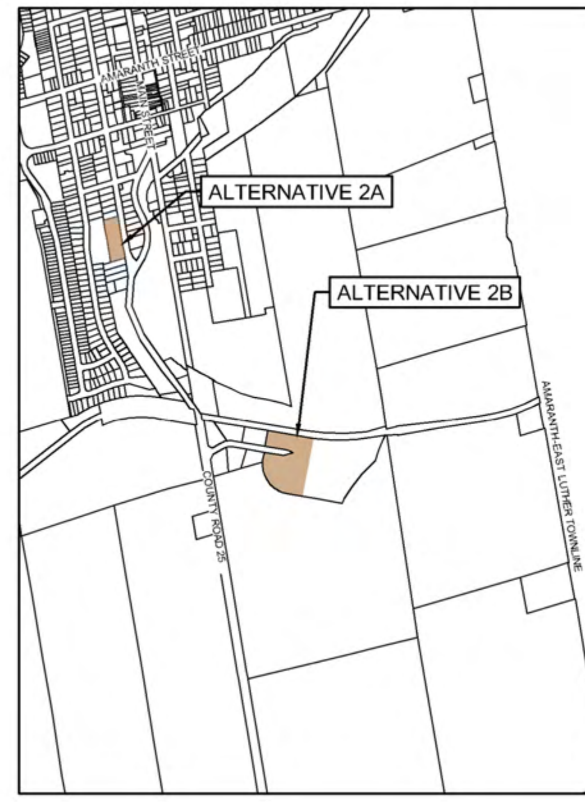
In 2014, Burnside reviewed the ability of the Grand Valley wastewater collection system to accommodate expected flows from the new boundaries of the Official Plan. An upgrade was found to be required for the Emma Street sewage pumping station and two new pumping stations were deemed necessary for growth areas in the north east and south east quadrants of the Town. Flow assumptions from that time have been refined in this current Master Plan EA, but reviews have concluded that all of the previous conclusions remain valid.

The pumping station located in the south east quadrant was shown on lands owned by Moco Developments. A development application is currently being processed for those lands under the Planning Act. The location of the sewage pumping station has been modified under that process to the buffer of the WPCP.

It is expected that details of the Emma Street pumping station upgrades as well as the North East Quadrant pumping station will also be refined in conjunction with applications under the Planning Act.

EQUALIZATION TANK ALTERNATIVE 2A LOCATION - EMMA STREET SPS





EQUALIZATION TANK ALTERNATIVE 2B LOCATION - WATER POLLUTION CONTROL PLANT

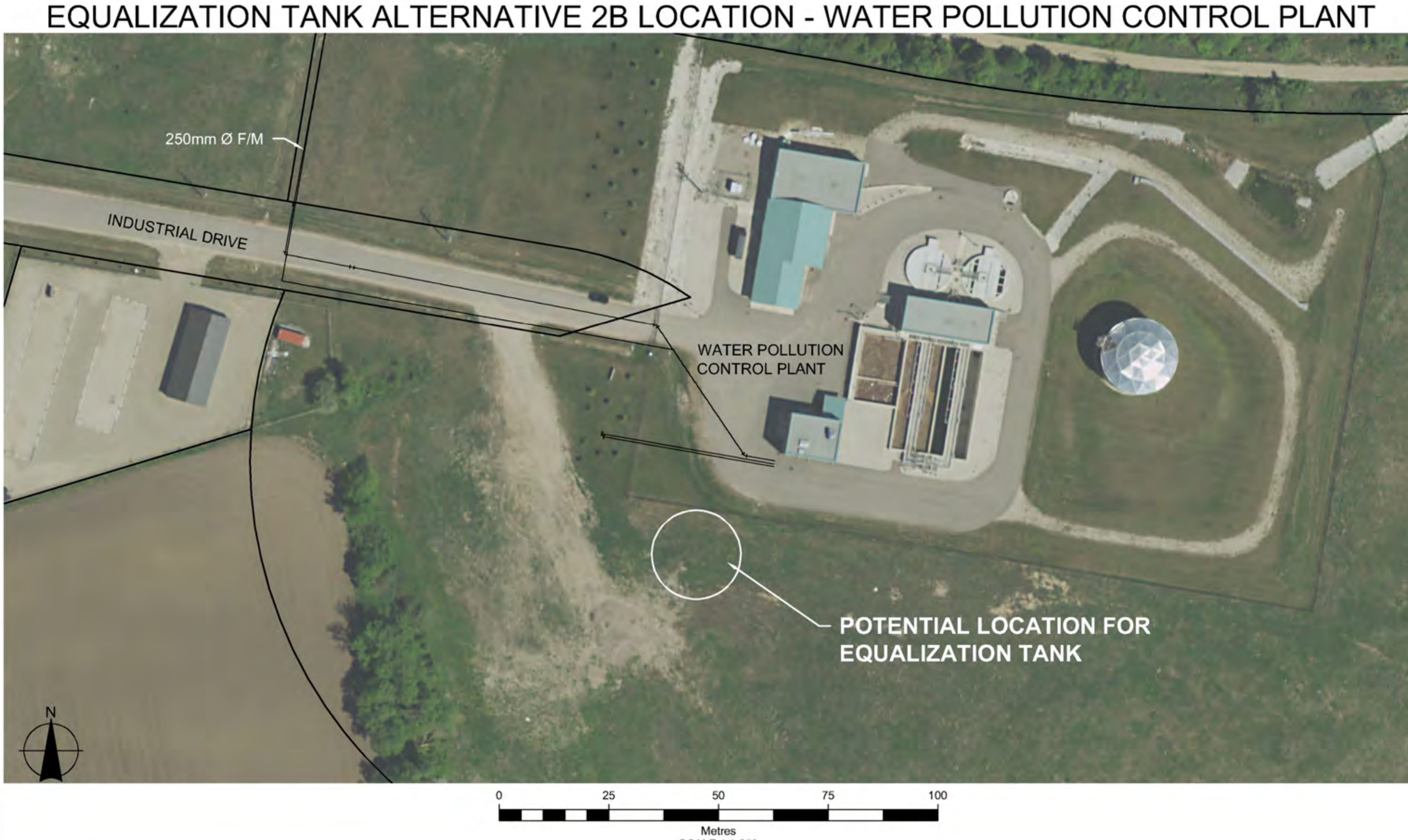


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Figure Title

GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT

EQUALIZATION TANK LOCATIONS

Client	Drawn	Checked	Date	Figure No.
TOWN OF GRAND VALLEY	CD	JP	February 2019	11
	Scale: AS NOTED		Project No.: 300040938.0000	

12.0 Description of the Existing Natural Environment

The following sections discuss the natural environment within the study area and more specifically within the site areas identified for various alternatives. The natural environmental features are shown on Figure 12.

12.1 Terrestrial Environment

A desktop review of the terrestrial environment for the possible sites was completed prior to Burnside staff conducting a field reconnaissance on October 18, 2017 from approximately 2:00 p.m. to 4:00 p.m. A detailed Ecological Land Classification (ELC), as per the methodology described in the Ecological Land Classification for Southern Ontario (Lee et al., 1998), was not considered to be applicable for the sites as they were predominantly cultivated agricultural lands and other culturally modified environments and therefore not considered to be natural. A description of the terrestrial conditions of the potential water supply and wastewater treatment sites are provided below.

12.1.1 Water Supply

Alternative 2A Location: Park Site - Intersection of Sideroad 28 & 29 and Concession Road 2 & 3

The area being considered for the construction of a well in the northwest corner of the property has been subject to significant disturbances. Dumping of yard waste and gravel appear to be the primary disturbances impacting the area.

The existing vegetation is comprised of early succession species including Canada Goldenrod (*Solidago canadensis*), Greater Burdock (*Arctium lappa*), Wild Carrot (*Daucus carota*) and various cool season grasses.

A White Spruce (*Picea glauca*) hedgerow occurs offsite along the northern property boundary. A small grouping of three Sugar Maples (*Acer saccharum*) occurs along Sideroad 28 and 29.

Alternative 2B Location: Existing Water Tower - 173363 County Road No. 25

The Existing Water Tower is located in a small fenced in lot where vegetation is comprised of manicured turf grass. Active agriculture dominates lands to the east and north while a roadway is present west of the site. South of the water tower on adjacent residential lands, several mature Carolina Poplars (*Populus canadensis*) and a single Norway Maple (*Acer platanoides*) are present.

Alternative 2C Location: Fire Hall – 173145 County Road No. 25

The Fire Hall lot contains a large gravel pad and paved driveway. A small structure has been erected for training purposes in the north-east corner of the lot. Manicured turf grass dominates the remainder of the property.

Adjacent off-site vegetation occurs north and west of the fire hall. North of the Fire Hall, a White Spruce and a White Pine (*Pinus strobus*) hedgerow are present while Sugar Maple, White Elm (*Ulmus americana*), White Spruce and Horse-chestnut (*Aesculus hippocastanum*) are present west of the site parallel to Water Street.

12.1.2 Water Storage

Alternative 2A Location - Within the Wastewater Treatment Plant Buffer

West of the Water Pollution Control Plant, an old field meadow occurs dominated by Canada Goldenrod, cool season grasses, and Aster species. A White Spruce hedgerow occurs offsite along the northern lot boundary. This site has been previously disturbed and is not anticipated to contain any significant or rare vegetation.

Alternative 2B Location - Behind the Melody Land Pumphouse

A variety of species were observed within the lots behind the Melody Lane Pumphouse including Scotts Pine (*Pinus sylvestris*), Trembling Aspen (*Populus tremuloides*), Common Apple (*Malus sylvestris*), and White Spruce. The co-dominant species in these lots are Manitoba Maple and Eastern White Cedar (*Thuja occidentalis*). Trees in this area are open grown or planted as hedgerows, although majority of the sites area is dominated by manicured turf grass and cool season grasses. Both sites are heavily disturbed and subject to regular maintenance. Neither site is anticipated to contain any significant or rare vegetation.

Alternative 2C Location - Amaranth East Luther Townline

This property is heavily disturbed and actively used as agricultural land. Treed hedgerows that surround the lot and are dominated by White Spruce and Maple species. The site is not anticipated to contain any significant or rare vegetation.

Alternative 3 Location - Park Site

The area being considered for the construction of a grade level water reservoir in the form of a standpipe near the south edge of the property. Dumping of yard waste and gravel in the northwest corner appear to be the primary disturbances impacting the area.

The existing vegetation is comprised of early succession species including Canada Goldenrod (*Solidago canadensis*), Greater Burdock (*Arctium lappa*), Wild Carrot (*Daucus carota*) and various cool season grasses.

A White Spruce (*Picea glauca*) hedgerow occurs off-site along the northern property boundary. A small grouping of three Sugar Maples (*Acer saccharum*) occurs along Sideroad 28 and 29.

12.1.3 Wastewater Treatment

Alternative 2A Location - Emma Street Sewage Pumping Station

The Emma Street Sewage Pumping Station is heavily disturbed and regularly maintained. There is a small cluster of mature White Spruce along the southern property boundary. In addition, five Colorado Blue Spruce (*Picea pungens 'glauca'*) have been planted on-site parallel to Emma Street while the remainder of the site's vegetation is comprised of manicured turf. A primarily deciduous woodlot, located offsite, immediately west of the site contains Common Apple, Silver Maple, Green Ash (*Fraxinus pennsylvanica*), and Hawthorn species. The site is not anticipated to contain any significant or rare vegetation.

Alternative 2B Location - Existing Water Pollution Control Plant

The existing WPCP is heavily developed with paved and gravel surfaces covering large areas of the property. An isolated area of standing water occurs in a constructed feature in the northeast corner of the property which has allowed for the growth of Narrow-leaf Cattail (*Typha angustifolia*) and Common Reed (*Phragmites australis*). The remainder of the property's vegetation is comprised of manicured turfgrass.

North of the property, a hedgerow has been planted containing Eastern White Cedar, Green Ash, and Norway Maple. West of the property, Colorado Blue Spruce, White Spruce, and Juniper species have been planted while remaining surrounding land is characterized as old field meadow dominated by Goldenrod and cool season grasses.

12.1.4 Wildlife and Wildlife Habitat

No wildlife was observed during Burnside's field investigation, however urban tolerant wildlife such as Eastern Grey Squirrel (*Sciurus carolinensis*), Eastern Chipmunk (*Tamias minimus*), Raccoon (*Procyon lotor*), Eastern Cottontail (*Sylvilagus floridanus*), White-tailed Deer (*Odocoileis virginianus*), and Striped Skunk (*Mephitis mephitis*) are expected. None of the observed or expected species are considered at risk either federally or provincially and are generally widespread in Ontario.

12.2 Aquatic Environment

Aquatic features found proximal to the alternative water supply and wastewater treatment sites are either constructed or resulting from recent disturbances. A description of the two features discovered is provided below.

A constructed water feature occurs at the existing WPCP in the northeast corner of the property. Common Reed and Narrow-leaf Cattail dominate the vegetation. Water availability and depth is anticipated to fluctuate seasonally. It is unlikely that this feature plays a significant ecological contribution to the local and regional natural heritage features and functions. An isolated area of standing water was observed at the Park Site Intersection of Sideroad 28 and 29 and Concession Road 2 and 3. The feature occurs southeast of the yard waste dumping area. Surface water is anticipated to collect in this area as developed berms are inhibiting surface water drainage. Narrow-leaf Cattail is the dominant vegetation. It is unlikely that this feature plays a significant ecological contribution to the local and regional natural heritage features and functions.

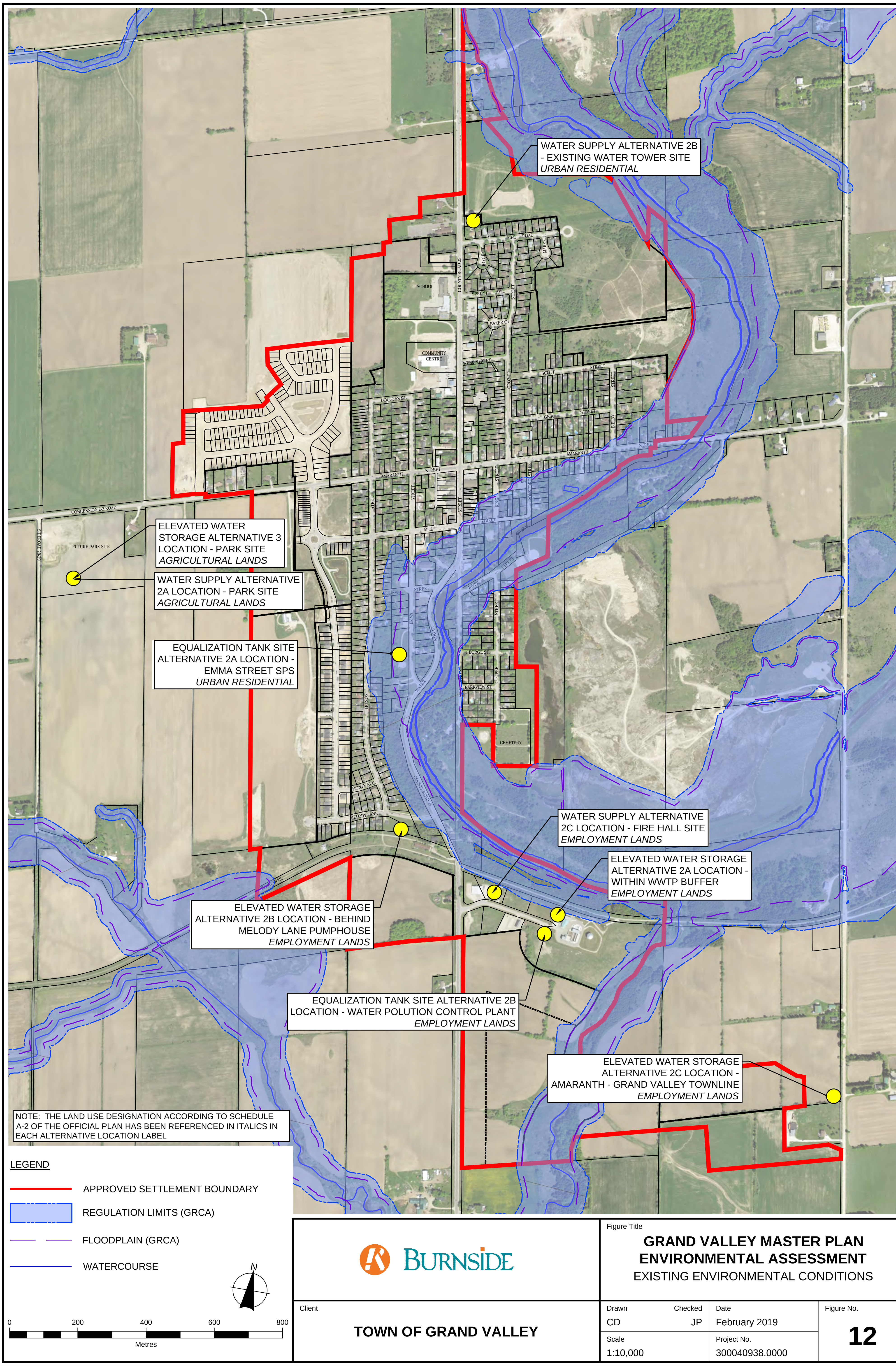

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Figure Title

GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT

EXISTING ENVIRONMENTAL CONDITIONS

Client: **TOWN OF GRAND VALLEY**

Drawn	Checked	Date	Figure No.
CD	JP	February 2019	**12**
Scale: 1:10,000		Project No.: 300040938.0000	

13.0 Social and Cultural Environment

The social and cultural environment is considered as part of the Master Plan Class EA to avoid significant negative impacts in the community. Impacts of a project on historical buildings, archaeological sites, or scenic landscapes that shape the community should be avoided. The social and cultural environment also considers impacts of how a project may impact people in the community with respect to adjacent land uses, any nuisances related to the project such as noise, overall aesthetics, traffic, air quality, and any temporary impacts associated with construction. Projects which require land acquisition also need careful consideration with respect to social impacts as it directly impacts someone's property of which they may have great attachment.

13.1 Local Planning Provisions

13.1.1 Provincial Policy Statement

The 2014 Provincial Policy Statement (PPS) states that municipal projects should be directed to existing settlement areas, create stronger and improved communities, and have little to no impact on the natural features of the area. In general, projects should have consideration for future needs to ensure the benefits of the project are far-reaching. Section 1.6 of the PPS contains specific guidance on Infrastructure and Public Service Facilities:

> *1.6.1 Infrastructure, electricity generation facilities and transmission and distribution systems, and public service facilities shall be provided in a coordinated, efficient and cost-effective manner that considers impacts from climate change while accommodating projected needs.*
>
> *Planning for infrastructure, electricity generation facilities and transmission and distribution systems, and public service facilities shall be coordinated and integrated with land use planning so that they are:*
>
> *a) financially viable over their life cycle, which may be demonstrated through asset management planning; and*
>
> *b) available to meet current and projected needs.*
>
> *1.6.2 Planning authorities should promote green infrastructure to complement infrastructure.*
>
> *1.6.3 Before consideration is given to developing new infrastructure and public service facilities:*

a) the use of existing infrastructure and public service facilities should be optimized; and

b) opportunities for adaptive re-use should be considered, wherever feasible.

1.6.4 Infrastructure and public service facilities should be strategically located to support the effective and efficient delivery of emergency management services.

1.6.5 Public service facilities should be co-located in community hubs, where appropriate, to promote cost-effectiveness and facilitate service integration, access to transit and active transportation. As such, improvements made to public infrastructure should be consistent with permitted uses of the adjacent land use designations.

13.1.2 Official Plan

None of the alternatives will impact the numbers, density or location of growth as shown in the Official Plan.

Land Use for all the potential development locations was determined according to Schedule A-1 and A-2 of the Town's Official Plan (Consolidated 2017). A copy of Schedule A-2 is included in Appendix H.

The land use designation of each potential site location for water and wastewater infrastructure has been described in detail below.

Water Supply

Alternative 2A's location (the Park Site) is currently outside of the Official Plan boundary and has been classified as Agricultural Lands. Alternative 2B's location (the Existing Water Tower Site) is classified as Urban Residential and Alternative 2C's location (the Fire Hall Site) is classified as Employment Lands.

Water Storage

Alternative 2A's location (within WPCP Buffer) is classified as Employment Lands. Alternative 2B's location (behind the Melody Lane Pumphouse) is classified as either Urban Residential or Open Space depending on placement. Alternative 2C (Amaranth-East Luther Townline) and the ground level water storage alternative (Park Site) locations are both classified as Agricultural Lands.

Wastewater Treatment

Alternative 2A's location (Emma St. SPS) is classified as Urban Residential and Alternative 2B's location (WPCP) is classified as Employment Lands.

13.2 Heritage Resources

The water and wastewater servicing infrastructure will not have an impact on the existing heritage resources, sites or conditions.

13.3 Cultural Resources

As part of the Environmental Study Report completed in 2005, a Stage 1-2 archaeological assessment was conducted at the WPCP. One deposit of cultural significance was discovered during a pedestrian survey. The area of significance is located outside of the fenced boundary of the WPCP; however, it is still within the property line. A copy of the Archaeological Research Associates Ltd. (ARA) Report illustrates the location of the archaeological site, and has been included in Appendix I.

Based on the proposed locations for both the water and wastewater servicing alternatives, the archaeological site will not be encroached upon during construction. The future expansion of the WPCP is planned with the footprint already present within the fenced area maintaining the separation distance between the Plant and the deposit site.

13.4 Nuisance Impacts

All alternatives will have temporary impacts associated with construction. This includes increased traffic to accommodate construction, noise impacts from construction and the use of heavy equipment as well as air quality issues such as dust.

Aesthetics of a project also need to be considered with respect to the compatibility of the project and the surrounding land uses. This consideration is important when evaluating water storage options. Some residents consider elevated water storage and ground level reservoirs in the form of standpipes to be aesthetically unpleasing and obtrusive, while others consider it to be unobtrusive or positive in the sense that it provides an identifiable landmark. For a new water storage site, sites that are the furthest away from existing residential uses are preferred and are easily accommodated in existing industrial areas. Additionally, buffers surrounding elevated water storage sites are required to avoid any issues with falling snow or ice from the structure.

Other impacts from the wastewater and water supply alternatives include noise attenuation and air quality concerns due to the inclusion of the standby generator on site. A proper air and noise evaluation will be completed for sites that are within proximity to residential areas.

Traffic to the new infrastructure sites would include daily visits by the Township's water and wastewater operators. No significant traffic impacts are anticipated with any of the locations proposed for the new water and wastewater infrastructure.

13.5 Land Acquisition / Construction Impacts

Many of the potential sites selected for the water supply, water storage and wastewater treatment infrastructure are on Town owned lands. This doesn't suggest that the lands are surplus or available without cost, as they may be intended for other purposes. However, they will not have the impact on private landowners that would be caused by expropriation and the timelines will not be affected by land division requirements. The only site that may require land acquisition from the current property owner is the elevated water storage location on Amaranth-East Luther Townline.

14.0 Evaluation of Water Supply, Water Storage and Wastewater Treatment Alternatives

This section identifies the water and wastewater alternatives that were considered as a part of this Master Plan Class EA. The above noted alternatives were evaluated using natural environment, social/cultural environment, financial and technical factors. An evaluation of each of the alternatives, using the identified criteria, is presented below in Table 16, Table 17, and Table 18.

Table 16: Evaluation of Water Supply Alternatives

Criteria for Evaluating Alternative Sites	Alternative 1 - Do Nothing	Alternative 2 - New Groundwater Sources		
		Location 2A – Park Site	Location 2B – Existing Water Tower	Location 2C – Fire Hall
A - Natural Environment	**Most Preferred** ●	**Partially Preferred** ◐	**Partially Preferred** ◐	**Partially Preferred** ◐
Terrestrial Habitat	No impact over existing conditions	Vegetation removal is anticipated to be minimal and will be limited to meadow species. Impacts to the terrestrial habitat are anticipated to be very low.	Vegetation removal is anticipated to be minimal and will be limited to meadow species / manicured turf. Off-site residential vegetation is not expected to be subject to any impacts. Impacts to the terrestrial habitat are expected to be very low.	Vegetation removal is anticipated to be minimal and will be limited to meadow species. Impacts to terrestrial habitat are very low.
Designated Sites/Species	No impact over existing conditions	The site is not anticipated to contain any sensitive / rare species or designated areas.	The site is not anticipated to contain any sensitive / rare species or designated areas.	The site is not anticipated to contain any sensitive / rare species. The proposed well location will remain outside the 30 m setback from the designated area north of the property.
Aquatic Habitat	No impact over existing conditions	The water feature is set back a significant distance (>30 m) from the proposed well location. No impacts are expected.	No impact over existing conditions. No water course in vicinity of site.	Minimal impact over existing conditions. Grand River within 100 m of the site.
Hazard Lands (Floodplains, etc.)	No impact over existing conditions	No impact over existing conditions. Pumping test required to confirm no affect on existing production wells.	No impact over existing conditions. Pumping test required to confirm no affect on existing production wells.	No impact over existing conditions. Pumping test required to confirm no affect on existing production wells.
B - Social and Cultural Environment	**Least Preferred** ○	**Most Preferred** ●	**Most Preferred** ●	**Most Preferred** ●
Conformity to Local Planning Provisions	Little conformity, given that the Town's Official Plan designates residential growth for various areas of Grand Valley. Additional storage and increase pumping capacity is required.	The additional water supply would be designed to accommodate future growth.	The additional water supply would be designed to accommodate future growth.	The additional water supply would be designed to accommodate future growth.
Heritage Resources (built heritage, landmarks, significant landscapes)	No impact over existing conditions	No impact over existing conditions	No impact over existing conditions	No impact over existing conditions
Cultural Resources (archaeological features)	No impact over existing conditions	No impact over existing conditions	No impact over existing conditions	No impact over existing conditions

Understanding the Rating System

Least Preferred to Most Preferred → ○ ◐ ●

Recommended Alternative (shaded)

Criteria for Evaluating Alternative Sites	**Alternative 1 - Do Nothing**	**Alternative 2 - New Groundwater Sources**		
		Location 2A – Park Site	**Location 2B – Existing Water Tower**	**Location 2C – Fire Hall**
Nuisance Impacts	No impact over existing conditions	Potential impacts on air quality (noise, dust, emissions) as a result of construction activities. Also, potential impacts on air quality as a result of the standby generator required to supply backup power or from routine testing of the generator.	Potential impacts on air quality (noise, dust, emissions) as a result of construction activities. Also, potential impacts on air quality as a result of the standby generator required to supply backup power or from routine testing of the generator.	Potential impacts on air quality (noise, dust, emissions) as a result of construction activities. Also, potential impacts on air quality as a result of the standby generator required to supply backup power or from routine testing of the generator.
Construction Impacts / Land Requirements	No impact over existing conditions	A small pumphouse will need to be constructed within proximity to the new well location. Potential source water protection issues.	A small pumphouse will need to be constructed within proximity to the new well location.	A small pumphouse will need to be constructed within proximity to the new well location. Existing on-site wastewater treatment system will need to be decommissioned and the firehall placed on the municipal system.
C - Financial Factors	**Most Preferred** ●	**Partially Preferred** ◐	**Least Preferred** ○	**Partially Preferred** ◐
Estimated Capital Costs	None	$ 2,400,000	N/A – no sufficient quantity of water available	$ 2,368,000
Estimated Operation & Maintenance Costs	None	$ 57,290	N/A – no sufficient quantity of water available	$ 68,080
50 Year Life Cycle Cost	None	$ 3,870,000	N/A – no sufficient quantity of water available	$ 4,120,000
D - Technical Factors	**Least Preferred** ○	**Most Preferred** ●	**Least Preferred** ○	**Partially Preferred** ◐
Water Quality	No impact on existing water quality	Dependent on water quality samples taken during test drilling; however, existing wells indicate that the water is typically very hard and often exceeds the ODWQS.	Dependent on water quality samples taken during test drilling; however, existing wells indicate that the water is typically very hard and often exceeds the ODWQS.	Dependent on water quality samples taken during test drilling; however, existing wells indicate that the water is typically very hard and often exceeds the ODWQS. Well would be classified as a GUDI well.
Water Quantity / Source Reliability	The existing water supply will not meet the future demand requirements specified in the Official Plan.	Reliable water source. Test well yielded potential for two reliable wells could be drilled at this site.	Test well drilled confirmed very low quantity of water present.	Well is close to existing WHPA zones and would be classified as a GUDI well due to its proximity to the Grand River.
Property Requirements	None	Taking up land intended for recreational use.	None. Located on Town lands.	None. Located on Town lands.
Suitability to Connect to Existing Water System	No connection required	Easily incorporated into the existing water distribution system.	Easily incorporated to the existing water distribution system.	On-site septic system decommissioning and municipal sanitary connection to the WPCP will need to occur prior to well drilling, pumphouse construction, and connection to the municipal water system.

Understanding the Rating System

Least Preferred to Most Preferred: ○ ◐ ●

Recommended Alternative: (shaded column)

Criteria for Evaluating Alternative Sites	Alternative 1 - Do Nothing	Alternative 2 - New Groundwater Sources		
		Location 2A – Park Site	**Location 2B – Existing Water Tower**	**Location 2C – Fire Hall**
Ease of Operation and Maintenance	Not applicable	Water treatment pumphouse will need to be maintained. Maintenance for groundwater sources is less compared to surface water sources.	Water treatment pumphouse will need to be maintained. Maintenance for groundwater sources is less compared to surface water sources.	Water treatment pumphouse will need to be maintained. GUDI treatment would require increased maintenance.
Treatment Requirements	None	Dependent on the groundwater quality.	Dependent on the groundwater quality.	Dependent on the groundwater quality. GUDI treatment would be required.
Regulatory Requirements	None	A Permit to Take Water Amendment and a Drinking Water Works Permit Amendment will be required for the new water source and treatment system. Building permit for treatment pumphouse construction.	A Permit to Take Water Amendment and a Drinking Water Works Permit Amendment will be required for the new water source and treatment system. Building permit for treatment pumphouse construction.	A Permit to Take Water Amendment and a Drinking Water Works Permit Amendment will be required for the new water source and treatment system. Building permit for treatment pumphouse construction.
Addresses Problem Statement	**No**	**Yes**	**No**	**Yes**
Recommended Solution	**Least Preferred**	**Most Preferred**	**Least Preferred**	**Partially Preferred**

Understanding the Rating System

Least Preferred to Most Preferred   Recommended Alternative

Criteria for Evaluating Alternatives	Alternative 1 - Do Nothing	Alternative 3 – New Surface Water Source	Alternative 4 – Use of Surplus from an Existing Municipal System
A - Natural Environment	**Most Preferred** ●	**Least Preferred** ○	**Least Preferred** ○
Terrestrial Habitat	No impact over existing conditions.	Removal of vegetation along the Grand River will likely be required to accommodate this alternative. Although impacts are expected to be low, they cannot be fully assessed until a final concept plan has been developed.	Impacts will be dependent on the placement of piping to connect to the municipal systems. Where possible, development plans should seek to reduce the amount of vegetation clearing to accommodate this alternative.
Designated Sites/Species	No impact over existing conditions.	There will be some disturbance to designated areas associated with the Grand River during construction/installation of the surface water intake.	Impacts will be dependent on the placement of piping to connect to the municipal systems.
Aquatic Habitat	No impact over existing conditions.	There will be some disturbance to the Grand River aquatic habitat during the construction/installation of the surface water intake.	Dependent on the placement of piping to connect the municipal systems. The Grand River passes through both areas and may need to be crossed for a successful connection.
Hazard Lands (Floodplain lands)	No impact over existing conditions.	The intake structure will be located within the Grand River floodplain.	Dependent on the placement of piping to connect the municipal systems. The Grand River may need to be crossed for a successful connection placing a portion of the piping within the river's floodplain.
B - Social and Cultural Environment	**Least Preferred** ○	**Least Preferred** ○	**Least Preferred** ○
Conformity to Local Planning Provisions	Little conformity, given that the Town's Official Plan designates residential growth for various areas of Grand Valley. Additional storage and increase pumping capacity is required.	The additional water supply would be designed to accommodate future growth.	The additional water supply would be designed to accommodate future growth.
Heritage Resources (built heritage, landmarks, significant landscapes)	No impact over existing conditions	No impact over existing conditions	No impact of existing conditions
Cultural Resources (archaeological features)	No impact over existing conditions	No impact over existing conditions	No impact over existing conditions
Nuisance Impacts	No impact over existing conditions	Potential impacts on air quality (noise, dust, emissions) as a result of construction activities. Also, potential impacts on air quality as a result of the standby generator required to supply backup power or from routine testing of the generator.	Potential impacts on air quality (noise, dust, emissions) as a result of construction activities.
Construction Impacts/ Land Requirements	No impact over existing conditions	A small pumphouse will need to be constructed within proximity to the new river intake structure.	Distribution piping will need to be constructed between Waldemar and Grand Valley in addition to the piping in the designated areas of development.
C - Financial Factors	**Most Preferred** ●	**Least Preferred** ○	**Least Preferred** ○
Estimated Capital Costs	None		

Understanding the Rating System

Least Preferred to Most Preferred → ○ ◐ ●

Recommended Alternative (light blue box)

Criteria for Evaluating Alternatives	Alternative 1 - Do Nothing	Alternative 3 – New Surface Water Source	Alternative 4 – Use of Surplus from an Existing Municipal System
Estimated Operation & Maintenance Costs	None	The costs associated with this alternative are significantly higher than the groundwater source alternative.	The costs associated with this alternative are significantly higher than both the groundwater and surface water source alternatives.
Life Cycle Cost	None		
Site Specific Costs	None		
D - Technical Factors	**Least Preferred** ○	**Least Preferred** ○	**Partially Preferred** ◐
Water Quality	No impact on existing water quality	Water quality fluctuates with seasonal variation. High turbidity issues at times.	Additional water supply will be treated by Waldemar's water treatment system prior to distribution; however, there are potential water quality and water age issues.
Water Quantity / Source Reliability	The existing water supply will not meet the future demand requirements specified in the Official Plan.	Provides a reliable water source.	Provides a reliable water source. Waldemar is the only system within proximity and it has no surplus.
Property Requirements	None	Water treatment pumphouse will be located on Town owned lands.	None
Suitability to Connect to Existing Water System	No connection required	Easily incorporated to the existing water distribution system.	More difficult to incorporate into the existing water distribution system.
Ease of Operation and Maintenance	Not applicable	Surface water WTP are more complex to operate, resulting in higher O&M costs and increased supervision.	Operational flexibility from use of existing infrastructure (pump, storage, etc.). Existing infrastructure in Waldemar would need to be evaluated to determine its remaining service life.
Treatment Requirements	None	The new treatment system will have a much larger footprint compared to a groundwater source, resulting in a larger building requirement and increased capital cost.	Additional chlorination may be required to maintain the minimum residual at the furthest point in the distribution system. If the chlorine residual can be maintained, no additional treatment is required.
Regulatory Requirements	None	A Permit to Take Water Amendment and a Drinking Water Works Permit Amendment will be required for the new water source and treatment system. A building permit would also be required for the water treatment pumphouse.	A Permit to Take Water Amendment and a Drinking Water Works Permit Amendment will be required for connection to Waldemar's water supply and distribution systems. A building permit would also be required for the water treatment pumphouse.
Addresses Problem Statement	**No**	**Yes**	**Yes**
Recommended Solution	**Least Preferred**	**Least Preferred**	**Least Preferred**

Understanding the Rating System

Least Preferred to Most Preferred → ○ ◐ ●

Recommended Alternative

Table 17: Evaluation of Water Storage Alternatives

Criteria for Evaluating Alternative Sites	Alternative 1 - Do Nothing	Alternative 2 – Elevated Water Storage	Alternative 3 – Grade Level Reservoir
A - Natural Environment	**Most Preferred** ●	**Most Preferred** ●	**Most Preferred** ●
Terrestrial Habitat	No impact over existing conditions	No impact over existing conditions	No impact over existing conditions
Designated Sites/Species	No impact over existing conditions	No impact over existing conditions	No impact over existing conditions
Aquatic Habitat	No impact over existing conditions	No impact over existing conditions	No impact over existing conditions
Hazard Lands (Floodplain Lands)	No impact over existing conditions	No impact over existing conditions.	No impact over existing conditions.
B - Social and Cultural Environment	**Least Preferred** ○	**Most Preferred** ●	**Standpipe – Partially Preferred** ◐ **In-Ground Reservoir – Most Preferred** ●
Conformity to Local Planning Provisions	Little conformity, given that the Town's Official Plan designates residential growth for various areas of Grand Valley. Additional storage and increase pumping capacity is required.	The additional water storage would be designed to accommodate future growth.	The additional water storage would be designed to accommodate future growth.
Heritage Resources (built heritage, landmarks, significant landscapes)	No impact over existing conditions	No impact over existing conditions	No impact over existing conditions
Cultural Resources (archaeological features)	No impact over existing conditions	No impact over existing conditions	No impact over existing conditions
Nuisance Impacts	No impact over existing conditions	Potential impacts on air quality (noise, dust, emissions) as a result of construction activities. Some consider elevated storage to be aesthetically unpleasing and obstructive, while others consider it to be an identifiable landmark.	Potential impacts on air quality (noise, dust, emissions) as a result of construction activities. In-ground reservoirs typically have low profiles integrated into the surroundings resulting in limited aesthetic issues. Standpipes are considered aesthetically unpleasing and obstructive by some, others consider it as an identifiable landmark. Grade level reservoirs require a generator which may cause a potential noise and emission impact.
Construction Impact / Land Requirements	No impact over existing conditions	Depending on storage placement, approval from the GRCA may be required if within regulated lands.	Depending on storage placement, approval from the GRCA may be required if within regulated lands.
C - Financial Factors	**Most Preferred** ●	**Most Preferred** ●	**Standpipe – Most Preferred** ● **In-Ground Reservoir – Least Preferred** ○
Estimated Capital Costs	None	$ 3,590,000	Standpipe - $ 2,400,000 In-Ground Reservoir - $ 2,810,000
Estimated Operation & Maintenance Costs	None	$ 28,680	Standpipe - $ 71,540 In-Ground Reservoir - $ 69,380
Life Cycle Cost	None	$ 4,330,000	Standpipe - $ 4,240,000 In-Ground Reservoir - $ 4,600,000

Understanding the Rating System

Least Preferred to Most Preferred → ○ ◐ ●

Recommended Alternative (shaded)

Criteria for Evaluating Alternative Sites	Alternative 1 - Do Nothing	Alternative 2 – Elevated Water Storage	Alternative 3 – Grade Level Reservoir
D - Technical Factors	**Least Preferred** ○	**Most Preferred** ●	**Partially Preferred** ◐
Capability to provide storage and water demands for existing and future development	No	Yes	Yes
Property Requirements	No property required	Most of the ideal locations for elevated storage are located on Town owned lands.	Most of the ideal locations for elevated storage are located on Town owned lands.
System Efficiency	Low given much greater need for additional storage.	Minimizes "double pumping" as water is distributed to the community via gravity. Ensure all well pumps (new and existing) are able to convey the max day demand to the new elevated tank.	Water delivered to consumers is "double-pumped", once at the point of supply and once at the point of storage. This inefficiency is reflected in operation and maintenance costs including significant hydro costs. Highlift pumping equipment and back-up power are required to meet peak hour demand and provide fire flows.
System Reliability	The existing storage (water tower) has minimal dependence on mechanical and electrical equipment, which reduces the potential mode of failure. Regular maintenance and testing should be carried out to ensure system reliability.	Under this alternative, the system reliability improves by avoiding double pumping. Water from the supply sources is only pumped once since it is distributed to the community by gravity. Regular maintenance and testing should be carried out to ensure system reliability.	Pumped discharge systems are dependent upon mechanical and electrical equipment, which introduces an additional potential mode of failure requiring that regular maintenance and testing be carried out to ensure system reliability.
Suitability of Connection to Existing Water System	No connection to the existing system.	Hydraulic profile will not be altered with elevated storage provided it operates at the same elevation. The Town already has an existing water tower.	Hydraulic profile will be altered if a grade level reservoir is introduced into the system due to differing operating levels. Multiple pressure zones may be required for proper system function.
Ease of Operation and Maintenance	Existing operation and maintenance procedures would exist and be more critical to ensure existing facilities maintain reliable.	Routine maintenance and testing of the well pumps are required under this alternative. Operational costs are lower due to the reduced number of pumps. Depending on the type of elevated water storage selected, the storage tank may require painting approximately every 30 years on average including cathodic protection anodes approximately every 10 years. Regular cleaning and maintenance are also required. Monitoring of discharge from the elevated tank is required. The selection of the type of elevated storage will be confirmed during detailed design. A standby generator is not required to supply back-up power during times of failure.	Pumped discharge systems are dependent upon mechanical and electrical equipment, which introduces an additional potential mode of failure requiring that regular maintenance and testing be carried out to ensure system reliability. Additionally, operational costs are significant for these options due to the large number of pumps required. A standby generator is required to supply back-up power during times of failure.

Understanding the Rating System

Least Preferred to Most Preferred → ○ ◐ ●

Recommended Alternative (shaded)

Criteria for Evaluating Alternative Sites	Alternative 1 - Do Nothing	Alternative 2 – Elevated Water Storage	Alternative 3 – Grade Level Reservoir
Regulatory Requirements	Town may be issued an order from the MECP if Township cannot meet water demands. Town may need to impose a by-law restricting water usage which could include banning all outside water usage, or during a fire or high use periods, impose very restrictive water usage.	Would require a drinking water works permit amendment from the MECP, and a building permit.	Would require a drinking water works permit amendment from the MECP, a building permit.
Addresses Problem Statement	**No**	**Yes**	**Yes**
Recommended Solution	**Least Preferred**	**Most Preferred**	**Partially Preferred**

Understanding the Rating System

Least Preferred to Most Preferred Recommended Alternative

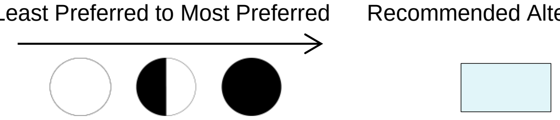

Table 18: Evaluation of Wastewater Treatment Alternatives

Criteria for Evaluating Alternative Sites	Alternative 1 - Do Nothing	Alternative 2 – Rerate the Existing WPCP		Alternative 3 – Expansion of Existing WPCP	Alternative 4 – Connection to an Existing Municipal System
		Equalization Tank Location 2A – Emma St. SPS	Equalization Tank Location 2B – Existing WPCP		
A - Natural Environment	**Most Preferred** ●	**Partially Preferred** ◐	**Most Preferred** ●	**Most Preferred** ●	**Least Preferred** ○
Terrestrial Habitat	No impact over existing conditions	The Emma St. SPS property contains some mature vegetation. However, it is expected that any development will occur within the meadow ecosites and will not pose any significant impacts to adjacent trees. Impacts to the terrestrial habitat are expected to be very low.	Vegetation removal will be limited to meadow species. Impacts to the terrestrial habitat are expected to be very low.	Vegetation removal will be limited to meadow species. Impacts to the terrestrial habitat are expected to be very low.	Impacts will be dependent on the placement of piping to connect the municipal systems.
Designated Sites/Species	No impact over existing conditions	No impact over existing conditions	Development is expected to occur beyond the protective buffer of the designated area north of the property. No impacts are expected over existing conditions.	Development is expected to occur beyond the protective buffer of the designated area north of the property. No impacts are expected over existing conditions.	Impacts will be dependent on the placement of piping to connect the municipal systems.
Aquatic Habitat	No impact over existing conditions	No impact over existing conditions	Impacts to the constructed water feature will be dependent on the location of the Equalization Tank.	Impacts to the constructed water feature will be dependent on the WPCP expansion plan.	Impacts will be dependent on the placement of piping to connect the municipal systems.
Hazard Lands	No impact over existing conditions	The entire Emma St. SPS site is within the Grand River floodplain.	Only a small portion of the WPCP property is within GRCA regulation limits, however the plant is not within the floodplain.	Only a small portion of the WPCP property is within GRCA regulation limits, however the plant is not within the floodplain.	The impact of this alternative would not be determined until the detailed design phase.
B - Social and Cultural Environment	**Least Preferred** ○	**Least Preferred** ○	**Most Preferred** ●	**Most Preferred** ●	**Least Preferred** ○
Conformity to Local Planning Provisions	Little conformity, given that the Town's Official Plan designates residential growth for various areas of Grand Valley. Additional wastewater treatment capacity is required.	Additional wastewater capacity generated by the WPCP rerating may allow for future demand accommodation and existing housing demands to be met. The capacity available will be dependent on the rerating. Equalization storage will potentially be required to accommodate the wastewater demands associated with the Official Plan population.	Additional wastewater capacity generated by the WPCP rerating may allow for future demand accommodation and existing housing demands to be met. The capacity available will be dependent on the rerating. Equalization storage will potentially be required to accommodate the wastewater demands associated with the Official Plan population.	WPCP expansion would be designed to accommodate future growth.	Connection to Orangeville Wastewater Treatment Plant would accommodate future growth.

Understanding the Rating System

Least Preferred to Most Preferred → ○ ◐ ●

Recommended Alternative (shaded)

Criteria for Evaluating Alternative Sites	Alternative 1 - Do Nothing	Alternative 2 – Rerate the Existing WPCP		Alternative 3 – Expansion of Existing WPCP	Alternative 4 – Connection to an Existing Municipal System
		Equalization Tank Location 2A – Emma St. SPS	Equalization Tank Location 2B – Existing WPCP		
Heritage Resources (built heritage, landmarks, significant landscapes)	No impact over existing conditions.	No impact over existing conditions.	No impact over existing conditions.	No impact over existing conditions.	No impact over existing conditions.
Cultural Resources (archaeological features)	No impact over existing conditions.	No impact over existing conditions.	No impact over existing conditions.	No impact over existing conditions. Expansion would occur outside of the archaeological area identified in a previous study.	No impact over existing conditions.
Nuisance Impacts	No impact over existing conditions.	Potential impacts on air quality (noise, dust, emissions) as a result of construction activities.	Potential impacts on air quality (noise, dust, emissions) as a result of construction activities.	Potential impacts on air quality (noise, dust, emissions) as a result of construction activities.	Potential impacts on air quality (noise, dust, emissions) as a result of construction activities.
Construction Impacts/ Land Requirements	No impact over existing conditions.	There is plenty of land available for a future equalization tank at the Emma St. location. Equalization tank would be constructible in 2018, allowing housing needs to be met.	Placement of equalization tank should not impede the potential for future plant expansion. Equalization tank would be constructible in 2018, allowing housing needs to be met.	Construction would occur no earlier than 2019, which will delay housing development.	A significant amount of construction would be required to connect Grand Valley's municipal sanitary system with Orangeville's.
C - Financial Factors	**Most Preferred** ●	**Partially Preferred** ◐	**Most Preferred** ●	**Least Preferred** ○	**Least Preferred** ○
Estimated Capital Costs	None	$ 2,830,000* *The equalization tank will be paid for by developers not the Town	$ 2,550,000* *The equalization tank will be paid for by developers not the Town	Capital Cost Range from $11 Million to $14 Million Accurate costs cannot be determined unit the detailed design phase	This alternative is not feasible.
Estimated Operation & Maintenance Costs	None				
Life Cycle Cost	None				
D - Technical Factors	**Least Preferred** ○	**Partially Preferred** ◐	**Most Preferred** ●	**Most Preferred** ●	**Least Preferred** ○
Capability to provide wastewater treatment capacity for existing and future development	No	Yes	Yes	Yes	Yes
System Efficiency	Low given much greater need for additional wastewater treatment capacity.	Projected peak flows currently exceed the rated pumping capacity at the SPS. To divert flows to the EQ tank, the SPS will require upgrades. The EQ tank will require an odour control	Projected peak flows currently exceed the rated pumping capacity at the SPS. To convey the future peak flows to the WPCP, the existing forcemain will not require replacement; however,	Expansion of existing treatment process at the WPCP would be designed to accommodate projected future flows to service the Official Plan population.	This alternative would be very inefficient due to the distance between Orangeville and Grand Valley. The Orangeville Wastewater Treatment Plant has no assimilative or plant capacity to accept additional

Understanding the Rating System

Least Preferred to Most Preferred: ○ ◐ ●

Recommended Alternative: shaded column

Criteria for Evaluating Alternative Sites	**Alternative 1 - Do Nothing**	**Alternative 2 – Rerate the Existing WPCP**		**Alternative 3 – Expansion of Existing WPCP**	**Alternative 4 – Connection to an Existing Municipal System**
		Equalization Tank Location 2A – Emma St. SPS	**Equalization Tank Location 2B – Existing WPCP**		
		system due to the proximity of neighbouring residential areas.	the SPS will require larger submersible pumps.	This option requires detailed assessment of the Emma St. SPS pumping capacity and forcemain hydraulics to determine if upgrades are required.	wastewater generation from Grand Valley.
Effluent Requirements	The existing system is currently in compliance with the effluent requirements.	Phosphorous loading in the Grand River will be the limiting factor of the Plant rerating.	Phosphorous loading in the Grand River will be the limiting factor of the Plant rerating.	Phosphorous loading in the Grand River will be the limiting factor of the Plant expansion.	Effluent requirements would need to be met at both the Grand Valley WPCP and the Orangeville Wastewater Treatment Plant.
Suitability to Connect to Existing Wastewater System	Not applicable	Easily connected to the existing wastewater system.	Easily connected to the existing wastewater system.	The difficulty of the connection will be heavily dependent on the detailed design of the expansion.	Due to the vast distance between Grand Valley and Orangeville, connection to the existing wastewater collection and treatment system is not a feasible alternative to increase capacity.
Ease of Operation and Maintenance	Existing operation and maintenance procedures would exist and be more critical to ensure existing facilities maintain reliable.	Alternations to the SPS SCADA system will be required to divert flow to and from the EQ tank.	Changes to the operation of the existing SPS and the WPCP would be required to divert excess flows to the EQ tank.	The difficulty associated with operation and maintenance is dependent on the detailed design of the expansion.	Increased operation and maintenance complexity due to the integration of a second municipal system.
Regulatory Requirements	Not applicable	Would require an ECA amendment from the MECP and a building permit. Appropriate air and noise assessment will need to be completed on the system along with the design of a proper odour control system due to the tank's proximity to the surrounding residential areas.	Would require an ECA amendment from the MECP and a building permit. Appropriate air and noise assessment will need to be completed on the system along with the design of a proper odour control system due to the tank's proximity to the surrounding residential areas.	Would require an ECA amendment from the MECP and a building permit. A small portion of the existing WPCP is located within GRCA regulated lands, a permit may be required depending on the expansion location.	Would require an ECA amendment from the MECP and an updated assimilative capacity study for the expansion of the Orangeville WWTP.
Addresses Problem Statement	**No**	**Yes**	**Yes**	**Yes**	**Yes**
Recommended Solution	**Least Preferred**	**Partially Preferred**	**Most Preferred as an Interim Solution**	**Most Preferred as a Long-Term Solution**	**Least Preferred**

Understanding the Rating System

Least Preferred to Most Preferred   Recommended Alternative

14.1 Water Supply Alternatives

14.1.1 Alternative 1 - Do Nothing

This alternative serves as a reference point for comparing other alternative solutions. The “Do Nothing” alternative means no action is taken in addressing the problem statement and would result in no additional water supply sources being introduced into the existing water supply system. It is not expected that any capital costs would be incurred for this option and it is expected that operating and maintenance costs for this option would be similar to those currently budgeted by the Township. A slight increase will occur as the existing equipment ages. Doing nothing does not accommodate approved and expected growth within the Township. It does not conform to local planning provisions. A restriction to the natural growth of a community will result in many negative socio-economic impacts. There will also be the need to modify and revise existing planning policies within the Township.

This alternative would not address the problem statement and was therefore not considered a viable solution.

14.1.2 Alternative 2 –New Groundwater Source

Burnside and the Town retained Well Initiatives Limited (WIL) to complete an exploratory drilling and testing program. A copy of the Well Testing Technical Memorandum is included in Appendix J.

This alternative would provide a reliable water source for the community that can be easily connected to the existing system with minimal impact on the environment. Each of the potential drilling locations have been described in detail below.

Location 2A - Park Site

Based on the evaluation criteria presented above, this location is one of two favourable sites for a new groundwater source. Even though this location is outside of the Official Plan Boundary, there is potential for future development in the surrounding area. This parcel of land is currently owned by the Town.

A monitoring well (EL-MW2) currently exists on the property that is monitored under the Town’s PTTW. It was completed as part of the 2001 Groundwater Management Study.

The deep monitoring well was only advanced 2 m into the bedrock, so the potential yield of the well was not established. This well could be deepened, however, a new test well on the property was installed since the monitoring well is currently located within the roadside ditch. There are a few wells in the area with high theoretical yields which supported the expectation that a high producing well could be drilled. Well 1703541 located just east of the property has a theoretical yield of 11 L/s and a well southwest of the site (1706608) has a theoretical yield of 26 L/s. Additionally, the land parcel for the park site is just outside the Well Head Protection Area (WHPA) for Wells 1 and 2 (PW1/PW2).

Test Well - TW1-17:

TW1-17 was drilled at the park site between December 11 and 14, 2017. The test well is located more than 100 m from any lands that will be used for agriculture. Overburden consisting primarily of clay was present to a depth of 26.2 m (86 ft) below grade. Limestone was present from 26.2 m (86 ft) to 126.5 m (415 ft). The hole was advanced into shale and was completed at a depth of 127.4 m (418 ft) below grade. Water was encountered at depths of 27.4 m, 84.7 m and 104.9 m (90 ft, 278 ft and 344 ft) below grade. A 50 mm (6-inch) steel casing was installed to a depth of 26.5 m (87 ft) below grade. The outside annulus was backfilled with bentonite grout from 26.5 m (87 ft) to 6 m (20 ft) and the remainder of the hole was filled to surface with bentonite Holeplug.

The well was initially pumped at a rate of 818 L/min (180 GPM) for 1 hour following completion. Water levels declined from 7.9 m to 16.7 m (25.8 ft to 54.0 ft) during the test with a resultant specific capacity of 1.6 L/s/m (6.4 IGPM/ft). Typically, pumps are installed within the well casing of bedrock wells and as a result, the available drawdown is calculated as the static water level minus the depth of the casing. The calculated theoretical yield of TW1-17 using an available drawdown to the base of the casing is 1,646 L/min (362 IGPM).

In order to provide a preliminary estimate of aquifer characteristics, the well was subsequently tested at rates of 4 L/s (52 IGPM), 8 L/s (106 IGPM), 11 L/s (145 IGPM) and 13 L/s (172 IGPM) with resultant specific capacities of 2.2 L/s/m, 1.8 L/s/m, 1.3 L/s/m and 1.3 L/s/m (9.3 IGPM/ft, 7.6 IGPM/ft, 5.2 IGPM/ft and 5.2 IGPM/ft). Graphs of water level responses during testing can be reference in the Technical Memorandum in Appendix J. At the lowest specific capacity, the theoretical yield to the bottom of the casing is 1,451 L/min (319 IGPM). However, using the depth to the water bearing fracture at 104.9 mbgs (344 ft) results in a calculated theoretical yield of 125 L/s (1649 IGPM).

A water quality sample was collected and submitted to Maxxam Analytics for analysis of general chemistry parameters. The laboratory Certificate of Analysis can be referenced in the Technical Memorandum in Appendix J. The water quality is generally good with nitrate/nitrite, iron and manganese below the laboratory detection limit. Hardness (300 mg/L) is elevated which is typical of bedrock water in the area.

The drilling program at this site confirmed that two wells could be drilled at this site with high yield and good quality of water. A significant cost savings could occur if two wells were drilled at same site and utilize one water treatment pumphouse.

Location 2B - Existing Water Tower

This site provides the second most favourable location for a new groundwater source as the land is currently occupied by the existing water tower. The minimum buffer required for a water tower of this size is approximately 8 m expanding radially outwards from the pedestal to prevent damage from falling ice and snow. Since the land parcel is much larger than the required buffer area, placement of a water treatment pumphouse and a groundwater well on site can be achieved.

Drilling a groundwater well at the location would allow for easy connection into the existing water distribution system as the water tower is located on the same site. Additionally, this land parcel is outside of the PW1/PW2 WHPA and there are a few wells within 200 m of the area with theoretical yields greater than 10 L/s (Figure 2). An aggregate pit, located north of the site, would need to be considered from a source water protection perspective. A Groundwater Under the Direct Influence of Surface Water (GUDI) assessment would be required since the test site is located within 500 m of the Grand River.

Test Well - TW2-17:

TW2-17 was drilled at the water tower site between December 19, 2017 and January 3, 2018. The drilling took longer than expected due to the Christmas shutdown and equipment problems. Overburden consisting primarily of clay was present to a depth of 27.1 m (88.9 ft) below grade. Limestone was present from 27.1 m (88.9 ft) to 127.4 m (418 ft). The hole was then advanced into shale and was completed at a depth of 130.4 m (428 ft) below grade. Water was encountered from 29 m to 97 m (95 ft to 318 ft) below grade. A 50 mm (6-inch) steel casing was installed to a depth of 28.9 m (94.8 ft) below grade. The outside annulus was backfilled with bentonite Holeplug from surface to a depth of 7.6 m (25 ft).

The well was initially pumped at a rate of 114 L/min (25 IGPM) for 1 hour following completion. Water levels declined from 21.09 m to 28.35 m (69.2 ft to 93.0 ft) during the test with a resultant specific capacity of 0.26 L/s/m (1.05 IGPM/ft). The resultant theoretical yield using an available drawdown to the base of the casing is 2.04 L/s (26.9 IGPM). No further testing was completed at this location.

Location 2C - Fire Hall

Drilling of a groundwater well at this location would likely provide a reliable water source however, additional alterations to the site are required prior to well drilling and pumphouse construction. As mentioned previously, the fire hall site has an on-site septic system within proximity to the proposed pumphouse and well location. The risks associated with potential contamination are too great to have the septic system remain in service. Therefore, the septic system would have to be decommissioned and wastewater servicing would have to be transferred to the communal system prior to well drilling and pumphouse construction.

In addition to the septic system, the Water Pollution Control Plant and non-residential development in the vicinity poses a contamination threat and the site is also located close to the Grand River, so a GUDI assessment will be required.

Hydrogeological research shows that the site is outside of the WHPAs for the existing municipal wells and revealed that there is a well (7253805) east of the area which has a theoretical yield of 30 L/s and a well just west of the site (1702261) with a theoretical yield of 15 L/s. Therefore, the site can be considered as a potential water source in the future if additional supply is deemed necessary.

Due to its proximity to the Grand River the well would be classified as groundwater under the direct influence of surface water and would require additional treatment.

14.1.3 Alternative 3 - New Surface Water Source

Even though this alternative would provide a reliable water source for the community, the costs and environmental concerns associated with the construction of a surface water intake structure and the need for additional treatment has made surface water an unfavourable source for the Town.

14.1.4 Alternative 4 - Connection to Nearby Municipal System

Utilizing surplus from an nearby municipal system provides a viable option for many communities that require additional water supply. However, a surplus must be available in the nearby system for this alternative to be feasible.

Waldemar is the only municipal water system within proximity to Grand Valley and it currently has no surplus to increase the Town’s water supply. If surplus was available, the additional water supply would be treated by Waldemar’s water treatment system prior to distribution which may lead to potential water quality and water age issues. Therefore, increasing the Town’s water supply by utilizing surplus from a nearby municipal system is one of the least preferred alternatives.

14.2 Water Storage Alternatives

14.2.1 Alternative 1 – Do Nothing

This alternative serves as a reference point for comparing other alternative solutions. The "Do Nothing" alternative means no action is taken in addressing the problem statement and would result in not providing any additional water storage or capacity to the existing water supply system. It is not expected that any capital costs would be incurred for this option and it is expected that operating and maintenance costs for this option would be similar to those currently budgeted by the Township. A slight increase will occur as the existing equipment ages. Doing nothing does not accommodate approved and expected growth within the Township. It does not conform to local planning provisions. A restriction to the natural growth of a community will result in several negative socio-economic impacts. There will also be the need to modify and revise existing planning policies within the Township.

This alternative would not address the problem statement and was therefore not considered a viable solution.

14.2.2 Alternative 2 – Elevated Water Storage

This alternative provides the most preferred method of water storage for the Town. All the potential construction locations have minimal impacts on the surrounding environment and are located outside of GRCA regulation limits.

Introducing a secondary elevated water storage tank in the community will minimize alterations to the hydraulic profile and the associated pressure zone. If the new elevated tank can be operated at the same elevation as the existing tower, the system's overall complexity will not be affected.

In addition to the hydraulic profile, elevated water storage has a simpler operation overall as the water is distributed by gravity. These systems eliminate the dependence on "double pumping" where water is pumped once at the source and once at distribution, increasing power consumption and maintenance. The water supply system can be set up to operate to fill the Tower during non-peak hydro times to decrease the cost of pumping compared to that of grade level storage operation.

As part of the evaluation, the aesthetics or nuisance impacts of the alternative were reviewed as well. Elevated tanks are considered aesthetically unpleasing and obstructive by some; however, others consider it an identifiable landmark for the Town.

14.2.3 Alternative 3 – Grade Level Storage (Standpipe and Reservoir)

As mentioned previously, introducing grade level storage in the Town's water distribution system may alter the hydraulic profile. The system would need to be designed to ensure that water is distributed and supplied evenly between the existing water tower and the grade level storage tank to avoid water aging issues.

Additionally, grade level storage systems require "double pumping" since the water cannot be solely distributed by gravity. Standpipes can have partial distribution via gravity if placed at a high enough elevation; however, the water storage near the bottom of the tank cannot be distributed without pumps due to minimal elevation differences.

With the grade level storage option, the Town will require to have larger distribution pumps rated for peak hour demand as well as fire pumps to supply the required fire flow. This causes larger hydro costs for the operation of this option.

Similar to elevated storage tanks, standpipes can be considered aesthetically unpleasing or they can be viewed as an identifiable landmark. Alternatively, in-ground reservoirs typically have low profiles integrated into the surroundings resulting in limited aesthetic issues. However, to accommodate the required water storage volume, the in-ground reservoir would occupy a large amount of space underground compared to a vertical storage solution.

This alternative provides the lowest cost option for capital but has the highest operation and maintenance compared to the other water storage options.

14.3 Wastewater Treatment Alternatives

14.3.1 Alternative 1 – Do Nothing

This alternative serves as a reference point for comparing other alternative solutions. The "Do Nothing" alternative means no action is taken in addressing the problem statement and would result in not providing any additional capacity to the existing wastewater treatment system. It is not expected that any capital costs would be incurred for this option and it is expected that operating and maintenance costs for this option would be similar to those currently budgeted by the Township. A slight increase will occur as the existing equipment ages. Doing nothing does not accommodate approved and expected growth within the Township. It does not conform to local planning provisions. A restriction to the natural growth of a community will result in several negative socio-economic impacts. There will also be the need to modify and revise existing planning policies within the Township.

This alternative would not address the problem statement and was therefore not considered a viable solution.

14.3.2 Alternative 2 - Rerate the Existing WPCP

If this alternative is selected, it will act as an interim solution so the WPCP can accommodate peak flows during the stages of development, acting as a branch between the interim population (for example 2024) and the Official Plan population (2031). The solution will be implemented in a two-stage process including equalization storage construction and a plant rerating. The construction of the equalization tank and the rerating of the liquid treatment train of the WPCP based on the approved increases in pollutant loadings to the receiver would be classified as a Schedule B activity under the MCEA process and therefore would not require further investigation prior to project initiation. The Capacity Assessment Summary completed by XCG, specifically states that the rerating of the liquid treatment train is a Schedule A activity, however, with the adjustment to the pollutant loadings and the recently approved effluent limits (outlined below) the activity now falls under Schedule B requirements. The XCG Summary also states that the plant's average daily flow (ADF) capacity could be increased to 1,555 m^3/d with the inclusion of an equalization tank.

Rerating the existing WPCP as an interim solution is beneficial to the community because it provides treatment capacity sooner than it would become available through other means, such as a plant expansion. This would allow the supply of homes to continue to meet the demands of the community without interruption and assists the Town in accommodating its share of future population as allocated in the Ontario Growth Plan. While the cost of an interim solution could potentially deplete the financial resources needed to achieve a more complete solution, the Town has had discussions with local developers who are willing to completely finance an interim solution without affecting the Town's finances at all.

With the interim solution, the effluent requirements for the interim capacity of 1,555 m^3/d must be confirmed. Blue Sky Energy Engineering & Consulting Inc. prepared a memorandum on February 6, 2019 outlining proposed interim effluent requirements for the plant rerating and can be found in Appendix K. The MECP approved the interim effluent requirements on February 8, 2019 and they are provided in the following table.

Table 19: MECP Approved Interim Effluent Requirements

Effluent Parameters	Effluent Limits [1]		Effluent Objectives
	Average concentrations (mg/L)	Average loadings (kg/d)	Average concentrations (mg/L)
$cBOD_5$	10.0	15.6	8.0
Total Suspended Solids	10.0	15.6	8.0
Total Phosphorus	0.135	0.21	0.11
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	6.22	3.0
Spring (Apr 1 – May 31)	1.0	1.56	0.8
Summer (Jun 1 – Sep 31)	0.7	1.09	0.5
Fall (Oct 1 – Nov 30)	1.0	1.56	0.8
E coli [2]	200 cfu/100 mL	N/A	100 cfu/100 mL
pH [3]	6.0 - 9.5		6.5 - 8.5

Notes:
(1) Based on monthly average, unless otherwise noted
(2) Based on monthly geometric mean density
(3) Any single grab sample

Alternative 2A Location: Emma Street Sewage Pumping Station

Placing the equalization tank at the Emma Street SPS would aid in peak flow reduction; however, many alterations would need to be completed at the SPS to incorporate the tank. A second set of pumps, or a larger pump capable of handling the peak flow would be required to convey wastewater from the wet well to the equalization tank, and the SCADA system would need to be altered to ensure flows are diverted accordingly.

In addition to technical aspects, the Emma St. SPS is located within the floodplain of the Grand River and is surrounded by a residential area. Even though this site was formerly the WPCP, residents will be negatively impacted by having a large tank being placed across from their homes.

Also, due to the proximity of the residential area, additional odour control will be required along with a small control building to house the necessary equipment to ensure the contents in the equalization tank do not become septic.

Alternative 2B Location - Water Pollution Control Plant

Based on the analysis completed in Table 18 above, installation of an equalization tank at the WPCP is the more preferred alternative. The advantage of having the equalization tank at the WPCP is the availability of existing equipment. The WPCP already utilizes blowers for the aeration basins and other storage areas throughout the Plant. A portion of this could be diverted to the equalization tank, or an additional unit could be added on-site. Additionally, by placing the tank at the Plant, the potential aesthetic concerns of residents will also be reduced as there are no receptors in the immediate vicinity.

In addition to the equalization tank being constructed at the WPCP, the Emma St. SPS would require minimal upgrades to accommodate peak flows. Preliminary analysis of the forcemain and pumping capacity during the assessment show that upgrades would only be required for the pumps. The forcemain capacity at this stage can accommodate the future peak flow; however, the capacity will have to be confirmed during the detailed design stage.

14.3.3 Alternative 3 – Expansion of Existing WPCP

Based on the analysis completed in Table 18 above, expanding the existing WPCP to accommodate the future flows is the long-term preferred solution for the Town. The existing WPCP currently can accommodate a population of approximately 3,000. The interim solution of an equalization tank and a Plant rerating will not be able to accommodate the future flows, making a Plant expansion the feasible long-term solution. Prior to completing the design for the WPCP expansion, Phase 3 and 4 of a Schedule C Class Environmental Assessment will be required.

This alternative provides minimal impacts on the environment as the expansion location was already considered in the original Plant design. A preliminary layout of the expansion places the new buildings and tanks within the fenced area. Therefore, areas of concern such as the archaeological site located to east of the Plant can be avoided.

The main concern with the future Plant expansion is the phosphorous loading limit of the Grand River and the potential need for advanced treatment technologies. These concerns will have to be analyzed further during the detailed design phase of the project.

The MECP completed a review of the Assimilative Capacity Study in December 2018 and found it satisfactory and is included in Appendix L. Based on the review, the following effluent criteria were deemed acceptable for an average daily discharge rate of 2,131 m^3/d.

Table 20: MECP Approved Effluent Requirements

Effluent Parameters	Effluent Limits[1]		Effluent Objectives
	Average concentrations (mg/L)	**Average loadings (kg/d)**	**Average concentrations (mg/L)**
$cBOD_5$	10.0	21.3	8.0
Total Suspended Solids	10.0	21.3	8.0
Total Phosphorus	0.10	0.21	0.09
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	8.52	3.0
Spring (Apr 1 – May 31)	1.0	2.13	0.8
Summer (Jun 1 – Sep 31)	0.7	1.49	0.5
Fall (Oct 1 – Nov 30)	1.0	2.13	0.8
E coli	200 cfu/100 mL[2]	N/A	100 cfu/100 mL
pH	6.0 - 9.5		6.5 - 8.5

Notes:
(1) Based on monthly average
(2) Based on monthly geometric mean density

14.3.4 Alternative 4 – Connection to an Existing Municipal System

This alternative was not feasible for the Town as the nearest municipal system within proximity to Grand Valley is Orangeville. The distance between the two Towns is too vast for this alternative to be considered viable. Additionally, there may not be enough available treatment capacity at the Orangeville Wastewater Treatment Plant to accommodate all the demand associated with the Official Plan population. For the Town's benefit, it is more logical to accommodate potential upgrades or expansions at the existing WPCP than to utilized potential surplus capacity in another municipal system.

15.0 Preferred Alternative

The preferred alternatives including an estimated timeline for construction are summarized below.

Estimated Timeline	**Preferred Alternative**
2019/2020	Rerating of existing WPCP to 1,555 m^3/day and construction of a wastewater equalization tank at the existing WPCP site
2020	New groundwater production well and water treatment pumphouse at the park site
2021	New elevated water storage in the form of a water tower within the WPCP boundary
2021 to 2029	Complete Schedule C EA, design, tender and build expansion to existing WPCP
2024	Additional groundwater production well at the park site
Per Development Process	Two new sewage pumping stations (southeast and northeast quadrants of Town)

The cost for drilling the additional required production well on the park site and connecting to the proposed water treatment pumphouse will be $370,000. This cost includes drilling the well as well as installation of the additional treatment process piping in the treatment pumphouse.

15.1 Preferred Alternatives - Class EA Requirements

Below is a summary of the Class EA requirements for each of the preferred alternative projects.

Preferred Alternative	**Class EA Requirements**
Rerating of existing WPCP to 1,555 m^3/day and construction of a wastewater equalization tank at the existing WPCP site	• Schedule B Class EA • This Master Plan EA satisfies all Class EA requirements for this project.
New groundwater production well and water treatment pumphouse at the park site	• Schedule B Class EA • This Master Plan EA satisfies all Class EA requirements for this project.
New elevated water storage in the form of a water tower within the WPCP boundary	• Schedule B Class EA • This Master Plan EA satisfies all Class EA requirements for this project.
Complete Schedule C EA for the expansion of the existing WPCP to	• Schedule C Class EA

Preferred Alternative	Class EA Requirements
design, tender and build expansion to existing WPCP including upgrades to Emma St SPS.	• Phase 3 and 4 will be required
Two new sewage pumping stations (southeast and northeast quadrants of Town)	Schedule B Class EA • This Master Plan EA satisfies all Class EA requirements for this project.
Additional groundwater production well at the park site	• Schedule B Class EA • This Master Plan EA satisfies all Class EA requirements for this project.

15.2 Impacts and Mitigation

The following measures should be implemented to mitigate negative impacts from the proposed infrastructure upgrades on the environmental features of the study area. All design and construction reports and plans will be based on a best management approach that center on the prevention of impacts, protection of the existing environment and opportunities for rehabilitation and enhancement of the impacted areas.

15.2.1 Surface Water/Hydrology & Soils and Sedimentation

Effect

1. Potential for sediments to enter watercourse as a result of the following project activities:
   - Site clearing;
   - Stockpiling;
   - Excavation; and
   - Construction.
2. Potential for localized water quality impacts as a result of spills.

Mitigation

1. The footprint of disturbed area will be minimized as much as possible.
2. An erosion and sediment control plan will be developed. Implementation of the erosion and sediment control measures will conform to recognized standard specifications such as Ontario Provincial Standards Specification (OPSS).

   Any stockpiled material will be stored at a safe distance from the waterway to ensure that no deleterious substances enter the water.

Sediment and erosion control measures (silt curtains, silt fence) will be installed and will be maintained during the work phase and until the site has been stabilized. Control measures should be inspected daily to ensure they are functioning and are maintained as required. If control measures are not functioning properly, no further work will occur until the problem is resolved.

Any temporary mitigation measures will be installed prior to the commencement of any site clearing, grubbing, excavation, filling or grading works and will be maintained on a regular basis, prior to and after runoff events.

15.2.2 Fish and Fish Habitat

Effect

1. Potential water quality impairments (sediment loading; fuels and lubricants from machinery). No in-water works will be undertaken.

Mitigation

1. Sediment and erosion control measures (such as silt fence barriers, turbidity curtains, etc.) will be installed and maintained at the outlet during the work phase and until the site has been stabilized. Control measures will be inspected daily to ensure they are functioning and are maintained as required. If control measures are not functioning properly, no further work will occur until the problem is resolved. All temporary erosion and sediment control measures will be installed in accordance with recognized provincial standards. Extra silt fence/turbidity curtain will be on site, should additional sediment control be required.

2. Prevent any in-water operation of heavy equipment and minimize operation on the banks of the watercourse. All equipment fueling, and maintenance will be done a safe distance from the edge of the water to ensure that no deleterious substances enter the water.

3. Any stockpiled material will be stored and stabilized away from the watercourse. All materials and equipment used for the purpose of site preparation and project completion should be operated and stored in a manner that prevents any deleterious substance (e.g., petroleum products, silt, etc.) from entering the water.

4. All disturbed areas of the work site should be stabilized immediately and re-vegetated as soon as conditions allow.

15.2.3 Vegetation, Wildlife/Habitat

Effect

1. Loss of vegetation/habitat loss. However, the project is primarily proposed in previously disturbed areas where limited vegetation/habitat exists. No direct impacts to vegetation or wildlife/habitat are anticipated.

Mitigation

1. Minimize disturbance to existing vegetation. Disturbed areas will be stabilized and re-vegetated upon project completion and restored to a pre-disturbed state. Topsoil will be stockpiled separately and used for restoration to facilitate natural regeneration of native species.

15.2.4 Noise/Vibration/Air Quality

Effect

1. Temporary nuisance noise and increased dust in air during construction activities.

Mitigation

1. Noise control measures, such as restricted hours of operation, the use of appropriate machinery/mufflers, will be implemented where required. Vehicles/machinery and equipment should be in good repair, equipped with emission controls, as applicable, and operated within regulatory requirements. If required, dust control measures may include the wetting of surfaces using a non-chloride based compound to protect water quality.

15.2.5 Human Health and Safety

Effect

1. Potential safety hazard from construction activities, heavy equipment and increased traffic.

Mitigation

1. The contactor will be required to implement a Health and Safety Plan (OHSA 1990).

16.0 Follow-up Commitments

The completion of the Master Plan Class Environmental Assessment process does not mean that a project can proceed directly. There are details, beyond the scope of a Master Plan Class EA undertaking that must be expanded upon by the Town before the project can proceed.

If concerns arise regarding this project which cannot be resolved in discussion with the Town, a person or party may request that the Minister of Environment make an Order for the project to comply with Part II of the *Environmental Assessment Act* (referred to as a Part II Order), which addresses individual Environmental Assessments. Requests must be received by the Minister within 30 calendar days of the Notice of Completion.

If the Minister does not receive Part II Orders regarding this project, then the project will continue forward to detailed design, approvals processes, and implementation of the preferred design.

16.1 Permits and Approvals

The Township will be required to secure all necessary permits and/or authorizations required for the project. The following is a list of the permits that will be potentially required for this project:

- Amendment to the Permit to Take Water and Drinking Water Works Permit from the MECP;
- Amendment to the Environmental Compliance Approval (C of A) from the MECP; and
- Building Permit from the Township Building Department.

[The Difference is our People]

Appendix A

Certificate of Approval (C of A) No. 9706-7KWQ57

Ministry of the Environment
Ministère de l'Environnement

CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS

NUMBER 9706-7KWQ57
Issue Date: February 2, 2009

The Corporation of the Township of East Luther Grand Valley
Post Office Box No. 249
Grand Valley, Ontario
L0N 1G0

Site Location: Grand Valley Wastewater Treatment Plant
Industrial Road, Part of Lot 31 Concession 1 and Part of Lot 31 Concession 2
East Luther Grand Valley Township, County of Dufferin
L0N 1G0

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

constructing a new wastewater treatment plant with a *Rated Capacity* of 1,244 m^3/day located east of County Road 25 and south of the Grand River, Township of East Luther Grand Valley, County of Dufferin, and constructing a new pumping station and forcemain to be located on the west side of Emma Street and south of the existing wastewater treatment plant site, consisting of the following:

PROPOSED WORKS:

Main Pumping Station and Forcemain

A sewage pumping station located on Emma Street on Part of Lot 30, Concession 2, consisting of the following:

- one (1) rectangular precast concrete wet well with approximate dimension of 3.0 m x 3.8 m x 11.0 m deep equipped with two (2) submersible VFD sewage pumps (one duty, one standby) each with a rated capacity of 88.9 L/sec at 48.9 m TDH and one (1) submersible VFD sewage pump (jockey pump) with a rated capacity of 29.5 L/sec at 34.1 m TDH, conveying sewage to the sewage treatment plant via a new forcemain described below;

- one (1) approximately 1,440 m long new 250 mm diameter forcemain extending from the main pumping station along the west side of Emma Street, west side of Water Street (County Road No. 25), along the north side of Melody Lane, south through an easement, east along the Upper Grand Trailway, south through an easement, and east along Industrial Road, equipped with a combination air release/vacuum breaker valve and a chamber, discharging to the inlet works of the wastewater treatment plant described below;

- one (1) 125 kW diesel standby power generator installed in a sound attenuated outdoor enclosure and mounted on a concrete pad located south of the sewage pumping station valve chamber; and

- including all controls and associated appurtenances.

Wastewater Treatment Plant

Septage Receiving Station

- one (1) cast-in-place concrete septage storage tank with approximate dimension of 2.8 m x 5.4 m x 3.2 m high located in the headworks building, equipped with septage unloading facility, spill containment system, grinding and screening system, a flow meter, and two (2) septage pumps each with a rated capacity of 9.0 L/sec @ 8.0 m TDH, discharging septage in a controlled manner to the inlet works described below;

Inlet Works

- one (1) 600 mm wide x 1,500 mm deep inlet channel equipped with one (1) 25 mm opening manual bar screen, one (1) 800 mm wide x 1,500 mm deep inlet channel equipped with one (1) 6.0 mm opening mechanical screen, discharging to grit separators described below, one (1) 800 mm wide overflow weir, and one 400 mm diameter overflow pipe;

- two (2)1,500 mm diameter grit separators each with a design peak flow capacity of 3,840 m^3/day equipped with a 200 mm diameter inlet gate valve and associated grit classifier, discharging to the aeration tanks and storm tank described below;

Flow Equalization Tank (Storm Tank)

- one (1) 400 m^3 capacity reinforced concrete flow equalization tank (storm tank) with approximate dimensions of 25 m long x 4 m wide x 4 m SWD, receiving flows from the a flow splitter chamber during influent flows exceeding 5,300 m^3/day, equipped with a return pipe to the inlet works via an on-site wastewater pumping station described below and an overflow pipe discharging to a UV disinfection system;

On-site Wastewater Sewage Pumping Station

- one (1) on-site wastewater pumping station with approximate dimensions of 2.4 m diameter and 7.8 m deep, equipped with two (2) submersible sewage pumps each with a rated capacity of 8.0 L/sec @ 14.9 m TDH (one duty, one standby) returning decant water, filter reject, on-site general sanitary sewage, and wastewater from the equalization tank to the inlet works described above;

Aeration Tanks

- one (1) influent splitter chamber equipped with adjustable gates designed to split flows evenly between the three (3) aeration tanks;

- three (3) aeration tanks each with approximate dimensions of 25.0 m long x 4.0 m wide x 4.0 m SWD, each aeration tank equipped with fine bubble membrane disc aeration system having three (3) separate sections where air flow rate to each section is regulated using an air flow control system;

- three (3) 14.3 m^3/min capacity positive displacement air blowers (two duty, one standby) providing air to all three aeration tanks; and

- including all controls and associated appurtenances.

Secondary Clarifiers

- two (2) secondary clarifiers each with approximate dimensions of 9.8 m diameter x 4.2 m SWD providing a total surface area of 150 m^2, equipped with a scum removal system and removable covers for use when necessary;

- one (1) scum chamber with a storage capacity of approximately 15 m^3, equipped with two (2) scum pumps each with a rated capacity of 7.8 L/sec at 15.24 m TDH returning scum to the primary digester;

- two (2) waste activated sludge pumps (one duty, one standby), each with a rated capacity of 14.4 L/sec at TDH of 11.89 m;

- three (3) return activated sludge pumps (two duty, one standby), each with a rated capacity of 14.4 L/sec at TDH of 9.12 m; and

- including all controls and associated appurtenances.

Effluent Filtration

- one (1) manual screen;

- four (4) continuous up-flow sand filters designed for a peak flow rate of 5,300 m^3/day, providing a total filtration area of 18.6 m^2, media depth of 2.0 m, and a surface loading rate of 11.6 m/hr, equipped with a backwash return pipe to the on-site wastewater pumping station, discharging to a UV disinfection system described below;

- two (2) 0.22 m^3/min capacity positive displacement air compressor (one duty, one standby) providing air to all four (4) effluent filters; and

Effluent Disinfection

- one (1) UV disinfection system (Trojan UV 3000B Model) designed to handle a peak flow of 7,680 m^3/day, consisting of two (2) banks, each bank containing seven (7) modules, and each module containing eight (8) low pressure high intensity UV lamps (total of 112 lamps), designed to achieve a UV dose of 30.0 mJ/cm^2 at a minimum of 55% UV transmittance, discharging to an effluent outfall described below;

Effluent Outfall

- one (1) approximately 124 m long 450 mm diameter sanitary sewer equipped a concrete outlet headwall and rip rap lined channel, discharging to the Grand River;

Phosphorus Removal

- two (2)19.1 L/hr capacity alum metering pumps with operating range between 1.2 to 12.0 L/hr (one duty, one shared standby) dosing alum upstream of secondary clarifiers;

- one (1)19.1 L/hr capacity alum metering pump with operating range between 1.2 to 12.0 L/hr dosing alum at the inlet to the equalization tank when required;

- two (2) 7.5 L/hr capacity alum metering pumps with operating range between 0.06 to 1.5 L/hr (one duty, one standby) adding alum to the tertiary filtration feed channel;

- one (1) approximately 9.6 m^3 capacity alum solution storage tank and one (1) 240 L capacity alum solution day storage tank;

Aerobic Sludge Digesters

- one (1) primary aerobic digester with a capacity of 500 m^3, equipped with coarse bubble diffused aeration system with an overflow to the secondary aerobic digester described below;

- one (1) secondary aerobic digester with a capacity of 250 m^3, equipped with coarse bubble diffused aeration system, a supernatant decanting system, and overflow, discharging via the on-site wastewater pumping station to the inlet works;

- two (2) air blowers each with a capacity of 22.48 m^3/min providing air to the coarse diffused aeration system of the primary and secondary aerobic digesters;

Biosolids Storage Tank

- one (1) 2,200 m^3 storage capacity glass lined digested biosolids storage tank with approximate dimensions of 17 m diameter and 10 m high, equipped with a 200 mm diameter decant pipe discharging to the on-site wastewater pumping station, two (2) 157.7 L/sec capacity @ 13.6 m TDH biosolids mixing pumps (one duty, one standby), and two (2) 17.0 L/sec capacity @ 20.97 m TDH biosolids transfer pumps;

- one (1) biosolids loading facility with spill containment;

- one (1) overflow line from storage tank to on-site wastewater pumping station;

Standby Power

- one (1) 400 kW capacity diesel standby power generator installed in a sound attenuated outdoor enclosure located west of the Administrative Building;

Control Building

- Control building housing an office, lunch/meeting room, laboratory, washrooms, blowers, chemical metering pumps and feed systems, electrical and control systems, SCADA, piping, heating and ventilation.

- including all controls and associated appurtenances.

Stormwater Management Facility

Establishment of a stormwater management facility to service a 2.83 ha drainage area out of the total drainage area of 7.33 ha at the new Grand Valley Wastewater Treatment Plant, located at the northeast corner of the site, designed to provide quality control for stormwater runoff from storm events up to 1:100 year return frequency, consisting of the following:

- one (1) extended detention wet pond having a permanent pool depth of 1.0 m providing a permanent storage capacity of 215 m^3, and an active storage depth of 0.1 m providing extended detention storage capacity of 77 m^3 (total storage capacity of 292 m^3), equipped with a forebay, an outlet structure consisting of a 300 mm diameter reverse slope PVC pipe fitted with a 50 mm diameter orifice plate and 25 mm perforation at the submerged end of the pipe, a 1200 mm diameter manhole, and a 2.0 m wide 3H:1V side slopes emergency overflow structure, discharging to an existing ditch and eventually to the Grand River;

- including all controls and associated appurtenances.

all in accordance with the Application for Approval of Municipal and Private Sewage Works submitted by the Township of East Luther Grand Valley dated October 15, 2008 and design specifications and drawings prepared by R. J. Burnside and Associates Limited., Collingwood, Ontario and the following documents:

1. " Township of East Luther Grand Valley, ELGV Wastewater Treatment Plant Design Brief" dated

October 15, 2008 prepared by R. J. Burnside and Associates Limited., Collingwood, Ontario.

For the purpose of this Certificate of Approval and the terms and conditions specified below, the following definitions apply:

"*Act* " means the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended;

"*BOD5* " (also known as $TBOD_5$) means five day biochemical oxygen demand measured in an unfiltered sample and includes carbonaceous and nitrogenous oxygen demand;

"*By-pass*" means any discharge from the *Works* that does not undergo any treatment before it is discharged to the environment;

"*CBOD5* " means five day carbonaceous (nitrification inhibited) biochemical oxygen demand measured in an unfiltered sample;

"*Certificate* " means this entire certificate of approval document, issued in accordance with Section 53 of the *Act* , and includes any schedules;

"*Daily Concentration* " means the concentration of a contaminant in the effluent discharged over any single day, as measured by a composite or grab sample, whichever is required;

"*Director* " means any *Ministry* employee appointed by the Minister pursuant to section 5 of the *Act* ;

"*District Manager* " means the District Manager of the Guelph District Office of the Ministry;

"*E. Coli* " refers to the thermally tolerant forms of Escherichia that can survive at 44.5 degrees Celsius;

"*Geometric Mean Density* " is the nth root of the product of multiplication of the results of n number of samples over the period specified;

"*Ministry* " means the Ontario Ministry of the Environment;

"*Monthly Average Concentration* " means the arithmetic mean of all *Daily Concentrations* of a contaminant in the effluent sampled or measured, or both, during a calendar month;

"*Monthly Average Daily Flow* " means the cumulative total sewage flow to the sewage works during a calendar month divided by the number of days during which sewage was flowing to the sewage works that month;

"*Monthly Average Loading* " means the value obtained by multiplying the *Monthly Average Concentration* of a contaminant by the *Monthly Average Daily Flow* over the same calendar month:

"*Owner* " means The Corporation of the Township of East Luther Grand Valley and includes its successors and assignees;

"*Peak Flow Rate* " means the maximum rate of sewage flow for which the plant or process unit was designed;

"Proposed Works " means the sewage works described in the *Owner* 's application, this *Certificate* and in the supporting documentation referred to herein, to the extent approved by this *Certificate* ;

"*Rated Capacity* " means the *Average Daily Flow* for which the *Works* are approved to handle;

"Substantial Completion" has the same meaning as *"substantial performance* " in the Construction Lien Act; and

"*Works* " means the sewage works described in the *Owner* 's application, this *Certificate* and in the supporting documentation referred to herein, to the extent approved by this *Certificate* .

You are hereby notified that this approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL PROVISIONS

(1) The *Owner* shall ensure that any person authorized to carry out work on or operate any aspect of the *Works* is notified of this *Certificate* and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

(2) Except as otherwise provided by these Conditions, the *Owner* shall design, build, install, operate and maintain the *Works* in accordance with the description given in this *Certificate* , the application for approval of the works and the submitted supporting documents and plans and specifications as listed in this *Certificate* .

(3) Where there is a conflict between a provision of any submitted document referred to in this *Certificate* and the Conditions of this *Certificate* , the Conditions in this *Certificate* shall take precedence, and where there is a conflict between the listed submitted documents, the document bearing the most recent date shall prevail.

(4) Where there is a conflict between the listed submitted documents, and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

(5) The requirements of this *Certificate* are severable. If any requirement of this *Certificate* , or the application of any requirement of this *Certificate* to any circumstance, is held invalid or unenforceable, the application of such requirement to other circumstances and the remainder of this certificate shall not be affected thereby.

2. EXPIRY OF APPROVAL

The approval issued by this *Certificate* will cease to apply to those parts of the *Works* which have not been constructed within five (5) years of the date of this *Certificate* .

3. CHANGE OF OWNER

(1) The *Owner* shall notify the *District Manager* and the *Director* , in writing, of any of the following changes within 30 days of the change occurring:

(a) change of *Owner* ;
(b) change of address of the *Owner* ;
(c) change of partners where the *Owner* is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act, R.S.O. 1990, c.B17 shall be included in the notification to the *District Manager* ;
(d) change of name of the corporation where the *Owner* is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification to the *District Manager* ;

(2) In the event of any change in ownership of the *Works* , other than a change to a successor municipality, the *Owner* shall notify in writing the succeeding owner of the existence of this *Certificate* , and a copy of such notice shall be forwarded to the *District Manager* and the *Director* .

4. UPON THE SUBSTANTIAL COMPLETION OF THE WORKS

(1) Upon the *Substantial Completion* of the *Proposed Works* , the Owner shall prepare a statement, certified by a Professional Engineer, that the works are constructed in accordance with this *Certificate* , and upon request, shall make the written statement available for inspection by Ministry personnel.

(2) Within one (1) year of the *Substantial Completion* of the *Proposed Works* , a set of as-built drawings showing the works “as constructed” shall be prepared. These drawings shall be kept up to date through revisions undertaken from time to time and a copy shall be retained at the *Works* for the operational life of the *Works* .

5. BY-PASSES

(1) Any *By-pass* of sewage from any portion of the *Works* is prohibited, except where:

(a) the *Peak Flow Rate* would exceed 5,300 cubic metres per day;

(b) it is necessary to avoid loss of life, personal injury, danger to public health or severe property damage;

(c) the *District Manager* agrees that it is necessary for the purpose of carrying out essential maintenance and the *District Manager* has given prior written acknowledgment of the *By-pass* ; or

(2) The *Owner* shall collect at least one (1) grab sample of the *By-pass* and have it analyzed for the parameters outlined in Condition 7 using the protocols in Condition 9.

(3) The *Owner* shall maintain a logbook of all *By-pass* events which shall include, at a minimum, the time, location, duration, quantity of *By-pass* , the authority for *By-pass* pursuant to subsection (1), and the reasons for the occurrence.

(4) The *Owner* shall, in the event of a *By-pass* event pursuant to subsection (1), disinfect the by-passed effluent prior to it reaching the receiver such that the receiver is not negatively impacted.

6. EFFLUENT OBJECTIVES

(1) The *Owner* shall use best efforts to design, construct and operate the *Works* with the objective that the concentrations of the materials named below as effluent parameters are not exceeded in the effluent from the *Works* .

Table 1 - Effluent Objectives

Effluent Parameter	**Concentration Objective** (milligrams per litre unless otherwise indicated)
CBOD5	8.0
Total Suspended Solids	8.0
Total Phosphorus	0.13
Total Ammonia Nitrogen Winter (Dec 1 to March 31)	3.0
Total Ammonia Nitrogen Spring (Apr 1 to May 31)	0.8
Total Ammonia Nitrogen Summer (June 1 to Sep 30)	0.6
Total Ammonia Nitrogen Fall (Oct 1 to Nov 30)	0.8
E. Coli	100 organism/ 100 mL

(2) The *Owner* shall use best efforts to:

(a) maintain the pH of the effluent from the *Works* within the range of 6.5 to 8.5, inclusive, at all times;

(b) operate the works within the *Rated Capacity* of the *Works* ;

(3) The *Owner* shall include in all reports submitted in accordance with Condition 10 summary of the efforts made and results achieved under this Condition.

7. EFFLUENT LIMITS

(1) The *Owner* shall design and construct the *Proposed Works* and operate and maintain the *Works* such that the concentrations and waste loadings of the materials named below as effluent parameters are not exceeded in the effluent from the *Works* .

Table 2 - Effluent Limits		
Effluent Parameter	**Average Concentration** (milligrams per litre unless otherwise indicated)	**Average Waste Loading** (kilograms per day unless otherwise indicated)
Column 1	Column 2	Column 3
CBOD5	10.0	12.4
Total Suspended Solids	10.0	12.4
Total Phosphorus	0.15	0.19
Total Ammonia Nitrogen Winter (Dec 1 to March 31)	4.0	4.98
Total Ammonia Nitrogen Spring (Apr 1 to May 31)	1.0	1.24
Total Ammonia Nitrogen Summer (June 1 to Sep 30)	0.7	0.87
Total Ammonia Nitrogen Fall (Oct 1 to Nov 30)	1.0	1.24
pH of the effluent maintained between 6.0 to 9.5, inclusive, at all times		

(2) For the purposes of determining compliance with and enforcing subsection (1):

(a) The *Monthly Average Concentration* of a parameter named in Column 1 of subsection (1) shall not exceed the corresponding maximum concentration set out in Column 2 of subsection (1).

(b) The *Monthly Average Loading* of a parameter named in Column 1 of subsection (1) shall not exceed the corresponding maximum waste loading set out in Column 3 of subsection (1).

(c) The pH of the effluent shall be maintained within the limits outlined in subsection (1), at all times.

(3) Notwithstanding subsection (1), the *Owner* shall operate and maintain the *Works* such that the effluent is continuously disinfected so that the monthly *Geometric Mean Density* of *E. Coli*

does not exceed 200 organisms per 100 millilitres of effluent discharged from the *works* .

(4) Paragraph (a), (b), and (c) of subsection (2) shall apply thirty (30) days after the commencement of operation of the *Proposed Works* .

(5) The effluent limit set out in subsection (3) shall apply thirty (30) days after the commencement of operation of the *Proposed Works* .

8. OPERATION AND MAINTENANCE

(1) The *Owner* shall exercise due diligence in ensuring that, at all times, the *Works* and the related equipment and appurtenances used to achieve compliance with this *Certificate* are properly operated and maintained. Proper operation and maintenance shall include effective performance, adequate funding, adequate operator staffing and training, including training in all procedures and other requirements of this *Certificate* and the *Act* and regulations, adequate laboratory facilities, process controls and alarms and the use of process chemicals and other substances used in the *Works* .

(2) The *Owner* shall prepare an operations manual within six (6) months of *Substantial Completion* of the *Proposed Works* , that includes, but not necessarily limited to, the following information:

(a) operating procedures for routine operation of the *Works* ;

(b) inspection programs, including frequency of inspection, for the *Works* and the methods or tests employed to detect when maintenance is necessary;

(c) repair and maintenance programs, including the frequency of repair and maintenance for the *Works* ;

(d) procedures for the inspection and calibration of monitoring equipment;

(e) a spill prevention control and countermeasures plan, consisting of contingency plans and procedures for dealing with equipment breakdowns, potential spills and any other abnormal situations, including notification of the *District Manager* ; and

(f) procedures for receiving, responding and recording public complaints, including recording any follow-up actions taken.

(3) The *Owner* shall maintain the operations manual current and retain a copy at the location of the *Works* for the operational life of the *Works* . Upon request, the *Owner* shall make the manual available to *Ministry* staff.

(4) The *Owner* shall provide for the overall operation of the *Works* with an operator who holds a licence that is applicable to that type of facility and that is of the same class as or higher than the class of the facility in accordance with Ontario Regulation 129/04.

9. MONITORING AND RECORDING

The *Owner* shall, upon commencement of operation of the *Works*, carry out the following monitoring program:

(1) All samples and measurements taken for the purposes of this *Certificate* are to be taken at a time and in a location characteristic of the quality and quantity of the effluent stream over the time period being monitored.

(2) For the purposes of this condition, the following definitions apply:

(a) Daily means once each day;
(b) Weekly means once each week; and
(c) Monthly means once every month;

(3) Samples shall be collected at the following sampling points, at the frequency specified, by means of the specified sample type and analyzed for each parameter listed and all results recorded:

Table 3 - Influent Monitoring Sampling Location: Inlet Works		
Parameters	**Sample Type**	**Frequency**
BOD5	Grab	Monthly
Total Suspended Solids	Grab	Monthly
Total Phosphorus	Grab	Monthly
Total Kjeldahl Nitrogen (TKN)	Grab	Monthly
E. Coli	Grab	Monthly
pH	Grab	Monthly
Temperature	Grab	Monthly

Table 4 - Effluent Monitoring Sampling Location: Effluent Sump after UV Disinfection		
Parameters	**Sample Type**	**Frequency**
CBOD5	Composite	Weekly
Total Suspended Solids	Composite	Weekly
Total Phosphorus	Composite	Weekly
Total Ammonia Nitrogen	Composite	Weekly
E. Coli	Grab	Weekly
pH	Grab	Weekly
Temperature	Grab	Weekly

(4) The methods and protocols for sampling, analysis and recording shall conform, in order of precedence, to the methods and protocols specified in the following:

(a) the Ministry's Procedure F-10-1, “Procedures for Sampling and Analysis Requirements for Municipal and Private Sewage Treatment Works (Liquid Waste Streams Only), as amended from time to time by more recently published editions;

(b) the Ministry's publication "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater" (January 1999), ISBN 0-7778-1880-9, as amended from time to time by more recently published editions;

(c) the publication "Standard Methods for the Examination of Water and Wastewater" (21st edition), as amended from time to time by more recently published editions;

(5) The temperature and pH of the effluent from the *Works* shall be determined in the field at the time of sampling for Total Ammonia Nitrogen. The concentration of un-ionized ammonia shall be calculated using the total ammonia concentration, pH and temperature using the methodology stipulated in "Ontario's Provincial Water Quality Objectives" dated July 1994, as amended, for ammonia (un-ionized).

(6) The measurement frequencies specified in subsection (2) in respect to any parameter are minimum requirements which may, after 24 months of monitoring in accordance with this Condition, be modified by the *District Manager* in writing from time to time.

(7) The *Owner* shall install and maintain (a) continuous flow measuring device(s), to measure the flow rate of the effluent from the *Works* with an accuracy to within plus or minus 15 per cent (+/- 15%) of the actual flow rate for the entire design range of the flow measuring device, and record the flow rate at a daily frequency.

(8) The *Owner* shall retain for a minimum of three (3) years from the date of their creation, all records and information related to or resulting from the monitoring activities required by this *Certificate* .

10. REPORTING

(1) One week prior to the start up of the operation of the *Proposed Works* , the *Owner* shall notify the *District Manager* in writing of the pending start up date.

(2) Ten (10) days prior to the date of a planned *By-pass* being conducted pursuant to Condition 5 and as soon as possible for an unplanned *By-pass* , the *Owner* shall notify the *District Manager* (in writing) of the pending start date, in addition to an assessment of the potential adverse effects on the environment and the duration of the *By-pass* .

(3) The *Owner* shall report to the *District Manager* or designate, any exceedence of any parameter specified in Condition 7 orally, as soon as reasonably possible, and in writing within seven (7) days of the exceedence.

(4) In addition to the obligations under Part X of the Environmental Protection Act, the *Owner* shall, within 10 working days of the occurrence of any reportable spill as defined in Ontario Regulation 675/98, bypass or loss of any product, by-product, intermediate product, oil, solvent, waste material or any other polluting substance into the environment, submit a full written report of the occurrence to the *District Manager* describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation.

(5) The *Owner* shall, upon request, make all manuals, plans, records, data, procedures and supporting documentation available to *Ministry* staff.

(6) The *Owner* shall prepare a performance report, and upon request submit to the *District Manager*, on an annual basis, within ninety (90) days following the end of the period being reported upon. The first such report shall cover the first annual period following the commencement of operation of the *Works* and subsequent reports shall be submitted to cover successive annual periods following thereafter. The reports shall contain, but shall not be limited to, the following information:

(a) a summary and interpretation of all monitoring data and a comparison to the effluent limits outlined in Condition 7, including an overview of the success and adequacy of the *Works* ;

(b) a description of any operating problems encountered and corrective actions taken;

(c) a summary of all maintenance carried out on any major structure, equipment, apparatus, mechanism or thing forming part of the *Works* ;

(d) a summary of any effluent quality assurance or control measures undertaken in the reporting period;

(e) a summary of the calibration and maintenance carried out on all effluent monitoring equipment; and

(f) a description of efforts made and results achieved in meeting the Effluent Objectives of Condition 6.

(g) a tabulation of the volume of sludge generated in the reporting period, an outline of anticipated volumes to be generated in the next reporting period and a summary of the locations to where the sludge was disposed;

(h) a summary of any complaints received during the reporting period and any steps taken to address the complaints;

(i) a summary of all *By-pass* , spill or abnormal discharge events; and

(j) any other information the *District Manager* requires from time to time.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the *Works* are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the *Certificate* and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review. The condition also advises the Owners their responsibility to notify any person they authorized to carry out work pursuant to this *Certificate* the existence of this *Certificate* .

2. Condition 2 is included to ensure that the *Works* are constructed in a timely manner so that standards applicable at the time of Approval of the *Works* are still applicable at the time of construction, to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the *Ministry* records are kept accurate and current with respect to the approved works and to ensure that subsequent owners of the *Works* are made aware of the *Certificate* and continue to operate the *Works* in compliance with it.

4. Condition 4 is included to ensure that the *Works* are constructed in accordance with the approval and that record drawings of the *Works* "as constructed" are maintained for future references.

5. Condition 5 is included to indicate that by-passes of untreated sewage to the receiving watercourse is prohibited, save in certain limited circumstances where the failure to *By-pass* could result in greater injury to the public interest than the *By-pass* itself where a *By-pass* will not violate the approved effluent requirements, or where the *By-pass* can be limited or otherwise mitigated by handling it in accordance with an approved contingency plan. The notification and documentation requirements allow the *Ministry* to take action in an informed manner and will ensure the *Owner* is aware of the extent and frequency of *By-pass* events.

6. Condition 6 is imposed to establish non-enforceable effluent quality objectives which the *Owner* is obligated to use best efforts to strive towards on an ongoing basis. These objectives are to be used as a mechanism to trigger corrective action proactively and voluntarily before environmental impairment occurs and before the compliance limits of Condition 6 are exceeded..

7. Condition 7 is imposed to ensure that the effluent discharged from the *Works* to the Grand River meets the *Ministry* 's effluent quality requirements thus minimizing environmental impact on the receiver and to protect water quality, fish and other aquatic life in the receiving water body.

8. Condition 8 is included to require that the *Works* be properly operated, maintained, funded, staffed and equipped such that the environment is protected and deterioration, loss, injury or damage to any person or property is prevented. As well, the inclusion of a comprehensive operations manual governing all significant areas of operation, maintenance and repair is prepared, implemented and kept up-to-date by the owner and made available to the *Ministry* . Such a manual is an integral part of the operation of the *Works* . Its compilation and use should assist the *Owner* in staff training, in proper plant operation and in identifying and planning for contingencies during possible abnormal conditions. The manual will also act as a benchmark for *Ministry* staff when reviewing the *Owner'* s operation of the work.

9. Condition 9 is included to enable the *Owner* to evaluate and demonstrate the performance of the *Works* , on a continual basis, so that the *Works* are properly operated and maintained at a level which is consistent with the design objectives and effluent limits specified in the *Certificate* and that the *Works* does not cause any impairment to the receiving watercourse.

10. Condition 10 is included to provide a performance record for future references, to ensure that the *Ministry* is made aware of problems as they arise, and to provide a compliance record for all the terms and conditions outlined in this *Certificate,* so that the *Ministry* can work with the *Owner* in resolving any problems in a timely manner.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act , R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto, Ontario
M5G 1E5

AND

The Director
Section 53, *Ontario Water Resources Act*
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 2nd day of February, 2009

Mansoor Mahmood, P.Eng.
Director
Section 53, *Ontario Water Resources Act*

SH/
c: District Manager, MOE Guelph
Jeff Langlois, R.J. Burnside & Associates Limited

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Appendix B

Master Servicing Plan Update

Appendix B

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Technical Memorandum

Date: May 30, 2014 **Project No.:** 300035222.0000

Project Name: Grand Valley Master Servicing Plan (MSP) Update

Client Name: Town of Grand Valley

Submitted To: Tracey Atkinson, Planner

Submitted By: Peggy Slama, P.Eng.

Reviewed By: Jeff Langlois, P.Eng., MBA

R.J. Burnside & Associates Limited (Burnside) was retained by the Town of Grand Valley to complete an update of the Water and Wastewater Master Servicing Plan. The update will reflect recent historical water demands and wastewater flows, and incorporate recent changes to the Official Plan settlement boundary. Burnside had previously completed a technical memo in 2010 with comments on the existing water and wastewater infrastructure and its ability to meet future demands.

1.0 Populations

The population projections are based on the recently accepted population forecast as per the revised Grand Valley Official Plan ('Attachment 2', Land Needs Assessment Summary, December 13, 2013 and recently adopted revised Official Plan Schedule A-2, February 2014). According to the Land Needs Assessment Summary the various populations are presented in Table 1. The population is expected in increase by 4,442 persons between 2011 and 2031. Approximately 426 persons will be accommodated through intensification of existing built up areas, 89 persons are expected in rural (unserviced areas) leaving 3,927 persons to be accommodated through greenfield developments. We have assumed that 100 of the existing 695 jobs are within the urban boundary. In the future, 485 jobs will be created in the urban boundary. Total projected greenfield service population is 485 jobs and 3,927 persons.

When considering water supply, water storage and wastewater treatment capacity an allowance for an additional 310 persons is included to accommodate the outcome of the Ontario Municipal Board decision.

Table 1 – Existing and Proposed Populations within the Urban Boundary

Item	Jobs	Population	Total
Existing 2011 – Urban Serviced Population	100*	1,482	1,582
Intensification	0	426	426
Greenfield Development	485	3,927	4,412
Total People and Jobs in 2031	**585**	**5,835**	**6,420**
Additional Lands		310	310
Total	585	6,145	6,730

*Assumed

The proposed greenfield developments will be located within the approved settlement boundary. The location of the additional lands is unknown, but is assumed to be outside the approved settlement boundary. Once the location is determined capacity of watermains and sewers will need to be revisited to assess the ability of the system to handle these flows or demands.

The location of the proposed developments is identified in Figure 1 – Overall Plan. .

2.0 Water Supply and Distribution System

2.1 Water Supply

The existing water supply system is comprised of 3 wells. The Cooper Street Pumphouse wells (PW1 and PW2) are not permitted to operate at the same time; therefore, the combined capacity is 2,290 m^3/day. The Melody Lane Pumphouse has 1 well (PW3). Normal pump operation includes PW3 operating with either PW1 or PW2 on an alternating basis. This provides a maximum system capacity of 2,944 m^3/day. The firm well capacity (well supply capacity with the largest well out of service) is therefore 1,963 m^3/d. These numbers are presented in the following summary table:

Table 2 – Water Supply

Pumphouse	Well	PTTW (m^3/d)	Maximum Capacity (m^3/d)	Firm Capacity (m^3/d)
Cooper Street	PW1	2,290	2,290	
	PW2	1,309		1,309
Melody Lane	PW3	654	654	654
Total			**2,944**	**1,963**

2.2 Water Storage

The existing water system includes distribution system water storage in the form of a water tower. The tank is of composite construction, including a precast concrete shaft and steel tank. The elevated water tower supplements the well supply during periods of high demand. The existing water tower is located on the north end of the system off Country Road 25, north of Fife Road. The tower has a storage capacity of 1,600 m^3 and a high water level of 519.3 m.

2.3 Historical Water Demands

The historical water demands for 2011 and 2013 were reviewed. The results are presented in Table 3 and discussed below.

Table 3 - Summary of Historical Water Demand

Pumphouse	Year	Pop.	Average Day Demand		Maximum Day Demand	Max Day Factor
			(m^3/d)	L/cap.d	(m^3/d)	
Water	2011	1482	451	305	1,174	2.6
	2013	1482	502	339	1,255	2.5

Based on historical information the average day per capita consumption was 305 L/capita/day and 339 L/capita/day respectfully. These consumption rates are at the low end of the typical range of 270 to 450 L/cap/d, presented in the Ministry of Environment (MOE) design guidelines.

2.4 Projected Water Demands

The projected demands are based on a consumption rate of 300 L/cap/d. The historical Maximum day factor ranged from 2.5 to 2.6. We have based the projections on MOE recommended maximum day factors of 2.50 for the 2011 and 2.0 for 2031 based on the projected populations

For 2031, the projected population is 6,145 persons and 585 jobs. We have allowed for 300 L/capita/day and 90 L/job/day.

The projected water demands are as summarized in Table 4:

Table 4 – Projected Water Demands for Supply and Storage

Year	Pop.	Average Day Demand (m^3/d)	Max Day Factor	Maximum Day Demand (m^3/d)	Surplus Supply Capacity* (m^3/d)
2011	1482	445	2.5	1113	850
2031	6145	1,896	2.0	3,792	1,829
	*Existing Firm Supply Rate (1,963 m^3/d) Less Projected demand				

The current supply is adequate for present day demands; however, it will not meet the projected demands for 2031. The work of environmental planning, design approval and construction associated with the provision of additional water supply should commence 3 to 5 years in advance of the need for the supply. A common threshold is when current needs exceed 80% of capacity although depending on the rate of growth this may not allow adequate lead time. These projections are subject to change as new data becomes available. For planning purposes it can be assumed that a new water supply will be needed when the population reaches 2,900. A Class Environmental Assessment (EA) for an increase of water supply should commence when the population is about 2,300.

2.5 Projected Water Storage Needs

The projected water storage requirements are based on MOE sizing formula.

Sufficient water storage is required to assist in meeting fire flow demands, equalizing peak demands and providing emergency supply. The sizing formula is based on recommended fire flows and fire durations, maximum day flow and population.

For the 2011 population of 1,482 persons, the recommended fire flow allowance of 79 L/s for 2 hours and maximum day flow of 1,113 m^3/d the recommended storage volume is 1,058 m^3. Therefore, the existing water storage tower provides adequate fire, equalization and emergency storage for the existing population.

For the 2031 population of 6,145 persons, the recommended fire flow and duration increases to 159 L/s for 3 hours. The total required storage is therefore 3,332 $m^{3.}$ An additional volume of 1,732 m^3 is recommended.

The work of environmental planning, design approval and construction associated with the provision of additional storage should commence 3 to 5 years in advance of the need for the storage. A common threshold is when current needs exceed 80% of capacity although depending on the rate of growth this may not allow adequate lead time. These capacities will be reached in a similar time frame to those of supply needs, so the Class EA for water storage should be undertaken at the same time.

2.6 Water Distribution System

The computer model of the Grand Valley water system (constructed in WaterCad) was updated to reflect existing and future water demand scenarios. The model determines water pressures throughout the system under these different scenarios, and identifies where system upgrades are required. The user can then input changes that improve the result. These could include watermain sizing, provision of water storage, and looping of the distribution mains.

The existing and proposed systems are illustrated in in Figure 2 – Water Distribution Plan.

The water model was run under 4 different demand or use scenarios, using calculated demands for both the 2011 and 2031 populations:

- Average Day Demand (ADD), Tower Full, Supply Pumps Off;
- Maximum Day Demand (MDD), Tower Full, Supply Pumps On;
- Peak Hour Demand (PHD), Equalization Spent, Supply Pumps On; and
- Maximum Day Demand plus fire flow (MDD + fire), Equalization and fire storage spent, supply pumps on.

Demands were calculated using the criteria mentioned in Section 2.4. When including fire flow in the model, a demand of 79 L/s was used. This value was used in previous iterations of the model (2010) and is typical level of service for a single fire in an area of residential development.

Under periods of average and maximum day demand the recommended pressures are within the range of 345 to 485 kPa. (Past MOE Guidelines recommended a range of 345 to 550 kPa.). During periods of peak hours demands pressure are to be in excess of 275 kPa, and during a fire event (or other emergency) pressure is required to remain in excess of 140 kPa. Pressures in excess of 485 kPa are permitted; however are not to exceed 690 kPa in order to avoid damage to household plumbing.

Areas where the resulting pressure is greater than 485 kPa may require pressure reducing valves, and areas where the pressure is lower than 345 kPa would require boosting. Future growth has been allocated within the approved settlement boundary. Almost all of the planned development is within the ideal range of elevations, which results in adequate system pressure. The exception is Davison Bus (Development K), which lies just outside the ideal range and may require pressure reduction be provided.

Watermain sizing was completed with the intention of limiting watermain diameter size, while ensuring watermains are sufficiently sized to allow the proposed development areas to meet the pressure and fire flow requirements outlined by the MOE. Watermains were modelled using MOE recommended C factors.

2.6.1 Existing 2011 Water System Model

The identified flow per job of 90 L/job/day when distributed across the lands identified as employment or mixed use results in a very small demand per unit area (<2 m^3/ha) which would be much less the MOE allowances referenced in the Town’s engineering standards. For analysis of the pipe network we have assumed demands consistent with the residential development.

The results for each scenario under the calculated 2011 demands summarized in the following Table:

Table 5 – Water Model Results, 2011 Demands

Demand Scenario	2011 Demand m^3/d	Minimum System Pressure (kPa)	Maximum System Pressure (kPa)
Average Daily Demand	475	370	654
Maximum Day Demand	1,187	374	658
Peak Hour Demand	1,779	328	612

The majority of the existing system is able to meet the fire flow requirements of 79.0 L/s available fire flow, while maintaining 138 kPa (20 psi) throughout the distribution system. The exception is a section of the distribution system in the northeast that is serviced by 150 mm, dead-end watermains. The minimum available fire flow within the system is 58 L/s on Mary Court.

A considerable portion of the existing system has water pressure in excess of the current MOE recommended maximum of 485 kPa. Pressure in excess of the MOE recommendation are permissible, however they need to remain below 690 kPa as this is the maximum permissible pressure for household plumbing fixtures. The existing system meets this criteria.

2.7 Allocation of Proposed Demands

The anticipated water demands were calculated for each development area based on the allocation of equivalent persons for each development. Proposed trunk mains were added to the model and loops through the development areas where this was reasonable. The layout and sizing of the proposed mains is shown in Figure 2. The demand for each development area was added to a node on the trunk main for each development.

For the proposed development arrangement the area of intensification (426 persons) is located on Scott Street, as agreed upon with the Town Planner.

2.7.1 2031 Water System Model

The identified flow per job of 90 L/job/day when distributed across the lands identified as employment or mixed use results in a very small demand per unit area (<2 m^3/Ha) which would be much less the MOE allowances referenced in the Town's engineering standards. For analysis of the pipe network we have assumed demands consistent with the residential development parcels.

The results for each scenario under the calculated 2031 demands are summarized in Table 6.

Table 6 – Water Model Results, 2031 Demands

Demand Scenario	2031 Demand m^3/d	Minimum System Pressure (kPa)	Maximum System Pressure (kPa)
Average Day Demand	1,926	370	654
Maximum Day Demand	3,852	370	654
Peak Hour Demand	5,778	327	611

All proposed developments are able to meet the fire flow requirements of 79.0 L/s available, while maintaining 138 kPa (20 psi) throughout the distribution system. In the 2031 scenario the recommended additional water storage is assumed to be present and is located at the south end of town. The tower is assumed to have similar characteristics to the existing tower (i.e., capacity and elevation). In the 2031 scenario an existing section of the water distribution system around Fife Road and Mary Court remains unable to meet the fire flow requirements, with only 58 L/s available on Mary Court. Future looping off Fife Road would improve the available fire flow.

There is the potential for water stagnation in development areas south of the proposed water tower (E and F), as these areas are serviced by only 1 supply main. Looping within these subdivisions should be provided to reduce stagnation and the need for system flushing. The area between J-62 and J-72 is also serviced by only 1 supply main. A connection between J-150 and J-72 would link the 2 vulnerable areas and enhance circulation of the water supply, reducing the risks associated with 1 supply. Alternatively, a local loop between J-64 and J-32 would increase the water circulation for the area between J-62 and J-72.

A considerable portion of the existing system has water pressure in excess of 485 kPa, the current MOE recommended maximum, under average, maximum day and peak hour demand conditions. However all pressures are under the acceptable upper limit of 690 kPa and exceed recommended minimums. Under the proposed development scenario maximum and minimum pressures are acceptable, however a small portion of the new development areas (those at lower elevations, typically less than 470 m) have maximum pressures in excess of the MOE recommended maximum.

A 300 mm diameter watermain, as modelled, is able to provide a fire flow of 79 L/s to service the Zietsma and Collini lands in the southeast of the settlement boundary, without additional elevated water storage. However, the storage is required to provide for an adequate duration of firefighting. Elevated water storage was modelled in south Grand Valley, off of Highway No. 25, as per Figure 2. With the proposed elevated water storage, a smaller 250 mm diameter watermain would be able to provide sufficient fire flows to the southeastern development areas.

A summary of the WaterCad output for the 2031 scenario is provided as Attachment C.

2.8 Water System Upgrades Summary

In order to accommodate the anticipated flows associated with the 2031 development scenario it will be necessary to provide additional water supply (and treatment) and additional water storage. The expanded water supply should have a firm capacity of 3,792 m^3/d. As water towers are not readily expanded, an additional water storage facility should be provided to provide a combined total of 3,332 m^3.

The addition of supply capacity and additional water storage require that a Schedule B Class EA be completed in advance of the design of these works being undertaken. These studies should be initiated 3 to 5 years in advance of the need for the facility.

3.0 Wastewater Collection and Treatment System

3.1 Wastewater Flows

The Wastewater Treatment Plant annual reports were reviewed to determine the historical flows of the wastewater system. In 2011 the average daily flow was 577 m^3/day or 389 L/capita/day. In 2012, the average daily flow was 718 m^3/day or 484 L/capita/day. These values include current average infiltration. The typical MOE allowance is 360 to 540 L/capita/day including infiltration of 90 L/capita/day.

For the sizing of the wastewater treatment facility, the flows for 2011 and 2031 service populations were calculated assuming an average residential flow of 465 L/capita/day including infiltration at 90 L/capita/day. Peak wastewater flows were calculated using a peaking factor generated with the Harmon formula and adding a peak infiltration allowance of 227 L/capita/day.

An average daily flow allowance of 90 L/job/day was also included.

For the 2031 an additional allowance of 310 persons was included

The total flow for 2011 and 2031 is summarized in Table 7. Note that the projected flows for 2031 are about 15% higher than previous projections. This is partially accounted for with the large projection of jobs to be created in the urban area. The difference is not material for current purposes.

Table 7 – Wastewater Flows Table

Year	Persons	Average Daily Flow	Peaking Factor	Peak Daily Flow	
		(m^3/d)		(m^3/d)	(L/s)
2011	1,482	689	3.68	2,383	28
2031	6,145	2,910	3.16	8,845	102

3.2 Wastewater Treatment Plant

The existing community is served by the Town of Grand Valley Water Pollution Control Plant (WPCP) located at the east end of Industrial Road. The treatment process is extended aeration with tertiary filtration and UV disinfection. The facility has an average daily flow rating of 1,244 m^3/d and was designed for a population of 2,950 persons.

The Ministry of the Environment has guidelines that recommend municipal servicing capacity is reviewed on the basis of average flows generated over a 3 year period. The Grand Valley WPCP was commissioned in July 2011. The flow data generated at the previous plant has been found to be unreliable, so the first opportunity to review servicing capacity will be after data becomes available for July, 2014. This exercise is fairly simply and will reset the population that can be serviced at the plant. Design flows are typically found to be conservative and generally the service populations increase by a modest amount.

When flows to a treatment plant are high enough to assess its technical performance, but prior to them reaching capacity, it is typical to conduct a stress test. This will test the plant's performance with respect to each of the discharge elements that it releases to the river. Some will be on target and others will be better than anticipated. The review gives an opportunity to make relatively inexpensive tweaks to the equipment and its operation that can increase the plant capacity without major capital expenditure. The stress test will not address the assimilative capacity of the river, but it will maximize the plant efficiency to keep within the previously permitted discharge criteria. This method of expanding plant capacity requires a Schedule B Class Environmental Assessment.

The next level of expanding capacity is to review the assimilative capacity and seek to increase the discharge parameters. In 2013, as background to expanding the urban boundary, a desktop servicing analysis was undertaken to provide an opinion on the potential assimilative capacity of the Grand River. The work was completed by XCG Environmental Engineers and Scientists in conjunction with Burnside. It was reviewed and accepted by the Ministry of the Environment although the level of reporting and review were both less than would be expected for a comprehensive Assimilative Capacity Study. Nevertheless the results are useful and will be incorporated into future work. The study concluded that it was feasible to expand the WPCP to a capacity of 2,547 m^3/d which would accommodate a serviced population of 6,050. In order to achieve this increase in capacity a Schedule C Class EA is required.

We recommend the following course of action for keeping sewage treatment plant capacity ahead of housing requirements:

1. Complete exercise of reviewing available capacity on an annual basis, starting when data is available from July 2014.

2. Consider a Stress Test when the flows to the plant reach 60% of rated capacity. In 2011 the flows were 46% of capacity.

3. Consider a Class EA to upgrade the plant. The timing for the Class EA needs to be discussed. It should be done well in advance of need, in case there are delays, and there is really no issue with it being done too soon as it has a 10 year life. The existing plant can handle the flow from the 2011 scenario.

The existing plant will need to be upgraded to handle the anticipated average daily flow of 2,910 m^3/day (including infiltration allowance).

3.3 Wastewater Collection System

The computer model of the Grand Valley wastewater collection system was previously created using SewerCad. This model was updated to reflect changes to the existing wastewater collection system (new wastewater treatment plant, new sewers and/or forcemains).

The existing sanitary sewage collection system includes 2 sewage pumping stations and 1 wastewater treatment facility. A small pumping station is located on Amaranth Street. The specific capacity of this station has not been confirmed. No additional flow has been directed to this station. A short forcemain discharges to the gravity collection system at MH15.

All of the gravity sewers are directed to the Emma Street Sewage Pumping Station. The station has a design capacity of 88.9 L/s and includes standby power. Sewage is directed by forcemain to the inlet works at the Grand Valley Water Pollution Control Plant.

3.4 Wastewater System Model, 2011 Flows

For the analysis of the sewer network the average day flow allowance was assumed to be 450 L/capita/day to be consistent with the Town's engineering standards. Infiltration in existing serviced areas was estimated based on MOE allowances of 227 L/person.

The existing SewerCad model was updated and used to identify to limitations in the existing system.

The existing collection system was found to be readily able to convey the peak flow associated with the 2011 scenario. The most heavily loaded pipe running at 33% of its capacity.

The peak flow at the Emma Street Sanitary Pumping Station (SPS) was determined using the model to be 34 L/s which is below the rated capacity of 89 L/s. The 2011 flow to the plant of 689 m^3/d (Average Daily Flow) represents approximately 55% of the current plant rating. It is noted the actual historical flow in 2012 was approximately 58% of the rated capacity.

3.5 Flow Allocation for 2031

In order to assess the ability of the existing sanitary sewer system to convey projected flows, preliminary sanitary drainage areas needed to be established. Sanitary drainage areas were established based on the location of the developments, the topography of the land and the extent of the existing sanitary collection system. Eight separate areas were established. It is anticipated that areas E1 and E2 will drain by gravity to a new SPS located in the south end of town, which will pump directly to the WPCP. Areas E3, E4, E5, E6 and E7 are anticipated to be able to drain by gravity to the existing collection system. Area E8 is anticipated to be require a new SPS which would discharge to the existing collection system. The existing lands subject to intensification are identified as contributing at existing MH 75. The additional lands have not been included in the analysis of the collection system. The drainage areas, the existing wastewater system and the points of connection are shown on Figure 3 – Wastewater Servicing Plan.

The new development connection points are summarized in the following table:

Table 8 – Location of Proposed Connections to Existing Sanitary System

Sanitary Drainage Are	Area (Ha)	Equivalent Persons	Street	Connection
E1	12.49	550	Water Street	WPCP through new SPS
E2	16.43	723	Water Street	WPCP through new SPS
E3	7.00	308	Melody Lane	MH 114
E4	20.50	902	Melody Lane	MH 114
E5	24.40	1074	Williams Street	MH 87
E6	3.63	160	Leeson Street/Douglas Street	MH 44
E7	14.90	656	Scott Street	MH 75
E8	0.96	42	Scott Street	MH 75 through new SPS
Total	**100.31**	**4415***		
Intensification		426	Scott Street	MH 75
*Minor Round off Error from target of 4412				

3.5.1 Wastewater System Model, 2031

For the analysis of the sewer network the average day flow allowance was assumed to be 450 L/capita/day to be consistent with the Town's engineering standards. The proposed contribution from employment lands based on 90 L/job/day is very low on an area basis and the proposed employment lands and mixed use lands where modelled with contribution consistent with residential development. As per Town standards, a peak infiltration allowance of 0.20 L/ha/s was used. Existing serviced areas are based on MOE allowance of 227 L/person.

The existing SewerCad model was updated to analyze the impacts of the proposed additional populations on the existing system. Future development flows were attributed to connection points within the existing wastewater system as identified above. The ability of the existing sewers to carry the proposed flows is based on full flow capacity of the existing sewer and the projected peak flow (including infiltration).

A number of the existing sewers are not able to carry the proposed flows.

There are several portions of the existing sewer system which are based on the assumed conditions consider to be over capacity and a number of in excess of 80% capacity. This will limit the opportunity to connect additional users without upgrades to the trunk system. There are sewers of concern (>80% full) on Emma Street, Mill Street, Ponsford Street, Amaranth Street and Leeson Street.

There are over capacity sewers on Emma Street, Amaranth Street, Bielby Street and Scott Street.

The peak flow at the Emma Street Sanitary Pumping Station (SPS) is estimated determined to be 106 L/s which exceeds the capacity of 89 L/s.

The 2031 flow of 2,910 m^3/d represents approximately 233% of the current plant rating.

The following upgrades are recommended to accommodate the projected flows under the proposed development arrangement.

- Existing 400 mm diameter on Emma Street from MH 3 to MH 2 – Upgrade to 450 mm diameter;
- Existing 250 mm diameter on Mill Street from Main Street to Ponsford Street – Upgrade to 300 m diameter;
- Existing 250 mm diameter on Ponsford Street from Mill Street to Amaranth Street – Upgrade to 300 mm diameter;
- Existing 250 mm diameter on Amaranth Street from Ponsford Street to MH13 – Upgrade to 300 mm diameter;
- Existing 200 mm diameter on Bielby Street from Amaranth Street to Scott Street – Upgrade to 250 mm diameter; and
- Existing 200 mm diameter on Scott Street from Bielby Street to East Limit Scott Street – Upgrade to 250 mm diameter.

These existing sewers are generally over capacity by less than 8 L/s. Relocating the contribution from the intensification area (8.9 L/s) would place the projected flows just below existing capacity although there would be little buffer.

Some of the future collection areas cannot be serviced by gravity sewers. The Zeitsma, Collinni and Moco developments (Areas E1 and E2) in the south end of town will need to be pumped to a single pumping station designed to convey 28 L/s. We have assumed these areas will be pumped directly to the WPCP.

The Davison Bus development in the northeast corner of the Town (Area E8) will also require a sanitary pump station to convey wastewater to the existing collection system. The required design capacity is 1.1 L/s and would discharge to MH 75 on Scott Street and conveyed by gravity to the Emma Street SPS.

3.6 Wastewater Upgrade Summary

Portions of the existing collection system, the Emma Street SPS and the existing WPCP will require capacity improvements to accommodate the proposed 2031 development scenario. A number of the developments will require new sewage pumping facilities and forcemains to make connections to the existing system.

An expansion of a wastewater treatment plant generally requires that a Schedule C Class EA be completed in advance of detailed design. An assimilation study would also be required to support the Class EA, as well as related studies of the natural environment. A minor re-rating may be possible through a Schedule B Class EA as described above. It is important to allow adequate time for the planning and design associated with such a project. A typical allowance would be to commence the study 5 years in advance of the need for additional capacity.

Similarly establishing a new SPS or upgrading a SPS typically requires a Schedule B Class EA be completed. An allowance of 3 years is typical for a SPS project to address planning, design and construction.

R.J. Burnside & Associates Limited

Peggy Slama, P.Eng.
PGS:sj

Jeff Langlois, P.Eng., MBA

Enclosure(s) Figure 1 – Water Distribution Plan
Figure 2 – Wastewater Servicing Plan

Notes

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2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

NOT FOR CONSTRUCTION

No.	Issue / Revision	Date	Auth.
1	ISSUED FOR CLIENT REVIEW	14/05/29	

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Client
TOWNSHIP OF EAST LUTHER
GRAND VALLEY

Drawing Title
GRAND VALLEY MASTER SERVICING PLAN UPDATE
WATER DISTRIBUTION PLAN

Drawn	Checked	Designed	Checked	Date	Drawing No.
CT	KT	KT	PGS	14/05/29	FIG 1
Project No. 300035222		Contract No. CONTRACT NO.		Revision No. 1	
Scale 1:5,000	0 50 100 200 300m				

File Name: 140507 Grand Valley for MSP.dwg Date Plotted: June 2, 2014 - 10:09 AM

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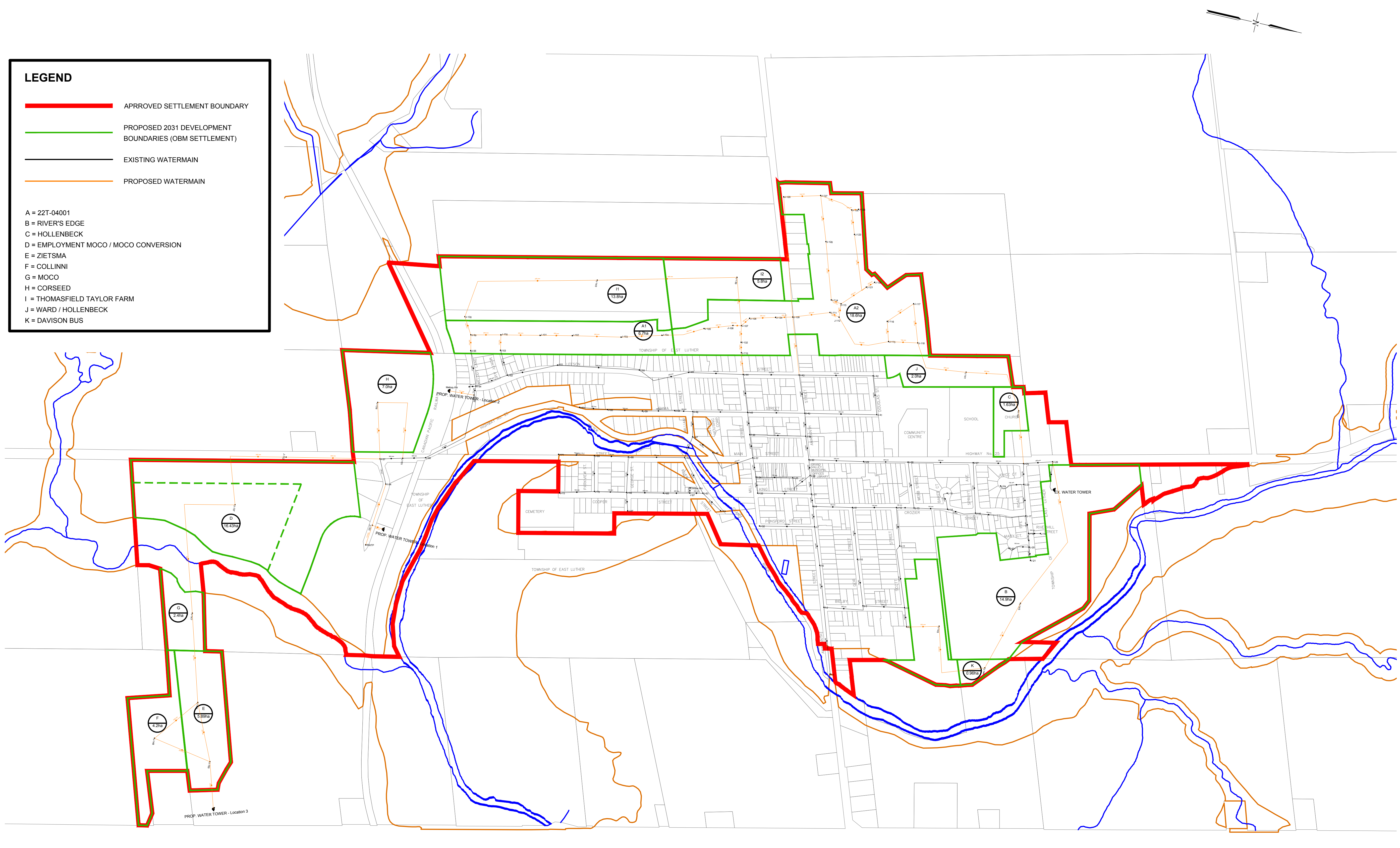
Client
TOWNSHIP OF EAST LUTHER
GRAND VALLEY

Drawing Title
GRAND VALLEY MASTER SERVICING PLAN UPDATE

WASTEWATER SERVICING PLAN

Drawn	Checked	Designed	Checked	Date	Drawing No.
CT	KL	KL	PGS	14/05/29	FIG 2
Project No. 300035222		Contract No. CONTRACT NO.		Revision No. 1	
Scale 1:5,000		0 50 100 200 300m			

File Name: 140507 Grand Valley for MSP-SANITARY.dwg Date Plotted: June 2, 2014 - 10:1



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NOT FOR CONSTRUCTION

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Client
TOWNSHIP OF EAST LUTHER
GRAND VALLEY

Drawing Title
GRAND VALLEY SERVICING MASTER PLAN
WATER DISTRIBUTION PLAN

Drawn	Checked	Designed	Checked	Date	Drawing No.
CT	JP	JD	JP	17/10/19	FIG 1
Project No. 300040938		Contract No. CONTRACT NO.		Revision No. 1	
Scale 1:5,000		0 50 100 200 300m			

File Name: 171017 Grand Valley for MSP 2017 Update.dwg Date Plotted: October 24, 2017

Scenario: HWL Pumps off ADD (2031)
Current Time Step: 0.000Hr
FlexTable: Junction Table

Water Tower Location 1

Label	Elevation (m)	Pressure (kPa)	Demand (L/s)
Cooper PH	454.2	637.5	0.000
J-1	456.4	616.0	0.105
J-2	455.7	622.9	0.076
J-3	459.7	583.7	0.076
J-4	460.7	573.9	0.076
J-5	460.5	575.8	1.605
J-6	456.6	614.1	0.076
J-7	457.4	606.2	0.076
J-8	457.8	602.3	0.076
J-9	458.8	592.5	0.076
J-10	460.0	580.7	0.076
J-11	479.2	392.5	0.076
J-12	466.4	518.0	0.076
J-13	472.2	461.2	0.076
J-14	477.0	414.2	0.076
J-15	477.4	409.9	0.076
J-16	480.0	384.9	0.076
J-17	481.5	370.6	0.076
J-18	481.6	369.4	0.076
J-19	481.6	369.4	0.076
J-20	481.2	372.7	0.076
J-21	478.8	396.9	0.076
J-22	481.2	372.7	0.076
J-23	479.7	388.0	0.076
J-24	479.3	391.6	0.076
J-25	479.3	391.9	0.076
J-26	478.9	396.0	0.076
J-27	477.9	405.8	0.076
J-28	477.0	414.2	0.076
J-29	475.3	430.8	0.076
J-30	462.7	554.3	0.076
J-31	457.8	602.3	0.076
J-32	454.0	639.6	0.076
J-33	454.8	631.7	0.076
J-34	455.2	627.8	0.076
J-35	458.0	600.3	0.076
J-36	459.0	590.5	0.076
J-37	455.9	620.9	0.076
J-38	456.9	611.1	0.076
J-39	456.6	614.0	0.076
J-40	465.2	529.7	0.076
J-41	474.6	437.5	0.076
J-42	471.0	472.8	0.076
J-43	472.7	456.1	0.076
J-44	470.7	475.7	0.076
J-45	460.5	575.7	0.076
J-46	454.0	639.5	0.076
J-47	453.2	647.3	0.076
J-48	454.5	634.6	0.076
J-49	468.5	497.3	0.076
J-50	470.7	475.7	0.076
J-51	471.6	466.9	0.076
J-52	472.6	457.0	0.076
J-53	472.8	455.1	0.076
J-54	471.0	472.7	0.076
J-55	473.0	453.1	0.076
J-56	462.2	559.0	0.076
J-57	472.0	462.9	0.076

J-58	454.0	639.5	0.076
J-59	453.0	649.3	0.076
J-60	452.6	653.2	0.076
J-61	453.2	647.3	0.076
J-62	454.4	635.6	0.076
J-63	454.2	637.5	0.076
J-64	454.0	639.5	0.076
J-65	459.6	584.6	0.076
J-66	459.3	587.5	0.076
J-67	459.0	590.5	0.076
J-68	456.7	613.0	0.076
J-69	457.3	607.1	0.076
J-70	458.7	593.4	0.076
J-71	453.6	643.4	0.076
J-72	458.5	595.4	0.076
J-94	472.0	463.5	0.000
J-97	454.2	637.5	0.000
J-99	473.1	452.1	0.117
J-100	474.3	440.4	0.117
J-101	475.6	427.6	0.207
J-102	476.5	418.8	0.225
J-103	476.0	423.7	0.171
J-104	475.2	431.5	0.171
J-105	475.5	428.6	0.090
J-106	475.7	426.6	0.090
J-107	475.6	427.6	0.099
J-108	475.9	424.7	0.081
J-109	476.5	418.8	0.081
J-110	475.3	430.6	0.072
J-111	474.8	435.5	0.072
J-112	474.8	435.5	0.072
J-113	475.2	431.5	0.090
J-114	475.2	431.5	0.144
J-115	476.3	421.0	0.153
J-116	475.0	433.7	0.117
J-117	475.8	425.9	0.162
J-118	476.8	416.1	0.108
J-121	475.4	429.6	0.162
J-122	476.5	418.8	0.081
J-123	475.4	429.6	0.234
J-124	475.4	429.6	0.135
J-125	475.6	427.6	0.072
J-126	475.3	430.6	0.198
J-127	475.5	428.6	0.162
J-128	476.0	423.7	0.108
J-130	473.4	449.2	0.117
J-132	475.5	428.6	0.114
J-134	476.3	420.8	0.090
J-137	471.6	466.7	2.500
J-138	470.9	473.7	1.100
J-139	479.1	393.2	1.500
J-140	480.0	384.4	1.500
J-141	475.2	431.9	0.300
J-142	477.5	409.4	0.300
J-143	459.7	583.7	0.000
J-144	459.6	584.7	0.100
J-145	464.7	534.7	2.300
J-146	470.2	480.4	0.900
J-147	465.2	529.5	0.400
J-148	473.5	448.0	0.600
J-150	473.5	448.1	0.000
J-151	467.1	511.0	0.000
J-152	471.8	464.7	0.000
J-153	470.3	480.4	0.000
Melody PH	471.0	472.7	0.000
WWTP	469.5	488.4	0.000

Scenario: Max Day Pumps On - No Fire Elev at 519.3 (2031)
Current Time Step: 0.000Hr
FlexTable: Junction Table

Water Tower Location 1

Label	Elevation (m)	Pressure (kPa)	Demand (L/s)
Cooper PH	454.2	638.8	-15.154
J-1	456.4	615.9	0.236
J-2	455.7	622.8	0.191
J-3	459.7	583.5	0.191
J-4	460.7	573.6	0.191
J-5	460.5	575.5	3.236
J-6	456.6	614.0	0.191
J-7	457.4	606.2	0.191
J-8	457.8	602.3	0.191
J-9	458.8	592.5	0.191
J-10	460.0	580.6	0.191
J-11	479.2	392.3	0.191
J-12	466.4	517.9	0.191
J-13	472.2	461.2	0.191
J-14	477.0	414.1	0.191
J-15	477.4	409.8	0.191
J-16	480.0	384.8	0.191
J-17	481.5	370.5	0.191
J-18	481.6	369.3	0.191
J-19	481.6	369.3	0.191
J-20	481.2	372.5	0.191
J-21	478.8	396.7	0.191
J-22	481.2	372.5	0.191
J-23	479.7	387.9	0.191
J-24	479.3	391.5	0.191
J-25	479.3	391.8	0.191
J-26	478.9	395.9	0.236
J-27	477.9	405.8	0.191
J-28	477.0	414.2	0.191
J-29	475.3	430.8	0.191
J-30	462.7	554.4	0.191
J-31	457.8	602.3	0.191
J-32	454.0	639.5	0.191
J-33	454.8	631.8	0.191
J-34	455.2	627.9	0.191
J-35	458.0	600.4	0.191
J-36	459.0	590.6	0.191
J-37	455.9	621.1	0.191
J-38	456.9	611.2	0.191
J-39	456.6	614.2	0.191
J-40	465.2	529.8	0.191
J-41	474.6	437.6	0.191
J-42	471.0	472.9	0.191
J-43	472.7	456.2	0.191
J-44	470.7	475.8	0.191
J-45	460.5	575.9	0.191
J-46	454.0	639.9	0.191
J-47	453.2	647.8	0.191
J-48	454.5	634.9	0.191
J-49	468.5	497.3	0.191
J-50	470.7	475.7	0.191
J-51	471.6	466.9	0.191
J-52	472.6	457.0	0.191
J-53	472.8	454.9	0.191
J-54	471.0	472.7	0.191
J-55	473.0	453.0	0.191
J-56	462.2	558.9	0.191
J-57	472.0	462.8	0.191

J-58	454.0	639.8	0.191
J-59	453.0	649.6	0.191
J-60	452.6	653.5	0.191
J-61	453.2	647.6	0.191
J-62	454.4	636.1	0.191
J-63	454.2	638.2	0.191
J-64	454.0	640.2	0.191
J-65	459.6	585.5	0.191
J-66	459.3	588.4	0.191
J-67	459.0	591.3	0.191
J-68	456.7	613.8	0.191
J-69	457.3	607.9	0.191
J-70	458.7	594.2	0.191
J-71	453.6	644.2	0.191
J-72	458.5	596.2	0.191
J-94	472.0	463.5	0.000
J-97	454.2	638.5	0.000
J-99	473.1	451.9	0.228
J-100	474.3	440.2	0.228
J-101	475.6	427.4	0.431
J-102	476.5	418.6	0.471
J-103	476.0	423.4	0.349
J-104	475.2	431.3	0.349
J-105	475.5	428.3	0.167
J-106	475.7	426.4	0.167
J-107	475.6	427.4	0.187
J-108	475.9	424.4	0.146
J-109	476.5	418.5	0.146
J-110	475.3	430.5	0.126
J-111	474.8	435.2	0.126
J-112	474.8	435.2	0.126
J-113	475.2	431.3	0.167
J-114	475.2	431.3	0.289
J-115	476.3	420.6	0.309
J-116	475.0	433.4	0.228
J-117	475.8	425.5	0.329
J-118	476.8	415.8	0.207
J-121	475.4	429.3	0.329
J-122	476.5	418.5	0.146
J-123	475.4	429.3	0.492
J-124	475.4	429.3	0.268
J-125	475.6	427.3	0.126
J-126	475.3	430.3	0.410
J-127	475.5	428.3	0.329
J-128	476.0	423.4	0.207
J-130	473.4	449.0	0.228
J-132	475.5	428.5	0.221
J-134	476.3	420.5	0.167
J-137	471.6	466.2	5.000
J-138	470.9	473.6	2.100
J-139	479.1	392.8	3.000
J-140	480.0	384.0	3.000
J-141	475.2	431.6	0.600
J-142	477.5	409.3	0.500
J-143	459.7	583.3	0.000
J-144	459.6	584.3	0.300
J-145	464.7	534.3	4.600
J-146	470.2	479.8	1.800
J-147	465.2	528.9	0.700
J-148	473.5	447.5	1.300
J-150	473.5	447.5	0.000
J-151	467.1	510.9	0.000
J-152	471.8	464.4	0.000
J-153	470.3	480.4	0.000
Melody PH	471.0	472.7	-7.569
WWTP	469.5	488.3	0.000

Scenario: Peak Hour (LWL - Bottom of Equalization 515 m) (2031)
Current Time Step: 0.000Hr
FlexTable: Junction Table

Water Tower Location 1

Label	Elevation (m)	Pressure (kPa)	Demand (L/s)
Cooper PH	454.2	594.7	-15.150
J-1	456.4	572.2	0.286
J-2	455.7	579.0	0.286
J-3	459.7	539.8	0.286
J-4	460.7	530.0	0.286
J-5	460.5	532.0	0.286
J-6	456.6	570.2	0.286
J-7	457.4	562.4	0.286
J-8	457.8	558.5	0.286
J-9	458.8	548.7	0.286
J-10	460.0	536.9	0.286
J-11	479.2	348.7	0.286
J-12	466.4	474.3	0.286
J-13	472.2	417.6	0.286
J-14	477.0	370.6	0.286
J-15	477.4	366.4	0.286
J-16	480.0	341.5	0.286
J-17	481.5	327.2	0.286
J-18	481.6	325.9	0.286
J-19	481.6	325.9	0.286
J-20	481.2	329.2	0.286
J-21	478.8	353.4	0.286
J-22	481.2	329.2	0.286
J-23	479.7	344.8	0.286
J-24	479.3	348.3	0.286
J-25	479.3	348.8	0.286
J-26	478.9	353.2	0.286
J-27	477.9	362.5	0.286
J-28	477.0	370.7	0.286
J-29	475.3	387.1	0.286
J-30	462.7	510.5	0.286
J-31	457.8	558.5	0.286
J-32	454.0	595.7	0.286
J-33	454.8	587.9	0.286
J-34	455.2	584.0	0.286
J-35	458.0	556.5	0.286
J-36	459.0	546.7	0.286
J-37	455.9	577.1	0.286
J-38	456.9	567.2	0.286
J-39	456.6	570.2	0.286
J-40	465.2	485.8	0.286
J-41	474.6	393.5	0.286
J-42	471.0	428.8	0.286
J-43	472.7	412.1	0.286
J-44	470.7	431.6	0.286
J-45	460.5	531.8	0.286
J-46	454.0	595.8	0.286
J-47	453.2	603.7	0.286
J-48	454.5	590.8	0.286
J-49	468.5	453.2	0.286
J-50	470.7	431.6	0.286
J-51	471.6	422.7	0.286
J-52	472.6	412.9	0.286
J-53	472.8	410.8	0.286
J-54	471.0	428.5	0.286
J-55	473.0	408.9	0.286
J-56	462.2	514.7	0.286
J-57	472.0	418.6	0.286

J-58	454.0	595.7	0.286
J-59	453.0	605.5	0.286
J-60	452.6	609.4	0.286
J-61	453.2	603.5	0.286
J-62	454.4	592.1	0.286
J-63	454.2	594.1	0.286
J-64	454.0	596.1	0.286
J-65	459.6	541.4	0.286
J-66	459.3	544.2	0.286
J-67	459.0	547.2	0.286
J-68	456.7	569.6	0.286
J-69	457.3	563.8	0.286
J-70	458.7	550.1	0.286
J-71	453.6	600.0	0.286
J-72	458.5	552.0	0.286
J-94	472.0	420.7	0.000
J-97	454.2	594.5	0.000
J-99	473.1	407.8	0.343
J-100	474.3	396.1	0.343
J-101	475.6	383.3	0.648
J-102	476.5	374.5	0.709
J-103	476.0	379.4	0.526
J-104	475.2	387.3	0.526
J-105	475.5	384.4	0.251
J-106	475.7	382.4	0.251
J-107	475.6	383.4	0.282
J-108	475.9	380.5	0.221
J-109	476.5	374.6	0.221
J-110	475.3	386.4	0.190
J-111	474.8	391.2	0.190
J-112	474.8	391.2	0.190
J-113	475.2	387.3	0.251
J-114	475.2	387.3	0.434
J-115	476.3	376.8	0.465
J-116	475.0	389.6	0.343
J-117	475.8	381.8	0.495
J-118	476.8	372.1	0.312
J-121	475.4	385.3	0.495
J-122	476.5	374.5	0.221
J-123	475.4	385.3	0.740
J-124	475.4	385.3	0.404
J-125	475.6	383.3	0.190
J-126	475.3	386.3	0.618
J-127	475.5	384.3	0.495
J-128	476.0	379.5	0.312
J-130	473.4	404.8	0.343
J-132	475.5	384.4	0.333
J-134	476.3	376.5	0.251
J-137	471.6	421.5	7.500
J-138	470.9	429.3	3.200
J-139	479.1	348.6	4.500
J-140	480.0	339.7	4.500
J-141	475.2	388.1	0.900
J-142	477.5	366.0	0.800
J-143	459.7	539.8	0.000
J-144	459.6	540.7	0.400
J-145	464.7	490.7	6.800
J-146	470.2	434.9	2.700
J-147	465.2	484.0	1.100
J-148	473.5	402.6	1.900
J-150	473.5	402.6	0.000
J-151	467.1	466.7	0.000
J-152	471.8	419.9	0.000
J-153	470.3	438.2	0.000
J-155	470.2	436.7	0.000
Melody PH	471.0	428.6	-7.569
WWTP	469.5	446.2	0.000

Scenario: LWL Max Day with Fire (Pumps On storage = 510.75 m) (2031)
Current Time Step: 0.000Hr
Fire Flow Node FlexTable: Fire Flow Report

Water Tower Location 1

Label	Flow (Total Available) (L/s)	Pressure (Calculated Residual) (kPa)
Cooper PH	84.846	495.3
J-1	100.236	364.5
J-2	100.191	464.4
J-3	100.191	429.7
J-4	100.191	412.5
J-5	103.236	400.4
J-6	100.191	460.5
J-7	100.191	466.9
J-8	100.191	476.3
J-9	100.191	432.9
J-10	100.191	369.1
J-11	100.191	184.5
J-12	100.191	368.5
J-13	100.191	321.3
J-14	100.191	242.6
J-15	97.251	137.9
J-16	100.191	235.0
J-17	100.191	180.9
J-18	83.361	137.9
J-19	71.543	137.9
J-20	70.753	137.9
J-21	67.608	137.9
J-22	57.918	137.9
J-23	100.191	231.7
J-24	87.487	137.9
J-25	100.191	296.9
J-26	100.236	305.4
J-27	100.191	306.3
J-28	100.191	310.7
J-29	100.191	325.1
J-30	100.191	447.2
J-31	100.191	481.6
J-32	100.191	190.3
J-33	100.191	463.0
J-34	100.191	480.6
J-35	100.191	449.5
J-36	100.191	475.2
J-37	100.191	509.2
J-38	100.191	501.5
J-39	100.191	505.9
J-40	100.191	412.2
J-41	100.191	183.1
J-42	100.191	217.0
J-43	100.191	334.4
J-44	100.191	364.5
J-45	100.191	465.6
J-46	100.191	522.3
J-47	100.191	527.6
J-48	100.191	466.4
J-49	100.191	381.6
J-50	100.191	357.8
J-51	100.191	347.9
J-52	100.191	338.6
J-53	100.191	297.9
J-54	100.191	354.3
J-55	100.191	323.0

J-56	100.191	434.3
J-57	100.191	336.1
J-58	100.191	368.5
J-59	100.191	194.7
J-60	85.708	144.1
J-61	75.075	137.9
J-62	100.191	512.6
J-63	100.191	509.6
J-64	100.191	371.8
J-65	100.191	428.6
J-66	100.191	413.3
J-67	100.191	390.7
J-68	100.191	422.4
J-69	100.191	361.7
J-70	100.191	351.8
J-71	100.191	196.2
J-72	100.191	157.6
J-94	100.000	347.8
J-97	100.000	500.7
J-99	100.228	322.8
J-100	100.228	310.4
J-101	100.431	292.1
J-102	100.471	281.0
J-103	100.349	286.1
J-104	100.349	297.4
J-105	100.167	302.2
J-106	100.167	309.1
J-107	100.187	313.6
J-108	100.146	309.7
J-109	100.146	301.2
J-110	100.126	317.8
J-111	100.126	296.8
J-112	100.126	293.8
J-113	100.167	281.3
J-114	100.289	248.8
J-115	100.309	168.7
J-116	100.228	143.7
J-117	96.357	137.9
J-118	100.207	174.8
J-121	100.329	254.1
J-122	100.146	230.1
J-123	100.492	180.0
J-124	100.268	190.7
J-125	100.126	149.9
J-126	100.410	192.7
J-127	100.329	244.5
J-128	100.207	287.6
J-130	100.228	304.0
J-132	100.221	315.2
J-134	100.167	304.1
J-137	105.000	288.5
J-138	102.100	310.7
J-139	103.000	224.3
J-140	103.000	169.3
J-141	100.600	217.0
J-142	100.500	249.9
J-143	100.000	391.8
J-144	100.300	370.8
J-145	104.600	325.5
J-146	101.800	243.1
J-147	100.700	313.2
J-148	101.300	168.5
J-150	100.000	190.3
J-151	100.000	356.6
J-152	100.000	282.3
J-153	100.000	394.4
J-155	100.000	361.8

Melody PH

	92.431	353.1
WWTP	100.000	373.8

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Scenario: HWL Pumps off ADD (2031)
Current Time Step: 0.000Hr
FlexTable: Junction Table

Water Tower Location 2

Label	Elevation (m)	Pressure (kPa)	Demand (L/s)
Cooper PH	454.2	638.1	0.000
J-1	456.4	616.5	0.105
J-2	455.7	623.4	0.076
J-3	459.7	584.2	0.076
J-4	460.7	574.3	0.076
J-5	460.5	576.3	1.605
J-6	456.6	614.6	0.076
J-7	457.4	606.7	0.076
J-8	457.8	602.8	0.076
J-9	458.8	593.0	0.076
J-10	460.0	581.2	0.076
J-11	479.2	393.0	0.076
J-12	466.4	518.5	0.076
J-13	472.2	461.7	0.076
J-14	477.0	414.5	0.076
J-15	477.4	410.3	0.076
J-16	480.0	385.2	0.076
J-17	481.5	370.9	0.076
J-18	481.6	369.7	0.076
J-19	481.6	369.7	0.076
J-20	481.2	373.0	0.076
J-21	478.8	397.2	0.076
J-22	481.2	373.0	0.076
J-23	479.7	388.2	0.076
J-24	479.3	391.8	0.076
J-25	479.3	392.1	0.076
J-26	478.9	396.1	0.076
J-27	477.9	406.2	0.076
J-28	477.0	414.6	0.076
J-29	475.3	431.3	0.076
J-30	462.7	554.8	0.076
J-31	457.8	602.8	0.076
J-32	454.0	640.1	0.076
J-33	454.8	632.3	0.076
J-34	455.2	628.3	0.076
J-35	458.0	600.9	0.076
J-36	459.0	591.1	0.076
J-37	455.9	621.5	0.076
J-38	456.9	611.7	0.076
J-39	456.6	614.6	0.076
J-40	465.2	530.3	0.076
J-41	474.6	438.1	0.076
J-42	471.0	473.4	0.076
J-43	472.7	456.7	0.076
J-44	470.7	476.3	0.076
J-45	460.5	576.4	0.076
J-46	454.0	640.1	0.076
J-47	453.2	648.0	0.076
J-48	454.5	635.2	0.076
J-49	468.5	497.9	0.076
J-50	470.7	476.4	0.076
J-51	471.6	467.6	0.076
J-52	472.6	457.8	0.076
J-53	472.8	455.8	0.076
J-54	471.0	473.5	0.076
J-55	473.0	453.9	0.076
J-56	462.2	559.7	0.076
J-57	472.0	463.6	0.076

J-58	454.0	640.1	0.076
J-59	453.0	649.9	0.076
J-60	452.6	653.8	0.076
J-61	453.2	647.9	0.076
J-62	454.4	636.2	0.076
J-63	454.2	638.1	0.076
J-64	454.0	640.1	0.076
J-65	459.6	585.2	0.076
J-66	459.3	588.1	0.076
J-67	459.0	591.1	0.076
J-68	456.7	613.6	0.076
J-69	457.3	607.7	0.076
J-70	458.7	594.0	0.076
J-71	453.6	644.0	0.076
J-72	458.5	596.0	0.076
J-94	472.0	463.6	0.000
J-97	454.2	638.1	0.000
J-99	473.1	452.8	0.117
J-100	474.3	441.1	0.117
J-101	475.6	428.3	0.207
J-102	476.5	419.5	0.225
J-103	476.0	424.4	0.171
J-104	475.2	432.2	0.171
J-105	475.5	429.3	0.090
J-106	475.7	427.3	0.090
J-107	475.6	428.3	0.099
J-108	475.9	425.3	0.081
J-109	476.5	419.5	0.081
J-110	475.3	431.2	0.072
J-111	474.8	436.1	0.072
J-112	474.8	436.1	0.072
J-113	475.2	432.2	0.090
J-114	475.2	432.2	0.144
J-115	476.3	421.4	0.153
J-116	475.0	434.2	0.117
J-117	475.8	426.3	0.162
J-118	476.8	416.5	0.108
J-121	475.4	430.2	0.162
J-122	476.5	419.4	0.081
J-123	475.4	430.2	0.234
J-124	475.4	430.2	0.135
J-125	475.6	428.3	0.072
J-126	475.3	431.2	0.198
J-127	475.5	429.2	0.162
J-128	476.0	424.4	0.108
J-130	473.4	449.9	0.117
J-132	475.5	429.3	0.114
J-134	476.3	421.4	0.090
J-137	471.6	467.4	2.500
J-138	470.9	474.4	1.100
J-139	479.1	393.9	1.500
J-140	480.0	385.1	1.500
J-141	475.2	432.3	0.300
J-142	477.5	409.7	0.300
J-143	459.7	584.1	0.000
J-144	459.6	585.1	0.100
J-145	464.7	535.1	2.300
J-146	470.2	481.1	0.900
J-147	465.2	530.1	0.400
J-148	473.5	448.7	0.600
J-150	473.5	448.7	0.000
J-151	467.1	511.7	0.000
J-152	471.8	465.4	0.000
J-153	470.3	480.2	0.000
J-155	470.2	481.7	0.000
Melody PH	471.0	473.5	0.000
WWTP	469.5	488.1	0.000

Scenario: Max Day Pumps On - No Fire Elev at 519.3 (2031)
Current Time Step: 0.000Hr
FlexTable: Junction Table

Water Tower Location 2

Label	Elevation (m)	Pressure (kPa)	Demand (L/s)
Cooper PH	454.2	639.3	-15.154
J-1	456.4	616.3	0.236
J-2	455.7	623.2	0.191
J-3	459.7	583.9	0.191
J-4	460.7	574.0	0.191
J-5	460.5	575.8	3.236
J-6	456.6	614.4	0.191
J-7	457.4	606.6	0.191
J-8	457.8	602.8	0.191
J-9	458.8	592.9	0.191
J-10	460.0	581.0	0.191
J-11	479.2	392.7	0.191
J-12	466.4	518.4	0.191
J-13	472.2	461.6	0.191
J-14	477.0	414.4	0.191
J-15	477.4	410.2	0.191
J-16	480.0	385.1	0.191
J-17	481.5	370.8	0.191
J-18	481.6	369.6	0.191
J-19	481.6	369.6	0.191
J-20	481.2	372.9	0.191
J-21	478.8	397.1	0.191
J-22	481.2	372.9	0.191
J-23	479.7	388.2	0.191
J-24	479.3	391.8	0.191
J-25	479.3	392.1	0.191
J-26	478.9	396.1	0.236
J-27	477.9	406.1	0.191
J-28	477.0	414.6	0.191
J-29	475.3	431.3	0.191
J-30	462.7	554.8	0.191
J-31	457.8	602.8	0.191
J-32	454.0	640.0	0.191
J-33	454.8	632.3	0.191
J-34	455.2	628.4	0.191
J-35	458.0	600.9	0.191
J-36	459.0	591.1	0.191
J-37	455.9	621.6	0.191
J-38	456.9	611.8	0.191
J-39	456.6	614.7	0.191
J-40	465.2	530.3	0.191
J-41	474.6	438.1	0.191
J-42	471.0	473.4	0.191
J-43	472.7	456.8	0.191
J-44	470.7	476.4	0.191
J-45	460.5	576.5	0.191
J-46	454.0	640.4	0.191
J-47	453.2	648.3	0.191
J-48	454.5	635.4	0.191
J-49	468.5	498.0	0.191
J-50	470.7	476.4	0.191
J-51	471.6	467.6	0.191
J-52	472.6	457.8	0.191
J-53	472.8	455.7	0.191
J-54	471.0	473.5	0.191
J-55	473.0	453.7	0.191
J-56	462.2	559.5	0.191
J-57	472.0	463.2	0.191

J-58	454.0	640.3	0.191
J-59	453.0	650.1	0.191
J-60	452.6	654.0	0.191
J-61	453.2	648.2	0.191
J-62	454.4	636.7	0.191
J-63	454.2	638.8	0.191
J-64	454.0	640.7	0.191
J-65	459.6	586.1	0.191
J-66	459.3	588.9	0.191
J-67	459.0	591.9	0.191
J-68	456.7	614.3	0.191
J-69	457.3	608.4	0.191
J-70	458.7	594.7	0.191
J-71	453.6	644.7	0.191
J-72	458.5	596.7	0.191
J-94	472.0	463.2	0.000
J-97	454.2	639.1	0.000
J-99	473.1	452.7	0.228
J-100	474.3	440.9	0.228
J-101	475.6	428.1	0.431
J-102	476.5	419.2	0.471
J-103	476.0	424.1	0.349
J-104	475.2	431.9	0.349
J-105	475.5	429.0	0.167
J-106	475.7	427.0	0.167
J-107	475.6	428.0	0.187
J-108	475.9	425.0	0.146
J-109	476.5	419.2	0.146
J-110	475.3	431.1	0.126
J-111	474.8	435.8	0.126
J-112	474.8	435.8	0.126
J-113	475.2	431.9	0.167
J-114	475.2	431.9	0.289
J-115	476.3	421.1	0.309
J-116	475.0	433.9	0.228
J-117	475.8	426.0	0.329
J-118	476.8	416.3	0.207
J-121	475.4	429.9	0.329
J-122	476.5	419.1	0.146
J-123	475.4	429.9	0.492
J-124	475.4	429.9	0.268
J-125	475.6	427.9	0.126
J-126	475.3	430.9	0.410
J-127	475.5	428.9	0.329
J-128	476.0	424.1	0.207
J-130	473.4	449.7	0.228
J-132	475.5	429.1	0.221
J-134	476.3	421.1	0.167
J-137	471.6	466.7	5.000
J-138	470.9	474.0	2.100
J-139	479.1	393.5	3.000
J-140	480.0	384.6	3.000
J-141	475.2	432.0	0.600
J-142	477.5	409.6	0.500
J-143	459.7	583.7	0.000
J-144	459.6	584.6	0.300
J-145	464.7	534.6	4.600
J-146	470.2	480.3	1.800
J-147	465.2	529.3	0.700
J-148	473.5	447.9	1.300
J-150	473.5	447.9	0.000
J-151	467.1	511.4	0.000
J-152	471.8	464.9	0.000
J-153	470.3	479.8	0.000
J-155	470.2	481.7	0.000
Melody PH	471.0	473.5	-7.569
WWTP	469.5	487.7	0.000

Scenario: LWL Max Day with Fire (Pumps On storage = 510.75 m) (2031)
Current Time Step: 0.000Hr
Fire Flow Node FlexTable: Fire Flow Report

Water Tower Location 2

Label	Flow (Total Available) (L/s)	Pressure (Calculated Residual) (kPa)
Cooper PH	84.846	509.6
J-1	100.236	372.3
J-2	100.191	472.2
J-3	100.191	437.0
J-4	100.191	418.9
J-5	103.236	406.3
J-6	100.191	468.8
J-7	100.191	475.8
J-8	100.191	485.7
J-9	100.191	440.9
J-10	100.191	376.8
J-11	100.191	191.4
J-12	100.191	375.7
J-13	100.191	328.3
J-14	100.191	248.7
J-15	98.909	137.9
J-16	100.191	240.5
J-17	100.191	185.6
J-18	84.519	137.9
J-19	72.359	137.9
J-20	71.532	137.9
J-21	68.212	137.9
J-22	58.419	137.9
J-23	100.191	236.1
J-24	88.525	137.9
J-25	100.191	300.9
J-26	100.236	307.5
J-27	100.191	312.0
J-28	100.191	318.5
J-29	100.191	334.5
J-30	100.191	458.9
J-31	100.191	491.7
J-32	100.191	199.1
J-33	100.191	475.0
J-34	100.191	493.1
J-35	100.191	460.7
J-36	100.191	486.2
J-37	100.191	523.4
J-38	100.191	515.8
J-39	100.191	518.8
J-40	100.191	426.5
J-41	100.191	197.5
J-42	100.191	231.5
J-43	100.191	349.2
J-44	100.191	381.4
J-45	100.191	480.6
J-46	100.191	536.5
J-47	100.191	541.9
J-48	100.191	480.9
J-49	100.191	401.2
J-50	100.191	379.2
J-51	100.191	372.5
J-52	100.191	366.0
J-53	100.191	322.5
J-54	100.191	384.6
J-55	100.191	348.1

J-56	100.191	448.1
J-57	100.191	341.0
J-58	100.191	382.9
J-59	100.191	209.2
J-60	86.979	144.1
J-61	75.965	138.1
J-62	100.191	526.9
J-63	100.191	523.8
J-64	100.191	386.1
J-65	100.191	442.9
J-66	100.191	427.5
J-67	100.191	405.0
J-68	100.191	436.7
J-69	100.191	375.9
J-70	100.191	366.0
J-71	100.191	210.5
J-72	100.191	171.8
J-94	100.000	211.9
J-97	100.000	514.9
J-99	100.228	346.7
J-100	100.228	333.7
J-101	100.431	314.3
J-102	100.471	302.6
J-103	100.349	306.8
J-104	100.349	317.4
J-105	100.167	321.3
J-106	100.167	327.1
J-107	100.187	331.0
J-108	100.146	326.9
J-109	100.146	317.5
J-110	100.126	334.9
J-111	100.126	311.3
J-112	100.126	308.1
J-113	100.167	295.6
J-114	100.289	263.4
J-115	100.309	175.5
J-116	100.228	150.3
J-117	97.963	137.9
J-118	100.207	181.1
J-121	100.329	268.6
J-122	100.146	244.6
J-123	100.492	194.9
J-124	100.268	205.7
J-125	100.126	164.9
J-126	100.410	207.6
J-127	100.329	259.8
J-128	100.207	303.7
J-130	100.228	327.2
J-132	100.221	332.5
J-134	100.167	320.7
J-137	105.000	293.4
J-138	102.100	318.2
J-139	103.000	243.5
J-140	103.000	189.9
J-141	100.600	222.7
J-142	100.500	255.0
J-143	100.000	397.1
J-144	100.300	375.0
J-145	104.600	329.1
J-146	101.800	248.0
J-147	100.700	318.1
J-148	101.300	173.4
J-150	100.000	195.2
J-151	100.000	365.5
J-152	100.000	287.2
J-153	100.000	168.7
J-155	100.000	393.7

Melody PH

	92.431	383.3
WWTP	100.000	148.0

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Scenario: Peak Hour (LWL - Bottom of Equalization 515 m) (2031)
Current Time Step: 0.000Hr
FlexTable: Junction Table

Water Tower Location 2

Label	Elevation (m)	Pressure (kPa)	Demand (L/s)
Cooper PH	454.2	596.5	-15.150
J-1	456.4	573.7	0.286
J-2	455.7	580.6	0.286
J-3	459.7	541.3	0.286
J-4	460.7	531.5	0.286
J-5	460.5	533.4	0.286
J-6	456.6	571.8	0.286
J-7	457.4	564.0	0.286
J-8	457.8	560.1	0.286
J-9	458.8	550.3	0.286
J-10	460.0	538.4	0.286
J-11	479.2	350.1	0.286
J-12	466.4	475.8	0.286
J-13	472.2	419.0	0.286
J-14	477.0	371.9	0.286
J-15	477.4	367.6	0.286
J-16	480.0	342.6	0.286
J-17	481.5	328.2	0.286
J-18	481.6	327.0	0.286
J-19	481.6	327.0	0.286
J-20	481.2	330.3	0.286
J-21	478.8	354.5	0.286
J-22	481.2	330.3	0.286
J-23	479.7	345.7	0.286
J-24	479.3	349.2	0.286
J-25	479.3	349.6	0.286
J-26	478.9	353.7	0.286
J-27	477.9	363.6	0.286
J-28	477.0	372.0	0.286
J-29	475.3	388.7	0.286
J-30	462.7	512.2	0.286
J-31	457.8	560.2	0.286
J-32	454.0	597.3	0.286
J-33	454.8	589.6	0.286
J-34	455.2	585.7	0.286
J-35	458.0	558.2	0.286
J-36	459.0	548.4	0.286
J-37	455.9	578.9	0.286
J-38	456.9	569.1	0.286
J-39	456.6	572.0	0.286
J-40	465.2	487.7	0.286
J-41	474.6	395.5	0.286
J-42	471.0	430.8	0.286
J-43	472.7	414.1	0.286
J-44	470.7	433.7	0.286
J-45	460.5	533.8	0.286
J-46	454.0	597.7	0.286
J-47	453.2	605.6	0.286
J-48	454.5	592.7	0.286
J-49	468.5	455.3	0.286
J-50	470.7	433.8	0.286
J-51	471.6	425.1	0.286
J-52	472.6	415.3	0.286
J-53	472.8	413.1	0.286
J-54	471.0	431.1	0.286
J-55	473.0	411.2	0.286
J-56	462.2	516.7	0.286
J-57	472.0	420.2	0.286

J-58	454.0	597.5	0.286
J-59	453.0	607.3	0.286
J-60	452.6	611.2	0.286
J-61	453.2	605.3	0.286
J-62	454.4	593.9	0.286
J-63	454.2	596.0	0.286
J-64	454.0	597.9	0.286
J-65	459.6	543.2	0.286
J-66	459.3	546.1	0.286
J-67	459.0	549.0	0.286
J-68	456.7	571.5	0.286
J-69	457.3	565.6	0.286
J-70	458.7	551.9	0.286
J-71	453.6	601.9	0.286
J-72	458.5	553.8	0.286
J-94	472.0	420.2	0.000
J-97	454.2	596.3	0.000
J-99	473.1	410.1	0.343
J-100	474.3	398.3	0.343
J-101	475.6	385.6	0.648
J-102	476.5	376.7	0.709
J-103	476.0	381.6	0.526
J-104	475.2	389.4	0.526
J-105	475.5	386.5	0.251
J-106	475.7	384.5	0.251
J-107	475.6	385.5	0.282
J-108	475.9	382.6	0.221
J-109	476.5	376.7	0.221
J-110	475.3	388.5	0.190
J-111	474.8	393.3	0.190
J-112	474.8	393.2	0.190
J-113	475.2	389.3	0.251
J-114	475.2	389.3	0.434
J-115	476.3	378.5	0.465
J-116	475.0	391.3	0.343
J-117	475.8	383.4	0.495
J-118	476.8	373.7	0.312
J-121	475.4	387.3	0.495
J-122	476.5	376.5	0.221
J-123	475.4	387.3	0.740
J-124	475.4	387.3	0.404
J-125	475.6	385.4	0.190
J-126	475.3	388.3	0.618
J-127	475.5	386.4	0.495
J-128	476.0	381.5	0.312
J-130	473.4	407.1	0.343
J-132	475.5	386.5	0.333
J-134	476.3	378.6	0.251
J-137	471.6	423.1	7.500
J-138	470.9	431.0	3.200
J-139	479.1	350.7	4.500
J-140	480.0	341.8	4.500
J-141	475.2	389.4	0.900
J-142	477.5	367.1	0.800
J-143	459.7	541.2	0.000
J-144	459.6	542.0	0.400
J-145	464.7	491.9	6.800
J-146	470.2	436.6	2.700
J-147	465.2	485.7	1.100
J-148	473.5	404.2	1.900
J-150	473.5	404.2	0.000
J-151	467.1	468.5	0.000
J-152	471.8	421.6	0.000
J-153	470.3	436.8	0.000
J-155	470.2	439.3	0.000
Melody PH	471.0	431.1	-7.569
WWTP	469.5	444.7	0.000

Scenario: HWL Pumps off ADD (2031)
Current Time Step: 0.000Hr
FlexTable: Junction Table

Water Tower Location 3

Label	Elevation (m)	Pressure (kPa)	Demand (L/s)
Cooper PH	454.2	637.7	0.000
J-1	456.4	616.2	0.105
J-2	455.7	623.0	0.076
J-3	459.7	583.8	0.076
J-4	460.7	574.0	0.076
J-5	460.5	576.0	1.605
J-6	456.6	614.2	0.076
J-7	457.4	606.4	0.076
J-8	457.8	602.4	0.076
J-9	458.8	592.7	0.076
J-10	460.0	580.9	0.076
J-11	479.2	392.6	0.076
J-12	466.4	518.2	0.076
J-13	472.2	461.3	0.076
J-14	477.0	414.3	0.076
J-15	477.4	410.0	0.076
J-16	480.0	385.0	0.076
J-17	481.5	370.7	0.076
J-18	481.6	369.5	0.076
J-19	481.6	369.5	0.076
J-20	481.2	372.8	0.076
J-21	478.8	397.0	0.076
J-22	481.2	372.8	0.076
J-23	479.7	388.1	0.076
J-24	479.3	391.6	0.076
J-25	479.3	392.0	0.076
J-26	478.9	396.0	0.076
J-27	477.9	405.9	0.076
J-28	477.0	414.3	0.076
J-29	475.3	430.9	0.076
J-30	462.7	554.4	0.076
J-31	457.8	602.4	0.076
J-32	454.0	639.7	0.076
J-33	454.8	631.8	0.076
J-34	455.2	627.9	0.076
J-35	458.0	600.5	0.076
J-36	459.0	590.7	0.076
J-37	455.9	621.0	0.076
J-38	456.9	611.2	0.076
J-39	456.6	614.2	0.076
J-40	465.2	529.8	0.076
J-41	474.6	437.7	0.076
J-42	471.0	473.0	0.076
J-43	472.7	456.3	0.076
J-44	470.7	475.9	0.076
J-45	460.5	575.9	0.076
J-46	454.0	639.7	0.076
J-47	453.2	647.5	0.076
J-48	454.5	634.8	0.076
J-49	468.5	497.5	0.076
J-50	470.7	475.9	0.076
J-51	471.6	467.1	0.076
J-52	472.6	457.3	0.076
J-53	472.8	455.3	0.076
J-54	471.0	472.9	0.076
J-55	473.0	453.3	0.076
J-56	462.2	559.2	0.076
J-57	472.0	463.1	0.076

J-58	454.0	639.7	0.076
J-59	453.0	649.5	0.076
J-60	452.6	653.4	0.076
J-61	453.2	647.5	0.076
J-62	454.4	635.7	0.076
J-63	454.2	637.7	0.076
J-64	454.0	639.7	0.076
J-65	459.6	584.7	0.076
J-66	459.3	587.7	0.076
J-67	459.0	590.6	0.076
J-68	456.7	613.2	0.076
J-69	457.3	607.3	0.076
J-70	458.7	593.6	0.076
J-71	453.6	643.6	0.076
J-72	458.5	595.5	0.076
J-94	472.0	463.1	0.000
J-97	454.2	637.7	0.000
J-99	473.1	452.3	0.117
J-100	474.3	440.6	0.117
J-101	475.6	427.8	0.207
J-102	476.5	419.0	0.225
J-103	476.0	423.9	0.171
J-104	475.2	431.7	0.171
J-105	475.5	428.8	0.090
J-106	475.7	426.8	0.090
J-107	475.6	427.8	0.099
J-108	475.9	424.9	0.081
J-109	476.5	419.0	0.081
J-110	475.3	430.8	0.072
J-111	474.8	435.7	0.072
J-112	474.8	435.7	0.072
J-113	475.2	431.7	0.090
J-114	475.2	431.7	0.144
J-115	476.3	421.1	0.153
J-116	475.0	433.8	0.117
J-117	475.8	426.0	0.162
J-118	476.8	416.2	0.108
J-121	475.4	429.8	0.162
J-122	476.5	419.0	0.081
J-123	475.4	429.8	0.234
J-124	475.4	429.8	0.135
J-125	475.6	427.8	0.072
J-126	475.3	430.7	0.198
J-127	475.5	428.8	0.162
J-128	476.0	423.9	0.108
J-130	473.4	449.4	0.117
J-132	475.5	428.8	0.114
J-134	476.3	421.0	0.090
J-137	471.6	467.1	2.500
J-138	470.9	473.9	1.100
J-139	479.1	393.4	1.500
J-140	480.0	384.6	1.500
J-141	475.2	432.0	0.300
J-142	477.5	409.5	0.300
J-143	459.7	583.8	0.000
J-144	459.6	584.8	0.100
J-145	464.7	534.8	2.300
J-146	470.2	481.1	0.900
J-147	465.2	530.0	0.400
J-148	473.5	448.9	0.600
J-150	473.5	449.1	0.000
J-151	467.1	511.3	0.000
J-152	471.8	465.0	0.000
J-153	470.3	479.7	0.000
J-155	470.2	481.1	0.000
Melody PH	471.0	472.9	0.000
WWTP	469.5	487.7	0.000

Scenario: Max Day Pumps On - No Fire Elev at 519.3 (2031)
Current Time Step: 0.000Hr
FlexTable: Junction Table

Water Tower Location 3

Label	Elevation (m)	Pressure (kPa)	Demand (L/s)
Cooper PH	454.2	639.0	-15.154
J-1	456.4	616.1	0.236
J-2	455.7	622.9	0.191
J-3	459.7	583.7	0.191
J-4	460.7	573.8	0.191
J-5	460.5	575.6	3.236
J-6	456.6	614.1	0.191
J-7	457.4	606.4	0.191
J-8	457.8	602.5	0.191
J-9	458.8	592.6	0.191
J-10	460.0	580.8	0.191
J-11	479.2	392.5	0.191
J-12	466.4	518.1	0.191
J-13	472.2	461.3	0.191
J-14	477.0	414.2	0.191
J-15	477.4	410.0	0.191
J-16	480.0	384.9	0.191
J-17	481.5	370.6	0.191
J-18	481.6	369.4	0.191
J-19	481.6	369.4	0.191
J-20	481.2	372.7	0.191
J-21	478.8	396.9	0.191
J-22	481.2	372.7	0.191
J-23	479.7	388.0	0.191
J-24	479.3	391.6	0.191
J-25	479.3	391.9	0.191
J-26	478.9	396.0	0.236
J-27	477.9	405.9	0.191
J-28	477.0	414.4	0.191
J-29	475.3	431.0	0.191
J-30	462.7	554.6	0.191
J-31	457.8	602.5	0.191
J-32	454.0	639.7	0.191
J-33	454.8	632.0	0.191
J-34	455.2	628.1	0.191
J-35	458.0	600.6	0.191
J-36	459.0	590.8	0.191
J-37	455.9	621.3	0.191
J-38	456.9	611.4	0.191
J-39	456.6	614.4	0.191
J-40	465.2	530.0	0.191
J-41	474.6	437.8	0.191
J-42	471.0	473.1	0.191
J-43	472.7	456.4	0.191
J-44	470.7	476.0	0.191
J-45	460.5	576.1	0.191
J-46	454.0	640.1	0.191
J-47	453.2	648.0	0.191
J-48	454.5	635.1	0.191
J-49	468.5	497.6	0.191
J-50	470.7	476.0	0.191
J-51	471.6	467.2	0.191
J-52	472.6	457.4	0.191
J-53	472.8	455.2	0.191
J-54	471.0	473.1	0.191
J-55	473.0	453.3	0.191
J-56	462.2	559.3	0.191
J-57	472.0	463.2	0.191

J-58	454.0	640.0	0.191
J-59	453.0	649.8	0.191
J-60	452.6	653.7	0.191
J-61	453.2	647.8	0.191
J-62	454.4	636.3	0.191
J-63	454.2	638.4	0.191
J-64	454.0	640.4	0.191
J-65	459.6	585.7	0.191
J-66	459.3	588.6	0.191
J-67	459.0	591.5	0.191
J-68	456.7	614.0	0.191
J-69	457.3	608.1	0.191
J-70	458.7	594.4	0.191
J-71	453.6	644.4	0.191
J-72	458.5	596.4	0.191
J-94	472.0	463.2	0.000
J-97	454.2	638.8	0.000
J-99	473.1	452.2	0.228
J-100	474.3	440.5	0.228
J-101	475.6	427.7	0.431
J-102	476.5	418.8	0.471
J-103	476.0	423.7	0.349
J-104	475.2	431.5	0.349
J-105	475.5	428.6	0.167
J-106	475.7	426.6	0.167
J-107	475.6	427.6	0.187
J-108	475.9	424.7	0.146
J-109	476.5	418.8	0.146
J-110	475.3	430.7	0.126
J-111	474.8	435.4	0.126
J-112	474.8	435.4	0.126
J-113	475.2	431.5	0.167
J-114	475.2	431.5	0.289
J-115	476.3	420.8	0.309
J-116	475.0	433.6	0.228
J-117	475.8	425.7	0.329
J-118	476.8	416.0	0.207
J-121	475.4	429.5	0.329
J-122	476.5	418.8	0.146
J-123	475.4	429.5	0.492
J-124	475.4	429.5	0.268
J-125	475.6	427.6	0.126
J-126	475.3	430.5	0.410
J-127	475.5	428.6	0.329
J-128	476.0	423.7	0.207
J-130	473.4	449.3	0.228
J-132	475.5	428.7	0.221
J-134	476.3	420.7	0.167
J-137	471.6	467.1	5.000
J-138	470.9	474.0	2.100
J-139	479.1	393.1	3.000
J-140	480.0	384.2	3.000
J-141	475.2	431.8	0.600
J-142	477.5	409.4	0.500
J-143	459.7	583.5	0.000
J-144	459.6	584.4	0.300
J-145	464.7	534.4	4.600
J-146	470.2	481.0	1.800
J-147	465.2	530.0	0.700
J-148	473.5	448.8	1.300
J-150	473.5	449.0	0.000
J-151	467.1	511.3	0.000
J-152	471.8	465.1	0.000
J-153	470.3	479.8	0.000
J-155	470.2	481.2	0.000
Melody PH	471.0	473.1	-7.569
WWTP	469.5	487.7	0.000

Scenario: LWL Max Day with Fire (Pumps On storage = 510.75 m) (2031)
Current Time Step: 0.000Hr
Fire Flow Node FlexTable: Fire Flow Report

Water Tower Location 3

Label	Flow (Total Available) (L/s)	Pressure (Calculated Residual) (kPa)
Cooper PH	84.846	497.7
J-1	100.236	366.0
J-2	100.191	465.9
J-3	100.191	431.1
J-4	100.191	413.7
J-5	103.236	401.6
J-6	100.191	462.1
J-7	100.191	468.5
J-8	100.191	478.1
J-9	100.191	434.4
J-10	100.191	370.5
J-11	100.191	185.8
J-12	100.191	369.9
J-13	100.191	322.7
J-14	100.191	243.8
J-15	97.570	137.9
J-16	100.191	236.1
J-17	100.191	181.8
J-18	83.601	137.9
J-19	71.724	137.9
J-20	70.927	137.9
J-21	67.745	137.9
J-22	58.038	137.9
J-23	100.191	232.6
J-24	87.703	137.9
J-25	100.191	297.8
J-26	100.236	305.9
J-27	100.191	307.4
J-28	100.191	312.2
J-29	100.191	326.8
J-30	100.191	449.3
J-31	100.191	483.4
J-32	100.191	191.9
J-33	100.191	465.1
J-34	100.191	482.8
J-35	100.191	451.5
J-36	100.191	477.2
J-37	100.191	511.6
J-38	100.191	503.9
J-39	100.191	508.1
J-40	100.191	414.6
J-41	100.191	185.5
J-42	100.191	219.4
J-43	100.191	336.9
J-44	100.191	367.3
J-45	100.191	468.1
J-46	100.191	524.7
J-47	100.191	530.1
J-48	100.191	468.9
J-49	100.191	384.7
J-50	100.191	361.0
J-51	100.191	351.6
J-52	100.191	342.6
J-53	100.191	301.5
J-54	100.191	358.6
J-55	100.191	326.7

J-56	100.191	440.1
J-57	100.191	342.6
J-58	100.191	370.9
J-59	100.191	197.1
J-60	85.932	144.1
J-61	75.233	138.0
J-62	100.191	515.0
J-63	100.191	512.0
J-64	100.191	374.2
J-65	100.191	431.0
J-66	100.191	415.7
J-67	100.191	393.1
J-68	100.191	424.8
J-69	100.191	364.1
J-70	100.191	354.2
J-71	100.191	198.6
J-72	100.191	160.0
J-94	100.000	213.5
J-97	100.000	503.1
J-99	100.228	326.3
J-100	100.228	313.8
J-101	100.431	295.3
J-102	100.471	284.2
J-103	100.349	289.1
J-104	100.349	300.4
J-105	100.167	305.1
J-106	100.167	312.0
J-107	100.187	316.4
J-108	100.146	312.5
J-109	100.146	303.9
J-110	100.126	320.6
J-111	100.126	299.2
J-112	100.126	296.3
J-113	100.167	283.7
J-114	100.289	251.3
J-115	100.309	170.0
J-116	100.228	144.9
J-117	96.656	137.9
J-118	100.207	176.0
J-121	100.329	256.6
J-122	100.146	232.6
J-123	100.492	182.5
J-124	100.268	193.2
J-125	100.126	152.4
J-126	100.410	195.2
J-127	100.329	247.0
J-128	100.207	290.3
J-130	100.228	307.4
J-132	100.221	318.1
J-134	100.167	306.8
J-137	105.000	344.6
J-138	102.100	317.0
J-139	103.000	227.2
J-140	103.000	172.3
J-141	100.600	218.0
J-142	100.500	250.8
J-143	100.000	392.9
J-144	100.300	371.7
J-145	104.600	326.3
J-146	101.800	368.6
J-147	100.700	412.5
J-148	101.300	321.8
J-150	100.000	379.3
J-151	100.000	362.8
J-152	100.000	311.4
J-153	100.000	170.3
J-155	100.000	366.2
Melody PH		

	92.431	357.3
WWTP	100.000	149.7

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Scenario: Peak Hour (LWL - Bottom of Equalization 515 m) (2031)
Current Time Step: 0.000Hr
FlexTable: Junction Table

Water Tower Location 3

Label	Elevation (m)	Pressure (kPa)	Demand (L/s)
Cooper PH	454.2	595.3	-15.150
J-1	456.4	572.7	0.286
J-2	455.7	579.6	0.286
J-3	459.7	540.4	0.286
J-4	460.7	530.5	0.286
J-5	460.5	532.5	0.286
J-6	456.6	570.8	0.286
J-7	457.4	562.9	0.286
J-8	457.8	559.0	0.286
J-9	458.8	549.2	0.286
J-10	460.0	537.4	0.286
J-11	479.2	349.2	0.286
J-12	466.4	474.8	0.286
J-13	472.2	418.1	0.286
J-14	477.0	371.0	0.286
J-15	477.4	366.8	0.286
J-16	480.0	341.8	0.286
J-17	481.5	327.5	0.286
J-18	481.6	326.3	0.286
J-19	481.6	326.3	0.286
J-20	481.2	329.6	0.286
J-21	478.8	353.8	0.286
J-22	481.2	329.6	0.286
J-23	479.7	345.1	0.286
J-24	479.3	348.6	0.286
J-25	479.3	349.1	0.286
J-26	478.9	353.4	0.286
J-27	477.9	362.9	0.286
J-28	477.0	371.1	0.286
J-29	475.3	387.7	0.286
J-30	462.7	511.1	0.286
J-31	457.8	559.1	0.286
J-32	454.0	596.3	0.286
J-33	454.8	588.5	0.286
J-34	455.2	584.6	0.286
J-35	458.0	557.1	0.286
J-36	459.0	547.3	0.286
J-37	455.9	577.7	0.286
J-38	456.9	567.9	0.286
J-39	456.6	570.8	0.286
J-40	465.2	486.4	0.286
J-41	474.6	394.2	0.286
J-42	471.0	429.5	0.286
J-43	472.7	412.8	0.286
J-44	470.7	432.4	0.286
J-45	460.5	532.5	0.286
J-46	454.0	596.5	0.286
J-47	453.2	604.4	0.286
J-48	454.5	591.4	0.286
J-49	468.5	453.9	0.286
J-50	470.7	432.3	0.286
J-51	471.6	423.5	0.286
J-52	472.6	413.7	0.286
J-53	472.8	411.6	0.286
J-54	471.0	429.4	0.286
J-55	473.0	409.7	0.286
J-56	462.2	515.7	0.286
J-57	472.0	419.6	0.286

J-58	454.0	596.3	0.286
J-59	453.0	606.1	0.286
J-60	452.6	610.0	0.286
J-61	453.2	604.1	0.286
J-62	454.4	592.7	0.286
J-63	454.2	594.8	0.286
J-64	454.0	596.7	0.286
J-65	459.6	542.0	0.286
J-66	459.3	544.9	0.286
J-67	459.0	547.8	0.286
J-68	456.7	570.3	0.286
J-69	457.3	564.4	0.286
J-70	458.7	550.7	0.286
J-71	453.6	600.7	0.286
J-72	458.5	552.7	0.286
J-94	472.0	419.6	0.000
J-97	454.2	595.1	0.000
J-99	473.1	408.6	0.343
J-100	474.3	396.9	0.343
J-101	475.6	384.1	0.648
J-102	476.5	375.3	0.709
J-103	476.0	380.2	0.526
J-104	475.2	388.0	0.526
J-105	475.5	385.1	0.251
J-106	475.7	383.2	0.251
J-107	475.6	384.1	0.282
J-108	475.9	381.2	0.221
J-109	476.5	375.3	0.221
J-110	475.3	387.2	0.190
J-111	474.8	392.0	0.190
J-112	474.8	392.0	0.190
J-113	475.2	388.0	0.251
J-114	475.2	388.0	0.434
J-115	476.3	377.4	0.465
J-116	475.0	390.2	0.343
J-117	475.8	382.4	0.495
J-118	476.8	372.6	0.312
J-121	475.4	386.0	0.495
J-122	476.5	375.2	0.221
J-123	475.4	386.0	0.740
J-124	475.4	386.0	0.404
J-125	475.6	384.0	0.190
J-126	475.3	387.0	0.618
J-127	475.5	385.0	0.495
J-128	476.0	380.2	0.312
J-130	473.4	405.6	0.343
J-132	475.5	385.2	0.333
J-134	476.3	377.3	0.251
J-137	471.6	423.5	7.500
J-138	470.9	430.3	3.200
J-139	479.1	349.3	4.500
J-140	480.0	340.4	4.500
J-141	475.2	388.5	0.900
J-142	477.5	366.4	0.800
J-143	459.7	540.3	0.000
J-144	459.6	541.2	0.400
J-145	464.7	491.2	6.800
J-146	470.2	437.9	2.700
J-147	465.2	486.7	1.100
J-148	473.5	405.9	1.900
J-150	473.5	406.7	0.000
J-151	467.1	467.7	0.000
J-152	471.8	421.4	0.000
J-153	470.3	436.1	0.000
J-155	470.2	437.6	0.000
Melody PH	471.0	429.4	-7.569
WWTP	469.5	444.1	0.000

BURNSIDE

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Appendix C

Agency Contact List

Agency/Organization	Screening Criteria	Title	First Name	Last Name	Position	Address 1	Address 2	City	Province	Postal Code	Email	Telephone	Fax
Fisheries and Oceans Canada	**The Fisheries Act requires that projects avoid causing serious harm to fish unless authorized by the Minister of Fisheries and Oceans Canada. Serious harm to fish is defined in the Fisheries Act as "the death of fish or any permanent alteration to, or destruction of, fish habitat." This applies to work being conducted in or near waterbodies that support fish that are part of or that support a commercial, recreational or Aboriginal fishery. An authorization from DFO under the Fisheries Act may be required. Seek advice from EPA Aquatic Ecologists if you are unsure about whether your project requires a review by DFO. ONLY CONTACT FISHERIES PROTECTION OFFICE if you need further advice on whether a review is required.** **Information about projects near water, and the self-assessment process for determining if DFO review is required is found at http //www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html** **Contact information for DFO by province http //www.dfo-mpo.gc.ca/pnw-ppe/contact-eng.html** **NOTE The self-assessment process must be undertaken once detailed design information is available. Therefore, unless the detailed design if running concurrently with the EA process, contacting DFO during the EA may not be appropriate.**				**Fisheries Protection Program**						**FisheriesProtection@dfo-mpo.gc.ca**	**1-855-852-8320**	
Hydro One Networks Inc.	Contact if possibility of utility being located within project area; Projects that could potentially directly impact HONI facilities or plants (including transmission/ distribution lines/stations). Proponents should clearly identify the proposal's location and outline the type of impact anticipated relative to HONI facilities/plants. 500 KV line in the area of project http //www hydroone.com/RegulatoryAffairs/Documents/EB-2006-0501/Exhibit%20A/Tab_6_Sched_1-Transmission_System_Map.pdf	Mr.	Walter	Kloostra	Manager, Transmission Lines Sustainment Investment Planning	483 Bay Street	North Tower, 15th Floor	Toronto	ON	M5G 2P5	w d.kloostra@hydroone.com	(416) 345-5114	(416) 345-5443
Ministry of Agriculture, Food and Rural Affairs	Circulate Individual EAs and Class EAs affecting agricultural operations and prime agricultural areas (i.e., predominantly prime agricultural lands which include specialty crop areas and/or, Canada Land Inventory (CLI) Class 1, 2 and 3 soils and any associated CLI Class 4 to 7 soils) and waste EAs to the appropriate Rural Planner. Do not circulate any Individual EAs or Class EAs that only include land in designated "settlement areas" (as defined by the Provincial Policy Statement). If necessary see map of regions on the intranet site: http //intra net.gov.on.ca/omafra-maps/files/2013/02/OMAF_MRA-Rural-Planner-Areas-of-Coverage png.				Rural Planner								
Ministry of the Environment, Conservation and Parks - Environmental Approvals Branch	**Contact in all cases, for NOTICE OF COMPLETION ONLY.**										**MEA.NOTICES.EAAB@ontario.ca**		
Ministry of Health and Long-Term Care	Send Summary of EA and map for sewage and water-works and for waste facility projects which may have health implications.	Mr.	Tony	Amalfa	Manager, Environmental Health Policy and Programs	393 University Avenue	21st Floor	Toronto	ON	M7A 2S1	tony.amalfa@ontario ca	(416) 327-7624	(416) 327-0984
Ministry of Municipal Affairs - Central Municipal Service Office	Class EA projects that have one or more of the following: a municipal proponent; relate to municipal servicing; and/or have federal involvement in upper- and single-tier municipalities of Dufferin, Durham, Halton, Hamilton, Toronto Muskoka Niagara Peel Simcoe and York.	Mr.	Tyler	Shantz	Planner	659 Exter Road	2nd Floor	London	ON	N6E 1L3	Tyler.Shantz@ontario.ca	519-873-4695	519-851-3954
Ministry of Municipal Affairs - Ontario Growth Secretariat	Contact to see if they have an interest in the EA.	Mr.	Charles	O'Hara	Manager, Growth Policy	777 Bay Street	4th Floor, Suite 425	Toronto	ON	M5G 2E5	charles.o'hara@ontario ca	(416) 325-5794	(416) 325-7403
Ministry of Natural Resources- Guelph (Southern Region)	All individual or Class EAs in District which covers upper- and single-tier municipalities Hamilton, Niagara, Brant, Waterloo, Wellington, Huron and Perth including Kitchener area and Haldimand County.	Mr.	David	Marriot	District Planner	1 Stone Road West		Guelph	ON	N1G 4Y2	david.marriott@ontario.ca	(519) 826-4926	(519) 826-4929
Ministry of Natural Resources- Guelph (Southern Region)	All individual or Class EAs in District which covers upper- and single-tier municipalities Hamilton, Niagara, Brant, Waterloo, Wellington, Huron and Perth including Kitchener area and Haldimand County. Note that Midhurst covers all individual or class EAs in District which covers upper and single-tier municipalities of Grey, Bruce, Simcoe, Duffern **(except East Luther - MNRF Guelph)**	Ms.	Tara	McKenna	District Planner	1 Stone Road West		Guelph	ON	N1G 4Y2	tara mckenna@ontario.ca	(519) 826-4912	(519) 826-4929
Ministry of the Environment, Conservation and Parks - Guelph District Office		Ms.	Amy	Shaw	Manager (Acting)	1 Stone Rd West	4th floor	Guelph	ON	N1G 4Y2	amy shaw@ontario ca	(519) 826-4258	
Ministry of the Environment, Conservation and Parks - West Central Region	Contact if project within West-Central Regional boundaries. Contact district or area office in project area in addition to regional office. See website for regional and district office listings: https://www ontario.ca/environment-and-energy/ministry-environment-regional-and-district-offices Map: http://www.ontario.ca/environment-and-energy/ministry-environment-and-climate-change-district-locator	Ms.	Barbara	Slattery	Environmental Resource Planner and Environmental Assessment Coordinator	119 King Street West	12th Floor	Hamilton	ON	L8P 4Y7	barbara.slattery@ontario ca.	Toll free: 1-800-668-4557; (905) 521-7864	(905) 521-7820
Ministry of Tourism, Culture and Sport Culture Services Unit, Programs and Services Branch-Central Ontario	Reference only; contact team lead to be forwarded to appropriate heritage planner for new projects. All individual and site-specific Class Eas in Central Ontario which covers upper and single-tier municipalities of Hamilton, Halton, Niagara, Peel, Dufferin, Durham, York, Toronto, Simcoe, Muskoka, Kawartha Lakes, Haliburton, Peterborough and Northumberland	Mr.	Dan	Minkin	Heritage Planner	401 Bay Street	Suite 1700	Toronto	ON	M7A 0A7	Dan.minkin@ontario ca	(416) 314-7147	(416) 314-7175
County of Dufferin		Ms.	Sonya	Pritchard	Chief Administrative Officer	55 Zina Street		Orangeville	ON	L9W 1E5	cao@dufferincounty ca		
Township of Amaranth		Ms.	Susan	Stone	CAO/Clerk-Treasurer	374028 6th Line		Amaranth	ON	L9W 0M6	s stone@amaranth-eastgary.ca.		
Township of Amaranth		Ms.	Christine	Gervais	Township Planner						cgervais@amaranth-eastgary.ca		
Township of East Garafraxa		Ms.	Christine	Gervais	Township Planner						cgervais@amaranth-eastgary.ca		
Aamjiwnaang First Nation	Yes	Chief	Joanne	Rogers	Chief	Aamjiwnaang Administra	978 Tashmoo Avenue	Sarnia	ON	N7T 7H5	jrogers@aamjiwnaang ca; Aamjiwnaang.chief@gmail com	Do Not Call (519) 336-8410	336-0382

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Agency/Organization	Screening Criteria	Title	First Name	Last Name	Position	Address 1	Address 2	City	Province	Postal Code	Email	Telephone	Fax
Alderville First Nation	Yes		Skye	Anderson	Consultation Clerical Support	11696 2nd Line Road	P.O. Box 46	Roseneath	ON	K0K 2X0	jsmoke@alderville.ca	(905) 352-2929	
Aundeck-Omni-Kaning	Yes		Patsy	Corbiere	Chief			Little Current	ON		corbierep@aokfn.com	(705) 368-2228	
Beausoleil First Nation	Yes		Chief	Mary	McCue-King	11 O'Gemaa Miikaan Street		Christian Island	ON	L9M 0A9	info@chimnissing ca; Website: http://www.chimnissing.ca/admin.html	(705) 247-2051	(705) 247-2239
Chippewas of Georgina Island	Yes	Chief	Donna	Big Canoe	Band ManagerChief	R.R #2	P.O. Box N13	Sutton West	ON	L0E 1R0	NA	(705) 437-1337	(705) 437-4597
Chippewas of Kettle and Stony Point First Nation	Yes		Valerie	George	Consultation Coordinator	Kettle and Stony Point F	RR#2	Forest	ON	N0N 1J1		(519) 786-2125	(519) 786-2108
Chippewas of Mnjikaning First Nation (Rama)	Yes	Chief	Rodney	Noganosh		5884 Rama Road	Suite 200	Rama	ON	L0K 1T0	website: http://www.mnjikaning.ca/contact.asp	Toll-free: 1-866-854-2121; (705) 325-3611	(705) 325-0879
Chippewas of Nawash First Nation	Yes	Chief	Gregory	Nadjiwon		#135 Lakeshore Blvd.		Neyaashiinigmiing	ON	N0H 2T0	cnadministrator@nawash.ca	(519) 534-1689	
Curve Lake First Nation	Yes		Kaitlin	Hill	Communications/ Community Engagement Officer	22 Winookeedaa Road		Curve Lake	ON	K0L 1R0	KaitlinH@curvelake ca	(705) 657-8045 x.239	(705) 657-8708
Great Lakes Metis Council		Mr.	James	Wagar	Consultation Assessment Coordinator	380 9th Street East		East Owen Sound	ON	N4K 1P1	jamesw@metisnation.org consultations@metisnation.org	(519) 370-0435	
Haudenosaunee Confederacy	Yes	Hohahes	Leroy	Hill	Secretary to Haudensaunee Confederacy	2634 6th Line	RR#2	Ohsweken	ON	N0A 1H0	jocko@sixnationsns.com	Cell: (519) 717-7326	
Hiawatha First Nation	Yes		Tom	Cowie	Land/ Resources Community Consultation	R.R #2	123 Paudash Street	Keene	ON	K0L 2G0		(705) 295-4421	
Historic Saugeen Metis		Mr.	George	Govier	Consultation Coordinator	204 High Street	Box 1492	Southampton	ON	N0H 2L0	saugeenmetisadmin@bmts com	(519) 483-4000	
Historic Saugeen Metis		President	Archie	Indoe	President	204 High Street	Box 1492	Southampton	ON	N0H 2L0	saugeenmetisadmin@bmts com	(519) 483-4000	
M'Chigeeng First Nation	Yes	Chief	Linda	Debassige		53 Why 511	Box 333	M'Chigeeng	ON		NA	(705) 377-5362	(705) 377-4980
Métis Nation of Ontario	Yes		Jesse	Fieldwebster	Consultation Assessment Coordinator	255 Cranston Crescent	P.O. Box 4	Midland	ON	L4R 4K6	consultation@metisnation org	(705) 526-6335 ext. 220	(705) 526-7537
Mississaugas of Scugog Island First Nation	Yes	Chief	Kelly	LaRocca		R.R. #5	22521 Island Road	Port Perry	ON	L9L 1B6		(905) 985-3337	(905) 985-8828
Mississaugas of Scugog Island First Nation	Yes	Dave	Mowat	Community Consultation Specia	22521 Island Road			Port Perry	ON	L9L 1B6	dmowat@scugogfirstnation.com	(905) 985- 3337 Ex. 263	

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Agency/Organization	Screening Criteria	Title	First Name	Last Name	Position	Address 1	Address 2	City	Province	Postal Code	Email	Telephone	Fax
Mississaugas of the New Credit First Nation	Yes	Chief	R. Stacey	LaForme	Chief	RR #6	2789 Mississauga Road	Hagersville	ON	N0A 1H0	stacey.laforme@newcreditfirstnation.com; www newcreditfirstnation com	(905) 768-1133	(519) 768-1225
Mohawks Council of Akwesasne	Yes	Executive	Karla	Ransom		EMAIL		Cornwall	ON	K6H 5T3	karla.ransom@akwesasne.com	(613) 575-2250	
Mohawks of the Bay of Quinte	Yes	Chief	R. Donald	Maracle		24 Meadow Dr.		Deseronto	ON	K0K 1X0	rdonm@mbq-tmt.org	(613) 396-3424	(613) 396-3627
Saugeen First Nation	Yes	Chief	Lester	Anoquot	Chief	R.R #1	6493 Highway 21	Southampton	ON	N0H 2L0	contactadmin@saugeenfirstnation ca	(519) 797-2781	(519) 797-2978
Saugeen Ojibway Nation	Yes	Mr.	Doran	Ritchie	Land Use Planning	25 Maadookii Subdivision		Neyaashiinigmiing	ON	N0H 2T0	d ritchie@saugeenojibwaynation.ca	(519) 534-5507	
Sheguiandah	Yes	Chief	Andrew	Aguonie		142 Ogemah Miikan		Sheguiandah	ON	P0P 1W0	NA	(705) 368-2781	(705) 368-3697
Six Nations of the Grand River	Yes	Chief	Ava	Hill			P.O. Box 5000	Ohsweken	ON	N0A 1M0	wkm@sixnations ca; arleenmaracle@sixnations.ca; www sixnations ca	(519) 445-2201	
Walpole Island First Nation (Bkejwanong Territory)	Yes		Dean	Jacobs	Consultation Manager	Bkejwanong Territory, 117 Tahgahoning Road	RR#3	Wallaceburg	ON	N8A 4K9		(519) 627-1481	(519) 627-0440
Williams Treaty First Nation	Yes	Ms.	Karry	Sandy-Mackenzie	Claims Coordinator	8 Creswick Court		Barrie	ON	L4M 2S7	inquiries@williamstreatiesfirstnations ca; k a.sandy-mckenzie@rogers com	(705) 792-5087	
Zhiibaahaasing First Nation	Yes	Chief	Irene	Sagon Kelly	Chief	General Delivery		Silver Water	ON	P0P 1Y0	NA	(705) 283-3963	(705) 283-3964
Bell Canada	Contact if there is a possibility of utility being located within project area.	Ms.	Wendy	Lefebvre	Design Manager, Access Network	5115 Creekbank Road West	3rd Floor	Mississauga	ON	L4W 5R1	wendy.lefebvre@bell ca	(905) 219-4558	(416) 701-6489
Bell Canada	Contact if there is a possibility of utility being located within project area.	Mr.	Scott	Moon	Implementation Department	5115 Creekbank Road	3rd Floor, West Tower	Mississauga	ON	L4W 5R1	scott moon@bell ca	(905) 219-4558	(416) 701-6489
Bell Canada, Municipal Operations Centre	Contact if there is a possibility of utility being located within project area.	Mr.	John	Lachapelle		100 Borough Drive	Floor 5 Blue	Scarborough	ON	M1P 4WZ			
Enbridge Gas Distribution Inc.	Contact if there is a possibility of utility being located within project area.	Mr.	Vince	Cina	Supervisor, Planning and Design	500 Consumers Road		North York	ON	M2J 1P8			
Enbridge Pipelines Inc.	1086 Modeland Road	Ms.	Ann	Newman	Crossing Co-ordinator	1086 Modeland Road.	Building 1050, 1st Floor	Sarnia	ON	N7S 6L2	ann.newman@enbridge com		
Enbridge Pipelines Inc.	Contact if there is a possibility of utility being located within project area.	Mr.	Chris	Pincombe	Lands & ROW Administrator - Crossings, Eastern Region	Western Research Park	1086 Modeland Road, Bldg. 1050 1st Floor	Sarnia	ON	N7S 6L2	Chris.Pincombe@enbridge.com est.reg.crossing@enbridge.com	(519) 333-6753	(519) 339-0510
Orangeville Hydro	Contact if there is a possibility of utility being located within project area; call agency to determine appropriate contact.				Director		400 C Line	Orangeville	ON	L9W 3Z8	info@orangevillehydro on ca	T: (519) 942-8000 TF: 1-888-844-8493	F: (519) 941-6061
Rogers Communications	Contact if there is a possibility of utility being located within project area.	Ms.	Marian	Wright	Planning Coordinator	3573 Wolfedale Road		Mississauga	ON	L5C 3T6	Marion.Wright@rci.rogers.com	(905) 897-3914; (888) 764-3771	
BluMetric Inc.		Ms.	Tiffany	Svensson	Risk Management Official	171 Victoria Street North		Kitchener	ON	N2H 5C5	svensson@wesa.ca		
THOMASFIELD HOMES L MITED			Katherine	McLaughlin		295 Southgate Drive	P.O. Box 1112	Guelph	ON	N1H 6N3	katherinem@thomasfield.com	(519) 836-4332	(519) 836-2119
MOCO FARMS LTD.						2800 Highway 7		Concord	ON	L4K 1W8		(905) 695-0800	XXX-XXX-XXXX
HRYCYNA GROUP						200 – 1081 Bloor Street West		Toronto	ON	M6H 1M5		(416) 532-8006	(416) 532-2666
CORSEED INC.						2800 Highway 7		Concord	ON	L4K 1W8		(905) 695-0800	
CACHET DEVELOPMENTS						361 Connie Crescent	Suite 200	Concord	ON	L4K 5R2		(905) 764-1983	(905) 764-3872

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Agency/Organization	Screening Criteria	Title	First Name	Last Name	Position	Address 1	Address 2	City	Province	Postal Code	Email	Telephone	Fax
ZEL NKA PRIAMO LTD. (on behalf of Sarah Properties Ltd.)		Mr.	Dave	Hannam	Senior Planner	318 Wellington Road		London	ON	L4K 5R2	dave.h@zpplan.com	519-474-7137	
Grand River Conservation Authority	All Individual and Class Eas within the area covered by this Conservation Authority	Mr.	Fred	Natolochny		400 Clyde Road	Box 729	Cambridge	ON	N1R 5W6	fnatolochny@grandriver ca	Toll Free: 1-866-900-4722; (519) 621-2761	(519) 621-4844
Grand River Conservation Authority	All Individual and Class Eas within the area covered by this Conservation Authority	Mr.	Mark	Anderson		400 Clyde Road	Box 729	Cambridge	ON	N1R 5W6	manderson@grandriver ca	Toll Free: 1-866-900-4722; (519) 621-2761	(519) 621-4844
Grand River Conservation Authority	All Individual and Class Eas within the area covered by this Conservation Authority	Mr.	Nathan	Garland	Planner	400 Clyde Road	Box 729	Cambridge	ON	N1R 5W6	ngarland@grandriver.ca	(519) 621-2763 Ext. 2236	(519) 621-4844
Wellington-Dufferin-Guelph Public Health Unit	Send summary of EA for sewage and water-works and for waste facility projects which may have health implications. See http //www.alphaweb.org/phunit (Click Public Health in Ontario for contact information for Local Public Health Units).	Dr.	Nicola	Mercer	Medical Officer of Health & Chief Executive Officer	475 Wellington Road 18,	Suite 100 RR #1	Fergus	ON	N1M 2W3		Tel: (519) 822-2715/ 1-800-265-7293	
Ontario Clean Water Association		Mr.	Scott	Craggs	Senior Operations Manager.						SCraggs@ocwa.com		
Dufferin Water Co Ltd		Mr.	Joe	Miedema	President						joe_miedema@bell.net	Telephone Number: (519) 928-5652	Fax: (519) 928-2275
Individual		[redacted]	[redacted]	[redacted]							[redacted]		
Friends of the Grand River		Mr.	Larry	McGratton	President	P.O. Box 271		Fergus	ON	N1M 3E2			

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Appendix D

Copy of Study Notice of Commencement and Newspaper Advertisement

NOTICE OF STUDY COMMENCEMENT
TOWN OF GRAND VALLEY MASTER PLAN

The Study

Prior to 2014, the Town of Grand Valley had an urban population of approximately 1,500 and had constructed infrastructure to accommodate the mature state urban population in its Official Plan, which was 2,950. In 2014, approval was given to change the Official Plan such that the mature state urban population increased to 6,145. This amendment was premised on the certainty that services could be provided to the new future population, but no infrastructure plans were put in place. The Town of Grand Valley is undertaking a Master Plan to address the problem of how Grand Valley can provide water and wastewater infrastructure to meet the demands in the community as it achieves the growth that is approved in its Official Plan.

The Process

The Study is being conducted in accordance with the requirements of Phases 1 and 2 of the Municipal Class Environmental Assessment, as outlined in the Municipal Engineers Association *Municipal Class Environmental Assessment Manual* (October 2000, as amended 2007, 2011 & 2015), which is an approved process under the *Ontario Environmental Assessment Act*. The study will evaluate alternative solutions with consideration for the natural, cultural, technical and economic environment, and recommend preferred solutions in consultation with the public, Aboriginal communities and regulatory agencies, documented for the public record. At the conclusion of the study, the Master Plan will be prepared for public review.

Input Invited

Consultation is important to this study. The Town of Grand Valley would like to ensure that anyone interested in this study has the opportunity to provide input into the planning and design of the project. For this first stage of the process, you are encouraged to provide your comments to us by August 24, 2017. To provide comment or to request additional information concerning this Study or if you would like to be added to the Project Contact List to receive future project notices, please email the dedicated email address GrandValleyMP@rjburnside.com or contact either of the following Project Team members:

Jane Wilson
Chief Administrative Officer
Town of Grand Valley
5 Main St. N.
Grand Valley, ON L9W 5S6
T 519-928-5652 ext. 224

Stephen Gendron, P.Eng.
EA Coordinator
R. J. Burnside & Associates Limited
128 Wellington Street West, Suite 301
Barrie, ON L4N 8J6
T 705- 797-4297

Project and notice information will be made accessible upon request in accordance with the Accessibility Standard for Information and Communication under the *Accessibility for Ontarians with Disabilities Act, 2005.*

Information will be collected and maintained to meet the requirements of the *Environmental Assessment Act* and for the purpose of creating a record that will be available to the general public as described in Section 37 of the *Freedom of Information and Protection of Privacy Act*. All comments and personal information such as name, address, telephone number and property location will become part of the public record that is available to the general public. For more information, please contact the Ministry's Freedom of Information and Privacy Coordinator at 416-327-1434.

This Notice Issued on July 24, 2017.

Town of GRAND VALLEY

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT STUDY
Notice of Public Information Centre
Grand Valley Water and Wastewater Servicing Master Plan

Background

The Town of Grand Valley (the Town) is undertaking a Master Plan Environmental Assessment (EA) to address how Grand Valley can provide water and wastewater infrastructure to meet future demands in the community as it achieves the Official Plan approved population. A series of servicing alternatives for both water and wastewater infrastructure have been provided, evaluated and assessed based on impacts to social, cultural, economic, and natural environments during the Master Plan EA Study. The Master Plan will identify and evaluate as necessary the related components for both the water and wastewater systems to arrive at a preferred servicing solution.

The approximate extent of the Study Area is shown on the map.

Master Plan EA Process

The Study is being conducted in accordance with the Phase 1 and 2 Master Plan process under the *Municipal Class Environmental Assessment* (October 2000, as amended 2007, 2011 & 2015), which is an approved process under the *Ontario Environmental Assessment Act.*

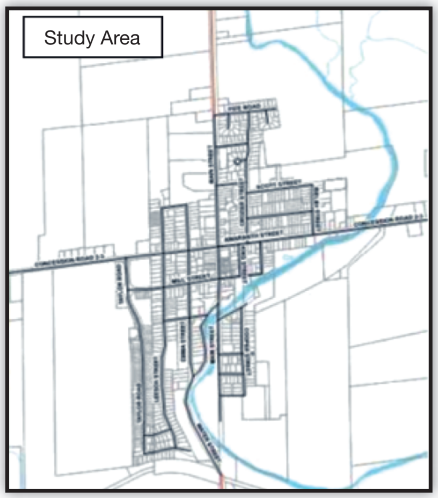
Consultation is an important part of the Master Plan EA process. Throughout the study, the Town makes contact with various agencies and members of the community, and considers their opinions as part of any decisions that are made.

As part of the Study, a Public Information Centre (PIC) is scheduled to allow the public and interested stakeholders to learn more about the Study, provide input and discuss any questions or comments with the Project Team directly. Representatives from the Town of Grand Valley and its consultant will be available to answer questions on the work completed to date and discuss the next steps in the Study at the PIC (drop-in format) which has been arranged for:

Date: Wednesday, November 1, 2017
Time: 6:00pm – 8:00 pm
Location: Grand Valley District Community Centre Grand River Room – Upper Hall
90 Main Street North, Grand Valley, ON
(This location is wheelchair accessible)

Comments

If you are unable to attend the PIC and would like to provide comments, please forward them to the project team members listed below by December 1st, 2017. Comments received through the course of the Study will be considered and documented in the Master Plan EA Report.



Jane Wilson, C.A.O.
Clerk-Treasurer
Town of Grand Valley
5 Main Street North
Grand Valley, ON, L9W 5S6
Phone: (519) 928-5652 ext. 224
Email: jwilson@townofgrandvalley.ca

Jeff Paznar, P.Eng., EP
Environmental Assessment Lead /
Project Engineer
R.J. Burnside & Associates Limited
292 Speedvale Ave. W, Unit 20
Guelph, Ontario, N1H 1C4
Phone: (226) 486-1558
Email: GrandValleyMP@rjburnside.com

Information provided in response to this notice will be collected in accordance with the *Freedom of Information and Protection of Privacy Act.* With the exception of personal information, all comments will become part of the public records.

(This Notice first issued October 16, 2017)

COMMUNITY

Philanthropists donate $1M to Pine River Institute

CHRIS HALLIDAY
challiday@orangevillebanner.com

Millionaire philanthropists Gary and Donna Slaight consider it a $1 million well spent.

The couple, which head a foundation that gave $100 million to six Toronto hospitals in 2014, and millions more to Indigenous communities and not-for-profit groups, have donated $1 million to the Pine River Institute in Mulmur.

Earlier this month, the addictions and mental health treatment facility announced the Slaights donation will be put toward bursaries aimed at eliminating financial barriers to care. The costs can be a significant obstacle for families seeking treatment for an adolescent child.

Gary currently serves as the CEO and president of radio broadcasting company Slaight Communications. The couple also runs the Slaight Family Foundation, which is committed to expanding programs that serve to defend and protect human rights.

"When a child is ill, the whole family struggles. Waiting months to start treatment is a torture no family should have to endure. And, to go without is unthinkable," Gary said in a news release.

"Donna and I are privileged to be able to help and we are excited that our gift toward bursaries will make it possible for more youth and their families to access Pine River's exceptional care," he added. "Every young person deserves the chance to build a healthy and productive life."

Ontario families in crisis have limited options. Pine River is one of the few places where youth between the ages of 13 to 19 can obtain simultaneous treatment for both addiction and mental health issues.

Unlike most "rehab" programs which run 21 or 30 days, there is no time limit at Pine River. Youth typically spend 14 to 16 months engaged in its program.

Their treatment is largely, but not entirely, covered by Ontario's Ministry of Health and Long-Term Care, which can leave families on the hook for bills of $10,000 or more.

Recognizing many families can't afford this expense, Pine River has offered partial subsidies since 2006 to finance program costs not covered by government or independent insurance providers. The Slaight donation will fund bursaries aimed at eliminating those financial barriers to care.

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT STUDY
Notice of Public Information Centre
Grand Valley Water and Wastewater Servicing Master Plan

Background

The Town of Grand Valley (the Town) is undertaking a Master Plan Environmental Assessment (EA) to address how Grand Valley can provide water and wastewater infrastructure to meet future demands in the community as it achieves the Official Plan approved population. A series of servicing alternatives for both water and wastewater infrastructure have been provided, evaluated and assessed based on impacts to social, cultural, economic, and natural environments during the Master Plan EA Study. The Master Plan will identify and evaluate as necessary the related components for both the water and wastewater systems to arrive at a preferred servicing solution.

The approximate extent of the Study Area is shown on the map.

Master Plan EA Process

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Date: Wednesday, November 1, 2017

Time: 6:00pm – 8:00 pm

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Grand River Room – Upper Hall

90 Main Street North, Grand Valley, ON

(This location is wheelchair accessible)

Comments

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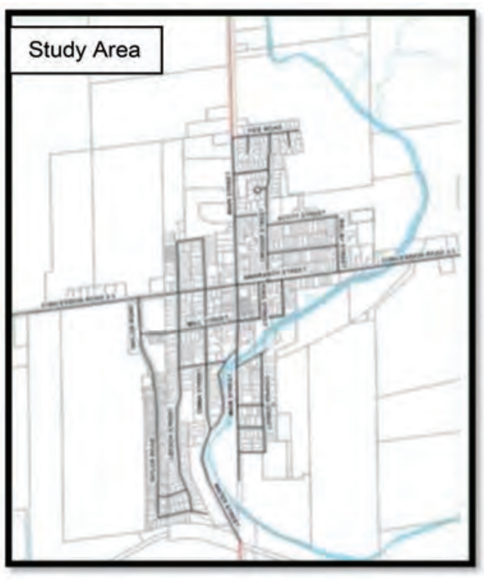

Jane Wilson, C.A.O.
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(This Notice first issued October 16, 2017)

Orangeville hosts annual economic outlook breakfast

Written By **JASEN OBERMEYER**

PHOTO: TABITHA WELLS

NEARLY 100 PEOPLE attended this year's annual economic outlook breakfast. The event is designed to recognize and celebrate Small Business Month in Orangeville, but also provides insight into Dufferin County's economy.

The Town of Orangeville, teaming up with TD Bank Group, hosted its annual economic outlook breakfast, adding a new feature where local business owners shared their insights into the state of the local economy.

The annual event took place Tuesday (October 17) at Orangeville's Best Western hotel, to celebrate Small Business Month in Orangeville and Canada's national Small Business Week.

The keynote speaker was Derek Burleton, TD Vice-President and deputy Chief Economist, who has been speaking at the breakfast for several years now.

He provided an analysis of the Canadian economy and financial markets, as well as the economic and financial developments to Dufferin County's economy.

Mr. Burleton discussed the North American Free Trade Agreement (NAFTA) negotiations, the planned rise in Ontario's minimum wage, and the federal Liberals' recent announcement of plans to cut the small business tax by nine per cent, and how all three are concerns for growth in the coming year.

He says that in the past year, Ontarians have been spending like "gangbusters," but he expects that to change, and 2018 "will be a tough act to follow."

Mr. Burleton explained that he's fine with a gradual increase of the minimum wage, but come 2018, when Ontario's goes up to $14 an hour, the huge increase comes "at a time when the economy will be facing other pressures."

He says the election of U.S. President Donald Trump "shook up the establishment" along with the recent talk of America wanting to leave NAFTA.

Mr. Burleton says he thinks the low inflation and interest rates will pick up soon, and though it creates a good environment and growth, "there's always something to worry about."

New to this year's event was a panel of local business owners discussing their experiences and opinions of the county's economy. They were Paul Nelson, of Data Cable Co. Inc., Buddy Pitt, from Orangeville's Home Hardware Building Centre, and Margorie Grime, with Royal LePage RCR Realty.

All three discussed the challenges they face in their business sector.

Mr. Pitt says Orangeville is a great place to be, and loves how uniquely the Town helps local businesses, but finds a challenge in retail with the Internet.

Ms. Grime says the housing market has gone from a "buyers' market, to a sellers' market," and there are currently lower and fewer offers on houses.

Mr. Nelson says the biggest challenge for marketing is digital technology, as "it's in every industry."

All three were asked how they are successful in their business.

Ms. Grime says the real estate industry is a "more team concept" today, to make it easier for one to balance time between work and having a life.

Mr. Pitt attributes his success to "simply people," as "products are the same everywhere… we recognize the retail industry is changing rapidly," and a business needs to specialize and have a specific skill that adds value, otherwise it will be difficult to compete.

Mr. Nelson says customer focus and responsiveness, as they compete on a global basis, but quality is "job one."

Orangeville Mayor Jeremy Williams spoke at the event, thanking everyone for attending, saying he is a "big proponent" of buying local.

He said he tries to keep grounded in technology, and advised businesses to "keep an open mind, don't get left behind" and says he thinks they are on the verge of a technological revolution, which businesses need to "take note and take advantage" of some of those changes.

Crafts on display

A craft sale and market was held at the Elora Community Centre on Oct. 14. A portion of the proceeds went to the Ontario Lyme Disease Association. Among those checking out the displays were Katelyn Boswell and three-year-old Mikalah Boswell of Grand Valley.
Photo by Patrick Raftis

NOTICES

Town of GRAND VALLEY

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT STUDY
Notice of Public Information Centre
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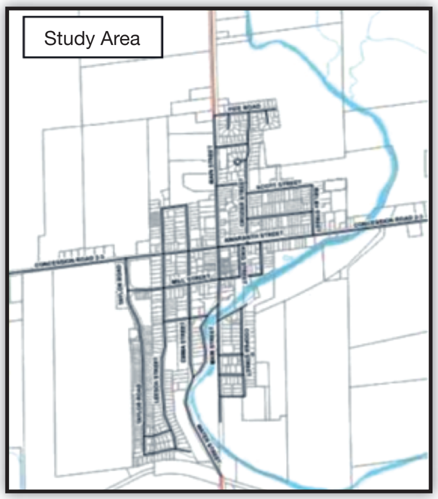

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(This Notice first issued October 16, 2017)

Orangeville draft budget calls for 2.53 per cent tax levy hike

● Continued from front

That would equate to about an extra $45 a year to ratepayers of median average properties assessed at $363,000.

A proposal to hire eight full-time firefighters at a cost of $800,162 in 2018 was shot down during Tuesday's meeting. It was determined the cost was just too high as that one expenditure would have added about 2.4 per cent to the tax levy requirement for about a five per cent increase.

The town's 2015 Fire Master Plan identified a need for a new fire hall for the town and recommended the hiring of eight new full-time firefighters to meet needs. The 2018 capital budget does include a proposed $45,000 to design the new fire hall. That money is to come from the tax levy.

Ronald Morden, the town's fire chief, said public lives are put at risk by delayed response times because of staff shortages. And, he said, firefighters are put at risk by delayed backup personnel coming behind them.

"We do a really good job," Morden said. "But the cases we do have of a delayed response are a cause of concern."

Among the capital projects council will consider is $1.1 million project to reconstruct Second Avenue from First Street to Second Street. A separate $1 million project to reconstruct the thoroughfare from Second Street to Third Street and repave Broadway from Diane Drive to C Line at a cost of about $311,000.

Council will also consider such expenditures as redesigned reception counters at town hall with a $60,000 price tag; electronic message signs that could cost $50,000; renovations and information technology upgrades to council chambers with a price tag of $180,000 from the tax levy; another new 30-foot low floor bus that is expected to cost $425,000; and $120,000 for spectator handrails at the Tony Rose Memorial Recreation Centre.

"There's truly something wrong here," said Coun. Don Kidd. "I voted against (hiring new firefighters) because we don't have the money."

Coun. Sylvia Bradley said ensuring residents' protection is one of the more important things on council's plate. Coun. Scott Wilson said any advantage that can be given to the fire personnel is worth the expense.

"We need these people to respond in a timely fashion," Wilson said. "The chief is telling us how to do that."

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT STUDY

Notice of Public Information Centre
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(This Notice first issued October 16, 2017)

Minto applies for flood relief fund

» FROM PAGE 1

website and also on the province's website.

"It's basic coverage," Duff noted. "It's not going to replace all your contents, but it might give you a furnace and some insulation."

The Harriston Kinsmen also set up a fund to accept and distribute donations for local flood relief.

NOTICES

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix E

Public Information Centre Sign-In Sheet and Display Boards

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT STUDY
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(This Notice first issued October 16, 2017)

Municipal Class Environmental Assessment Study
Grand Valley Water and Wastewater Servicing Master Plan

Town of GRAND VALLEY — BURNSIDE

SIGN-IN SHEET (PLEASE PRINT)

Public Information Centre – November 1, 2017 6:00 p.m. – 8:00 p.m.
Grand Valley District Community Centre – Grand River Room (Upper Hall) – 90 Main Street North, Grand Valley, Ontario

NAME PLEASE PRINT	ORGANIZATION	MAILING ADDRESS (incl. Postal Code) PLEASE PRINT	PHONE NO. / E-MAIL	DO YOU WISH TO BE ON THE MAILING LIST? Y/N
Rob Walton	RWZ Engineering		robertwalton@xplornet.ca	✓
Rachel Walton	RWZ Engineering		waltonr@uoguelph.ca	
Meghan Townsend	Town of Grand Valley		mtownsend@townofgrandvalley.ca	✓
Jane Wilson	Town of Grand Valley		jwilson@townofgrandvalley.ca	✓
[illegible]	" "		928-5723	
Randy McClelland		10 Joyce Court, Grand Valley L9W 5R5	943-5471	
Rick Taylor	Town of Grand Valley			
DON LOVELESS	RESIDENT	113508 SIDEROAD 27/28 GRAND VALLEY, L9W 0K4	519-928 5373 FIREGUY286@SYMPATICO.CA	✓
John Ince	Town of Grand Valley	58 Krozier st	519.928.3126 SJINCE@SYMPATICO.CA	✓

The Town of Grand Valley and R.J. Burnside & Associates Limited thank you for your involvement in the Grand Valley Water and Wastewater Servicing Master Plan Class Environmental Assessment. Information will be collected and maintained to meet the requirements of the *Environmental Assessment Act* and for the purpose of creating a record that will be available to the general public as described in Section 37 of the *Freedom of Information and Protection of Privacy Act*. All comments and personal information such as name, address, telephone number and property location will become part of the public record that is available to the general public **unless you request that your personal information remain confidential**. For more information, please contact the Ministry's Freedom of Information and Privacy Coordinator at 416-327-1434. Project and notice information will be made accessible upon request in accordance with the Accessibility Standard for Information and Communication under the *Accessibility for Ontarians with Disabilities Act, 2005*.

Town of GRAND VALLEY

BURNSIDE

Municipal Class Environmental Assessment Study
Grand Valley Water and Wastewater Servicing Master Plan

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Public Information Centre – November 1, 2017 6:00 p.m. – 8:00 p.m.
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Katherine McLaughlin	Thomasfield Homes	295 Southgate Dr Guelph PO BOX 1112 N1H 6N5	katherinem@thomasfield.com	Y
Thomas Krizan	Thomasfield Homes	" "	tomk@thomasfield.com	Y
Elizabeth Dayer	Town of Grand Valley	50 Main St. N. Grand Valley L9W-1V9		
Chris Sims	GM BluePlan		chris.sims@gmblueplan.ca	Y
Daniel Hrycyna	Hrycyna	200-1081 Bloor St W, Toronto, ON, M6H 1M5	hrycynad@gmail.com	Y
Jason DeLuca			jasondeluca01@gmail.com	Y
Frank DeLuca		47 Eden Valley Dr. Toronto	frank@delucagroup.ca	Y

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GRAND VALLEY
WATER AND WASTEWATER SERVICING MASTER PLAN CLASS ENVIRONMENTAL ASSESSMENT

Public Information Centre

Wednesday, November 1, 2017

6:00 PM – 8:00 PM

Grand Valley District Community Centre

Grand River Room – Upper Hall

90 Main Street North, Grand Valley ON

WELCOME

to the Public Information Centre for

Grand Valley Water and Wastewater Master Plan Class Environmental Assessment

Please:

- Sign in
- Review the display materials and discuss your questions and ideas with our team members
- We will review and incorporate feedback from public, agencies, etc.
- We will respond to written questions and comments
- Fill in a comment sheet and place in "Comment Box" or send comments **before December 1, 2017** to:

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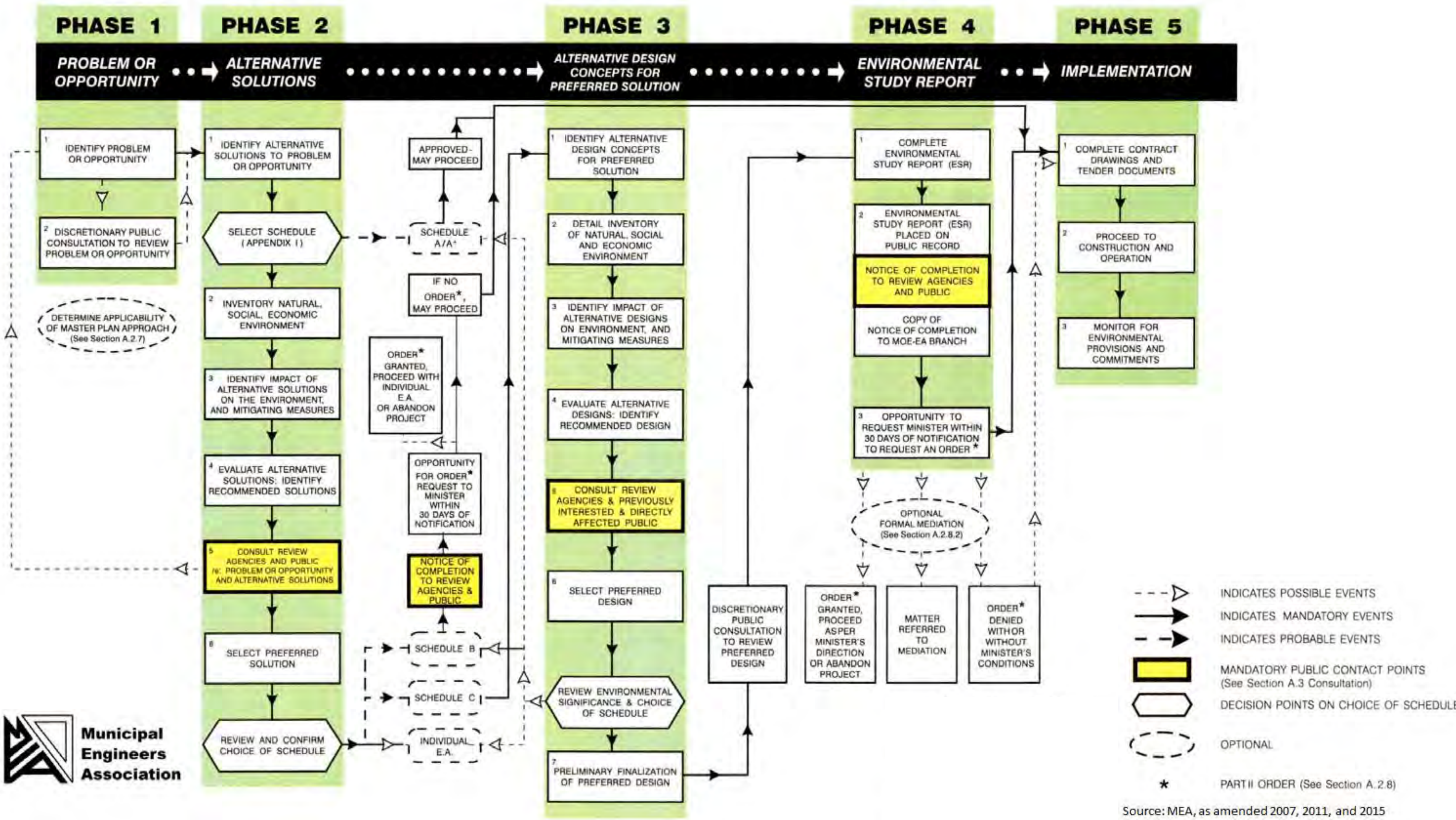
MUNICIPAL CLASS EA PROCESS - FOR MASTER PLAN

PHASE 1 PROBLEM OR OPPORTUNITY	•Identify problems or opportunities
PHASE 2 ALTERNATIVE SOLUTIONS	•Identify alternative solutions to address the problems or opportunities •Consider environmental , social economic, financial and technical impacts on each alternative solution •Identify preliminary preferred solutions **•Consult with agencies/stakeholders and the public** ← **We Are Here** •Select a preferred solution to address the problems or opportunities •Evaluate preliminary preferred solutions based on public input and feedback •Select a preferred solution to address the problems or opportunities •Re-confirm project as a Schedule B undertaking
PHASE 3 ALTERNATIVE DESIGN CONCEPTS FOR PREFERRED SOLUTION **PHASE 4** ENVIRONMENTAL STUDY REPORT	• Only required for the Water Pollution Control Plant Expansion Treatment Alternatives
PROJECT FILE REPORT	•Prepare project file report that documents Phase 1 and Phase 2 of the process • Include copies of all notices and letters relating to public consultation • Include all comments received and feedback provided to/from agencies/stakeholders and the public
NOTICE OF COMPLETION	•Issue Notice of Completion and Project File Report for a 30-day public review period •Person or Party may request a Part II Order from the Minister of the Environment and Climate Change if concerns regarding the project cannot be resolved with the Town
PHASE 5 IMPLEMENTATION	•Proceed to detailed design and construction of the project •Monitor for environmental provisions and commitments

MUNICIPAL CLASS EA FLOWCHART



Source: MEA, as amended 2007, 2011, and 2015

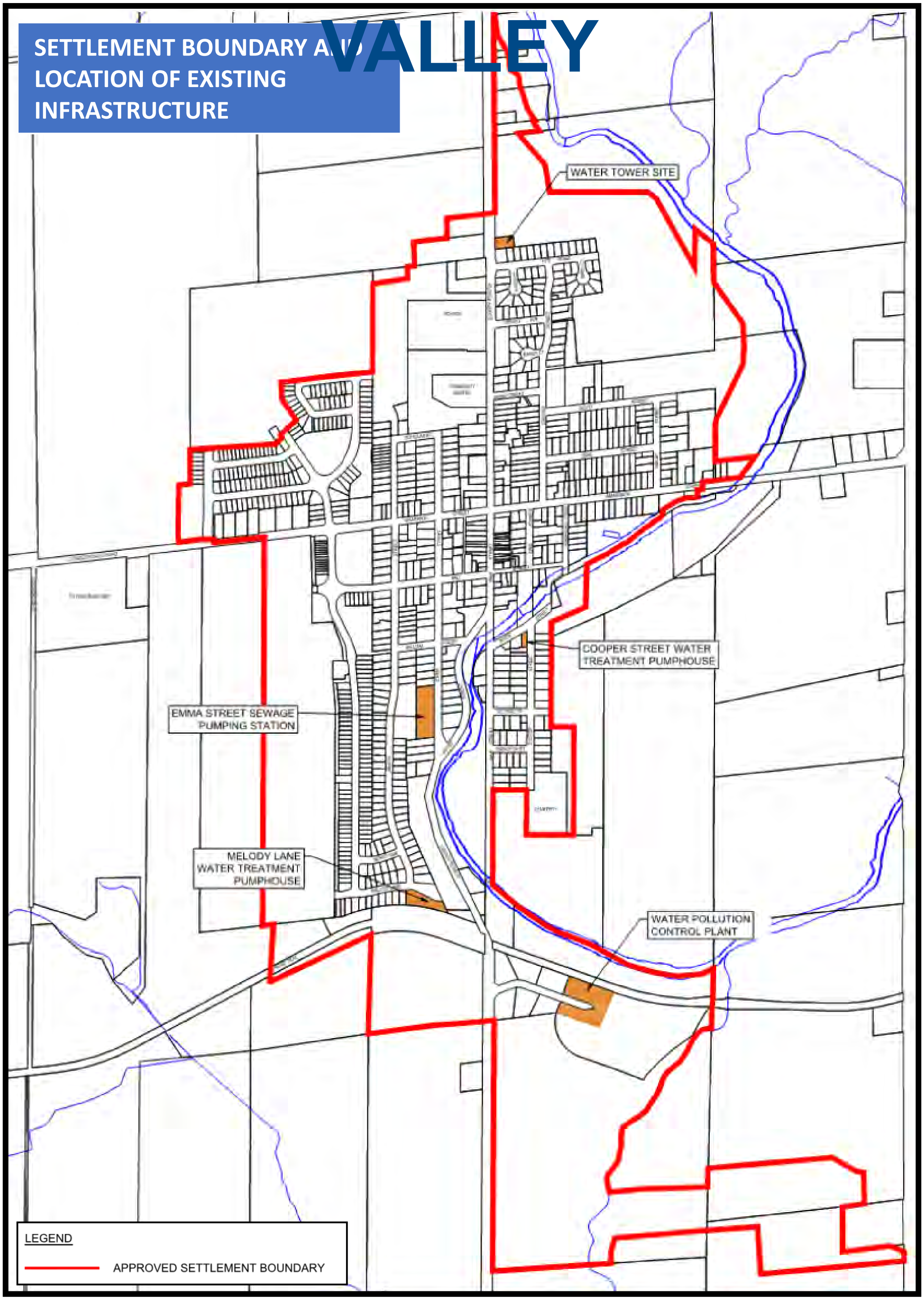
CONSULTATION TIMELINE

We Are Here (pointing to Public Information Centre)

TIMELINE MAY VARY PENDING COMMENTS RECIEVED

- **Project Start** — July 2017
- **Agency and Stakeholder Consultation** — July 2017
  - Mailed letters to Stakeholders and Agencies with copy of Notice of Commencement
- **Notice of Commencement** — July 2017
  - On Town website (July 24, 2017 publication)
- **Public Information Centre** — October 2017
  - On Town website
  - Orangeville Banner (October 19 and 26 publications)
  - Orangeville Citizen (October 19 and 26 publications)
  - Wellington Advertiser (October 20 and 27 publications)
- **Project File Report** — November 2017
  - Will be on Town website
  - Will be available at Town Office for viewing
- **Notice of Completion** — Feb 2018
  - Will be on Town website
  - Will be published in Orangeville Banner and Orangeville Citizen
  - Will be mailed to stakeholders, agencies, and public on contact list
- **30 Day Public / Agency Review of Project File Report** — March 2018
  - Review and coordinate comments received
  - Any member of the public or agency / stakeholder can request that the Minister of Environment and Climate Change issue a Part II Order. This is made in certain circumstances where concerns are unresolved during the Municipal Class Environmental Assessment.
- **Proceed to Design/ Construction** — 2019/ 2020
- **Proceed to Phase 3/4 Water Pollution Control Plant Upgrades**

PROJECT AREA – GRAND VALLEY



Town of GRAND VALLEY

BURNSIDE

EXISTING DRINKING WATER SYSTEM

Cooper Street Pumphouse - South West Corner of River and Cooper Street Intersection

- Two groundwater wells operating on alternating duty/standby basis
- Maximum capacity = 2,290 m^3/day

Melody Lane Pumphouse – Intersection of Melody Lane and Leeson Street

- Two groundwater wells – One is a production well and the other is used for monitoring
- Well operates concurrently with either of the Copper Street wells
- Maximum capacity = 654 m^3/day

Water Tower – 173363 County Road No. 25

- Supplements wells in periods of high demand
- Provides fire flow and emergency storage
- Storage capacity = 1,600 m^3

EXISTING WASTEWATER COLLECTION AND TREATMENT SYSTEM

Collection System

- Gravity sewer collection to main sewage pumping station

Emma Street Sewage Pumping Station (SPS) – 130 Emma Street, Lot 30 and 31

- Designed for instantaneous peak flow of 7,680 m^3/d (88.9 L/s)
- 1.1 km forcemain conveys wastewater to treatment plant

Water Pollution Control Plant (WPCP) – Located at the end of Industrial Road

- Tertiary activated sludge plant operating as an extended aeration process
- Rated capacity = 1,244 m^3/d

FUTURE ESTIMATED WATER DEMANDS

PARAMETERS	DESIGN PARAMETERS		EXISTING WATER SYSTEM CAPABILITIES
	Existing	Year 2031 (OP Population)	Provided
Population	2,004	6,145	N/A
Per capita flow (L/cap/d)	365	300	N/A
Jobs	100	585	N/A
Per job flow (L/job/day)	Included in Per Capita Flow	90	N/A
Max Day Flow (m^3/d)	1,682	3,792	**1,963** (RECOMMENDED - This is firm capacity, the amount of water that would be available if the largest well failed) 2,944 (relies on both wells being in service)
Fire Flow (L/s)	95 (MOECC)	159 (MOECC)	Available Fire Flow Based on modelling results: 58 L/s – 80 L/s
Storage Requirements (m^3)	1,300	3,400	1,600

PROBLEMS

- **The firm capacity of the existing well supply will not support the future maximum daily flow**
- **The existing system does not have sufficient storage to meet Ministry of Environment and Climate Change guidelines for future demand**

FUTURE ESTIMATED WASTEWATER DEMANDS

PARAMETERS	DESIGN PARAMETERS		EXISTING WASTEWATER SYSTEM CAPABILITIES
	Existing (2017)	Year 2031 (OP Population)	Provided
Population	2,004	6,145	N/A
Jobs	100	262*	N/A
Per Capita Demand – Residential (L/cap/d)	410	343**	N/A
Per Capita Demand – Non-Residential (L/cap/d)	Included in Residential Demand Calculation	90	N/A
Average Daily Demand (m^3/d)	823***	2,131	1,244 (Grand Valley WPCP currently rated for this average day capacity)

* 323 jobs included as part of the residential demand calculation leaving 262 jobs to be accounted for separately
** two-year average (between 2016 and 2017) based on accurate flow records from the WPCP
***average daily demand only includes flows from January to September

PROBLEMS

- **The existing system does not have sufficient treatment capacity to accommodate future flows**

PROBLEM STATEMENT

- **Prior to 2014, Grand Valley's urban population was approximately 1,500 with infrastructure to accommodate the mature state urban population of 2,950 in the Official Plan.**
- **In 2014, approval was given to increase the mature state urban population in the Official Plan to 6,145 based on the certainty that services could be provided; however, no infrastructure plans were put in place.**
- **The Town of Grand Valley is undertaking a Master Plan to address the demands in the community as it achieves the growth that is approved in its Official Plan.**

ALTERNATIVE SOLUTIONS – WATER SUPPLY

Alternative 1 - Do Nothing	To assess what would happen if no action is taken to address the problem statement.
Alternative 2 – New Groundwater Source	To assess sites where additional groundwater sources could be located.
Alternative 3 – New Surface Water Source	To assess where a surface water treatment plant and surface water intake could be located.
Alternative 4 – Use of Surplus from an Existing Municipal System	To assess if the existing Grand Valley drinking water system could be connected to the Waldemar drinking water system for additional supply.

ALTERNATIVE SOLUTIONS – WATER STORAGE

Alternative 1 - Do nothing	To assess what would happen if no action is taken to address the problem statement.
Alternative 2 – Elevated Water Storage	To assess sites where additional elevated storage could be located and how it will effect the existing pressure distribution through Grand Valley.
Alternative 3 – Grade Level Reservoir / Standpipe	To assess sites where additional grade level storage could be located and how it will effect the existing pressure distribution through Grand Valley.

ALTERNATIVE SOLUTIONS - WASTEWATER

Alternative 1 - Do nothing	To assess what would happen if no action is taken to address the problem statement.
Alternative 2 – Rerate the Existing WPCP	To assess if operational adjustments can increase the treatment capacity at the existing WPCP.
Alternative 3 – Expansion of Existing WPCP	To assess if the existing Grand Valley WPCP can be expanded to increase treatment capacity.
Alternative 4 – Connection to an Existing Municipal System	To assess if Grand Valley could be connected to the Orangeville wastewater system for additional treatment capacity.

EVALUATION FACTORS CONSIDERED

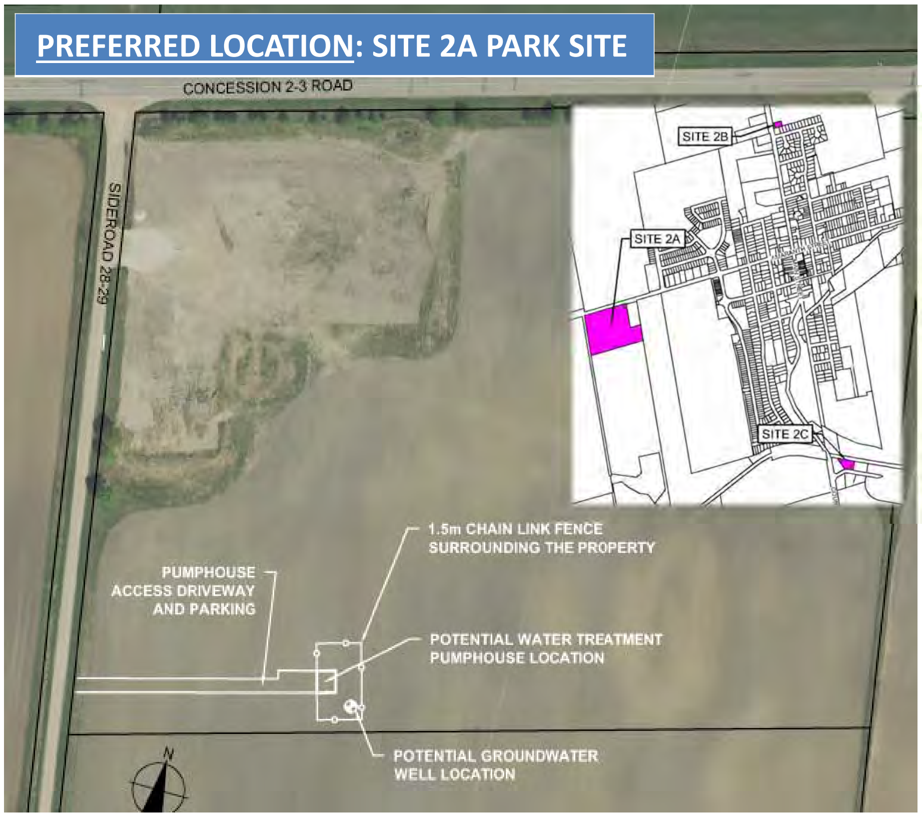
Natural Environment	Socio-Economic/ Cultural Environment	Financial Factors	Technical Factors
• Designated Sites/Species • Terrestrial Habitat • Aquatic Habitat • Hazard Lands (Floodplains, etc.)	• Conformity to Local Planning Provisions • Heritage Resources (built heritage, landmarks, significant landscapes) • Cultural Resources (archaeological features) • Nuisance Impacts • Construction Impacts/ Land Requirements	• Capital Costs • Operation & Maintenance Costs • Life Cycle Costs • Site Specific Costs	• Ease of operation and maintenance • Regulatory Requirements • System Reliability • System Specific Requirements ➢ **Water Supply**: treatment requirements, water quality, water quantity and source reliability ➢ **Water Storage**: system efficiency, capability to provide storage, suitability of connection to existing system ➢ **Wastewater Treatment Capacity**: system efficiency, effluent requirements, suitability of connection to existing system

Water Supply Alternatives

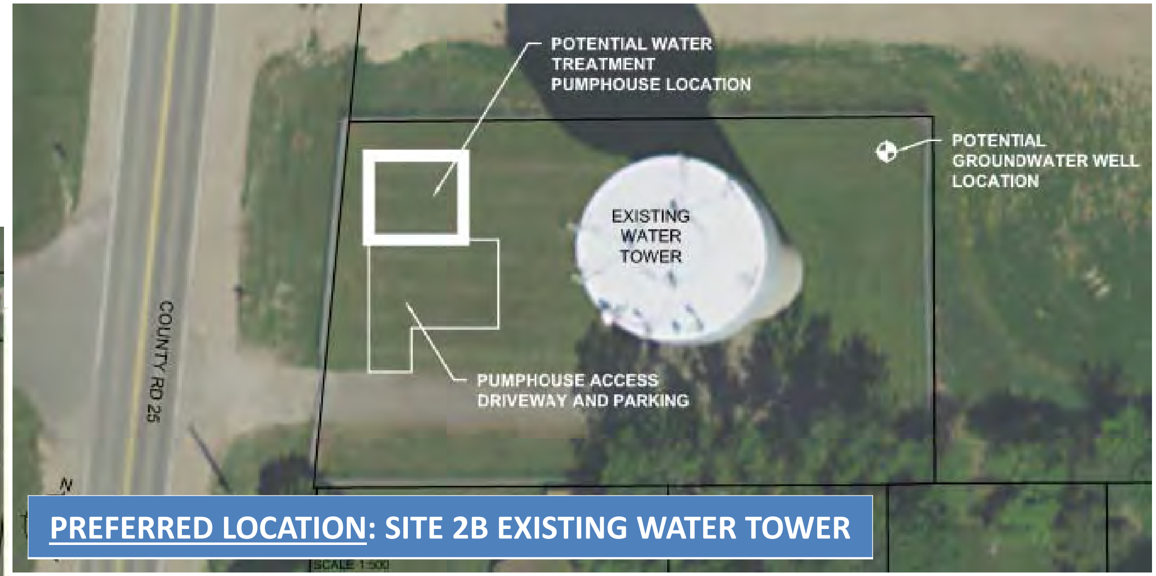
	Natural Environment	Socio-Economic / Cultural Environment	Technical Factors	Financial Factors	Recommended Solution
Do Nothing (Alternative 1)	- Alternative 1 does not address the problem statement. Therefore this alternative was not selected as the preliminary preferred alternative.				- Least Preferred
New Groundwater Source (Alternative 2)	- No impact on existing conditions - Pumping test required to confirm no affect on existing production wells	- No impact on existing cultural or natural conditions - Additional water supply would be designed to accommodate future growth - Potential air quality and noise impact from standby generator - Potential source water protection issues	- Water quality and treatment required is dependent on samples taken during test drilling - Reliable water source - The new supply and treatment system could be easily incorporated in to the existing water distribution system - Maintenance required for groundwater sources is less compared to surface water sources - Amendments to the Permit to Take Water and Drinking Water Works Permit will be required along with a Building Permit for the treatment pumphouse.	- Capital Cost: $1.4 million per well for a total of $2.8 million	- **Most Preferred**
New Surface Water Source (Alternative 3)	- Some disturbance to aquatic habitat during construction of surface water intake	- Additional water supply would be designed to accommodate future growth - No impact on existing cultural or natural conditions - Potential air quality and noise impact from standby generator	- Water quality fluctuates with seasonal variation. High turbidity at times. - The new supply and treatment system could be easily incorporated in to the existing water distribution system - Surface water treatment pumphouses are more complex to operate - Larger building footprint - Amendments to the Permit to Take Water and Drinking Water Works Permit will be required along with a Building Permit for the treatment pumphouse.	- The costs associated with this alternative are significantly higher than the groundwater source alternative	- Least Preferred
Utilize Surplus from an Existing Municipal System (Alternative 4)	- Impacts are dependent on placement of piping to connect to Waldemar's municipal system. - Grand River crossing may be required.	- Additional water supply would be designed to accommodate future growth	- Waldemar is the only system within reasonable proximity and it has no surplus . - Additional water supply will be treated by Waldemar's water treatment system prior to distribution; however, there are potential water quality and water age issues - Provides a reliable water source - Additional chlorination may be required to ensure the minimum residual is maintained at the furthest point in the distribution system. - Amendments to the Permit to Take Water and Drinking Water Works Permit will be required along with a Building Permit for the treatment pumphouse.	- The costs associated with this alternative are significantly higher than both the groundwater and surface water source options	- Least Preferred

* Potential impacts on air quality (noise, dust, emissions) as a result of construction activities is a Socio-Economic/ Cultural Environment Impact for each of the alternatives listed above

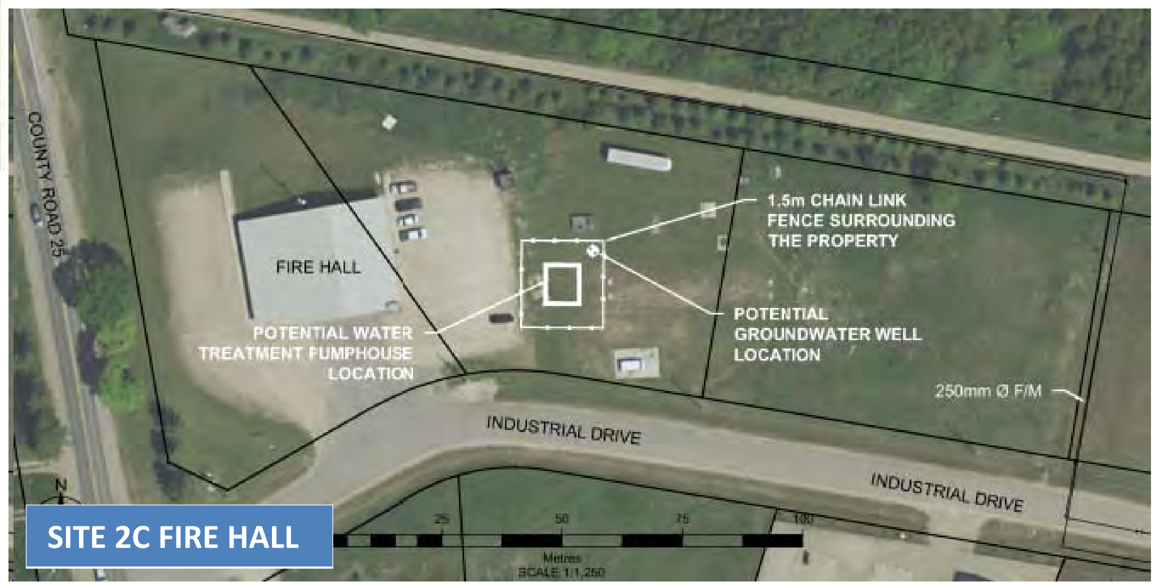
GROUNDWATER SOURCE – POTENTIAL SITE LOCATIONS



PREFERRED LOCATION: SITE 2A PARK SITE

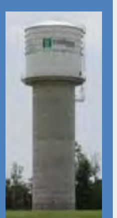


PREFERRED LOCATION: SITE 2B EXISTING WATER TOWER



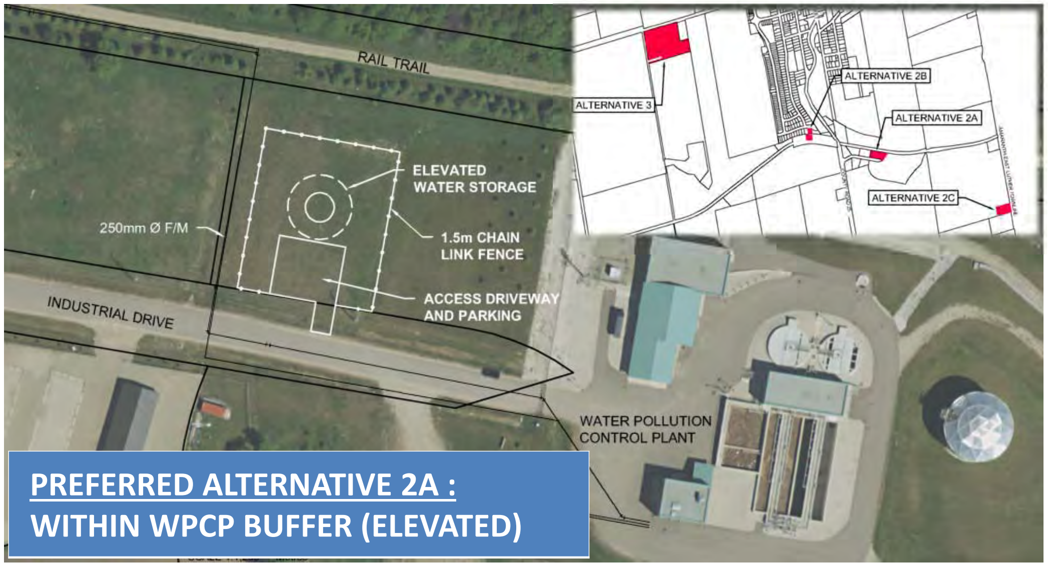
SITE 2C FIRE HALL

Water Storage Alternatives

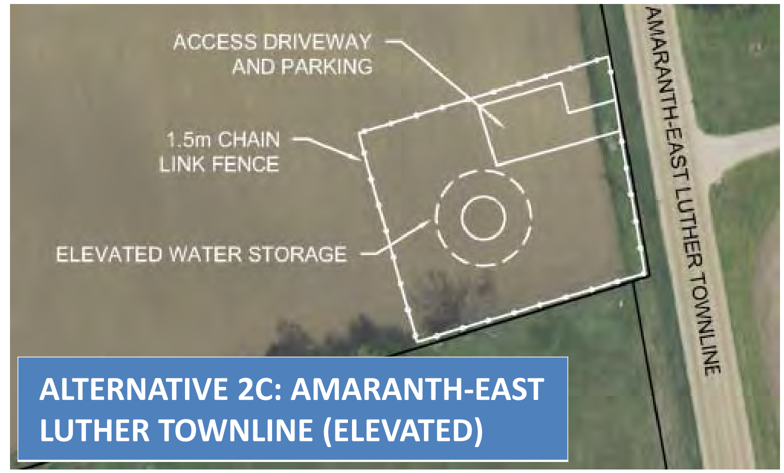
	Natural Environment	Socio-economic / Cultural Environment	Technical Factors	Financial Factors	Recommended Solution
Do Nothing (Alternative 1)	- Alternative 1 does not address the problem statement. Therefore this alternative was not selected as the preliminary preferred alternative.				- Least Preferred
Elevated Water Storage (Alternative 2)  	- No impact over existing conditions	- Additional water storage would be designed to accommodate future growth - No impact on existing cultural or natural conditions - Some consider it aesthetically unpleasing and obstructive, others consider it as an identifiable landmark - Depending on storage placement, approval from the GRCA may be required if within regulated lands	- Minimizes "double pumping" as water is distributed to the community via gravity - Hydraulic profile will not be altered provided the elevated storage operates at the same water level as the existing water tower. - Routine maintenance and testing of well pumps is required under this alternative - Operational costs , energy consumption are lower due to reduced number of pumps - Depending on the type of elevated water storage selected, the storage tank may require painting approximately every 30 years on average including cathodic protection anodes done approximately every 10 years - Monitoring of discharge from the elevated tank is required - Drinking Water Works Permit Amendment and Building Permit would be required - No need for backup power	- Capital Cost: $2,860,000 - 50 Year Life Cycle Cost: $3,530,000	- **Most Preferred**
Grade Level Reservoir (Alternative 3) 	- No impact over existing conditions	- Additional water storage would be designed to accommodate future growth - No impact on existing cultural or natural conditions - **In-ground reservoirs** have low profiles limiting aesthetic concerns - **Standpipes** are considered aesthetically unpleasing and obstructive by some, others consider it as an identifiable landmark - Depending on storage placement, approval from the GRCA may be required if within regulated lands	- Water delivered to consumers is "double pumped", once at the point of supply and once at the point of storage. This inefficiency is reflected in operation and maintenance costs including significant hydro costs. - Highlift pumping equipment and back-up power are required to meet peak hour demand and provide fire flows. - Pumped discharge systems are dependent upon mechanical and electrical equipment, which introduces an additional potential mode of failure requiring that regular maintenance and testing be carried out to ensure system reliability - The hydraulic profile will be altered if a grade level reservoir is introduced due to differing operating levels. - Multiple pressure zones may be required for proper system function - Operational costs are significant due to large number of pumps required - Drinking Water Works Permit Amendment and Building Permit would be required - Backup power is required is case of power outage	- **In-Ground Reservoir** - Capital Cost: $2,410,000 - 50 Year Life Cycle Cost: $4,030,000 - **Standpipe** - Capital Cost: $1,800,000 - 50 Year Life Cycle Cost: $3,440,000	- Partially Preferred

* Potential impacts on air quality (noise, dust, emissions) as a result of construction activities is a Socio-Economic/ Cultural Environment Impact for each of the alternatives listed above

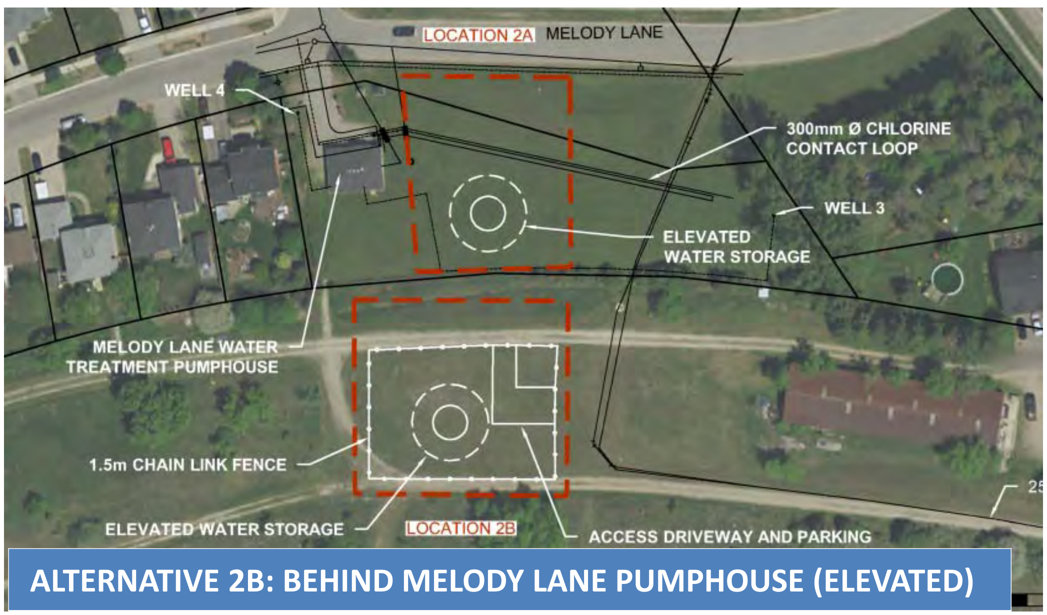
WATER STORAGE ALTERNATIVES



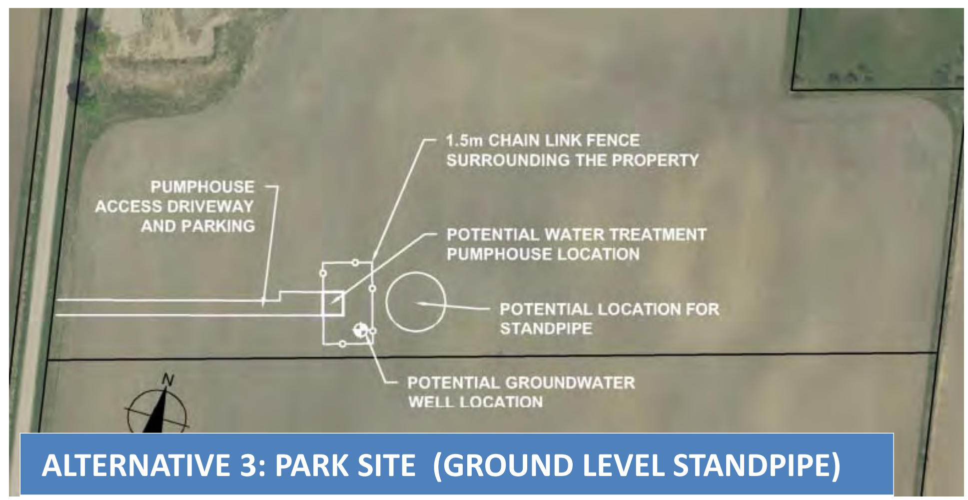
PREFERRED ALTERNATIVE 2A : WITHIN WPCP BUFFER (ELEVATED)



ALTERNATIVE 2C: AMARANTH-EAST LUTHER TOWNLINE (ELEVATED)



ALTERNATIVE 2B: BEHIND MELODY LANE PUMPHOUSE (ELEVATED)



ALTERNATIVE 3: PARK SITE (GROUND LEVEL STANDPIPE)

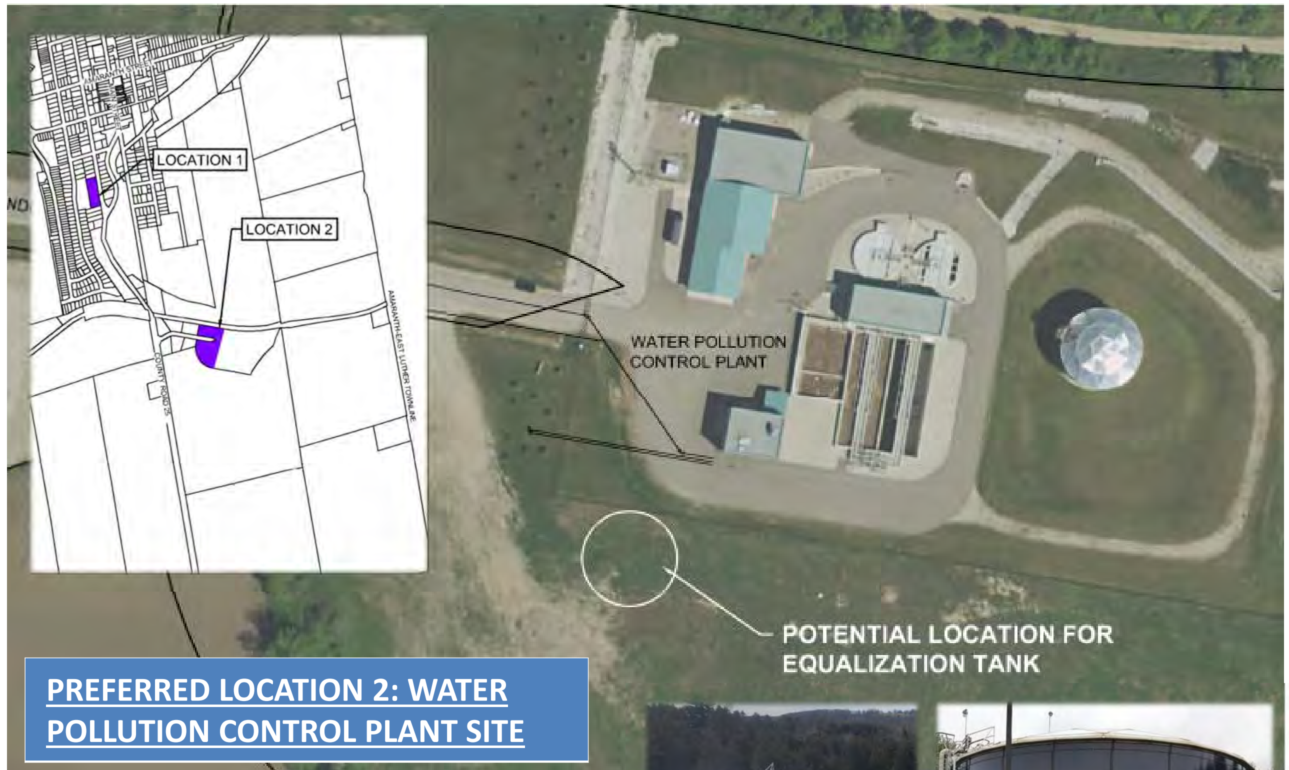
Wastewater Treatment Alternatives

	Natural Environment	Socio-economic / Cultural Environment	Technical Factors	Financial Factors	Recommended Solution
Do Nothing (Alternative 1)	- Alternative 1 does not address the problem statement. Therefore this alternative was not selected as the preliminary preferred alternative.				- Least Preferred
Rerate the Existing WPCP (Alternative 2)	- No impact on existing conditions	- Additional wastewater capacity generated by the WPCP rerating may allow for future demand accommodation and existing housing demands to be met. - The capacity available will be dependent on the rerating. - Equalization storage will potentially be required to accommodate the wastewater demands associated with the Official Plan population. - No impact on existing cultural or natural conditions	- Equalization Tank constructible in 2018, allowing housing needs to be met - **Equalization Tank at Emma St. SPS** •Projected peak flows currently exceed the rated pumping capacity at the SPS •The SPS will require upgrades to divert peak flows to the Equalization Tank. •The forcemain conveying wastewater to the WPCP would not require replacement •The EQ tank will require an odour control system due to proximity to neighbouring residential areas •ECA Amendment required from MOECC along with a Building Permit - **Equalization Tank at Existing WPCP** •Projected peak flows currently exceed the rated pumping capacity at the SPS. •To convey the future peak flow to the WPCP, the existing forcemain will not require replacement; however, the SPS will require larger submersible pumps •Changes to the operation of the existing SPS and the WPCP would be required to divert excess flows to the EQ tank •ECA Amendment required from MOECC along with a Building Permit	- Capital Cost: $2,577,000 - Capital Cost: $2,317,000	- Partially Preferred - **Most Preferred as an Interim Solution**
Expansion of Existing WPCP (Alternative 3)	- No impact on existing conditions	- WPCP expansion would be designed to accommodate future growth - No impact on existing cultural or natural conditions - Expansion would occur outside of archaeological area identified in previous study	- Expansion of existing treatment process at the WPCP would be designed to accommodate projected future flows to service the Official Plan population - This option requires detailed assessment of the Emma St. SPS pumping capacity and forcemain hydraulics to determine if upgrades are required - The difficulty associated with operation and maintenance is dependent on the detailed design of the expansion - ECA Amendment required from MOECC along with a Building Permit. - GRCA approval required - Construction no earlier than 2019, will delay housing	- Capital Cost Range: $11 million - $14 million - Accurate costs cannot be determined until detailed design phase	- **Most Preferred as a Long-Term Solution**
Connection to an Existing Municipal System (Alternative 4)		- Connection to Orangeville WWTP would accommodate future growth - No impact on existing cultural or natural conditions	- This alternative would be very inefficient due to the distance between Orangeville and Grand Valley - Orangeville has no assimilative or plant capacity - Increased operation and maintenance complexity due to integration with a second municipal system - ECA Amendment required from MOECC	- Alternative is not feasible	- Least Preferred

* Potential impacts on air quality (noise, dust, emissions) as a result of construction activities is a Socio-Economic/ Cultural Environment Impact for each of the alternatives listed above

WASTEWATER EQUALIZATION STORAGE POTENTIAL SITE LOCATIONS

LOCATION 1: EMMA ST. SEWAGE PUMPING STATION



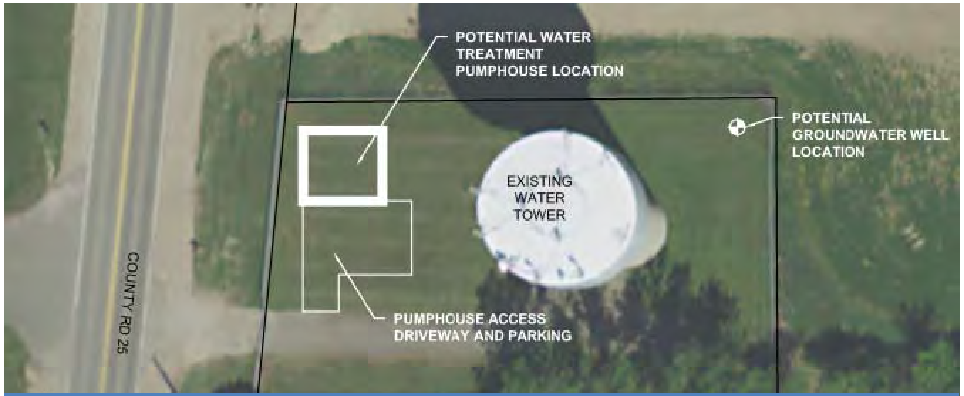
PREFERRED LOCATION 2: WATER POLLUTION CONTROL PLANT SITE

SUMMARY OF PRELIMINARY PREFERRED ALTERNATIVES

Water Supply at Park Site

Infrastructure	Preferred Alternative
Water Supply	• Groundwater Wells • Two preferred locations (Park Site and Existing Water Tower)
Water Storage	• Elevated Water Storage in the form of a water tower or composite elevated tank • Location – Within the Existing WPCP Buffer
Wastewater Treatment	• **Interim Solution**: Plant Rerating and Construction of an Equalization Tank at the WPCP • **Long Term Solution**: Expansion of existing WPCP

EQ Tank at Water Pollution Control Plant



Water Supply at Existing Water Tower Site

Elevated Water Storage Within Water Pollution Control Plant Buffer

NEXT STEPS

1. Provide comments by completing the comment sheet and placing into "Comment Box" or send to Jane Wilson or Jeff Paznar before **December 1st, 2017**
2. We will review comments received and conduct additional work if necessary
3. We will re-evaluate alternatives in light of comments received
4. We will select preferred alternatives and finalize Project File Report
5. We will issue Notice of Completion
6. There will be a 30 Day Public / Agency Review of Project File Report once Notice of Completion is issued
7. If no Part II order is received, proceed to Schedule C Class Environmental Assessment of Water Pollution Control Plant expansion and proceed to construction of water supply, water storage, and wastewater equalization tank.

These presentation materials will be available online at: **www.townofgrandvalley.ca**

THANK YOU FOR ATTENDING

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix F

Correspondence with Agencies/ Stakeholders

ThomasfieldHomes
Limited

August 3, 2017

Jane Wilson
Chief Administrative Officer
Town of Grand Valley
5 Main Street North
Grand Valley ON L9W 5S6

Re: Notice of Study Commencement
Town of Grand Valley Master Plan

Dear Jane,

We received the Notice of Study Commencement for the Town of Grand Valley Master Plan which is being initiated to address the Town's water and wastewater infrastructure. This notice invites input prior August 24, 2017. At this early stage of the Master Plan process, we hope that the Project Team considers long-range infrastructure planning for the Town to maximize the length of time before the Town has to make more costly infrastructure investments in the future. The Master Plan should take into consideration a water supply and wastewater system that encompasses the full planning horizon contemplated by the Growth Plan for the Greater Golden Horseshoe being 2041. Looking at the housing growth in Grand Valley over the last four years, using a 100 homes as a growth rate would be a realistic target for infrastructure to 2041.

We are pleased to see the Master Plan process advancing and kindly request that Thomasfield Homes Ltd. be kept on the circulation list for this project (katherinem@thomasfield.com) and continue to be provided notice. We look forward to providing additional comments as the study progresses.

Sincerely,

Tom Krizsan
President

cc. Stephen Gendron, EA Coordinator, RJ Burnside (via email)
Astrid Clos, Astrid J. Clos Planning Consultants (via email)
Chris Sims, GM Blue Plan (via email)

295 Southgate Drive, P.O. Box 1112, Guelph, Ontario N1H 6N3
Phone: (519) 836-4332 Fax: (519) 836-2119 info@thomasfield.com

Tricia Radburn

From: Steve Gendron
Sent: Monday, August 21, 2017 11:54 AM
To: grandvalleymp
Subject: FW: Grand Valley Master Plan - Notice of Commencement

Follow Up Flag: Follow up
Flag Status: Flagged

From: Doran Ritchie [mailto:d.ritchie@saugeenojibwaynation.ca]
Sent: Tuesday, August 15, 2017 2:24 PM
To: Steve Gendron
Cc: Danielle Langlois
Subject: Re: Grand Valley Master Plan - Notice of Commencement

Hello both,

Thank you for sending the information along. I appreciate that this is a long-term study and that there are no specific works being proposed at this time. Saugeen Ojibway Nation (SON) has participated in these types of studies with other municipalities and were consulted. SON would like the opportunity to discuss at a meeting with yourselves on how we would like to be consulted and of course hear more about the Master plan study.

I kindly ask that you provide a few meeting dates for consideration.

Please don't hesitate to call me on my cell if you have any further questions.

Thank you,
Doran

From: Steve Gendron <Steve.Gendron@rjburnside.com>
Date: Thursday, August 10, 2017 at 11:42 AM
To: Doran Ritchie <d.ritchie@saugeenojibwaynation.ca>
Cc: Danielle Langlois <Danielle.Langlois@rjburnside.com>
Subject: Grand Valley Master Plan - Notice of Commencement

Hello,

On behalf of the Town of Grand Valley, please find attached the Commencement Notice for the Master Plan, as per your request.

Please be advised that the Grand Valley project is a Long Term Master Plan for Water and Wastewater for the Town, so there is no specific Study Area.

Thank you for your participation.

Stephen Gendron, P.Eng, CAN-CISEC
Process and Environmental Engineer

R.J. Burnside & Associates Limited
128 Wellington Street West, Suite 301, Barrie ON L4N 8J6
Office: 705-797-2047   Direct: 705-797-4297
www.rjburnside.com

Tricia Radburn

From: Christine Gervais <cgervais@amaranth-eastgary.ca>
Sent: Thursday, August 24, 2017 2:30 PM
To: jwilson@townofgrandvalley.ca; grandvalleymp
Cc: Susan Stone; Dave Menary
Subject: FW: Notice of Study Commencement - Town of Grand Valley Master Plan

Good afternoon,

The Township of East Garafraxa is in receipt of your Notice of Study Commencement dated July 24, 2017. The Township is requesting a copy of any additional information and reports concerning this Study and also request to be added to the Project Contact List to receive future project notices.

Thank you,

Christine Gervais, MCIP, RPP, Township Planner
Township of Amaranth & Township of East Garafraxa
Tel.: 519-941-1007 | Email: cgervais@amaranth-eastgary.ca

Ministry of Tourism,
Culture and Sport

Heritage Program Unit
Programs and Services Branch
401 Bay Street, Suite 1700
Toronto ON M7A 0A7
Tel: 416 314 3108
Fax: 416 212 1802

Ministère du Tourisme,
de la Culture et du Sport

Unité des programmes patrimoine
Direction des programmes et des services
401, rue Bay, Bureau 1700
Toronto ON M7A 0A7
Tél: 416 314 3108
Téléc: 416 212 1802

Ontario

September 14, 2017 (EMAIL ONLY)

Stephen Gendron
EA Coordinator
R.J. Burnside & Associates Limited
128 Wellington Street West, Suite 301
Barrie, ON L4N 8J6
E: GrandValleyMP@rjburnside.com

RE: MTCS file #: 0007196
Proponent: Town of Grand Valley
Subject: Notice of Commencement
Town of Grand Valley Master Plan
Location: Town of Grand Valley, Ontario

Dear Mr. Gendron:

Thank you for providing the Ministry of Tourism, Culture and Sport (MTCS) with the Notice of Commencement for your project. MTCS's interest in this Master Plan project relates to its mandate of conserving Ontario's cultural heritage, which includes:

- Archaeological resources, including land-based and marine;
- Built heritage resources, including bridges and monuments; and,
- Cultural heritage landscapes.

Under the Municipal Class Environmental Assessment (EA) process, the proponent is required to determine a project's potential impact on cultural heritage resources. A Master Plan project at minimum will address Phases 1 and 2 of the Municipal Class EA process. Developing and reviewing inventories of known and potential cultural heritage resources within the study area can identify specific resources that may play a significant role in guiding the evaluation of alternatives for subsequent project-driven EAs.

While some cultural heritage resources may have already been formally identified, others may be identified through screening and evaluation. Aboriginal communities may have knowledge that can contribute to the identification of cultural heritage resources, and we suggest that any engagement with Aboriginal communities includes a discussion about known or potential cultural heritage resources that are of value to these communities. Municipal Heritage Committees, historical societies and other local heritage organizations may also have knowledge that contributes to the identification of cultural heritage resources.

Archaeological Resources
Your Master Plan project may impact archaeological resources and you should screen the project with the MTCS *Criteria for Evaluating Archaeological Potential* to determine if archaeological assessments will be needed for subsequent project-driven Municipal Class EAs. MTCS archaeological sites data are available at *archaeology@ontario.ca*, and if your Master Plan project area exhibits archaeological potential or encompasses archaeological sites of high cultural heritage value or interest, these data should be used in the evaluation of alternatives.

Built Heritage and Cultural Heritage Landscapes

The MTCS *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* should be completed to help determine whether your Master Plan project may impact cultural heritage resources. The Clerk for the Town of Grand Valley can provide information on property registered or designated under the *Ontario Heritage Act* and may have other information that will assist you in completing the checklist. A determination of whether the Master Plan project area impacts potential or known heritage resources of cultural heritage value or interest should be used in the evaluation of alternatives.

If subsequent project-driven Municipal Class EAs may impact potential or known heritage resources MTCS recommends that a Heritage Impact Assessment (HIA), prepared by a qualified consultant, should be completed to assess potential project impacts. Our Ministry's *Info Sheet #5: Heritage Impact Assessments and Conservation Plans* outlines the scope of HIAs. Please send the HIA to MTCS for review, and make it available to local organizations or individuals who have expressed interest in review.

Environmental Assessment Reporting

All technical heritage studies and their recommendations are to be addressed and incorporated into Master Plan projects. Please advise MTCS whether any technical heritage studies will be completed for your Master Plan project, and provide them to MTCS before issuing a Notice of Completion. If your screening has identified no known or potential cultural heritage resources, or no impacts to these resources, please include the completed checklists and supporting documentation in the Master Plan report or file.

Thank-you for consulting MTCS on this project: please continue to do so through the Master Plan process, and contact me for any questions or clarification.

Sincerely,

Laura Hatcher
Heritage Planner
laura.e.hatcher@Ontario.ca

It is the sole responsibility of proponents to ensure that any information and documentation submitted as part of their Master Plan report or file is accurate. MTCS makes no representation or warranty as to the completeness, accuracy or quality of the any checklists, reports or supporting documentation submitted as part of the Master Plan process, and in no way shall MTCS be liable for any harm, damages, costs, expenses, losses, claims or actions that may result if any checklists, reports or supporting documents are discovered to be inaccurate, incomplete, misleading or fraudulent.

Please notify MTCS if archaeological resources are impacted by Master Plan project work. All activities impacting archaeological resources must cease immediately, and a licensed archaeologist is required to carry out an archaeological assessment in accordance with the Ontario Heritage Act and the Standards and Guidelines for Consultant Archaeologists.

If human remains are encountered, all activities must cease immediately and the local police as well as the Cemeteries Regulation Unit of the Ministry of Government and Consumer Services must be contacted. In situations where human remains are associated with archaeological resources, MTCS should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act.

Tricia Radburn

From: Bruce Li <byli666@gmail.com>
Sent: Monday, September 18, 2017 2:34 PM
To: grandvalleymp
Subject: Grand valley project

Hi,

Can you add me to receive future project notices please?

Thx

Grand River Conservation Authority

400 Clyde Road, P.O. Box 729 Cambridge, ON N1R 5W6

Phone: 519.621.2761 **Toll free:** 866.900.4722 **Fax:** 519.621.4844 **Online:** www.grandriver.ca

RECEIVED
SEP 28 2017

September 21st, 2017

Jane Wilson
Chief Administrative Officer
Town of Grand Valley
5 Main Street North
Grand Valley, ON L9W 5S6

Stephen Gendron, P.Eng.
EA Coordinator
R.J. Burnside and Associates Ltd.
128 Wellington Street West, Suite 301
Barrie, ON L4N 8J6

Dear Ms. Wilson and Mr. Gendron,

Re: Notice of Project Commencement, Town of Grand Valley Master Plan, Town of Grand Valley

---

The Grand River Conservation Authority (GRCA) has received the Notice of Project Commencement for the Town of Grand Valley Master Plan Municipal Class Environmental Assessment. The purpose of the study is to assess alternative access for commercial and industrial vehicles in an effort to avoid the downtown core of Dundalk.

The Grand River flows through the Town of Grand Valley and the area contains Natural Heritage and Natural Hazard features.

Based on the above, we ask that you forward any information pertaining to the Class EA as it becomes available and we would like the opportunity to participate in the study process.

Should you have any questions, please contact me at 519-621-2763 ext. 2236.

Yours truly,

Nathan Garland
Resource Planner
Grand River Conservation Authority

Ministry of the Environment and Climate Change
West Central Region

119 King Street West
12th Floor
Hamilton, Ontario L8P 4Y7
Tel.: 905 521-7640
Fax: 905 521-7820

Ministère de l'Environnement et de l'Action en matière de changement climatique
Direction regionale du Centre-Quest

119 rue King Quest
12e étage
Hamilton (Ontario) L8P 4Y7
Tél. : 905 521-7640
Téléc. : 905 521-7820

Ontario

September 25, 2017

Ms. J. Wilson
C.A.O.
Town of Grand Valley
5 Main Street North
Grand Valley, ON
L9W 5S6

Mr. S. Gendron
R.J. Burnsides & Assoc. Ltd.
128 Wellington Street West, Suite 301
Barrie, ON
L4N 8J6

Dear Ms. Wilson and Mr. Gendron:

Re: Town of Grand Valley Master Plan
MEA Class EA
Response to Notice of Commencement

This letter is in response to the Notice of Commencement for the above noted project. The Ministry of the Environment and Climate Change (MOECC) acknowledges that the Town of Grand Valley has indicated that its study is following the requirements for Master Plan to determine water and wastewater infrastructure improvements that are required in order for the Town to meet its future development commitment as approved through Official Plan policy and the Growth Plan. The Master Plan should result in a list of identified projects, determine additional EA requirements and prioritize implementation of these projects to meet the stated objective within a timely manner.

The Crown has a legal duty to consult Aboriginal communities when it has knowledge, real or constructive, of the existence or potential existence of an Aboriginal or treaty right and contemplates conduct that may adversely impact that right. Before authorizing this project, the Crown must ensure that its duty to consult has been fulfilled, where such a duty is triggered. Although the duty to consult with Aboriginal peoples is a duty of the Crown, the Crown may delegate procedural aspects of this duty to project proponents while retaining oversight of the consultation process.

Your proposed project may have the potential to affect Aboriginal or treaty rights protected under Section 35 of Canada's *Constitution Act* 1982. Where the Crown's duty to consult is triggered in relation to your proposed project, **the MOECC is delegating the procedural aspects of rights-based consultation to you through this letter.** The Crown intends to rely on the delegated consultation process in discharging its duty to consult and maintains the right to participate in the consultation process as it sees fit.

Based on information you have provided to date and the Crown`s preliminary assessment you are required to consult with the following communities who have been identified as potentially affected by your proposed project.

<table>
<tr><th>Nation</th><th colspan="2">Contact Information</th></tr>
<tr><td>Saugeen First Nation</td><td rowspan="2">Saugeen Ojibway Nation
Environment Office
25 Maadookii Road
Neyaashiinigmiing, ON
N0H 2T0
519-534-5507
Doran Ritchie
Land Use Planning Coordinator
d.ritchie@saugeenojibwaynation.ca
(Please send hard copy to Doran Ritchie)</td><td>Saugeen First Nation
6493 Highway 21 R.R.#1
Southampton, ON N0H 2L0
519-797-2781
Chief Lester Anoquot
lanoquot@saugeenfirstnation.ca
(Email copy to Chief Anoquot)</td></tr>
<tr><td>Chippewas of Nawash Unceded First Nation</td><td>Chippewas of Nawash Unceded First Nation
R.R.#5 Wiarton, ON N0H 2T0
519-534-1689
Chief Gregory Nadjiwon
chiefsdesk@nawash.ca
(Email copy to Chief Nadjiwon)</td></tr>
<tr><td>Historic Saugeen Metis</td><td colspan="2">Historic Saugeen Metis
204 High Street, Box 1492 Southampton, ON N0H 2L0
President, Archie Indoe Other Contact: George Govier Consultation Coordinator
519-483-4000 saugeenmetisadmin@bmts.com</td></tr>
<tr><td>Great Lakes Metis Council</td><td colspan="2">Great Lakes Metis Council
380 9th Street East Owen Sound, ON N4K 1P1 519-370-0435
Other Contact: James Wagar, Consultation Assessment Coordinator
jamesw@metisnation.org and consultations@metisnation.org
(Please send email copies to email addresses listed above)</td></tr>
<tr><td>Beausoleil First Nation</td><td colspan="2">Mary McCue-King
11 O'Gemaa Miikaan
Christian Island, ON
L9M 0A9
Phone: (705) 247-2051
Fax: (705) 247-2239</td></tr>
</table>

Steps that you may need to take in relation to Aboriginal consultation for your proposed project are outlined in the "Code of Practice for Consultation in Ontario's Environmental Assessment Process" which can be found at the following link:
https://www.ontario.ca/document/consultation-ontarios-environmental-assessment-process
Additional information related to Ontario's Environmental Assessment Act is available online at: www.ontario.ca/environmentalassessments

You must contact the Director of Environmental Approvals Branch under the following circumstances subsequent to initial discussions with the communities identified by MOECC:

- Aboriginal or treaty rights impacts are identified to you by the communities
- You have reason to believe that your proposed project may adversely affect an Aboriginal or treaty right
- Consultation has reached an impasse
- A Part II Order request or elevation request is expected based on the nature of public feedback

The Director of the Environmental Approvals Branch can be notified either by email with the subject line "Potential Duty to Consult" to EAASIBgen@ontario.ca or by mail or fax at the address provided below:

Email:	EAASIBGen@ontario.ca Subject: Potential Duty to Consult
Fax:	416-314-8452
Address:	Environmental Approvals Branch 135 St. Clair Avenue West Toronto, ON, M4V 1P5

The MOECC will then assess the extent of any Crown duty to consult for the circumstances and will consider whether additional steps should be taken, including what role you will be asked to play in them.

Due to the extensive involvement of the ministry in the municipal servicing issues, we would like the opportunity to be involved as needed in the process to provide advice and advise as to legislative and approval requirements. Also, please take note that once you have completed the EA process and have prepared a Notice of Completion, a copy of the Notice and final document should be sent to me and a copy of the Notice should also be sent to the MOECC EAB email (MEA.Notices.EAAB@ontario.ca) Should you or any members of your project team have any questions regarding the material above, please contact me at (905) 521-7864 or at Barbara.slattery@ontario.ca

Yours truly,

Barbara Slattery

Barbara Slattery
EA/Planning Coordinator

c. Ms. A. Shaw, Guelph District Office (via email only)
Mr. Z. Bhatti, MOECC (via email only)

A PROPONENT'S INTRODUCTION TO THE DELEGATION OF PROCEDURAL ASPECTS OF CONSULTATION WITH ABORIGINAL COMMUNITIES

DEFINITIONS

The following definitions are specific to this document and may not apply in other contexts:

Aboriginal communities – the First Nation or Métis communities identified by the Crown for the purpose of consultation.

Consultation – the Crown's legal obligation to consult when the Crown has knowledge of an established or asserted Aboriginal or treaty right and contemplates conduct that might adversely impact that right. This is the type of consultation required pursuant to s. 35 of the *Constitution Act, 1982*. Note that this definition does not include consultation with Aboriginal communities for other reasons, such as regulatory requirements.

Crown – the Ontario Crown, acting through a particular ministry or ministries.

Procedural aspects of consultation – those portions of consultation related to the process of consultation, such as notifying an Aboriginal community about a project, providing information about the potential impacts of a project, responding to concerns raised by an Aboriginal community and proposing changes to the project to avoid negative impacts.

Proponent – the person or entity that wants to undertake a project and requires an Ontario Crown decision or approval for the project.

I. PURPOSE

The Crown has a legal duty to consult Aboriginal communities when it has knowledge of an existing or asserted Aboriginal or treaty right and contemplates conduct that may adversely impact that right. In outlining a framework for the duty to consult, the Supreme Court of Canada has stated that the Crown may delegate procedural aspects of consultation to third parties. This document provides general information about the Ontario Crown's approach to delegation of the procedural aspects of consultation to proponents.

This document is not intended to instruct a proponent about an individual project, and it does not constitute legal advice.

II. WHY IS IT NECESSARY TO CONSULT WITH ABORIGINAL COMMUNITIES?

The objective of the modern law of Aboriginal and treaty rights is the *reconciliation* of Aboriginal peoples and non-Aboriginal peoples and their respective rights, claims and interests. Consultation is an important component of the reconciliation process.

The Crown has a legal duty to consult Aboriginal communities when it has knowledge of an existing or asserted Aboriginal or treaty right and contemplates conduct that might adversely impact that right. For example, the Crown's duty to consult is triggered when it considers issuing a permit, authorization or approval for a project which has the potential to adversely impact an Aboriginal right, such as the right to hunt, fish, or trap in a particular area.

The scope of consultation required in particular circumstances ranges across a spectrum depending on both the nature of the asserted or established right and the seriousness of the potential adverse impacts on that right.

Depending on the particular circumstances, the Crown may also need to take steps to accommodate the potentially impacted Aboriginal or treaty right. For example, the Crown may be required to avoid or minimize the potential adverse impacts of the project.

III. THE CROWN'S ROLE AND RESPONSIBILITIES IN THE DELEGATED CONSULTATION PROCESS

The Crown has the responsibility for ensuring that the duty to consult, and accommodate where appropriate, is met. However, the Crown may delegate the procedural aspects of consultation to a proponent.

There are different ways in which the Crown may delegate the procedural aspects of consultation to a proponent, including through a letter, a memorandum of understanding, legislation, regulation, policy and codes of practice.

If the Crown decides to delegate procedural aspects of consultation, the Crown will generally:

- Ensure that the delegation of procedural aspects of consultation and the responsibilities of the proponent are clearly communicated to the proponent;
- Identify which Aboriginal communities must be consulted;
- Provide contact information for the Aboriginal communities;
- Revise, as necessary, the list of Aboriginal communities to be consulted as new information becomes available and is assessed by the Crown;
- Assess the scope of consultation owed to the Aboriginal communities;

- Maintain appropriate oversight of the actions taken by the proponent in fulfilling the procedural aspects of consultation;
- Assess the adequacy of consultation that is undertaken and any accommodation that may be required;
- Provide a contact within any responsible ministry in case issues arise that require direction from the Crown; and
- Participate in the consultation process as necessary and as determined by the Crown.

IV. THE PROPONENT'S ROLE AND RESPONSIBILITIES IN THE DELEGATED CONSULTATION PROCESS

Where aspects of the consultation process have been delegated to a proponent, the Crown, in meeting its duty to consult, will rely on the proponent's consultation activities and documentation of those activities. The consultation process informs the Crown's decision of whether or not to approve a proposed project or activity.

A proponent's role and responsibilities will vary depending on a variety of factors including the extent of consultation required in the circumstance and the procedural aspects of consultation the Crown has delegated to it. Proponents are often in a better position than the Crown to discuss a project and its potential impacts with Aboriginal communities and to determine ways to avoid or minimize the adverse impacts of a project.

A proponent can raise issues or questions with the Crown at any time during the consultation process. If issues or concerns arise during the consultation that cannot be addressed by the proponent, the proponent should contact the Crown.

a) What might a proponent be required to do in carrying out the procedural aspects of consultation?

Where the Crown delegates procedural aspects of consultation, it is often the proponent's responsibility to provide notice of the proposed project to the identified Aboriginal communities. The notice should indicate that the Crown has delegated the procedural aspects of consultation to the proponent and should include the following information:

- a description of the proposed project or activity;
- mapping;
- proposed timelines;
- details regarding anticipated environmental and other impacts;
- details regarding opportunities to comment; and
- any changes to the proposed project that have been made for seasonal conditions or other factors, where relevant.

Proponents should provide enough information and time to allow Aboriginal communities to provide meaningful feedback regarding the potential impacts of the project. Depending on the nature of consultation required for a project, a proponent also may be required to:

- provide the Crown with copies of any consultation plans prepared and an opportunity to review and comment;
- ensure that any necessary follow-up discussions with Aboriginal communities take place in a timely manner, including to confirm receipt of information, share and update information and to address questions or concerns that may arise;
- as appropriate, discuss with Aboriginal communities potential mitigation measures and/or changes to the project in response to concerns raised by Aboriginal communities;
- use language that is accessible and not overly technical, and translate material into Aboriginal languages where requested or appropriate;
- bear the reasonable costs associated with the consultation process such as, but not limited to, meeting hall rental, meal costs, document translation(s), or to address technical & capacity issues;
- provide the Crown with all the details about potential impacts on established or asserted Aboriginal or treaty rights, how these concerns have been considered and addressed by the proponent and the Aboriginal communities and any steps taken to mitigate the potential impacts;
- provide the Crown with complete and accurate documentation from these meetings and communications; and
- notify the Crown immediately if an Aboriginal community not identified by the Crown approaches the proponent seeking consultation opportunities.

b) What documentation and reporting does the Crown need from the proponent?

Proponents should keep records of all communications with the Aboriginal communities involved in the consultation process and any information provided to these Aboriginal communities.

As the Crown is required to assess the adequacy of consultation, it needs documentation to satisfy itself that the proponent has fulfilled the procedural aspects of consultation delegated to it. The documentation required would typically include:

- the date of meetings, the agendas, any materials distributed, those in attendance and copies of any minutes prepared;
- the description of the proposed project that was shared at the meeting;
- any and all concerns or other feedback provided by the communities;
- any information that was shared by a community in relation to its asserted or established Aboriginal or treaty rights and any potential adverse impacts of the proposed activity, approval or disposition on such rights;

- any proposed project changes or mitigation measures that were discussed, and feedback from Aboriginal communities about the proposed changes and measures;
- any commitments made by the proponent in response to any concerns raised, and feedback from Aboriginal communities on those commitments;
- copies of correspondence to or from Aboriginal communities, and any materials distributed electronically or by mail;
- information regarding any financial assistance provided by the proponent to enable participation by Aboriginal communities in the consultation;
- periodic consultation progress reports or copies of meeting notes if requested by the Crown;
- a summary of how the delegated aspects of consultation were carried out and the results; and
- a summary of issues raised by the Aboriginal communities, how the issues were addressed and any outstanding issues.

In certain circumstances, the Crown may share and discuss the proponent's consultation record with an Aboriginal community to ensure that it is an accurate reflection of the consultation process.

c) Will the Crown require a proponent to provide information about its commercial arrangements with Aboriginal communities?

The Crown may require a proponent to share information about aspects of commercial arrangements between the proponent and Aboriginal communities where the arrangements:

- include elements that are directed at mitigating or otherwise addressing impacts of the project;
- include securing an Aboriginal community's support for the project; or
- may potentially affect the obligations of the Crown to the Aboriginal communities.

The proponent should make every reasonable effort to exempt the Crown from confidentiality provisions in commercial arrangements with Aboriginal communities to the extent necessary to allow this information to be shared with the Crown.

The Crown cannot guarantee that information shared with the Crown will remain confidential. Confidential commercial information should not be provided to the Crown as part of the consultation record if it is not relevant to the duty to consult or otherwise required to be submitted to the Crown as part of the regulatory process.

V. WHAT ARE THE ROLES AND RESPONSIBILITIES OF ABORIGINAL COMMUNITIES' IN THE CONSULTATION PROCESS?

Like the Crown, Aboriginal communities are expected to engage in consultation in good faith. This includes:

- responding to the consultation notice;
- engaging in the proposed consultation process;
- providing relevant information;
- clearly articulating the potential impacts of the proposed project on Aboriginal or treaty rights; and
- discussing ways to mitigate any adverse impacts.

Some Aboriginal communities have developed tools, such as consultation protocols, policies or processes that provide guidance on how they would prefer to be consulted. Although not legally binding, proponents are encouraged to respect these community processes where it is reasonable to do so. Please note that there is no obligation for a proponent to pay a fee to an Aboriginal community in order to enter into a consultation process.

To ensure that the Crown is aware of existing community consultation protocols, proponents should contact the relevant Crown ministry when presented with a consultation protocol by an Aboriginal community or anyone purporting to be a representative of an Aboriginal community.

VI. WHAT IF MORE THAN ONE PROVINCIAL CROWN MINISTRY IS INVOLVED IN APPROVING A PROPONENT'S PROJECT?

Depending on the project and the required permits or approvals, one or more ministries may delegate procedural aspects of the Crown's duty to consult to the proponent. The proponent may contact individual ministries for guidance related to the delegation of procedural aspects of consultation for ministry-specific permits/approvals required for the project in question. Proponents are encouraged to seek input from all involved Crown ministries sooner rather than later.

From: Lands and Resources Consultation Coordinator [mailto:saugeenmetisadmin@bmts.com]
Sent: Thursday, October 05, 2017 1:54 PM
To: Tricia Radburn
Subject: Re: Notice of Commencement- Grand Valley Master Plan

Your File:
Our File: Beyond Geographical Area

Good Afternoon Ms. Radburn,

Acknowledge your e-mail from earlier this afternoon regarding Notice of Commencement- Grand Valley Master Plan.

The Historic Saugeen Metis (HSM) Lands, Resources, and Consultation Department has reviewed the relevant documents and advise that the location is beyond the geographical area of Historic Saugeen Metis traditional territory.

The attached map, Hudson Bay Company Outposts – Lake Huron District 1821 is a photo of the map which is displayed in our Interpretive Centre. The information is based on historical written records from Fort La Cloche Post History and shows the location of trading posts around Lake Huron and Georgian Bay.

In general, HSM traditional territory includes Grey, Bruce, and Huron Counties, as well as portions of Lambton, Perth, and Wellington Counties. The eastern boundary is generally interpreted from Collingwood to Mount Forest to Grand Bend.

I trust this may be helpful.

Regards,

George Govier

Co-ordinator Lands, Resources, and Consultation

Historic Saugeen Metis
204 High Street
Southampton, Ontario
N0H 2L0
Direct Line (519) 483-4001
Fax (519) 483-4002
Email saugeenmetisadmin@bmts.com

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From: Tricia Radburn <Tricia.Radburn@rjburnside.com>
Date: Thursday, October 5, 2017 at 1:04 PM
To: Saugeen Metis Admin <saugeenmetisadmin@bmts.com>
Subject: Notice of Commencement- Grand Valley Master Plan

Mr. Archie Indoe,

The Town of Grand Valley is assessing ways to provide water and waste water services to meet the demands of its growing population. The assessment is being carried out under the Municipal Class Environmental Assessment process. A Notice of Study Commencement is attached.

Please feel free to contact me if you have any questions or concerns about the study or if you would like to be removed from the project mailing list.

Kind Regards,

BURNSIDE

Tricia Radburn, M.Sc.(Pl), MCIP, RPP
Senior Environmental Planner

R.J. Burnside & Associates Limited
292 Speedvale Ave. Unit 20, Guelph, ON N1H 1C4
Office: 800-265-9662 Direct: 226-486-1778
www.rjburnside.com

NOTICE OF STUDY COMMENCEMENT
TOWN OF GRAND VALLEY MASTER PLAN

The Study

Prior to 2014, the Town of Grand Valley had an urban population of approximately 1,500 and had constructed infrastructure to accommodate the mature state urban population in its Official Plan, which was 2,950. In 2014, approval was given to change the Official Plan such that the mature state urban population increased to 6,145. This amendment was premised on the certainty that services could be provided to the new future population, but no infrastructure plans were put in place. The Town of Grand Valley is undertaking a Master Plan to address the problem of how Grand Valley can provide water and wastewater infrastructure to meet the demands in the community as it achieves the growth that is approved in its Official Plan.

The Process

The Study is being conducted in accordance with the requirements of Phases 1 and 2 of the Municipal Class Environmental Assessment, as outlined in the Municipal Engineers Association *Municipal Class Environmental Assessment Manual* (October 2000, as amended 2007, 2011 & 2015), which is an approved process under the *Ontario Environmental Assessment Act*. The study will evaluate alternative solutions with consideration for the natural, cultural, technical and economic environment, and recommend preferred solutions in consultation with the public, Aboriginal communities and regulatory agencies, documented for the public record. At the conclusion of the study, the Master Plan will be prepared for public review.

Input Invited

Consultation is important to this study. The Town of Grand Valley would like to ensure that anyone interested in this study has the opportunity to provide input into the planning and design of the project. For this first stage of the process, you are encouraged to provide your comments to us by August 24, 2017. To provide comment or to request additional information concerning this Study or if you would like to be added to the Project Contact List to receive future project notices, please email the dedicated email address GrandValleyMP@rjburnside.com or contact either of the following Project Team members:

Jane Wilson
Chief Administrative Officer
Town of Grand Valley
5 Main St. N.
Grand Valley, ON L9W 5S6
T 519-928-5652 ext. 224

Tricia Radburn, M.Sc.(Pl), MCIP, RPP
Sr. Environmental Planner
R. J. Burnside & Associates Limited
292 Speedvale Avenue West, Unit 20
Guelph, ON N1H 1C4
T 226-486-1778

Project and notice information will be made accessible upon request in accordance with the Accessibility Standard for Information and Communication under the *Accessibility for Ontarians with Disabilities Act, 2005.*

Information will be collected and maintained to meet the requirements of the *Environmental Assessment Act* and for the purpose of creating a record that will be available to the general public as described in Section 37 of the *Freedom of Information and Protection of Privacy Act*. All comments and personal information such as name, address, telephone number and property location will become part of the public record that is available to the general public. For more information, please contact the Ministry's Freedom of Information and Privacy Coordinator at 416-327-1434.

This Notice Issued on July 24, 2017.

Tricia Radburn

From: Tricia Radburn
Sent: Wednesday, May 02, 2018 1:00 PM
To: Avid Banihashemi
Subject: FW: Grand Valley Master Plan
Attachments: 040938_Grand Valley W WW Master Plan EA_PIC Notice.pdf

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From: Tricia Radburn
Sent: Thursday, October 26, 2017 2:22 PM
To: d.ritchie@saugeenojibwaynation.ca
Cc: Gord Feniak <Gord.Feniak@rjburnside.com>; Jeff Paznar <Jeff.Paznar@rjburnside.com>; Porchae Baird <Porchae.Baird@rjburnside.com>
Subject: Grand Valley Master Plan

Good Afternoon,

Thank you for your interest in the Grand Valley Water and Wastewater Servicing Master Plan. We did receive your request for a meeting and for further information about the Master Plan project, sent to Steve Gendron of R.J. Burnside Limited on August 15, 2017. We are now able to provide you with more detailed information about the project which will include new wells for municipal drinking water, a new water tower and expanded wastewater treatment capacity. All of the proposed infrastructure is located within, or in close proximity to, the community of Grand Valley. We are intending to present a variety of alternative locations for each component at an upcoming public meeting. A Notice of the event is attached. We welcome you to attend, but if you unable to be there, the display boards will be posted on the Town's website on the day following the Public Information Centre, found under the tab "Official Plan, Zoning and Planning Documents" in the Doing Business section of the website.

If you have any comments or would like to meet at a separate date and time to discuss the project and an appropriate consultation process, please respond to grandvalleymp@rjburnside.com or contact Tricia Radburn at 226-486-1778.

Best regards
Grand Valley EA Study Team

Tricia Radburn

From: Katherine McLaughlin <katherinem@thomasfield.com>
Sent: Monday, November 20, 2017 9:58 AM
To: Jane Wilson; grandvalleymp
Cc: Tom Krizsan; Tracey Atkinson; Chris Sims; Astrid Clos; 'Brian Fritz - GM BluePlan'; Gord Feniak
Subject: Grand Valley Water and Wastewater Servicing Master Plan
Attachments: Letter - EA Water and Wastewater Servicing Master Plan (Nov 15-17).pdf

Good morning –

Please see attached letter providing comments on the Municipal Class Environmental Assessment Study for the Grand Valley Water and Wastewater Servicing Master Plan.

Thank you,

ThomasfieldHomes Limited

Katherine McLaughlin ***BES, MBA***
Manager, Land Development & Acquisitions
295 Southgate Drive, Guelph, ON, N1G 3M5
P (519) 836-4332 **ext. 25** **F** (519) 836-2119
katherinem@thomasfield.com

ThomasfieldHomes Limited

November 15, 2017

Jane Wilson, CAO
Clerk Treasurer
5 Main St. N.
Grand Valley, ON L9W 5S6

Jeff Paznar, P. Eng., EP
Environmental Assessment Lead/Project Engineer
R.J. Burnside and Associates Limited
292 Speedvale Ave. W., Unit 20
Guelph, ON N1H 1C4

Dear Jeff and Jane:

RE: Municipal Class Environmental Assessment Study
Grand Valley Water and Wastewater Servicing Master Plan

Thank you for answering our questions at the PIC for the Grand Valley Water and Wastewater Servicing Master Plan on November 1st, 2017. We are encouraged by the progress being made to address the Town's water and wastewater servicing issues (surge tank and water storage), although we question the 2031 time horizon for the wastewater treatment plant (WWTP) expansion which is identified as "Phase 3/4 Water Pollution Control Plant Upgrades".

Currently, the Future Estimated Wastewater Demand is being projected to the year 2031 for an Official Plan population of 6,145 and a capacity of 2,131 m3/d. Population projections beyond 2031 should be considered in the EA process for the estimated wastewater demands. If Grand Valley uses the 2031 population projections, the net increase in capacity will be 581 m3. A process like this EA should aim to secure additional capacity in the range of 1,000 m3 at minimum. If the 2036 or 2041 population projections are considered, additional capacity could be secured without having to go through the EA process again.

I thank you for your consideration of our comments.

Sincerely,

Tom Krizsan

cc. Mayor Soloman and Members of Council
Gord Feniak, R.J. Burnside (via email)
Tracey Atkinson, Town of Grand Valley (via email)
Astrid Clos, Astrid J. Clos Planning (via email)
Chris Sims, GM Blue Plan (via email)
Brian Fritz, GM Blue Plan (via email)

Tricia Radburn

From: Hollie Nolan <hollien@ramafirstnation.ca> on behalf of Chief Rodney Noganosh <chief@ramafirstnation.ca>
Sent: Wednesday, November 29, 2017 3:09 PM
To: jwilson@townofgrandvalley.ca; grandvalleymp
Subject: re: Municipal Class Environmental Assessment Study – Notice of Public Information Centre – Grand Valley Water and Wastewater Servicing Master Plan.

Dear Jane & Jeff;

Thank you for your letter re: Municipal Class Environmental Assessment Study – Notice of Public Information Centre – Grand Valley Water and Wastewater Servicing Master Plan.

Please be advised that we reviewed your letter. I have shared it with Council and we've forwarded the information to Karry Sandy McKenzie, Williams Treaties First Nation Process Co-ordinator/Negotiator. Ms. McKenzie will review your letter and take the necessary action if required. In the interim, should you wish to contact Ms. McKenzie directly, please do so at k.a.sandy-mckenzie@rogers.com

Thank you,

Chief Rodney Noganosh

Hollie Nolan
Executive Assistant to the Chief, Administration
Chippewas of Rama First Nation
(ph) 705-325-3611,1216
(cell)
(fax) 705-325-0879
(url) www.ramafirstnation.ca

From: Gord Feniak
Sent: Thursday, November 30, 2017 11:50 AM
To: dave.h@zpplan.com
Cc: Tracey Atkinson; Tricia Radburn
Subject: Re: REQUEST: Development application(S) and/or EA near municipal boundary within Waldemar

Hi Dave- the PIC boards are posted on the Town of Grand Valley website and that provide you with everything that you need. If not, please let me know. We will also add you to the circulation list for this file.....gf

Sent from my iPhone

Gord Feniak, | R.J. Burnside & Associates Limited | www.rjburnside.com
Office: 800-265-9662 Direct: 519-938-3076

On Nov 30, 2017, at 10:31 AM, Dave Hannam - Zelinka Priamo Ltd. <dave.h@zpplan.com> wrote:

> Gord, please see my request below for further info.
>
> Thanks and regards
>
> Dave Hannam
>
> **From:** Tracey Atkinson [mailto:tatkinson@townofgrandvalley.ca]
> **Sent:** Wednesday, November 29, 2017 4:23 PM
> **To:** dave.h@zpplan.com; Gord Feniak <Gord.Feniak@rjburnside.com>

Subject: Re: REQUEST: Development application(S) and/or EA near municipal boundary within Waldemar

Hi Dave,
By way of this email I am providing your email to Burnsides.
Kind regards
Tracey

Sent from my iPhone

On Nov 29, 2017, at 3:43 PM, Dave Hannam - Zelinka Priamo Ltd. <dave.h@zpplan.com> wrote:

> Hi Tracey, we are the planning consultants for Sarah Properties Ltd. We are currently coordinating development applications with the township of Amaranth for a new residential subdivision in the Hamlet of Waldemar.
>
> It is our understanding that the Town of Grand Valley has a current development application(s) and/or Class EA for a project in proximity to the municipal boundary. We would like to obtain further details for this project, including its status. Can you assist please.
>
> Thanks and regards
>
> ---
>
> Dave Hannam, BRP, MCIP, RPP
> Senior Planner
>
> **Zelinka Priamo Ltd.**
> London Office
> 318 Wellington Road
> London, ON N6C 4P4
> (P) +1 (519) 474-7137
> dave.h@zpplan.com
> www.zpplan.com

Tricia Radburn

From: Avid Banihashemi
Sent: Friday, May 11, 2018 11:58 AM
To: Van de Valk, Jackie (OMAFRA)
Cc: Gord Feniak; Jeff Paznar; Tricia Radburn; grandvalleymp
Subject: RE: Grand Valley Master Plan - Notice of Public Information Centre
Attachments: Land Registry Info-1023_001.pdf; Map -040938 Grand Valley EA Agricultural Response Figures-PREFERRED ALTERNATIVES.pdf; RPLAN-7R-6134.pdf; Slide-040938_Grand Valley Master Plan EA-Preferred Alternatives.pdf

Hello Jackie,

The main components of the Grand Valley Master Plan and the preliminary preferred alternative locations (see attached summary slide) are:

1- Water Supply, including groundwater wells at two preliminary preferred locations of Park Site [2A] and existing water tower site [2B] (see the attached map)
2- Water Storage, including elevated water storage in the form of a water tower or composite elevated tank, at preliminary preferred location – within the existing Water Pollution Control Plant (WPCP) buffer [2A] (see attached map).
3- Wastewater Treatment, including (1) an interim solution: plant re-rating and construction of an Equalization Tank at the WPCP, (2) Long term solution: expansion of existing WPCP

Except for the Park Site, all these future proposed improvements are located on disturbed and already in-use lands for water/wastewater services. The Park Site, legally described as Part Lot 29, Concession 2 (see attached), is currently part of a Subdivision Agreement (December 2012) between the Town of Grand Valley and Thomasfield Homes Ltd. Developer, agreed to be dedicated as 'parkland' to fulfill the developer's parkland obligations (the R-plan attached).

I trust that this would address your question. Please let us know if you have any further questions or concerns.

Best Regards,
Avid

Avid Banihashemi
Environmental Project Manager
R.J. Burnside & Associates Limited | www.rjburnside.com
Office: 800-265-9662 Direct: 226-486-1562

From: Van de Valk, Jackie (OMAFRA) [mailto:Jackie.VandeValk@ontario.ca]
Sent: Monday, October 30, 2017 12:10 PM
To: grandvalleymp <grandvalleymp@rjburnside.com>
Cc: jwilson@townofgrandvalley.ca
Subject: RE: Grand Valley Master Plan - Notice of Public Information Centre

Grand Valley EA Study Team,

Thanks for the information below and in your email attachment.

I do not see any study area boundaries outlined on the PIC notice attachment map. Does that mean that the study area is intended to be the entire area depicted on the map?

From a mitigation of impacts to agriculture perspective, it is preferred that any future development related to this project **not** be located on prime agricultural land as identified in the Town of Grand Valley Official Plan.

Jackie

Jackie Van de Valk, P.Ag., Rural Planner
Land Use & Policy Stewardship
Ontario Ministry of Agriculture, Food and Rural Affairs
10 – 6484 Wellington Road 7, Elora, ON N0B 1S0 ● Tel: 519.846.3415

From: Porchae Baird [mailto:Porchae.Baird@rjburnside.com]
Sent: October 30, 2017 11:48 AM
To: Van de Valk, Jackie (OMAFRA)
Subject: Grand Valley Master Plan - Notice of Public Information Centre

Good Morning,

Thank you for your interest in the Grand Valley Water and Wastewater Servicing Master Plan. Attached is a Notice of the upcoming Public Information Centre.   We welcome you to attend, but if you unable to be there the display boards will be posted on the Town's website on the day following the Public Information Centre, found under the tab "Official Plan, Zoning and Planning Documents" in the Doing Business section of the website.

If you would like to ask any questions or provide comments, please email grandvalleymp@rjburnside.com. We request that your comments be received by December 1, 2017.

Best regards
Grand Valley EA Study Team

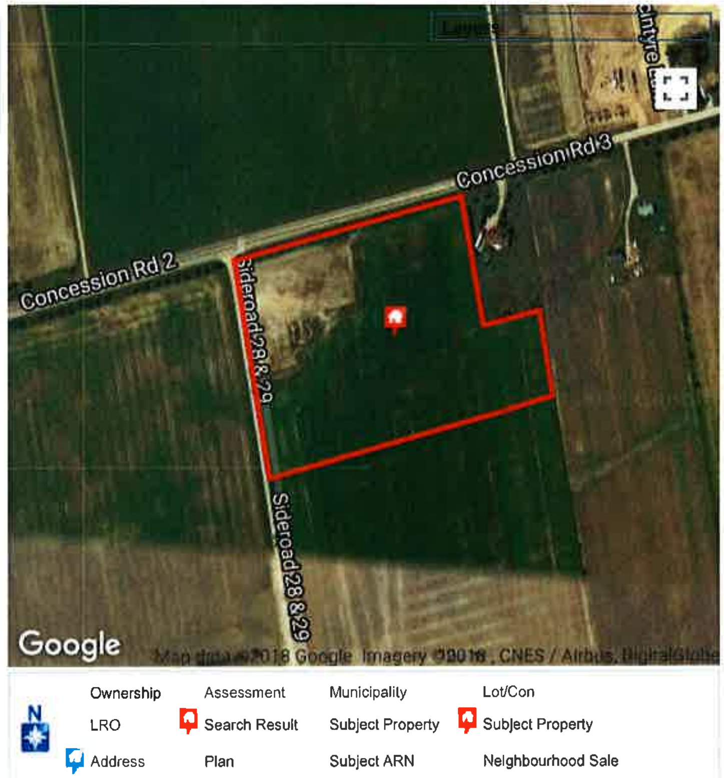
BURNSIDE
Porchae Baird, MSc
Environmental Scientist

R.J. Burnside & Associates Limited
292 Speedvale Avenue West, Unit 20, Guelph, Ontario N1H 1C4
Office: 800-265-9662   Direct: 519.938.3058
www.rjburnside.com

N/A

GRAND VALLEY | ACTIVE | PIN 340690428

Search By Block | Enhanced Report | GeoWarehouse Store



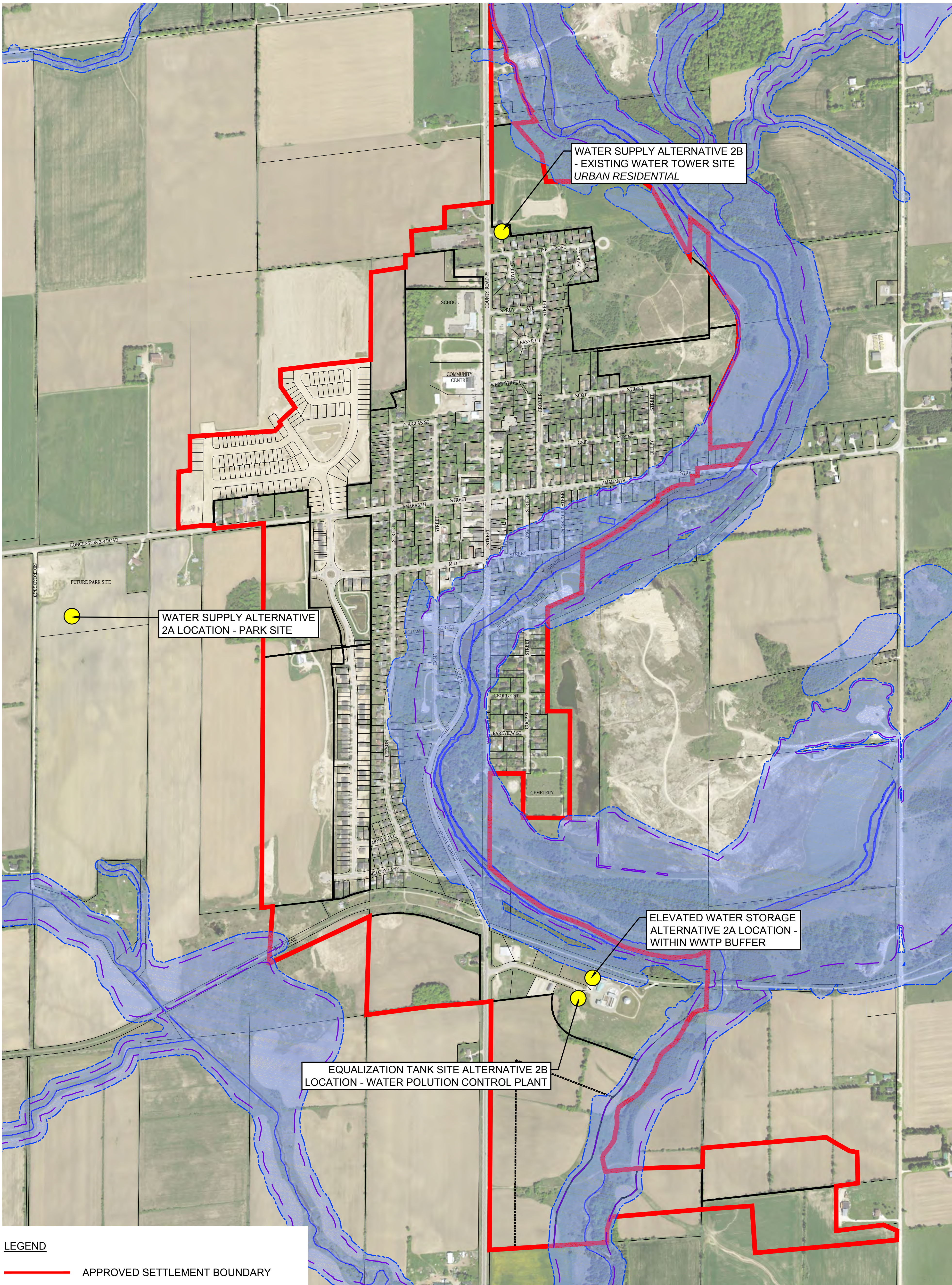
Land Registry Information - PIN: 340690428

Print Store Parcel Register

Address:	N/A				
Municipality:	GRAND VALLEY	LRO:	07	Area:	62,046 m2
Land Registry Status:	ACTIVE	Registration Type:	LT	Perimeter:	1,078 m
Description:	PT LOT 29, CON 2 BEING PTS 1 & 2, 7R6134 TOWNSHIP OF EAST LUTHER GRAND VALLEY				
Party To:	THE CORPORATION OF THE TOWN OF GRAND VALLEY;				

Sales History Information

DATE:	TYPE:	AMOUNT:
01/23/2013	T	$0
PARTY TO:	THE CORPORATION OF THE TOWN OF GRAND VALLEY;	



LEGEND

- APPROVED SETTLEMENT BOUNDARY
- REGULATION LIMITS (GRCA)
- FLOODPLAIN (GRCA)
- WATERCOURSE

N

0 200 400 600 800
Metres

BURNSIDE

Figure Title

GRAND VALLEY MASTER PLAN ENVIRONMENTAL ASSESSMENT

MINISTRY OF AGRICULTURE RESPONSE
PRELIMINARY PREFERRED ALTERNATIVES

Client	Drawn	Checked	Date	Figure No.
TOWN OF GRAND VALLEY	CD	AVHJ	May 2018	1
	Scale: 1:10,000		Project No.: 300040938.0000	

File: \\ELMO\Shared Work Areas\040938_Grand Valley EA\02_Production\040938 Grand Valley EA Agricultural Response Figures.dwg Date Plotted: May 3, 2018 - 11:35 AM

SCHEDULE				
PART	LOT	PLAN/CON	PIN	AREA Ha.
1	PART OF LOT 29	CONCESSION 2 (TOWNSHIP OF EAST LUTHER)	PART OF PIN 34069-0278	0.13 Ha.
2				6.07 Ha.

I REQUIRE THIS PLAN TO BE DEPOSITED UNDER THE LAND TITLES ACT.

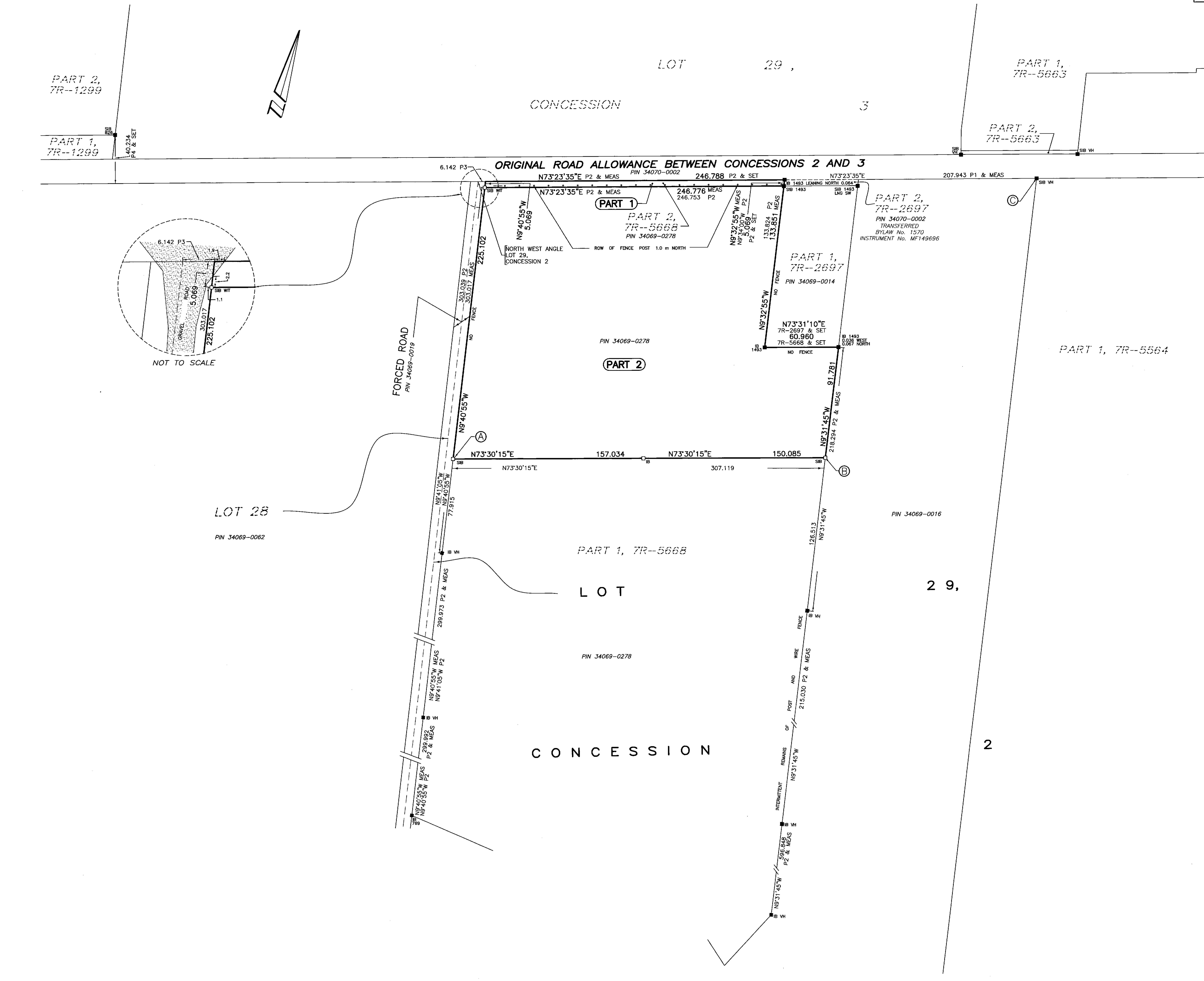
DATE: JANUARY 16, 2013

RON MAK
ONTARIO LAND SURVEYOR

PLAN 7R- 6134
RECEIVED AND DEPOSITED

DATE: January 16, 2013

Cathy Norman
REPRESENTATIVE FOR THE LAND REGISTRAR FOR THE LAND TITLES DIVISION OF DUFFERIN No. 7



PLAN OF SURVEY OF PART OF LOT 29, CONCESSION 2

(GEOGRAPHIC TOWNSHIP OF EAST LUTHER)
TOWN OF GRAND VALLEY
COUNTY OF DUFFERIN

SCALE 1 : 1500
0 25 50 75 metres
VAN HARTEN SURVEYING INC.

BEARING AND COORDINATE NOTE:

1. BEARINGS ARE GRID BEARINGS AND ARE DERIVED FROM GPS OBSERVATIONS AND ARE REFERRED TO THE UTM PROJECTION, ZONE 17, NAD 83 (CSRS-2002) ADJUSTMENT.
2. DISTANCES SHOWN ON THIS PLAN ARE ADJUSTED GROUND DISTANCES AND CAN BE CONVERTED TO GRID DISTANCES BY MULTIPLYING BY AN AVERAGED COMBINED SCALE FACTOR OF 0.999568.
3. COORDINATES ON THIS PLAN ARE UTM, ZONE 17, NAD83 (CSRS-2002) ADJUSTMENT AND ARE BASED ON GPS OBSERVATIONS FROM A NETWORK OF PERMANENT GPS REFERENCE STATIONS.

UTM COORDINATES (METRES)		
POINT ID	NORTHING	EASTING
A	4,860,299.20	553,843.79
B	4,860,386.37	554,138.14
C	4,860,655.91	554,240.73
THESE COORDINATE VALUES COMPLY WITH SECTION 14(2) O.REG 216/10. THESE COORDINATES CANNOT, IN THEMSELVES, BE USED TO RE-ESTABLISH THE CORNERS OR BOUNDARIES SHOWN ON THIS PLAN.		

BEARING COMPARISONS:

FOR THE PURPOSES OF BEARING COMPARISONS, PREVIOUS SURVEYS HAVE BEEN ROTATED TO UTM BEARINGS BY THE ANGLES SHOWN BELOW.

PLAN	ROTATION FOR NORTHEAST BEARINGS
P2	-1°35'40"

SURVEYOR'S CERTIFICATE

I CERTIFY THAT:

1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE LAND TITLES ACT AND THE REGULATIONS MADE UNDER THEM.
2. THIS SURVEY WAS COMPLETED ON THE 24TH DAY OF AUGUST 2012.

DATE: JANUARY 16, 2013

RON MAK
ONTARIO LAND SURVEYOR

LEGEND:

—□—	DENOTES SURVEY MONUMENT SET
—■—	DENOTES SURVEY MONUMENT FOUND
SIB	DENOTES .025 x .025 x 1.20 STANDARD IRON BAR
IB	DENOTES .015 x .015 x 0.60 IRON BAR
SSIB	DENOTES .025 x .025 x 0.60 SHORT STANDARD IRON BAR
RP	DENOTES .015 DIA. X 0.07 ROUND IRON BAR WITH STAMPED WASHER
PB	DENOTES .025 x .025 x 0.30 PLASTIC BAR
CC	DENOTES CUT CROSS
WIT	DENOTES WITNESS
OU	DENOTES ORIGIN UNKNOWN
VH	DENOTES VAN HARTEN SURVEYING INC., O.L.S.'s
1493	DENOTES YOUNG & YOUNG, O.L.S
826	DENOTES MINOS B. WONG, O.L.S.'s
P1	DENOTES PLAN OF SURVEY BY VAN HARTEN INC., O.L.S.'S DATED AUGUST 7, 2012
P2	DENOTES PLAN 7R-5668
P3	DENOTES PLAN OF SUREVY BY LLYOD I. THOMSON, O.L.S DATED MARCH 29, 1961 ATTACHED TO INSTRUMENT No. MF23618
P4	DENOTES PLAN 7R-1299
o	DENOTES FENCE POST

METRIC: DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

Van Harten
SURVEYING INC.
LAND SURVEYORS and ENGINEERS

423 WOOLWICH STREET
GUELPH, ONTARIO NIH 3X3
PHONE: 519-821-2763
FAX: 519-821-2770
www.vanharten.com

660 RIDDELL ROAD, UNIT 1
ORANGEVILLE, ONTARIO L9W 5G5
PHONE: 519-940-4110
FAX: 519-940-4113
www.vanharten.com

DRAWN BY: TDM | CHECKED BY: AJM | PROJECT No. 17479-07

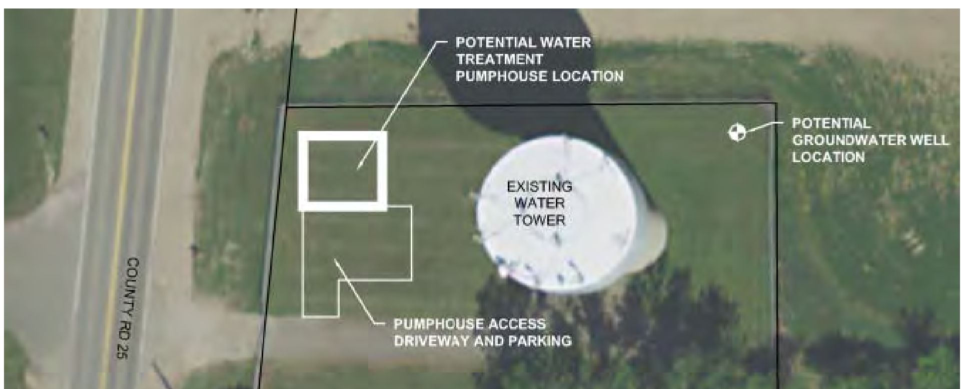
Jan 15,2013-4:26pm
L:\East Luther\Con2\acad\RP-LOT 29 (RODDA) 17479-07 UTM.dwg

SUMMARY OF PRELIMINARY PREFERRED ALTERNATIVES

Water Supply at Park Site

Infrastructure	Preferred Alternative
Water Supply	• Groundwater Wells • Two preferred locations (Park Site and Existing Water Tower)
Water Storage	• Elevated Water Storage in the form of a water tower or composite elevated tank • Location – Within the Existing WPCP Buffer
Wastewater Treatment	• **Interim Solution**: Plant Rerating and Construction of an Equalization Tank at the WPCP • **Long Term Solution**: Expansion of existing WPCP

EQ Tank at Water Pollution Control Plant



Water Supply at Existing Water Tower Site

Elevated Water Storage Within Water Pollution Control Plant Buffer

Tricia Radburn

From: Van de Valk, Jackie (OMAFRA) <Jackie.VandeValk@ontario.ca>
Sent: Monday, October 30, 2017 12:10 PM
To: grandvalleymp
Cc: jwilson@townofgrandvalley.ca
Subject: RE: Grand Valley Master Plan - Notice of Public Information Centre

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10 – 6484 Wellington Road 7, Elora, ON N0B 1S0 ● Tel: 519.846.3415

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Best regards
Grand Valley EA Study Team

BURNSIDE
Porchae Baird, MSc
Environmental Scientist

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292 Speedvale Avenue West, Unit 20, Guelph, Ontario N1H 1C4
Office: 800-265-9662 Direct: 519.938.3058
www.rjburnside.com

****

Shannon Glassford

From:	Gord Feniak
Sent:	Wednesday, March 06, 2019 5:48 PM
To:	Tom Krizsan
Cc:	Jane Wilson (jwilson@townofgrandvalley.ca); Jeff Paznar
Subject:	Grand Valley EA

Hi Tom - We are just finishing up our report for the Grand Valley Water and Wastewater Servicing Master Plan and have reviewed all correspondence. Although I have discussed your letter of November 15, 2017 with you we have not sent a written reply and I am taking this opportunity to do so. Your letter suggested that we extend our target population from that in the current Official Plan, which is 6,145 people, to a greater number such as a projection into the years 2036 or 2041. I couldn't agree more with the concept of building for the future. However, we are restricted by a number of requirements that we must meet;

- It has taken longer to gain approvals for the Master Plan than originally scheduled and the time consuming part came in the determination of Assimilative Capacity of the Grand River. The approval that was eventually gained was premised on a flow projection which in turn was derived from the Official Plan population. In my opinion it would have caused further delay and required more resources to secure approval for a larger population.

- Section 24(1) of the Planning Act, which is titled "Public works and by-laws to conform with plan", states "*Despite any other general or special Act, where an official plan is in effect, no public work shall be undertaken and, except as provide in subsections (2) and (4), no by-law shall be passed for any purpose that does not conform therewith."* While subsection (3) allows the study of future infrastructure it prohibits any such construction. The design of the upgrades to the wastewater plant will consider ease of expandability when future amendments to the Official Plan come into effect.

- We are in the Class Environmental Assessment process, which begins with a "Problem Statement". We are following the typical approach whereby the "problem" is the question of how to properly service a population that has been approved in the Official Plan. There is no speculation on what may or may not be approved from a planning perspective and the location of the growth has been finalized. While the location is not important in decisions relating to the wastewater plan, it is important in the other services being considered in the Master Plan such as fire flows needed for the water tower design and pumping stations for wastewater collection. It would be presumptuous of us to make assumptions beyond the approved Official Plan.

- The municipality has no assured mechanism for cost recovery of oversizing infrastructure beyond the needs of the Official Plan.

We appreciate your input and trust that this confirms our previous discussion. Please feel free to contact me if you would like to discuss it further…..gf

BURNSIDE
Gord Feniak

R.J. Burnside & Associates Limited
15 Townline, Orangeville, Ontario L9W 3R4
Office: +1 800-265-9662 Direct: +1 519-938-3076
www.rjburnside.com

****

BURNSIDE
[THE DIFFERENCE IS OUR PEOPLE]

Appendix G

XCG's January 2017 Report

Grand Valley WPCP Re-Rating Feasibility Study: Summary of Capacity Assessment and Re-Rating Potential

XCG CONSULTING LIMITED
T 905 829 8880 F 905 829 8890 | toronto@xcg.com
2620 Bristol Circle, Suite 300, Oakville, Ontario, Canada L6H 6Z7

XCG File No.: 3-252-57-01
January 24, 2017

GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY
SUMMARY OF CAPACITY ASSESSMENT AND RE-RATING POTENTIAL

Prepared for:

TOWN OF GRAND VALLEY
5 Main Street, North
Grand Valley, Ontario
L9W 5S6

Attention: Jane Wilson

Prepared by:

XCG CONSULTING LIMITED
Suite 300, 2620 Bristol Circle
Oakville, Ontario
L6H 6Z7

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FIGURES

APPENDICES

1. INTRODUCTION

1.1 Background

The Grand Valley WPCP provides treatment for wastewater generated in the community of Grand Valley within the Town of Grand Valley (Town). The plant is currently operated by the Ontario Clean Water Agency (OCWA) under the Ministry of Environment and Climate Change (MOECC) Certificate of Approval (C of A) No. 9706-7KWQ57, issued on February 2, 2009. The quality and quantity of effluent currently discharged by the existing WPCP is regulated by the C of A. The Grand Valley WPCP has a rated average capacity of 1,244 m^3/d.

XCG recently completed an update to the Assimilative Capacity Study to propose effluent limits associated with an increase in the rated capacity to 2,547 m^3/d. The proposed effluent limit associated with total phosphorus (TP) for this increased capacity was very low at 0.073 mg/L. Consistently achieving such low TP concentrations requires enhanced tertiary treatment, such as dual-stage tertiary filtration or membrane ultrafiltration. Upgrading the Grand Valley WPCP to provide this level of treatment would require a significant capital expenditure.

At this time, the Town would like to investigate the potential to re-rate the existing WPCP to provide additional treatment capacity and to defer the facility's next upgrade and expansion. As such, the Town has retained XCG to undertake a capacity assessment of the Grand Valley WPCP to evaluate the potential for plant re-rating.

1.2 Approach

Re-rating of the Grand Valley WPCP could be completed as a Schedule A activity under the requirements of the Municipal Class Environmental Assessment (Class EA) process (MEA, 2015) as defined in the Class EA document, provided it can meet the following conditions:

"Increase sewage treatment plant capacity beyond existing rated capacity through improvements to operations and maintenance activities only, but without construction of works to expand, modify or retrofit the plant or the outfall to the receiving water body, with no increase to total mass loading to receiving water body as identified in the Certificate of Approval."

As such, final effluent design requirements were developed to establish the effluent concentrations that the existing facility must produce to maintain effluent loadings that are equal to or less than the existing C of A effluent loadings. The capacity of the existing treatment processes was evaluated based on its ability to treat future projected flows and loads while achieving projected effluent quality requirements.

1.3 Objectives

XCG was retained by the Town to undertake a capacity assessment of the Grand Valley WPCP to investigate a plant capacity re-rating. The specific objective of this report is to provide a brief summary of the estimated treatment capacity of the Grand Valley WPCP, and to discuss the feasibility of re-rating of the Grand Valley WPCP, including implications of the Municipal Class EA process.

2. DESIGN BASIS

The future design basis was developed to project raw wastewater flows and loads transferred to the Grand Valley WPCP from the collection system via the Emma St. SPS at several future annual average day flow scenarios. For the purposes of developing this design basis, flows and loadings were developed for three scenarios, details of which are presented briefly below.

- Scenario I: Full completion of planned residential developments;
- Scenario II: A 15% increase above the current C of A rated ADF (1,430 m^3/d); and,
- Scenario III: A 25% increase above the current C of A rated ADF (1,555 m^3/d).

The original design basis, completed November 2015, considered plant operational data collected between 2012 and 2014 (XCG, 2015). This design basis was subsequently updated with additional plant operational data collected between January 2015 and May 2016 (XCG, 2016). A summary of the previous and updated design basis is provided in Table 2.1.

Table 2.1 Summary of Design Basis

Parameter	Scenario I		Scenario II		Scenario III	
	Previous	Updated	Previous	Updated	Previous	Updated
Population	2,919	2,919	3,260	3,252	3,536	3,527
ADF	1,276 m^3/d	1,279 m^3/d	1,430 m^3/d		1,555 m^3/d	
MDF	5,828 m^3/d	5,839 m^3/d	6,165 m^3/d	6,169 m^3/d	6,439 m^3/d	6,442 m^3/d
MDF Factor	4.6		4.3		4.1	
PIF	7,811 m^3/d	7,811 m^3/d	8,303 m^3/d	8,291 m^3/d	8,695 m^3/d	8,684 m^3/d
PIF Factor	6.1		5.8		5.6	
BOD_5						
Avg. Load	186 kg/d	200 kg/d	211 kg/d	225 kg/d	232 kg/d	245 kg/d
Max Load	353 kg/d	379 kg/d	402 kg/d	427 kg/d	441 kg/d	466 kg/d
Avg. Conc.	146 mg/L	156 mg/L	148 mg/L	157 mg/L	149 mg/L	158 mg/L
TSS						
Avg. Load	239 kg/d	268 kg/d	269 kg/d	298 kg/d	294 kg/d	322 kg/d
Max Load	453 kg/d	509 kg/d	512 kg/d	566 kg/d	559 kg/d	613 kg/d
Avg. Conc.	187 mg/L	210 mg/L	188 mg/L	208 mg/L	189 mg/L	208 mg/L
TKN						
Avg. Load	47.9 kg/d	49.3 kg/d	53.4 kg/d	54.7 kg/d	57.9 kg/d	59.1 kg/d
Max Load	91.1 kg/d	93.7 kg/d	104 kg/d	104 kg/d	110 kg/d	112 kg/d
Avg. Conc.	37.6 mg/L	38.6 mg/L	37.4 mg/L	38.2 mg/L	37.2 mg/L	38.0 mg/L
TP						
Avg. Load	5.72 kg/d	6.21 kg/d	6.43 kg/d	6.91 kg/d	7.01 kg/d	7.48 kg/d
Max Load	12.6 kg/d	13.7 kg/d	14.2 kg/d	15.2 kg/d	15.4 kg/d	16.5 kg/d
Avg. Conc.	4.48 mg/L	4.85 mg/L	4.50 mg/L	4.83 mg/L	4.51 mg/L	4.81 mg/L

It is important to note that the projected peak instantaneous flow for each scenario is in excess of the rated capacity of the Emma St. SPS. Analysis suggests the Emma St. SPS may require upgrades to accommodate future flows if peak flows cannot be abated by any I/I reduction strategies. An extensive review of the Emma St. SPS was not conducted as part of this analysis.

Final effluent design requirements were developed to establish the effluent concentrations that the existing facility must produce to maintain effluent loadings that are equal to or less than the existing C of A effluent loadings. Table 2.2 presents the existing effluent loading limits for the C of A rated capacity of 1,244 m^3/d. Also shown are the associated effluent concentration limits for the Grand Valley WPCP at the each of the three scenarios.

Table 2.2 Effluent Concentration Limits for a Re-rated Grand Valley WPCP

Parameter	Existing C of A	Scenario I	Scenario II	Scenario III
	Loading Limit (kg/d)	Concentration Limit (mg/L)	Concentration Limit (mg/L)	Concentration Limit (mg/L)
ADF	1,244 m^3/d	1,273 m^3/d	1,430 m^3/d	1,555 m^3/d
$cBOD_5$	12.4	9.7	8.7	8.0
TSS	12.4	9.7	8.7	8.0
TP	0.19	0.15	0.13	0.12
TAN				
Winter	4.98	3.9	3.5	3.2
Spring	1.24	1.0	0.9	0.8
Summer	0.87	0.7	0.6	0.6
Fall	1.24	1.0	0.9	0.8

Notes:
Existing loading and concentration limits based on monthly average values.

The C of A defines compliance limits for *E. coli* and pH. The limit for *E. coli* is 200 organisms/100 mL and pH must be maintained within the range of 6.0 to 9.5. It is expected that these requirements would remain the same for a re-rated Grand Valley WPCP.

3. CAPACITY ASSESSMENT SUMMARY

3.1 Capacity of the Existing Grand Valley WPCP

To facilitate comparison between treatment units, the equivalent average day flow capacity of all treatment processes was calculated using information from the updated projected design basis. The attenuation of future peak flows by the existing storm tank was considered, where applicable.

A summary of the equivalent ADF capacity of each treatment processes is given in Table 3.1. A visual representation of this information is included as Figure 3.1. Complete details of the Grand Valley WPCP capacity assessment is included in Appendix A.

Table 3.1 Capacity Assessment Summary

Treatment Unit	Capacity Assessment			
	Average Day Flow	Maximum Day Flow	Peak Flow	Equivalent Average Day Flow
Screens	-	-	9,650 m^3/d	1,555 m^3/d
Grit Removal	-	-	7,680 m^3/d	1,371 m^3/d
Biological Treatment	1,582 m^3/d	-	-	1,582 m^3/d
Oxygenation	1,713 m^3/d	-	-	1,713 m^3/d
Secondary Clarifiers (SOR)	-	-	4,388 m^3/d	952 m^3/d
Secondary Clarifiers (SLR)	-	5,203 m^3/d	-	1,146 m^3/d
Tertiary Filters	-	-	5,300 m^3/d	1,169 m^3/d
UV Disinfection	-	-	7,680 m^3/d	1,371 m^3/d

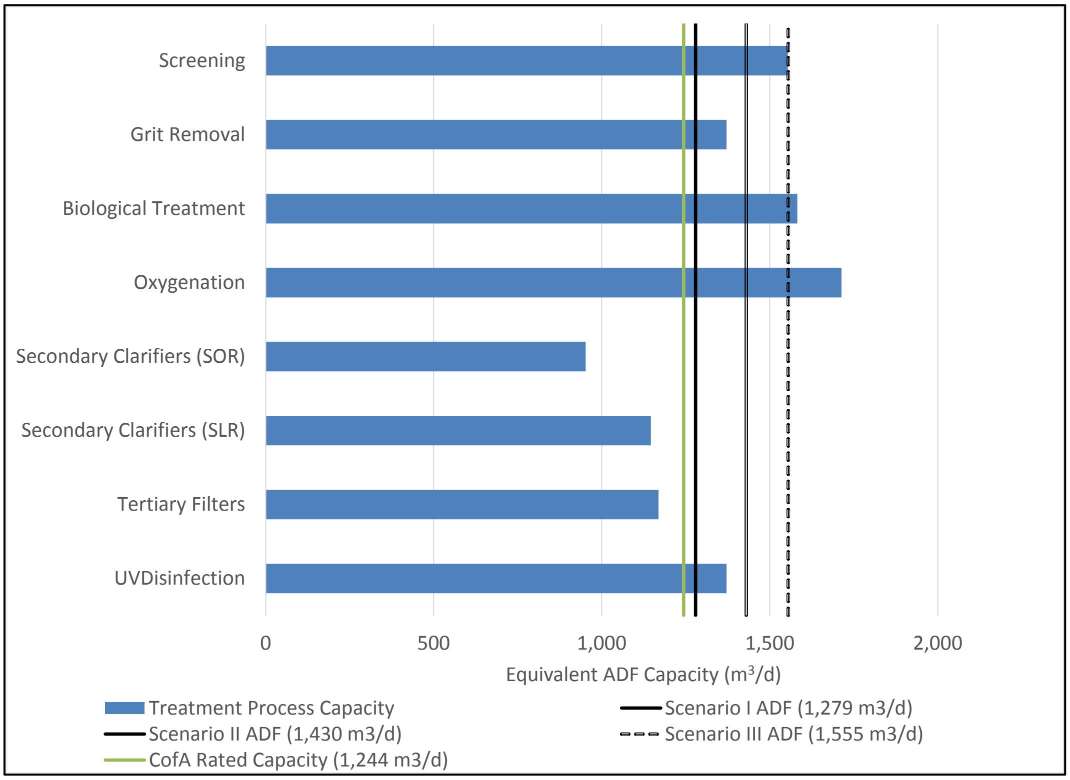

Figure 3.1 Summary of Grand Valley WPCP Capacity

Based on results presented above, the capacity of several treatment processes at the Grand Valley WPCP may be limited by maximum day and peak hour flows to the treatment plant. Projected peak flows are driven by a single extreme peak flow event recorded during the review period (April 2014). Although significantly greater in magnitude that other peak flow events over the review period, this peak flow event cannot be excluded from analysis due, in part, to uncertainty in flow data collected by OCWA at the Grand Valley WPCP, the limited data set which was available for analysis (dating back to only 2012), and the increasing frequency of extreme weather events. As such, based on the estimated capacity of existing treatment processes, re-rating of the Grand Valley WPCP as a Schedule A activity under the Municipal Class EA process is not feasible.

3.2 Impact of Additional Equalization

The construction of additional equalization volume in Grand Valley would reduce peak flows to the Grand Valley WPCP. There are two locations which additional equalization could be constructed in Grand Valley; at the Emma St. SPS and/or onsite at the Grand Valley WPCP. Construction of additional equalization at the Emma St. SPS reduces peak flow in the forcemain between the pumping station and the treatment plant, and through the headworks at the treatment plant. Therefore, to avoid the potential of additional required upgrades to the forcemain, it was assumed equalization volume would be installed at the Emma St. SPS. A thorough analysis and conceptual level design of the construction of additional equalization at the Emma St.

SPS is included as Appendix B. It is important to note that optimization of the equalization location and volume would be completed during the detailed design.

The possible impact of additional equalization on the estimated equivalent ADF capacity of each treatment process is summarized in Table 3.2. This information is shown visually in Figure 3.2. Results show that the construction of additional equalization can provide sufficient capacity to treat projected Scenario III flows and loads thereby making it feasible to pursue a plant re-rating to increase the rated capacity up to an ADF capacity of 1,555 m^3/d.

It is important to note that this analysis has evaluated the capacity of treatment processes in the liquid treatment train. If plant re-rating is pursued, additional analysis of the solids treatment train would be required, including evaluation of the existing treatment capacity and strategies to handle future sludge flows.

Table 3.2 Impact of Additional Equalization on the Grand Valley WPCP Capacity Assessment

Treatment Unit	Capacity Assessment	
	Existing Equivalent ADF	Equivalent ADF with Additional Equalization
Screens	1,555 m^3/d	3,466 m^3/d
Grit Removal	1,371 m^3/d	2,758 m^3/d
Biological Treatment	1,582 m^3/d	1,582 m^3/d
Oxygenation	1,713 m^3/d	1,713 m^3/d
Secondary Clarifiers (SOR)	952 m^3/d	1,576 m^3/d
Secondary Clarifiers (SLR)	1,146 m^3/d	1,728 m^3/d
Tertiary Filters	1,169 m^3/d	1,763 m^3/d
UV Disinfection	1,371 m^3/d	2,758 m^3/d

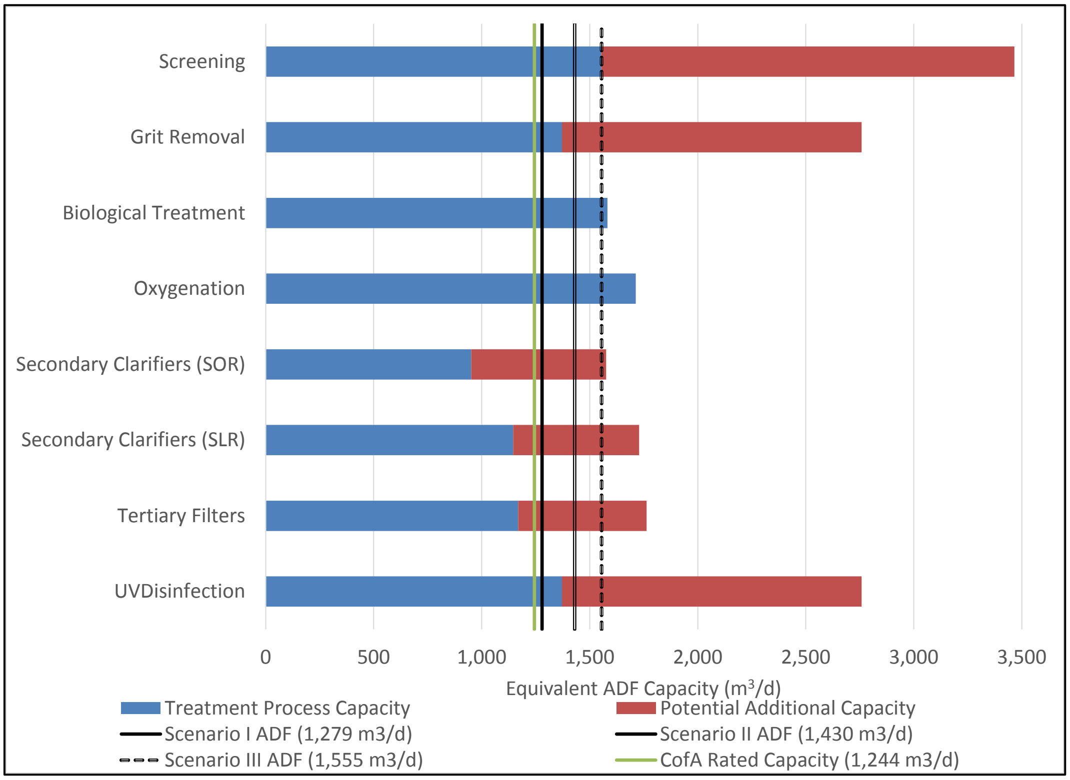

Figure 3.2 Impact of Additional Equalization on the Estimated Treatment Capacity at the Grand Valley WPCP

Installation of additional equalization volume can be carried out as a Schedule B activity under the Municipal Class EA Process as per the following text:

"Establish sewage flow equalization tankage in existing sewer system or at existing sewage treatment plants, or at existing pumping stations for influent and/or effluent control"

As a Schedule B project, Phase 1 and Phase 2 of the Class EA process must be completed prior to implementation of the project (i.e. construction). Brief requirements of each Phase are given below.

Phase 1

During this phase, the problem or opportunity must be identified and described. Projects which are expected to generate significant public interest can also begin the public consultant process.

Phase 2

During this phase, potential alternative solutions will be identified and evaluated. Solutions will consider the size (volume) and location of additional equalization. This Phase will also include mandatory consultation with relevant review agencies and other stakeholders (e.g. MOECC, GRCA, First Nations, etc.) and the public.

At the completion of Phase 2, the entire planning process (i.e. Phase 1 and Phase 2 activities) will be summarized and placed on file for a period of 30 days. A notice of completion will be issued to review agencies and to the public.

Assuming no request for an Order is received during the review period, the Town may proceed with the design and construction of the equalization tank. Detailed design of the equalization tank would need to consider the integration of the equalization tank into the existing infrastructure in the Town of Grand Valley. Specifically, detailed design would establish the following:

- Type and location of the tank (e.g. glass fused steel storage tank located primarily above ground, rectangular cement tank located above ground or below ground, etc.);
- Additional treatment processes required upstream of the equalization tank (e.g. communitor, etc.);
- Regular maintenance required of the equalization tank (e.g. washing, etc.) and provisions to allow for required maintenance;
- Integration into the existing infrastructure, including the reuse of existing pumps and piping where possible; and,
- Evaluation of existing utilities and standby power on the site.

For purposes of this conceptual level design, it is assumed a circular glass fused steel storage tank would be installed at the Emma St. SPS. A conceptual level site layout of equalization at the Emma St. SPS is included as Figure 3.3 and indicates that the site has sufficient space for construction of the equalization tank. Exact dimensions of the equalization tank and the optimal location on the site would be finalized during the detailed design.

Figure 3.3 Overview of Conceptual Level Layout for Equalization at the Emma St. SPS

Conceptual level capital costs were estimated for the installation of additional equalization volume at the Emma St. SPS. Conceptual level capital costs include installation the equalization tank, as well as allowances for excavation, piping, installation of a tank cleaning mechanism, and electrical works. These additional considerations are critical for the integration of the equalization tank into the existing infrastructure and SCADA system.

For purposes of this investigation, two equalization options were developed and evaluated. Details of each equalization option is included in Table 3.3.

Table 3.3 Summary of Equalization Options

Option	Details
Option 1	• Provide sufficient equalization volume to facilitate re-rating of the Grand Valley WPCP to the Scenario I flows and loads.
Option 2	• Provide sufficient equalization volume to facilitate re-rating of the Grand Valley WPCP to the Scenario III flows and loads.

Conceptual level costs are generally considered to be accurate to -25% to +40%. Actual costs will depend on site specific factors, such as soil and groundwater conditions, the engineering design applied, construction conditions at the time of tendering, and the extent of additional upgrades to the works that may be included in the final design. Capital costs include a 30% allowance for contingency and a 12%

allowance for engineering and approvals. A summary of conceptual level capital costs for the two equalizations options are summarized in Table 3.4.

Table 3.4 Summary of Conceptual Level Capital Cost Estimates for Equalization at the Emma St. SPS

Item	Option 1 (Sufficient Capacity for Scenario I Flows)	Option 2 (Sufficient Capacity for Scenario III Flows)
General/Miscellaneous	$130,000	$155,000
Equalization Tank	$1,302,000	$1,545,000
Sub Total	$1,432,000	$1,700,000
Contingency (30%)	$429,000	$510,000
Engineering (12%)	$172,000	$204,000
Estimated Equalization Capital Costs (1)	**$2,033,000**	**$2,414,000**

Notes:
1. All costs are conceptual level opinions of probable costs and are considered to be accurate to within -25 to +40 percent and are exclusive of HST.

4. SUMMARY AND CONCLUSIONS

Based on the capacity assessment of the Grand Valley WPCP, and on projections of future flows and loadings, the capacity of the liquid treatment train is limited by the peak flow treatment capacity. Due to these existing limitations, re-rating the Grand Valley WPCP is not a feasible option at this time.

Through installation of additional equalization at the Emma St. SPS, peak flows to the plant could be reduced, thereby making it feasible to pursue a plant re-rating, potentially up to an ADF capacity of 1,555 m^3/d. Additional analysis of the solids treatment train would be required if plant re-rating is pursued.

Construction of additional equalization volume would be carried out as a Schedule B activity under the Municipal Class EA process, therefore requiring an evaluation of alternative solutions and consultation with the public and with relevant review agencies.

A high level assessment of equalization options was completed, and there appears to be sufficient space at the existing Emma St. SPS to construct additional equalization. Estimated costs for equalization will depend on several factors, including the type of equalization tank selected and additional equipment required to integrate the equalization tank into existing infrastructure.

The estimated costs for equalization ranged from approximately $2.03 million to $2.41 million.

APPENDIX A

GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY CAPACITY EVALUATION

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XCG File No.: 3-252-57-01
January 24, 2017

GRAND VALLEY WATER POLLUTION CONTROL PLANT CAPACITY EVALUATION

Prepared for:

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1. INTRODUCTION

1.1 Background

The Grand Valley WPCP provides treatment for wastewater generated in the community of Grand Valley within the Town of Grand Valley (Town). The plant is currently operated by the Ontario Clean Water Agency (OCWA) under the Ministry of Environment and Climate Change (MOECC) Certificate of Approval (C of A) No. 9706-7KWQ57, issued on February 2, 2009. The quality and quantity of effluent currently discharged by the existing WPCP is regulated by the C of A. The Grand Valley WPCP has a rated average capacity of 1,244 m^3/d.

XCG recently completed an update to the Assimilative Capacity Study to propose effluent limits associated with an increase in the rated capacity to 2,547 m^3/d. The proposed effluent limit associated with total phosphorus (TP) for this increased capacity was very low at 0.073 mg/L. Consistently achieving such low TP requirements requires enhanced tertiary treatment, such as dual-stage tertiary filtration or membrane ultrafiltration. Upgrading the Grand Valley WPCP to provide this level of treatment would require a significant capital expenditure.

At this time, the Town would like to investigate the potential to re-rate the existing WPCP to provide additional treatment capacity and to defer the facility's next upgrade and expansion. As such, the Town has retained XCG to undertake a capacity assessment of the Grand Valley WPCP to support a plant capacity re-rating.

1.2 Objectives

XCG was retained by the Town to undertake a capacity assessment of the Grand Valley WPCP to investigate a plant capacity re-rating. The specific objectives of this technical memorandum are to:

1. Conduct a review of historic plant performance.
2. Assess the capacity of treatment processes at the Grand Valley WPCP using typical design guideline values, desktop analytical methods, a BioWin™ process model, and results from field testing.
3. Determine the overall capacity of the Grand Valley WPCP.

2. EXISTING TREATMENT PROCESS

Raw sewage flows from the collection system are conveyed to the Grand Valley WPCP from the Emma St. sewage pumping station (SPS) via a forcemain. The Emma St. SPS is equipped with the following equipment:

- Two variable frequency drive (VFD) pumps (one duty and one standby), each with a rated capacity of 88.9 L/s (7,680 m^3/d).
- One VFD jockey pump with a rated capacity of 29.5 L/s (2,550 m^3/d).
- One wet will, with approximate volume of 125 m^3.

The jockey pump will not operate at peak flows. As such, the capacity of the Emma St. SPS is approximately 7,680 m^3/d. Over the review period (2012 to May 2016) there are no records of raw sewage bypassing at the Emma St. SPS or at the Grand Valley WPCP.

The Grand Valley WPCP receives septage at the septage receiving station. The septage receiving station removes solids from the raw septage using a comgination of grinding, washing, and dewatering. The septage is then discharged to the plant headworks, upstream of the plant screens.

Plant influent raw wastewater flow consists of wastewater from the following sources:

- Raw wastewater from the Emma St. SPS;
- Septage from the onsite receiving station;
- Tertiary filter backwash; and
- Digester supernatant.

Tertiary filter backwash and digester supernatant are transferred back to the head of the plant via an onsite pumping station. All flows are combined at the head of the plant, upstream of the plant headworks.

Headworks at the Grand Valley WPCP consists of a mechanical bar screen and two vortex grit separators. A manual screen also exists in parallel to the mechanical screen, and can be used as required. Headworks effluent flow is discharged to a splitter box, where flow is directed to the aeration tanks, or to a bypass channel. Sustained peak flows in excess of 64 L/s (5,530 m^3/d) for greater than 10 minutes will be directed to the bypass channel and into the 400 m^3 equalization tank. From the equalization tank, flow can be returned to the head of the plant through the onsite pumping station. Flows in excess of the equalization tank capacity are disinfected and discharged. There have been no recorded plant bypasses at the Grand Valley WPCP.

Secondary treatment at the Grand Valley WPCP consists of three aeration tanks and two secondary clarifiers. Oxygen is provided to each aeration tank through fine bubble diffusers. Alum is added immediately upstream of the secondary clarifiers for chemical phosphorus removal. Activated sludge is separated from the treated stream in the secondary clarifiers. Return activated sludge (RAS) is returned to the raw wastewater upstream of the aeration tanks. Waste activated sludge (WAS) is pumped to the aerobic digester located onsite. RAS and WAS are pumped from the same location in the secondary clarifier. Overflow from the secondary clarifiers is passed through one of four tertiary filters at the plant. Filter effluent is disinfected using ultraviolet (UV) radiation, then discharged to the Grand River. Waste activated sludge is digested and thickened onsite in the aerobic digester. Thickened sludge is pumped to the onsite biosolids storage tank, then trucked offsite for disposal.

Wastewater flow is measured at several locations at the plant. Raw wastewater from the collection system is metered at the Emma St. SPS. Wastewater flows from septage and the onsite pumping station are separately metered. Collectively, they represent the plant influent flow. Effluent flow from the Grand Valley WPCP is measured by a V-notch weir, downstream of the UV disinfection.

A summary of unit processes is included in Table 2.1, and flow schematic is presented in Figure 2.1.

Table 2.1 Grand Valley WPCP Unit Process Design Information

Unit Process	Design Parameter (1)
Preliminary Treatment	
Screening	
Type	Mechanical and Manual Bar
Number	1 mechanical (duty)
	1 bar (standby)
Peak Flow Capacity (mechanical screen)	7,680 m^3/d
Grit Removal	
Type	Vortex
Number	2
Capacity	3,840 m^3/d (each)
	7,680 m^3/d (total)
Flow Equalization Tank	
Number	1
Volume	400 m^3
Secondary Treatment	
Bioreactor Tanks	
Type	Rectangular, with fine bubble diffusers
Number	3
Dimensions (each)	25.0 m x 4.0 m x 4.0 m SWD
Operating Liquid Volume	400 m^3 (each)
	1,200 m^3 (total)
Secondary Clarifiers	
Number	2
Surface Area	75.4 m^2 (each)
	150.8 m^2 (total)
Return Activated Sludge Pumping	
Number	3
Capacity	1,244 m^3/d (each)
	3,732 m^3/d (total)

Unit Process	Design Parameter [1]
Waste Activated Sludge Pumping	
Number	2
Capacity	1,244 m^3/d (each) 2,488 m^3/d (total)
Tertiary Treatment	
Filters	
Type	Continuous up-flow, deep bed, granular media
Backwash	Continuous
Number	Four (4)
Filtration Area	4.65 m^2 (each) 18.6 m^2 (total)
Peak Flow Capacity	5,300 m^3/d
Aeration	
Blowers (Air Supply to Aeration Tanks)	
Number	3 (2 duty, 1 standby)
Capacity	858 m^3/h (each)
Type of Aeration	Fine bubble
Blowers (Air Supply to Primary and Secondary Digester)	
Number	2
Capacity	1,349 m^3/h (each)
Type of Aeration	Coarse bubble
Chemical Treatment	
Phosphorus Removal	
Chemical	Alum
Chemical Storage Tanks	1 x 240 L (day tank) 1 x 9,600 L (main storage tank)
Chemical Dosing Pumps	2 x 13.8 L/h (one duty, one standby) for dosage upstream of the secondary clarifiers 1 x 13.8 L/h for dosage to the equalization tank (when required) 2 x 2.5 L/h for dosage to the tertiary filtration feed channel (when required)
Disinfection	
Disinfection	
Type	UV Disinfection
Capacity	7,680 m^3/d
Sludge Management	
Aerobic Digestion	
Volume	500 m^3 (Primary Digester) 250 m^3 (Secondary Digester)
Digested Sludge Storage Tank	
Number	1
Capacity	2,200 m^3

Notes:
SWD - side water depth
TDH - total dynamic head
1. Based on Amended Certificate of Approval Number 9706-7KWQ57, issued February 2, 2009 and Grand Valley Wastewater Treatment Plant Operations Manual (RJ Burnside, 2015).

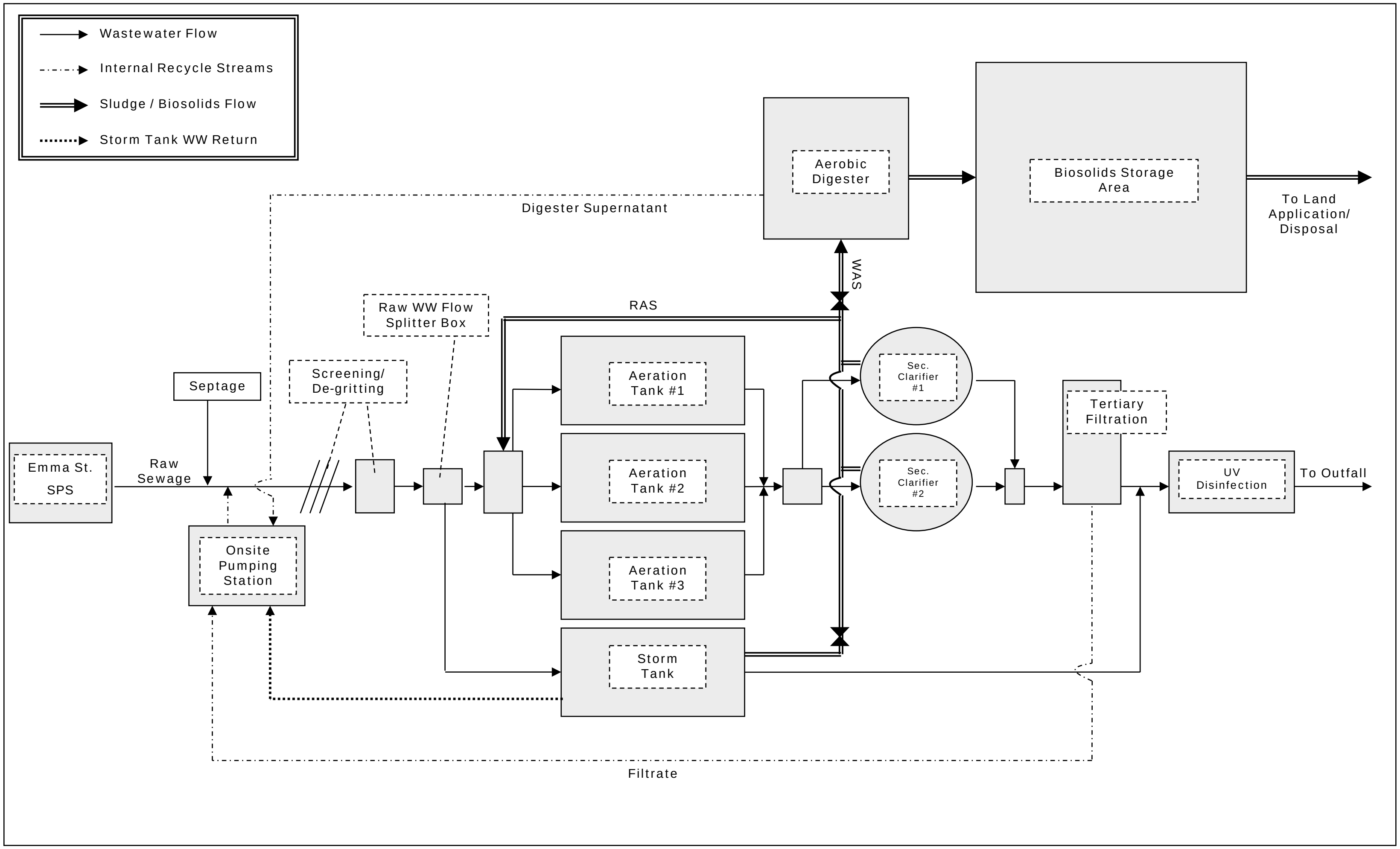

Figure 2.1 Process Flow Schematic – Grand Valley WPCP

3. FINAL EFFLUENT QUALITY

3.1 Treatment Objectives and Compliance Requirements

The Grand Valley WPCP has a rated ADF capacity of 1,244 m^3/d. It is operated under C of A No. 9706-7KWQ57 issued on February 2, 2009. The C of A specifies concentration objectives for carbonaceous biochemical oxygen demand ($cBOD_5$), total suspended solids (TSS), total phosphorus (TP), total ammonia nitrogen (TAN), and *E. coli*. Final effluent is also subject to monthly concentration compliance limits for $cBOD_5$, TSS, TP, TAN, *E. coli*, and pH. Monthly loading compliance limits are also specified for $cBOD_5$, TSS, TP, and TAN. Table 3.1 presents the C of A effluent requirements for the Grand Valley WPCP.

Table 3.1 Amended C of A Objectives and Compliance Limits

Parameter	Effluent Objectives	Effluent Compliance Limits	
	Concentration	Concentration	Total Loading
$cBOD_5$ (1)	8.0 mg/L	10 mg/L	12.4 kg/d
TSS (1)	8.0 mg/L	10 mg/L	12.4 kg/d
TP (1)	0.13 mg/L	0.15 mg/L	0.19 kg/d
TAN (1)			
Winter (Dec. 1 - Mar. 31)	3.0 mg/L	4.0 mg/L	4.98 kg/d
Spring (Apr. 1 - May 31)	0.8 mg/L	1.0 mg/L	1.24 kg/d
Summer (June 1 - Sep. 30)	0.6 mg/L	0.7 mg/L	0.87 kg/d
Fall (Oct. 1 - Nov. 30)	0.8 mg/L	1.0 mg/L	1.24 kg/d
E. coli (2)	100 organisms / 100 mL		
pH	6.0 – 9.5		

Notes:
1. Based on monthly average values.
2. Based on monthly geometric mean density.

3.2 Historical Final Effluent Quality

Table 3.2 and Table 3.3 present historical final effluent concentrations and loadings, respectively, from the Grand Valley WPCP, with maximum monthly average values shown in parentheses. For purposes of this evaluation, data collected between 2012 and May 2016 was analyzed. It is important to note, however, that the accuracy of influent and effluent flow data collected in 2015 cannot be confirmed. As such, effluent loads in 2015 cannot be calculated and have not been presented in Table 3.3. Additional details regarding the accuracy of flow measurement at the Grand Valley WPCP is included in the Updated Design Basis located in Appendix B.

Table 3.2 Final Effluent Quality over the Review Period (2012 to May 2016)

Parameter	2012	2013	2014	2015	2016 [(1)]	Effluent Limit	
						Obj.	Limit
$cBOD_5$ (mg/L)	2.06 (2.50)	2.18 (3.75)	2.16 (3.40)	2.04 (2.25)	2.10 (2.50)	8.0	10.0
TSS (mg/L)	2.91 (4.25)	3.16 (7.00)	4.29 (24.8)	2.19 (2.50)	2.00 (2.00)	8.0	10.0
TAN (mg/L)							
Winter (Dec.1 - Mar.31)	0.11 (0.12)	0.56 (2.15)	0.11 (0.13)	0.10 (0.10)	0.10 (0.10)	3.0	4.0
Spring (Apr.1 - May31)	0.10 (0.10)	0.10 (0.10)	0.72 (1.18)	0.10 (0.10)	0.14 (0.18)	0.8	1.0
Summer (June1 - Sep.30)	0.11 (0.13)	0.12 (0.20)	0.11 (0.13)	0.10 (0.10)	- (-)	0.6	0.7
Fall (Oct.1 - Nov.30)	0.10 (0.10)	0.11 (0.13)	0.10 (0.10)	0.10 (0.10)	- (-)	0.8	1.0
TP (mg/L)	0.06 (0.10)	0.07 (0.14)	0.10 (0.32)	0.06 (0.10)	0.05 (0.07)	0.13	0.15
E. coli (organisms / 100 mL)	2.00 (2.00)	2.03 (2.40)	2.28 (9.60)	2.00 (2.00)	2.49 (6.00)	100	100

Notes:

Values in parentheses represent maximum monthly average concentrations.

All samples measured below the detection limit were assumed at the detection limit for purposes of average concentration calculation.

1. Considers data collected from January to May.

Table 3.3 Final Effluent Loads over the Review Period (2012 to May 2016)

Parameter	2012	2013	2014	2015 (1)	2016	Effluent Compliance Limit (2)
$cBOD_5$ (kg/d)	1.33 (2.47)	1.79 (3.25)	1.82 (6.55)	-	1.73 (2.19)	12.4
TSS (kg/d)	1.91 (3.59)	2.68 (6.08)	5.51 (47.8)	-	1.67 (2.19)	12.4
TAN (kg/d)				-		
Winter (Dec.1 - Mar.31)	0.08 (0.09)	0.52 (1.87)	0.07 (0.07)		0.08 (0.10)	4.98
Spring (Apr.1 - May31)	0.09 (0.11)	0.11 (0.14)	1.21 (2.27)		0.13 (0.19)	1.24
Summer (June1 - Sep.30)	0.05 (0.06)	0.09 (0.13)	0.07 (0.08)		- (-)	0.87
Fall (Oct. 1 - Nov. 30)	0.06 (0.06)	0.10 (0.13)	0.06 (0.07)		- (-)	1.24
TP (kg/d)	0.04 (0.07)	0.06 (0.12)	0.10 (0.62)	-	0.04 (0.05)	0.19

Notes:
Values in parentheses represent maximum monthly loading conditions.
1. Accuracy of 2015 flow data could not be confirmed. As such, effluent loading could not be calculated.
2. Effluent loading compliance evaluated based on the monthly average loading.

Over the review period (2012 to May 2016), effluent concentrations were consistently below the C of A effluent concentration and loading limits, with the exception of one month (April 2014). During this month, the plant reported exceedances in TSS, TP, and TAN.

Figure 3.1, Figure 3.2, Figure 3.3, and Figure 3.4 present the average final effluent concentrations for $cBOD_5$, TSS, TAN, and TP, respectively. The objectives and compliance limits as outlined in the C of A are provided for reference.

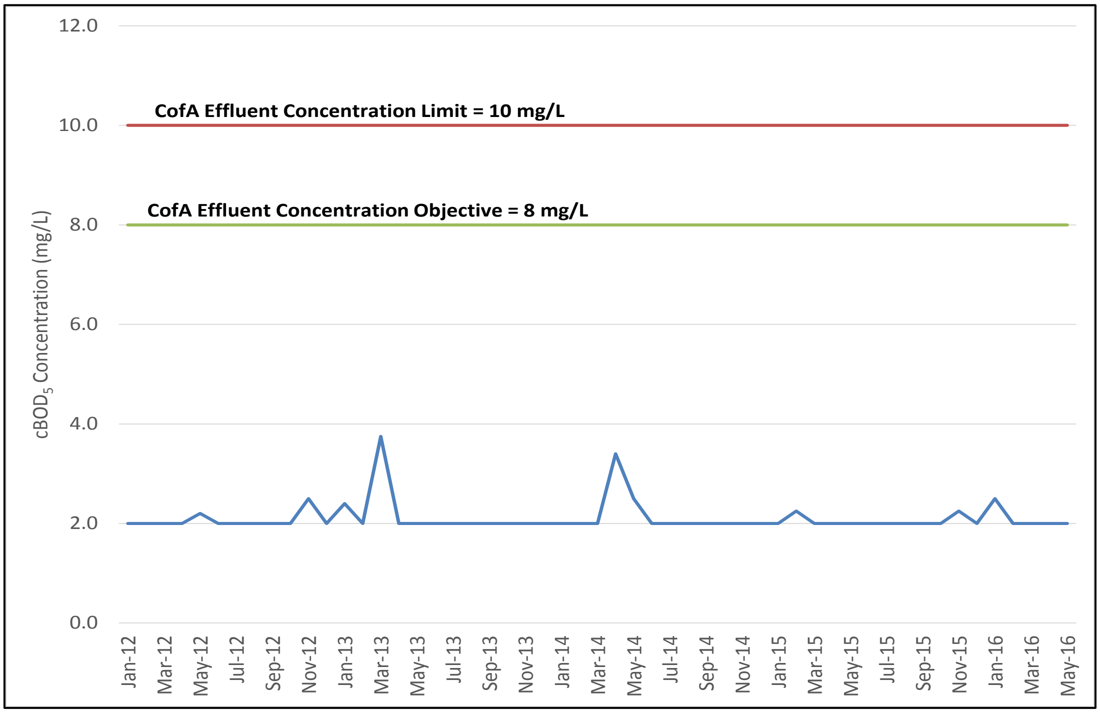

Figure 3.1 Average Monthly Final Effluent cBOD$_5$ Concentration

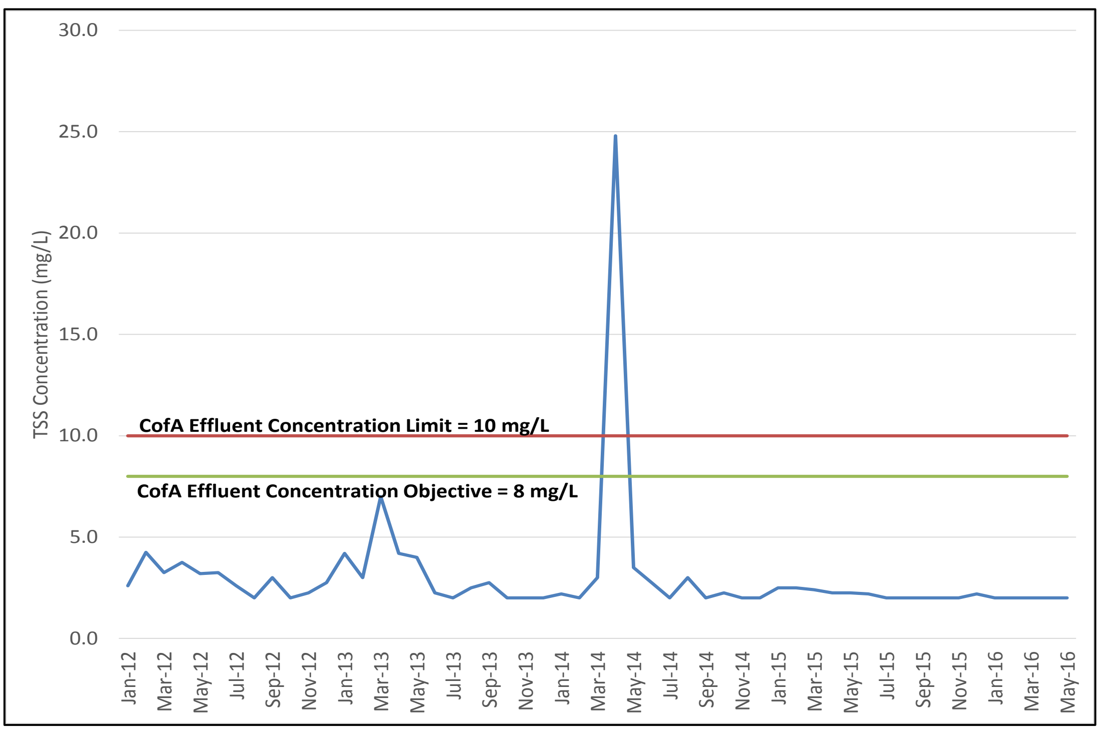

Figure 3.2 Average Monthly Final Effluent TSS Concentration

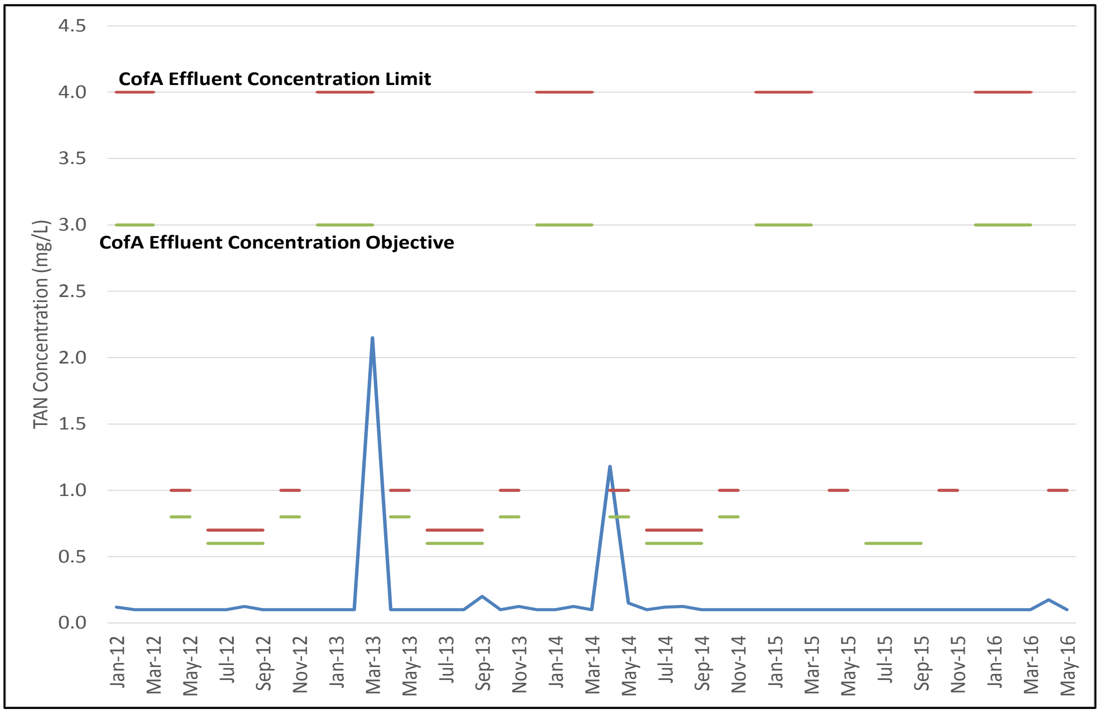

Figure 3.3 Average Monthly Final Effluent TAN Concentration

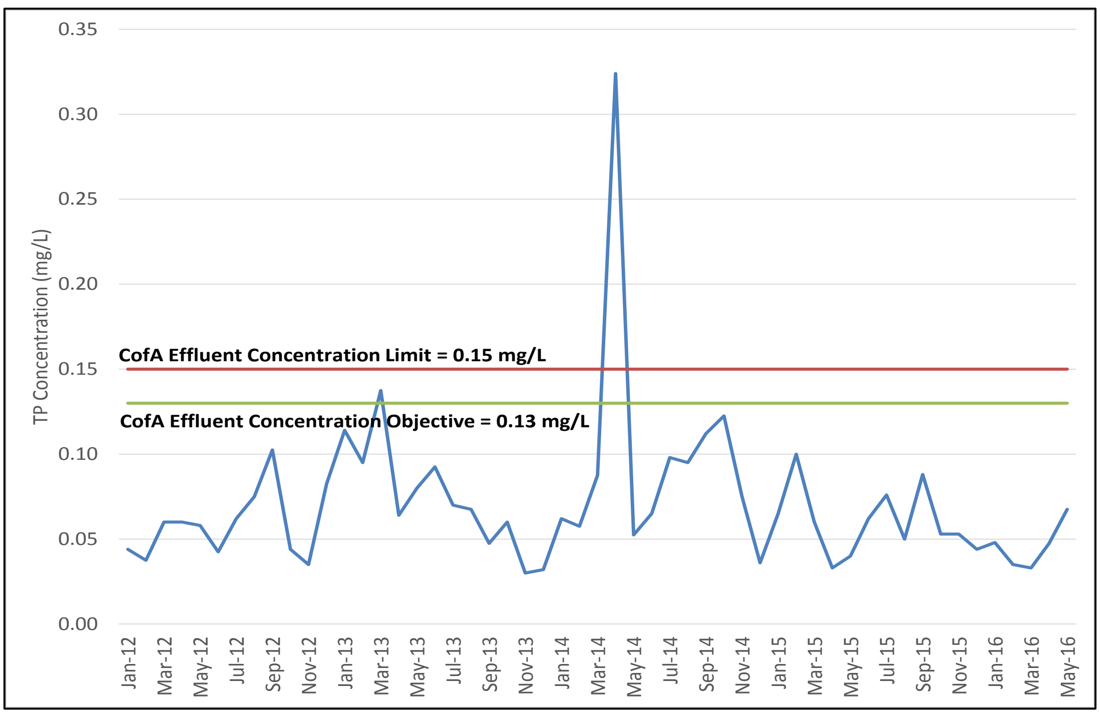

Figure 3.4 Average Monthly Final Effluent TP Concentration

4. DESIGN BASIS

The future design basis was developed to project raw wastewater flows and loads transferred to the Grand Valley WPCP from the collection system via the Emma St. SPS at several future annual average day flow scenarios. For the purposes of developing this design basis, flows and loadings were developed for three scenarios, details of which are presented briefly below.

- Scenario I: Full completion of planned residential developments;
- Scenario II: A 15% increase above the current C of A rated ADF (1,430 m^3/d); and,
- Scenario III: A 25% increase above the current C of A rated ADF (1,555 m^3/d).

The original design basis, completed November 2015, considered plant operational data collected between 2012 and 2014 (XCG, 2015). This design basis was subsequently updated with additional plant operational data collected between January 2015 and May 2016 (XCG, 2016). A summary of the previous and updated design basis is provided as Table 4.1. Additional details regarding the development of the previous design basis and the updated design basis are provided in Appendix A and Appendix B, respectively.

Table 4.1 Summary of Design Basis

Parameter	Scenario I		Scenario II		Scenario III	
	Previous	Updated	Previous	Updated	Previous	Updated
Population	2,919	2,919	3,260	3,252	3,536	3,527
ADF	1,276 m^3/d	1,279 m^3/d	1,430 m^3/d		1,555 m^3/d	
MDF	5,828 m^3/d	5,839 m^3/d	6,165 m^3/d	6,169 m^3/d	6,439 m^3/d	6,442 m^3/d
MDF Factor	4.6		4.3		4.1	
PIF	7,811 m^3/d	7,811 m^3/d	8,303 m^3/d	8,291 m^3/d	8,695 m^3/d	8,684 m^3/d
PIF Factor	6.1		5.8		5.6	
BOD_5						
Avg. Load	186 kg/d	200 kg/d	211 kg/d	225 kg/d	232 kg/d	245 kg/d
Max Load	353 kg/d	379 kg/d	402 kg/d	427 kg/d	441 kg/d	466 kg/d
Avg. Conc.	146 mg/L	156 mg/L	148 mg/L	157 mg/L	149 mg/L	158 mg/L
TSS						
Avg. Load	239 kg/d	268 kg/d	269 kg/d	298 kg/d	294 kg/d	322 kg/d
Max Load	453 kg/d	509 kg/d	512 kg/d	566 kg/d	559 kg/d	613 kg/d
Avg. Conc.	187 mg/L	210 mg/L	188 mg/L	208 mg/L	189 mg/L	208 mg/L
TKN						
Avg. Load	47.9 kg/d	49.3 kg/d	53.4 kg/d	54.7 kg/d	57.9 kg/d	59.1 kg/d
Max Load	91.1 kg/d	93.7 kg/d	104 kg/d	104 kg/d	110 kg/d	112 kg/d
Avg. Conc.	37.6 mg/L	38.6 mg/L	37.4 mg/L	38.2 mg/L	37.2 mg/L	38.0 mg/L
TP						
Avg. Load	5.72 kg/d	6.21 kg/d	6.43 kg/d	6.91 kg/d	7.01 kg/d	7.48 kg/d
Max Load	12.6 kg/d	13.7 kg/d	14.2 kg/d	15.2 kg/d	15.4 kg/d	16.5 kg/d
Avg. Conc.	4.48 mg/L	4.85 mg/L	4.50 mg/L	4.83 mg/L	4.51 mg/L	4.81 mg/L

It is important to note that the projected peak instantaneous flow for each scenario is in excess of the rated capacity of the Emma St. SPS. Analysis suggests the Emma St. SPS may require upgrades to accommodate future flows if peak flows cannot be abated by any I/I reduction strategies. An extensive review of the Emma St. SPS was not conducted as part of this analysis. Additional details regarding projected peak flow analysis is available in Appendix A and Appendix B.

Re-rating of the Grand Valley WPCP could be completed as a Schedule A activity under the requirements of the Municipal Class Environmental Assessment (Class EA) process (MEA, 2015) as defined in the Class EA document, provided it can meet the following conditions:

"Increase sewage treatment plant capacity beyond existing rated capacity through improvements to operations and maintenance activities only, but without construction of works to expand, modify or retrofit the plant or the outfall to the receiving water body, with no increase to total mass loading to receiving water body as identified in the Certificate of Approval."

As such, final effluent design requirements were developed to establish the effluent concentrations that the existing facility must produce to maintain effluent loadings that are equal to or less than the existing C of A effluent loadings.

Table 4.2 presents the existing effluent loading limits for the C of A rated capacity of 1,244 m^3/d. Also shown are the associated effluent concentration limits for the Grand Valley WPCP at each of the three scenarios.

Table 4.2 Effluent Concentration Limits for a Re-rated Grand Valley WPCP

Parameter	Existing C of A	Scenario I	Scenario II	Scenario III
	Loading Limit (kg/d)	Concentration Limit (mg/L)	Concentration Limit (mg/L)	Concentration Limit (mg/L)
ADF	1,244 m^3/d	1,273 m^3/d	1,430 m^3/d	1,555 m^3/d
$cBOD_5$	12.4	9.7	8.7	8.0
TSS	12.4	9.7	8.7	8.0
TP	0.19	0.15	0.13	0.12
TAN				
Winter	4.98	3.9	3.5	3.2
Spring	1.24	1.0	0.9	0.8
Summer	0.87	0.7	0.6	0.6
Fall	1.24	1.0	0.9	0.8

Notes:
Existing loading and concentration limits based on monthly average values.

The C of A defines compliance limits for *E. coli* and pH. The limit for *E. coli* is 200 organisms/100 mL and pH must be maintained within the range of 6.0 to 9.5. It is expected that these requirements would remain the same for a re-rated Grand Valley WPCP.

5. HISTORICAL REVIEW AND CAPACITY ASSESSMENT

5.1 Basis for Evaluation

A review of the current performance of each unit process at the Grand Valley WPCP, along with typical design guideline values, were used to assess the capacity and performance of each major unit process. The unit process review incorporated the plant operations manual, plant design brief, and plant performance communicated through annual reports and operational data from the period of 2012 to May 2016.

The process capacity assessment was performed using traditional desktop analytical methods, historical plant operational data, plant design criteria, process modelling, and approved C of A capacities, as well as typical design guidelines. For the purposes of the desktop capacity assessment, the design influent raw wastewater characteristics used are those developed in the design basis presented in Table 4.1.

The capacity assessment of the Grand Valley WPCP unit processes were conducted using the following assumptions:

- All tanks and treatment equipment will be online;
- Treated effluent must meet the effluent requirements defined in Table 4.2;
- Final effluent must meet the existing C of A treatment requirements for pH and *E. coli*; and
- Future alum dosages will be consistent with historic values.

5.2 Preliminary Treatment

Preliminary treatment at the Grand Valley WPCP consists of screening and grit removal. This section details the performance and capacity assessment of both treatment processes.

Screening Performance and Design Information

Screening is provided by one perforated plate type mechanical screen operating as the duty screen and one manually raked bar screen operating in stand-by. The mechanical screen has a rated capacity of 7,680 m^3/d based on the CofA and operations manual (RJ Burnside, 2015). Screenings are collected and compacted then transferred to a bin and disposed off-site. The quantity of screenings generated at the Grand Valley WPCP is not measured; therefore the performance of the screens in terms of screenings generation per m^3 of wastewater treated could not be assessed as part of this study.

Grit Removal Performance and Design Information

Grit removal is provided by two vortex grit separators, each 1.83 m in diameter. The rated capacity of each vortex grit separator is 3,840 m^3/d, for a total peak capacity of 7,680 m^3/d. Grit from both separators is collected and compacted then transferred to a bin and disposed off-site. The quantity of grit generated at the Grand Valley WPCP is not measured; therefore the performance of the grit separators in terms of volume generation per m^3 of wastewater treated could not be assessed as part of this study.

Capacity Assessment of the Grand Valley WPCP Headworks

As previously noted, the rated peak flow capacity of the mechanical screen is approximately 7,680 m^3/d, and the rated capacity of each vortex grit separator is 3,840 m^3/d, providing a total capacity of 7,680 m^3/d.

To evaluate the treatment capacity of the screening and grit removal processes, a detailed hydraulic analysis of the Grand Valley WPCP headworks was completed at projected Scenario III flows. It is important to note that projected peak flows presented in Table 4.1 exceed the existing rated capacity of the Emma St. SPS. Therefore, the Emma St. SPS may require upgrades to accommodate future flows if peak flows cannot be abated by any I/I reduction strategies. An extensive review of the Emma St. SPS capacity was not conducted as part of this review. Further, it was assumed that future peak flows to the Grand Valley WPCP will not be inhibited by the pumping capacity of the Emma St. SPS. Complete results of the hydraulic analysis are included as Appendix C. A brief summary of key points is as follows:

- Due to the existing bypass around the grit removal process, future hydraulic capacity of the plant headworks is expected to be limited by the hydraulic capacity of the mechanical screen channel.
- A detailed relationship between peak flow and headloss across the grit removal process was not available from the manufacturer. It is possible that a portion of future un-equalized Scenario III peak flows will bypass the grit removal process. However, possible bypass around the grit removal treatment process is expected to have a negligible impact on downstream treatment processes.
- There is sufficient hydraulic capacity in the mechanical screening channel to treat un-equalized Scenario III peak flows.

Overall, the estimated treatment capacity of the existing headworks treatment processes exceeds the projected Scenario III peak flows.

5.3 Biological Treatment

Performance and Design Information

The Grand Valley WPCP has three rectangular bioreactors providing a total liquid volume of approximately 1,200 m^3 at the operating water depth of 4.0 m. Over the review period (2012 to May, 2016), only two bioreactors were used, providing a total liquid volume of approximately 800 m^3. The tanks are operated in parallel. RAS is combined with raw wastewater upstream of the bioreactor, and the combined stream is equally split between reactors. Channels exist along the length of each bioreactor which allow for the wastewater to be added at several locations. Currently these channels are closed, and all wastewater is charged to the head each bioreactor. Each bioreactor is equipped with a fine bubble diffuser for the provision of oxygen.

For purposes of this evaluation, plant operating data between 2012 and May 2016 was available for analysis. However, the accuracy of both influent and effluent flow measurements in 2015 could not be confirmed and, as such, this operating data has been excluded from the historical analysis of biological treatment at the Grand Valley

WPCP. Additional details are included in the updated design basis located in Appendix B.

Table 5.1 presents a summary of the bioreactor operating conditions between 2012 and 2016. Where applicable, each value is compared to typical operating values based on the MOECC Design Guidelines for an extended aeration process. It should be noted that operating data were not available for MLVSS concentrations. Where required, the MLVSS:MLSS ratio was assumed to be 0.70 based on the range observed from samples collected during the intensive sampling program (0.67 - 0.70).

Key findings of the bioreactor process review are summarized below:

- Over the review period, the average daily WAS flow rate significantly decreased. As a result, increased solids were retained within the bioreactors, leading to an increase in the observed MLSS concentration, WAS solids concentration, and estimated solids retention time (SRT).
- In 2014 and 2016, the average MLSS concentration (6,459 mg/L and 5,096 mg/L, respectively) was outside typical operating MLSS concentrations of an extended aeration plant (2,000 to 5,000 mg/L). Although MLSS concentrations were high, there was no observed negative impact on the final effluent TSS concentrations.
- The estimated SRT over the review period was calculated from plant records of WAS flows and solids concentrations. During the review period, the estimated SRT ranged from 21.8 days (2012) to 58.2 days (2014). Increased estimated SRT values is a direct result of reduced solids wasting at the plant. High SRTs can contribute to low food to microorganism (F/M_v) conditions in the bioreactor.
- Due to high MLSS concentrations and low influent loads, the average F/M_v ratio over the review period was 0.03 d^{-1}, which is slightly less than the typical design range for an extended aeration treatment plant. Low F/M_v conditions in the bioreactor can promote the growth of filamentous bacteria, which can lead to issues related to sludge bulking.
- The settling characteristics of the mixed liquor, as measured by the SVI, is similar between bioreactors. Despite the high estimated SRT and low F/M_v ratio, mixed liquor in both bioreactors was readily settleable over the review period. There were no significant changes to the settleability over the review period.

Table 5.1 Summary of Bioreactors Operation during the Review Period (January 2012 to May 2016)

Parameter	2012	2013	2014	2015 (7)	2016	Typical Design Values
Flow to Bioreactors (m^3/d)	735	910	847	-	918	-
Operating Volume (m^3)	800 (1)					-
BOD_5 Load (kg/d)	89.2	96.0	74.1	-	90.5	-
MLSS (mg/L)	3,223	4,525	6,459	-	5,096	2,000 - 5,000 (2) 3,000 - 5,000 (3)
MLVSS (mg/L)	2,256	3,168	4,521	-	3,567	-
Estimated MLVSS:MLSS (4)	0.7					0.7
HRT (hrs)	26.1	21.1	22.7	-	20.9	> 15 (3)
OLR (kg BOD_5/(m^3·d))	0.11	0.12	0.09	-	0.11	0.10 -0.30 (2) 0.17 -0.24 (3)
F/Mv (d^{-1}) (4)	0.05	0.04	0.02	-	0.03	0.04 - 0.10 (3) 0.05 - 0.15 (3)
RAS:ADF Ratio (%)	99	86	41	-	34	50 - 150 (2) 50 - 200 (3)
Estimated WAS Flow (m^3/d)	14.05	10.93	4.05	-	4.73	n/a
WAS Production (kg/d)	118	133	88.8	-	108	n/a
Estimated Yield (kg TSS/kg BOD_5)	1.32	1.39	1.20	-	1.19	-
SRT (days) (5)	21.8	27.2	58.2	-	37.7	20 - 40 (2) > 15 (3)
Effluent TAN (mg/L) (6)	0.10	0.26	0.21	-	0.13	-
Bioreactor 1 SVI	58	47	46	-	-	-
Bioreactor 2 SVI	56	47	46	-	-	-

Notes:

F/Mv – food to micro-organisms ratio
HRT – hydraulic retention time
MLSS / MLVSS – mixed liquor suspended solids / mixed liquor volatile suspended solids
OLR – organic loading rate
RAS – return activated sludge
SRT – solids retention time
SS – suspended solids
WAS – waste activated sludge

1. Only two bioreactors in operation during the review period (2012 to May 2016).
2. Metcalf & Eddy, 2003.
3. MOECC Design Guidelines for Sewage Works (MOECC, 2008) for extended aeration.
4. Assumes a MLVSS:MLSS ratio of 0.70, based on samples collected during the intensive sampling program.
5. Estimated based on available plant solids concentrations and wasting records.
6. The minimum detection limit was 0.1 mg/L. All samples below the minimum detection limit were assumed equal to the minimum detection limit to calculate the average concentration.
7. Accuracy of flow data could not be confirmed. Therefore, 2015 data has not been included in the analysis above.

Capacity Assessment

The biological treatment capacity assessment of the Grand Valley WPCP was completed using BioWin™ process modelling, and based on historic operating conditions, typical design guidelines, and the following assumptions:

- At the biological treatment capacity, all secondary treatment processes (i.e. three aeration tanks and two secondary clarifiers) will be online, and flow will be equally split between all treatment processes;
- Typical DO concentrations of 2.0 mg/L will be maintained in all aeration tanks;
- RAS flow is approximately 100% of the raw influent flow; and
- Future recycle stream flow is approximately 11% of the projected raw influent flow, as estimated from historical plant records.

BioWin™ modelling of the Grand Valley WWTP was conducted to verify the potential biological treatment capacity of the secondary treatment train at the projected Scenario III flows and loads. The BioWin™ model of the existing plant was configured as shown in Figure 5.1.

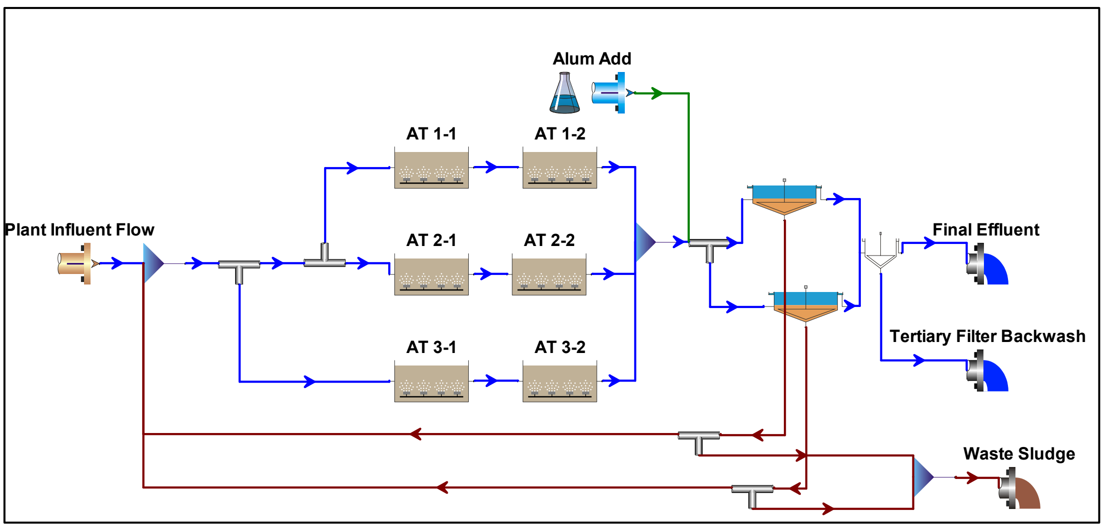

Figure 5.1 Schematic of the BioWin™ Model Setup of the Grand Valley WPCP

Using a calibrated and validated BioWin™ model of the Grand Valley WPCP, a minimum design SRT was developed to meet future projected effluent requirements of TAN. Applying a safety factor of 2.3, a design SRT of 15 days was established.

The biological treatment capacity of the Grand Valley WPCP was estimated given the design SRT and given the following assumptions:

- Design yield of 0.96 kg TSS/kg BOD_5, estimated from BioWin™ simulations;
- Target operating MLSS concentration of 3,000 mg/L, estimated to maximize secondary clarifier treatment capacity;
- A bioreactor operating volume of 1,200 m^3, assuming all three bioreactors (at 400 m^3 each) will be online at future flows; and

- A future influent BOD_5 concentration of 158 mg/L, as per projected Scenario III design basis.

Given the above assumptions, the ADF biological treatment capacity of the Grand Valley WPCP was estimated to be 1,582 m^3/d.

To verify this calculation, the calibrated BioWin™ model of the Grand Valley WPCP was tested to evaluate its ability to treat projected average day and maximum month flows and loads at Scenario III. Complete details of the plant modelling and analysis are included in Appendix D. Briefly, results indicate the Grand Valley WPCP is capable of meeting all projected effluent ECA limits at the projected average day and maximum month Scenario III flow, BOD_5 load, and TKN load while operating at an MLSS concentration of approximately 3,000 mg/L.

The following key points should also be highlighted from the assessment of biological treatment performance:

- Results presented in the appendix depend on the accuracy of future projections of BOD_5 and TKN to the plant.
- The capacity of downstream treatment processes (i.e. secondary clarifiers, tertiary filters, UV disinfection) will be impacted by operation of the biological treatment train. Specifically, the biological treatment capacity will increase with increasing MLSS concentrations. However, the secondary clarifier treatment capacity, based on the SLR, will decrease with increasing MLSS concentrations. The specific relationship between the operating MLSS concentration and secondary clarifier treatment capacity was not explored as part of this evaluation. In order to maximize the potential capacity of the secondary clarifiers, a target operating MLSS concentration of 3,000 mg/L was assumed.
- The biological capacity assessment was based on achieving effluent objectives for TAN at projected Scenario III flows and loads. Future effluent targets for all parameters are presented in Table 4.2. Future effluent TP requirements may be approaching the removal limit of existing tertiary filtration equipment installed at the plant.

5.4 Secondary Clarification and Tertiary Filtration

Secondary Clarifier Historic Performance and Design Information

Secondary clarification at the Grand Valley WPCP is provided by two circular clarifiers. Each clarifier has a diameter of 9.8 m and operates with a side water depth of 4.2 m. The total surface area for settling is approximately 150 m^2. The clarifier is equipped with a sludge collector mechanism, a scum removal system, and covers to prevent the growth of algae on the clarifier surface. RAS and WAS are both pumped from a single pipe at the bottom of the sludge hopper located in the centre of each clarifier.

Table 5.2 summarizes operation of the online secondary clarifier over the review period. As previously noted, the accuracy of both influent and effluent flow measurements in 2015 could not be confirmed and, as such, the summary presented in

Table 5.2 has excluded data collected during 2015. Additional details regarding the plant operating data are included in the updated design basis located in Appendix B.

Table 5.2 Summary of Secondary Clarifier Operation during the Review Period (January 2012 to May 2016)

Parameter	2012	2013	2014	2015 (7)	2016	Typical Design Values
Clarifier Surface Area (m^2)	75 (1)					-
Flow to Secondary Clarifiers (m^3/d)	735	910	847	-	918	-
MDF (m^3/d)	2,780	2,361	4,630	-	2,508	-
PHF (m^3/d)	4,003 (4)	3,400 (4)	5,011 (5)	-	3,612 (4)	-
MLSS (mg/L)	3,223	4,525	6,459	-	5,096	-
RAS:ADF Ratio (%)	99	88	41	-	34	50 - 150 (2) 50 - 200 (3)
Peak Hour SOR ($m^3/(m^2 \cdot d)$)	53.4	45.3	66.8	-	48.2	< 37 (3)
Maximum Day SLR ($kg/(m^2 \cdot d)$) (6)	152	191	429	-	192	< 170 (3)

Notes:

ADF – Average Day Flow
MDF – Maximum Day Flow
PHF – Peak Hour Flow
SOR – Surface Overflow Rate
SLR – Solids Loading Rate
RAS – Return Activated Sludge
MLSS – Mixed Liquor Suspended Solids

1. Operators have indicated only one secondary clarifier in operation during the review period (2012 to May 2016).
2. Metcalf & Eddy, 2003.
3. MOECC Design Guidelines for Sewage Works (MOECC, 2008) for settling after an extended aeration process.
4. Estimated based on the observed MDF and a typical PHF peaking factor of 1.44 (WEF, 2010).
5. Estimated based on effluent flow records from a peak flow event in April 2014.
6. Estimated based on plant records of the MLSS concentration and RAS flow rates.
7. Accuracy of flow information could not be confirmed. Therefore, secondary clarifier performance could not be accurately evaluated.

Over the review period, estimated peak hour SORs and maximum day SLRs have exceeded typical design values. Secondary clarifier effluent is not currently sampled. As such, the performance of the secondary clarifier during peak flow events cannot be quantified. High estimations of SOR and SLR are due in part to high peak flows observed through the plant and, in 2014, high MLSS concentrations.

Due to tertiary filters located downstream of the secondary clarifiers, final effluent TSS concentrations remained below the C of A compliance limits over the duration of the review period, with the exception of April, 2014. During this month, simultaneous snow melt and rainfall events led to estimations of peak SOR (66.8 $m^3/(m^2 \cdot d)$) and

SLR (429 kg/(m^2·d)) in excess of typical design values. Due to operational issues, the second secondary clarifier could not be brought online during the peak flow event observed in April 2014. Operations staff have indicated that plugging or blinding of filters due to high TSS concentrations has not been a consistent issue during the review period (January 2012 to May 2016).

Tertiary Filtration Historic Performance and Design Information

Tertiary filtration at the Grand Valley WPCP is accomplished by four continuous up-flow, deep bed, granular media filters. Each filter has a filtration area of 4.65 m^2, for a total filtration area of 18.6 m^2.

The filters have a design peak flow capacity of 5,300 m^3/d, as detailed in the operations manual (R.J. Burnside, 2015). The design filter influent TSS and TP concentrations are 20 mg/L and 1 mg/L, respectively.

Each filter is backwashed continually. Filter backwash water is collected at the onsite pumping station, and pumped back to the plant headworks. Filters are designed to provide tertiary effluent quality of 10 mg/L or less total suspended solids, and 0.15 mg/L or less total phosphorus. Tertiary filter influent quality was not monitored over the review period. As such, the performance of tertiary filters over the review period could not be evaluated.

Secondary Clarifier and Tertiary Filter Capacity Assessment

The capacity of the secondary clarifiers and tertiary filters was evaluated through stress testing which was conducted at the Grand Valley WPCP from July 12 to 18, 2016. During testing, flows and solid loading to the secondary clarifier and tertiary filters was artificially increased while the performance of each treatment process was carefully monitored. Only half of the secondary clarifier and tertiary filter treatment capacity was brought online during the stress test (i.e. one secondary clarifier and two tertiary filters, respectively). It was assumed capacity between equal unit treatment processes was identical.

Complete results and analysis of the stress testing program is included as Appendix E. A summary of key observations and conclusions is as follows:

- Capacity evaluations of the secondary clarifier typically consist of a peak hour capacity (determined by the SOR) and a maximum day capacity (determined by the SLR). However, as a result of attenuation by the storm tank, peak hour and max day flows at the Grand Valley WPCP are expected to be similar. As such, a 'peak day' capacity of the secondary clarifier based on both SOR and SLR was made using measurements of secondary clarifier effluent TSS and TP concentrations, and on the height and stability of sludge blanket level measurements.
- Using results from both Day 2 and Day 3, capacity of the secondary clarifier was found to be limited by the SOR. Detailed analysis of results from Day 3 of testing identified a period of stable clarifier operation between 10:00 am and 11:00 am, and was characterized by stable secondary clarifier effluent concentrations of TSS and TP, and stable measurements of sludge height. The SOR capacity, estimated from this period of stable operation, is approximately 29.1 m^3/m^2·d.

- Capacity evaluations of tertiary filters were based on tertiary effluent TSS and TP concentrations. Capacity was found to be limited by the filtration rate, and was estimated to be 3.30 L/m²·s.

Based on the results of the stress testing, Table 5.3 summarizes the estimated capacities of the selected treatment units.

It is important to note that the clarifier capacity calculated based on the measured SLR assumed an operating MLSS concentration of 3,000 mg/L. This is consistent with previous evaluations of the biological treatment capacity at the Grand Valley WPCP. Operating MLSS concentrations in excess of 3,000 mg/L would simultaneously increase the biological treatment capacity and decrease the secondary clarifier treatment capacity as evaluated by the SLR. Historically, the plant has operated at MLSS concentrations from approximately 2,500 mg/L to greater than 8,000 mg/L. As flows increase, operating at high MLSS concentrations in the future may result in the clarifier being limited by the SLR to a peak capacity less than 4,388 m^3/d.

Table 5.3 Estimated Secondary Clarifier and Tertiary Filter Operating Capacity

Treatment Process	Limiting Factor	Estimated Capacity
Secondary Clarification		
Peak Hour	SOR (29.1 $m^3/m^2·d$)	4,388 m^3/d
Maximum Day	SLR (153 $kg/m^2·d$)	5,203 m^3/d (1)
Tertiary Filtration		
Peak Hour	Filtration Rate (3.30 $L/m^2·s$)	5,300 m^3/d

Notes:
1. Assuming a future target operating MLSS concentration of 3,000 mg/L, an ADF of 1,244 m^3/d, and a RAS:ADF ratio of 2:1.

5.5 Oxygenation

Historic Performance and Design Information

Air is supplied to the three bioreactors from three positive displacement air blowers (two duty, one standby). Each blower has a rated capacity of 858 m^3/h.

Each bioreactor is equipped with a fine bubble diffuser assembly. Diffusers are arranged in three identical grids along the bioreactor floor. Piping to each grid has its own butterfly valve to control the amount of air delivered to the grid. Therefore, tapered aeration is possible, but is not practiced at the Grand Valley WPCP.

Currently, the Grand Valley WPCP operates only two of the three existing bioreactors. The target DO concentration in each bioreactor is 4.5 mg/L.

According to the MOECC Design Guidelines (MOECC, 2008), the field oxygen transfer efficiency (FOTE) of fine bubble diffusers is 6 to 15 percent. For the purposes of this report, a FOTE of 9 percent was assumed for the bioreactors. The oxygen demand for the bioreactors was calculated based on the oxygen required for the removal of BOD_5 and for complete nitrification. Table 5.4 presents the historic operating conditions of the aeration system at average and peak loadings. Peak TKN loads were estimated from average historical TKN loads and a dry weather peaking factor of 2.1, which was estimated from historical meteorological data. As previously noted, the accuracy of raw influent and final effluent flows from 2015 cannot be confirmed and, as such, Table 5.4 has excluded this data.

Table 5.4 Aeration System Operating Conditions during the Review Period (2012 to May 2016)

Design Parameter	Oxygen Demand	Air Requirement
Average Loading		
Process Requirement (1)	260 kg O_2/d	430 m^3/h
Mixing Requirement (3)	-	439 m^3/h
Bioreactor Air Requirement	439 m^3/h	
Peak Loading		
Process Requirement (2)	401 kg O_2/d	665 m^3/h
Mixing Requirement (3)	-	439 m^3/h
Bioreactor Air Requirement	962 m^3/h	

Notes:
1. Based on an oxygen demand of 1.5 kg O_2/kg BOD_5 + 4.6 kg O_2/kg TKN (MOECC, 2008). Based on average BOD_5 and TKN loadings of 87 kg/d and 27.9 kg/d, respectively.
2. Based on an oxygen demand of 1.5 kg O_2/kg BOD_5 + 4.6 kg O_2/kg TKN (MOECC, 2008). Based on average BOD_5 loading of 87 kg/d and a peak day TKN loading of 58.7 kg/d.
3. Mixing requirements are based on 0.61 L/(m^2·s) for fine bubble diffusers (MOECC, 2008), and considers only two bioreactors in operation.

Results presented in Table 5.4 suggest that two existing blowers have sufficient capacity to handle oxygen demands over the review period.

Capacity Assessment

Table 5.5 presents the equivalent ADF capacity of the Grand Valley WPCP based on the design organic loadings, aeration zone oxygenation requirements, and an assumed FOTE of 9 percent. Based on MOECC Design Guidelines (MOECC, 2008), the aeration capacity is estimated based on maintaining a minimum DO concentration of 2.0 mg/L at the average BOD_5 loading and peak daily TKN loading.

Table 5.5 Oxygenation – Capacity Assessment

Parameter	Estimated Total Plant Capacity
Existing Blowers Firm Capacity	1,716 m^3/h (1)
Equivalent ADF Capacity	1,713 m^3/d (2,3)

Notes:
1. Assuming two blowers operating at the design capacity.
2. Based on an oxygen demand of 1.5 kg O_2/kg BOD_5 + 4.6 kg O_2/kg TKN (MOECC, 2008).
3. Based on design average raw wastewater BOD_5 and TKN concentrations of 158 mg/L and 38.0 mg/L, respectively, and the design raw wastewater dry weather flow factor of 2.1 applied to TKN.

Therefore, the equivalent ADF capacity of the existing blowers is approximately 1,713 m^3/d based on an assumed FOTE of 9 percent.

5.6 Phosphorus Removal

Historic Performance and Design Information

Currently, the plant uses aluminum sulphate (alum) for phosphorus precipitation and removal. The alum is dripped into the wastewater stream following the aeration tanks, upstream of the secondary clarifiers. The alum is stored in a chemical storage tank with a volume of 9,600 L. Alum from the storage tank is pumped to a 240 L day storage tank prior to dosage into the wastewater stream. From the 2015 Operations Manual, the alum day tank has five chemical feed pumps:

- Two (2) pumps, each with a capacity of 13.8 L/h, to dose upstream of the secondary clarifier;
- One (1) pump with a capacity of 13.8 L/h to dose the equalization tank, as required; and,
- Two (2) pumps, each with a capacity of 2.5 L/h, to dose the filter influent stream.

Currently, alum is only dosed upstream of the secondary clarifiers on a regular basis.

Alum dosage data collected from the annual reports was used for this evaluation. Over this period, the monthly average alum dosages ranged from 47 mg/L to 82 mg/L as $Al_2(SO_4)_3.14H_2O$, with an overall average of 70 mg/L as $Al_2(SO_4)_3.14H_2O$. The MOECC Design Guidelines recommends an alum dosage of 110 mg/L to 225 mg/L as $Al_2(SO_4)_3.14H_2O$. Therefore, alum dosages have been lower than the MOECC Design Guidelines typical range. During the review period, the monthly average final effluent TP concentration exceeded the CofA limit on only one occasion (April 2014). The average effluent TP concentration between January 2012 and May 2016 was 0.07 mg/L, indicating that, on average, the plant has operated with a chemical dosage sufficient to meet the current effluent phosphorus objective.

Capacity Assessment

The equivalent ADF capacity of the Grand Valley WPCP based on the alum feed system capacity is presented in Table 5.6. The table shows the estimate equivalent ADF capacity at the historical average dosage of 70 mg/L as $Al_2(SO_4)_3 \cdot 14H_2O$.

Table 5.6 Phosphorus Removal – Capacity Assessment

Parameter	Estimated Capacity
Existing Feed Pumps Total Capacity	16.3 L/h (1)
Equivalent ADF Capacity at historical Alum Dose (2)	3,670 m^3/d

Notes:
1. Combined capacity of the chemical feed pumps upstream of the secondary clarifiers and upstream of the tertiary filters.
2. Based on the historic alum dosage of 70 mg/L, as $Al_2(SO_4)_3 \cdot 14H_2O$ (MOECC, 2008) and alum concentration in solution of 48.5 percent with a specific gravity of 1.335.

Based on Table 5.6, the alum dosage pumps at the Grand Valley WPCP have an equivalent ADF capacity of approximately 3,670 m^3/d at historical dosage rates. This capacity assessment assumes alum will be dosed upstream of both the secondary clarifiers and tertiary filters.

The alum storage tank has a volume of 9,600 L. At the total feed pump capacity of 16.3 L/h, the storage tank can provided a total of 24.5 days of storage time.

It is important to note that, during the secondary clarifier and tertiary filter stress testing, it was found that alum dosing restrictions at the Grand Valley WPCP had a negative impact on final effluent concentrations of orthophosphate and TP. Specifically, the capacity of the dosing pump at the secondary clarifier limited the alum concentration to approximately 55 mg/L Future removal of orthophosphate can be optimized by increasing the alum dosing capacity to achieve historical (70 mg/L) or typical (110 to 225 mg/L) dosage rates (MOE, 2008) at projected peak flows.

5.7 Disinfection

Historic Performance and Design Information

The existing UV disinfection system is a Trojan UV 3000B Model consisting of two (2) banks of seven (7) modules. Each module contains eight (8) low pressure high intensity UV lamps. The design UV dose is 30.0 mJ/cm^2 at a minimum UV transmittance of 55%. The existing UV disinfection system has a rated capacity of 7,680 m^3/d.

There were no exceedances of the monthly effluent *E. coli* compliance limit over the review period (2012 to May 2016).

Capacity Assessment

Capacity evaluations of the UV disinfection system were based on secondary clarifier and tertiary filter effluent UVT measurements taken during this test, and on previous work which measured the UVT of final effluent and raw influent samples combined in different volumetric ratios. Capacity of the UV disinfection system was estimated to be in excess of the design peak capacity of 7,680 m^3/d.

6. CAPACITY ASSESSMENT SUMMARY

6.1 Capacity of the Existing Grand Valley WPCP

Results presented in the preceding sections can be used to estimate the treatment capacity of all unit treatment processes at the Grand Valley WPCP. It is important to note, however, that the capacity of different treatment units is determined by different measurements of plant flow (i.e. average day, maximum day, or peak hour). To facilitate comparison between treatment units, the equivalent average day flow capacity of all treatment processes was calculated using information from the updated projected design basis. The attenuation of future peak flows by the existing storm tank was considered where applicable.

A summary of the equivalent ADF capacity of each treatment processes is given in Table 6.1. A visual representation of this information is included as Figure 6.1.

Table 6.1 Capacity Assessment Summary

Treatment Unit	Capacity Assessment			
	Average Day Flow	Maximum Day Flow	Peak Flow	Equivalent Average Day Flow
Screens	-	-	9,650 m^3/d	1,555 m^3/d
Grit Removal	-	-	7,680 m^3/d	1,371 m^3/d
Biological Treatment	1,582 m^3/d	-	-	1,582 m^3/d
Oxygenation	1,713 m^3/d	-	-	1,713 m^3/d
Secondary Clarifiers (SOR)	-	-	4,388 m^3/d	952 m^3/d
Secondary Clarifiers (SLR)	-	5,203 m^3/d	-	1,146 m^3/d
Tertiary Filters	-	-	5,300 m^3/d	1,169 m^3/d
UV Disinfection	-	-	7,680 m^3/d	1,371 m^3/d

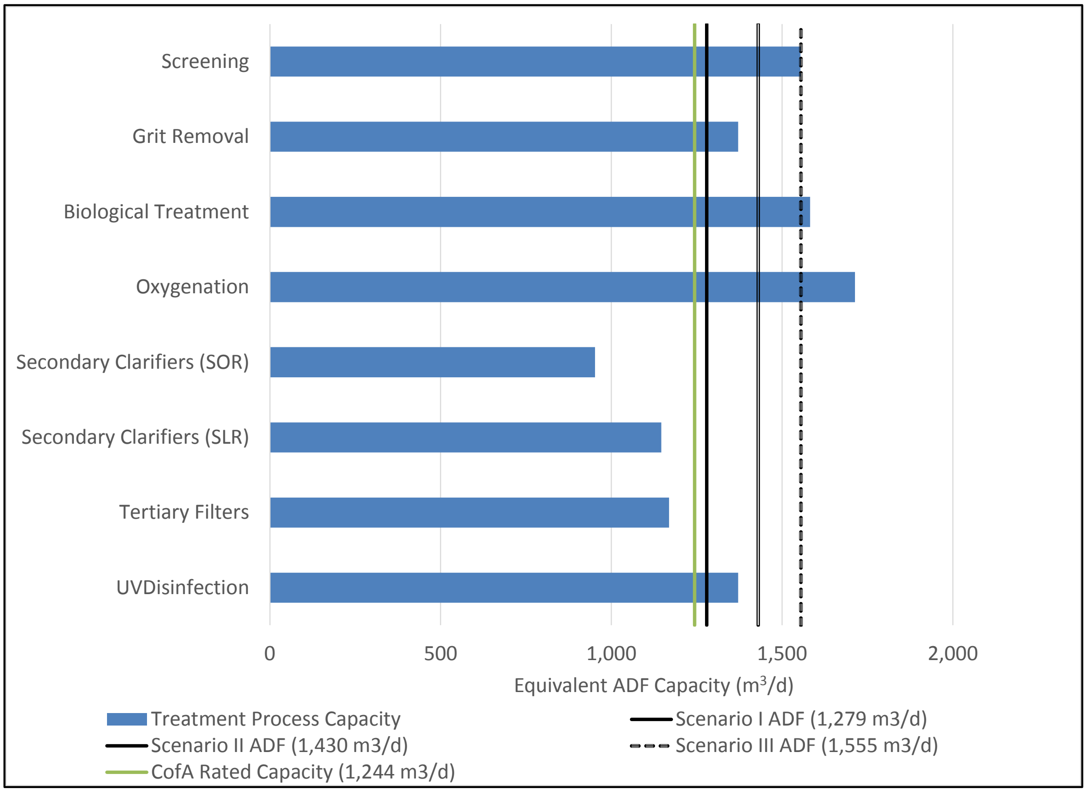

Figure 6.1 Summary of Grand Valley WPCP Capacity

Based on results presented above, the capacity of several treatment processes at the Grand Valley WPCP may be limited by maximum day and peak hour flows to the treatment plant. Projected peak flows are driven by a single extreme peak flow event recorded during the review period (April 2014). Although significantly greater in magnitude that other peak flow events over the review period, this peak flow event cannot be excluded from analysis due, in part, to uncertainty in flow data collected by OCWA at the Grand Valley WPCP, the limited data set which was available for analysis (dating back to only 2012), and the increasing frequency of extreme weather events. As such, based on the estimated capacity of existing treatment processes, re-rating of the Grand Valley WPCP as a Schedule A activity under the Municipal Class EA process is not feasible.

6.2 Impact of Additional Equalization

Through installation of additional equalization at the Emma St. SPS, peak flows to the plant may be reduced, thereby making it feasible to pursue a plant re-rating to increase the rated capacity, potentially up to an ADF capacity of 1,555 m^3/d. Construction of additional equalization can be completed as a Schedule B activity under the Municipal Class EA process.

The impact of additional equalization on the estimated equivalent ADF capacity of each treatment process is summarized in Table 6.2. This information is shown visually in Figure 6.2. Results show that the construction of additional equalization at the Grand Valley WPCP can provide sufficient capacity to treat projected Scenario III flows and loads in the liquid treatment train.

Table 6.2 Impact of Additional Equalization on the Grand Valley WPCP Capacity Assessment

Treatment Unit	Capacity Assessment	
	Existing Equivalent ADF	Equivalent ADF with Additional Equalization
Screens	1,555 m^3/d	3,466 m^3/d
Grit Removal	1,371 m^3/d	2,758 m^3/d
Biological Treatment	1,582 m^3/d	1,582 m^3/d
Oxygenation	1,713 m^3/d	1,713 m^3/d
Secondary Clarifiers (SOR)	952 m^3/d	1,576 m^3/d
Secondary Clarifiers (SLR)	1,146 m^3/d	1,728 m^3/d
Tertiary Filters	1,169 m^3/d	1,763 m^3/d
UV Disinfection	1,371 m^3/d	2,758 m^3/d

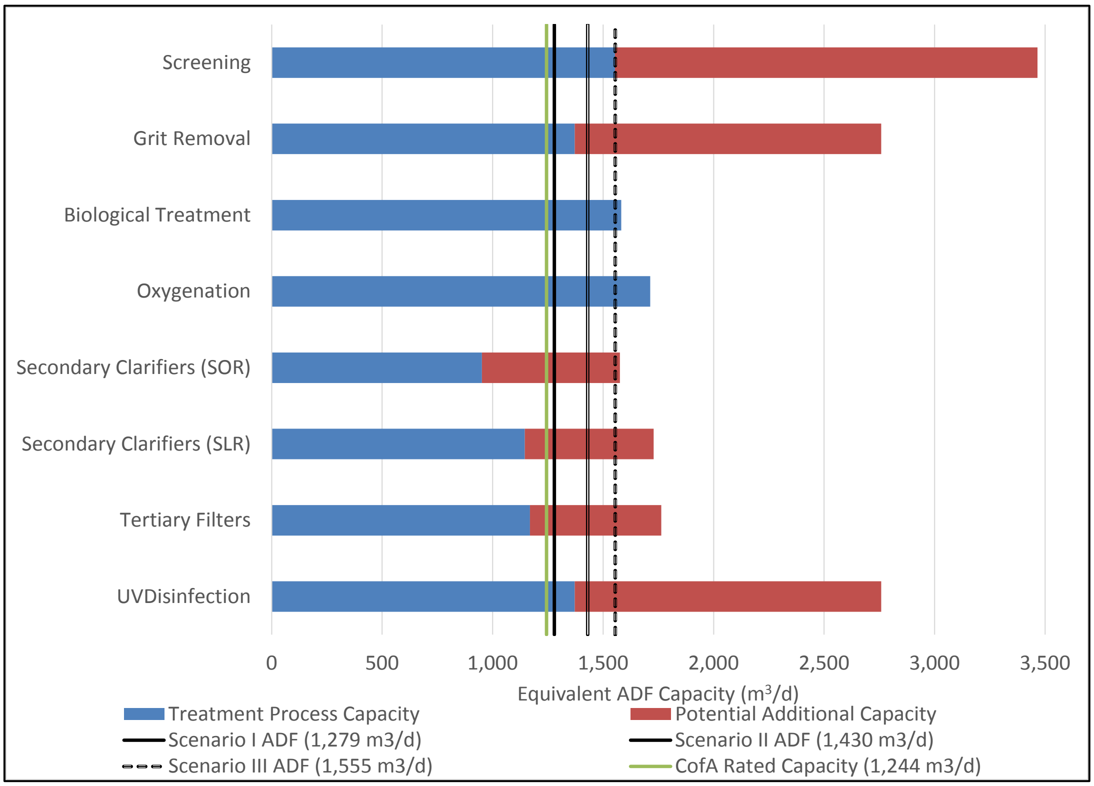

Figure 6.2 Impact of Additional Equalization on the Estimated Treatment Capacity at the Grand Valley WPCP

7. REFERENCES

1. R.J. Burnside & Associates Limited. Grand Valley Wastewater Treatment Plant Operations Manual. 2015.
2. Ontario Ministry of the Environment. Design Guidelines for Sewage Works. 2008.
3. Metcalf & Eddy. Wastewater Engineering: Treatment and Resource Recovery. Fourth Edition. Toronto. 2003.

APPENDIX A

GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY PROPOSED DESIGN FLOWS AND LOADS

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XCG File No.: 3-252-57-01
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GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY
PROPOSED DESIGN FLOWS AND LOADS

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1. INTRODUCTION

1.1 Background

The Grand Valley WPCP provides treatment for wastewater generated in the community of Grand Valley within the Town of Grand Valley (Town). The plant is currently operated by the Ontario Clean Water Agency (OCWA) under the Ministry of Environment and Climate Change (MOECC) Certificate of Approval (CofA) No. 9706-7KWQ57, issued on February 2, 2009. The quality and quantity of effluent currently discharged by the existing Water Pollution Control Plant (WPCP) is regulated by the CofA. The Grand Valley WPCP has a rated average capacity of 1,244 m^3/d.

XCG Consulting Limited (XCG) recently completed an update to the Assimilative Capacity Study to propose effluent limits associated with an increase in the rated capacity to 2,547 m^3/d. The proposed effluent limit associated with total phosphorus (TP) for this increased capacity was very low at 0.073 mg/L. Consistently achieving such low TP requirements requires enhanced tertiary treatment, such as dual-stage tertiary filtration or membrane ultrafiltration. Upgrading the Grand Valley WPCP to provide this level of treatment would require a significant capital expenditure.

At this time, the Town would like to investigate the potential to re-rate the existing WPCP to provide additional treatment capacity and to defer the facility's next upgrade and expansion. As such, the Town has retained XCG to undertake a capacity assessment of the Grand Valley WPCP to support a plant capacity re-rating.

1.2 Objectives

The specific objectives of this technical memorandum are to:

- Conduct a review of plant raw wastewater flows and loads; and,
- Develop a design basis for future raw wastewater flows and loads.

1.3 Data Sources

The following data sources were used in part to develop projections of plant flows and loads:

- 2012 to 2014 plant flow and quality information;
- Memorandum completed by R.J. Burnside regarding the existing and future service populations of the Grand Valley WPCP (May, 2015);
- East Luther Grand Valley (ELGV) Wastewater Treatment Plant Design Brief (2008);
- ELGV Inflow and Infiltration (I/I) Study Report (July, 2009);
- Grand Valley Wastewater Treatment Plant Operations Manual (July, 2015); and,
- Grand Valley WPCP facility tour (September, 2015).

2. REVIEW OF RAW WASTEWATER FLOW AND QUALITY

Raw sewage flows from the collection system are conveyed to the Grand Valley WPCP from the Emma St. sewage pumping station (SPS) via a forcemain. The Emma St. SPS is equipped with the following equipment:

- Two variable frequency drive (VFD) pumps (one duty and one standby), each with a rated capacity of 88.9 L/s (7,680 m^3/d);
- One VFD jockey pump with a rated capacity of 29.5 L/s (2,550 m^3/d); and,
- One wet well, with an approximate volume of 125 m^3.

Only one of the above pumps is in operation at a time. As such, the existing peak capacity of the Emma St. SPS is approximately 7,680 m^3/d. Over the review period (2012 - 2014) there were no records of raw sewage bypasses at the Emma St. SPS or at the Grand Valley WPCP.

It is important to note that a condition assessment of the Emma St. SPS was not completed as part of this study. Although the existing capacity of the Emma St. SPS was taken into consideration as part of the review of historic operating conditions, its capacity was not assumed to be a limiting factor when developing future anticipated peak flows at the Grand Valley WPCP.

2.1 Review of Raw Wastewater Flow over the Review Period (2012 - 2014)

The Grand Valley WPCP currently serves a residential population of approximately 1,752 persons. Influent flow to the Grand Valley WPCP is comprised of:

- Raw wastewater from the Grand Valley sanitary collection system, pumped to the plant via the Emma St. SPS;
- Septage flow from the onsite septage receiving station; and,
- Plant recycle flow (i.e. digester supernatant and filter backwash flow), pumped to the head of the plant from the onsite pumping station.

Flow from each source above is metered separately. Reported total influent flow to the plant is calculated as the sum of flow from each source. In addition, effluent flow is monitored using a V-notch weir. During a tour of plant treatment facilities, operators indicated the accumulation of grit within the magnetic flowmeter measuring flows from the Emma St. SPS led to false high measurements during the review period. As such, plant effluent flow measurements were used as the basis for the evaluation of average raw wastewater flows from the Grand Valley sanitary collection system over the review period (2012 - 2014).

Table 2.1 presents a summary of the estimated collection system raw influent flow and per capita flows to the Grand Valley WPCP. The table includes an estimation of dry weather plant flow and per capita flows, and quantification of the historical I/I observed at the plant. Meteorological data was obtained from the Environment Canada station at Fergus, Ontario. Days were considered dry when no precipitation occurred for that day and three days prior. Only data from May to October was used for dry weather flow analysis.

Table 2.1 Summary of Treated Flow over the Review Period (2012 - 2014)

	Units	2012	2013	2014	Overall (1)
Estimated Service Population	Persons	1,494	1,683	1,752	-
Average Daily Flow	m^3/d	643	821	776	746
Per Capita Flow	L/cap/d	430	488	443	454
Estimated Dry Weather Flow (2)	m^3/d	554	658	620	603
Estimated Per Capita Dry Weather Flow	L/cap/d	371	391	354	372
Estimated Per Capita I/I	L/cap/d	59	97	89	82

Notes:
Estimated flows are based on flow measurements taken at the effluent flow meter over the review period.
1. Represents the average flow over the entire review period (2012 - 2014).
2. Days were considered dry when no precipitation occurred for that day, and two days prior from May to September.

Results in Table 2.1 indicate that the overall average per capita flow to the Grand Valley WPCP over the review period was 454 L/cap/d, inclusive of I/I. The estimated dry weather per capita flow (372 L/cap/d) is consistent with the typical range of per capita flows of 225 to 450 L/cap/d, exclusive of extraneous flows (MOE, 2008). The calculated per capita I/I was 82 L/cap/d, which is slightly less than the typical design I/I flow of 90 L/cap/d (MOE, 1985).

Summary of Maximum Day Flows during the Review Period (2012 - 2014)

Similar to average day flow analysis, maximum day flows for 2012 and 2013 were estimated from effluent flow meter measurements. In 2014, the maximum day flow event (April 14, 2014) was caused by simultaneous rainfall and snow melt events, and required use of the storm tank to equalize peak flows through the secondary treatment train. Volume accumulated in the storm tank was returned to the head of the plant in the days following the peak flow event. As such, the measured flow at the effluent flow meter is not an accurate representation of total maximum day influent flow in 2014.

As previously discussed, the accumulation of grit at the Emma St. SPS flow meter has caused false high flow measurements over the review period (2012 - 2014). However, during the seven days preceding the peak flow event in 2014, the average percent difference between flows measured at the Emma St. SPS and at the effluent flow meter was 3%. Therefore, it was assumed that flow measured at the Emma St. SPS represents an accurate estimation of total influent flow to the Grand Valley WPCP during the peak flow event recorded in April 2014. A summary of maximum day flows and calculated maximum day factors (MDF) during the review period is shown as Table 2.2.

Results in Table 2.2 indicate the Grand Valley WPCP has been subject to significant peak flows over the review period. Specifically, the extreme peak flows observed in 2014 are attributed to simultaneous snow melt and rain fall events in April 2014. There have been no recorded observations of raw wastewater bypass during the review period.

Table 2.2 Summary Maximum Day Flows over the Review Period (2012 - 2014)

	Units	2012	2013	2014	Overall
Average Daily Flow	m^3/d	643	821	776	746
Maximum Day Flow	m^3/d	2,601	2,254	4,671 (1)	4,671 (1)
MDF	-	4.0	2.8	6.0	6.3

Notes:
Unless otherwise indicated, flows are based on flow measurements taken at the effluent flow meter over the review period (2012 - 2014)
1. Based on Emma St. SPS flow measurements.

Summary of Peak Flows during the Review Period (2012 - 2014)

As discussed, operators have indicated that the accumulation of grit within the magnetic flow meter has contributed to false high measurements of flow from the Emma St. SPS. In 2015, operators began periodically operating the Emma St. SPS pump at capacity to flush any accumulated solids from the magnetic flow meter. Since beginning this practice, operators have reported consistent agreement between influent and effluent flow measurements.

Similarly, it is likely that peak flow periods which occurred during the review period, and which required pumps at the Emma St. SPS to run at or near capacity, would remove any accumulated grit at the magnetic flow meter. Therefore, it was assumed that peak flow data collected from the Emma St. SPS represents an accurate representation of peak flows to the Grand Valley WPCP during the review period (2012 - 2014).

For selected days with high measured effluent flows, measured flow from the Emma St. SPS was further analyzed to understand the existing peak flows to the plant. Specifically, several days from the peak flow event in April 2014 were examined. A SCADA screenshot of Emma St. SPS flows on April 13 and April 14, 2014 is included as Appendix A.

During these days, the observed peak flow from the Emma St. SPS reached approximately 88 L/s, which is near the rated capacity of the SPS. However, detailed analysis of these figures suggests that the observed peak flows are likely related to pump operation at the Emma St. SPS rather than actual raw influent flow to the wet well. Plant operations staff have indicated that the VFD of the large duty pump was programmed to operate between 60 L/s and 90 L/s. As indicated, the capacity of the jockey pump is approximately 29.5 L/s. Influent flow greater than the jockey pump capacity, but less than the minimum programmed operation of the large duty pump is likely the cause of unstable periods of pump operation, characterized by rapid changes in pumping output and cycling of pump on/off cycles. These unstable periods are detailed in the screenshots included in Appendix A. During the morning of April 14, 2014, operations staff modified operation of the VFD control to allow the large pump to operate between 40 L/s and 89 L/s in an attempt to smooth pump output during this high flow event. This can be clearly seen on Figure A.2 in Appendix A. It is recommended the Town conduct further investigation into the PLC programming at the Emma St. SPS to optimize pumping control if required.

Excluding periods of unstable pump operation, the peak flow from the collection system was estimated to be approximately 70 L/s (6,048 m^3/d) during the review period (2012 - 2014).

Evaluation of Plant Recycle and Septage Flows over the Review Period (2012 - 2014)

Decant flow from the aerobic digester and backwash flow from the tertiary filters are directed to the onsite pumping station, which pumps flow to the head of the plant, upstream of the plant headworks. Flow from the pumping station is measured with a magnetic flow meter. Over the review period, measured flow from the onsite pumping station represented approximately 12% of the final effluent measured flow. On an average monthly basis, there was a positive linear correlation between the measured final effluent flow and the measured flow from the onsite pumping station. As such, plant recycle flow is expected to increase as raw wastewater flows increase.

Flow from the onsite septage receiving tank is also metered. Plant operators have indicated there are some drains and rain water which are directed to the onsite septage receiving tank. Over the review period, the plant has received an average of approximately 11 m^3/d of flow from the septage receiving tank. However, due to the contributions from the connected drains, this value overestimates the actual volume of septage received at the Grand Valley WPCP.

Plant operators also indicated that issues were experienced with solenoids associated with wash water for the screening and grit removal system sticking in the open position, resulting in potable water flowing directly into the liquid stream. This flow is not measured directly, however it contributes to the measured effluent flow from the WPCP. The impact of these valves on total effluent wastewater flow is expected to be negligible.

2.2 Analysis of Inflow / Infiltration in the Collection System

The Town has recently conducted an investigation of I/I in the collection system (RJ Burnside, 2009). The investigation found significant volumes of I/I in the Grand Valley collection system. The investigation identified structural deficiencies at several manholes, but observed that the overall structural integrity of the collection system was not a significant factor contributing to I/I. Instead, it identified that significant I/I flows are generated on private property, specifically from the direct connection of footings to the sanitary collection system. Historically, the implementation of I/I reduction strategies on private property is difficult. The Town and R.J. Burnside have indicated they are currently pursuing provincial funding assistance to conduct an I/I reduction program.

Overall, I/I in the Grand Valley collection system impacts the magnitude of peak flows to the Emma St. SPS, and flow to the Grand Valley WPCP. It is important to note that several treatment processes at the Grand Valley WPCP are dependent on the maximum day and peak raw wastewater flows. As such, I/I may directly impact the available treatment capacity at the Grand Valley WPCP. Implementation of an I/I reduction strategy may reduce the intensity of peak flows to the Grand Valley WPCP in the future.

2.3 Plant Influent Raw Wastewater Quality during the Review Period (2012 - 2014)

Over the review period, grab samples of the raw wastewater stream were collected monthly. Samples were collected immediately upstream of the influent screens, and are representative of the plant influent raw wastewater flow. It includes contributions from the collection system raw wastewater, septage, tertiary filter backwash, and digester supernatant.

Table 2.3 presents a summary of the plant influent raw wastewater quality over the review period (2012 - 2014).

Generally, the combined influent was found to be of low strength with respect to biological oxygen demand (BOD_5), total suspended solids (TSS), and TP, and of low to medium strength with respect to total Kjeldahl nitrogen (TKN).

As discussed, only grab samples of the combined influent stream were collected during the review period (2012 - 2014). These samples are a representation of influent quality at the moment they are collected, but may not be an accurate representation of the average influent quality over 24 hours. Therefore, the results presented in Table 2.3 may not accurately represent average combined influent quality.

Table 2.3 Plant Influent Raw Wastewater Characteristics

Parameter	Units	Plant Influent Raw Wastewater (1)	Typical Wastewater Strength (2)
BOD_5	(mg/L)	105	110 *(Low)* 190 *(Med)* 350 *(High)*
TSS	(mg/L)	133	120 *(Low)* 210 *(Med)* 400 *(High)*
TKN	(mg/L)	33.4	20 *(Low)* 40 *(Med)* 70 *(High)*
TP	(mg/L)	3.45	4 *(Low)* 7 *(Med)* 12 *(High)*

Notes:
BOD - Biochemical Oxygen Demand
TSS - Total Suspended Solids
TKN - Total Kjeldahl Nitrogen
TP - Total Phosphorus
1. Includes filter backwash and digester supernatant recycle streams.
2. Metcalf and Eddy (2003).

2.4 Liquid Train Influent Loadings during the Review Period

Using results presented in Table 2.3 and the estimated average day plant flow over the review period, Table 2.4 presents a summary of the average day liquid train loading and per capita loading from data collected during the review period. This assumes a current service population of approximately 1,752.

Table 2.4 Summary of Plant and Per Capita Loading over the Review Period (2012 - 2014)

Parameter	Average Daily Load (kg/d) (1)	Historic Per Capita Load (g/cap/d)	Typical Per Capita Load (g/cap/d)
BOD_5	88.2	50.4	75 (2)
TSS	112	64.0	90 (2)
TKN	28.2	16.1	13.3 (3)
TP	2.91	1.66	2.1 (3)

Notes
1. Includes loading from recycle streams (digester supernatant and tertiary filter backwash), and from septage.
2. As per Design Guidelines for Sewage Works (MOE, 2008).
3. As per Metcalf and Eddy, 2010.

From the table above, the estimated per capita loading during the review period was below typical per capita loading rates for BOD_5, TSS, and TP. However, the estimated per capita TKN loading rate was greater than typical.

3. DEVELOPMENT OF DESIGN BASIS

The following subsections outline the future design basis in terms of raw wastewater flows and loadings for the Grand Valley WPCP. This design basis will be used to evaluate the capacity of the Grand Valley WPCP from both a hydraulic and biological treatment perspective in subsequent phases of this study.

For the purposes of this evaluation, flows and loads were developed for three future scenarios as follows:

- Scenario I: Full completion of planned residential developments;
- Scenario II: A 15% increase above the current CofA rated average day flow (ADF) (1,430 m^3/d); and,
- Scenario III: A 25% increase above the current CofA rated ADF (1,555 m^3/d).

3.1 Raw Wastewater Flows from the Collection System

3.1.1 Design Average Day Flow

Population projections for the Town were based on a recently completed review of future planned residential developments for the Town (R.J. Burnside, 2015). Specifically, future planned developments consist of:

- 321 housing units constructed as part of three residential developments (Mayberry Phase 1 and 2, and Hollenbeck); and,
- The 'Moco Allocation', consisting of 7 residential units and 15.3 hectares of developable land.

A summary of these planned residential developments is presented in Table 3.1.

Table 3.1 Summary of Serviced New Developments

Development	Population
Moco Allocation (1)	192
Mayberry Phase 1	190
Mayberry Phase 2	507
Hollenbeck	278
Total Additional Equivalent Service Population from New Developments	1,167

Notes:
1. Equivalent service population, consisting of serviced residential lots, and developed land.

New services corresponding to an equivalent population of 1,167 persons have been allocated by the Township, for a total equivalent service population of approximately 2,919.

Projected future wastewater flows from planned developments (Scenario I) were based on a design dry weather per capita flow of 372 L/cap/d, and an average I/I allowance of 82 L/cap/d. Both values are based on a review of 2012 - 2014 plant operating records. The overall design per capita wastewater flow for future development (454 L/cap/d) is identical to the 3-year average observed at the plant.

From Table 3.1, the estimated new equivalent service population associated with completion of all planned developments is 1,167 and is projected to contribute approximately 529 m^3/d on average to the plant. The existing average day flow is 746 m^3/d. Therefore, the overall projected average day flow is 1,276 m^3/d, which is only 32 m^3/d more than the CofA rated average day flow for the Grand Valley WPCP of 1,244 m^3/d.

Table 3.2 presents a summary of the ADF design basis for each presented scenario. For Scenario II and Scenario III, growth service populations were estimated from the increase in ADF and the design per capita flow.

Table 3.2 Design Per Capita Flows, Populations, and ADFs

Source	Per Capita Flow (L/cap·d)[1]		Design Serviced Population			Design ADF (m^3/d) [2]
	Existing	New Growth	Existing	New Growth	Total	
Scenario I	454	454	1,752	1,167	2,919	1,276
Scenario II				1,508	3,260	1,430
Scenario III				1,784	3,536	1,555

Notes:
1. Inclusive of I/I flow allowance.
2. Raw wastewater from the collection system.

3.1.2 Design Maximum Day Flow

The design MDF is based on the historic base MDF for the existing service area, plus a MDF allowance for future residential development.

To calculate the MDF allowance for new growth, a MDF peaking factor for the new growth flows was determined. This was done by applying the historic dry weather flow (DWF) factor to the non-I/I portion of the per capita flow rate, and applying a typical per capita generation rate of 227 L/cap/d for I/I flows (MOE, 2008).

A dry weather flow analysis was completed to determine the historic DWF factor. The analysis of DWF was conducted based on flow data from 2012 to 2014 and meteorological data from Environment Canada. Days were considered to be "dry" when no precipitation occurred for that day and three days prior between the months of May and October, inclusive. Based on the flow analysis, the historic DWF peaking factor for the existing service area was 2.1. In addition, the existing per capita DWF for the residential service area was estimated to be 372 L/cap/d, based on a service population of 1,752, and the existing I/I flow was estimated to be 82 m^3/d. Details of existing flows are presented in Table 2.1.

By applying the historic DWF peaking factor of 2.1 to the dry weather flow portion of the per capita flow, and the I/I flow peak factor to the I/I portion of the per capita flow, the overall MDF peaking factor for new growth was determined to be 2.2.

To determine the conceptual level design MDF for each phase, the new growth MDF factors were applied to the increase in average day design flows for each phase, and these growth MDF values were added to the existing base MDF. The conceptual level design MDF values for each phase are presented in Table 3.3.

Table 3.3 Design Maximum Day Flows

Parameter	Scenario I	Scenario II	Scenario III
Design ADF			
Existing	746 m^3/d	746 m^3/d	746 m^3/d
Growth	529 m^3/d	684 m^3/d	809 m^3/d
Overall (1)	**1,276 m^3/d**	**1,430 m^3/d**	**1,555 m^3/d**
MDF Factor			
Existing	6.3	6.3	6.3
Growth	2.2	2.2	2.2
Overall (1)	**4.6**	**4.3**	**4.1**
Design MDF			
Existing	4,671 m^3/d	4,671 m^3/d	4,671 m^3/d
Growth	1,157 m^3/d	1,494 m^3/d	1,768 m^3/d
Overall (1)	**5,828 m^3/d**	**6,165 m^3/d**	**6,439 m^3/d**

Notes:
1. Projected maximum day raw wastewater flow from the collection system.

Therefore, the conceptual level design MDF flows are 5,828 m^3/d, 6,165 m^3/d, and 6,439 m^3/d for Scenario I, Scenario II, and Scenario III, respectively.

3.1.3 Design Peak Flows

As previously noted, peak flow data indicate that peak flow of raw wastewater from the collection system via the Emma St. SPS has approached 6,048 m^3/d. This peak flow was observed during a peak flow event in April 2014, resulting from both a large snow melt and precipitation event.

Future peak instantaneous flow (PIF) values were calculated based on the PIF observed over the review period, plus a peak flow allowance for new growth. To calculate the PIF allowance for new growth, a PIF peaking factor for the new growth flows was determined for each design scenario. This was done by applying the Harmon peaking factor to the non-I/I portion of the per capita flow value, and applying a typical per capita peak I/I flow rate of 227 L/cap/d (MOE, 2008). The Harmon peaking factor was calculated for each phase based on the overall design equivalent populations of 2,919 for Scenario I; 3,260 for Scenario II; and 3,536 for Scenario III. Accordingly, the Harmon peaking factors for Scenarios I, II, and III were determined to be 3.5, 3.4, and 3.4, respectively.

By applying the appropriate Harmon peaking factor to the dry weather flow portion of the per capita flow, and the I/I flow peak factor to the I/I portion of the per capita flow, the overall PIF peaking factor for new growth was determined to be 3.3 for all three scenarios.

To determine the conceptual level design PIF for each scenario, the new growth PIF peaking factors were applied to the increase in average day design flows for each phase, and these growth PIF values were added to the existing base PIF. For the purposes of this conceptual level design basis, the PIF factor for new growth was applied to the growth flows. The conceptual level design PIF values for each phase are presented in Table 3.4.

Table 3.4 Design Peak Instantaneous Flows

Parameter	Scenario I	Scenario II	Scenario III
Design ADF			
Existing	746 m^3/d	746 m^3/d	746 m^3/d
Growth	529 m^3/d	684 m^3/d	809 m^3/d
Overall	**1,276 m^3/d**	**1,430 m^3/d**	**1,555 m^3/d**
PIF Factor			
Existing	10.2	10.2	10.2
Growth	3.3	3.3	3.3
Overall	**6.1**	**5.8**	**5.6**
Design PIF			
Existing	6,048 m^3/d	6,048 m^3/d	6,048 m^3/d
Growth	1,763 m^3/d	2,255 m^3/d	2,647 m^3/d
Overall	**7,811 m^3/d**	**8,303 m^3/d**	**8,695 m^3/d**

The conceptual level design PIF values are 7,811 m^3/d for Scenario I; 8,303 m^3/d for Scenario II; and 8,695 m^3/d for Scenario III.

The following important observations can be made based on results in Table 3.4:

- The overall design PIF factor for all scenarios is in excess of a typical peak factor given the equivalent service population of the Grand Valley WPCP. This is primarily a result of the large peak instantaneous flow observed in April 2014. Excessive peaking factors suggest the collection system may be susceptible to high extraneous flows during wet weather events; and,
- The projected PIF for all scenarios is in excess of the CofA rated Emma St. SPS capacity (7,680 m^3/d). This analysis suggests the Emma St. SPS may require upgrades at future flows provided that existing peak flows are not abated by any I/I reduction strategies. An extensive review of the Emma St. SPS capacity was not conducted as part of this review.

3.2 Raw Wastewater Loads

For purposes of developing loading projections, typical per capita loading rates were assumed for BOD_5, TSS, and TP. This is a conservative approach that accounts for the uncertainty of future development, and the uncertainty in grab sample data collected during the review period. Future per capita TKN loadings were assumed to be identical to per capita loadings observed during the review period (2012 - 2014).

Estimations of maximum month loading factors were established from plant records of effluent flows and influent concentrations. Data from April 2014 was found to be outlying due to high observed flows, and was excluded from analysis. Maximum month factors were estimated to be 1.9, 1.9, 1.9, and 2.2 for BOD_5, TSS, TKN and TP, respectively. Typical maximum month loading factors are much less than those observed at the Grand Valley

WPCP, and range from 1.4 to 1.6. As previously discussed, raw influent quality data over the review period (2012 - 2014) represents results from a single grab sample, collected on a monthly basis. This sampling technique may result in increased variability in results. The discrepancy between typical maximum month loading factors and those observed at the Grand Valley WPCP may be in part related to the type and frequency of raw influent sample collection. In order to develop a conservative design basis, maximum month factors developed from plant data were used.

Base raw wastewater loading included contributions from the following sources:

- Raw wastewater from the collection system;
- Recycle flow from the onsite pumping station; and,
- Septage.

Wastewater from all three sources are combined at the plant headworks, upstream of the grab sample location. As such, it is assumed that raw wastewater quality collected over the review period is a representation of all three streams and, therefore, base wastewater loadings include contributions from all three sources.

Septage receiving facilities at the Grand Valley WPCP were designed to treat an average day septage flow of 3.6 m^3/d. Plant operators have indicated that the septage receiving tank also receives drain water and some rain water from the plant. As such, accurate records of septage flow over the review period (2012 - 2014) are not available. Currently, the plant is operating at approximately 60% of its CofA rated ADF capacity of 1,244 m^3/d. For purposes of loading projections, it is assumed the plant also receives 60% of its designed septage capacity (i.e. approximately 2.2 m^3/d), and will receive the full design volume of septage when raw wastewater flows from the collection system reach the full projected capacity. Septage quality was assumed from typical values reported in literature (US EPA, 1984/1994).

Table 3.5 presents the projected future average day loadings to the Grand Valley WPCP.

Table 3.5 Design Average Raw Wastewater Loadings

Parameter	Base Raw Wastewater Loading	Loading Due to Growth (1,2,3)	Total Design Average Loading	Average Design Concentration
Scenario I				
BOD_5	88.2 kg/d	97.6 kg/d	186 kg/d	146 mg/L
TSS	112 kg/d	127 kg/d	239 kg/d	187 mg/L
TKN	28.2 kg/d	19.8 kg/d	47.9 kg/d	37.6 mg/L
TP	2.91 kg/d	2.81 kg/d	5.72 kg/d	4.48 mg/L
Scenario II				
BOD_5	88.2 kg/d	123 kg/d	211 kg/d	148 mg/L
TSS	112 kg/d	157 kg/d	269 kg/d	188 mg/L
TKN	28.2 kg/d	25.3 kg/d	53.4 kg/d	37.4 mg/L
TP	2.91 kg/d	3.53 kg/d	6.43 kg/d	4.50 mg/L
Scenario III				
BOD_5	88.2 kg/d	144 kg/d	232 kg/d	149 mg/L
TSS	112 kg/d	182 kg/d	294 kg/d	189 mg/L
TKN	28.2 kg/d	29.7 kg/d	57.9 kg/d	37.2 mg/L
TP	2.91 kg/d	4.11 kg/d	7.01 kg/d	4.51 mg/L

Notes:
1. Based on an assumed per capita loading of 75 g/cap/d for BOD5, 90 g/cap/d for TSS, 15.86 g/cap/d for TKN, and 2.1 g/cap/d for TP.
2. Based on an assumed population growth of 1,167 for Scenario 1, 1,515 for Scenario 2, and 1,793 for Scenario 3.
3. Assumed approximate 1.4 m^3/d increase in septage flows. Assumed septage quality (7,000 mg/L BOD_5, 15,000 mg/L TSS, 700 mg/L TKN, and 250 mg/L TP) as reported in literature (EPA 1984/1994)

The maximum monthly loadings were based on the maximum month loading peak factors observed over the review period for each parameter. The peak factors were 1.9 for BOD_5, 1.9 for TSS, 1.9 for TKN, and 2.2 for TP. Table 3.6 presents the design maximum monthly loadings to the Grand Valley WPCP.

Table 3.6 Design Maximum Month Raw Wastewater Loadings

Parameter	Average Design Wastewater Loading	Maximum Month Loading Peak Factor	Design Maximum Month Loading
Scenario I			
BOD_5	186 kg/d	1.9	353 kg/d
TSS	239 kg/d	1.9	453 kg/d
TKN	47.9 kg/d	1.9	91.1 kg/d
TP	5.72 kg/d	2.2	12.6 kg/d
Scenario II			
BOD_5	211 kg/d	1.9	402 kg/d
TSS	269 kg/d	1.9	512 kg/d
TKN	53.4 kg/d	1.9	101 kg/d
TP	6.43 kg/d	2.2	14.2 kg/d
Scenario III			
BOD_5	232 kg/d	1.9	441 kg/d
TSS	294 kg/d	1.9	559 kg/d
TKN	57.9 kg/d	1.9	110 kg/d
TP	7.01 kg/d	2.2	15.4 kg/d

4. SUMMARY OF PLANT FLOW AND LOAD PROJECTIONS

Table 4.1 contains a summary of the projected plant design basis flows and loads to the Grand Valley WPCP for all three scenarios. Projections of future plant loads were made using typical per capita loading rates, or based on the estimated historical per capita loading rate, whichever resulted in the more conservative estimate of future loads. Plant data collected from 2012 to 2014 was used as part of this review.

Table 4.1 Summary of Design Basis

Parameter	Scenario I	Scenario II	Scenario III
Population	2,919	3,260	3,536
ADF	1,276 m^3/d	1,430 m^3/d	1,555 m^3/d
MDF	5,828 m^3/d	6,165 m^3/d	6,439 m^3/d
MDF Factor	4.6	4.3	4.1
PIF	7,811 m^3/d	8,303 m^3/d	8,695 m^3/d
PIF Factor	6.1	5.8	5.6
BOD_5			
Average Loading	186 kg/d	211 kg/d	232 kg/d
Maximum Month Loading	353 kg/d	402 kg/d	441 kg/d
Average Concentration	146 mg/L	148 mg/L	149 mg/L
TSS			
Average Loading	239 kg/d	269 kg/d	294 kg/d
Maximum Month Loading	453 kg/d	512 kg/d	559 kg/d
Average Concentration	187 mg/L	188 mg/L	189 mg/L
TKN			
Average Loading	47.9 kg/d	53.4 kg/d	57.9 kg/d
Maximum Month Loading	91.1 kg/d	101 kg/d	110 kg/d
Average Concentration	37.6 mg/L	37.4 mg/L	37.2 mg/L
TP			
Average Loading	5.72 kg/d	6.43 kg/d	7.01 kg/d
Maximum Month Loading	12.6 kg/d	14.2 kg/d	15.4 kg/d
Average Concentration	4.48 mg/L	4.50 mg/L	4.51 mg/L

5. REFERENCES

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APPENDIX A
SCREENSHOTS OF EMMA ST. SPS MEASURED FLOW

Figure A.1 Emma St. SPS Measured Flows - April 13, 2014

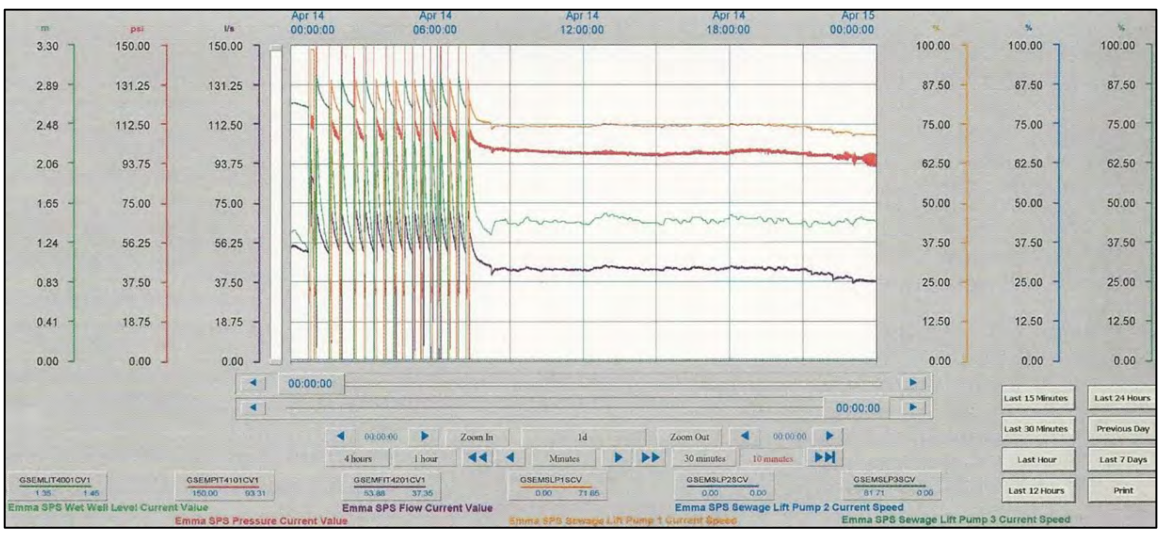

Figure A.2 Emma St. SPS Measured Flows - April 14, 2014

APPENDIX B

GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY UPDATED DESIGN BASIS

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XCG File No.: 3-252-57-01
January 24, 2017

GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY
UPDATED DESIGN BASIS

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1. INTRODUCTION

1.1 Background

The Grand Valley WPCP provides treatment for wastewater generated in the community of Grand Valley within the Town of Grand Valley (Town). The plant is currently operated by the Ontario Clean Water Agency (OCWA) under the Ministry of Environment and Climate Change (MOECC) Certificate of Approval (C of A) No. 9706-7KWQ57, issued on February 2, 2009. The quality and quantity of effluent currently discharged by the existing Water Pollution Control Plant (WPCP) is regulated by the C of A. The Grand Valley WPCP has a rated average capacity of 1,244 m^3/d.

The Town has initiated an investigation to analyze the potential to re-rate the existing Grand Valley WPCP to provide additional treatment capacity and to defer the facility's next upgrade and expansion. The Town has retained XCG Consulting Limited (XCG) to undertake a capacity assessment of the Grand Valley WPCP to evaluate the potential to re-rate the plant. As part of this assessment, XCG recently completed a review of plant raw wastewater flows and loads, and developed a design basis for future raw wastewater flows and loads (XCG, 2015). This review was completed using historic plant operating data, collected between 2012 and 2014. The purpose of this document is to update the design basis using additional raw wastewater flow and load information collected at the plant between January 2015 and May 2016.

1.2 Objectives

The specific objectives of this technical memorandum are to:

- Conduct an updated review of plant raw wastewater flows and loads; and
- Develop an updated design basis for future raw wastewater flows and loads.

1.3 Data Sources

The following data sources were used in part to develop projections of plant flows and loads:

- Plant flow and quality information (2012 - May 2016);
- Memorandum completed by R.J. Burnside regarding the existing and future service populations of the Grand Valley WPCP (May, 2015);
- East Luther Grand Valley (ELGV) Wastewater Treatment Plant Design Brief (2008);
- ELGV Inflow and Infiltration (I/I) Study Report (July, 2009);
- Grand Valley Wastewater Treatment Plant Operations Manual (July, 2015); and,
- Grand Valley WPCP facility tour (September, 2015).

2. REVIEW OF RAW WASTEWATER FLOW AND QUALITY

Raw sewage flows from the collection system are conveyed to the Grand Valley WPCP from the Emma St. sewage pumping station (SPS) via a forcemain. Complete details of equipment and operation of the Emma St. SPS are given in the design basis developed earlier in this study (XCG, 2015) that used historic operating data over the period 2012 to 2014.

2.1 Review of Raw Wastewater Flow over the Review Period (2012 - May 2016)

As of 2015, the Grand Valley WPCP serves a residential population of approximately 1,807 persons. Influent flow to the Grand Valley WPCP liquid treatment train is comprised of:

- Raw wastewater from the Grand Valley sanitary collection system, pumped to the plant via the Emma St. SPS;
- Septage flow from the onsite septage receiving station; and,
- Plant recycle flows (i.e. digester supernatant and filter backwash flow), pumped to the head of the plant from the onsite pumping station.

Flow from each source above is metered separately. In addition, effluent flow from the plant is measured using a V-notch weir. Although the recycle flows are metered and impact flows through the liquid treatment train, they do not contribute to the recorded plant influent and effluent flows since they simply recirculate internally within the process. A summary of the recorded plant influent (Emma St. SPS + septage) and recorded effluent flow (effluent V-notch weir) to the Grand Valley WPCP is shown as Table 2.1. For reference, the ADF as given in the annual report has also been included. The following points must be considered for purposes of flow analysis:

- Raw influent flow to the Grand Valley WPCP was calculated as the sum of flow from the Emma St. SPS and the onsite septage receiving station.
- Plant operators reported that the accumulation of grit in the magnetic flow meter at the Emma St. SPS led to false high measurements from 2012 - 2014. Beginning in July 2014, operators began regular flushing to prevent grit accumulation at the Emma St. SPS.
- In 2015, plant operators noted that malfunctioning solenoid valves at the plant headworks resulted in a larger volume of potable flushing water being added to the WPCP downstream of the influent flow measurement devices. Although this flushing water did not impact reported influent flow, it contributed to the final effluent flow readings, artificially increasing them. Unfortunately, potable water use at the WPCP is not metered, so it is not possible to estimate the volume of flushing water added to the process. The malfunctioning solenoid valves were replaced in early January 2016, and therefore this excess source of potable water would not have impacted effluent flows from February 2016 on.
- The final effluent V-notch weir was recalibrated in January 2016, approximately two weeks after the solenoid valves were replaced. As such, there is insufficient

data available to quantify the impact of replacing the malfunctioning solenoid valves on effluent flow measurements.

- The effluent flow meter calibration record indicates the 'zero' reading was adjusted during the calibration process in January 2016. Records do not detail the magnitude of the adjustment. Plant operators have indicated that the effluent meter was calibrated using influent flow data. Overall, details of calibration process and its impact on measured effluent flow from the Grand Valley WPCP are not clear from the available information and should be further investigated. The Town should also consider performing an additional assessment and calibration of the effluent flow meter, as required, to ensure the accuracy of the recorded final effluent flow.
- At the time of this analysis, 2016 flow data was only available for the months of January to May. To project annual 2016 ADF values, historic operating data were used to develop a ratio of (average January to May flow):(annual ADF). This method was used to account for the typically high flows experienced during the spring freshet. 2016 flows shown in Table 2.1 represent the projected 2016 annual ADF values.

Table 2.1 Summary of Plant Influent and Effluent Flow (2012 - 2016)

Average Day Flow	2012	2013	2014	2015	Projected 2016 (1)	Overall
Service Population	1,494	1,683	1,752	1,807	1,807 (2)	-
Raw Influent Flow (m^3/d) (3)	- (4)	- (4)	- (4)	471	675	573
Plant Effluent Flow (m^3/d)	643	821	776	710	719	734
OCWA Reported ADF (m^3/d) (5)	718	815	772	473	-	

Notes:
1. Flows measured from January to May 2016. Average daily influent flow (777 m^3/d) and effluent flow (828 m^3/d) have been adjusted here to account for the spring freshet.
2. Population data not available. Assumed equal to the 2015 service population.
3. Includes flows from the Emma St. SPS and the onsite septage receiving station.
4. Measured flow not available as a result of grit accumulation at the Emma St. SPS magmeter.
5. As reported in the Grand Valley WPCP Annual Report.

In 2016, raw influent and final effluent flow measurements from January to May were within 10%, indicating good agreement between the flow meters. The adjusted 2016 ADF as measured by either the influent or effluent flow meters is consistent with flows reported from 2012 to 2014.

Based on the available information, raw influent flow measured in 2015 (471 m^3/d) is not consistent with the range of effluent flows measured from 2012 - 2014 (643 m^3/d to 821 m^3/d) or ADF values reported in the Annual Reports over the same period (718 m^3/d to 815 m^3/d). Further, the 2015 raw influent flow also appears to be inconsistent with projected 2016 influent and effluent measurements at the Grand Valley WPCP (675 m^3/d and 719 m^3/d, respectively). Therefore, the accuracy of the 2015 raw influent data cannot be confirmed and, as such, these flows were not used as part of this design basis update.

As previously noted, measured final effluent flow in 2015 was impacted by malfunctioning solenoid valves in the headworks. However, the increase in final effluent flow resulting from the solenoid valves cannot be determined using the available information. Further, a dry weather flow analysis conducted using the 2015 final effluent data was found to be inconsistent with historical dry weather flows observed from 2012 to 2014. Therefore, the accuracy of the 2015 final effluent data could also not be confirmed and the data set was similarly excluded from the design basis update.

Table 2.2 presents a summary of the estimated final effluent flow and per capita flows to the Grand Valley WPCP. For comparison, projected flows from 2016 are included in the table. However, since the 2016 data set is not complete (i.e. only flows to May have been considered), it has not been used to develop flow projections. As previously noted, 2015 flows have also been excluded since their accuracy cannot be confirmed.

The table includes an estimate of dry weather plant flow and per capita flows, and quantification of the historical I/I observed at the plant for the period 2012 to 2014. Meteorological data was obtained from the Environment Canada station at Fergus, Ontario. Days were considered dry when no precipitation occurred for that day and three days prior. Only data from May to October was used for dry weather flow analysis. Since a complete data set is not available, dry weather flow analysis was not conducted on 2016 data.

Table 2.2 Summary of Treated Flow over the Review Period

	Units	2012	2013	2014	Projected 2016	Overall (3)
Estimated Service Population	Persons	1,494	1,683	1,752	1,807 (2)	-
Average Daily Flow (1)	m^3/d	643	821	776	719	746
Per Capita Flow	L/cap/d	430	488	443	398	454
Estimated Per Capita Dry Weather Flow	L/cap/d	371	391	354	-	372
Estimated Per Capita I/I	L/cap/d	59	97	89	-	82

Notes:
1. Based on flow measurements taken at the effluent flow meter over the review period.
2. Assumed population is unchanged from 2015.
3. Overall flows consider data collected from 2012 - 2014 only.

Results presented in Table 2.2 are unchanged from the design basis developed earlier in this study. The overall average per capita flow to the Grand Valley WPCP over the review period was 454 L/cap/d, inclusive of I/I. The estimated dry weather per capita flow (372 L/cap/d) is consistent with the typical range of per capita flows of 225 to 450 L/cap/d, exclusive of extraneous flows (MOE, 2008). The calculated per capita I/I was 82 L/cap/d, which is slightly less than the typical design I/I flow of 90 L/cap/d (MOE, 1985).

Summary of Maximum Day Flows during the Review Period (2012 - May 2016)

Table 2.3 provides an updated summary of the maximum day flows observed over the review period as measured at the final effluent flow meter. In 2014, the maximum day flow event required use of the storm tank. As such, the maximum day flow was estimated from influent flow as measured by the magmeter at the Emma St. SPS. Additional details are given in the previously completed design basis (November 17, 2015).

For comparison, data collected between January and May 2016 has also been included in the table. However, as previously noted, the accuracy of flow data from 2015 cannot be confirmed. As such, 2015 flow information has been excluded from this review.

Table 2.3 Summary Maximum Day Flows over the Review Period (2012 - May 2016)

	Units	2012	2013	2014	2016	Overall
ADF	m^3/d	643	821	776	719 (2)	734
MDF	m^3/d	2,601	2,254	4,671 (1)	2,370 (3)	4,671 (1)
MDF Factor	-	4.0	2.8	6.0	3.3	6.3

Notes:
Unless otherwise indicated, flows are based on flow measurements taken at the effluent flow meter over the review period (2012 - May 2016)
1. Based on Emma St. SPS flow measurements on April 13, 2014.
2. Projected 2016 ADF.
3. Maximum day flow recorded over the period January to May 2016.

Summary of Peak Flows during the Review Period (2012 - May 2016)

Peak flows were estimated from flow records at the Emma St. SPS. Additional details of the flow analysis are included in the design basis developed earlier in this study (XCG, 2015) and the analysis remains unchanged for this updated design basis. The peak flow from the collection system was estimated to be approximately 70 L/s (6,048 m^3/d).

Evaluation of Plant Recycle and Septage Flows over the Review Period (2012 - May 2016)

Decant flow from the aerobic digester and backwash flow from the tertiary filters are directed to the onsite pumping station, which pumps flow to the head of the plant, upstream of the plant headworks. Flow from the pumping station is measured with a magnetic flow meter. Over the review period, measured flow from the onsite pumping station represented approximately 11% of the final effluent measured flow. On an average monthly basis, there was a positive linear correlation between the measured final effluent flow and the measured flow from the onsite pumping station. As such, plant recycle flow is expected to increase as raw wastewater flows increase. As noted above, plant recycle flows impact flows to the liquid treatment train, but do not impact raw influent or final effluent flows.

Flow from the onsite septage receiving tank is also metered. From 2012 to 2014, plant operators indicated the annual average volume of septage received and treated at the Grand Valley WPCP was 75 m^3, or an equivalent daily flow of approximately 0.2 m^3/d. However, from 2012 to 2014, the plant received an average of approximately

11 m^3/d of flow from the septage receiving tank, significantly greater than the estimated equivalent daily septage flow. Exact reason for the discrepancy is not known, but plant operators have indicated there are some drains and rain water which are directed to the onsite septage receiving tank. The design average day septage treatment capacity is 3.6 m^3/d (R.J.Burnside, 2015).

2.2 Plant Influent Raw Wastewater Quality during the Review Period (2012 - May 2016)

Over the review period, grab samples of the raw wastewater stream were collected monthly. Samples were collected immediately upstream of the influent screens, and are representative of the plant influent raw wastewater flow. It includes contributions from the collection system raw wastewater, septage, tertiary filter backwash, and digester supernatant.

Table 2.4 presents a summary of the plant influent raw wastewater quality over the review period (2012 - May 2016). For purposes of comparison, plant influent quality as reported in the previously developed design basis (XCG, 2015) is also reported in the table.

Generally, the combined influent was found to be of low strength with respect to biological oxygen demand (BOD_5), total suspended solids (TSS), and TP, and of low to medium strength with respect to total Kjeldahl nitrogen (TKN). Inclusion of additional historical data had little impact on the average quality of the influent stream.

It is important to note that only one grab sample per month of the combined influent stream was collected during the review period (2012 - May 2016). These samples are a representation of influent quality at the moment they are collected, but may not be an accurate representation of the average influent quality over 24 hours. Therefore, the results presented in Table 2.4 may not accurately represent average combined influent quality.

Table 2.4 Plant Influent Raw Wastewater Characteristics

Parameter	Units	Plant Influent Raw Wastewater (1)				Typical Wastewater Strength (2)
		(2012 - 2014)	(2015)	(January - May, 2016)	Overall (2012 - May 2016)	
BOD_5	(mg/L)	105	134	99	111	110 *(Low)* 190 *(Med)* 350 *(High)*
TSS	(mg/L)	133	147	90	134	120 *(Low)* 210 *(Med)* 400 *(High)*
TKN	(mg/L)	33.4	38.7	31.2	34.4	20 *(Low)* 40 *(Med)* 70 *(High)*
TP	(mg/L)	3.45	4.02	3.02	3.54	4 *(Low)* 7 *(Med)* 12 *(High)*

Notes:
BOD - Biochemical Oxygen Demand
TSS - Total Suspended Solids
TKN - Total Kjeldahl Nitrogen
TP - Total Phosphorus
1. Includes filter backwash and digester supernatant recycle streams.
2. Metcalf and Eddy (2003).

Results presented in Table 2.4 indicate that raw wastewater in 2015 was slightly stronger than the 2012 - 2014 average raw wastewater strength. Conversely, raw wastewater samples collected from January to May 2016 were slightly weaker than the 2012 - 2014 average.

Due to the sampling method, there is significant variability expected in the quality results which impact the average concentration observed in a given year. For example, Figure 2.1 plots the measured BOD_5 concentration in the raw influent stream from 2012 - May 2016. Results show that, in 2015, the measured BOD_5 concentration was significantly greater than other measurements in the months of February, November, and December. However, over all other months, the BOD_5 concentration was comparable to other historical measurements. This figure is representative of other influent parameters (i.e. TSS, TKN, and TP). As such, there is no apparent trend in the raw influent concentrations, and data collected between January 2015 and May 2016 agrees with previous characterization of raw influent flow using data collected between 2012 and 2014.

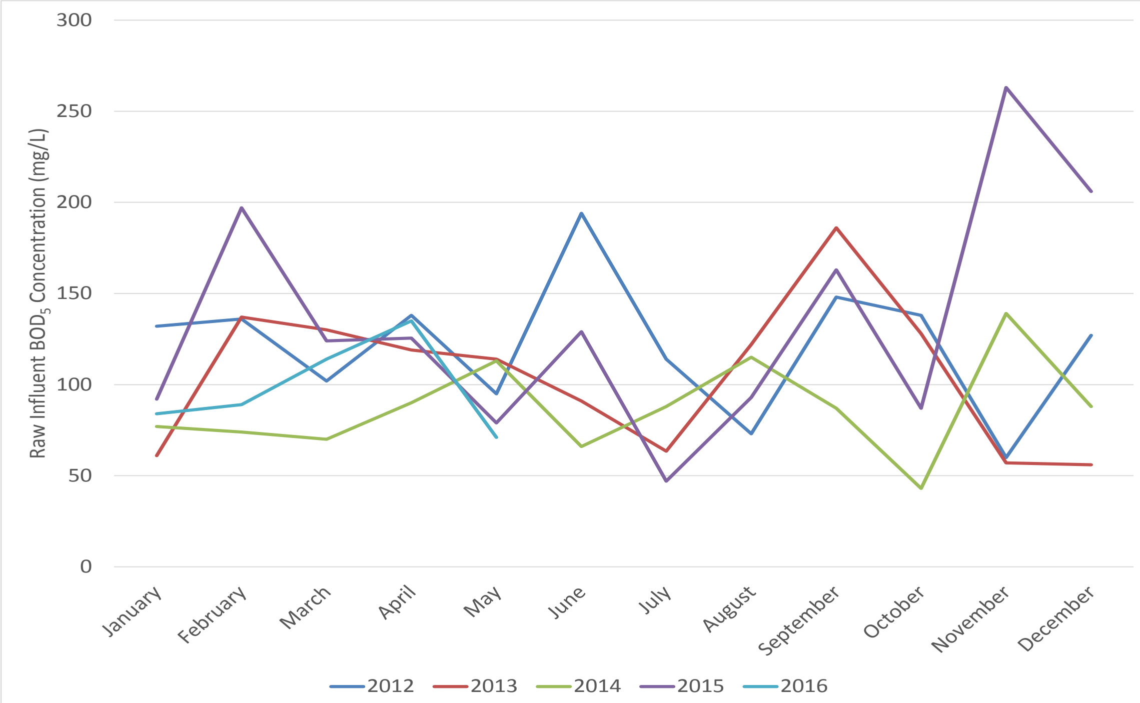

Figure 2.1 Raw Influent BOD$_5$ Concentrations (2012 - May 2016)

2.3 Liquid Train Influent Loadings during the Review Period

As previously presented, the accuracy of 2015 influent and effluent flows cannot be confirmed and have been excluded from consideration as part of this review. Further, raw wastewater quality information collected in 2015 and 2016 is consistent with previous data collected between 2012 and 2014.

As such, the estimated plant and per capita loading considers data collected from 2012 to 2014, and therefore is identical to the design basis which was previously developed. This information is reproduced in Table 2.5.

Table 2.5 Summary of Plant and Per Capita Loading over the Review Period (2012 - 2014)

Parameter	Average Daily Load (kg/d) (1)	Historic Per Capita Load (g/cap/d)	Typical Per Capita Load (g/cap/d)
BOD$_5$	88.2	50.4	75 (2)
TSS	112	64.0	90 (2)
TKN	28.2	16.1	13.3 (3)
TP	2.91	1.66	2.1 (3)

Notes

3. Includes loading from recycle streams (digester supernatant and tertiary filter backwash), and from septage.
4. As per Design Guidelines for Sewage Works (MOE, 2008).
5. As per Metcalf and Eddy, 2010.

From the table above, the calculated per capita loading during the review period was below typical per capita loading rates for BOD$_5$, TSS, and TP. However, the calculated per capita TKN loading rate was greater than typical.

3. DEVELOPMENT OF DESIGN BASIS

The following subsections outline the updated design basis in terms of raw wastewater flows and loadings for the Grand Valley WPCP. Similar to the previous design basis, flows and loads were developed for three future scenarios as follows:

- Scenario I: Full completion of planned residential developments;
- Scenario II: A 15% increase above the current CofA rated average day flow (ADF) (1,430 m^3/d); and,
- Scenario III: A 25% increase above the current CofA rated ADF (1,555 m^3/d).

3.1 Raw Wastewater Flows from the Collection System

3.1.1 Design Average Day Flow

Population projections for the Town were based on a recently completed review of future planned residential developments for the Town (R.J. Burnside, 2015).

New services corresponding to an equivalent population of 1,167 persons have been allocated by the Township, for a total equivalent service population of 2,974 based on the estimated 2015 existing service population. Details of planned developments were included in the design basis developed earlier in this study (XCG, 2015).

Projected future wastewater flows from planned developments (Scenario I) were based on a design dry weather per capita flow of 372 L/cap/d, and an average I/I allowance of 82 L/cap/d. Both values are based on the updated review of 2012 - May 2016 plant operating records. The overall design per capita wastewater flow for future development is 454 L/cap/d, contributing approximately 529 m^3/d on average to the plant. The existing average day flow is approximately 746 m^3/d, including septage contributions. For purposes of these projections, it is assumed future septage flows to the plant will be equal to the design treatment capacity (3.6 m^3/d). Plant records indicate the equivalent average daily septage flow treated at the plant is approximately 0.2 m^3/d, and therefore projections must consider an additional septage flow of 3.4 m^3/d.

The overall projected average day flow is approximately 1,279 m^3/d, which comparable to the CofA rated average day flow for the Grand Valley WPCP of 1,244 m^3/d.

Table 3.1 presents a summary of the ADF design basis for each presented scenario. For Scenario II and Scenario III, growth service populations were estimated from the increase in ADF and the design per capita flow of 454 L/cap/d (inclusive of I/I).

Table 3.1 Design Per Capita Flows, Populations, and ADFs

Source	Per Capita Flow (L/cap·d)[1]		Design Serviced Population			Added Septage Flow (m^3/d)	Design ADF (m^3/d)[2]
	Existing	New Growth	Existing	New Growth	Total		
Scenario I	454	454	1,752	1,167	2,919	3.4	1,279
Scenario II				1,508	3,260		1,430
Scenario III				1,784	3,536		1,555

Notes:
1. Inclusive of I/I flow allowance. Represents the average per capita flow observed over the review period.
2. Sum of base flow from the collection system (746 m^3/d from plant records), and growth flows from the collection and from received septage at the treatment plant.

3.1.2 Design Maximum Day Flow

The design MDF is based on the historic base MDF for the existing service area, plus a MDF allowance for future residential development. Details regarding the development of design maximum day flows are presented in the design basis developed earlier in this study (XCG, 2015). Design MDFs must also consider design maximum day septage flows of 11 m^3/d (R.J.Burnside, 2015). All design MDFs were based on the historic MDF observed at the Grand Valley WPCP. The updated conceptual level design MDF values for each phase are presented in Table 3.2.

Table 3.2 Design Maximum Day Flows

Parameter	Scenario I	Scenario II	Scenario III
Design ADF Existing Growth **Overall** [1]	 746 m^3/d 533 m^3/d **1,279 m^3/d**	 746 m^3/d 684 m^3/d **1,430 m^3/d**	 746 m^3/d 809 m^3/d **1,555 m^3/d**
MDF Factor Existing Growth **Overall** [1]	 6.3 2.2 **4.7**	 6.3 2.2 **4.3**	 6.3 2.2 **4.1**
Design MDF Existing Growth **Overall** [1]	 4,671 m^3/d 1,168 m^3/d **5,839 m^3/d**	 4,671 m^3/d 1,498 m^3/d **6,169 m^3/d**	 4,671 m^3/d 1,771 m^3/d **6,442 m^3/d**

Notes:
1. Projected maximum day raw wastewater flow from the collection system.

Therefore, the conceptual level design MDF flows are 5,839 m^3/d, 6,169 m^3/d, and 6,442 m^3/d for Scenario I, Scenario II, and Scenario III, respectively.

3.1.3 Design Peak Flows

As previously noted, peak flow data indicate that peak flow of raw wastewater from the collection system via the Emma St. SPS has approached 6,048 m^3/d. This peak flow was observed during a peak flow event in April 2014, resulting from both a large snow melt and precipitation event.

Future peak instantaneous flow (PIF) values were calculated based on the PIF observed over the review period, plus a peak flow allowance for new growth. Details regarding the development of peak instantaneous flows are presented in the design basis developed earlier in this study (XCG, 2015). The updated conceptual level design PIF values for each scenario are presented in Table 3.3.

Table 3.3 Design Peak Instantaneous Flows

Parameter	Scenario I	Scenario II	Scenario III
Design ADF Existing Growth **Overall**	 746 m^3/d 533 m^3/d **1,279 m^3/d**	 746 m^3/d 684 m^3/d **1,430 m^3/d**	 746 m^3/d 809 m^3/d **1,555 m^3/d**
PIF Factor Existing Growth **Overall**	 10.2 3.3 **6.1**	 10.2 3.3 **5.8**	 10.2 3.3 **5.6**
Design PIF Existing Growth **Overall**	 6,048 m^3/d 1,763 m^3/d **7,811 m^3/d**	 6,048 m^3/d 2,255 m^3/d **8,303 m^3/d**	 6,048 m^3/d 2,647 m^3/d **8,695 m^3/d**

The conceptual level design PIF values are 7,811 m^3/d for Scenario I; 8,303 m^3/d for Scenario II; and 8,695 m^3/d for Scenario III.

The following important observations can be made based on results in Table 3.3:

- The overall design PIF factor for all scenarios is in excess of a typical peak factor given the equivalent service population of the Grand Valley WPCP. This is primarily a result of the large peak instantaneous flow observed in April 2014. Excessive peaking factors suggest the collection system may be susceptible to high extraneous flows during wet weather events; and,
- The projected PIF for all scenarios is in excess of the CofA rated Emma St. SPS capacity (7,680 m^3/d). This analysis suggests the Emma St. SPS may require upgrades at future flows provided that existing peak flows are not abated by any I/I reduction strategies. An extensive review of the Emma St. SPS capacity was not conducted as part of this review.

3.2 Raw Wastewater Loads

For purposes of developing loading projections, typical per capita loading rates were assumed for BOD_5, TSS, and TP. This is a conservative approach that accounts for the uncertainty of future development and the uncertainty in grab sample data collected during the review period. Future per capita TKN loadings were assumed to be identical to per capita loadings observed during the review period (2012 - 2014).

Estimations of maximum month loading factors were established from plant records of effluent flows and influent concentrations. Data from April 2014 was found to be outlying due to high observed flows, and was excluded from analysis. Maximum month factors were estimated to be 1.9, 1.9, 1.9, and 2.2 for BOD_5, TSS, TKN and TP, respectively. Typical maximum month loading factors are much less than those observed at the Grand Valley WPCP, and range from 1.4 to 1.6. As previously discussed, raw influent quality data over the review period (2012 - 2014) represents results from a single grab sample, collected on a monthly basis. This sampling technique may result in increased variability in results. The discrepancy between typical maximum month loading factors and those observed at the Grand Valley WPCP may be in part related to the type and frequency of raw influent sample collection. In order to develop a conservative design basis, maximum month factors developed from plant data were used.

Base raw wastewater loading included contributions from the following sources:

- Raw wastewater from the collection system;
- Recycle flow from the onsite pumping station; and,
- Septage.

Wastewater from all three sources are combined at the plant headworks, upstream of the grab sample location. As such, it is assumed that raw wastewater quality collected over the review period is a representation of all three streams and, therefore, base wastewater loadings include contributions from all three sources.

Septage receiving facilities at the Grand Valley WPCP were designed to treat an average day septage flow of 3.6 m^3/d (R.J.Burnside, 2015). Plant operators have indicated that the septage receiving tank also receives drain water and some rain water from the plant. As such, accurate records of septage flow over the review period (2012 - May 2016) are not available. Using annual septage received records from plant operators, the estimated equivalent daily septage flow is 0.2 m^3/d. For purposes of loading projections, it is assumed the plant will receive the full design volume of septage when raw wastewater flows from the collection system reach the full projected capacity. Septage quality was assumed from typical values reported in literature (US EPA, 1984/1994).

Table 3.4 presents the projected future average day loadings to the Grand Valley WPCP.

Table 3.4 Design Average Raw Wastewater Loadings

Parameter	Base Raw Wastewater Loading	Loading Due to Growth (1,2,3)	Total Design Average Loading	Average Design Concentration
Scenario I				
BOD_5	88.2 kg/d	111 kg/d	200 kg/d	156 mg/L
TSS	112 kg/d	156 kg/d	268 kg/d	210 mg/L
TKN	28.2 kg/d	21.1 kg/d	49.3 kg/d	38.6 mg/L
TP	2.91 kg/d	3.30 kg/d	6.21 kg/d	4.85 mg/L
Scenario II				
BOD_5	88.2 kg/d	136 kg/d	225 kg/d	157 mg/L
TSS	112 kg/d	186 kg/d	298 kg/d	208 mg/L
TKN	28.2 kg/d	26.5 kg/d	54.7 kg/d	38.2 mg/L
TP	2.91 kg/d	4.00 kg/d	6.91 kg/d	4.83 mg/L
Scenario III				
BOD_5	88.2 kg/d	157 kg/d	245 kg/d	158 mg/L
TSS	112 kg/d	211 kg/d	322 kg/d	208 mg/L
TKN	28.2 kg/d	30.9 kg/d	59.1 kg/d	38.0 mg/L
TP	2.91 kg/d	4.58 kg/d	7.48 kg/d	4.81 mg/L

Notes:
1. Based on an assumed per capita loading of 75 g/cap/d for BOD5, 90 g/cap/d for TSS, 16.1 g/cap/d for TKN, and 2.1 g/cap/d for TP.
2. Based on an assumed population growth of 1,167 for Scenario 1, 1,500 for Scenario 2, and 1,775 for Scenario 3.
3. Assumed approximate 3.4 m^3/d increase in septage flows. Assumed septage quality (7,000 mg/L BOD_5, 15,000 mg/L TSS, 700 mg/L TKN, and 250 mg/L TP) as reported in literature (EPA 1984/1994)

The maximum monthly loadings were based on the maximum month loading peak factors observed over the review period for each parameter. The peak factors were 1.9 for BOD_5, 1.9 for TSS, 1.9 for TKN, and 2.2 for TP. Table 3.5 presents the design maximum monthly loadings to the Grand Valley WPCP.

Table 3.5 Design Maximum Month Raw Wastewater Loadings

Parameter	Average Design Wastewater Loading	Maximum Month Loading Peak Factor	Design Maximum Month Loading
Scenario I			
BOD_5	200 kg/d	1.9	379 kg/d
TSS	268 kg/d	1.9	509 kg/d
TKN	49.3 kg/d	1.9	93.7 kg/d
TP	6.21 kg/d	2.2	13.7 kg/d
Scenario II			
BOD_5	225 kg/d	1.9	427 kg/d
TSS	298 kg/d	1.9	566 kg/d
TKN	54.7 kg/d	1.9	104 kg/d
TP	6.91 kg/d	2.2	15.2 kg/d
Scenario III			
BOD_5	245 kg/d	1.9	466 kg/d
TSS	322 kg/d	1.9	613 kg/d
TKN	59.1 kg/d	1.9	112 kg/d
TP	7.48 kg/d	2.2	16.5 kg/d

4. SUMMARY OF PLANT FLOW AND LOAD PROJECTIONS

Table 4.1 contains a summary of the projected plant design basis flows and loads to the Grand Valley WPCP for all three scenarios. Projections of future plant loads were made using typical per capita loading rates, or based on the estimated historical per capita loading rate, whichever resulted in the more conservative estimate of future loads. Plant data collected from 2012 to May 2016 was used as part of this review.

Table 4.1 Summary of Design Basis

Parameter	Scenario I		Scenario II		Scenario III	
	Previous	Updated	Previous	Updated	Previous	Updated
Population	2,919	2,919	3,260	3,252	3,536	3,527
ADF	1,276 m^3/d	1,279 m^3/d	1,430 m^3/d		1,555 m^3/d	
MDF	5,828 m^3/d	5,839 m^3/d	6,165 m^3/d	6,169 m^3/d	6,439 m^3/d	6,442 m^3/d
MDF Factor	4.6		4.3		4.1	
PIF	7,811 m^3/d	7,811 m^3/d	8,303 m^3/d	8,291 m^3/d	8,695 m^3/d	8,684 m^3/d
PIF Factor	6.1		5.8		5.6	
BOD_5						
Avg. Load	186 kg/d	200 kg/d	211 kg/d	225 kg/d	232 kg/d	245 kg/d
Max Load	353 kg/d	379 kg/d	402 kg/d	427 kg/d	441 kg/d	466 kg/d
Avg. Conc.	146 mg/L	156 mg/L	148 mg/L	157 mg/L	149 mg/L	158 mg/L
TSS						
Avg. Load	239 kg/d	268 kg/d	269 kg/d	298 kg/d	294 kg/d	322 kg/d
Max Load	453 kg/d	509 kg/d	512 kg/d	566 kg/d	559 kg/d	613 kg/d
Avg. Conc.	187 mg/L	210 mg/L	188 mg/L	208 mg/L	189 mg/L	208 mg/L
TKN						
Avg. Load	47.9 kg/d	49.3 kg/d	53.4 kg/d	54.7 kg/d	57.9 kg/d	59.1 kg/d
Max Load	91.1 kg/d	93.7 kg/d	104 kg/d	104 kg/d	110 kg/d	112 kg/d
Avg. Conc.	37.6 mg/L	38.6 mg/L	37.4 mg/L	38.2 mg/L	37.2 mg/L	38.0 mg/L
TP						
Avg. Load	5.72 kg/d	6.21 kg/d	6.43 kg/d	6.91 kg/d	7.01 kg/d	7.48 kg/d
Max Load	12.6 kg/d	13.7 kg/d	14.2 kg/d	15.2 kg/d	15.4 kg/d	16.5 kg/d
Avg. Conc.	4.48 mg/L	4.85 mg/L	4.50 mg/L	4.83 mg/L	4.51 mg/L	4.81 mg/L

5. REFERENCES

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APPENDIX C
GRAND VALLEY WPCP HEADWORKS HYDRAULICS ANALYSIS

XCG Environmental Engineers & Scientists

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Date:	January 24, 2017	**XCG File No.: 3-252-57-02**
To:	Jane Wilson, Town of Grand Valley	
From:	XCG Consultants Ltd (XCG)	
Re:	Grand Valley WPCP Headworks Hydraulics Analysis	

1. INTRODUCTION

The Grand Valley Water Pollution Control Plant (WPCP) provides treatment for wastewater generated in the community of Grand Valley, within the Town of Grand Valley (Town). The plant is currently operated by the Ontario Clean Water Agency (OCWA) and has a rated average day flow (ADF) capacity of 1,244 m^3/d.

The town has initiated an investigation to analyze the potential to re-rate the existing Grand Valley WPCP to provide additional treatment capacity and to defer the facility's next upgrade and expansion. The Town has retained XCG Consulting Limited. (XCG) to conduct a capacity evaluation and re-rating study of the Grand Valley WPCP to potentially defer the next required plant expansion.

The purpose of this memorandum is to present the methodology and results of the hydraulic analysis of the Grand Valley WPCP headworks facilities.

2. BACKGROUND

2.1 Future Design Basis

For purposes of this capacity evaluation, three future design scenarios are being considered:

- Scenario I: Full completion of planned residential developments;
- Scenario II: A 15% increase above the current C of A rated ADF (1,430 m^3/d); and
- Scenario III: A 25% increase above the current C of A rated ADF (1,555 m^3/d).

A summary of the Grand Valley WPCP flow design basis is included in Table 2.1. This table includes flow details as presented in the updated design basis (XCG, 2016), but does not include comparison to previous design basis projections nor projections of parameter loads. Flows shown in Table 2.1 represent the projected raw influent flow from the collection system to the Grand Valley WPCP. It is important to note the projected peak flows for all three scenarios exceed the existing rated capacity of the Emma St. SPS (7,680 m^3/d). Therefore, the Emma St. SPS may require upgrades at future flows provided that existing peak flows are not abated by any I/I reduction strategies. An extensive review of the Emma St. SPS capacity was not conducted as part of this review. Further, it is assumed that future peak flows to the Grand Valley WPCP will not be inhibited by the pumping capacity of the Emma St. SPS.

Table 2.1 Summary of Raw Influent Flow from the Collection System (XCG, 2016)

Parameter	Scenario I	Scenario II	Scenario III
Population	2,919	3,252	3,527
ADF	1,279 m^3/d	1,430 m^3/d	1,555 m^3/d
MDF	5,839 m^3/d	6,169 m^3/d	6,442 m^3/d
MDF Factor	4.6	4.3	4.1
PIF	7,811 m^3/d	8,291 m^3/d	8,684 m^3/d
PIF Factor	6.1	5.8	5.6

However, backwash flow from the tertiary filters is discharged to the on-site pumping station where it is pumped to the head of the plant upstream of the plant headworks. As such, hydraulic analysis of the plant headworks must also consider peak flow from the onsite pumping station.

The on-site pumping station is equipped with two pumps, one duty and one standby. However, records of plant operation indicate that both pumps will operate under peak flow conditions. Both pumps have a rated capacity of 8.0 L/s (691 m^3/d), but the peak pumping rate when both pumps are in operation is approximately 11 L/s (950 m^3/d).

Headworks at the Grand Valley WPCP consists of screening and grit removal. The capacity of these processes is evaluated based on peak instantaneous and peak hour flows, respectively. Table 2.2 summarizes the projected peak flow through the plant headworks considering contributions from the Emma St. SPS (i.e. raw influent from the collection system) and from the onsite pumping station (i.e. tertiary filter backwash flow).

Table 2.2 Summary of Peak Flow through the Grand Valley WPCP Headworks

Peak Flow	Scenario I	Scenario II	Scenario III
Emma St. SPS (Collection System)	7,811 m^3/d	8,291 m^3/d	8,684 m^3/d
Onsite Pumping Station (Filter Backwash)		950 m^3/d	
Total Projected Peak Instantaneous Flow	8,761 m^3/d	9,241 m^3/d	9,634 m^3/d
Total Projected Peak Hour Flow (1)	7,885 m^3/d	8,317 m^3/d	8,670 m^3/d

Notes:
1. Assumed to be 90% of the peak instantaneous flow.

2.2 Existing Plant Headworks

As previously noted, headworks at the Grand Valley WPCP consists of screening and grit removal processes. Screening is provided by one perforated plate type mechanical screen, operating as the duty screen, and one manually raked bar screen operating in stand-by. The mechanical screen has a rated capacity of 7,680 m^3/d based on the C of A and the plant operations manual (RJ Burnside, 2015). Screenings are collected and compacted then transferred to a bin and disposed off-site. The quantity of screenings generated at the Grand Valley WPCP is not measured; therefore the performance of the screens in terms of screenings generation per m^3 of wastewater treated could not be assessed.

Flow to the manual screen channel is controlled by a gate. Under typical flow conditions, the gate remains closed, thereby directing all flow through the mechanical screen. In the closed position, the top elevation of the gate is well below the elevation at the top of the channel. As such, in the closed position, the gate serves as an emergency bypass weir. Peak flows which exceed the elevation at the top of the gate will automatically bypass the mechanical screen through the manual screen channel.

Grit removal is provided by two vortex grit separators, each 1.83 metres in diameter. The rated capacity of each vortex grit separator is 3,840 m^3/d, for a total peak capacity of 7,680 m^3/d. Grit from both separators is collected and compacted then transferred to a bin and disposed off-site. The quantity of grit generated at the Grand Valley WPCP is not measured; therefore the performance of the grit separators in terms of volume generation per m^3 of wastewater treated could not be assessed.

A bypass exists around the vortex grit separators which transports screened raw influent wastewater to the raw wastewater flow splitter box located upstream of biological treatment at the Grand Valley WPCP. Grit bypass is controlled by an overflow weir which has a set elevation. It is assumed the height of the weir controls flow through the grit removal process to the design peak flow (7,680 m^3/d).

A summary of the Grand Valley WPCP headworks treatment process design information is included in Table 2.3.

Table 2.3 Grand Valley WPCP Headworks Process Design Information

Unit Process	Design Parameter (1)
Preliminary Treatment	
Screening	
Type	Mechanical and Manual Bar
Number	1 mechanical (duty) 1 bar (standby)
Peak Flow Capacity (mechanical screen)	7,680 m^3/d
Grit Removal	
Type	Vortex
Number	2
Capacity	3,840 m^3/d (each) 7,680 m^3/d (total)

Notes:
1. Based on Amended Certificate of Approval Number 9706-7KWQ57, issued February 2, 2009 and Grand Valley Wastewater Treatment Plant Operations Manual (RJ Burnside, 2015).

A plan view of influent channel, screening, and grit removal is shown as Figure 2.1. The figure has been modified from available plant as-built drawings (R.J. Burnside, 2012).

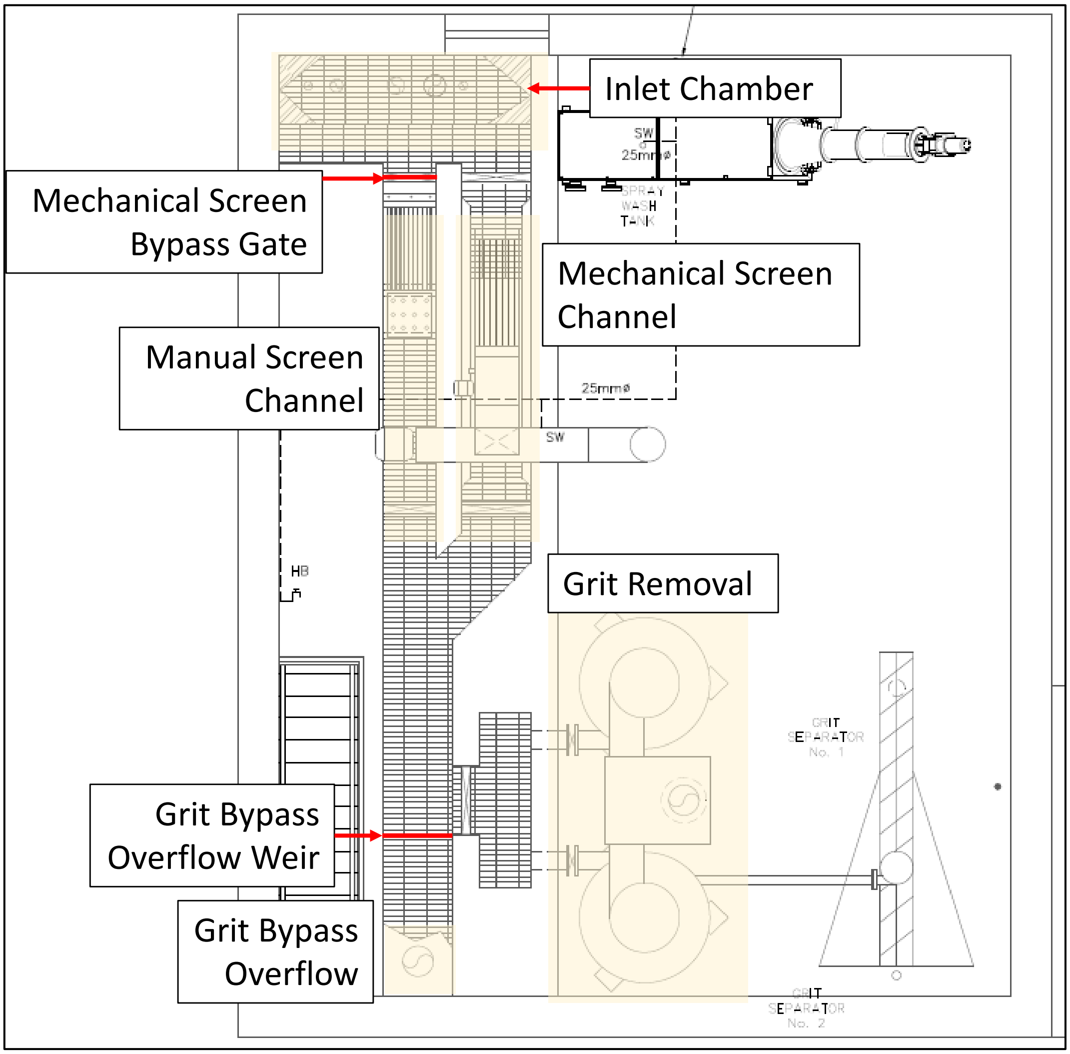

Figure 2.1 Plan View of Grand Valley WPCP Headworks

3. HYDRAULIC ANALYSIS OF GRAND VALLEY WPCP HEADWORKS

As previously discussed, peak flow through the grit removal process is limited by a fixed-height grit bypass overflow weir. For purposes of this analysis, it is assumed the weir-controlled peak flow through the grit removal process is equal to the design peak capacity of the grit removal process (7,680 m^3/d) and that excess flows will bypass the grit removal process. As such, the grit bypass weir controls the hydraulic level in the screen channel immediately upstream of the grit removal process.

It is important to note that a hydraulic analysis of the grit removal process was not completed as part of this work. As such, the exact relationship between the raw influent flow rate and grit removal performance is not known.

Overall, it is acknowledged that grit removal performance may decrease at future peak flows as a result of operation in excess of the rated capacity and/or bypass of the grit removal treatment processes. However, the existing grit removal processes have the rated capacity to treat approximately 89% of the projected peak hour flow for Scenario III. Therefore, the impact of grit removal performance on the estimated capacity of downstream treatment processes is expected to be negligible.

As such, this analysis focused on estimating the headloss in the mechanical screen channel upstream of the grit removal process. Headloss in the channel was estimated from three distinct sources:

- Headloss due to friction between the wastewater and channel walls;
- Headloss due to form changes (i.e. corners) in the channel; and
- Headloss across the mechanical screening process.

From plant as-built drawings, the channel width was noted to be 0.8 metres, and was assumed unchanged along the length of the channel.

Headloss due to friction was estimated using the process described by Nicklow & Boulos (2005). For this calculation, a reference hydraulic head level is required at a downstream location. The process then calculates the hydraulic level at upstream locations given the projected flow rate and characteristics of the channel (e.g. width, construction material, slope, etc.). The reference head level at the grit bypass weir was estimated from weir flow equations given the known height of the bypass weir and the estimated grit bypass flow at Scenario III peak flows.

Headloss due to form changes was estimated as described by Hager (1999). Headloss due to form changes depends the configuration of the form change, the estimated velocity in the channel, and a headloss coefficient which is estimated based on the geometry of the channel.

Headloss across the mechanical screen was estimated by the screen supplier (John Meunier). Headloss across the screen will depend on the volumetric flow rate and screen blockage. For purposes of this work, a conservative assumption of 70% screen blockage was used for calculations. A summary of the estimated headloss across the mechanical screen from the supplier is included as Appendix A.

A summary of estimated headloss in the mechanical screen channel from each source is given in Table 3.1.

Table 3.1 Summary of Estimated Headloss in the Screen Channel at a Peak Flow of 9,634 m^3/d

Parameter	Headloss (m)	Percentage of Total (%)
Friction Losses	0.005	2.6%
Form Losses	0.004	2.4%
Across the Mechanical Screen	0.175	95.0%
Total Headloss	0.184	-

Based on results presented in Table 3.1, the majority of headloss in the screen channel occurs across the mechanical screen. At the conservative estimation of screen blockage (70%), the headloss is approximately 175 millimetres (0.175 metres), or approximately 95% of the total estimated headloss in the mechanical screen channel.

Given the estimated downstream head level at the grit removal bypass weir (474.26 metres) and the estimated headloss in the mechanical screen channel (0.184 m), the estimated hydraulic level at the mechanical screen channel inlet at projected peak flows for Scenario III is approximately 474.45 metres. Therefore, the estimated head level at peak flows is less than both the current high level alarm in the influent chamber (474.49 metres) and the mechanical screen bypass (474.59 metres).

A visual representation of the estimated hydraulic level in the mechanical screen channel is given as Figure 3.1. The hydraulic levels immediately upstream and downstream of the mechanical screen have been modified from the hydraulic profile given as part of the plant as-built drawings. Modified hydraulic levels are shown in red text.

Therefore, based on preceding discussion and results presented in Figure 3.1, the estimated hydraulic level in the mechanical screen channel at projected peak flows for Scenario III is below both the high-level float in the inlet chamber and mechanical screen bypass levels. As such, the headworks appear to have sufficient hydraulic capacity to treat flows the projected Scenario III peak flows.

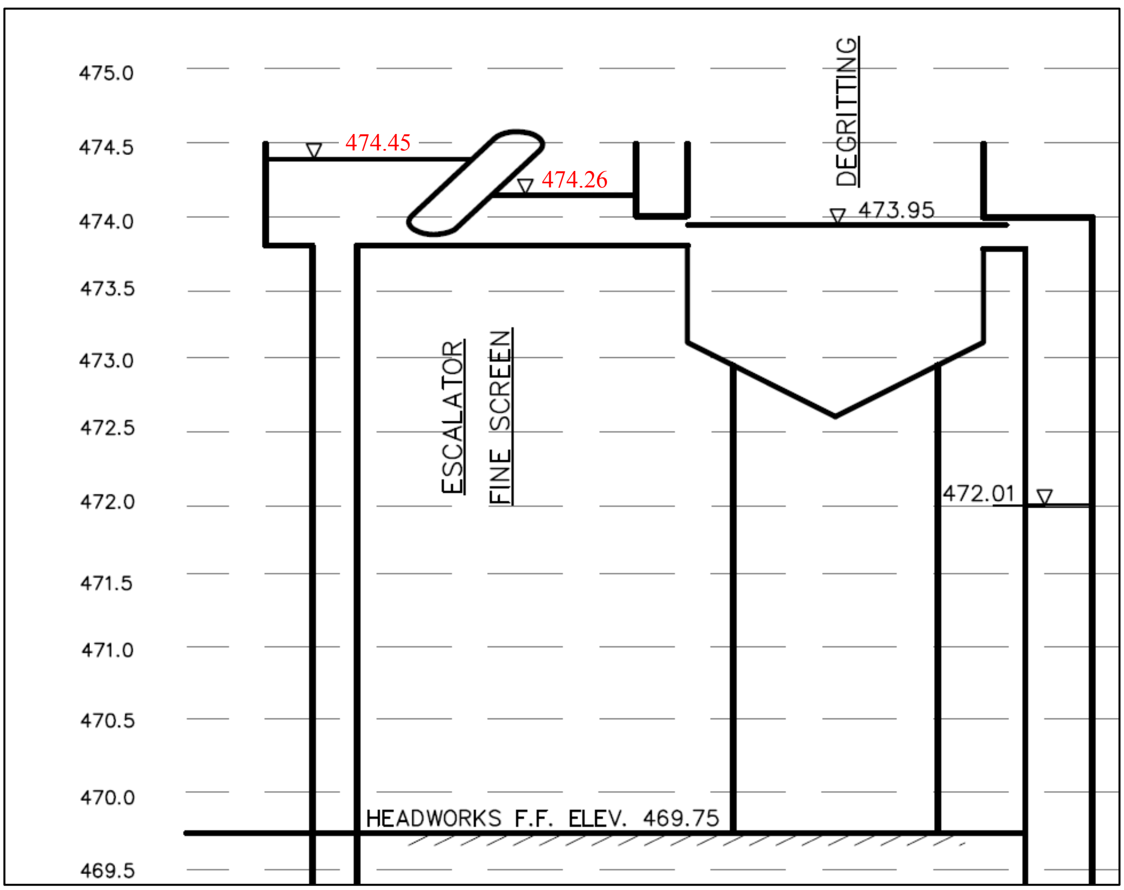

Figure 3.1 Projected Hydraulic Level in the Grand Valley WPCP Headworks at Scenario III Peak Flows

4. REFERENCES

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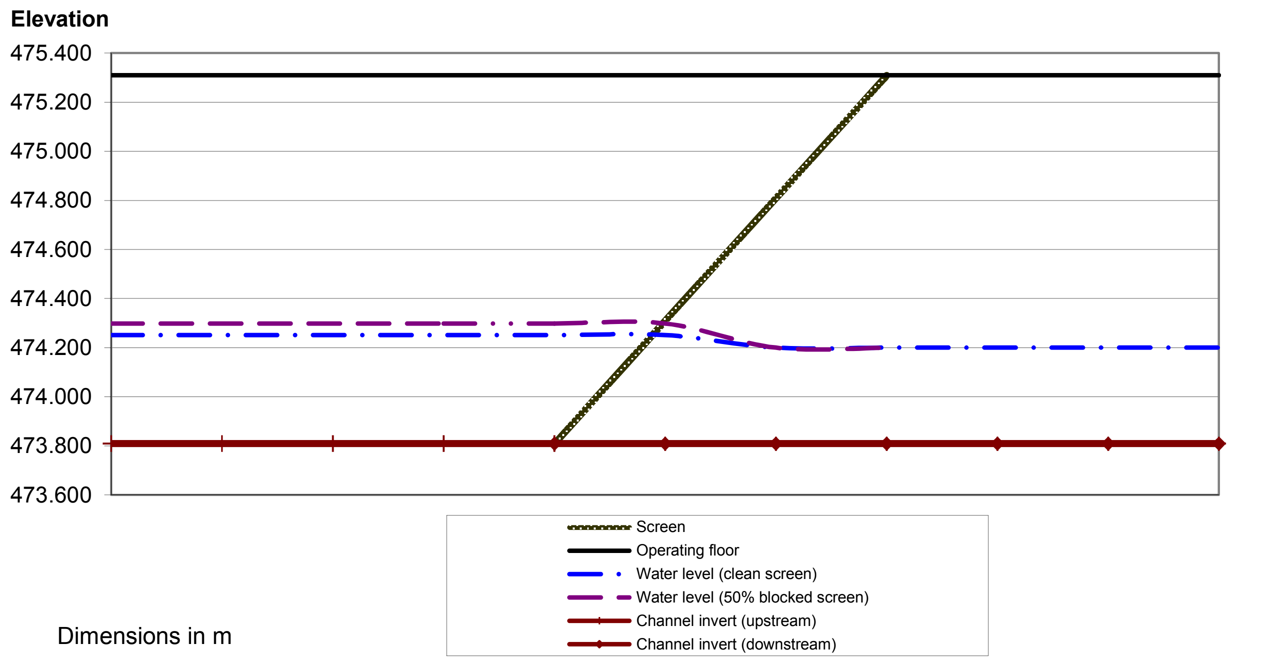
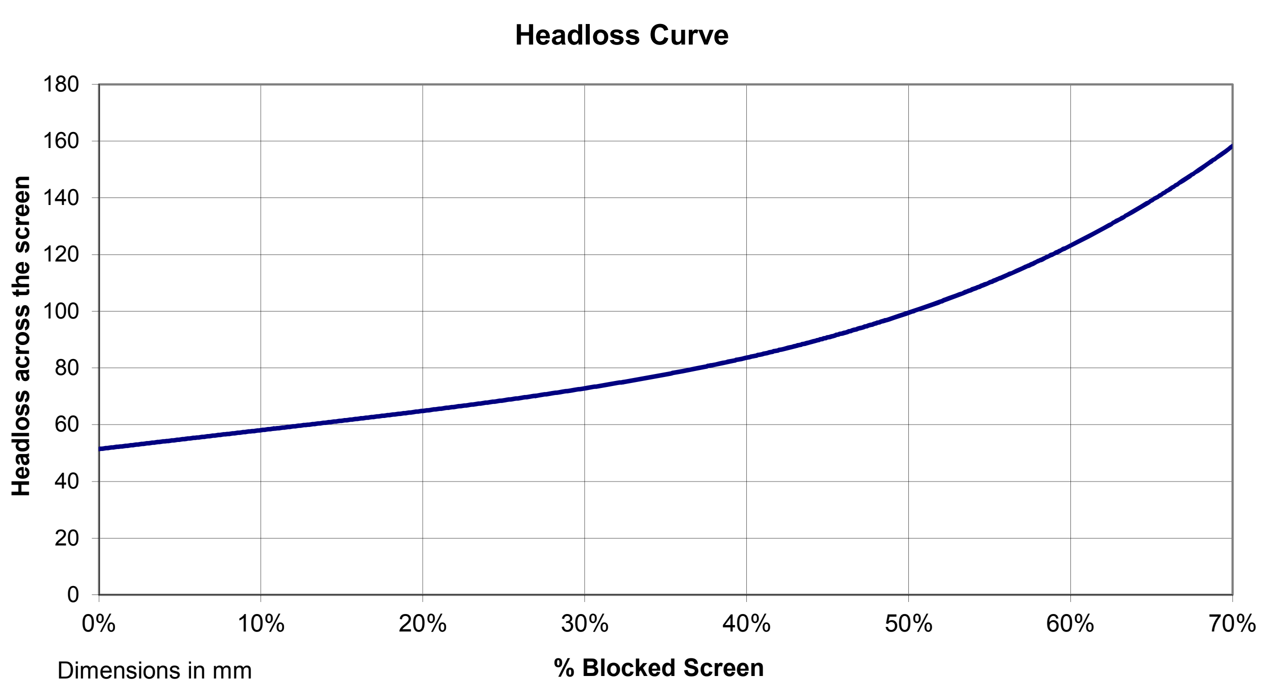
APPENDIX A
EXPECTED HEADLOSS ACROSS MECHANICAL SCREEN

Project name	**Grand Valley, ON**
Project ref.	**AD04 Rev 0**
Model reference	**ESH6-24XA**

Peak flow per unit	**8695.00** m³/d	**Downstream hydraulic condition**	**Client profile**
Screen openings	**6.00** mm	**Downstream water depth**	**390.00** mm
Channel width	**800.00** mm	**Approach velocity (clean screen)**	**0.29** m/s
Side recess (total)	**0.00** mm	**Velocity through screen (clean screen)**	**0.62** m/s
Channel depth	**1500.00** mm	**Downstream velocity**	**0.32** m/s
Bottom recess	**150.00** mm	**Available freeboard upstream at 0%**	**1058.70** mm
Installation angle	**60** °	**Available freeboard upstream at 50%**	**1011.27** mm



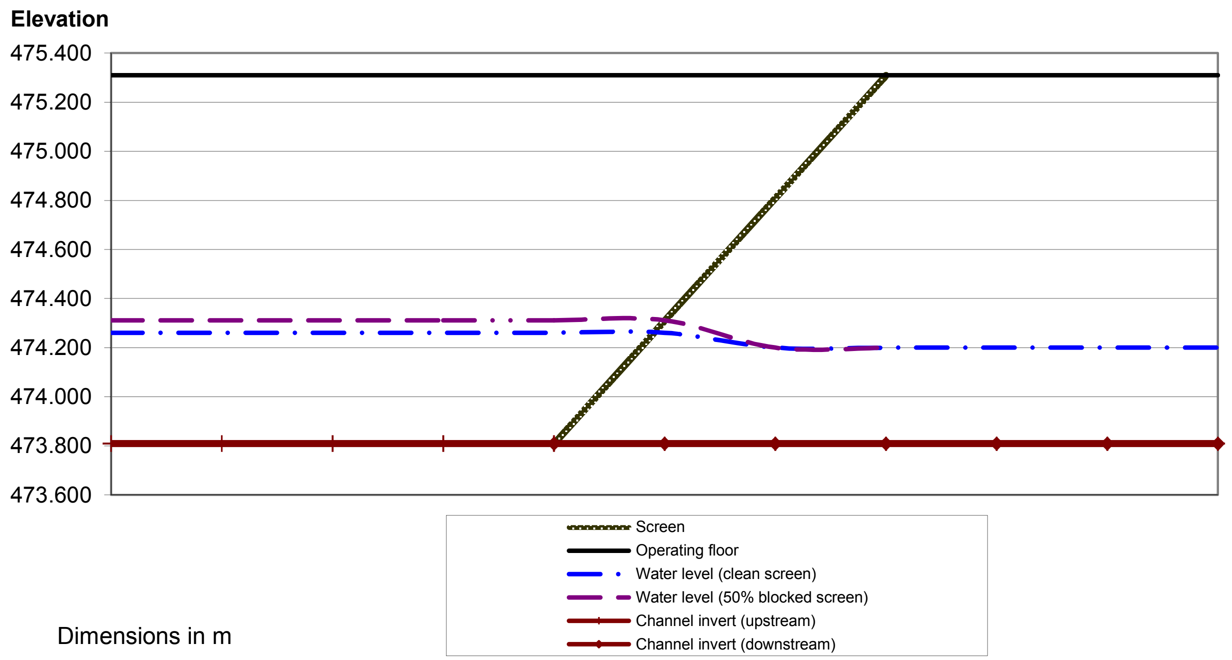
Dimensions in m



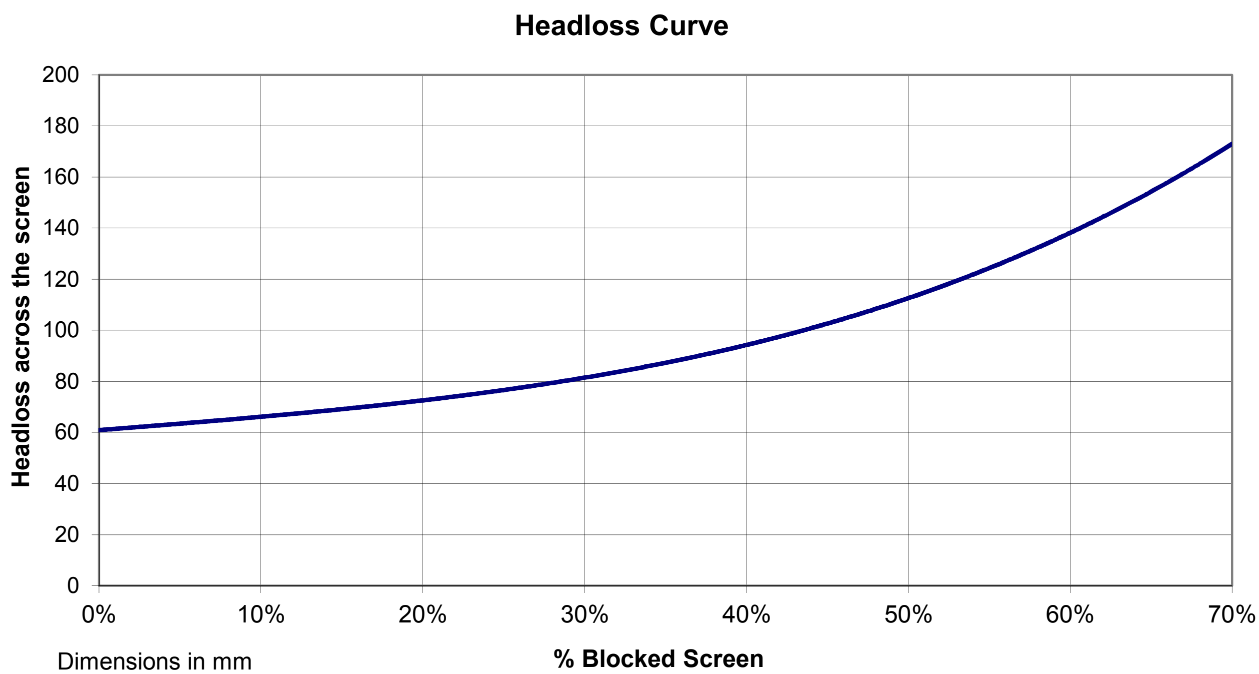
Dimensions in mm

Project name	Grand Valley, ON
Project ref.	AD04 Rev 0
Model reference	ESH6-24XA

Peak flow per unit	9650.00 m³/d	Downstream hydraulic condition	Client profile
Screen openings	6.00 mm	Downstream water depth	390.00 mm
Channel width	800.00 mm	Approach velocity (clean screen)	0.31 m/s
Side recess (total)	0.00 mm	Velocity through screen (clean screen)	0.68 m/s
Channel depth	1500.00 mm	Downstream velocity	0.36 m/s
Bottom recess	150.00 mm	Available freeboard upstream at 0%	1049.00 mm
Installation angle	60 °	Available freeboard upstream at 50%	998.26 mm



Dimensions in m



Dimensions in mm

APPENDIX D

GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY SUMMARY OF BIOWIN™ MODELLING

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XCG File No.: 3-252-57-01
January 24, 2017

GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY
SUMMARY OF BIOWIN™ MODELLING

Prepared for:

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1. INTRODUCTION

1.1 Background

The Grand Valley Water Pollution Control Plant (WPCP) provides treatment for wastewater generated in the community of Grand Valley within the Town of Grand Valley (Town). The plant is currently operated by the Ontario Clean Water Agency (OCWA) under the Ministry of Environment and Climate Change (MOECC) Certificate of Approval (C of A) No. 9706-7KWQ57, issued on February 2, 2009. The quality and quantity of effluent currently discharged by the existing WPCP is regulated by the C of A. The Grand Valley WPCP has a rated average day flow (ADF) capacity of 1,244 m^3/d.

The Town has initiated an investigation to analyze the potential to re-rate the existing Grand Valley WPCP to provide additional treatment capacity and to defer the facility's next upgrade and expansion. The Town has retained XCG Consulting Limited (XCG) to undertake a capacity assessment of the Grand Valley WPCP to evaluate the potential to re-rate the plant.

As part of this assessment, XCG evaluated the biological treatment capacity of the Grand Valley WPCP using historical plant data, results from an intensive sampling program conducted from October 20 – 29, 2015, and BioWin™ modelling software.

1.2 Objectives

The specific objectives of this technical memorandum are to:

- Present details of model construction and configuration;
- Present results of model calibration and validation; and
- Use future projected flows and loads to the Grand Valley WPCP to estimate the biological treatment capacity.

2. BIOWIN™ MODEL SETUP, CALIBRATION AND VALIDATION

2.1 Model Setup

A BioWin™ model of the Grand Valley WPCP was configured as shown in Figure 2.1. The model was calibrated using data obtained during the Intensive Sampling Program, conducted in October 2015. Detailed results of the Intensive Sampling Program are included in Appendix A. Specifically, the model calibration used raw wastewater quality results, final effluent quality results, and plant operating conditions recorded over the Intensive Sampling Program.

Ideal clarifiers and point clarifiers were used to model secondary clarifiers and tertiary filters, respectively, using a defined solids removal percentage estimated based on plant data. RAS and WAS were modelled as per historic plant operation, with RAS flows returned to the aeration tanks. Alum addition was added to the combined aeration tank effluent stream, ahead of the secondary clarifiers.

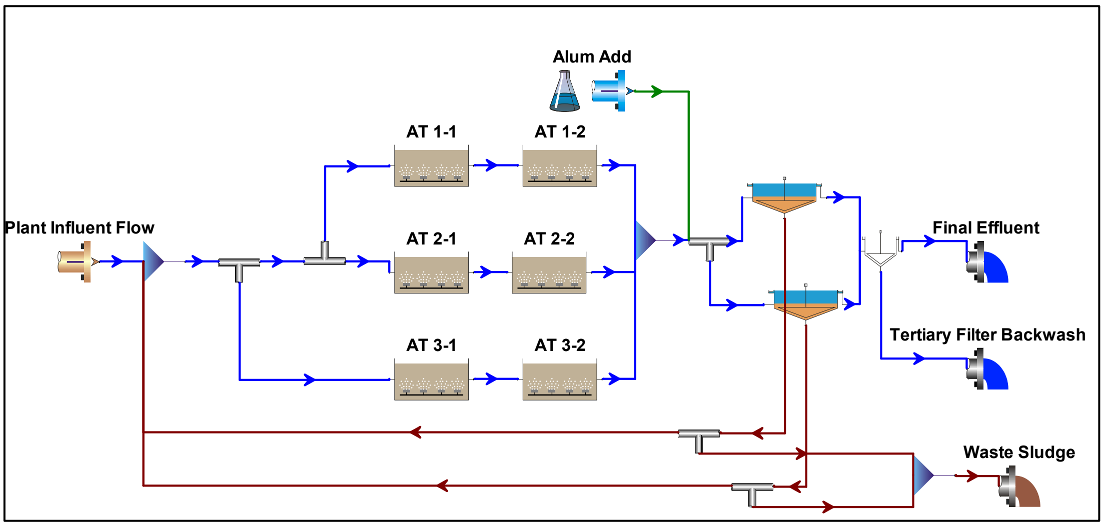

Figure 2.1 Schematic of the BioWin™ Calibration Model for the Grand Valley WPCP

2.2 Model Calibration

The model for the Grand Valley WPCP was calibrated under steady state conditions according to the procedure for model calibration detailed in Methods for Wastewater Characterization in Activated Sludge Modelling (WEF, 2003).

Influent wastewater characteristics were estimated based on results from the Intensive Sampling Program, conducted in October 2015, and using an influent specifier tool included in the BioWin™ software package. Raw influent samples were collected at the raw wastewater flow splitter box and thus contain contributions from the following three sources:

- Collection system via the Emma St. SPS;
- Septage from the onsite septage receiving station; and

- Plant recycle flow (i.e. digester supernatant and tertiary filter backwash) from the onsite pumping station.

As such, contributions from the onsite pumping station and septage receiving station were not modelled as separate inputs to the Grand Valley WPCP during calibration of the plant model.

It is important to note that, during the intensive sampling program, measured influent and effluent flow at the Grand Valley WPCP was significantly different. This difference may be, in part, related to malfunctioning solenoid valves in the plant headworks which contribute additional flow to the treatment plant. Additional details are included in Appendix A.

For purposes of model calibration and validation, modeled plant flow must represent the total estimated flow through the aeration bioreactors, secondary clarifiers and tertiary filters. Plant influent flow was estimated from the measured final effluent flow (which includes contributions from the Emma St. SPS, from the septage receiving station, and from the malfunctioning solenoid valves) and recycled flow from the onsite pumping station.

A summary of raw influent characteristics measured during the intensive sampling program and modelled raw influent characteristics is shown in Table 2.1.

Table 2.1 Raw Influent Characteristics

Parameter	Model Value	Intensive Sampling Results
Plant Influent Flow (m^3/d) (1)	781	781
Raw Wastewater Quality		
cBOD (mg/L)	100	100
COD (mg/L)	184	139
TSS (mg/L)	110	110
VSS (mg/L)	88	102
TKN (mg/L)	19.7	19.7
TP (mg/L)	2.18	2.18
Temperature (°C)	13.0	13.0

Notes:
1. Estimated from final effluent flow measurements (696 m^3/d) and the onsite pumping station (85 m^3/d).

It is important to note that the raw influent COD:BOD ratio observed during the intensive sampling program was significantly less than typically measured for residential raw wastewater. However, the observed BOD:TSS was acceptable, suggesting raw influent COD measurements were inconsistent with other measurements taken. Reasons for inconsistent COD measurements is unclear. For purposes of modelling, influent COD concentrations were adjusted as suggested by the BioWin™ influent specifier tool.

The raw wastewater fractions used in the model are presented in Table 2.2.

Table 2.2 Influent Specifier Raw Wastewater Fractions

Parameter	Modelled Plant Influent	BioWin™ Default
Fbs (g COD / g total COD)	0.304	0.160
Fac (g COD / g readily biodegradable COD)	0.151	0.150
Fxsp (g COD / g slowly biodegradable COD)	0.464	0.750
Fus (g COD / g total COD)	0.053	0.05
Fup (g COD / g total COD)	0.140	0.130
Fna (g NH_3-N / g TKN)	0.780	0.660
Fnox (g N / g Organic N)	0.500	0.500
Fnus (g N / g TKN)	0.020	0.020
FupN (g N / g COD)	0.035	0.035
Fpo4 (g PO_4-P / g TP)	0.541	0.500
FupP (g P / g COD)	0.011	0.011
Particulate Substrate COD:VSS ratio (mg COD / mg VSS)	0.75	1.60
Particulate Inert COD:VSS ratio (mg COD / mg VSS)	0.75	1.60

Notes:
Fbs - readily biodegradable COD fraction
Fac - acetate fraction of readily biodegradable COD
Fxsp - non-colloidal fraction of slowly biodegradable COD
Fus - unbiodegradable soluble COD fraction
Fup - unbiodegradable particulate COD fraction
Fna - ammonia fraction of TKN
Fnox - particulate organic nitrogen
Fnus - soluble unbiodegradable TKN
FupN - N:COD ratio for unbiodegradable particulate COD
Fpo4 - phosphate fraction of TP
FupP - P:COD ratio for unbiodegradable particulate COD

All other influent wastewater fractions, kinetic, and stoichiometric parameters were assumed to be the BioWin™ default values.

Not all treatment processes at the Grand Valley WPCP were online during the intensive sampling program. Specifically, due to low raw influent flows, the plant operated with two aerated bioreactors and one secondary clarifier online. For purposes of model calibration, there was no flow directed to Aeration Tank 3 or Secondary Clarifier 2 as shown in Figure 2.1. Flow was assumed evenly split between Aeration Tank 1 and Aeration Tank 2. Alum dosages were estimated based on operational records, and based on effluent TP concentrations.

The results of the steady state model calibration, as compared to measured plant performance during the October 2015 intensive sampling program, are presented in Table 2.3. The primary goal of the BioWin™ model is to assess the biological performance at future flows and loads. Therefore, particular attention was paid to biological process indicators, specifically effluent total ammonia nitrogen (TAN) and biochemical oxygen demand ($cBOD_5$) concentrations, during the calibration stage.

Table 2.3 BioWin™ Model Calibration Results

Parameter	Model Value	Intensive Sampling Results
Bioreactor MLSS (mg/L)		
Aeration Tank 1	6,373	6,550
Aeration Tank 2	6,373	6,480
Bioreactor MLVSS (mg/L)		
Aeration Tank 1	4,116	4,556
Aeration Tank 2	4,116	4,350
MLVSS:MLSS		
Aeration Tank 1	0.65	0.70
Aeration Tank 2	0.65	0.67
RAS Flow (m^3/d)	340	343
WAS Flow (m^3/d)	2.94	2.93
Final Effluent Quality		
COD (mg/L)	11.87	10.0
cBOD (mg/L)	0.74	< 4.0 (1)
TSS (mg/L)	1.53	< 4.0 (1)
TAN (mg/L)	0.11	< 0.10 (1)
TP (mg/L)	0.09	0.08
pH	7.07	7.5

Notes:
1. All samples from the intensive sampling program measured below the detection limit.

Based on the above results, the following conclusions can be drawn:

- During the intensive sampling program, final effluent concentrations of $cBOD_5$ and TAN consistently measured below the laboratory reported Method Detection Limit (MDL) concentrations (4.0 mg/L and 0.1 mg/L, respectively).
- With respect to $cBOD_5$ and TAN, the calibrated model predicted effluent concentrations consistent with those found during the intensive sampling program. With respect to effluent TAN concentrations, the calibrated model conservatively predicts slightly greater effluent concentrations than observed in plant records.
- The modelled mixed liquor volatile suspended solids (MLVSS) and mixed liquor suspended solids (MLSS) concentrations were slightly less than those recorded at the plant. The modelled MLVSS:MLSS ratio (0.65) is slightly less than the ratio measured in Aeration Tank 1 (0.70) and in Aeration Tank 2 (0.67).

Overall, calibration results indicate the BioWin™ model is capable of providing a reasonable estimate of the biological treatment capacity of the Grand Valley WPCP.

2.3 Model Validation

The BioWin™ model for the Grand Valley WPCP was validated based on effluent characteristics (particularly effluent TAN) by conducting simulations using historical plant influent flow and raw influent quality characteristics. Similar to above, plant influent flow was modelled as the sum of measured flow at the onsite pumping station and from the final effluent v-notch weir. Specifically, the following three periods, which cover a range of operating temperatures, were used for model validation:

- January to March, 2012
- April to June, 2013
- July to September, 2014

Key results from model validation are summarized in Table 2.4. With respect to plant effluent $cBOD_5$ concentrations, 100% of plant measurements were recorded to be at or below the MDL (2.0 mg/L). Similarly, 92.5% of all effluent TAN measurements were at or below the MDL (0.1 mg/L). For purposes of Table 2.4, measurements at or below the detection limit were assumed to be equal to the detection limit.

Table 2.4 BioWin™ Model Validation Results

Parameter	January to March, 2012		April to June, 2013		July to Sept. 2014	
	Model Value	Plant Measured	Model Value	Plant Measured	Model Value	Plant Measured
MLSS (1)	2,847	2,737	4,296	4,620	7,925	7,869
RAS	818	816	1,347	1,339	323	318
WAS	15.6	13.8	11.7	14.7	1.8	1.9
Effluent Characteristics (2)						
$cBOD_5$	1.02	2.0	1.10	2.0	0.83	2.0
TAN	0.18	0.11	0.10	0.10	0.06	0.12

Notes:
1. Reported MLSS concentrations are averaged between aeration tanks.
2. 100% of plant effluent $cBOD_5$ measurements and 92.5% of plant effluent TAN measurements were measured at or below the minimum detection limit. Average concentrations reported in the table have assumed concentrations equal to the minimum detection limit, where required.

In general, the BioWin™ model predicted effluent concentrations of $cBOD_5$ and TAN were comparable to final effluent samples collected at the plant. Therefore, it appears the BioWin™ model is an accurate representation of the Grand Valley WPCP and can be used to evaluate the biological treatment capacity of the plant.

3. BIOWIN™ MODELLING TO PREDICT PLANT CAPACITY

The biological treatment capacity of the Grand Valley WPCP was estimated by applying the validated BioWin™ model at projections of future flows and loads. The following assumptions were made regarding future operation of the treatment plant:

- At the biological treatment capacity, all secondary treatment processes (i.e. three aeration tanks and two secondary clarifiers) will be online, and flow will be equally split between all treatment processes;
- Typical DO concentrations of 2.0 mg/L will be maintained in all aeration tanks;
- RAS flow is approximately 100% of the raw influent flow; and,
- Future recycle stream flow is approximately 11% of the projected raw influent flow, as estimated from historical plant records.

3.1 Determining Design SRT

The approach used to determine the capacity of the Grand Valley WPCP was to first determine the minimum SRT required to achieve effluent C of A limits at projected flows and loads. Previous investigation has established a design basis for the Grand Valley WPCP at three future design scenarios. It was assumed that total effluent loading would not increase at future flows. As such, effluent objective and limit concentrations must decrease proportionally with the increase in treated flow. Design Scenario III has the greatest average day flow (1,555 m^3/d) and therefore also has the most stringent effluent quality requirements. A summary of the current C of A objectives (at an ADF of 1,244 m^3/d) and the predicted effluent requirements under Scenario III is given in Table 3.1.

Table 3.1 C of A Objective and Non-compliance Limit Concentrations

Parameter	Current C of A Effluent Requirements (ADF = 1,244 m^3/d)		Projected Effluent Requirements (ADF = 1,555 m^3/d)	
	Objective (1)	Limit (1)	Objective (1)	Limit (1)
$cBOD_5$	8.0 mg/L	10.0 mg/L	6.4 mg/L	8.0 mg/L
TSS	8.0 mg/L	10.0 mg/L	6.4 mg/L	8.0 mg/L
TP	0.13 mg/L	0.15 mg/L	0.10 mg/L	0.12 kg/d
TAN (2)				
Winter	3.0 mg/L	4.0 mg/L	2.4 mg/L	3.2 mg/L
Spring	0.8 mg/L	1.0 mg/L	0.64 mg/L	0.80 mg/L
Summer	0.6 mg/L	0.7 mg/L	0.48 mg/L	0.56 mg/L
Fall	0.8 mg/L	1.0 mg/L	0.64 mg/L	0.80 mg/L
E. coli (3)	100 CUFs/100 mL	-	100 CUFs/100 mL	-

Notes:
1. Expressed as an average monthly concentration.
2. TAN concentrations are regulated for each season: Winter (December 1 to March 31), Spring (April 1 to May 31), Summer (June 1 to September 30), and Fall (October 1 to November 30).
3. Monthly geometric mean density.

As previously noted, the purpose of developing this plant model is to estimate the biological treatment capacity of the Grand Valley WPCP through evaluation of effluent concentrations of $cBOD_5$ and TAN. However, it is important to note that objective and limit effluent concentrations of TP may decrease to 0.10 mg/L and 0.12 mg/L, respectively, at an ADF of 1,555 m^3/d. Tertiary effluent filtration can be designed to reduce effluent TP concentrations to a minimum of 0.10 mg/L (MOE, 2008). However, the existing tertiary filters have been designed for an effluent performance quality of 0.15 mg/L (R.J. Burnside, 2015). As such, Scenario III likely approaches the limit of phosphorus treatment capacity given the existing treatment processes at the Grand Valley WPCP. This TM addresses only the biological treatment capacity of the Grand Valley WPCP (i.e. its ability to meet effluent $cBOD_5$ and TAN requirements).

At the concentrations presented in Table 3.1, it is anticipated that the minimum required SRT will be limited by meeting effluent TAN requirements rather than $cBOD_5$ requirements. As noted in Table 3.1, effluent objectives for TAN vary by season. Modelling at varying mixed liquor concentrations was carried out in order to determine the minimum SRT to achieve effluent TAN limit concentrations under:

- Summer conditions (minimum temperature = 14°C);
- Winter conditions (minimum temperature = 9°C); and,
- Spring/Fall conditions (minimum temperature = 12°C).

Figure 3.1, Figure 3.2, and Figure 3.3 present the relationship between effluent TAN and SRT for winter, summer, and spring/fall conditions, respectively.

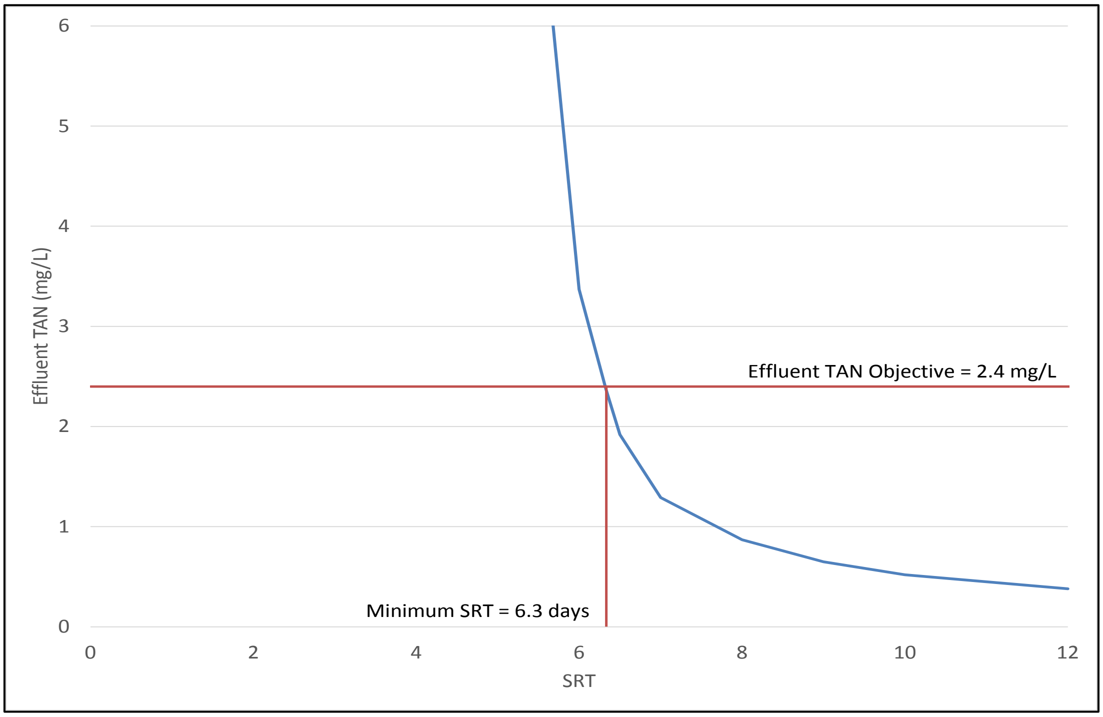

Figure 3.1 Effluent TAN Concentration** [GS1]**v. SRT – Winter Conditions (9°C)

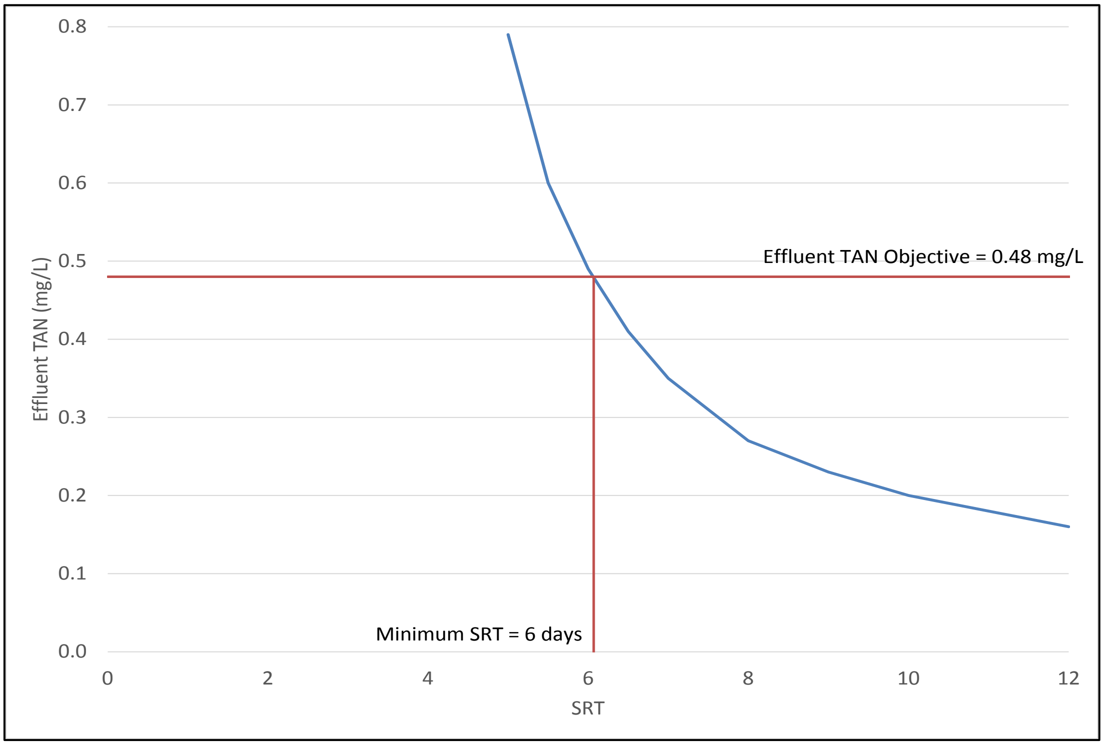

Figure 3.2 Effluent TAN Concentration v. SRT – Summer Conditions (14°C)

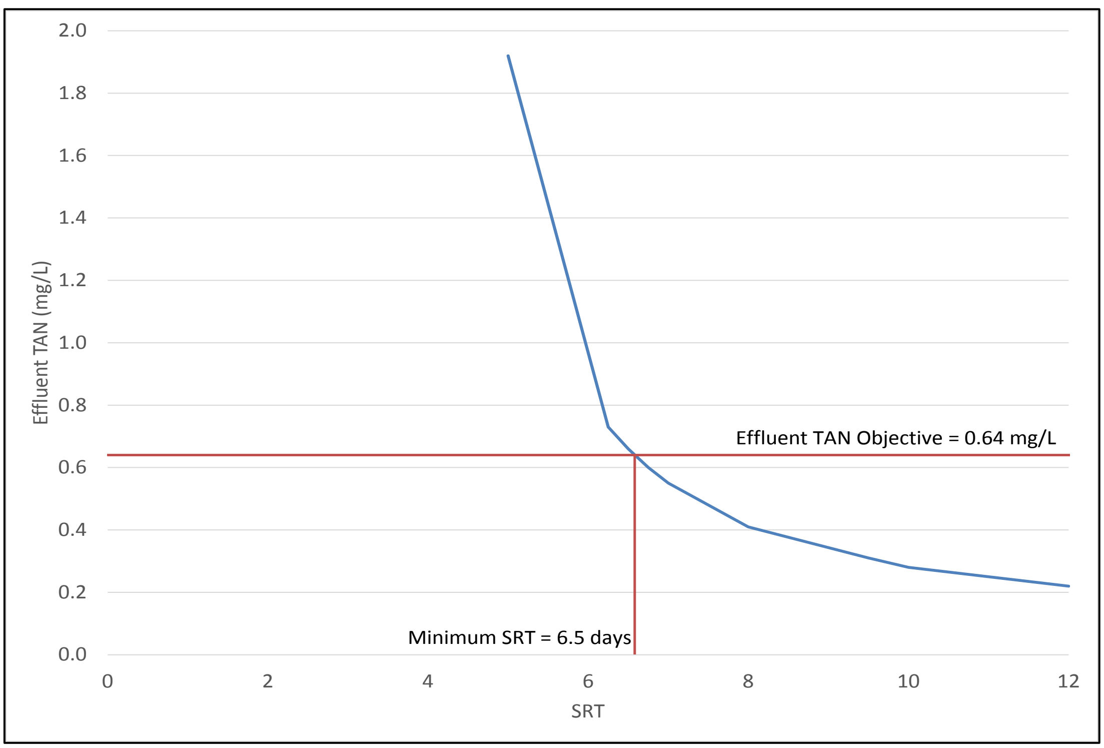

Figure 3.3 Effluent TAN Concentration v. SRT – Spring/Fall Conditions (12°C)

Based on results presented in the figures above, the most stringent minimum required SRT is 6.5 days based on spring/fall conditions.

For purposes of defining the minimum required design SRT, a safety factor of 2.3 was applied to the minimum required spring/fall SRT of 6.5 days to ensure effluent TAN requirements can be met even with fluctuations in influent flows and loadings, as well as operating conditions in the liquid treatment train. Therefore, a design SRT of 15 days was carried forward for subsequent analyses.

3.2 Biological Treatment Capacity Assessment

The objective of this section is to estimate the biological treatment capacity of the Grand Valley WPCP given the estimated design SRT of 15 days. To facilitate the capacity evaluation, the following assumptions were made:

- Design yield of 0.96 kg TSS/kg BOD_5;
- Target operating MLSS concentration of 3,000 mg/L;
- A bioreactor operating volume of 1,200 m^3; and,
- A future influent BOD_5 concentration of 158 mg/L, as per projected Scenario III design basis.

The design operating volume assumes all three bioreactors (400 m^3 each) will be online at future flows. The design yield was selected based on results of BioWin™ modelling of the Grand Valley WPCP. The recommended operating mixed liquor concentration for an extended aeration treatment process is approximately 3,000 mg/L to 5,000 mg/L (Metcalf & Eddy, 2003). In order to maximize the equivalent ADF capacity of the secondary clarifiers, a target operating MLSS concentration of 3,000 mg/L was assumed for purposes of this investigation. This is consistent with previous investigations which evaluated the equivalent ADF treatment capacity of the secondary clarifiers at the Grand Valley WPCP (XCG, 2016). MLSS concentrations greater than 3,000 mg/L will increase the biological treatment capacity, but may limit the equivalent treatment capacity of the secondary clarifiers.

Based on the assumptions above, the estimated biological treatment capacity of the Grand Valley WPCP is approximately 1,582 m^3/d, which is comparable to the projected Scenario III ADF (1,555 m^3/d).

Using the validated model of the Grand Valley WPCP, two simulations were conducted to evaluate the performance of the treatment plant at the projected Scenario III ADF under average day and maximum month loading conditions. Maximum month factors (MMFs) from historical plant operating data were found to range from 1.9 to 2.2. This is greater than typical MMFs, which range from 1.4 to 1.6. Large MMFs observed at the Grand Valley WPCP may be due to the type of raw influent sample collected at the plant (one grab sample collected per month). To be conservative, historical MMFs from plant operating data were assumed.

As noted in Section 3.1, performance of the Grand Valley WPCP was limited by operation under spring/fall conditions. Table 3.2 presents a summary of the projected plant performance at average day and maximum month loadings under spring/fall operating conditions.

Table 3.2 Summary of Plant Performance at ADF = 1,555 m^3/d Under Spring/Fall Conditions

Parameter	Average Day	Maximum Month	Typical Design Guideline
Liquid Treatment Train Influent			
Flow (m^3/d)	1,555	-	-
BOD_5 (kg/d)	245	466	-
TSS (kg/d)	322	613	-
TKN (kg/d)	59.1	112	-
TP (kg/d)	7.48	16.5	-
Aeration Tank			
MLVSS (mg/L)	1,833	1,948	-
MLSS (mg/L)	2,962	3,035	3,000 - 5,000 (1)
Organic Loading Rate (kg $BOD_5/m^3 \cdot d$)	0.20	0.39	0.17 - 0.24 (1)
F/Mv (kg BOD_5/kg MLVSS·d)	0.11	0.20	0.05 - 0.15 (1)
SRT (days)	15	7.3	>15 (1)
Secondary Clarifier			
RAS Flow (m^3/d)	1,517	1,475	-
RAS Flow %	98	95	50 - 200% of ADF (1)
RAS SS (mg/L) (1)	6,217	6,294	-
WAS Solids (kg/d)	238	507	-
Final Effluent			**Projected Effluent Objectives**
$cBOD_5$ (mg/L)	0.89	0.99	6.4
TAN (mg/L)	0.14	0.29	0.64 (Spring/Fall)
Temperature (°C)	12	12	-

Notes:
1. 2008 MOE Design Guidelines for Sewage Works for an extended aeration process.

Based on the model results presented in Table 3.2, the Grand Valley WPCP has the capacity to handle projected Scenario III average day and maximum month wastewater loads at the target MLSS concentration of 3,000 mg/L while meeting the projected ECA objectives for $cBOD_5$ and TAN.

4. SUMMARY AND CONCLUSIONS

Results of the BioWin™ modelling indicate the Grand Valley WPCP is capable of meeting all projected effluent ECA limits at the projected Scenario III ADF flow (1,555 m^3/d), BOD_5 load (245 kg/d), and TKN load (59.1 kg/d) while operating at an MLSS concentration of approximately 3,000 mg/L.

In addition, the following key points should also be highlighted:

- Results presented in this report depend on the accuracy of future projections of BOD_5 and TKN to the plant.
- The capacity of downstream treatment processes (i.e. secondary clarifiers, tertiary filters, UV disinfection) will be impacted by operation of the biological treatment train. Specifically, the biological treatment capacity will increase with increasing MLSS concentrations. However, the secondary clarifier treatment capacity, based on the SLR, will decrease with increasing MLSS concentrations. The specific relationship between the operating MLSS concentration and secondary clarifier treatment capacity was not explored as part of this evaluation.
- Future effluent requirements were estimated by assuming that current final effluent loads would not change at future flows. By this method, it was observed future effluent TP requirements at the Scenario III ADF may be approaching the phosphorus removal limit of the existing tertiary filtration technology installed at the plant.

APPENDIX A
INTENSIVE SAMPLING PROGRAM RESULTS

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XCG File No.: 3-252-57-01
January 24, 2017

GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY INTENSIVE SAMPLING PROGRAM RESULTS

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APPENDICES

1. INTRODUCTION

The Grand Valley Water Pollution Control Plant (WPCP) provides treatment for wastewater generated in the community of Grand Valley within the Town of Grand Valley (Town). The plant is currently operated by the Ontario Clean Water Agency (OCWA) under the Ministry of Environment and Climate Change (MOECC) Certificate of Approval (C of A) No. 9706-7KWQ57, issued on February 2, 2009. The quality and quantity of effluent currently discharged by the existing WPCP is regulated by the C of A. The Grand Valley WPCP has a rated average day flow (ADF) capacity of 1,244 m^3/d.

The Town has initiated an investigation to analyze the potential to re-rate the existing Grand Valley WPCP to provide additional treatment capacity and to defer the facility's next upgrade and expansion. The Town has retained XCG Consulting Limited (XCG) to undertake a capacity assessment of the Grand Valley WPCP to evaluate the potential to re-rate the plant.

To assist with the evaluation of the biological treatment capacity, an intensive sampling program was conducted to better characterize wastewater in the plant, and to assess the performance of individual unit processes. The purpose of this technical memorandum is to present results of the intensive sampling program.

2. SAMPLING PROGRAM OVERVIEW

The intensive sampling program was completed over seven business days from October 20 – 29, 2015. The objective of the intensive sampling program was to evaluate the performance of individual unit processes and to characterize the wastewater throughout the plant. Results of the intensive sampling program were also used for purposes of biological modelling and to review the biological treatment capacity of the Grand Valley WPCP.

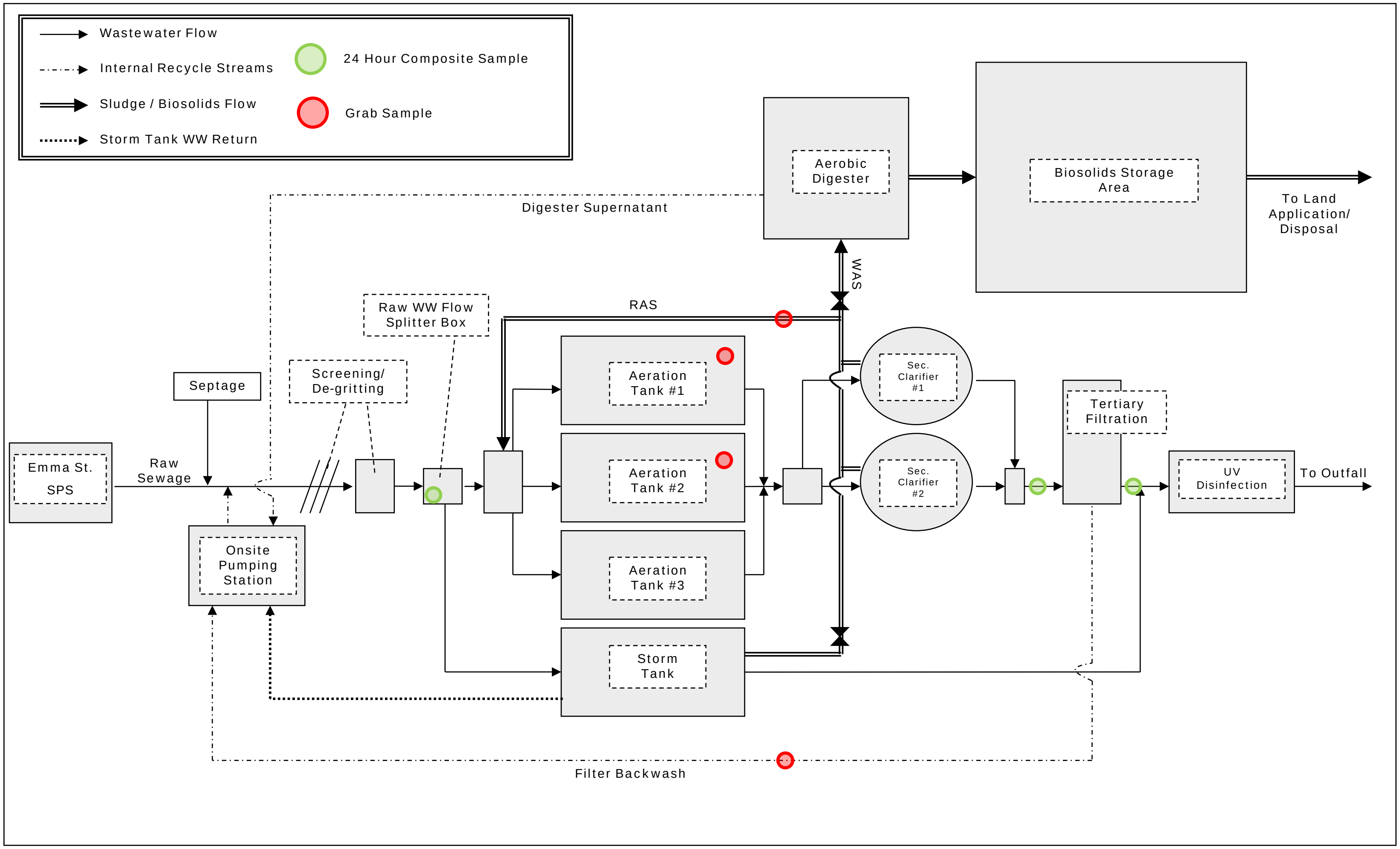
In total, seven process streams were sampled during the intensive sampling program. Plant operators did not supernate the aerobic digester during the intensive sampling program. In addition, there was no septage received at the septage receiving station. As such, samples from both these process streams could not be collected.

Figure 2.1 presents an overview of the sampling locations at the plant and identifies the type of sample collected at each location (i.e. 24-hour composite or grab). Analyzed parameters varied between samples, but included the following:

- Total COD (COD), filtered COD (COD-f), and flocculated and filtered COD (COD-ff)
- Total BOD5 (BOD5), carbonaceous BOD5 (cBOD5), and filtered cBOD5 (cBOD5-f)
- Total phosphorus (TP) and dissolved reactive phosphorus
- Total Kjeldahl nitrogen (TKN), total ammonia nitrogen (TAN), Nitrate + Nitrite Nitrogen
- Alkalinity ($CaCO_3$ equivalent)
- Total suspended solids (TSS) and volatile suspended solids (VSS)
- pH

A copy of the intensive sampling program protocol, which includes details regarding sampling locations, frequencies, handling and required analyses, is included as Appendix A.

Figure 2.1 Summary of Sampling Locations at the Grand Valley WPCP



3. RESULTS

The purpose of this section is to present results from the Grand Valley WPCP Intensive Sampling Program. A full copy of all results from the accredited laboratory is included in Appendix B.

3.1 Plant Flows

For the duration of the intensive sampling program, daily measured flows were monitored at the following locations within the Grand Valley WPCP:

- Raw wastewater from the collection system as measured at the Emma St. SPS;
- Plant recycle flow as measured at the onsite pumping station;
- Measured flow from the onsite septage pumping station;
- RAS;
- WAS; and
- Final effluent flow as measured at the Grand Valley WPCP downstream of the UV disinfection system.

Table 3.1 summarizes the measured flows over the intensive sampling program.

Table 3.1 Summary of Monitored Plant Flows during the Intensive Sampling Program (m^3/d)

Date	Emma St. SPS	Onsite PS	Septage	RAS	WAS	Final Effluent
October 20	338	73	4.6	384	2.8	703
October 21	332	101	4.6	341	2.8	707
October 22	341	97	4.8	310	2.8	679
October 26	326	87	4.9	385	3.3	651
October 27	342	88	5.1	325	2.8	664
October 28	439	84	4.8	315	3.0	763
October 29	379	68	5.2	337	3.0	708
Average	**357**	**85**	**4.9**	**343**	**2.9**	**696**

Results indicate that measured flows from each monitored source were relatively stable over the entire monitoring period.

Flow continuity within the Grand Valley WPCP can be evaluated by analyzing the total influent flow (Emma St. SPS + Septage) relative to the Final Effluent flow. Considering average data collected over the entire sampling program, the total influent flow (362 m^3/d) is significantly less than the final effluent flow (696 m^3/d).

Exact rationale for the noted discrepancy is not known. However, the difference may be, in part, related to malfunctioning solenoid valves in the plant headworks and the accuracy of flow meters at the plant. In 2015, plant operators noted malfunctioning solenoid valves resulted in a larger volume of potable flushing water being added to the WPCP downstream of the influent flow meters. Malfunctioning solenoid valves were replaced at the plant in January 2016. The final effluent flow meter was also recalibrated in January 2016, approximately two weeks after the solenoid valves were replaced. Details of the calibration process and its impact on measured effluent flow from the Grand Valley WPCP are not clear.

3.2 Plant Influent Raw Wastewater

Over the duration of the intensive sampling program, seven (7) 24-hour composite samples were collected at the raw wastewater flow splitter box, located immediately upstream of the aeration tanks and downstream of the plant headworks. As such, collected samples include contributions from the Emma St. SPS, the septage receiving station, and the onsite pumping station.

A summary of raw wastewater characterization during the intensive sampling program is given as Table 3.2. The characterization of the raw wastewater stream included several parameters which are not historically monitored to allow development of modelling parameters for BioWin™. This included approximation of the readily biodegradable chemical oxygen demand fraction (rbCOD) using a filtration-flocculation method (COD-ff). Further, the fraction of soluble carbonaceous biochemical oxygen demand ($cBOD_5$) was approximated by filtering the sample ($cBOD_5$-f).

In general, the chemical oxygen demand (COD) is a measure of the organic material in the wastewater sample which can be chemically oxidized. Biochemical oxygen demand (BOD) is a similar measurement that estimates the oxygen used by microorganisms in the oxidation of organic material. The total BOD is the sum of the carbonaceous BOD (cBOD) and nitrogenous BOD (nBOD). The cBOD measures oxygen consumption from the degradation of carbon sources, while nBOD considers the consumption of oxygen by nitrifying bacteria to oxidize ammonia into nitrate.

BOD tests are typically carried out over five days (BOD_5). $cBOD_5$ tests are commonly chemically inhibited to prevent oxygen consumption by nitrifying bacteria over the duration of the test. As such, the $cBOD_5$ is a measurement of a fraction of the total BOD_5. However, results from the sampling program show that measured concentrations of $cBOD_5$ were, on occasion, greater than the measured BOD_5 concentration. Previous discussion with staff from an accredited laboratory has indicated that such results may be a result of uncertainty within the BOD test (e.g. slight variations in the test water, the use of nitrification suppressant chemicals, etc.). For purposes of this work, influent concentrations of $cBOD_5$ which exceeded BOD_5 measurements were assumed equal to BOD_5 measurements.

As well, the measured COD concentration is expected to be greater than the BOD_5 concentration of a given wastewater sample because:

- Some complex organics present within the sample are difficult to biologically oxidize;
- Some substances within the sample can be chemically but not biologically oxidized; and
- The BOD_5 test is limited to five days.

Results from the intensive sampling program indicate one instance where the measured COD concentration was less than the BOD_5 concentration. This sample was assumed to be an outlier and removed from consideration.

Table 3.2 Summary of Raw Wastewater Characterization Results

	BOD_5	$cBOD_5$	$cBOD_5$-f	COD	COD-f	COD-ff	TP	Ortho-P	TKN	TAN	Alkalinity	TSS	VSS	pH
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
October 20	81	81 [1]	28	150	62	58	1.95	0.97	16.2	15.1	300	83	78	7.72
October 21	86	85	17	150	50	40	2.17	0.99	19.8	15.2	288	85	80	-
October 22	145	99	26	- [2]	62	51	2.17	1.51	21.4	15	286	134	122	7.88
October 26	154	154 [1]	36	160	60	60	2.27	0.97	20.8	15.6	289	109	98	-
October 27	134	97	25	136	70	51	2.29	1.30	19	16	287	115	105	-
October 28	125	117	25	146	63	48	2.4	1.55	20.3	16.4	297	150	142	-
October 29	84	66	21	94	51	40	1.98	0.96	19.8	13.8	275	94	89	-
Average	**116**	**100**	**25**	**139**	**60**	**50**	**2.18**	**1.18**	**19.7**	**15.3**	**289**	**110**	**102**	**7.80**

Notes:
1. Influent $cBOD_5$ concentration assumed equal to influent BOD_5 concentration.
2. Sample result assumed an outlier and removed.

3.3 Tertiary Filter Backwash

The Grand Valley WPCP uses continuous backwash tertiary filters to treat secondary effluent flow prior to disinfection and discharge. Backwash is directed to the onsite pumping station, and returned to the head of the plant. Over the duration of the intensive sampling program, seven (7) grab samples were collected of the tertiary filter backwash stream and were analyzed for BOD_5, COD, TP, orthophosphate, TSS, and VSS. Results are summarized in Table 3.3.

Results indicate the quality of backwash flow was relatively stable over the sampling period.

Table 3.3 Summary of Tertiary Filter Backwash Quality

	BOD_5	COD	TP	Ortho-P	TSS	VSS
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
October 20	10	9	0.74	0.07	32	22
October 21	13	35	0.65	0.07	38	27
October 22	12	12	0.85	0.11	45	32
October 26	19	20	0.8	0.07	46	35
October 27	12	14	0.7	0.12	37	26
October 28	13	40	0.71	0.08	40	28
October 29	10	13	0.83	0.08	38	28
Average	**13**	**20**	**0.75**	**0.09**	**39**	**28**

3.4 Mixed Liquor Characteristics

The mixed liquor suspended solids (MLSS) and mixed liquor volatile suspended solids (MLVSS) concentrations within each aeration tank was measured daily during the intensive sampling program. In addition, the RAS stream was sampled daily. It is important to note that RAS and WAS is pumped from the same location in the secondary clarifiers at the Grand Valley WPCP. As such, this sample is expected to be representative of both the RAS and WAS streams.

Samples were analyzed for TSS and VSS. As well, the dissolved oxygen (DO) from each aeration tank was measured daily. A summary of sample results is given in Table 3.4.

Measured MLSS concentrations in each aeration tank were relatively stable over the sampling period with two notable exceptions:

- Sample collected from Aeration Tank 1 on October 29, 2015 (MLSS concentration of 10,200 mg/L); and,

- Sample collected from Aeration Tank 2 on October 28, 2015 (MLSS concentration of 4,350 mg/L, MLVSS concentration of 3,080 mg/L).

Both samples were assumed to be outliers and removed from consideration. Between aeration tanks, MLSS and MLVSS concentrations were comparable. In general, MLSS concentrations ranged between 6,080 mg/L and 7,260 mg/L. This exceeds the typical MLSS concentration of an extended aeration process (3,000 mg/L to 5,000 mg/L). MLVSS concentrations during the sampling program ranged from 4,100 mg/L to 4,940 mg/L.

Similarly, measured solids concentrations in the RAS/WAS stream were relatively stable over the sampling period.

The pH of one grab sample from each stream was also measured during the sampling period. The pH of each sample was found to be 7.05, 7.09, and 7.05 for samples collected from Aeration Tank 1, Aeration Tank 2, and the RAS/WAS stream, respectively.

Table 3.4 Summary of Mixed Liquor Quality

	Aeration Tank 1			Aeration Tank 2			RAS/WAS	
	MLSS	MLVSS	DO	MLSS	MLVSS	DO	TSS	VSS
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
October 20	6,460	4,420	5.0	6,390	4,320	4.5	23,600	15,300
October 21	6,700	4,480	5.0	6,700	4,250	4.4	20,400	13,500
October 22	6,670	4,850	5.1	6,200	4,100	4.5	24,900	16,907
October 26	6,810	4,650	5.0	7,260	4,940	4.3	18,700	13,000
October 27	6,500	4,410	5.0	6,080	4,100	5.0	20,700	14,000
October 28	6,160	4,260	5.0	- (1)	- (1)	4.6	24,800	17,400
October 29	- (1)	4,820	5.0	6,250	4,380	4.4	20,600	14,000
Average	**6,550**	**4,556**	**5.0**	**6,480**	**4,350**	**4.5**	**21,957**	**14,873**

Notes:
1. Sample considered outlier and removed.

3.5 Secondary Clarifier Effluent

Over the duration of the intensive sampling program, seven (7) 24-hour composite samples were collected from the tertiary filter influent channel, and are representative of the secondary clarifier effluent stream. Due to low influent flows, only one secondary clarifier was operated for the duration of the sampling program. A summary of sampling results is located in Table 3.5.

The concentration of several measured parameters was below the minimum detection limit (MDL) established by the accredited laboratory. Samples measuring below the

MDL were assumed to be at the MDL for purposes of calculating the average concentration over the sampling program.

Over the sampling program, the TAN concentration of all samples was below the MDL, indicating complete nitrification in the aeration tanks. Further, TSS and TP concentrations were quite low, indicating the biological solids were readily settleable in the secondary clarifier.

In addition to the above results, the pH of the sample collected October 22, 2015 was measured to be 7.28.

Table 3.5 Summary of Secondary Clarifier Effluent Quality

	BOD_5	$cBOD_5$	COD	TP	Ortho-P	TKN	TAN	Nitrate	Alkalinity	TSS	VSS
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
October 20	< 4	< 4	< 8	0.14	0.03	< 0.5	< 0.1	11.8	195	6	4
October 21	< 4	< 4	12	0.14	0.04	1.4	< 0.1	12.2	174	4	3
October 22	< 4	< 4	8	0.16	0.05	0.9	< 0.1	12.8	170	5	5
October 26	5	< 4	10	0.16	<0.03	< 0.5	< 0.1	13.3	165	6	5
October 27	< 4	< 4	< 8	0.12	0.08	< 0.5	< 0.1	13.1	169	4	4
October 28	< 4	< 4	10	0.13	0.04	< 0.5	< 0.1	13.4	171	5	5
October 29	6	< 4	< 8	0.16	0.04	1.0	< 0.1	13.0	165	4	4
Average	**4.4**	**4.0**	**9.1**	**0.14**	**0.04**	**0.76**	**0.1**	**12.8**	**173**	**4.8**	**4.3**

3.6 Final Effluent

Over the duration of the intensive sampling program, seven (7) 24-hour composite samples were collected from the channel immediately downstream of the UV disinfection process, and are representative of the final effluent stream. A summary of sampling results is located in Table 3.6. The table also presents the final effluent objective and limit concentrations, where applicable.

Similar to above, the concentration of several measured parameters was below the minimum detection limit (MDL) established by the accredited laboratory. Samples measuring below the MDL were assumed to be at the MDL for purposes of calculating the average concentration over the sampling program.

Results show final effluent remained at a high quality over the duration of the intensive sampling program.

Table 3.6 Summary of Final Effluent Quality

	BOD_5	$cBOD_5$	COD	TP	Ortho-P	TAN	Nitrate	Alkalinity	TSS	VSS	pH
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
October 20	< 4	< 4	< 8	0.09	0.06	< 0.1	11.5	177	2	2	7.42
October 21	< 4	< 4	< 8	0.08	0.04	< 0.1	12.2	173	< 2	< 2	-
October 22	< 4	< 4	8	0.09	0.06	< 0.1	12.7	171	< 2	2	7.49
October 26	< 4	< 4	9	0.06	<0.03	< 0.1	13.3	164	< 2	< 2	-
October 27	< 4	< 4	17	0.07	0.04	< 0.1	13.1	157	< 2	< 2	-
October 28	< 4	< 4	12	0.06	0.03	< 0.1	13.3	170	< 2	2	-
October 29	< 4	< 4	8	0.11	0.04	< 0.1	13.0	176	< 2	2	-
Average	**4.0**	**4.0**	**10**	**0.08**	**0.04**	**0.1**	**12.7**	**170**	**2**	**2**	**7.46**
Eff. Obj.		**8.0**		**0.13**		**0.8 (1)**			**8.0**		
Eff. Lim.		**10.0**		**0.15**		**1.0 (1)**			**10.0**		

Notes:
1. Final effluent TAN objective and limit for the fall period (October 1 to November 30).

APPENDIX A

INTENSIVE SAMPLING PROGRAM PROTOCOL

XCG Environmental Engineers & Scientists
XCG CONSULTING LIMITED
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2620 Bristol Circle, Suite 300, Oakville, Ontario, Canada L6H 6Z7

October 14, 2015 **XCG File No.:3-252-57-01**

To: Jane Wilson, Town of Grand Valley

cc: Glenn Sterret, Town of Grand Valley
Jeff Bunn, Town of Grand Valley
Scott Craggs, OCWA

From: Graham Seggewiss and Melody Johnson, XCG Consulting Limited

Re: Grand Valley Water Pollution Control Plant Capacity Evaluation Re-rating Study - Intensive Sampling Program Protocol

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The Grand Valley Water Pollution Control Plant (WPCP) provides treatment for wastewater generated in the community of Grand Valley, within the Town of Grand Valley (Town). The plant is currently operated by the Ontario Clean Water Agency (OCWA) under the Ministry of Environment and Climate Change (MOECC) Certificate of Approval (CofA) N. 9706-7KWQ57, issued February 2, 2009. The quality and quantity of effluent currently discharged by the existing WPCP is regulated by the CofA. The Grand Valley WPCP has a rated average capacity of 1,244 m^3/d.

XCG Consulting Limited (XCG) recently completed an update to the Assimilative Capacity Study to propose effluent limits associated with an increase in the rated capacity to 2,547 m^3/d. The proposed effluent limit associated with total phosphorus (TP) for this increased capacity was very low at 0.073 mg/L. Consistently achieving such low TP requirements requires enhanced tertiary treatment, such as dual-stage tertiary filtration or membrane ultrafiltration. Upgrading the Grand Valley WPCP to provide this level of treatment would require a significant capital expenditure.

As such, the Town has retained XCG to conduct a capacity evaluation and re-rating study at the Grand Valley WPCP to potentially defer the next required plant update. An intensive sampling program was proposed as part of the capacity evaluation in order to characterize the wastewater at the plant for the purposes of subsequent BioWin™ modelling, to assess the performance of individual unit processes, and to review the ability of the current plant to maintain its required level of performance at the plant's rated capacity.

The objective of this document is to present the proposed sampling protocol developed to obtain wastewater characterization data.

1. SAMPLING PROGRAM OVERVIEW

The sampling program will consist of the collection of 24-hour composite samples at the following locations:

- Plant influent raw wastewater (including raw wastewater, septage, and recycle flow from the onsite pumping station);
- Secondary clarifier effluent; and,
- Tertiary filter effluent.

The sampling program will take place over a seven day period. As such, seven 24-hour composite samples will be collected over the duration of the sampling program at each of the locations identified above.

The sampling program will also include collection of grab samples of the following streams:

- Septage influent;
- Aeration Tank 1;
- Aeration Tank 2;
- Return activated sludge (RAS)/waste activated sludge (WAS); and,
- Tertiary filter backwash.

Seven discrete grab samples will be collected from each of the locations identified above over the duration of the sampling program, or one sample per day per stream.

With respect to the proposed sampling locations, it is important to note the following:

- Samples of raw wastewater from the collection system will not be collected. Plant operators have indicated there is no suitable location to install a composite sampler upstream of the headworks building at the Grand Valley WPCP. Raw wastewater strength will be characterised by the plant influent raw wastewater sample; and,
- Samples of the digester supernatant will not be collected. Plant operators have indicated all solids from the biosolids holding tank and the digesters were recently hauled from the plant. As such, the digesters will not be supernated over the sampling program.

A process flow diagram of the Grand Valley Wastewater Treatment Plant with identified sampling locations is presented in Figure 1. A matrix summarizing the sampling parameters and sampling locations is provided in Table 1.

Table 2 summarizes the tests which have been requested as part of this intensive sampling program. The table also indicates whether analysis will be carried out onsite or by an accredited laboratory, as well as sampling handling requirements, which are described in greater detail in Section 2.

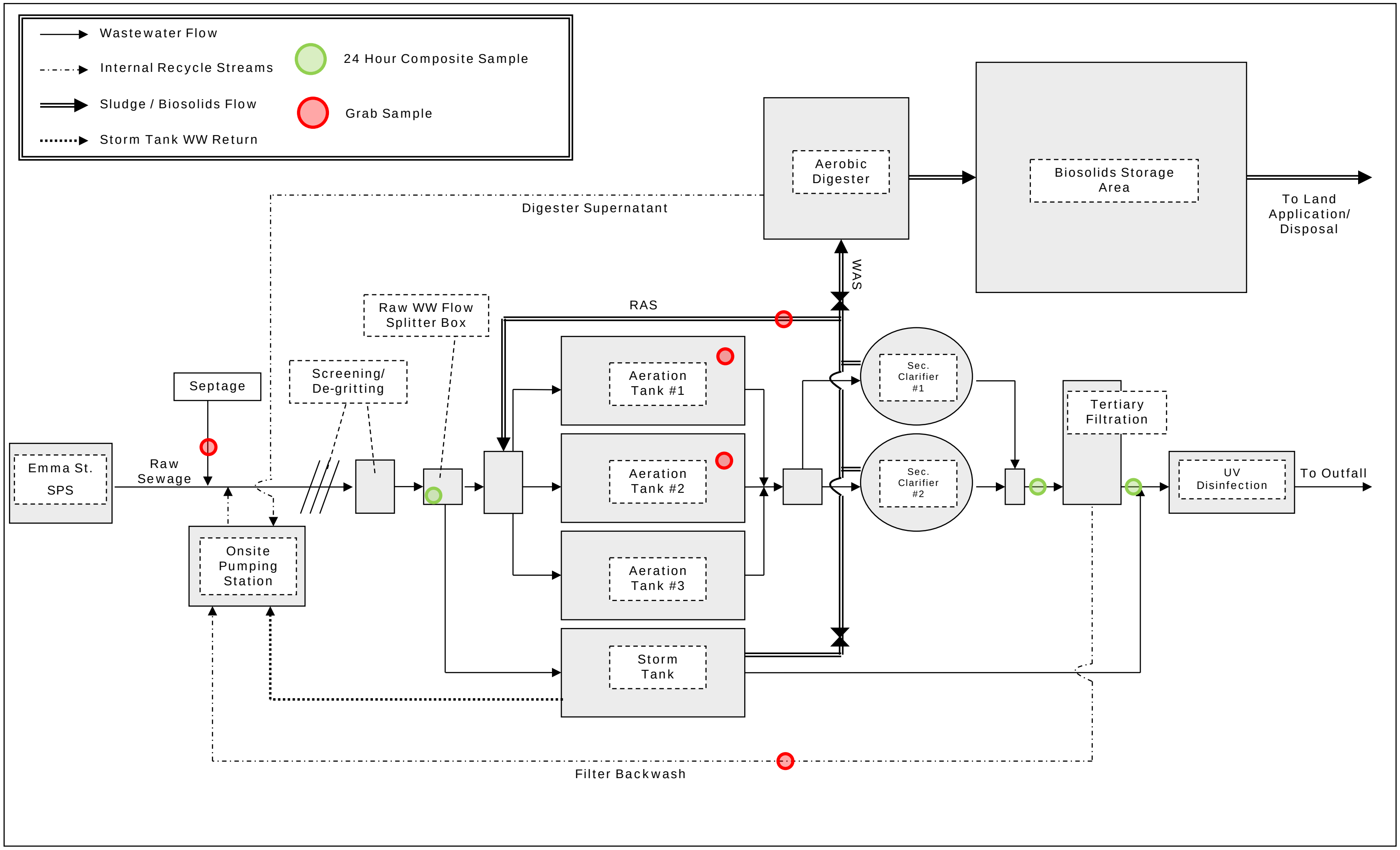

Figure 1 Process Flow Diagram of the Grand Valley WPCP

Table 1 Summary Matrix of Intensive Sampling Program

	Sample Type	BOD_5	$cBOD_5$	$fcBOD_5$	COD	fCOD	ffCOD	Total Phosphorus	Orthophosphate [1]	TKN	Total Ammonia - N	Nitrite	Nitrate	Alkalinity	TSS	VSS	pH	DO
Plant Influent Raw Wastewater	24-hr Comp.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Secondary Effluent	24-hr Comp.	x	x		x			x	x	x	x	x	x	x	x	x	x	
Tertiary Effluent	24-hr Comp.	x	x		x			x	x		x	x	x	x	x	x	x	
Aeration Tank 1	Grab														x	x	x	x
Aeration Tank 2	Grab														x	x	x	x
RAS/WAS	Grab														x	x	x	
Tertiary Filter Backwash	Grab	x			x			x	x						x	x		
Septage	Grab	x	x		x			x	x		x	x	x	x	x	x	x	

Notes:
1. Orthophosphate concentration represented by measurements of soluble reactive phosphorus (SRP)

Table 2 Wastewater Characterization - Parameters for Analysis

Parameters Required	Sample Analysis	Sample Handling Requirements Prior to Bottling Sample
Total COD (tCOD)	Accredited Laboratory	None
Filtered COD (fCOD) (1)	Accredited Laboratory	On-site filtration
Flocculated and Filtered COD (ffCOD) (1)	Accredited Laboratory	On-site flocculation and filtration
$tBOD_5$	Accredited Laboratory	None
$cBOD_5$	Accredited Laboratory	None
Filtered $cBOD_5$ ($fcBOD_5$) (1)	Accredited Laboratory	On-site filtration
Total Phosphorus (TP)	Accredited Laboratory	None
Soluble Reactive Phosphorus (SRP)	Accredited Laboratory	On-site filtration
Total Kjeldahl Nitrogen (TKN)	Accredited Laboratory	None
Total Ammonia Nitrogen (TAN)	Accredited Laboratory	None
Nitrate + Nitrite Nitrogen	Accredited Laboratory	None
Alkalinity ($CaCO_3$ equivalent)	Accredited Laboratory	None
Total Suspended Solids (TSS)	Accredited Laboratory	None
Volatile Suspended Solids (VSS)	Accredited Laboratory	None
pH	Onsite	None
Dissolved Oxygen (DO) (2)	Onsite	None

Notes:
1. To be completed on the plant influent raw wastewater only.
2. As measured in the aeration tanks.

2. SAMPLING HANDLING AND ANALYSIS REQUIREMENTS

2.1 Sample Analysis

Sample containers will be obtained from the accredited laboratory pre-cleaned and will not be rinsed prior to sample collection. Preservatives, if required, will be added by the laboratory to the containers prior to shipment of the containers to the site.

All samples will be collected into the correct sample container and kept in an insulated container (i.e., cooler) packed with ice, until delivered to the laboratory.

The following procedure will be followed when filling sample bottles:

- Fill bottles to the shoulder only (do not overfill or overflow containers),
- Do not rinse out bottles or preservatives, and,
- Keep samples on ice in a cooler after collection.

A list of the analytical method for each analyte of interest is provided in Appendix A. The table also lists the type of container and sample quantity needed, preservatives and holding times for each analytical method.

2.2 Special Sample Handling Protocols

Special sample handling protocols are required for the analysis of the following parameters:

- Filtered COD;
- Filtered $cBOD_5$;
- Soluble reactive phosphorus (SRP); and,
- Flocculated / filtered COD.

The sampling handling requirements are outlined in detail below.

2.2.1 On-site Sample Filtration - for fCOD, $fcBOD_5$ and Soluble Reactive Phosphorus

Filtered COD (fCOD) and filtered $cBOD_5$ ($fcBOD_5$) analyses of wastewater samples will require on-site filtration of the samples collected prior to placement in the applicable sample bottles and subsequent submission to the laboratory for analysis. It is also recommended, but not required, that dissolved reactive phosphorus analyses be conducted on filtered samples.

Sample filtration can be accomplished by utilizing glass filters, such as those commonly used for mixed liquor suspended solids (MLSS) determinations. All filter apparatus / glassware should be thoroughly cleaned prior to filtering the samples.

The filtered samples can then be submitted for standard COD, $cBOD_5$ and dissolved reactive phosphorus analyses at the laboratory while ensuring that the filtered samples are appropriately labelled.

2.2.2 On-site Sample Flocculation and Filtration - for ffCOD

The flocculated and filtered COD (ffCOD) analysis requires the on-site flocculation and filtration of the samples prior to placement in the applicable sample bottles and subsequent submission to the laboratory for analysis.

The flocculation and filtration protocol is presented below:

FFCOD Analysis Procedure

Materials/Equipment List:

- Zinc sulfate ($ZnSO4.7H_2O$);
- 6 M sodium hydroxide;
- Distilled/deionized water;
- 500 mL beaker;
- pH analyser;
- Stir plate;
- Glass fiber filters (preferred size of 0.45 µm);

- Filtration apparatus; and,
- 0 to 10 mL pipette.

Stock Solution Procedure:

Make up a stock solution of zinc sulfate as follows:

- Dissolve 20 g of zinc sulfate (ZnSO4.7H2O) into 200 mL of distilled/deionized water.

ffCOD Procedure:

The ffCOD procedure is as follows:

- Pipette 2 mL of the 100 g/L zinc sulfate stock solution into a 200 mL sample (or 1 mL 100 g/L zinc sulfate stock solution into a 100 mL sample) of filtered wastewater (if you are doing filtered CODs, it is convenient to save some additional filtered sample for the ffCOD procedure);
- Mix the sample vigorously for approximately one minute (i.e. use a stir plate);
- Turn the mixer to low, set up a pH probe in the sample and add 6 M sodium hydroxide solution drop-wise until the pH is adjusted to approximately 10.5;
- You should see flocs start to form in the sample;
- Gently mix the sample for several minutes (e.g. 10-15);
- Turn off the mixer and allow the sample to settle. A fairly clear supernatant should be evident; and,
- Withdraw 40-50 mL of the supernatant with a pipette (trying not to pull up any of the settled solids) and filter the sample.

As with the on-site filtration procedure, the filtration steps can be accomplished by utilizing glass filters, such as those commonly used for MLSS determinations.

The flocculated and filtered samples can then be submitted for standard COD analyses at the Laboratory.

3. ROLES AND RESPONSIBILITY

XCG will coordinate set-up of the intensive sampling program with assistance from plant personnel and Town Staff. Plant personnel and Town Staff will be responsible for sample collection, chain-of-custody preparation, and sample submission.

A summary of the responsibilities of the Consultant Team and plant personnel is provided in the following Sections.

3.1 Consultant Staff Roles and Responsibilities

XCG staff will be responsible for the following:

- Provision and temporary installation of three auto-samplers installed to collect samples of plant influent raw wastewater, secondary clarifier effluent, and tertiary filter effluent;
- Program the installed auto-sampler(s) to collect composite samples as required by the testing protocol;

- Provision of pre-mixed zinc sulfate and sodium hydroxide solutions at concentrations specified in Section 2.2.2;
- Provide training to OCWA staff with respect to the operation of the auto-samplers, as well as conducting the specialized sample handling procedures for the "filtered" and "flocculated and filtered" samples as per Section 2.2; and
- Provide input to plant personnel throughout the duration of the intensive sampling program, as required. XCG's main point of contact for questions or concerns during the sampling program will be Graham Seggewiss. If there are any questions in advance or during the testing period, he can be reached at 905-829-8880 x 4224 or graham.seggewiss@xcg.com.

3.2 Plant Personnel Roles and Responsibilities

Plant personnel will be responsible for the following:

- Operation, monitoring and control of plant process and equipment to maintain plant performance during the intensive sampling program;
- Providing guidance to XCG staff with respect to appropriate installation locations for the field testing equipment. This will include providing access to 120V power outlets to power the equipment;
- Ordering the required number of sample bottles from an accredited laboratory, and co-ordinating their delivery to and pick up from the Grand Valley WPCP;
- Collecting samples from the temporary auto-samplers, placing sample aliquots in the proper sample bottles, and filling in the chain of custody forms to obtain the required analyses;
- Collecting grab samples from locations identified in Section 1, placing sample aliquots in the proper sample bottles and filling in the chain of custody forms to obtain the required analyses;
- Conduct onsite flocculation and filtration procedures for samples as identified in Section 2.2, completed onsite pH measurements as required, and measure DO at locations identified in Section 1; and,
- Provision of plant flows, pH measurements and DO concentrations during the intensive sampling period.

ATTACHMENT A
ANALYTICAL METHODS

Table A.1 Analytical Methods

Parameter	Analytical Method	Minimum Required Sample Volume (mL) [1]	Sample Bottle Type	Preservation Requirements	Maximum Holding Time (d)	
					External Lab	MOE
COD	APHA 5220 D	50	Plastic or glass	Chill to < 4°C	28	30
BOD_5	SM 5210 B	300	Plastic	Chill to < 4°C	4	4
$cBOD_5$	SM 5210B	300	Plastic	Chill to < 4°C	4	4
TSS	SM 2540 B,D,E	500	Plastic	Chill to < 4°C	7	7
TAN	MOE STKNP-E3199A.I	300	Plastic or glass	Chill to < 4°C	3	10
TP	MOE STKNP-E3199A.I	100	Plastic or glass	Chill to < 4°C	28	30
TKN	MOE STKNP-E3199A.I	100	Plastic or glass	pH < 2, H_2SO_4 Chill to < 4°C	28	NA
SRP	MOE STKNP-E3199A.I	- [2]	Plastic	Chill to < 4°C	48hr	NA
Nitrate + Nitrite	APHA 5220D	50	Plastic	Chill to < 4°C	7	7
Nitrate	APHA 4110C	50	Plastic	Chill to < 4°C	7	7
Nitrite	APHA 4110C	50	Plastic	Chill to < 4°C	7	7
Alkalinity	SM 2320B	50	Plastic	Chill to < 4°C	7	7
VSS	SM 2540 B,D,E					

Notes:

NA not applicable
1. All sample volumes should be confirmed with selected accredited laboratory.
2. Required volume as indicated by selected accredited laboratory.

APPENDIX B
COPY OF SAMPLING RESULTS

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Works #: 110000301
Project : PO#017844

04-November-2015

OCWA-Grand Valley-XCG (WPCP)
Attn : Lisa Benoit

78 Centennial Road, Unit 6
Orangeville, ON
L9W 1P9, Canada

Phone: 519-941-1938
Fax:519-941-1794 pdf

Date Rec. : 21 October 2015
LR Report: CA13574-OCT15

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	Temperature Upon Receipt °C	Field pH no unit	Field Temperature celcius	Biochemical Oxygen Demand (BOD5) mg/L	Carbonaceous Biochemical Oxygen Demand (CBOD5) mg/L	Total Suspended Solids mg/L	Volatile Suspended Solids mg/L
1: Analysis Start Date		---	---	---	21-Oct-15	21-Oct-15	22-Oct-15	22-Oct-15
2: Analysis Start Time		---	---	---	17:50	19:51	11:10	11:10
3: Analysis Approval Date		---	---	---	27-Oct-15	28-Oct-15	23-Oct-15	26-Oct-15
4: Analysis Approval Time		---	---	---	12:58	08:53	14:28	11:27
6: Raw-1	20-Oct-15 10:50	12.0	7.72	12.9	81	142	83	78
7: RawF-1	20-Oct-15 10:50	12.0	---	---	---	28	---	---
8: RawFF-1	20-Oct-15 12:00	12.0	---	---	---	---	---	---
9: SE-1	20-Oct-15 10:30	12.0	---	---	< 4	< 4	6	4
10: TE-1	20-Oct-15 10:40	12.0	7.41	16.0	< 4	< 4	2	2
11: AT1-1	20-Oct-15 09:05	12.0	7.05	12.3	---	---	6480	4420
12: AT2-1	20-Oct-15 09:05	12.0	7.09	12.4	---	---	6390	4320
13: RAS-1	20-Oct-15 09:10	12.0	7.05	12.9	---	---	23600	15300
14: TBW-1	20-Oct-15 09:20	12.0	7.24	14.1	10	---	32	22

Sample ID	Alkalinity mg/L as CaCO3	Chemical Oxygen Demand mg/L	Phosphorus (total reactive) mg/L	Phosphorus (total) mg/L	Total Kjeldahl Nitrogen as N mg/L	Ammonia+Ammonium (N) mg/L	Nitrite (as N) mg/L	Nitrate (as N) mg/L	Nitrate + Nitrite (as N) mg/L
1: Analysis Start Date	21-Oct-15	27-Oct-15	22-Oct-15	22-Oct-15	23-Oct-15	22-Oct-15	24-Oct-15	24-Oct-15	24-Oct-15
2: Analysis Start Time	15:52	09:20	08:08	10:00	07:30	07:30	08:22	08:22	08:22
3: Analysis Approval Date	22-Oct-15	04-Nov-15	23-Oct-15	24-Oct-15	23-Oct-15	26-Oct-15	27-Oct-15	27-Oct-15	27-Oct-15
4: Analysis Approval Time	14:57	09:48	09:25	21:05	15:32	11:50	15:21	15:21	15:21
6: Raw-1	300	150	0.97	1.95	16.2	15.1	< 0.03	< 0.06	< 0.06
7: RawF-1	---	62	---	---	---	---	---	---	---
8: RawFF-1	---	58	---	---	---	---	---	---	---
9: SE-1	195	< 8	0.03	0.14	< 0.5	< 0.1	< 0.03	11.8	11.8
10: TE-1	177	< 8	0.06	0.09	---	< 0.1	< 0.03	11.5	11.5
11: AT1-1	---	---	---	---	---	---	---	---	---
12: AT2-1	---	---	---	---	---	---	---	---	---
13: RAS-1	---	---	---	---	---	---	---	---	---
14: TBW-1	---	9	0.07	0.74	---	---	---	---	---

SGS

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Works #: 110000301
Project : PO#017844
LR Report : CA13574-OCT15

*CBOD values should not exceed BOD values. These differences in results on the "Raw-1" sample may indicate differences in sample portions used for analysis (non-homogenous).

Carrie Greenlaw
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OnLine LIMS

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Works #: 110000301
Project : PO#017844

29-October-2015

OCWA-Grand Valley-XCG (WPCP)
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Phone: 519-941-1938
Fax:519-941-1794 pdf

Date Rec. : 22 October 2015
LR Report: CA12483-OCT15

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	Temperature Upon Receipt °C	Biochemical Oxygen Demand (BOD5) mg/L	Carbonaceous Biochemical Oxygen Demand (CBOD5) mg/L	Total Suspended Solids mg/L	Volatile Suspended Solids mg/L	Alkalinity mg/L as CaCO3	Chemical Oxygen Demand mg/L	Phosphorus (total reactive) mg/L	Phosphorus (total) mg/L	Total Kjeldahl Nitrogen as N mg/L	Ammonia+Ammonium (N) mg/L	Nitrite (as N) mg/L	Nitrate (as N) mg/L	Nitrate + Nitrite (as N) mg/L
1: Analysis Start Date		—	22-Oct-15	22-Oct-15	23-Oct-15	23-Oct-15	23-Oct-15	28-Oct-15	23-Oct-15	22-Oct-15	22-Oct-15	22-Oct-15	26-Oct-15	26-Oct-15	26-Oct-15
2: Analysis Start Time		—	17:33	19:20	09:03	09:03	11:09	11:21	06:08	22:00	20:00	22:00	08:40	08:40	08:40
3: Analysis Approval Date		—	28-Oct-15	28-Oct-15	29-Oct-15	29-Oct-15	26-Oct-15	29-Oct-15	24-Oct-15	25-Oct-15	29-Oct-15	24-Oct-15	28-Oct-15	28-Oct-15	28-Oct-15
4: Analysis Approval Time		—	16:12	21:55	09:33	13:05	11:48	11:19	14:39	15:41	13:05	15:29	12:56	12:56	12:56
5: Client Limits		—		10	10					0.15		0.7	—	—	—
6: Raw-1	21-Oct-15 10:50	14.0	86	85	85	80	288	150	0.99	2.17	19.8	16.2	< 0.03	< 0.06	< 0.06
7: RawF-1	21-Oct-15 10:50	14.0	—	17	—	—	—	50	—	—	—	—	—	—	—
8: RawFF-1	21-Oct-15 11:30	14.0	—	—	—	—	—	40	—	—	—	—	—	—	—
9: SE-1	21-Oct-15 10:30	14.0	< 4	4	4	3	174	12	0.04	0.14	1.4	< 0.1	< 0.03	12.2	12.2
10: TE-1	21-Oct-15 10:40	14.0	< 4	4	< 2	< 2	173	< 8	0.04	0.08	—	< 0.1	< 0.03	12.2	12.2
11: AT1-1	21-Oct-15 07:55	14.0	—	—	6700	4480	—	—	—	—	—	—	—	—	—
12: AT2-1	21-Oct-15 07:55	14.0	—	—	6700	4260	—	—	—	—	—	—	—	—	—
13: RAS-1	21-Oct-15 07:55	14.0	—	—	20400	13500	—	—	—	—	—	—	—	—	—
14: TBW-1	21-Oct-15 08:10	14.0	13	—	38	27	—	35	0.07	0.65	—	—	—	—	—

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Works #: 110000301
Project : PO#017844
LR Report : CA12483-OCT15

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Works #: 110000301-NR
Project : PO#017844

04-November-2015

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Date Rec. : 23 October 2015
LR Report: CA13692-OCT15

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CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	Temperature Upon Receipt °C	Field pH no unit	Field Temperature celcius	Biochemical Oxygens Demand (BOD5) mg/L	Carbonaceou Biochemical Oxygen Demand (CBOD5) mg/L	Total Suspended Solids mg/L	Volatile Suspended Solids mg/L
1: Analysis Start Date		---	---	---	23-Oct-15	23-Oct-15	27-Oct-15	23-Oct-15
2: Analysis Start Time		---	---	---	17:24	19:29	16:11	10:55
3: Analysis Approval Date		---	---	---	28-Oct-15	29-Oct-15	29-Oct-15	30-Oct-15
4: Analysis Approval Time		---	---	---	22:29	09:09	13:00	09:12
6: Raw-1	22-Oct-15 11:00	12.0	7.68	13.3	145	99	134	122
7: RawF-1	22-Oct-15 11:00	12.0	---	---	---	26	---	---
8: RawFF-1	22-Oct-15 11:00	12.0	---	---	---	---	---	---
9: SE-1	22-Oct-15 10:35	12.0	7.28	16.4	< 4	< 4	5	5
10: TE-1	22-Oct-15 10:50	12.0	7.49	15.8	< 4	< 4	< 2	2
11: AT1-1	22-Oct-15	12.0	7.22	13.6	---	---	6670	4850
12: AT2-1	22-Oct-15	12.0	7.21	13.5	---	---	6200	4100
13: RAS-1	22-Oct-15	12.0	7.11	13.7	---	---	24900	16917
14: TBW-1	22-Oct-15 08:00	12.0	7.30	14.6	12	---	45	32

Sample ID	Alkalinity mg/L as CaCO3	Chemical Oxygen Demand mg/L	Phosphorus (total reactive) mg/L	Phosphorus (total) mg/L	Total Kjeldahl Nitrogen as N mg/L	Ammonia+Ammonium (N) mg/L	Nitrite (as N) mg/L	Nitrate (as N) mg/L	Nitrate + Nitrite (as N) mg/L
1: Analysis Start Date	26-Oct-15	29-Oct-15	23-Oct-15	23-Oct-15	23-Oct-15	27-Oct-15	27-Oct-15	27-Oct-15	27-Oct-15
2: Analysis Start Time	08:54	11:04	15:30	22:00	21:00	21:57	21:10	21:10	21:10
3: Analysis Approval Date	27-Oct-15	04-Nov-15	28-Oct-15	26-Oct-15	27-Oct-15	27-Oct-15	30-Oct-15	30-Oct-15	30-Oct-15
4: Analysis Approval Time	16:34	09:49	15:50	09:52	13:36	14:39	12:30	12:30	12:30
6: Raw-1	286	99	1.51	2.17	21.4	15.0	< 0.03	< 0.06	< 0.06
7: RawF-1	---	62	---	---	---	---	---	---	---
8: RawFF-1	---	51	---	---	---	---	---	---	---
9: SE-1	170	8	0.05	0.16	0.9	< 0.1	< 0.03	12.8	12.8
10: TE-1	171	8	0.06	0.09	---	< 0.1	< 0.03	12.7	12.7
11: AT1-1	---	---	---	---	---	---	---	---	---
12: AT2-1	---	---	---	---	---	---	---	---	---
13: RAS-1	---	---	---	---	---	---	---	---	---
14: TBW-1	---	12	0.11	0.85	---	---	---	---	---

OnLine LIMS

0005430050

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Works #: 110000301-NR
Project : PO#017844
LR Report : CA13692-OCT15

*BOD values should not exceed COD values. These differences in results on the "Raw-1" sample may indicate differences in sample portions used for analysis (non-homogenous).

Carrie Greenlaw
Project Specialist
Environmental Services, Analytical

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Works #: 110000301
Project : PO#017844

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04-November-2015

Date Rec. : 27 October 2015
LR Report: CA12566-OCT15

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CERTIFICATE OF ANALYSIS
Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	6: Raw-1	7: RawF-1	8: RawFF-1	9: SE-1	10: TE-1	11: AT1-1	12: AT2-1	13: RAS-1	14: TBW-1
Sample Date & Time					26-Oct-15 09:00	26-Oct-15	26-Oct-15	26-Oct-15 08:45	26-Oct-15 08:50	26-Oct-15 08:20	26-Oct-15 08:20	26-Oct-15 08:20	26-Oct-15 08:35
Temperature Upon Receipt [°C]	—	—	—	—	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Biochemical Oxygen Demand (BOD5) [mg/L]	27-Oct-15	16:35	02-Nov-15	20:19	154	—	—	6	< 4	—	—	—	19
Carbonaceous Biochemical Oxygen Demand [(CBOD5) m	27-Oct-15	18:26	02-Nov-15	19:58	160	36	—	< 4	< 4	—	—	—	—
Total Suspended Solids [mg/L]	28-Oct-15	13:47	03-Nov-15	09:55	109	—	—	6	< 2	6810	7280	18700	46
Volatile Suspended Solids [mg/L]	28-Oct-15	13:47	03-Nov-15	14:46	98	—	—	5	< 2	4650	4940	13000	35
Alkalinity [mg/L as CaCO3]	28-Oct-15	06:31	28-Oct-15	20:43	289	—	—	165	164	—	—	—	—
Chemical Oxygen Demand [mg/L]	03-Nov-15	10:18	04-Nov-15	15:07	160	60	65	10	9	—	—	—	20
Phosphorus (total reactive) [mg/L]	27-Oct-15	16:50	28-Oct-15	15:32	0.97	—	—	< 0.03	< 0.03	—	—	—	0.07
Phosphorus (total) [mg/L]	27-Oct-15	21:49	28-Oct-15	14:26	2.27	—	—	0.16	0.06	—	—	—	0.80
Total Kjeldahl Nitrogen [as N mg/L]	28-Oct-15	06:20	29-Oct-15	13:01	20.8	—	—	< 0.5	—	—	—	—	—
Ammonia+Ammonium (N) [mg/L]	28-Oct-15	21:25	28-Oct-15	12:17	15.6	—	—	< 0.1	< 0.1	—	—	—	—
Nitrite (as N) [mg/L]	28-Oct-15	23:51	29-Oct-15	09:54	< 0.03	—	—	< 0.03	< 0.03	—	—	—	—
Nitrate (as N) [mg/L]	28-Oct-15	23:51	29-Oct-15	09:54	< 0.06	—	—	13.3	13.3	—	—	—	—
Nitrate + Nitrite (as N) [mg/L]	28-Oct-15	23:51	29-Oct-15	09:54	< 0.06	—	—	13.3	13.3	—	—	—	—

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Works #: 110000301
Project : PO#017844
LR Report : **CA12566-OCT15**

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Works #: 110000301
Project : PO#017844

04-November-2015

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Date Rec. : 28 October 2015
LR Report: CA12617-OCT15

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	Temperature Upon Receipt °C	Biochemical Oxygen Demand (BOD5) mg/L	Carbonaceous Biochemical Oxygen Demand (CBOD5) mg/L	Total Suspended Solids mg/L	Volatile Suspended Solids mg/L	Alkalinity mg/L as CaCO3	Chemical Oxygen Demand mg/L	Phosphorus (total reactive) mg/L	Phosphorus (total) mg/L	Total Kjeldahl Nitrogen as N mg/L	Ammonia+Ammonium (N) mg/L	Nitrite (as N) mg/L	Nitrate (as N) mg/L	Nitrate + Nitrite (as N) mg/L
1: Analysis Start Date		—	28-Oct-15	28-Oct-15	29-Oct-15	29-Oct-15	29-Oct-15	03-Nov-15	30-Oct-15	28-Oct-15	28-Oct-15	29-Oct-15	30-Oct-15	30-Oct-15	30-Oct-15
2: Analysis Start Time		—	17:45	19:17	10:38	10:38	06:46	12:37	09:30	21:15	21:59	21:57	20:37	20:37	20:37
3: Analysis Approval Date		—	03-Nov-15	03-Nov-15	03-Nov-15	03-Nov-15	30-Oct-15	04-Nov-15	02-Nov-15	30-Oct-15	29-Oct-15	29-Oct-15	03-Nov-15	03-Nov-15	03-Nov-15
4: Analysis Approval Time		—	13:54	14:57	10:29	14:46	10:07	15:05	14:14	08:28	13:05	15:34	15:27	15:27	15:27
6: Raw-1	27-Oct-15 09:00	9.0	134	97	115	105	287	136	1.30	2.29	19.3	16.3	< 0.03	< 0.06	< 0.06
7: RawF-1	27-Oct-15 09:00	9.0	—	28	—	—	—	70	—	—	—	—	—	—	—
8: RawFF-1	27-Oct-15 09:00	9.0	—	—	—	—	—	51	—	—	—	—	—	—	—
9: SE-1	27-Oct-15 08:10	9.0	< 4	< 4	4	4	169	< 8	0.08	0.12	< 0.5	< 0.1	< 0.03	13.1	13.1
10: TE-1	27-Oct-15 08:15	9.0	< 4	< 4	< 2	< 2	157	17	0.04	0.07	—	< 0.1	< 0.03	13.1	13.1
11: AT1-1	27-Oct-15 08:30	9.0	—	—	6500	4410	—	—	—	—	—	—	—	—	—
12: AT2-1	27-Oct-15 08:30	9.0	—	—	6080	4110	—	—	—	—	—	—	—	—	—
13: RAS-1	27-Oct-15 08:30	9.0	—	—	20700	14000	—	—	—	—	—	—	—	—	—
14: TBW-1	27-Oct-15 08:05	9.0	12	—	37	26	—	14	0.12	0.70	—	—	—	—	—

Test method information available upon request. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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Works #: 110000301
Project : PO#017844
LR Report : CA12617-OCT15

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Environmental Services, Analytical

SGS

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Works #: 110000301
Project : PO#017844

05-November-2015

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Date Rec. : 29 October 2015
LR Report: CA13855-OCT15

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CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	Temperature Upon Receipt °C	Field pH no unit	Field Temperature celcius	Biochemical Oxygen Demand (BOD5) mg/L	Carbonaceous Biochemical Oxygen Demand (CBOD5) mg/L	Total Suspended Solids mg/L	Volatile Suspended Solids mg/L
1: Analysis Start Date		—			29-Oct-15	29-Oct-15	30-Oct-15	30-Oct-15
2: Analysis Start Time		—			16:55	18:29	16:16	16:16
3: Analysis Approval Date		—			03-Nov-15	03-Nov-15	04-Nov-15	04-Nov-15
4: Analysis Approval Time		—			15:28	16:02	15:53	16:20
6: Raw-1	28-Oct-15 09:00	14.0	7.64	10.6	125	117	150	142
7: RawF-1	28-Oct-15 09:00	14.0	—	—	—	25	—	—
8: RawFF-1	28-Oct-15 09:00	14.0	—	—	—	—	—	—
9: SE-1	28-Oct-15 08:30	14.0	7.38	14.6	< 4	< 4	5	5
10: TE-1	28-Oct-15 08:35	14.0	7.49	14.7	< 4	< 4	< 2	2
11: AT1-1	28-Oct-15	14.0	7.04	12.9	—	—	6160	4350
12: AT2-1	28-Oct-15	14.0	7.12	12.3	—	—	4260	3060
13: RAS-1	28-Oct-15	14.0	7.06	12.3	—	—	24800	17400
14: TBW-1	28-Oct-15 08:20	14.0	7.23	13.7	13	—	40	28

Sample ID	Alkalinity mg/L as CaCO3	Chemical Oxygen Demand mg/L	Phosphorus (total reactive) mg/L	Phosphorus (total) mg/L	Total Kjeldahl Nitrogen as N mg/L	Ammonia+Ammonium (N) mg/L	Nitrite (as N) mg/L	Nitrate (as N) mg/L	Nitrate + Nitrite (as N) mg/L
1: Analysis Start Date	30-Oct-15	03-Nov-15	30-Oct-15	29-Oct-15	30-Oct-15	29-Oct-15	31-Oct-15	31-Oct-15	31-Oct-15
2: Analysis Start Time	06:39	14:04	09:30	21:30	21:55	21:55	12:02	12:02	12:02
3: Analysis Approval Date	30-Oct-15	04-Nov-15	02-Nov-15	30-Oct-15	02-Nov-15	03-Nov-15	04-Nov-15	04-Nov-15	04-Nov-15
4: Analysis Approval Time	15:23	09:38	11:28	11:33	11:51	12:33	16:37	16:37	16:37
6: Raw-1	297	146	1.55	2.40	20.3	16.4	< 0.03	< 0.06	< 0.06
7: RawF-1	—	63	—	—	—	—	—	—	—
8: RawFF-1	—	48	—	—	—	—	—	—	—
9: SE-1	171	10	0.04	0.13	< 0.5	< 0.1	< 0.03	13.4	13.4
10: TE-1	170	12	0.03	0.06	—	< 0.1	< 0.03	13.3	13.4
11: AT1-1	—	—	—	—	—	—	—	—	—
12: AT2-1	—	—	—	—	—	—	—	—	—
13: RAS-1	—	—	—	—	—	—	—	—	—
14: TBW-1	—	40	0.06	0.71	—	—	—	—	—

OnLine LIMS

0000544778

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Works #: 110000301
Project : PO#017844
LR Report : CA13855-OCT15

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05-November-2015

Date Rec. : 30 October 2015
LR Report: CA13923-OCT15

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CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	Temperature Upon Receipt °C	Biochemical Oxygen Demand (BOD5) mg/L	Carbonaceous Biochemical Oxygen Demand (CBOD5) mg/L	Total Suspended Solids mg/L	Volatile Suspended Solids mg/L	Alkalinity mg/L as CaCO3	Chemical Oxygen Demand mg/L	Phosphorus (total reactive) mg/L	Phosphorus (total) mg/L	Total Kjeldahl Nitrogen as N mg/L	Ammonia+Ammonium (N) mg/L	Nitrite (as N) mg/L	Nitrate (as N) mg/L	Nitrate + Nitrite (as N) mg/L
1: Analysis Start Date		—	30-Oct-15	30-Oct-15	02-Nov-15	02-Nov-15	30-Oct-15	04-Nov-15	30-Oct-15	02-Nov-15	30-Oct-15	30-Oct-15	31-Oct-15	31-Oct-15	31-Oct-15
2: Analysis Start Time		—	16:25	17:53	15:11	15:11	20:34	10:48	16:06	09:30	18:15	19:56	00:01	00:01	00:01
3: Analysis Approval Date		—	04-Nov-15	04-Nov-15	05-Nov-15	04-Nov-15	03-Nov-15	04-Nov-15	03-Nov-15	03-Nov-15	02-Nov-15	02-Nov-15	04-Nov-15	04-Nov-15	04-Nov-15
4: Analysis Approval Time		—	13:30	14:48	07:57	16:20	09:43	15:07	13:13	16:12	12:02	12:26	17:06	17:06	17:06
6: Raw-1	29-Oct-15 09:00	11.0	84	66	94	89	276	94	0.96	1.98	19.8	13.8	< 0.03	< 0.06	< 0.06
7: RawF-1	29-Oct-15 09:00	11.0	—	21	—	—	—	51	—	—	—	—	—	—	—
8: RawFF-1	29-Oct-15 09:00	11.0	—	—	—	—	—	40	—	—	—	—	—	—	—
9: SE-1	29-Oct-15 08:30	11.0	6	< 4	4	4	165	< 8	0.04	0.16	1.0	< 0.1	< 0.03	13.0	13.0
10: TE-1	29-Oct-15 08:35	11.0	< 4	< 4	< 2	2	176	8	0.04	0.11	—	< 0.1	< 0.03	13.0	13.0
11: AT1-1	29-Oct-15 08:05	11.0	—	—	10200	4820	—	—	—	—	—	—	—	—	—
12: AT2-1	29-Oct-15 08:05	11.0	—	—	6250	4380	—	—	—	—	—	—	—	—	—
13: RAS-1	29-Oct-15 08:05	11.0	—	—	20600	14000	—	—	—	—	—	—	—	—	—
14: TBW-1	29-Oct-15 08:20	11.0	10	—	38	28	—	13	0.08	0.83	—	—	—	—	—

Test method information available upon request. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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APPENDIX E

GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY SECONDARY CLARIFIER, TERTIARY FILTER, AND DISINFECTION STRESS TEST RESULTS

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XCG File No.: 3-252-57-02
January 24, 2017

GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY SECONDARY CLARIFIER, TERTIARY FILTER, AND DISINFECTION STRESS TEST RESULTS

Prepared for:

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1. INTRODUCTION

The Grand Valley WPCP provides treatment for wastewater generated in the community of Grand Valley within the Town of Grand Valley (Town). The plant is currently operated by the Ontario Clean Water Agency (OCWA) under the Ministry of Environment and Climate Change (MOECC) Certificate of Approval (C of A) No. 9706-7KWQ57, issued on February 2, 2009. The quality and quantity of effluent currently discharged by the existing Water Pollution Control Plant (WPCP) is regulated by the C of A. The Grand Valley WPCP has a rated average day flow (ADF) capacity of 1,244 m^3/d.

The Town has initiated an investigation to analyze the potential to re-rate the existing Grand Valley WPCP to provide additional treatment capacity and to defer the facility's next upgrade and expansion. The Town has retained XCG Consulting Limited (XCG) to undertake a capacity assessment of the Grand Valley WPCP to evaluate the potential to re-rate the plant. Stress testing of the secondary clarifiers, tertiary filters, and ultraviolet (UV) disinfection system was carried out from July 12 - 18, 2016. The purpose of this technical memorandum (TM) is to present the results and conclusions from the stress testing program.

2. STRESS TESTING METHODOLOGY

2.1 Background

The Grand Valley WPCP is equipped with two identical circular secondary clarifiers, four identical continuous-backwash tertiary filters, and a UV disinfection system. A summary of these processes is presented in Table 2.1.

Table 2.1 Grand Valley WPCP Process Design Information

Unit Process	Design Parameter [1]
Secondary Clarifiers	
Number	2
Surface Area	75.4 m^2 (each)
	150.8 m^2 (total)
Filters	
Type	Continuous up-flow, deep bed, granular media
Backwash	Continuous
Number	4
Filtration Area	4.65 m^2 (each)
	18.6 m^2 (total)
Design Peak Flow Capacity	5,300 m^3/d
Disinfection	
Type	UV Disinfection
Design Peak Flow Capacity	7,680 m^3/d

Notes:
1. Based on Amended Certificate of Approval Number 9706-7KWQ57, issued February 2, 2009, and the Grand Valley Wastewater Treatment Plant Operations Manual (R.J. Burnside, 2015).

Previous analysis has developed a future design basis in terms of raw wastewater flows and loadings for the Grand Valley WPCP under three future scenarios:

- Scenario I: Full completion of planned residential developments to an ADF of 1,279 m^3/d;
- Scenario II: A 15% increase above the current C of A rated average day flow (ADF) (1,430 m^3/d); and,
- Scenario III: A 25% increase above the current C of A rated ADF (1,555 m^3/d).

Stress testing was carried out on the secondary clarifiers and tertiary filters to simulate projected peak hour and maximum day flows conditions anticipated when the plant is operated under Scenario III flows and loads. These conditions are presented in Section 2.2.1.

2.2 Detailed Description of Testing Methodology

As previously noted, the two secondary clarifiers at the Grand Valley WPCP have identical dimensions and therefore it is assumed they have equal treatment capacities. Stress testing was conducted on only one secondary clarifier, which was assumed to be representative of the performance of both secondary clarifiers.

Similarly, since the existing tertiary filters have identical dimensions and configurations, it is assumed that the capacity of each filter is equal. As such, stress testing focused on evaluating the performance of two tertiary filters.

Operation of the UV disinfection system was not modified during the stress testing program. Instead, samples of secondary clarifier and tertiary filter effluent were collected over the duration of each testing day. The performance of the UV disinfection system was evaluated by taking UVT measurements of secondary clarifier and tertiary filter effluent samples during the stress test and, comparing the observed UVT to the design UVT.

Field work was carried out over three days in July, 2016. A summary of field activities is presented in Table 2.2.

Table 2.2 Summary of Field Activities

Date	Testing Day	Processes Tested	Testing Conditions
July 12	Day 1	Set up, preparation, and baseline testing	
July 13	Day 2	Secondary Clarifiers, Tertiary Filters and UV Disinfection	Peak Hour Flow
July 18	Day 3	Secondary Clarifiers, Tertiary Filters and UV Disinfection	Maximum Day Flow

Detailed descriptions of how target flows were achieved, and the sampling and monitoring program carried out during the performance testing was included in the Secondary Clarifier and Tertiary Filter Stress Testing Protocol (XCG, 2016). A copy of the protocol is included in Appendix A. Brief details of the target flows and sampling program are included in subsequent subsections.

2.2.1 Target Operating Conditions

For purposes of this test, target peak hour and maximum day flow rates were estimated using the following assumptions:

- Proposed Scenario III future flows (XCG, 2015);
- Future storm tank overflow operation to provide sufficient volume to equalize two days of peak flows; and,
- Peak flow event characteristics similar to a historical peak flow event available from plant records.

Based on the above assumptions, the future projected maximum day flow (MDF) and peak hour flow (PHF) to secondary treatment are approximately 6,250 m^3/d and 6,500 m^3/d, respectively. As only half of the plant capacity was tested, the target MDF and PHF for purposes of this Stress Test were 3,125 m^3/d and 3,250 m^3/d, respectively. A summary of test target conditions, including surface overflow rates (SOR), solids loading rates (SLR), and filtration rates is given in Table 2.3. UVT measurements of secondary clarifier and tertiary filter effluent samples were taken for the duration of the stress testing period to evaluate the capacity of the UV system.

Table 2.3 Summary of Target Test Conditions

Test Condition	Surface Overflow Rate ($m^3/m^2·d$)	Solids Loading Rate ($kg/m^2·d$)	Filtration Rate ($L/m^2·s$)
Test Target	43 (1)	210 (2)	4.0 (1)
Typical Design (3)	37	170	3.3

Notes:
1. Based on target peak hour flows.
2. Based on target maximum day flows
3. From Design Guidelines for Sewage Works (MOE, 2008). For an extended aeration activated sludge process with nitrification and chemical phosphorus removal.

Adequate flow from the Emma St. SPS was not available to achieve the target MDF and PHF for the Stress Test. As such, prior to Day 2 and Day 3 of the Stress Test, the offline aeration tank and storm tank were filled with sufficient supplementary volume for purposes of testing that day. Plant operators were responsible for filling the offline aeration tank was with raw wastewater and the storm tank with potable water. Supplemental volume was returned to the flow split chamber immediately upstream of the aeration tanks using temporary pumps and hoses.

2.2.2 Process Monitoring and Sampling

A brief description of the monitoring program during the Stress Test is as follows:

- An automatic sampler was configured to collect effluent samples from the test clarifier and test filters. On Day 1 and Day 3, samples were collected every 15 minutes and combined to form 1 hour composite samples. On Day 2, samples were collected every 15 minutes and combined to form 30 minute composite samples. Each sample was analyzed for total suspended solids (TSS), total phosphorus (TP), orthophosphate, turbidity, and UVT.
- Mixed liquor was collected once (Day 1) and once per hour (Days 2 and 3) and analyzed for mixed liquor suspended solids (MLSS). A 30 minute settling test on the mixed liquor was conducted once on Day 2 and Day 3. Results from the settling test were used to calculate the sludge volume index (SVI).
- Sludge blanket height in the secondary clarifier was monitored using a sludge judge at three measurement points along the radius of the test secondary clarifier (i.e. exterior, middle, interior). Approximate locations for the three measurement points are shown in Figure 2.1.
- All processes were monitored continually for hydraulic limitations.

Additional details regarding the sampling and monitoring program are included in Appendix A.

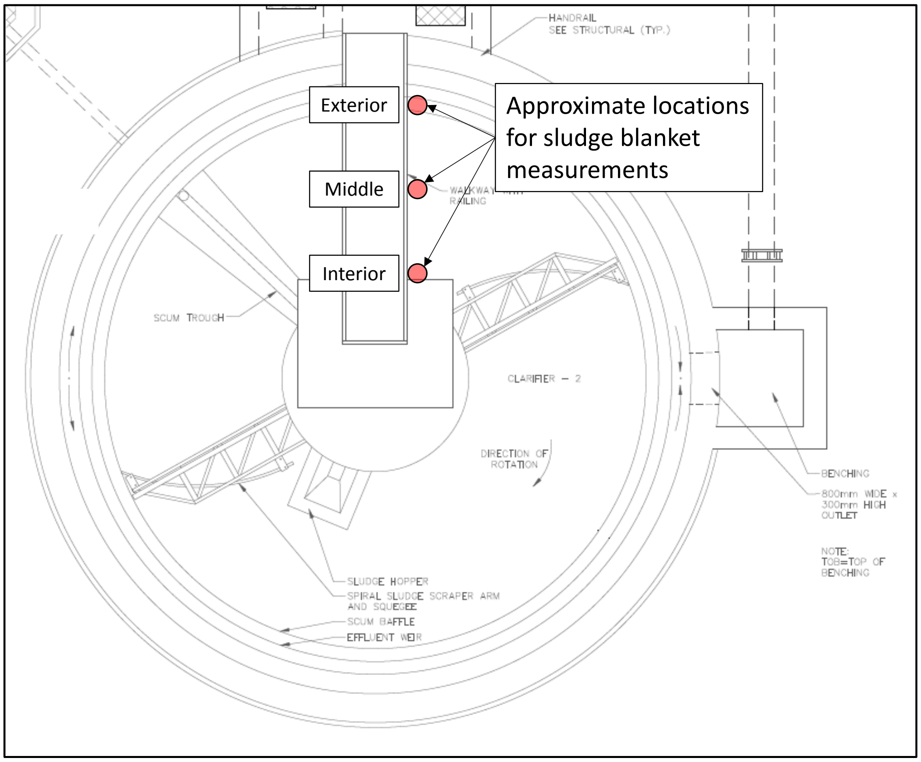

Figure 2.1 Locations for Sludge Blanket Measurements

2.2.3 Target Alum Dosage

The Grand Valley WPCP doses alum at the aeration tank effluent to precipitate phosphorus and control effluent phosphorus concentrations. The historical target alum dosage was 70 mg/L, which is less than the typical dosage rate of 110 mg/L to 225 mg/L as alum (MOE, 2008). The target alum dosage for purposes of this test was equal to the average historical alum dosage (70 mg/L). Plant operators were responsible for adjusting the alum dosage pumps based on the measured effluent of the plant.

During the testing period, it was discovered that only one alum pump could be used to deliver alum at the dosage location (aeration tank effluent), and that duty and standby pumps could not be used simultaneously. As per the plant C of A, the capacity of the alum dosing pump is approximately 12.0 L/hr which restricts the maximum alum dose to approximately 173 kg/d. As such, operational restrictions at the plant limited the alum dose to approximately 55 mg/L at target conditions.

2.2.4 Return Activated Sludge

There are three return activated sludge (RAS) pumps at the Grand Valley WPCP (two duty and one standby). The capacity of each pump is 1,244 m^3/d, giving a total RAS capacity of 200% of the existing C of A rated ADF. For the duration of the testing period, RAS pumps were set to approximately 90% of the target ADF (700 m^3/d).

3. RESULTS

3.1 Day 1 - Baseline Testing

The purpose of baseline testing was to evaluate the secondary clarifier and tertiary filter effluent quality immediately prior to the stress test at current average day flows. One secondary clarifier and two tertiary filters were online during the baseline sampling period. As previously discussed, the baseline sample consisted of four (4) discrete samples collected at 15 minute intervals and combined into one single composite sample. A summary of sample results is presented in Table 3.1. For comparison, the historical average from available plant data (2012 to May 2016) is also presented.

Table 3.1 Summary of Baseline Sample Results

Parameter	Secondary Clarifier Effluent	Tertiary Filter Effluent	Historical Final Effluent	C of A Effluent Requirements	
				Objectives	Limits
Total Suspended Solids (1)	7.0 mg/L	2.0 mg/L	3.4 mg/L	8.0 mg/L	10.0 mg/L
Total Phosphorus (1)	0.18 mg/L	0.085 mg/L	0.076 mg/L	0.13 mg/L	0.15 mg/L
Orthophosphate (2)	0.2 mg/L	0.12 mg/L	-	-	-
Turbidity (2)	2.8	1.3	-	-	-
UVT (2)	85.6	88.2	-	-	-

Notes
1. As measured by an accredited laboratory.
2. As measured onsite by XCG.

The following observations can be made from results presented in the above table:

- Tertiary filters improved the effluent quality as measured by all considered parameters.
- Both tertiary effluent TSS and TP concentrations measured during the baseline testing are comparable to the final effluent TSS and TP concentrations observed over the historical period.
- Baseline UVT measurements are significantly greater than the design minimum UVT (55%).
- Onsite orthophosphate concentrations were greater than TP concentrations measured at the accredited laboratory, in spite of the fact that orthophosphate concentrations should always be less than or equal to TP concentrations for a given sample. Given the low measured concentrations of both TP and orthophosphate, it is likely this is due to anticipated variability as concentrations approach the method detection limit (MDL) of the test methods. For the purposes of this study, it was assumed that reported TP concentrations are accurate and that almost all remaining phosphorus is soluble.

3.2 Day 2 - Peak Hour Flow Testing

The purpose during Day 2 of testing was to incrementally increase flow over one hour periods to evaluate the hydraulic capacity of the secondary clarifier. Testing took place on July 13, 2016 from approximately 9:00 am to 12:45 pm.

During testing, mixed liquor suspended solids (MLSS) concentrations decreased from approximately 5,300 mg/L to 4,400 mg/L in Aeration Tank 1 and from approximately 5,000 mg/L to 4,300 mg/L in Aeration Tank 2, indicating that mixed liquor was being transferred to the test clarifier during the stress testing.

To evaluate sludge settleability, a 30 minute settling test was conducted once during the peak hour flow test and results were used to calculate the sludge volume index (SVI). Mixed liquor concentrations were adjusted as required for purposes of calculating the SVI. One settling test was conducted for each aeration tank, and the calculated sludge settleability was assumed to be representative for the duration of the peak hour testing period. Results are summarized in Table 3.2.

Table 3.2 Summary of Settleability Tests

	Aeration Tank 1	Aeration Tank 2
Settled Volume (mL)	270	270
Estimated SVI (mL/g)	54	58

As presented, estimated SVIs for Aeration Tank 1 and Aeration Tank 2 are 54 mL/g and 58 mL/g, respectively. SVIs less than 100 mL/g are desired, and indicate a sludge with good settleability (Metcalf & Eddy, 2003). The RAS flow rate was maintained at approximately 700 m^3/d for the duration of the test period.

3.2.1 Measured Flows and Loading Rates

Surface overflow rates (SOR) from the test secondary clarifier were recorded by a velocity-area (VA) flow meter, installed by XCG on July 12, 2016. The solids loading rate (SLR) to the test secondary clarifier was estimated from the measured overflow rate, RAS flow rate, and the measured MLSS concentration. SLR calculations account for observed changes in MLSS concentrations over the test period. Filtration rates were estimated using the measured clarifier overflow rate given the tertiary filter surface area.

Figure 3.1 and Figure 3.2 show the calculated secondary clarifier SOR and SLR, respectively, for the duration of Day 2 of testing. Figure 3.3 and Figure 3.4 shows the estimated tertiary filter filtration rate and solids loading rate, respectively. Target rates are also shown on all figures where applicable.

For the duration of the testing period, secondary clarifier effluent and tertiary filter effluent channels were continuously visually monitored for hydraulic limitations and poor effluent quality (turbid).

At approximately 11:30 am, a third tertiary filter was brought online as a result of visual observations of solids in the tertiary effluent stream. The additional tertiary filter had an impact on the filtration rates (sudden decrease at approximately 11:30

am, as shown in Figure 3.3), however SOR and SLR values of the test secondary clarifier were not affected.

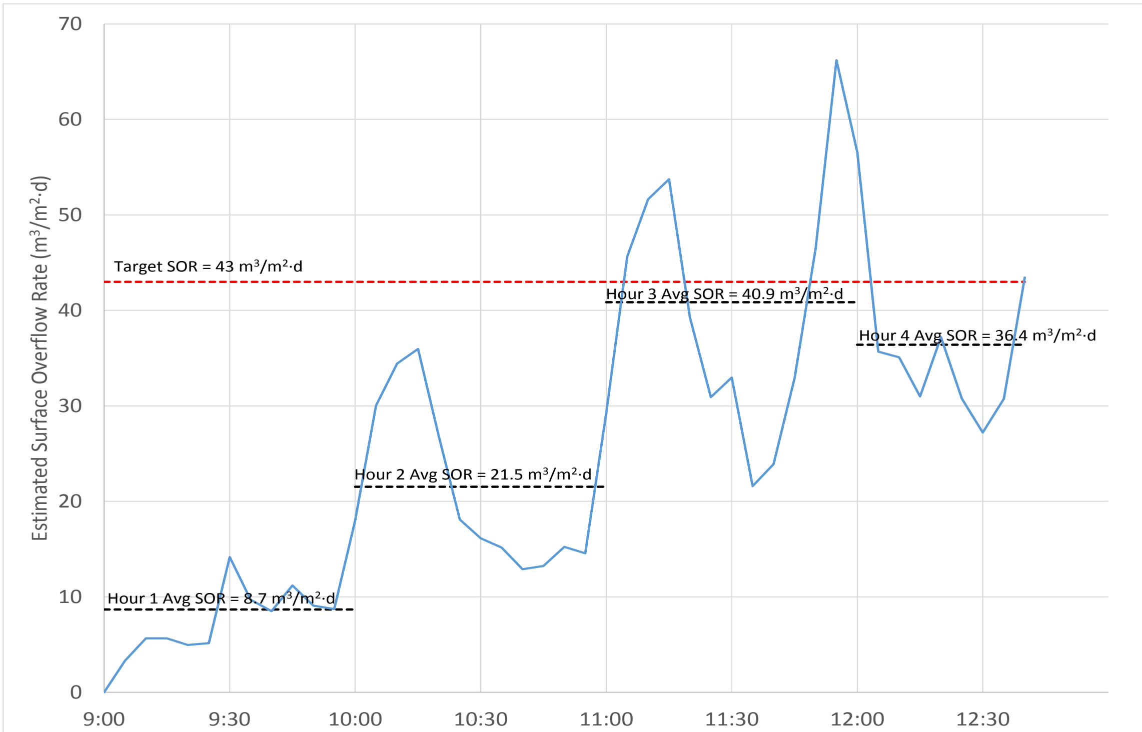

Figure 3.1 Calculated SOR for Test Secondary Clarifier (Day 2)

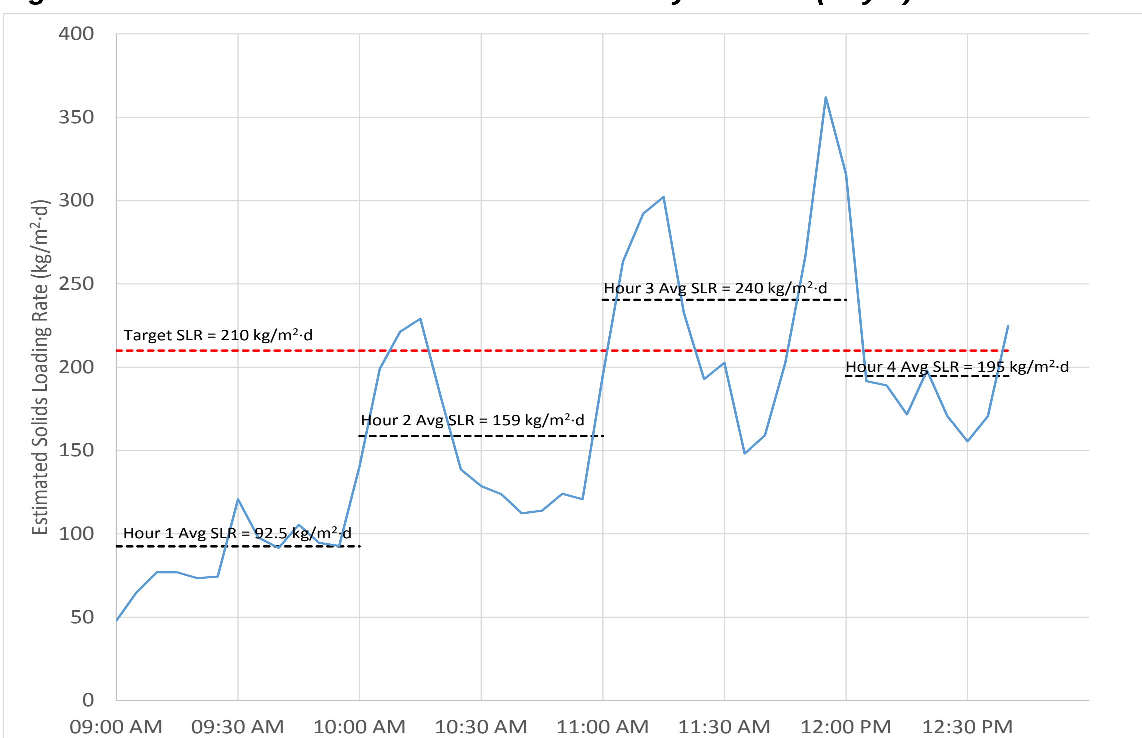

Figure 3.2 Calculated SLR for Test Secondary Clarifier (Day 2)

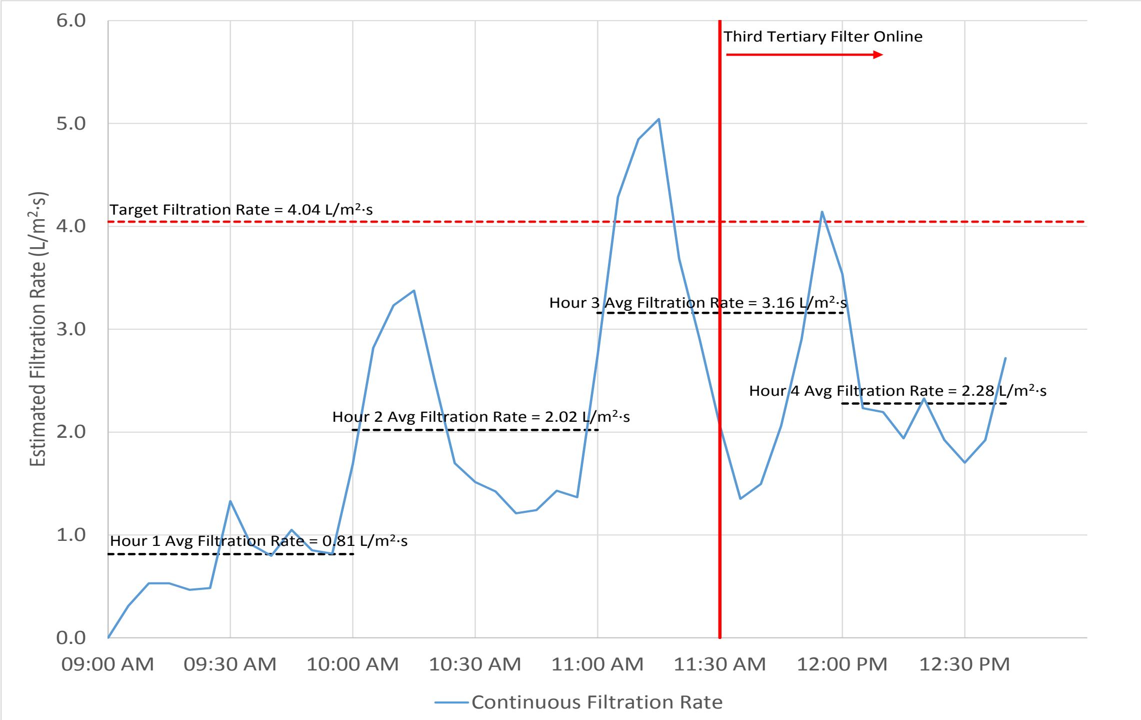

Figure 3.3 Calculated Filtration Rate for Test Tertiary Filters (Day 2)

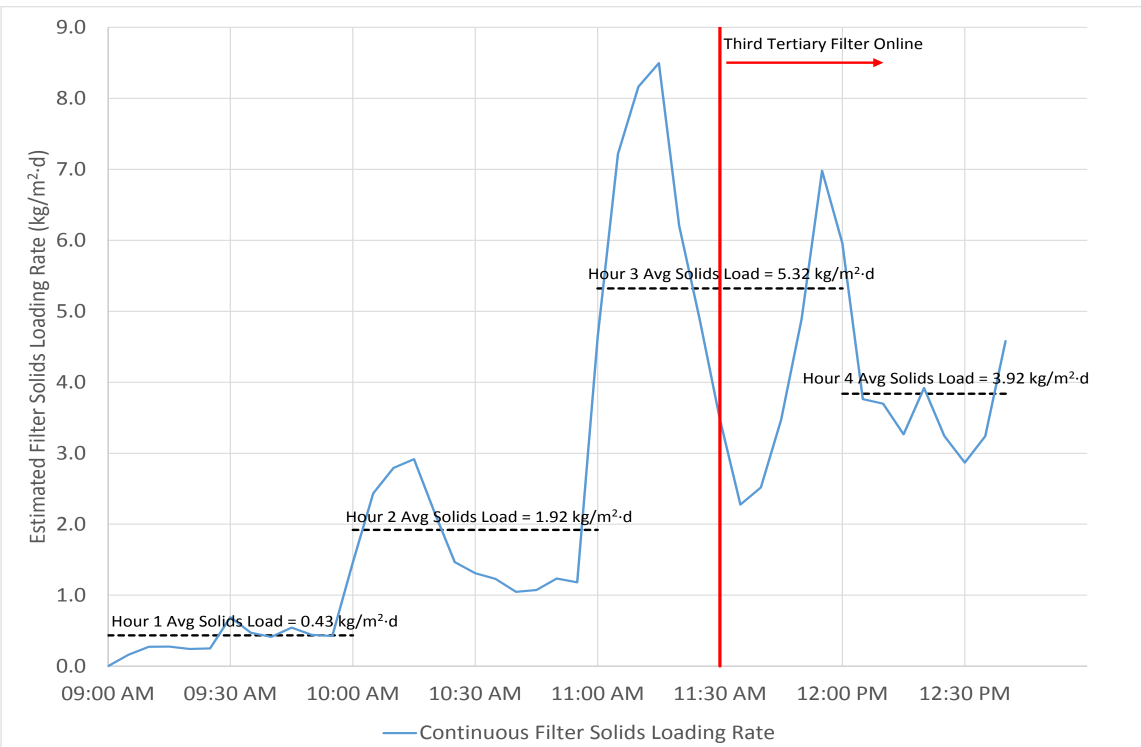

Figure 3.4 Calculated Filter Solids Loading Rate for Test Tertiary Filters (Day 2)

The test reached peak flows between 11:00 am and 12:00 pm. 1-hour average SOR, SLR, and filtration rates achieved during this period are summarized in Table 3.3.

Table 3.3 Summary Day 2 Peak Hour Operating Conditions

Test Unit	Value	Target
Secondary Clarifier		
SOR ($m^3/m^2 \cdot d$)	40.9	43
SLR ($kg/m^2 \cdot d$)	240	210
Tertiary Filter		
Filtration Rate ($L/m^2 \cdot s$)	3.16 (1)	4.04
Solids Loading Rate ($kg/m^2 \cdot d$)	5.32 (1)	-

Notes:
1. Estimated filtration rate average between 11:00 am and 12:00 pm. Average includes impact of third filter, which was brought online at 11:30 am.

The following observations can be made from results presented in Figure 3.1, Figure 3.2, Figure 3.3, Figure 3.4, and Table 3.3:

- With respect to the test secondary clarifier, the SOR and SLR reached during peak hour flow was comparable to targets established for this test.
- With respect to the filtration rate and filter solids loading rate during testing, increased solids concentrations in the tertiary effluent stream were visually observed. As a result, an additional tertiary filter was brought online prior to reaching sustained peak hour flows. As such, achieved filtration rates were below target filtration rates.

3.2.2 Measured Clarifier and Filter Performance

As previously discussed, samples of secondary clarifier and tertiary filter effluent were collected for the duration of peak hour testing. To evaluate the performance of the secondary clarifiers and tertiary filters, each sample was sent to an accredited laboratory for TSS and TP measurements. In addition, samples were processed onsite for orthophosphate, turbidity, and UVT measurements.

Figure 3.5 shows the measured TSS concentrations over the duration of Day 2. Similarly, Figure 3.6 shows the measured TP and orthophosphate concentrations. C of A final effluent objective and limit concentrations are also shown on each figure. It is important to note that current C of A effluent limits are enforced on a monthly average basis, and effluent samples are composited over a 24-hour period. As such, objectives and limits have been included for reference only, and results from samples collected during this test do not indicate compliance or exceedance with the existing C of A. Figure 3.7 and Figure 3.8 show secondary effluent and tertiary effluent measurements for turbidity and UVT, respectively, over the duration of Day 2 of testing.

For reference, the approximate time when the third tertiary filter was brought online is indicated in all figures.

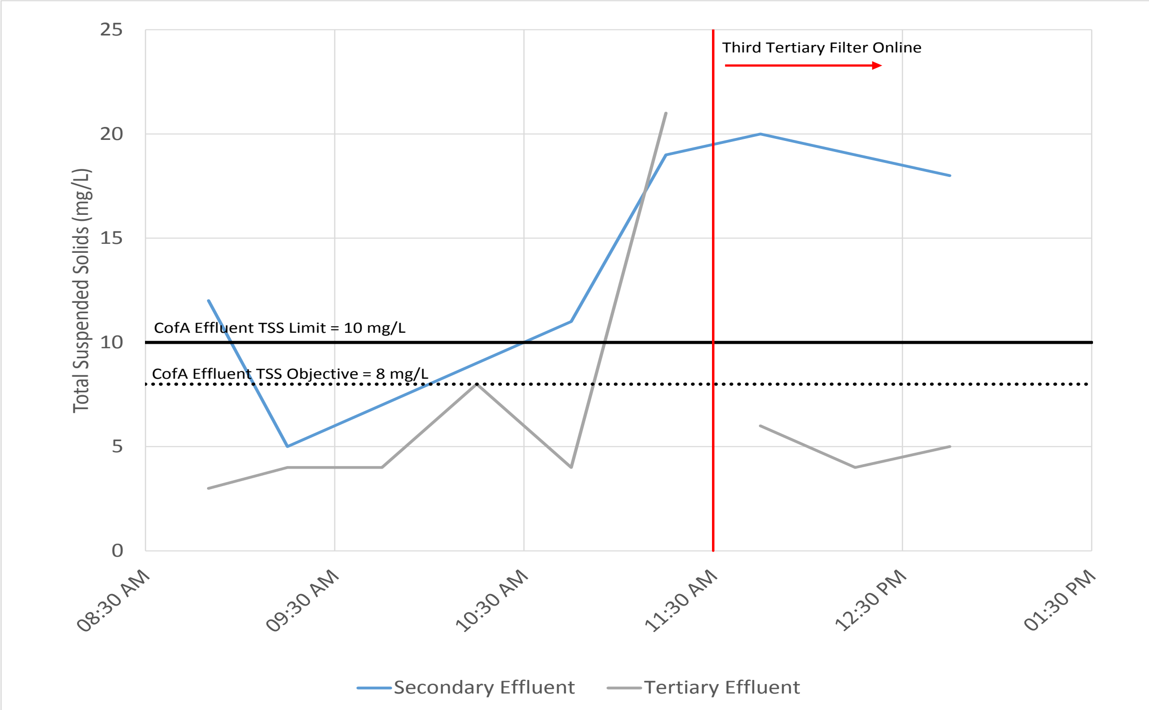

Figure 3.5 Measured Secondary Clarifier and Tertiary Filter Effluent TSS Concentrations (Day 2)

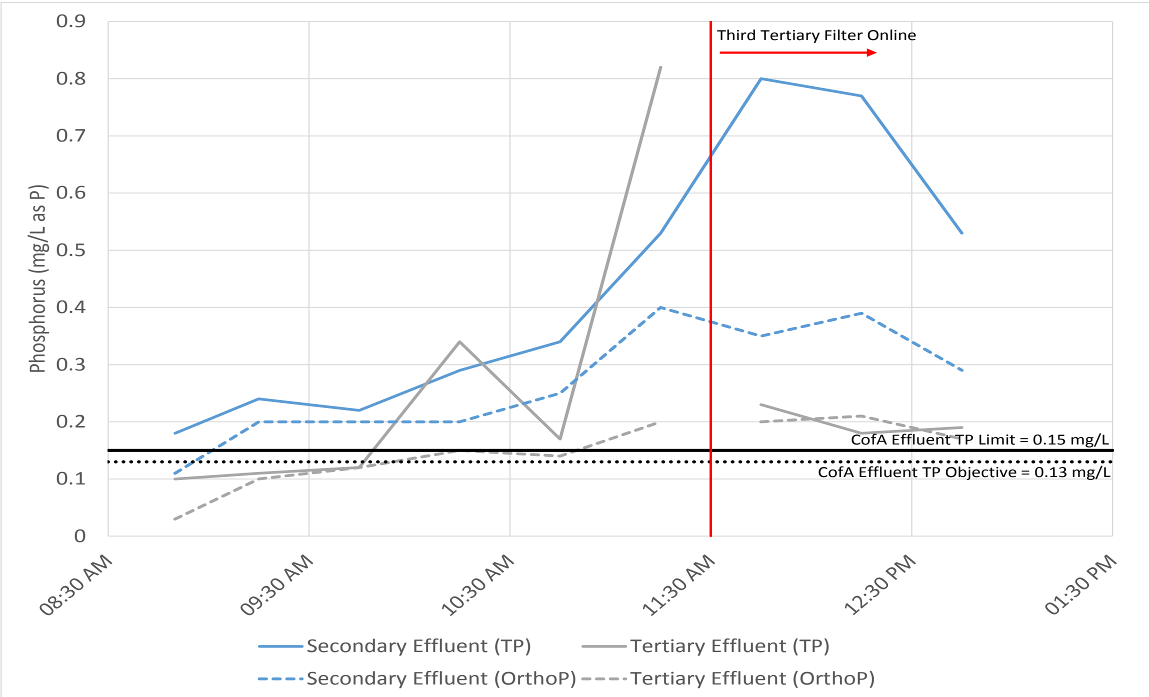

Figure 3.6 Measured Secondary Clarifier and Tertiary Filter Effluent Total Phosphorus and Orthophosphate Concentrations (Day 2)

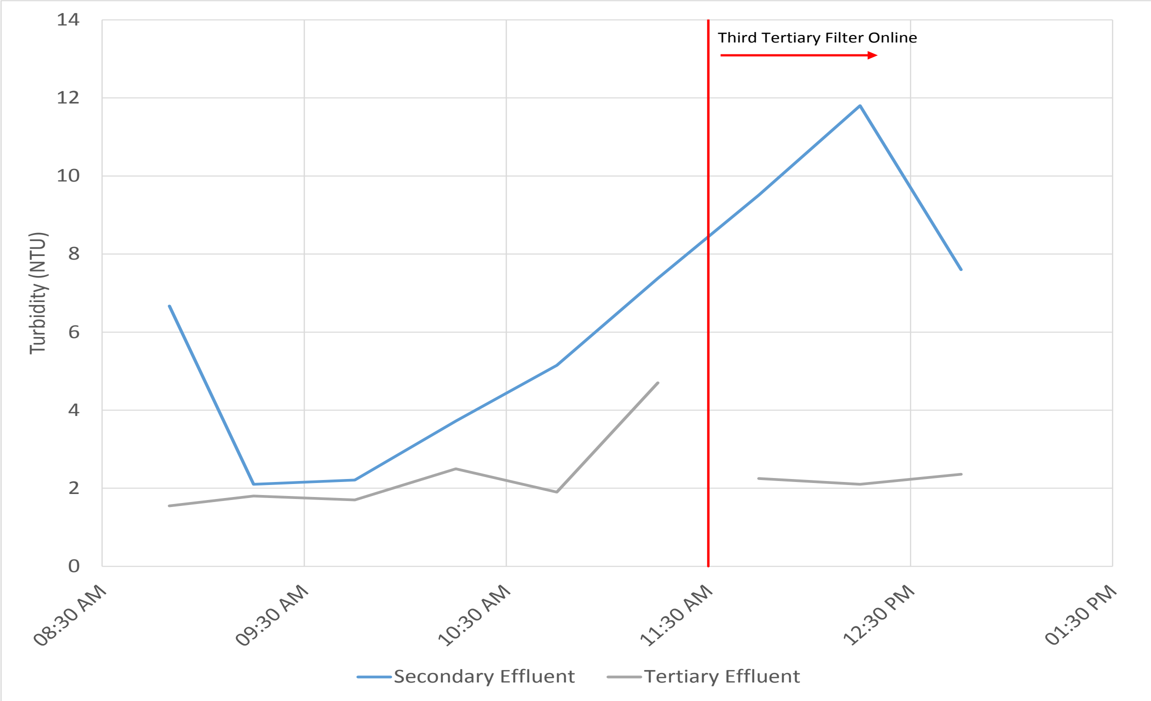

Figure 3.7 Measured Secondary Clarifier and Tertiary Filter Effluent Turbidity (Day 2)

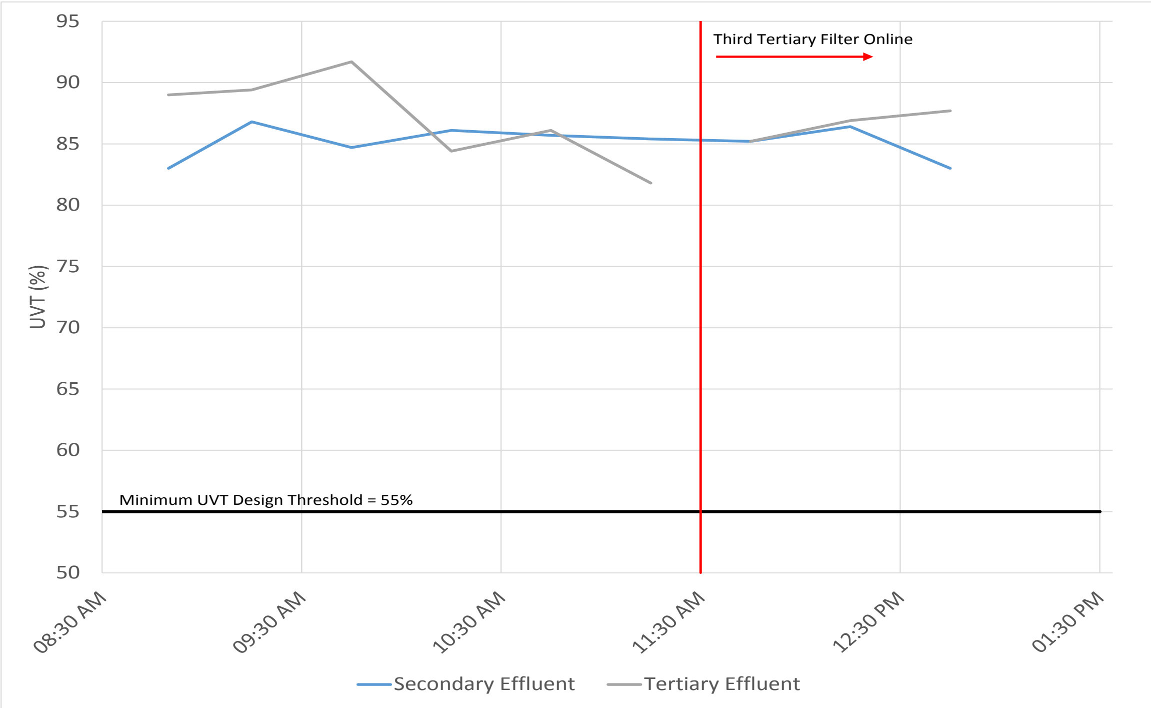

Figure 3.8 Measured Secondary Clarifier and Tertiary Filter Effluent UVT (Day 2)

Based on results presented in Figure 3.5, Figure 3.6, Figure 3.7, and Figure 3.8, the following conclusions can be drawn about the peak hour flow testing at the Grand Valley WPCP.

- Secondary effluent TSS concentrations generally rose over the duration of the test. Effluent TSS concentrations at peak flows were stable and consistently less than 20 mg/L. This is comparable to the expected secondary clarifier effluent TSS concentration from an extended aeration plant with phosphorus removal (15 mg/L) (MOE, 2008).
- Secondary effluent TP, orthophosphate, and turbidity measurements generally rose over the duration of the test. During peak flows, secondary effluent TP concentrations peaked at approximately 0.8 mg/L. Secondary effluent TP concentrations from an extended aeration plant with phosphorus removal are typically less than 1.0 mg/L (MOE, 2008).
- During peak flows, secondary effluent orthophosphate concentrations represented approximately 50% of TP concentration measurements.
- Tertiary effluent TSS and TP concentrations generally rose between 9:00 am and 11:30 am, at which point the third tertiary filter was brought online. The peak TSS concentration of 21 mg/L was measured from samples collected between 11:00 am and 11:30 am and was comparable to secondary effluent TSS concentrations over the same period, indicating the tertiary filter was likely overloaded with respect to the filtration rate or solids loading rate. The average filtration rate during this period (11:00 am to 11:30 am) was 3.65 $L/m^2 \cdot s$, and the average filter solids loading rate was 6.15 $kg/m^2 \cdot d$.
- Upon bringing the third tertiary filter online, tertiary effluent TSS concentrations fell and stabilized below the C of A objective concentration. Tertiary effluent TP concentrations also fell, and stabilized at approximately 0.2 mg/L. The estimated filtration and filter solids loading rates during this period of stable operation were 2.39 $L/m^2 \cdot s$ and 4.03 $g/m^2 \cdot d$, respectively.
- Orthophosphate concentrations in the tertiary effluent generally rose over the duration of the testing period. Tertiary effluent samples collected during the period of three filter operation showed comparable concentrations of TP and orthophosphate, indicating filters had removed almost all particulate phosphorus. Elevated concentrations of orthophosphate are likely related to alum dosing restrictions at the plant. Further TP removal may be possible by optimizing the alum dose.
- Secondary effluent and tertiary effluent UVT measurements were relatively stable over the duration of the test and consistently exceed 80%.

3.2.3 Secondary Clarifier Solids Blanket

Sludge height measurements were taken regularly over the duration of the test period. Measurements were taken at three locations along the walkway of the test clarifier to measure blanket height at the exterior, middle, and interior of the clarifier. Approximate locations for sludge blanket measurements is previously shown in Figure 2.1 Sludge blanket height measurements over the duration of the testing period is shown in Figure 3.9. The clarifier side water depth is 4.2 m, and is represented by the top of Figure 3.9.

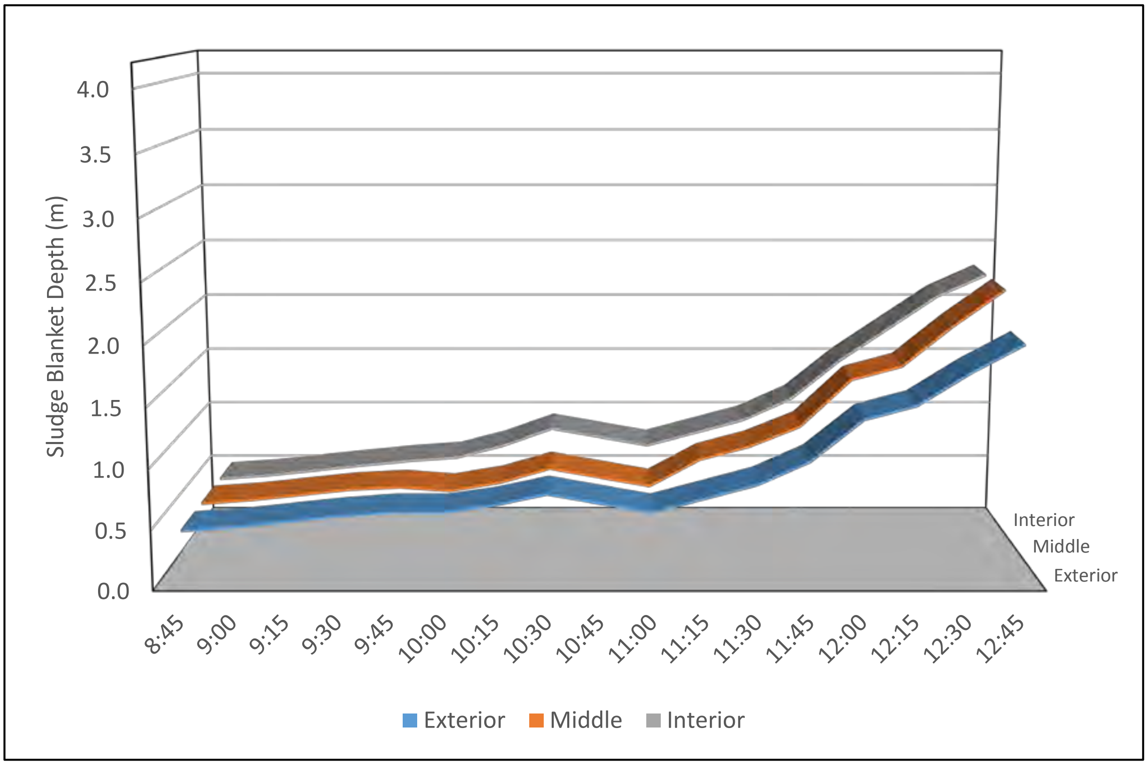

Figure 3.9 Secondary Clarifier Sludge Blanket Profile (Day 2)

The blanket depth ranged from approximately 450 mm (1.5 feet) at first measurement to approximately 2,300 mm (7.5 feet) at the middle and interior measurement points at the end of the test. From the first measurement until approximately 11:00 am, the measured sludge blanket height was relatively stable, as only minor increases to the blanket height were observed. Between 11:00 am and 12:45 pm, the measured sludge blanket height increased steadily. Day 2 of the stress test was stopped at 12:45 pm at sludge blanket heights of approximately 6.5 feet (2.0 m), 7.5 feet (2.3 m), and 7.5 feet (2.3 m) at the exterior, middle, and interior measurement points, respectively. Although blanket washout did not appear imminent, the test was stopped due to operator concerns regarding the integrity of the secondary clarifier mechanical equipment at the elevated sludge blanket height.

3.2.4 Evaluation of Secondary Clarifier Performance - Day 2

Based on results presented in Figure 3.5 and Figure 3.6, secondary clarifier effluent concentrations of TSS and TP rose significantly during the testing period. During the peak hour flow period from 11:00 am to 12:00 pm (SOR = 40.9 $m^3/m^2 \cdot d$) effluent concentrations remained stable and comparable to typical secondary clarifier effluent quality of an extended aeration treatment process (MOE, 2008). However, the secondary clarifier sludge blanket was observed to rise significantly during this period, indicating steady state operation was not achieved. The SLR during the peak flow period was calculated to be approximately 240 $kg/m^2 \cdot d$, which was significantly greater than both the target SLR (210 kg/m^2·d) and a typical design SLR (170 kg/m^2·d). The peak estimated SLR is due, in part, to relatively high operating MLSS concentrations in the bioreactors. Despite rising sludge blanket levels, washout of the sludge blanket did not appear imminent. Results from Day 2 of testing suggest the peak hour capacity of the secondary clarifier is less than the peak hour SOR and SLR achieved.

Conversely, sample results collected between 10:00 am and 11:00 am indicate relatively stable sludge blanket levels and increasing but low concentrations of TSS and TP in the secondary effluent. The calculated SOR and SLR achieved during this period were 21.5 m^3/m^2·d and 159 kg/m^2·d, respectively. Results from Day 2 of testing suggest the peak SOR and SLR capacity of the secondary clarifier is greater than the rates achieved between 10:00 and 11:00 am.

3.2.5 Evaluation of Tertiary Filter Performance - Day 2

As presented in Figure 3.5 and Figure 3.6, TSS and TP concentrations in the tertiary effluent rose to peak concentrations of 21 mg/L and 0.82 mg/L, respectively, between 11:00 am and 11:30 am (the beginning of the peak hour flow period). The filtration rate and filter solids loading rate between 11:00 am and 11:30 am, estimated to be 3.65 L/m^2·s and 6.15 kg/m^2·d, respectively, represent overload conditions for the tertiary filter.

Conversely, during the period of three filter operation, tertiary effluent concentrations of TSS, TP, and orthophosphate were found to be stable. The estimated filtration rate and solids loading rate during this period of stable operation was estimated to be 2.40 L/m^2·s and 4.03 kg/m^2·d, respectively. Results from Day 2 suggest the hydraulic and solids loading capacity of the tertiary filters is greater than those estimated during the period of three filter operation.

3.2.6 Evaluation of Disinfection Performance - Day 2

The UV disinfection system at the Grand Valley WPCP was designed for a peak flow of 7,680 m^3/d at a UVT of 55%. Overflow from the existing storm equalization tank will flow directly to the UV disinfection system, thereby bypassing secondary treatment. Further, a tertiary filter bypass exists for peak flows in excess of tertiary filter capacity. As a result of these bypass streams, final plant effluent flow may be of lower quality relative to the tertiary effluent stream during peak flow events. In addition, because the UV disinfection system would be subject to the design peak flow through the filters as well contributions from these bypass streams, the design peak flow capacity of the UV disinfection system exceeds the design capacity of the tertiary filters.

Results presented in Figure 3.8 indicate that the measured secondary clarifier and tertiary filter UVT remained stable and consistently above the design UVT for the entirety of the testing period, even when both of these process were pushed beyond their treatment capacities.

In the fall of 2015, samples of the raw influent and tertiary effluent streams were collected from the Grand Valley WPCP. Samples were combined in different volumetric ratios, and the UVT of these combined samples was measured to determine the potential impact from storm tank bypass flows on the UVT of the final effluent. Samples consisting of 100% tertiary effluent had a UVT of approximately 88%, comparable to results from baseline testing conducted for the stress test. Combined samples consisting of 40% raw influent or less (by volume) consistently measured a UVT greater than 55%. However, during a peak flow event, the storm tank bypass would make up significantly less than 40% of the effluent; in addition, when stressed, the secondary clarifiers and tertiary filters continue to produce a tertiary effluent with UVT > 80%.

Overall, these results indicate that even during wet weather event, the WPCP effluent would have a UVT > 55% and, therefore, this suggests that the capacity of the existing UV disinfection system is greater than its design peak flow capacity of 7,680 m^3/d.

3.3 Day 3 - Maximum Day Flow Testing

The purpose during Day 3 of testing was to maintain a target flow rate to simulate a maximum day flow event and evaluate the performance of the secondary clarifiers and tertiary filters. Testing took place on July 18, 2016 from approximately 8:30 am to 12:30 pm. During testing, mixed liquor suspended solids (MLSS) concentrations decreased from approximately 4,500 mg/L to 2,700 mg/L in Aeration Tank 1 and from approximately 4,300 mg/L to approximately 3,700 mg/L in Aeration Tank 2.

To evaluate sludge settleability, a 30 minute settling test was conducted once during the maximum day flow test and results were used to calculate the sludge volume index (SVI). Mixed liquor concentrations were adjusted as required for purposes of calculating the SVI. One settling test was conducted for each aeration tank, and the sludge settleability was assumed unchanged for the duration of the peak hour testing period. Results are summarized in Table 3.4.

Table 3.4 Summary of Settleability Tests (Day 3)

	Aeration Tank 1	Aeration Tank 2
Settled Volume (mL)	275	265
Estimated SVI (mL/g)	81	67

As presented, estimated SVIs for Aeration Tank 1 and Aeration Tank 2 are 81 mL/g and 67 mL/g, respectively. SVIs less than 100 mL/g are desired, and indicate a sludge with good settleability (Metcalf & Eddy, 2003). The return activated sludge (RAS) flow rate was maintained at approximately 700 m^3/d for the duration of the test period.

3.3.1 Measured Flows and Loading Rates

Surface overflow rates (SOR) from the test secondary clarifier were recorded by a velocity-area (VA) flow meter, installed by XCG on July 12, 2016. The solids loading rate (SLR) to the test secondary clarifier was estimated from the measured overflow rate, RAS flow rate, and the measured MLSS concentration. SLR calculations account for observed changes in MLSS concentrations over the test period. Filtration rates were estimated using the measured clarifier overflow rate given the tertiary filter surface area.

Figure 3.10 and Figure 3.11 show the calculated secondary clarifier SOR and SLR, respectively, for the secondary clarifier for the duration of Day 3 of testing. Figure 3.12 and Figure 3.13 shows the estimated tertiary filter filtration rate and tertiary filter solids loading rate, respectively. Target rates are also shown on all figures where applicable.

For the duration of the testing period, secondary clarifier effluent and tertiary filter effluent channels were continuously visually monitored for hydraulic limitations and for solids concentrations.

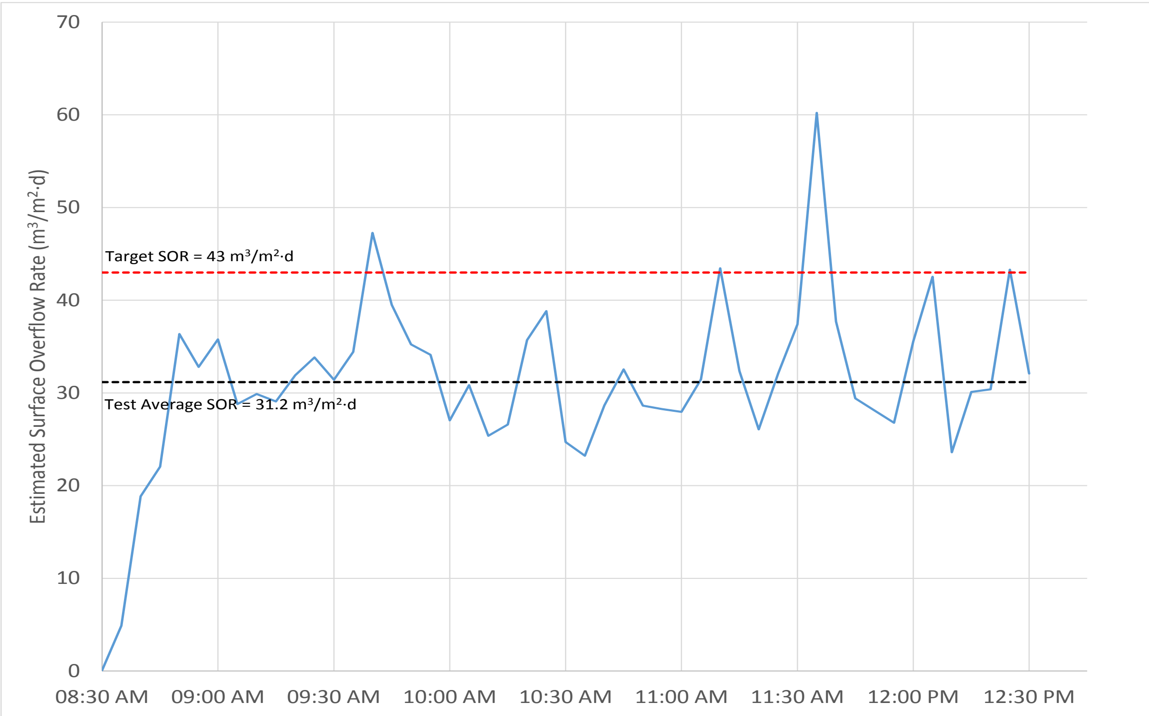

Figure 3.10 Calculated SOR for Test Secondary Clarifier (Day 3)

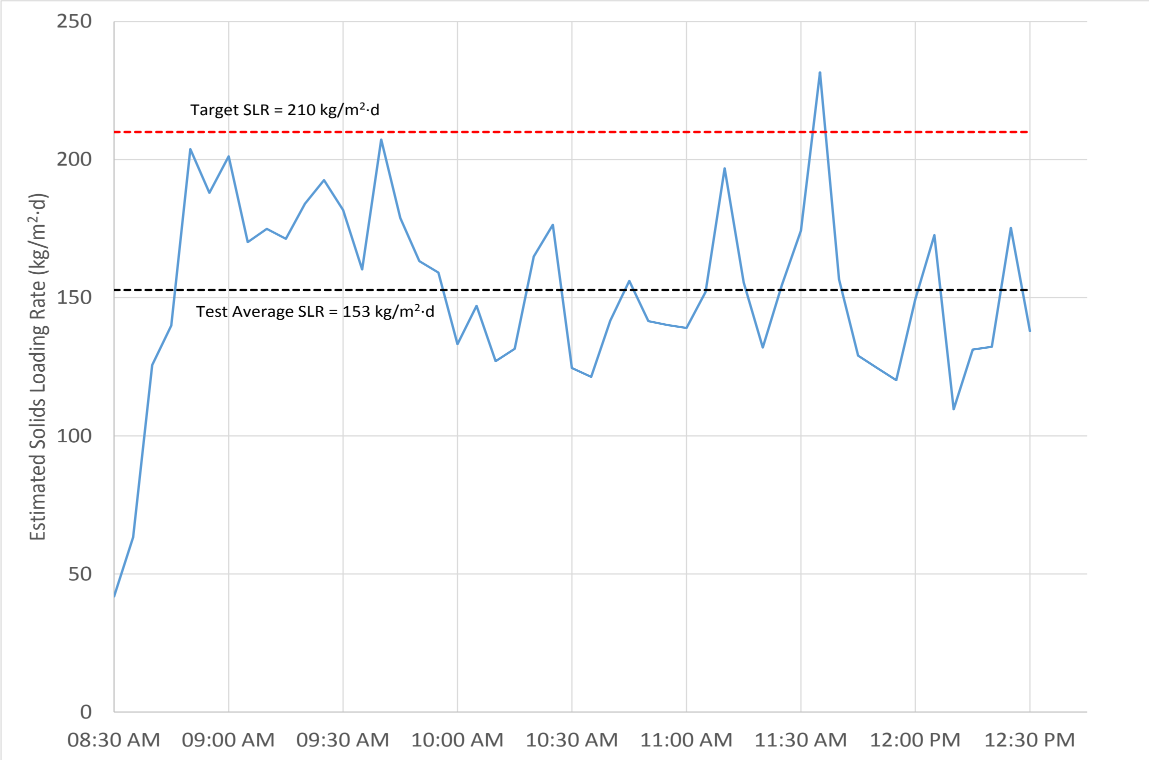

Figure 3.11 Calculated SLR for Test Secondary Clarifier (Day 3)

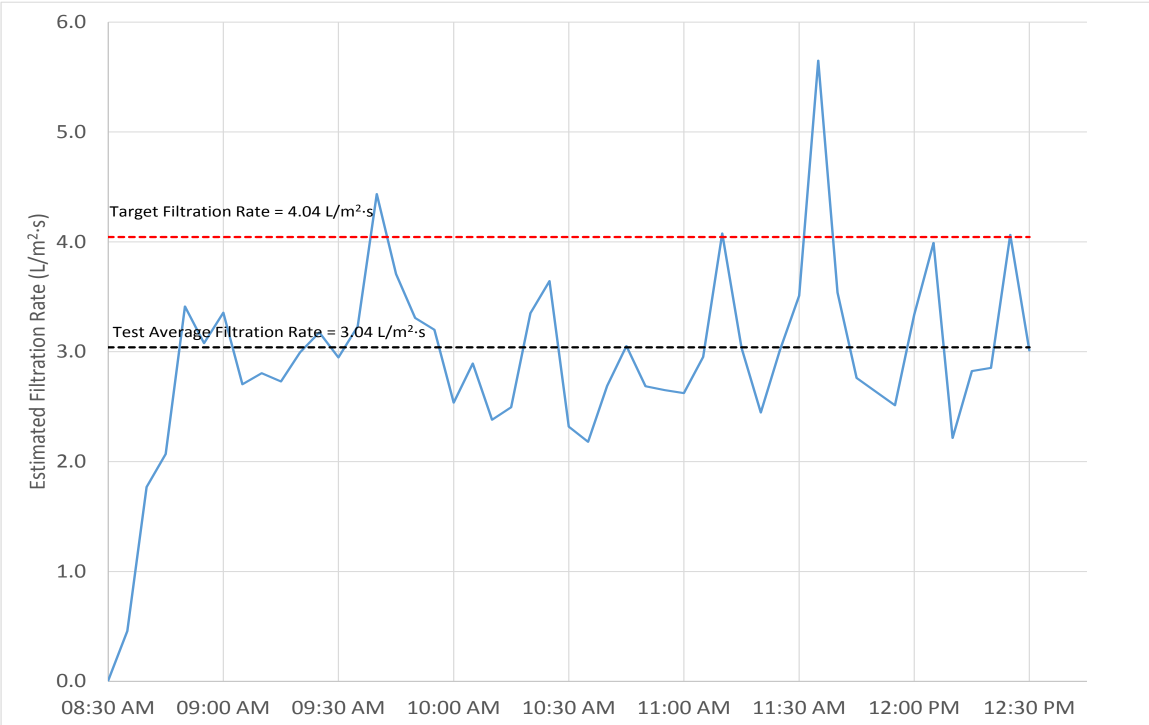

Figure 3.12 Calculated Filtration Rate for Test Tertiary Filter (Day 3)

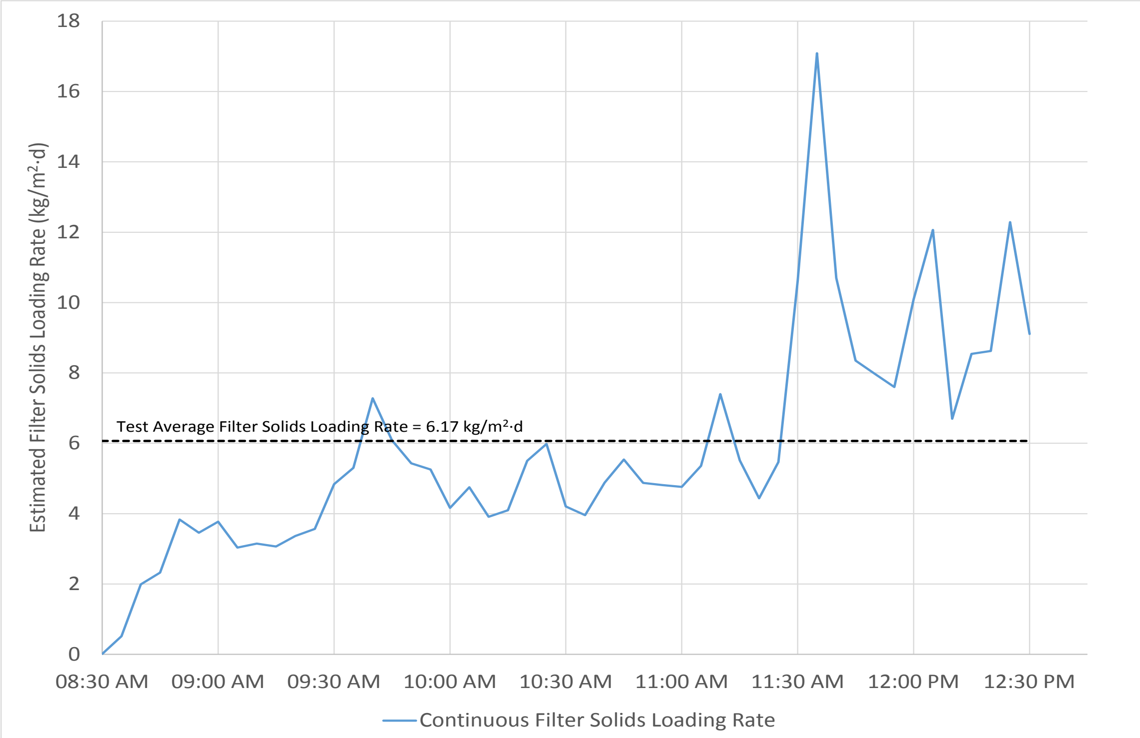

Figure 3.13 Calculated Filter Solids Loading Rate for Test Tertiary Filter (Day 3)

Test average SOR, SLR, and filtration rates achieved during this period are summarized in Table 3.5. Further, unlike Day 2 of testing, Day 3 required only two tertiary filters for the duration of the test. As such, peak hour filtration rates achieved during Day 3 exceed peak hour tertiary filtration rates achieved during Day 2 of testing. Peak filtration rates achieved during Day 3 are also presented in Table 3.5.

Table 3.5 Summary Day 3 Operating Conditions

Test Unit	Value	Target
Secondary Clarifier		
SOR ($m^3/m^2·d$)	31.2	43
SLR ($kg/m^2·d$)	153	210
Tertiary Filtration Rate ($L/m^2·s$)		
Test Average	3.03	4.04
Peak Hour	3.30 (1)	
Tertiary Filter Solids Loading Rate ($kg/m^2·d$)		
Test Average	6.17	-
Peak Hour	9.98	-

Notes:
1. Estimated filtration rate during peak hour flows from 11:30 am to 12:30 pm.

The following observations can be made from results presented in Figure 3.10, Figure 3.11, Figure 3.12, Figure 3.13, and Table 3.5:

- With respect to the test secondary clarifier, the average SOR and SLR achieved for the test duration were less than targets established for this test. This is, in part, due to variability in the influent flow from the Emma St. SPS and decreasing MLSS concentrations in the bioreactors over the duration of the test.
- With respect to the tertiary filters, average filtration rates achieved for the duration of the test were less than targets established for the test. This is, in part, due to the variability in influent flow from the Emma St. SPS. The peak filtration rate was estimated to be 3.30 $L/m^2 \cdot s$, identical to both the C of A rated peak flow capacity and typical design peak flow rates for deep bed filters (MOE, 2008). The estimated tertiary filter solids loading rate was relatively consistent until approximately 11:30 am when a significant increase in the solids loading rate was observed due to an increase in the secondary clarifier effluent solids concentration.

3.3.2 Measured Clarifier and Filter Performance

As previously discussed, samples of secondary clarifier and tertiary filter effluent were collected for the duration of peak hour testing. To evaluate the performance of the secondary clarifiers and tertiary filters, each sample was sent to an accredited laboratory for TSS and TP measurements. In addition, samples were processed onsite for orthophosphate, turbidity, and UVT measurements.

Figure 3.14 shows the measured TSS concentrations over the duration of Day 3. Similarly, Figure 3.15 shows the measured TP and orthophosphate concentrations. C of A final effluent objective and limit concentrations are also shown on each figure. It is important to note that current C of A effluent limits are enforced on a monthly average basis, and effluent samples are composited over a 24-hour period. As such, objectives and limits have been included for reference only, and results from samples collected during this test do not indicate compliance or exceedance with the existing C of A. Figure 3.16 and Figure 3.17 show secondary effluent and tertiary effluent measurements for turbidity and UVT, respectively, over the duration of Day 3 of testing.

During regular plant operation, plant staff have observed periodic accumulation of solids in the tertiary effluent channel. Staff indicated that the channel is regularly cleaned to remove the solids, however they were not able to clean the channel prior to the stress test. Beginning at approximately 9:30 am, plant staff initiated a cleaning of the tertiary effluent channel. As a result, samples collected between approximately 9:30 am and 10:00 am reported elevated concentrations of TSS and TP. These samples were not representative of the testing conditions and were therefore excluded from this analysis.

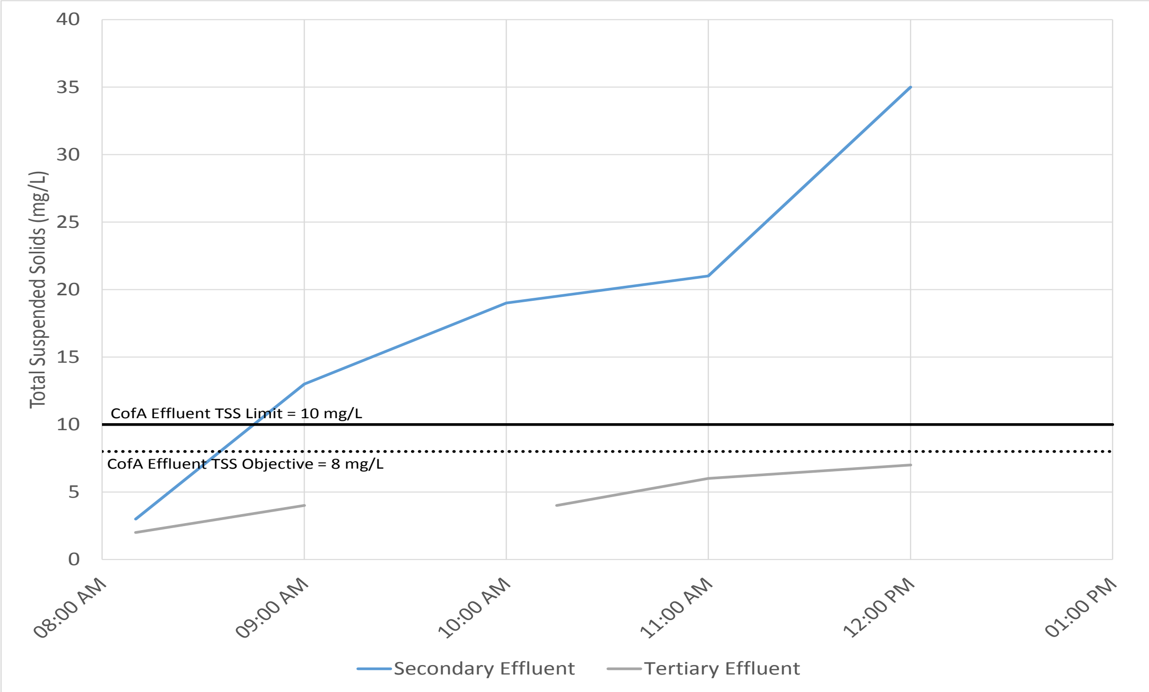

Figure 3.14 Measured Secondary Clarifier and Tertiary Filter Effluent TSS Concentrations (Day 3)

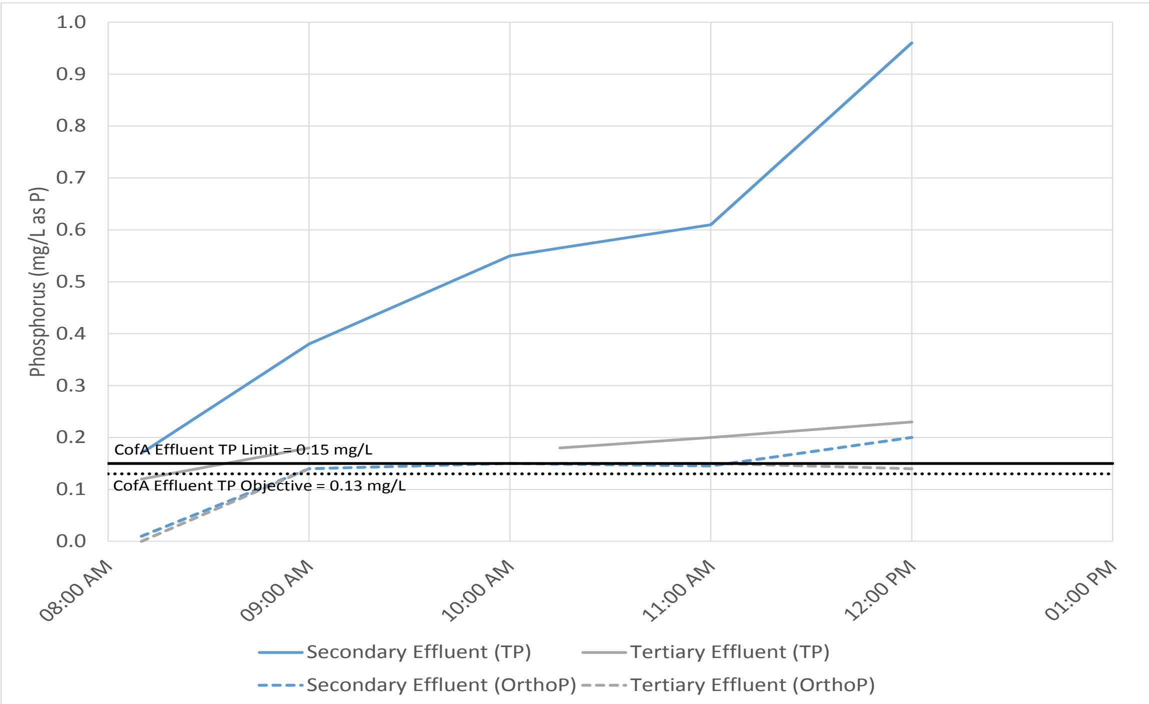

Figure 3.15 Measured Secondary Clarifier and Tertiary Filter Effluent Total Phosphorus and Orthophosphate Concentrations (Day 3)

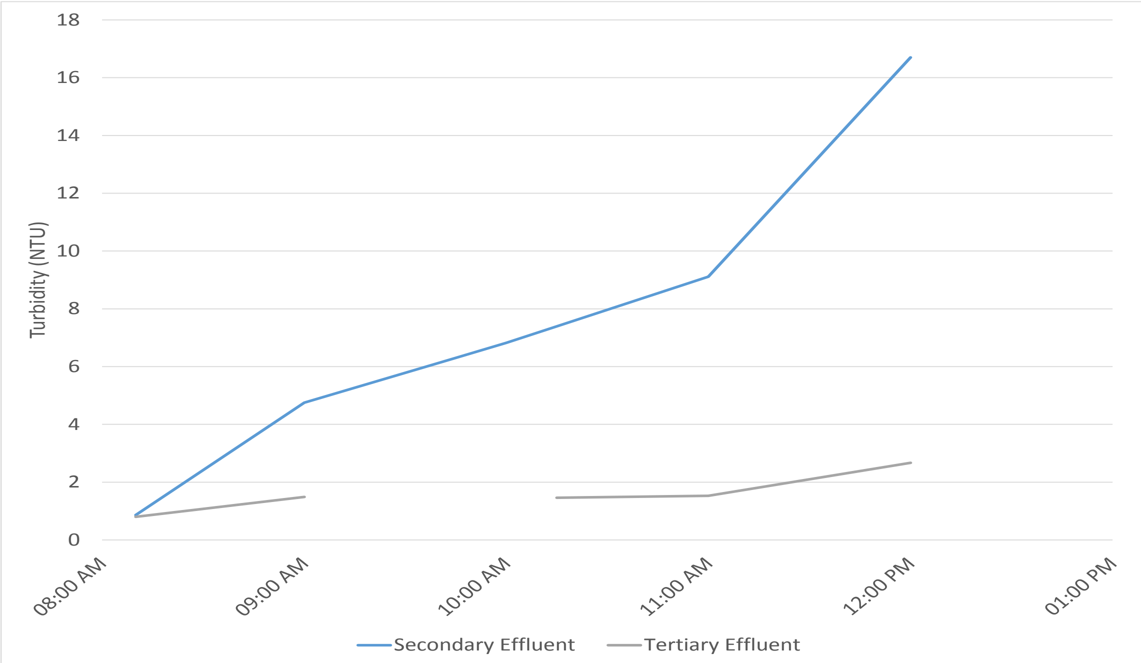

Figure 3.16 Measured Secondary Clarifier and Tertiary Filter Effluent Turbidity (Day 3)

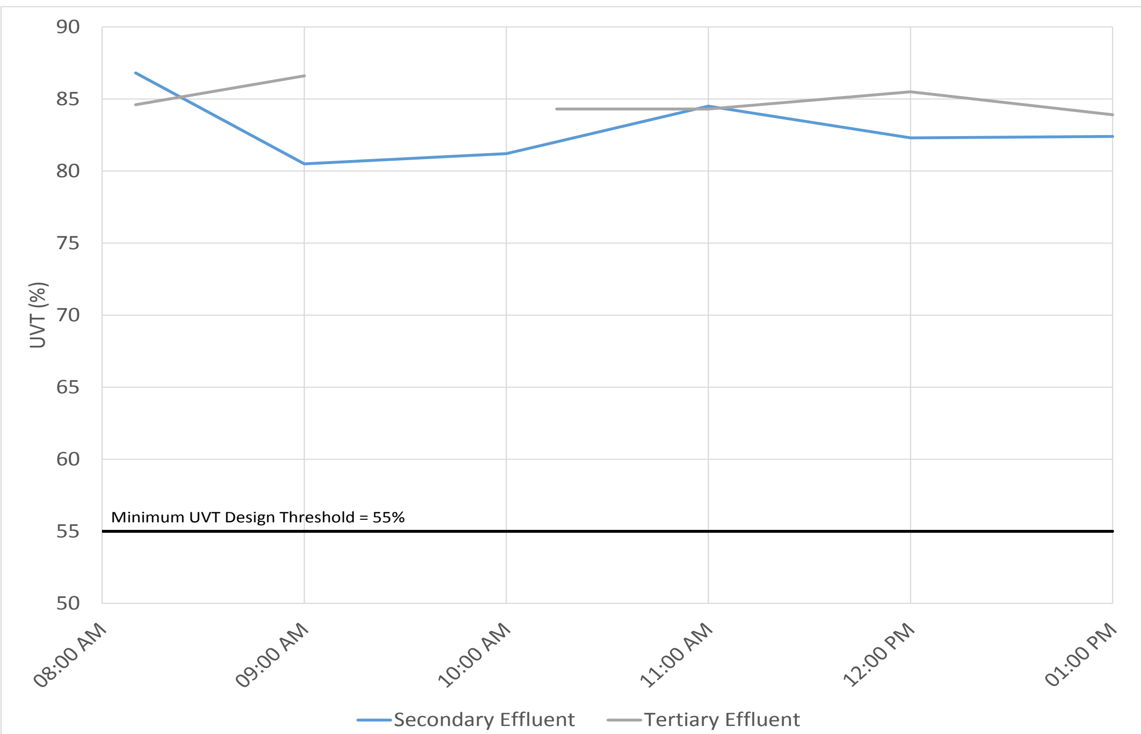

Figure 3.17 Measured Secondary Clarifier and Tertiary Filter Effluent UVT (Day 3)

Based on results presented in Figure 3.14, Figure 3.15, Figure 3.16, and Figure 3.17, the following conclusions can be drawn about the maximum day flow testing at the Grand Valley WPCP.

- Secondary effluent TSS and TP concentrations and turbidity measurements rose steadily over the duration of the test. Secondary effluent TSS concentrations peaked during the last hour of testing at approximately 35 mg/L, which is greater than expected from an extended aeration plant with phosphorus removal (15 mg/L) (MOE, 2008). Secondary effluent TP concentrations peaked at approximately 0.96 mg/L, which is consistent with expected secondary effluent TP concentrations from an extended aeration plant with phosphorus removal (less than 1.0 mg/L) (MOE, 2008).
- Tertiary effluent TSS concentrations rose steadily during the test, however all concentrations remained below the C of A effluent TSS objective concentration of 8 mg/L.
- Tertiary effluent TP and orthophosphate concentrations rose slightly over the duration of the test. Peak concentrations were measured at 0.23 mg/L and 0.15 mg/L, respectively. TP concentrations were slightly above C of A effluent limits (0.15 mg/L), but less than typical effluent TP concentrations for an extended aeration plant with chemical phosphorus removal and tertiary filtration (0.3 mg/L) (MOE, 2008). Elevated concentrations of orthophosphate (and therefore TP) are likely related to alum dosing restrictions at the plant. Further TP removal may be possible by optimizing the alum dose.
- Tertiary effluent turbidity measurements rose slightly over the duration of testing.
- Secondary and tertiary effluent UVT measurements remained relatively stable. All UVT measurements were in excess of 80%, well above the design UVT of 55%.

3.3.3 Secondary Clarifier Solids Blanket

Sludge height measurements were taken regularly over the duration of the test period. Measurement were taken at three locations along the walkway of the test clarifier to measure blanket height at the exterior, middle, and interior of the clarifier. Approximate locations for sludge blanket measurements were previously shown in Figure 2.1. Sludge blanket height measurements over the duration of the Day 3 testing period is shown in Figure 3.18. The clarifier side water depth is 4.2 m, and is represented by the top of Figure 3.18.

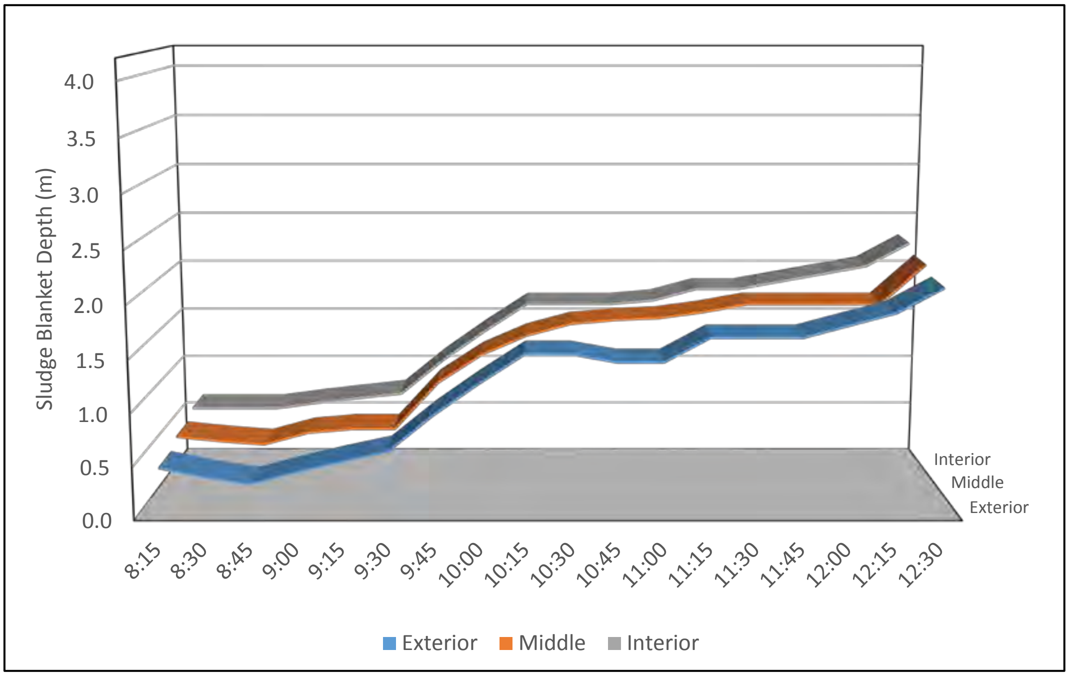

Figure 3.18 Secondary Clarifier Sludge Blanket Profile (Day 3)

The blanket depth ranged from approximately 450 mm (1.5 feet) at first measurement to approximately 2.1 m - 2.3 m (7.0 - 7.5 feet) at the end of the test. From approximately 8:30 am to 10:30 am, the sludge blanket depth rose rapidly in the secondary clarifier. For the remaining portion of the test, the sludge blanket appeared relatively stable, and sludge blanket height rose slowly. Day 3 of the stress test was stopped at 12:30 pm at sludge blanket heights of approximately 7.0 feet (2.1 m), 7.25 feet (2.2 m), and 7.5 feet (2.3 m) at the exterior, middle, and interior measurement points, respectively. Although blanket washout did not appear imminent, the test was stopped due to operator concerns regarding the integrity of the secondary clarifier mechanical equipment at the elevated sludge blanket height.

3.3.4 Evaluation of Secondary Clarifier Performance - Day 3

Average SOR and SLR values achieved during Day 3 of testing were 31.2 $m^3/m^2 \cdot d$ and 153 $kg/m^2 \cdot d$, respectively. Based on results presented in Figure 3.14 and Figure 3.15, average secondary clarifier effluent concentrations of TSS and TP from all samples collected over the duration of the testing period remained comparable to typical secondary effluent quality of an extended aeration treatment process (MOE, 2008).

However, secondary clarifier effluent concentrations of TSS and TP consistently rose during the testing period. Further, sludge blanket levels also rose consistently, indicating that steady state was not achieved during Day 3 of testing. Results from Day 3 of testing suggest the maximum day SLR and SOR capacities of the secondary clarifiers are less than approximately 153 $kg/m^2 \cdot d$ and 31.2 $m^3/m^2 \cdot d$, respectively.

3.3.5 Evaluation of Tertiary Filter Performance - Day 3

Average and peak hour filtration rates achieved during Day 3 of testing were 3.03 L/m^2·s, and 3.30 L/m^2·s, respectively. Similarly, the average and peak solids loading rates to the tertiary filter was 6.17 kg/m^2·d and 9.98 kg/m^2·d, respectively. It is important to note that the solids loading rates achieved during Day 3 of testing significantly exceed the maximum estimated solids load observed during stable filter operation on Day 2 (4.03 kg/m^2·d). As such, tertiary filter capacity at the Grand Valley WPCP appears to be limited by the filtration rate.

Based on results presented in Figure 3.14, Figure 3.15, Figure 3.16, and Figure 3.17, tertiary filter effluent quality remained high for the duration of the Day 3 testing period. As such, results from Day 3 of testing confirm the peak hour capacity of the tertiary filters to be 3.30 L/m^2·s, equal to the C of A rated peak capacity and typical design peak filtration rates (MOE, 2008).

3.3.6 Evaluation of Disinfection Performance - Day 3

All UVT measurements of secondary clarifier and tertiary filter effluent taken during Day 3 of testing measured > 80% and were consistent with results from Day 2 of testing. Therefore, results from Day 3 support previous conclusions which suggest the capacity of the UV disinfection system is greater than the peak rated capacity of 7,680 m^3/d.

4. ESTIMATED UNIT PROCESS CAPACITIES

4.1 Secondary Clarifiers

The estimated capacity of a secondary clarifier is typically evaluated at both peak hour and maximum day flows and expressed using the calculated peak hour SOR and maximum day SLR. However, as previously discussed, operation of the storm equalization tank at the Grand Valley WPCP is expected to attenuate peak flows through the treatment plant resulting in comparable maximum day and peak hour flows. Therefore, evaluation of secondary clarifier capacity at the Grand Valley WPCP should simultaneously consider both SOR and SLR under 'peak day' conditions.

For the purposes of developing clarifier capacities, the following future operating conditions were assumed:

- Both secondary clarifiers in operation (each with a surface area of 75.4 m^2);
- Operating MLSS concentration of 3,000 mg/L in the aeration tanks; and,
- An ADF of 1,244 m^3/d and a RAS:ADF ratio of 200%.

Based on results from Day 2 presented in Section 3.2, the estimated SOR and SLR capacity of the secondary clarifier was greater than 21.5 $m^3/m^2{\cdot}d$ (equivalent peak day flow capacity of 3,242 m^3/d) and 159 $kg/m^2{\cdot}d$ (equivalent peak day flow capacity of 5,504 m^3/d), respectively, but less than 40.9 $m^3/m^2{\cdot}d$ and 240 $kg/m^2{\cdot}d$.

During Day 3, the average SOR sustained for the duration of the testing period was 31.2 $m^3/m^2{\cdot}d$ (equivalent daily flow of 4,705 m^3/d). However, the sustained SLR was relatively unchanged from Day 2 (i.e. within 5% of the measured SLR during stable operation on Day 2) and represented an equivalent peak daily flow of approximately 5,203 m^3/d. Stable operation of the test secondary clarifier was not observed during Day 3, therefore the capacity of the secondary clarifier appears to be limited by the SOR.

Together, results from Day 2 and Day 3 suggest that the capacity of the secondary clarifier is greater than 21.5 $m^3/m^2{\cdot}d$ (3,242 m^3/d) based on stable operation observed during Day 2, but less than 31.2 $m^3/m^2{\cdot}d$ (4,705 m^3/d) based on unstable operation observed during Day 3.

As previously discussed, flow through the treatment plant during the testing period was controlled using several pumps from several flow sources thereby making it difficult to maintain consistent flow through the plant. This limited ability to control plant flows also made it difficult to develop specific estimates of secondary clarifier capacity. However, periods of relatively stable flows during Day 3 of the testing period can be used to develop a more accurate estimate of clarifier capacity. Specifically, consider the period from 10:00 am to 11:00 am on Day 3. Measured secondary clarifier effluent concentrations of TSS and TP (shown as Figure 3.14 and Figure 3.15, respectively) appear relatively stable and comparable to typical secondary effluent quality of an extended aeration treatment process (MOE, 2008). As shown in Figure 3.18, sludge blanket height measurements during this period also remained relatively stable. As such, it appears steady operation of the secondary clarifier was achieved. The estimated SOR during this period of stable operation between 10:00 am and 11:00 am on Day 3 was 29.1 $m^3/m^2{\cdot}d$ (4,388 m^3/d) and represents the estimated capacity of the secondary clarifiers at the Grand Valley WPCP.

4.2 Tertiary Filters

Performance of the tertiary filters was evaluated using tertiary effluent measurements of TSS and TP. The capacity was expressed in terms of both a filtration rate per surface area ($L/m^2{\cdot}s$) and solids loading rate ($kg/m^2{\cdot}d$). Based on results from Day 2 of testing, the filtration capacity was found to be greater than 2.40 $L/m^2{\cdot}s$, but less than 3.65 $L/m^2{\cdot}s$. The design peak filtration rate is 3.30 $L/m^2{\cdot}s$. Similarly, the solids loading capacity was found to be greater than 4.03 $kg/m^2{\cdot}d$, but less than 6.15 $kg/m^2{\cdot}d$.

During Day 3 of testing, stable filter operation was observed over the duration of the testing period. Peak hour filter flow and solids loading conditions achieved during Day 3 were 3.30 $L/m^2{\cdot}s$ and 9.98 $kg/m^2{\cdot}d$, respectively. Therefore, relative to Day 2, stable filter operation was achieved at significantly higher filter solids loading rates during Day 3.

Overall, results suggest filter capacity is limited by the filtration rate. Further, from the testing results, the estimated capacity of the tertiary filters is 3.30 $L/m^2{\cdot}s$, equal to the design peak flow capacity.

4.3 UV Disinfection System

As previously discussed, the capacity of the UV disinfection system was evaluated using secondary clarifier and tertiary filter UVT measurements from samples collected over the duration of the testing period. Samples collected from both locations over both days of testing consistently had UVTs which measured greater than 80%, well in excess of the design UVT of 55%.

However, as a result of possible bypass flows, the quality of flow through the UV disinfection system could be of lower quality relative to the tertiary effluent stream during peak flow events. In the fall of 2015, samples of the raw influent and tertiary effluent streams were collected from the Grand Valley WPCP. Samples were combined in different volumetric ratios, and the UVT of these combined samples was measured to determine the potential impact from storm tank bypass flows on the UVT of the final effluent. Samples consisting of 100% tertiary effluent had a UVT of approximately 88%, comparable to results from baseline testing conducted for the stress test. Combined samples consisting of 40% raw influent or less (by volume) consistently measured a UVT greater than 55%. During a peak flow event, the storm tank bypass would make up significantly less than 40% of the effluent; in addition, when stressed, the secondary clarifiers and tertiary filters continue to produce a tertiary effluent with UVT > 80%.

Overall, these results suggest the capacity of the UV disinfection system is greater than the design peak flow capacity of 7,680 m^3/d.

5. CONCLUSIONS

5.1 Summary of Stress Testing Conducted

Peak hour performance testing was carried out on the secondary clarifiers and tertiary filters at the Grand Valley WPCP on July 12 (Day 1), July 13 (Day 2), and July 18 (Day 3).

During Day 2 of testing, flows were increased incrementally over 1 hour periods to try and reach the hydraulic capacity of the secondary clarifiers and tertiary filters. The test began with one secondary clarifier and two tertiary filters. As a result of increased solids concentrations in the tertiary effluent stream, an additional tertiary filter was brought online approximately halfway through the test. Testing was continued, and results were used to estimate the peak hour hydraulic capacity of the secondary clarifiers. Peak hour operating conditions achieved during the test are summarized in Table 5.1.

Table 5.1 Summary - Day 2 Peak Hour Operating Conditions Achieved During Testing

Test Unit	Value	Target
Secondary Clarifier		
SOR ($m^3/m^2 \cdot d$)	40.9	43
SLR ($kg/m^2 \cdot d$)	240	210
Tertiary Filter		
Filtration Rate ($L/m^2 \cdot s$)	3.16 (1)	4.04
Solids Loading Rate ($kg/m^2 \cdot d$)	5.32 (1)	-

Notes:
1. Estimated filtration rate average between 11:00 am and 12:00 pm. Average includes impact of third filter, which was brought online at 11:30 am.

During Day 3 of testing, flows were held constant over a 4 hour period to evaluate the maximum day capacity of the secondary clarifiers and tertiary filters. The test was conducted with one secondary clarifier and two tertiary filters. Average operating conditions over the Day 3 testing period are summarized in Table 5.2. Since only two filters were kept online for the duration of the testing period, the peak hour filtration rate achieved during Day 3 of testing was greater than the peak hour filtration rate achieved during Day 2. The peak hour filtration rate is also shown in Table 5.2.

Table 5.2 Summary - Day 3 Operating Conditions Achieved During Testing

Test Unit	Value	Target
Secondary Clarifier		
SOR ($m^3/m^2\cdot d$)	31.2	43
SLR ($kg/m^2\cdot d$)	153	210
Tertiary Filtration Rate ($L/m^2\cdot s$)		
Test Average	3.03	4.04
Peak Hour	3.30 (1)	
Tertiary Solids Loading Rate ($kg/m^2\cdot d$)		-
Test Average	6.17	
Peak Hour	9.98	

Notes:
1. Estimated filtration rate during peak hour flows from 11:30 am to 12:30 pm.

5.2 Estimated Treatment Capacities

Capacity evaluations of the secondary clarifier typically consist of a peak hour capacity (determined by the SOR) and a maximum day capacity (determined by the SLR). However, as a result of attenuation by the storm tank, peak hour and max day flows at the Grand Valley WPCP are expected to be similar. As such, a 'peak day' capacity of the secondary clarifier based on both SOR and SLR was made using measurements of secondary clarifier effluent TSS and TP concentrations, and on the height and stability of sludge blanket level measurements.

Using results from both Day 2 and Day 3, capacity of the secondary clarifier was found to be limited by the SOR. Detailed analysis of results from Day 3 of testing identified a period of stable clarifier operation between 10:00 am and 11:00 am, and was characterized by stable secondary clarifier effluent concentrations of TSS and TP, and stable measurements of sludge height. The SOR capacity, estimated from this period of stable operation, is approximately 29.1 $m^3/m^2\cdot d$.

Capacity evaluations of tertiary filters were based on tertiary effluent TSS and TP concentrations. Capacity was found to be limited by the filtration rate, and was estimated to be 3.30 $L/m^2\cdot s$.

Capacity evaluations of the UV disinfection system were based on secondary clarifier and tertiary filter effluent UVT measurements taken during this test, and on previous work which measured the UVT of final effluent and raw influent samples combined in different volumetric ratios. Capacity of the UV disinfection system was estimated to be in excess of the design peak capacity of 7,680 m^3/d.

Based on the results of the stress testing, Table 5.3 summarizes the estimated capacities of the selected treatment units.

Table 5.3 Recommended Operating Capacity from Stress Test Results

Treatment Process	Limiting Factor	Estimated Capacity
Secondary Clarification		
Peak Hour	SOR (29.1 $m^3/m^2\cdot d$)	4,388 m^3/d
Maximum Day	SLR (153 kg/ $m^2\cdot d$)	5,203 m^3/d (1)
Tertiary Filtration		
Peak Hour	Filtration Rate (3.30 L/ $m^2\cdot s$)	5,300 m^3/d
Disinfection		
Peak Hour	UVT (>55%)	>7,680 m^3/d

Notes:
1. Assuming future MLSS concentration of 3,000 mg/L, an ADF of 1,244 m^3/d, and a RAS:ADF of 2:1.

It is important to note that the clarifier capacity calculated based on the measured SLR assumed an operating MLSS concentration of 3,000 mg/L. This target was established as part of the capacity assessment of the biological treatment system. Historically, the plant has operated at MLSS concentrations from approximately 2,500 mg/L to greater than 8,000 mg/L. As flows increase, operating at high MLSS concentrations in the future may result in the clarifier being limited by the SLR to a peak capacity less than 5,203 m^3/d, as defined above.

Secondary clarifiers at the Grand Valley WPCP are typically covered to prevent growth of algae. For purposes of this test, select panels were removed to allow for installation of a flow meter and for sludge height readings. However, several panels were left during the testing period. Therefore, it was not possible to visually observe the entire overflow weir for localized areas of solids carryover resulting from short-circuiting within the clarifier. Future testing could include tracer testing to evaluate the hydraulics within the clarifier.

Finally, results from the stress test also found that alum dosing restrictions at the Grand Valley WPCP had a negative impact on final effluent concentrations of orthophosphate and TP. Future removal of orthophosphate can be optimized by increasing the alum dosing capacity to achieve historical (70 mg/L) or typical (110 to 225 mg/L) dosage rates (MOE, 2008) at design peak flows.

6. REFERENCES

1. Ministry of the Environment. Design Guidelines for Sewage Works. 2008.
2. Metcalf & Eddy. Wastewater Engineering: Treatment and Resource Recovery. Fourth Edition. Toronto. 2003.
3. R.J. Burnside & Associates Limited. Township of East Luther Grand Valley - Grand Valley Wastewater Treatment Plant Operations Manual. July 2015.
4. XCG. Grand Valley WPCP Re-rating Feasibility Study - Proposed Design Flows and Loads. November 2015.

APPENDIX A
COPY OF SECONDARY CLARIFIER AND TERTIARY FILTER STRESS TESTING PROTOCOL

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Date:	June 16, 2016	**XCG File No.: 3-252-57-01**
To:	Jane Wilson, Town of Grand Valley (Town) Scott Craggs, Ontario Clean Water Agency	
cc:	Jeff Bunn and Glenn Sterret, Town	
From:	Graham Seggewiss, Melody Johnson and Linda Perry, XCG Consulting Limited (XCG)	
Re:	Grand Valley WPCP Rerating Study - Secondary Clarifier and Tertiary Filter Stress Testing Protocol	

1. INTRODUCTION

The Grand Valley Water Pollution Control Plant (WPCP) provides treatment for wastewater generated in the community of Grand Valley within the Town of Grand Valley (Town). The plant is currently operated by the Ontario Clean Water Agency (OCWA) under the Ministry of the Environment and Climate Change (MOECC) Certificate of Approval (C of A) No. 9706-7KWQ57, issued on February 2, 2009. The quality and quantity of effluent currently discharged by the existing WPCP is regulated by the C of A. The Grand Valley WPCP has a rated average day flow (ADF) capacity of 1,244 m^3/d.

The Town has initiated an investigation to analyze the potential to re-rate the existing Grand Valley WPCP to provide additional treatment capacity and to defer the facility's next upgrade and expansion. The Town has retained XCG Consulting Limited (XCG) to undertake a capacity assessment of the Grand Valley WPCP to evaluate the potential to re-rate the plant. Stress testing of the secondary clarifiers, tertiary filters, and ultraviolet (UV) disinfection system was proposed to confirm the actual peak hydraulic and solids loading capacities of these unit processes.

The objective of this document is to present the proposed protocol for stress testing of the secondary clarifiers, tertiary filters, and UV disinfection processes at the Grand Valley WPCP.

2. SECONDARY CLARIFIER AND TERTIARY FILTER STRESS TESTING

2.1 Overview of Test Procedures

The Grand Valley WPCP is equipped with two circular secondary clarifiers, four continuous-backwash tertiary filters, and a UV disinfection system. A summary of these processes is included as Table 2.1.

Table 2.1 Grand Valley WPCP Process Design Information

Unit Process	Design Parameter [1]
Secondary Clarifiers	
Number	2
Surface Area	75.4 m^2 (each) 150.8 m^2 (total)
Filters	
Type	Continuous up-flow, deep bed, granular media
Backwash	Continuous
Number	4
Filtration Area	4.65 m^2 (each) 18.6 m^2 (total)
Peak Flow Capacity	5,300 m^3/d
Disinfection	
Type	UV Disinfection
Peak Flow Capacity	7,680 m^3/d

Notes:
1. Based on Amended Certificate of Approval Number 9706-7KWQ57, issued February 2, 2009, and the Grand Valley Wastewater Treatment Plant Operations Manual (R.J. Burnside, 2015).

The purpose of the stress testing is to assess the treatment capacity of the existing secondary clarifiers, tertiary filters, and UV disinfection system while meeting the effluent total suspended solids (TSS), total phosphorus (TP) and *E. coli* objectives for the plant.

The Stress Test will consist of three days of testing onsite at the Grand Valley WPCP, and will evaluate the peak hour and maximum day treatment capacities of the secondary clarifiers, tertiary filters, and UV disinfection system. During the stress tests, flow through the plant and the number of unit processes online at any given time will be controlled by operations staff to achieve the stress testing target flows.

As detailed in Table 2.1, secondary clarification at the Grand Valley WWTP consists of two identical secondary clarifiers. As the secondary clarifiers have identical dimensions, it is assumed that they have equal potential treatment capacities. Therefore, the performance of only one secondary clarifier will be tested during this program, and is assumed to be representative of the performance of both secondary clarifiers.

Similarly, since the existing tertiary filters have identical dimensions and configurations, it is assumed that the capacity of each filter is equal. For purposes of this test, the performance of two tertiary filters will be evaluated. The remaining two tertiary filters will be used as required to provide additional filtration capacity should the capacity of the two test filters be exceeded during the stress test. Additional details regarding contingency plans during the stress test are included in Section 4.

The existing UV disinfection system has been designed with a minimum UV Transmittance (UVT) of 55%. The treatment capacity of the UV system will be evaluated by collecting tertiary effluent samples throughout and recording the UVT of each sample.

2.2 Proposed Testing Schedule

Stress testing will be conducted on the secondary clarifiers, tertiary filters, and UV disinfection system at the Grand Valley WPCP by XCG, with assistance from plant personnel. Stress testing will be completed over three days, consisting of:

- Day 1 - Setup, Preparation, and Baseline Testing of the clarifiers and filters.
- Day 2 - Peak Hourly Flow Testing.
- Day 3 - Maximum Day Flow Testing.

Plant operators will be required to ensure adequate supplementary volume is available at the plant prior to testing. As such, testing may not occur on concurrent days. Additional details regarding test set up and the provision of supplemental volume is included in Section 3.

Prior to conducting the Stress Test, plant operators will be asked to adjust sludge wasting as required to achieve target MLSS concentrations in the aeration tanks. For purposes of the Stress Test, the target MLSS concentration is approximately 4,000 to 4,500 mg/L.

Day 1 – Setup, Preparation and Baseline Testing

1. Confirm sampling locations. Install and calibrate autosamplers, flow meters, and temporary pumps.
2. Collect pre-test samples of mixed liquor, secondary clarifier effluent, and tertiary filter effluent (See Section 3.2 for general sampling procedure).
3. Record the radial profile of the sludge blanket of the secondary clarifier. A sludge judge will be used to measure the sludge blanket level along the radius of the secondary clarifier and the results recorded.
4. Ensure that sludge blanket level in the secondary clarifiers is within typical range and, if higher, increase return activated sludge (RAS) pumping rate to lower the sludge blanket level in advance of the testing.
5. Record the observed headloss across the tertiary filters.

Day 2 – Peak Hourly Flow Testing

Day 2 will consist of peak hour flow (PHF) testing of the test secondary clarifier and the two test tertiary filters. The following steps will be performed on the testing day:

1. Collect pre-test samples (See Section 3.2 for general sampling procedure).
2. Gradually ramp up flows until the initial target peak hour flow is achieved (See Section 3.1 for general flow adjustment procedures).
3. Flows will be held constant for one hour periods to allow test clarifier and filters to stabilize. During each hour period, monitor flow rates, secondary and tertiary effluent quality, sludge blanket levels, and filter headloss levels (See Section 3.2 for general sampling and monitoring procedures). Continuously monitor secondary effluent will for solids carry-over throughout stress test.

4. Provided the clarifier and filters are still operating well, the supplemental flow rate will be increased incrementally at the end of each one hour period. The flow increments will be determined by XCG and OCWA staff at the time of the testing based on specific site conditions and the ultimate target PHF. See Section 3.1 for a description of the methodology to be used to increase flows to the test clarifier and filters.
5. Collect required samples during each flow increment (See Section 3.2 for general sampling procedures).
6. Record the radial profile of the sludge blanket of the secondary clarifier. A sludge judge will be used to measure the sludge blanket level along the radius of the clarifier and the results recorded.
7. Observe any flow patterns in the clarifier or along the weirs such as areas of low flow, high flow, or solids upflow. Observe channels, troughs, and weirs for any indication of hydraulic limitations.
8. Repeat steps 1 to 5 until an imminent failure of the clarifier and/or filter is observed and/or hydraulic capacity of the channels is reached and/or the target peak flow rate is met or exceeded. An imminent failure of the secondary clarifier is indicated by a significant increase in sludge blanket depth and/or deterioration in effluent quality as measured by a significant increase in the TSS concentration or turbidity. An imminent failure of the tertiary filter is indicated by increasing/unstable measured headloss, and/or a deterioration in the effluent quality as measured by effluent TSS concentrations, turbidity or UVT.
9. When PHF stress test is complete, collect post-test samples (See Section 3.2 for general sampling procedure).
10. Return plant to normal operating conditions by shutting off all supplemental flows. Coordinate with plant operations to fill supplemental flow volumes in preparation of Day 3 of testing (See Section 3.1 for general tank filling procedure).

Day 3 – Maximum Day Flow Testing

Day 3 of testing will consist of maximum day flow testing of the test secondary clarifier and two test tertiary filters. The following steps will be performed on the testing day.

1. Collect pre-test samples (See Section 3.2 for general sampling procedure).
2. Gradually ramp up flows until the target flow is achieved (See Section 3.1 for general flow adjustment procedure). The target flow will be selected based on projections and the results of the peak hourly flow testing (Day 2).
3. Flows will be held constant for up to a five hour period, representative of a high flow event controlled by the storm tank.
4. Collect required samples during test event (See Section 3.2 for general sampling procedure).
5. Record the radial profile of the sludge blanket of the secondary clarifier. A sludge judge will be used to measure the sludge blanket level along the radius of the secondary clarifier and the results recorded.

6. Continuously monitor secondary effluent for solids carry-over and tertiary effluent for a deterioration in quality. Monitor the stability of the measured filter headloss throughout the stress test.
7. Observe flow patterns in the clarifier or the effluent weirs such as areas of low flow, high flow, or solids upflow. Observe channels, troughs, and weirs for any indication of hydraulic limitations.
8. When the stress test is complete, collect post-test samples (See Section 3.2 for general sampling procedures). Return plant to normal operating conditions, and empty supplemental volume reservoirs.

3. General Procedures for Field Testing

3.1 Supplemental Flow

Test flows through the secondary clarifier and tertiary filters will be monitored over the duration of the testing period. This will be accomplished using existing flow meters measuring plant influent flow and return activated sludge flows, and a temporary flow meter to monitor test secondary clarifier effluent flow. Secondary clarifier effluent flow will be monitored through installation of a velocity-area (VA) flow meter in the effluent trough of the test secondary clarifier. Secondary clarifiers at the Grand Valley plant are typically covered to prevent algae growth. Installation of the VA flow meter will require the removal of selected covering panels by plant personnel. The procedure to achieve the target flow will depend on the influent flows to the plant during the stress test. The assistance of plant personnel will be required for flow split control and adjustment.

It is expected that sufficient, steady flow from the Emma St. SPS will not be available to achieve target flows for the duration of the proposed testing period. As such, the raw influent flow will be supplemented with flow from the offline aeration tank and the storm equalization tank. This section will review how supplemental volumes will be filled and drained for purposes of testing.

3.1.1 Tank Filling Procedure

Prior to each day of testing (i.e. Day 2 and Day 3), operations staff will ensure that the offline aeration tank and storm tank are storing sufficient supplementary volume. The offline aeration tank will be filled with raw wastewater. Air will be turned on in the offline aeration tank to prevent septic conditions prior to the test. The storm tank will be filled with potable water by plant operators using available hosing and an onsite potable water connection.

3.1.2 Target Peak Flows

For purposes of this test, target peak hour and maximum day flow rates were estimated using the following assumptions:

- Proposed Scenario III future flows (XCG, 2015);
- Future storm tank overflow operation to provide sufficient volume to equalize two days of peak flows; and

- Peak flow event characteristics similar to a historic peak flow event available from plant records.

Please note that, during the Stress Test, plant flows will be increased only as permitted by acceptable plant performance. Based on the above assumptions, the future projected MDF and PHF to the plant are approximately 6,250 m^3/d and 6,500 m^3/d, respectively. As only half of the plant capacity will be tested, the target MDF and PHF for purposes of this Stress Test are, at a minimum, 3,125 m^3/d and 3,250 m^3/d, respectively.

3.1.3 Supplemental Flows and Volume

Required supplemental flow and volume was estimated assuming an average raw influent plant flow of 500 m^3/d (approximately 5.8 L/s), estimated from historic plant records for this time of year. A summary of the available supplemental volume and pumping capacity is given in Table 3.1.

Table 3.1 Supplemental Flow Details

Supplemental Flow Source	Volume (m^3)	Return Method	Pumping Capacity (m^3/d)
Offline Aeration Tank	400	Temporary Pump	1,625 (1)
Storm Equalization Tank	400	Temporary Pump	1,625 (1)
Total	800	-	3,250 (2)
Estimated Requirements for Stress Testing			
MDF testing PHF testing	605 (3) 461 (4)	-	2,625 (5) 2,750 (5)

Notes:

1. Estimated approximate capacity of temporary pumps required to achieve total target flow (3,250 m^3/d). Temporary pump capacity to be confirmed with equipment supplier prior to testing.
2. Proposed target pumping capacity to ensure sufficient pumping capacity is available for testing purposes.
3. Assumed target flow (3,125 m^3/d) less raw influent flow (500 m^3/d) sustained for five hours and including a 10% buffer volume.
4. Assumed target starting flow (1,500 m^3/d) sustained for one hour and increased by approximately 500 m^3/d each hour for five hours or until imminent failure is observed. Assumed raw influent flow of 500 m^3/d. Assumed 10% buffer on required supplemental volume. Actual supplemental volume requirements will depend on the return pump capacity.
5. Estimated from the projected target MDF (3,125 m^3/d) or PHF (3,250 m^3/d) less the raw influent plant flow (500 m^3/d).

Actual supplemental volume requirements may differ from above and will depend on the sustained raw influent flow during the Stress Test, and the variable supplemental flows achieved during the PHF testing. To accommodate for this uncertainty, a 10% buffer has been added to the estimated required supplemental volumes in Table 3.1.

3.1.4 Flow Adjustment Procedure

Procedures to achieve required supplemental flow rates may vary depending on the influent flow to the Grand Valley WPCP during testing. Supplemental flow will be added to the head of the aeration tanks via the flow split chamber using temporary pumps and hoses. Flow from all sources of supplemental volume should be variable and measurable to provide flexibility to achieve target flow rates. Flow control on the temporary pumping system can be accomplished by providing valving on the discharge header of the temporary pumps; flow metering can be provided by meters installed on the temporary piping and/or recording liquid levels in the offline aeration tank and storm tank and/or by monitoring secondary effluent flow using the temporary area-velocity flow meter. Exact set-up of the supplemental flow system will be confirmed by XCG with a supplier prior to the Stress Test.

3.2 Process Monitoring and Sampling

An automatic sampler will be configured to collect composite samples of effluent from the test clarifier and test filters. XCG will provide and install the required autosamplers. Autosampler operation and sample collection will vary from day to day as described below.

- On Day 1: Each sample will consist of four 15 minute "sub-samples" to obtain a 1 hour composite sample.
- On Day 2: Each sample will consist of two 15 minute "sub-samples" to obtain a 30 minute composite sample for the duration of the stress test period, plus one sample before and after stress testing has been completed.
- On Day 3: Each sample will consist of four 15 minute "sub-samples" to obtain a 1 hour composite sample for the duration of the stress test period, plus one sample before and after stress testing has been completed.

Each sample will be submitted to an accredited laboratory for TSS and TP analysis. Analysis of orthophosphate, turbidity, and UVT will be conducted on-site by XCG staff.

Mixed Liquor will be collected once per hour to determine the mixed liquor suspended solids (MLSS) concentration. Each sample will be submitted to an accredited laboratory for TSS analysis. One sample of mixed liquor per day will also be analyzed for 30-minute settling sludge volume index (SVI).

A summary of the proposed sampling is in Table 3.2.

A velocity-area flow meter will be installed in the secondary clarifier effluent trough to monitor secondary clarifier effluent flow. The test secondary clarifier will be monitored for sludge blanket depth and solids carryover. If deterioration in tertiary effluent UVT below the design UVT is observed during testing, grab samples of tertiary effluent will be collected and submitted to an external laboratory for collimated beam testing to determine the potential impact on downstream UV disinfection unit performance and capacity.

Table 3.2 Proposed Sampling Details

Sample Location	Sample Type	Sample Frequency	Monitored Parameters
Mixed Liquor	Grab	Day 1: Once Day 2/3: Hourly	TSS, VSS, SVI (1)
Secondary Clarifier Effluent	Composite	Day 1: Once Day 2: Semi-hourly Day 3: Hourly	TSS, TP, Orthophosphate, turbidity, UVT
Tertiary Filter Effluent	Composite	Day 1: Once Day 2: Semi-hourly Day 3: Hourly	TSS, TP, Orthophosphate, turbidity, UVT

Notes:
1. Analyzed once per day.

4. PERFORMANCE AND CONTINGENCY PLANS

The performance of the secondary clarifier, tertiary filters, final effluent quality, and plant water levels will be carefully monitored throughout the testing. Plant tankage, channels, weirs and other control structures will be observed for any indication of hydraulic limitations as identified by submergence of weirs or imminent process bypass.

In the event of a clarifier failure, as indicated by excessive solids carry-over or sudden rise in sludge blanket depth, test flows will be gradually decreased and the secondary clarifier performance testing will be terminated. Testing will also be terminated in the event of a filter failure, as indicated by increasing headloss levels and/or a deterioration in effluent quality. In the event of tertiary filter failure before secondary clarifier failure, additional tertiary filters will be brought online and the test will be continued.

5. ROLES AND RESPONSIBILITY

XCG will coordinate the stress test with assistance from OCWA personnel and Town Staff to set-up for the stress test, operation of required equipment and instrumentation, as well as process monitoring, sample collection, and chain-of-custody preparation.

A summary of the responsibilities of XCG and plant personnel is provided in the following Sections.

5.1 XCG Staff Roles and Responsibilities

XCG staff will be responsible for the following:

- Obtaining quotes from suppliers for the installation of required equipment to transfer supplemental flow from the offline aeration tank and storm tank during the test.
- Provision and temporary installation of equipment required for the duration of the testing, including:
  - Two auto-samplers installed to collect samples of secondary and tertiary effluent from test units.
  - Secondary clarifier effluent flow monitoring equipment.

  - One sludge judge for sludge blanket depth measurement.
- Provide input to plant personnel for flow adjustment during testing.
- Program the installed auto-samplers to collect composite samples as required by the testing protocol.
- Collecting samples from the temporary auto-samplers and placing sample aliquots in the proper sample bottles and filling in the chain of custody forms to obtain the required analyses.
- Collecting grab samples of mixed liquor, settling as required, and placing sample aliquots in the proper sample bottles and filling in the chain of custody forms to obtain the required analyses.
- Provide input to plant personnel throughout the duration of the testing program, as required. XCG's main point of contact for questions or concerns during the sampling program will be Graham Seggewiss. If there are any questions in advance of the testing, he can be reached at 905-829-8880 or graham.seggewiss@xcg.com. He can also be reached on his cell phone at 519-536-3788 during the testing.

5.2 OCWA Staff Roles and Responsibilities

Plant personnel will be responsible for the following:

- Removal of selected secondary clarifier cover panels to allow for installation of the temporary VA meter in the secondary clarifier effluent trough.
- Operation, monitoring, and control of plant processes and equipment, maintain plant performance during stress testing and to achieve target flow rates.
- Coordinating the installation of the temporary pumps to transfer supplemental flow with the equipment supplier.
- Operation of temporary pumps to transfer supplemental flow from the offline aeration tank and storm tank during the test.
- Fill offline tankage (offline aeration tank with raw wastewater; equalization storm tank with potable water) to provide supplemental flow volumes prior to each day of testing.
- Adjusting the operation of the Emma St. SPS during testing as required. It is anticipated this will involve modifying the liquid level / VFD set points to operate with the jockey pump at its lowest discharge setting to reduce the frequency of pump on/off cycles.
- Providing key flow data (Emma St. SPS flow, RAS flow, Onsite Pumping Station Flow, Septage Pumping Station Flow, Final effluent flow) over the course of the stress testing in 2-5 minute intervals.
- Providing guidance to XCG staff with respect to appropriate installation locations for the field testing equipment. This will include providing access to 120V power outlets to power the equipment.

APPENDIX B

GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY IMPACT OF ADDITIONAL EQUALIZATION VOLUME

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GRAND VALLEY WPCP RE-RATING FEASIBILITY STUDY
IMPACT OF ADDITIONAL EQUALIZATION VOLUME

Prepared for:

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1. INTRODUCTION

The Grand Valley Water Pollution Control Plant (WPCP) provides treatment for wastewater generated in the community of Grand Valley within the Town of Grand Valley (Town). The plant is currently operated by the Ontario Clean Water Agency (OCWA) under the Ministry of Environment and Climate Change (MOECC) Certificate of Approval (C of A) No. 9706-7KWQ57, issued on February 2, 2009. The quality and quantity of effluent currently discharged by the existing WPCP is regulated by the C of A. The Grand Valley WPCP has a rated average capacity of 1,244 m^3/d.

The Town has initiated an investigation to analyze the potential to re-rate the existing Grand Valley WPCP to provide additional treatment capacity and to defer the facility's next upgrade and expansion. The Town has retained XCG Consulting Limited (XCG) to undertake a capacity assessment of the Grand Valley WPCP to evaluate the potential to re-rate the plant.

Preliminary results of the assessment indicate the plant treatment capacity may be limited by peak flows capacity. As such, XCG conducted an analysis to evaluate the impact that additional equalization volume may have on the overall capacity of the Grand Valley WPCP. The purpose of this technical memorandum is to present results of that analysis.

2. GRAND VALLEY WPCP BACKGROUND INFORMATION

2.1 Existing Treatment Process

Raw sewage flows from the collection system are conveyed to the Grand Valley WPCP from the Emma St. sewage pumping station (SPS) via a forcemain. The Emma St. SPS is equipped with the following equipment:

- Two variable frequency drive (VFD) pumps (one duty and one standby), each with a rated capacity of 88.9 L/s (7,680 m^3/d).
- One VFD jockey pump with a rated capacity of 29.5 L/s (2,550 m^3/d).
- One wet will, with approximate volume of 125 m^3.

The jockey pump will not operate at peak flows. As such, the firm capacity of the Emma St. SPS is approximately 7,680 m^3/d. Over the review period (January 2012 – May 2016) there are no records of raw sewage bypassing at the Emma St. SPS or at the Grand Valley WPCP.

The Grand Valley WPCP receives septage at the septage receiving station. The septage receiving station removes solids from the raw septage using a combination of grinding, washing, and dewatering. The septage is then discharged to the plant headworks, upstream of the plant screens.

Plant influent raw wastewater flow consists of wastewater from the following sources:

- Raw wastewater from the Emma St. SPS;
- Septage from the on-site receiving station;
- Tertiary filter backwash; and,
- Digester supernatant.

Tertiary filter backwash and digester supernatant are transferred back to the head of the plant via an on-site pumping station. All flows are combined at the head of the plant, upstream of the plant headworks.

Headworks at the Grand Valley WPCP consists of a mechanical bar screen and two vortex grit separators. A manual screen also exists in parallel to the mechanical screen, and can be used as needed during peak flows or to isolate the mechanical screen. Flow to the manual screen is controlled using gates. High water levels in the screening channel can overflow the control gate, thereby initiating an emergency bypass of the mechanical screens.

Headworks effluent flow is discharged to a splitter box, where flow is directed to the aeration tanks, or to a bypass channel. Sustained peak flows in excess of 64 L/s (5,530 m^3/d) for greater than 10 minutes are directed to the bypass channel and into the 400 m^3 equalization tank (storm tank). From the equalization tank, flow can be returned to the head of the plant through the on-site pumping station. Bypass flows in excess of the equalization tank capacity are disinfected and discharged. There have been no recorded plant bypasses at the Grand Valley WPCP.

Secondary treatment at the Grand Valley WPCP consists of three aeration tanks and two secondary clarifiers. Oxygen is provided to each aeration tank through fine bubble diffusers. Alum is added immediately upstream of the secondary clarifiers for chemical phosphorus removal. Activated sludge is separated from the treated stream in the secondary clarifiers. Return activated sludge (RAS) is returned to the raw wastewater upstream of the aeration tanks. Waste activated sludge (WAS) is pumped to the aerobic digester located on-site. RAS and WAS are pumped from the same location in the secondary clarifier. Overflow from the secondary clarifiers is passed through one of four tertiary filters at the plant. Filter effluent is disinfected using ultraviolet (UV) radiation, then discharged to the Grand River. Waste activated sludge is digested and thickened on-site in the aerobic digester. Thickened sludge is pumped to the on-site biosolids storage tank, then trucked offsite for disposal.

Wastewater flow is measured at several locations at the plant. Raw wastewater from the collection system is metered at the Emma St. SPS. Wastewater flows from septage and the on-site pumping station are separately metered. Collectively, they represent the plant influent flow. Effluent flow from the Grand Valley WPCP is measured by a V-notch weir, downstream of the UV disinfection.

A process flow diagram of the Grand Valley WPCP is presented in Figure 2.1.

2.2 Plant Design Basis

For purposes of this evaluation, flows and loads to the Grand Valley WPCP were developed for three distinct scenarios. Details of each scenario are presented briefly below:

- Scenario I: Full completion of planned residential developments;
- Scenario II: A 15% increase above the current C of A rated ADF (1,430 m^3/d); and,
- Scenario III: A 25% increase above the current C of A rated ADF (1,555 m^3/d).

A summary of the updated flow design basis is given in Table 2.1 (XCG, 2016). For simplicity, the previous design basis (XCG, 2015) has not been presented in the table. This table represents raw the projected raw influent flow from the collection system to the Grand Valley WPCP, and does not include any recycle flow from the on-site pumping station. It is important to note the projected peak flows for all three scenarios exceed the existing rated capacity of the Emma St. SPS (7,680 m^3/d). Therefore, the Emma St. SPS may require upgrades at future flows provided that existing peak flows are not abated by any I/I reduction strategies. An extensive review of the Emma St. SPS capacity was not conducted as part of this review. Further, it is assumed that future peak flows to the Grand Valley WPCP will not be inhibited by the pumping capacity of the Emma St. SPS.

Table 2.1 Summary of Raw Influent Flow from the Collection System (XCG, 2016)

Parameter	Scenario I	Scenario II	Scenario III
Population	2,919	3,252	3,527
ADF	1,279 m^3/d	1,430 m^3/d	1,555 m^3/d
MDF	5,839 m^3/d	6,169 m^3/d	6,442 m^3/d
MDF Factor	4.6	4.3	4.1
PIF	7,811 m^3/d	8,291 m^3/d	8,684 m^3/d
PIF Factor	6.1	5.8	5.6

For purposes of this analysis, evaluation of the required equalization volume will be based on the projected maximum day flow through the treatment plant. It is important to note that backwash flow from the tertiary filters and supernatant from the on-site digester is discharged to the on-site pumping station where it is pumped to the head of the plant upstream of the plant headworks. As such, maximum day and peak instantaneous flows through the treatment plant are greater than those given in Table 2.1.

The maximum design backwash flow rate from the existing tertiary filters is 390 m^3/d (R.J. Burnside, 2015). For purposes of this analysis, it is assumed the digester is not supernated during a peak flow event. Table 2.2 summarizes the projected maximum day flow through the plant considering contributions from the Emma St. SPS (i.e. raw influent from the collection system) and from the on-site pumping station (i.e. tertiary filter backwash flow).

Table 2.2 Summary of Peak Flow through the Grand Valley WPCP Headworks

Maximum Day Flow	Scenario I	Scenario II	Scenario III
Emma St. SPS (Collection System)	5,839 m^3/d	6,169 m^3/d	6,442 m^3/d
On-site Pumping Station (Filter Backwash)		390 m^3/d	
Total Projected Maximum Day Flow	6,229 m^3/d	6,559 m^3/d	6,832 m^3/d

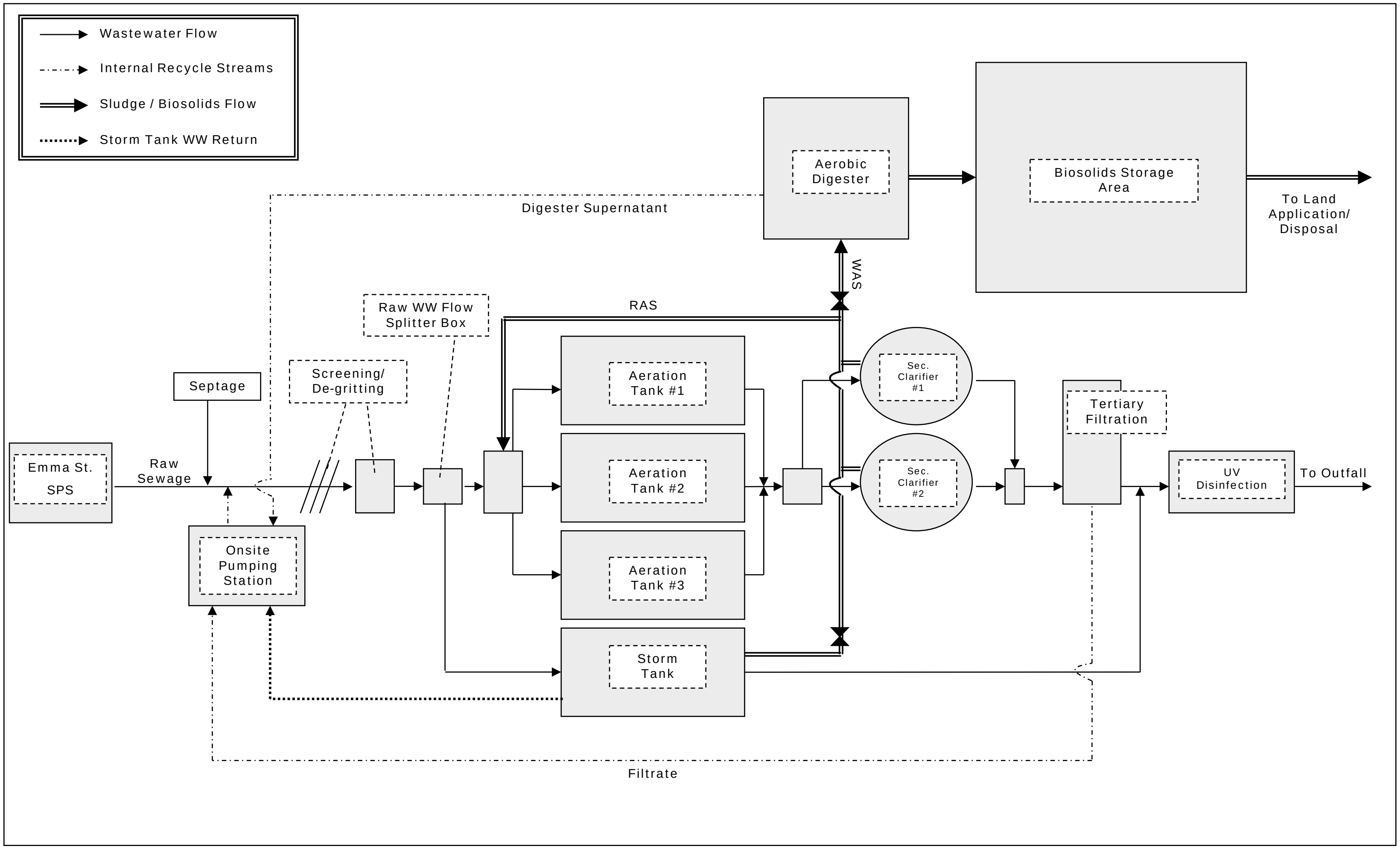

Figure 2.1 Process Flow Schematic – Grand Valley WPCP

3. DETAILS OF ADDITIONAL EQUALIZATION FOR THE GRAND VALLEY WPCP

Currently, equalization for the Grand Valley WPCP is provided by a 400 m^3 storm tank located on-site at the Grand Valley WPCP. It is assumed this storm tank would continue to be used in the future.

For purposes of this investigation, two equalization options were developed and evaluated. Details of each equalization option is included in Table 3.1.

Table 3.1 Summary of Equalization Options

Option	Details
Option 1	• Provide sufficient equalization volume to facilitate re-rating of the Grand Valley WPCP to the Scenario I flows and loads.
Option 2	• Provide sufficient equalization volume to facilitate re-rating of the Grand Valley WPCP to the Scenario III flows and loads.

The purpose of this section is to present considerations for the construction of additional equalization volume in the Town of Grand Valley.

3.1 Impact of Equalization Location

There are two potential locations where additional equalization could be constructed in Grand Valley, Ontario: at the Emma St. SPS and/or at the Grand Valley WPCP. Although space is available on-site at the Grand Valley WPCP, construction of additional equalization volume may limit the land available for future expansion of the plant. For purposes of this study, it is assumed that additional equalization installed at the Grand Valley WPCP would divert flow from the same location as the existing equalization tank. As such, projected peak flows through the plant headworks and from the Emma St. SPS would not be reduced via the installation of additional equalization volume at the WPCP site.

Conversely, the Emma St. SPS is located at the site of the old wastewater treatment plant. The majority of infrastructure has been removed from the site and minimal expansion of the existing infrastructure is expected to be required to meet future flows. As such, there is significant land available for the construction of additional equalization as required. By constructing equalization volume at the Emma St SPS, peak flows requiring conveyance through the SPS and, by extension, influent peak flows to the WPCP would be reduced.

An analysis of the hydraulic treatment capacity of the existing plant headworks (i.e. screening and grit removal) has also been completed (XCG, 2016). The results indicate that the hydraulic capacity of the existing headworks exceeds the projected Scenario III peak flows without the installation of any additional equalization volume.

As noted in Table 2.1, projected peak flows from the collection system exceed the current rated pumping capacity of the Emma St. SPS. Installation of equalization volume at Emma St. would reduce peak flows below the existing rated capacity of the raw influent pumps. Conversely, if additional equalization volume is installed at the

Grand Valley WPCP, peak flows from the Emma St. SPS would not be reduced. As such, installation of equalization volume at the Grand Valley WPCP would need to be accompanied by a detailed investigation of the pumping capacity of the Emma St. SPS and hydraulics of the forcemain between the plant and pumping station.

Therefore, to avoid the potential of additional required upgrades to the Emma St. SPS and/or the forcemain, this analysis has assumed additional equalization volume would be installed at the Emma St. SPS. Ultimate selection of the location and volume of additional equalization would be finalized during the detailed design.

3.2 Analysis of Projected Peak Flows and Estimate of Required Equalization Volumes

The following assumptions were made to develop an estimate of the required equalization volume for each equalization option:

- Sufficient volume is required to provide 24-hours of equalization at a simulated future peak flow event.
- Detailed flow characteristics of the historical peak flow event (recorded on April 14, 2014) are representative of future peak flow events.

The peak treatment capacity of the Grand Valley WPCP was evaluated through stress testing of the secondary clarifiers, tertiary filters, and UV disinfection system. Results were previously presented in the Secondary Clarifier, Tertiary Filter, and Disinfection Stress Test Results Technical Memorandum (XCG, 2016). Based on the results, the estimated peak treatment capacity of the plant including flow from the tertiary filter backwash is approximately 4,400 m^3/d and is limited by the secondary clarifiers.

Table 3.1 summarizes the estimated required equalization volume for each equalization option that maintains the projected peak flow through secondary treatment at the WPCP to less than 4,400 m^3/d.

Table 3.2 Summary of Estimated Required Equalization Volume

	Option 1 (Sufficient Capacity for Scenario I Flows)	Option 2 (Sufficient Capacity for Scenario III Flows)
Projected MDF	6,229 m^3/d	6,832 m^3/d
Total Estimated Equalization Volume Required	1,900 m^3	2,500 m^3
Existing Equalization Volume (1)	400 m^3	
Additional Equalization Volume Required at Emma St SPS	1,500 m^3	2,100 m^3
Estimated Equalized Peak Flow (2)	4,327 m^3	4,330 m^3

Notes:
1. Volume of existing storm tank at the Grand Valley WPCP.
2. Due to size of the proposed equalization volume for each option, the projected equalized maximum day and peak hour flows for each option are equal.

3.3 Installation Considerations and Capital Cost Estimations

As previously discussed, it has been assumed that additional equalization volume would be constructed at the Emma St. SPS located upstream of the Grand Valley WPCP.

Installation of additional equalization volume can be carried out as a Schedule B activity under the Municipal Class Environmental Assessment Process as per the following text:

"Establish sewage flow equalization tankage in existing sewer system or at existing sewage treatment plants, or at existing pumping stations for influent and/or effluent control"

As a Schedule B project, Phase 1 and Phase 2 of the Class EA process must be completed prior to implementation of the project (i.e. construction). Brief requirements of each Phase are given below.

Phase 1

During this phase, the problem or opportunity must be identified and described. Projects which are expected to generate significant public interest can also begin the public consultant process.

Phase 2

During this phase, potential alternative solutions will be identified and evaluated. Solutions will consider the size (volume) and location of additional equalization. This Phase will also include mandatory consultation with relevant review agencies and stakeholders (e.g. MOECC, GRCA, First Nations, etc.) and the public.

At the completion of Phase 2, the entire planning process (i.e. Phase 1 and Phase 2 activities) will be summarized and placed on file for a period of thirty (30) days. A notice of completion will be issued to review agencies and to the public.

Assuming no request for an Order is received during the review period, the Town may proceed with the design and construction of the equalization tank. Detailed design of the equalization tank would need to consider the integration of the equalization tank into the existing infrastructure in the Town of Grand Valley. Specifically, detailed design would establish the following:

- Type and location of the tank (e.g. glass fused steel storage tank located primarily above ground, rectangular cement tank located above ground or below ground, etc.);
- Additional treatment processes required upstream of the equalization tank (e.g. communitor, etc.);
- Regular maintenance required of the equalization tank (e.g. washing, etc.) and provisions to allow for required maintenance;
- Integration into the existing infrastructure, including the reuse of existing pumps and piping where possible; and

- Evaluation of existing utilities and standby power on the site.

For purposes of this conceptual level design, it is assumed a circular glass fused steel storage tank would be installed at the Emma St. SPS. A conceptual level site layout of equalization at the Emma St. SPS is included as Figure 3.2 and indicates that the site has sufficient space for construction of the equalization tank. Exact dimensions of the equalization tank and the optimal location on the site would be finalized during the detailed design.

Figure 3.1 Overview of Conceptual Level Layout for Equalization at the Emma St. SPS

Conceptual level capital costs were estimated for the installation of additional equalization volume at the Emma St. SPS. Conceptual level capital costs include installation the equalization tank, as well as allowances for excavation, piping, installation of a tank cleaning mechanism, and electrical works. These additional considerations are critical for the integration of the equalization tank into the existing infrastructure and SCADA system.

Conceptual level costs are generally considered to be accurate to -25% to +40%. Actual costs will depend on site specific factors, such as soil and groundwater conditions, the engineering design applied, construction conditions at the time of tendering, and the extent of additional upgrades to the works that may be included in the final design. Capital costs include a 30% allowance for contingency and a 12%

allowance for engineering and approvals. A summary of conceptual level capital costs for each equalization option is summarized in Table 3.2.

Table 3.3 Summary of Conceptual Level Capital Cost Estimates for Equalization at the Emma St. SPS

Item	Option 1 (Sufficient Capacity for Scenario I Flows)	Option 2 (Sufficient Capacity for Scenario III Flows)
General/Miscellaneous	$130,000	$155,000
Equalization Tank	$1,302,000	$1,545,000
Sub Total	$1,432,000	$1,700,000
Contingency (30%)	$429,000	$510,000
Engineering (12%)	$172,000	$204,000
Estimated Equalization Capital Costs [1]	**$2,033,000**	**$2,414,000**

Notes:
1. All costs are conceptual level opinions of probable costs and are considered to be accurate to within -25 to +40 percent and are exclusive of HST.

4. SUMMARY AND CONCLUSIONS

Based on the capacity assessment of the Grand Valley WPCP, and on projections of future flows and loadings, the capacity of the overall facility is limited by the peak flow treatment capacity. Through installation of additional equalization at the Emma St. SPS, peak flows to the plant may be reduced, thereby making it feasible to pursue a plant rerating to increasing the rated capacity, potentially up to an ADF capacity of 1,555 m^3/d.

There appears to be sufficient space at the existing Emma St. SPS to construct additional equalization. Estimated costs for equalization will depend on several factors, including the type of equalization tank selected and additional equipment required to integrate the equalization tank into existing infrastructure.

For purposes of this analysis, two equalization options were evaluated:

- Option 1: Sufficient equalization volume to facilitate plant rerating to Scenario I flows and loads (ADF of 1,279 m^3/d).
- Option 2: Sufficient equalization volume to facilitate plant rerating to Scenario III flows and loads (ADF of 1,555 m^3/d).

The estimated costs for equalization ranged from approximately $2.03 million (Option 1) to $2.41 million (Option 2). Construction of additional equalization volume would be carried out as a Schedule B activity under the Municipal Class EA process, therefore requiring an evaluation of alternative solutions and consultation with the public and with relevant review agencies.

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4. XCG Consulting Limited. Grand Valley WPCP Headworks Hydraulics Analysis. 2016.
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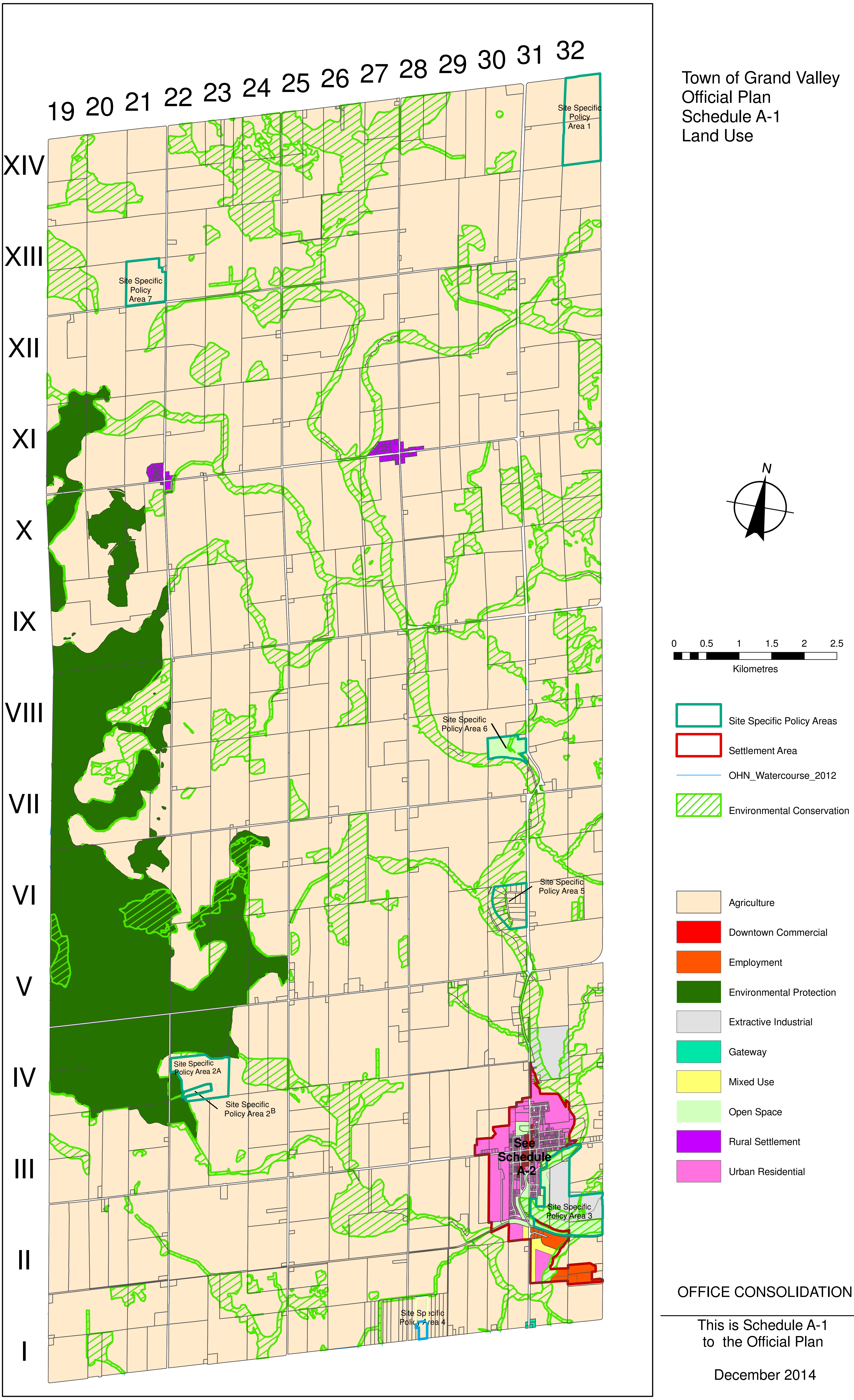
Appendix H

Official Plan Land Use (Schedule A-1 and A-2)

Town of Grand Valley
Official Plan
Schedule A-1
Land Use



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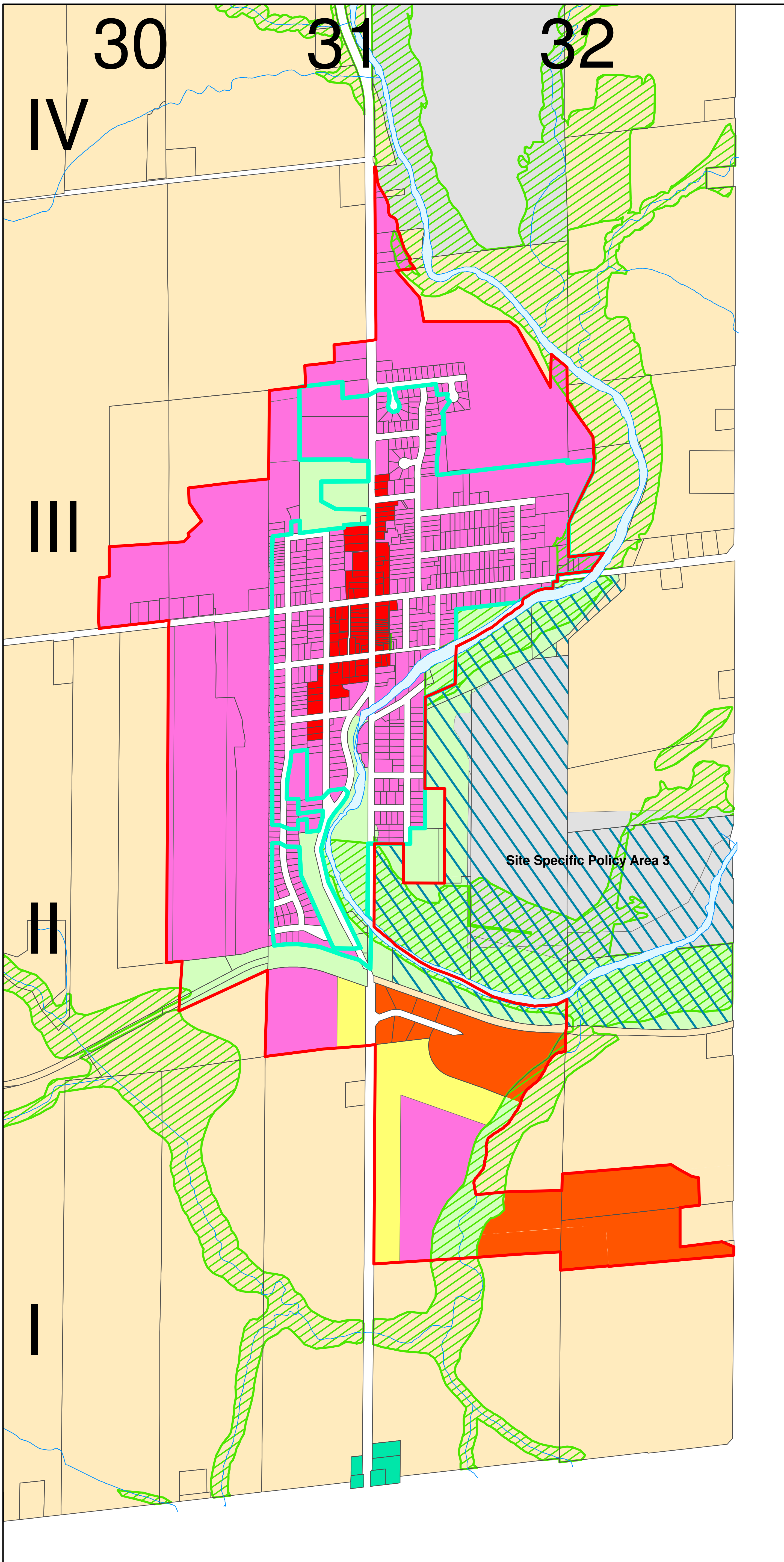
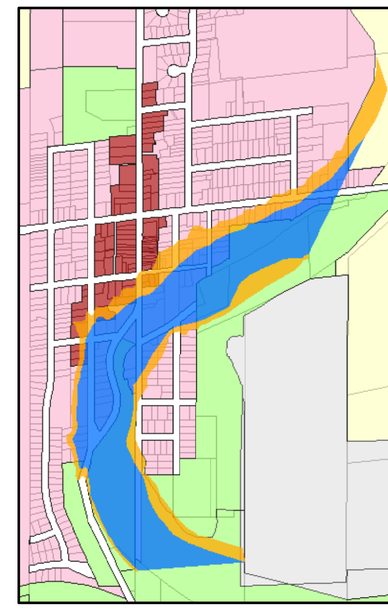
This is Schedule A-1
to the Official Plan

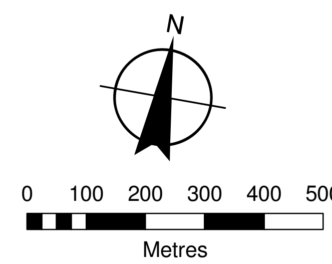
December 2014

Consolidated Dec 2016

Town of Grand Valley
Official Plan
Schedule A-2
Land Use (Village)







- Floodway (Inset)
- Flood Fringe (Inset)
- Settlement Boundary
- OHN_Waterbody_2012
- OHN_Watercourse_2012
- Delineated Built Boundary
- Site Specific Policy Areas
- Environmental Conservation
- Agriculture
- Downtown Commercial
- Employment
- Environmental Protection
- Extractive Industrial
- Gateway
- Mixed Use
- Open Space
- Rural Settlement
- Urban Residential

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This is Schedule A-2 to the Official Plan

Consolidated December 2016

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Appendix I

Archaeological Research Associates Ltd. 2007 Report

Stage 1 and 2 Archaeological Assessment

Proposed Waste Water Treatment Plant

Appendix I

Archaeological Research Associates Ltd.

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Stage 1 and 2 Archaeological Assessment
Proposed Waste Water Treatment Plant
Part Lot 31, Concessions 1 and 2
Township of East Luther Grand Valley
Dufferin County, Ontario

Prepared for
R.J. Burnside & Associates Limited
292 Speedvale Avenue West, Unit 7
Guelph, Ontario N1H 1C4
Tel: (519) 823-4995 Fax: (519) 836-5477
&
The Ontario Ministry of Culture

By
Christina Gohm, B.A.
Archaeological Research Associates Ltd.
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Ontario Ministry of Culture Licence# P-007
Project # P007-106-2006
PIF# P007-106-2006

February 2007

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Personnel:

Project Director: P.J. Racher

Project Manager: P.J. Racher

Field Director: C.E. Gohm

Field Work: C.E. Gohm, P.J. Racher

Photographer: C.E. Gohm

Background Research: C.E. Gohm

Report Preparation: C.E. Gohm

Graphics: C.E. Gohm

Acknowledgements:

Special thanks for their assistance with this study are extended to Mr. Dave Arsenault, of R.J. Burnside & Associates Ltd., and to Mr. Robert Von Bitter, Archaeological Data Coordinator at the Archaeology Unit, Heritage Branch of the Ontario Ministry of Culture, Toronto.

1.0 Introduction

Under a contract awarded in July of 2006, **Archaeological Research Associates Ltd**. **(ARA)** conducted a Stage 1-2 archaeological assessment of the proposed Grand Valley Sewage Treatment Plant, in the Township of East Luther Grand Valley, Dufferin County, Ontario. This project was conducted under licence # P-007, PIF # P007-106-2006. The work was completed under contract to **R. J. Burnside & Associates Ltd.** as part of pre-design site investigations for a proposed waste water treatment plant.

The Stage 1-2 archaeological assessment was conducted in December of 2006 to determine the presence of any heritage resources which might be present on the property and, if so, what steps need be taken for their protection and management. The assessment was carried out in accordance with the provisions of the Ontario Heritage Act (A.S.O. 1990), and with the technical guidelines for archaeological assessments formulated by the Ministry of Culture (MCTR 1993:12-22). All records pertaining to this assessment are currently housed in a company storage facility located in the Department of Archaeology and Classical Studies at Wilfrid Laurier University. The Ministry of Culture is asked to review the results and recommendations presented in this report.

2.0 Location

The proposed waste water treatment plant and its surrounding allowances are to cover an area of roughly 16 acres, located on part of Lot 31, Concessions 1 and 2, in the Township of East Luther Grand Valley, Dufferin County, Ontario (see Figures 1-4). This rectangular-shaped parcel of land is accessed from County Road 25 by an existing road, Industrial Drive, which runs into the eastern portion of the study area. The subject property is bounded by the Waldemar – Grand Valley Rail Trail, formerly the Toronto Grey & Bruce Railway, to the north, the limits of the protected environmental zone of Boyne Creek to the east, agricultural lands to the south and disturbed industrial lands to the west. Boyne Creek lies roughly 20 metres from the eastern limits of the study area and the Grand River lies 60 metres north of the northern limits. These water courses intersect roughly 100 metres northeast of the property (see Figure 2).

3.0 Geography

It has long been understood that environment plays a key role in determining site location, particularly in small societies with non-complex, subsistence-oriented economies. The local environment of the subject property lies within the Carolinian-Canadian Transitional Biotic Province, which is described as favouring the growth of a mixture of northern and southern forest species (Mason 1981:60).

Figure 1: Location of Study Area in the Province of Ontario

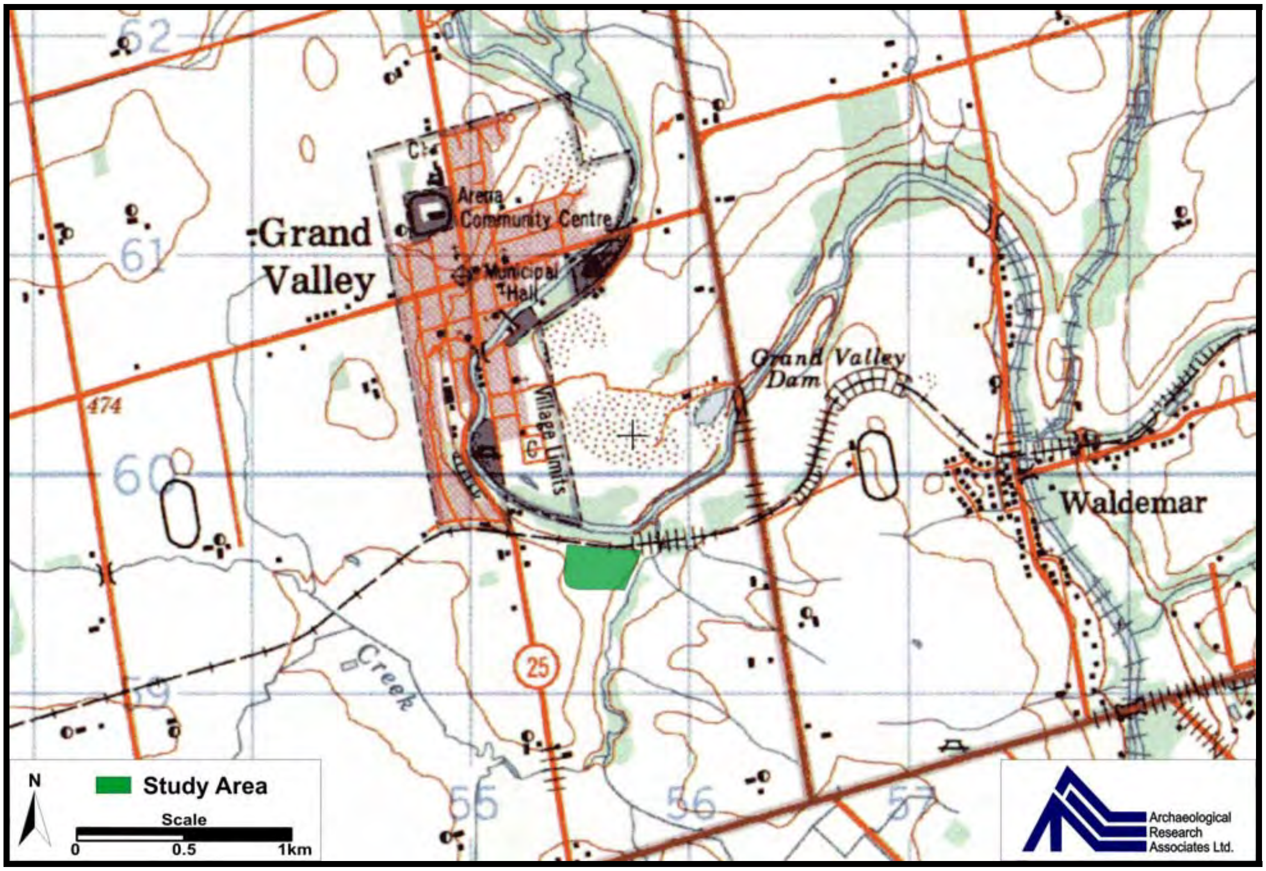

Figure 2: Study Area in the Township of East Luther

Physiographically, the study area lies in the region known as the Dundalk Till Plain, an undulating till plain characterized by low drumlins, morainic ridges, poorly drained depressions, swamps and bogs (Chapman & Putnam 1984: 130). Bedrock in the area is Silurian in date. The uppermost strata consists of dolomite, shale and sandstone underlain by cream to buff dolomite of the Guelph Formation (Hoffman et al. 1964:8). Soils on the property consist mainly of Guelph Loam and Huron Clay Loam (Hoffman et al. 1964: Map 38).

4.0 Background Research

An archival search was conducted using the Ontario Ministry of Culture Archaeological Sites Database in order to determine the presence of any registered heritage resources which might be located on or within a 2 kilometre radius of the study area. It was found that one registered site, a Late Archaic findspot consisting of a single winged bannerstone (AlHb-1), lay within 2 kilometres of the subject property.

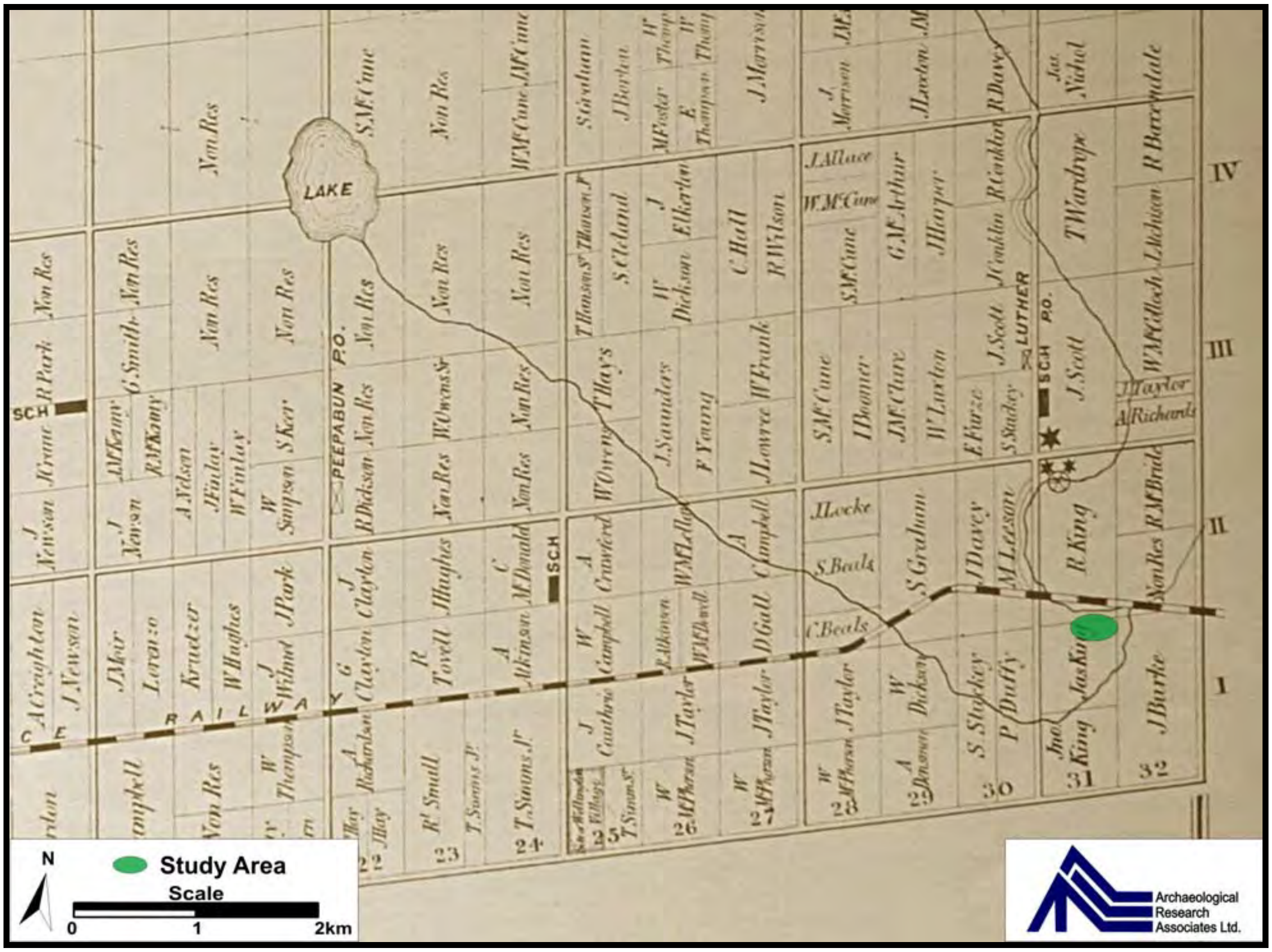

Figure 3: Walker & Miles' Illustrated Atlas of the County of Wellington (1877)

Originally part of Wellington County, Luther Township divided into Luther West and Luther East in 1880. In 1883 East Luther Township separated from Wellington County and was annexed to Dufferin County. Grand Valley and East Luther Township then amalgamated in 1995 (Dufferin Museum).

Walker & Miles' ***Illustrated Atlas of the County of Wellington*** **(1877)** shows the study area situated on part Lot 31, Concession 1 and 2 (see Figure 3). In 1877 Lot 31, Concession 1 was owned by Jas. King and Lot 31, Concession 2 was owned by R. King. No evidence of any historic structures was located on or immediately adjacent to the subject lands.

5.0 Archaeological Potential

The archaeological potential of the property was assessed using its soils, hydrology and landforms as considerations. Young et al. (1995) note that, "*either the number of streams and/or stream order is always a significant factor in the positive prediction of site presence*" (1995:23). They further note that certain types of landforms, such as moraines, seem to have been favoured by different groups throughout prehistory (Ibid.: 33). According to several researchers, such as Janusas (1988:1) "*The location of early settlements tended to be dominated by the proximity to reliable and potable water resources.*" Site potential modeling studies (Peters 1986; Pihl 1986) have found that most prehistoric archaeological sites are located within 300 metres of remnant or extant water sources. However, non-habitational sites (i.e. burials, resource gathering sites, kill sites, etc.) may be located anywhere. Historic sites tend to be near the transportation routes. Specifically pre-1850 sites are located near the major rivers and creeks; while post-1850 sites are located along the historically surveyed roads.

Bearing in mind these factors, it is clear that the study area would, in its pristine state, have a high potential for containing both pre-Contact and Historic era archaeological sites. The potential for Pre-Contact sites is suggested by the property's proximity to Boyne Creek (20 metres) and the Grand River (60 metres) (see Figure 4). The banks of the Grand River contain some of the densest deposits of archaeological materials to be found in all of Ontario.

The potential for Historic era sites is similarly high, due to its location relative to the former Toronto Grey & Bruce Railway, which was an important transportation route in the 19th Century, and by its proximity to the historically-surveyed road which became County Road 25.

6.0 Field Methods

As this study area consisted of ploughed lands, it was necessary to utilize the pedestrian survey method. In this method, crewmembers traverse the study area along parallel transects established at intervals of either 5 or 10 metres, depending upon the archaeological potential of the property. Due to its close proximity to Boyne Creek and the Grand River, the study area was felt to have a high archaeological potential and, as such, was surveyed at 5 metre intervals. If cultural materials were encountered in the course of the survey, the transect interval would be closed to 1 metre and a close inspection of the ground would be conducted for 20 metres in all directions.

Artifacts that may indicate the presence of significant cultural deposits include bone, charcoal, lithics (stone tools and refuse generated by their production and use), ceramics, glass, and metal. Archaeological features such as pits, foundations, and other non-portable remains may also be detected during a Stage 2 survey.

Any archaeological materials encountered are flagged, mapped, photographed and collected for further analysis. Artifact locations are recorded on topographic maps, in field notes and on a GPS. All recovered materials are sent to Wilfrid Laurier University for processing, cataloguing, and analysis. Storage of all artifacts, photographs, mapping materials, and field notes takes place in the Department of Archaeology and Classical Studies at Wilfrid Laurier University.

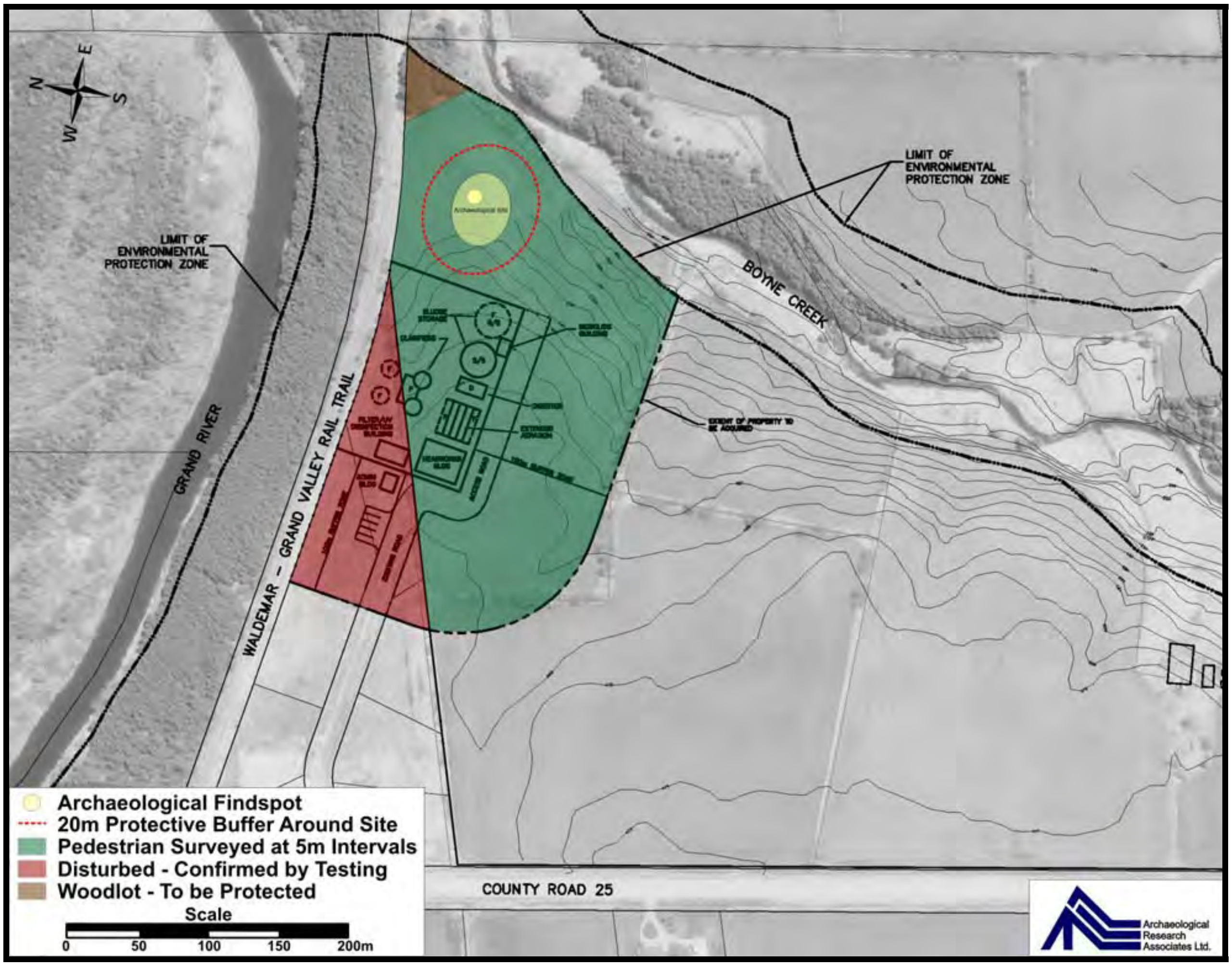

Figure 4: Study Area in Detail

Plate 1: View of Soil Conditions at Time of Survey

Plate 2: View of Study Area, Looking West

7.0 Results and Recommendations

The Stage 1-2 archaeological assessment was conducted in December of 2006. Key personnel involved were P.J. Racher, Project Director and C.E Craig-Paul, Field Director.

It the field, it became apparent that a portion of the study area was disturbed. A triangular shaped portion of land in the northwest corner of the study area showed evidence of disturbance due to industrial dumping, grading that may be associated with the adjacent trail system, and the existing road (Industrial Drive) which runs through this area. A small woodlot in the northwest corner of the property was not assessed. This woodlot was not slated for any impacts and will be protected (see Figure 4, Plate 3).

In the course of conducting the pedestrian survey, one significant cultural deposit was discovered. Findspot 1 was originally identified as a dense scatter of 20+ flakes in an area roughly 5 metres in diameter. After further investigation, additional flakes were identified in a very thin scatter outside of the initial findspot. These flakes greatly expanded Findspot 1 to an area of 50 x 40 metres. Of the 30+ flakes identified during the assessment 10 were collected as part of the controlled surface collection for further analysis. Analysis of the artifacts collected determined that 1 was a modified flake, 9 were secondary thinning flakes and all were Collingwood chert (see Plate 4). Collingwood chert is a highly significant archaeological find because it was favoured in the Palaeo-Indian Period (ca. 11,000 – 9,500 B.P.).

Given the rarity of Palaeo-Indian sites it is recommended that the site be avoided entirely. Since the exact extent of the site is unknown the **Ministry of Culture** has recommended that a 20 metre buffer be established around the identified limits of Findspot 1. Snow fencing should be erected along these limits during construction activities (see Figure 4). Should complete avoidance not be an option, a full Stage 3 archaeological assessment should be carried out in <u>all areas of indirect and direct impacts</u> on the site. Furthermore, should the protected woodlot be threatened by any future activities, a Stage 2 assessment of that area will be necessary.

Should human remains be identified during any future construction or maintenance operations, all work in the vicinity of the discovery will be suspended **immediately**. Notification will be made to the Ontario Provincial Police, or local police, who will conduct a site investigation and contact the district coroner. Notification should also be made to the Registrar of Cemeteries, Ministry of Consumer and Commercial Relations (416-326-8404). Other government staff may be contacted as appropriate; however, media contact should not be made in regard to the discovery. Should other cultural heritage values (archaeological or historical materials or features) be identified during operations, all activity in the vicinity of the recovery will be suspended and the Ministry of Culture archaeologist contacted (519-675-7742). This condition provides for the potential for deeply buried or enigmatic local site areas not typically identified in evaluations of potential.

Plate 3: Location of Findspot 1, Looking East
(Note Protected Woodlot in Background)

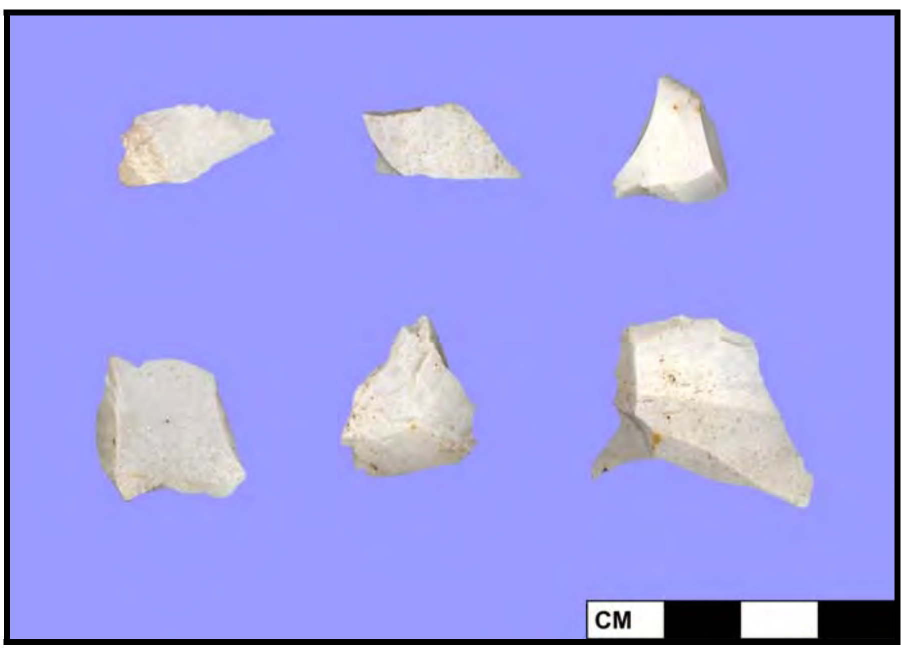

Plate 4: Sample of Artifacts Recovered from Findspot 1

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Appendix J

Water Supply and Sewage Servicing Master Plan – Well Testing Technical Memorandum

Appendix J

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Technical Memorandum

Date: January 31, 2019 **Project No.:** 300040938.0000

Project Name: Water Supply and Sewage Servicing Master Plan-Well Testing

Client Name: Town of Grand Valley

Submitted To: Jeff Paznar, P.Eng., EP

Submitted By: David Hopkins, P.Geo

1.0 Introduction

R.J. Burnside & Associates Ltd. (Burnside) has completed exploratory well drilling at two locations in the Town of Grand Valley. To ensure that adequate water capacity is supplied to the Town, new groundwater sources are required in addition to the three existing wells (two located at Copper Street-PW1 and PW2, and one at Melody Lane-PW3). Two test wells were drilled to demonstrate the viability of obtaining additional groundwater supplies. This memorandum provides details on the site selection process and the results of the drilling/preliminary well testing.

2.0 Well Locations

There are several factors that influence the siting of a new well. According to Ontario Regulation 903 (Wells Regulation), a new water supply must comply with minimum separation distances from potential sources of contamination, must be accessible at all times, and must be at a higher elevation than the surrounding area. There are also provisions in the Clean Water Act (2006) that restrict or prohibit certain land use activities within the wellhead protection area (WHPA) for a municipal well. One of the most significant prohibitions is the restriction on the application of nutrients within 100 m of a municipal well. This is particularly important in an agricultural area such as Grand Valley.

Previous testing of PW2 resulted in widespread well interference and on-going water level monitoring indicates that many of the monitoring wells are affected by the pumping on Cooper Street. As a result, it was considered important to locate potential well sites outside the area of influence of the existing municipal wells.

Based on these requirements, three potential locations were selected. Figure 1 shows the proposed drilling locations and the locations of the existing municipal wells and their associated WHPA's.

Location 1: Park Site- Intersection of Sideroad 28 & 29 and Concession Road 2 & 3

This well site is located at the intersection of Sideroad 28 & 29 and Concession Road 2 & 3. The site is located a substantial distance away from the existing wells and is within proximity of the Thomasfield subdivisions located at the west end of Amaranth Street. An existing Monitoring Well EL-MW-2 is located at the northwest corner on this site and is monitored as part of the Town's monitoring program. The well shows no response to pumping of the municipal wells. This site was also selected because a new well could be situated so that agricultural lands would be outside the 100m radius.

Location 2: Existing Water Tower

The second proposed well site is located adjacent to the existing water tower near the intersection of Fife Road and Main Street North (County Road 25). This location provides an ideal connection into the existing distribution system as it is located in close proximity to the existing water tower.

Location 3: Fire Hall

The third proposed well site is located on the fire hall property. This proposed location has the closest proximity to the existing Melody Lane Water Plant; however, it is not located within the zone of influence of the Melody Lane well. This site was removed from consideration due to concerns about possible impacts from fire training activities.

3.0 Well Drilling Program

Burnside and the Town retained Well Initiatives Limited (WIL) to complete the exploratory drilling and testing program. Well records are found in Appendix A.

3.1 TW1-17

TW1-17 was drilled at the park site between December 11 and December 14, 2017. The test well is located more than 100 m from any lands that will be used for agriculture. Overburden consisting primarily of clay was present to a depth of 86 feet (26.2 m) below grade. Limestone was present from 86 feet (26.2 m) to 415 feet (126.5 m). The hole was advanced into shale and was completed at a depth of 418 feet (127.4 m) below grade. Water was encountered at depths of 90 feet, 278 feet and 344 feet (27.4 m, 84.7 m and 104.9 m) below grade. A 6inch (50 mm) steel casing was installed to a depth of 87 feet (26.5 m) below grade. The outside annulus was backfilled with bentonite grout from 87 feet (26.5 m) to 20 feet (6 m) and the remainder of the hole was filled to surface with bentonite Holeplug.

The well was initially pumped at a rate of 180 GPM (818 L/min) for 1 hour following completion. Water levels declined from 25.8 feet to 54.0 feet (7.9 m to 16.7 m) during the test with a resultant specific capacity of 6.4 IGPM/ft (1.6L/S/m). Typically, in bedrock wells pumps are installed within the well casing and as a result, the available drawdown is calculated as the static water level minus the depth of the casing. The calculated theoretical yield of TW1-17 using an available drawdown to the base of the casing is 362 IGPM (1646 L/min).

In order to provide a preliminary estimate of aquifer characteristics, the well was subsequently tested at rates of 4L/s (52 IGPM), 8 L/s (106 IGPM),11 L/s (145 IGPM) and 13 L/s (172 IGPM) with resultant Specific Capacities of 2.2 L/s/m, 1.8 L/s/m, 1.3 L/s/m and 1.3 L/s/m (9.3 IGPM/ft, 7.6 IGPM/ft, 5.2 IGPM/ft and 5.2 IGPM/ft). Graphs of water level responses during testing are found in Appendix B. At the lowest Specific Capacity, the theoretical yield to the bottom of the casing is 1451 L/min (319 IGPM). However, using the depth to the water bearing fracture at 104.9 mbgs (344 feet) results in a calculated theoretical yield of 125 L/s (1649 IGPM).

A water quality sample was collected and submitted to Maxxam Analytics for analysis of general chemistry parameters. The laboratory Certificate of Analysis is included in Appendix C. Water quality is generally good with nitrate/nitrite, iron and manganese below the laboratory detection limit. Hardness (300 mg/L) is elevated which is typical of bedrock water in the area.

3.2 TW2-17

TW2-17 was drilled at the water tower site between December 19, 2017 and January 3, 2018. The drilling took longer than as typical due to the Christmas shutdown and equipment problems. The well record is included in Appendix A. Overburden consisting primarily of clay was present to a depth of 88.9 feet (27.1 m) below grade. Limestone was present from 88.9 feet (27.1 m) to 418 feet (127.4 m). The hole was then advanced into shale and was completed at a depth of 428 feet (130.4m) below grade. Water was encountered from 95 feet to 318 feet (29 m to 97 m) below grade. A 6inch (50 mm) steel casing was installed to a depth of 94.8 feet (28.9m) below grade. The outside annulus was backfilled with bentonite Holeplug from surface to a depth of 7.6 m (25feet).

The well was initially pumped at a rate of 25 IGPM (114 L/min) for 1 hour following completion. Water levels declined from 69.2 feet to 93.0 feet (21.09 m to 28.35 m) during the test with a resultant specific capacity of 1.05 IGPM/ft (0.26L/S/m). The resultant theoretical yield using an available drawdown to the base of the casing is 26.9 IGPM (121 L/min). No further testing was completed at this location.

4.0 Recommendations

Based on the information above, Burnside recommends the following:

- A downhole flow profile be completed in TW1-17 to evaluate the percentage contribution from each of the “water found” zones.

- The flow profile data should be used to select the optimum depth of casing to maximize the available drawdown.
- The existing 6- inch (150mm) casing at TW1-17 should be removed and a 10- inch (250mm) diameter production well should be drilled.
- A long- term test should be completed in order to obtain a permit to take water (PTTW) for the new well.
- TW2-17 should be considered for use as a monitoring well.

R.J. Burnside & Associates Limited

DH:sgd

Enclosure(s) Figure 1–Well Locations
Appendix A-Well Water Records
Appendix B-Pumping Test Results
Appendix C-Laboratory Certificates of Analysis

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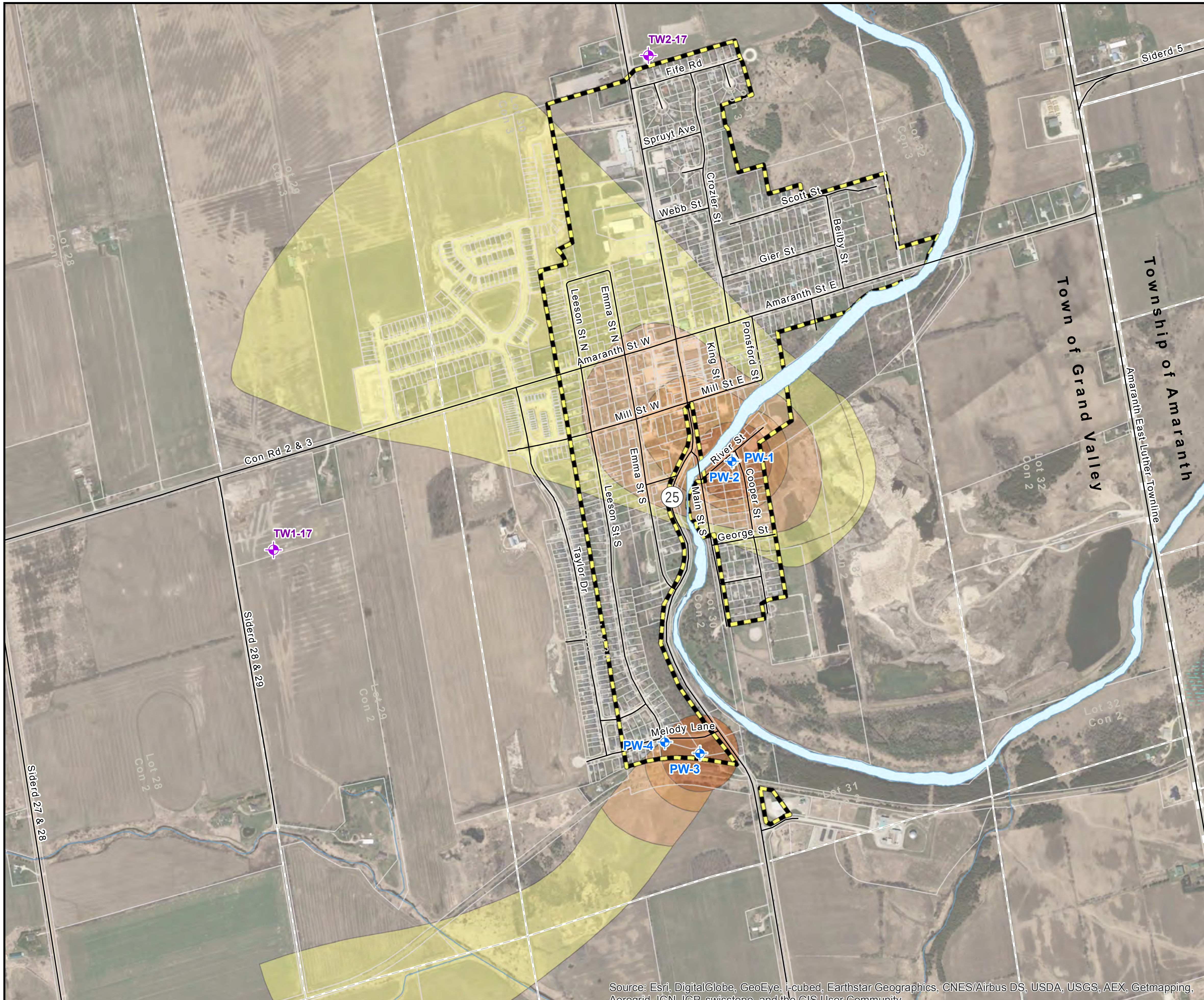
Figures



LEGEND

- New Test Well Location
- Production Well Location
- WHPA-A: 100m Buffer Zone (Pathogen Security/Prohibition Zone)
- WHPA-B: Pathogen Management Zone (0 to 2 Year Time of Travel)
- WHPA-C: DNAPL/Contaminant Protection Zone (2 to 5 Year Time of Travel)
- WHPA-D: Secondary Protection Zone (5 to 25 Year Time of Travel)
- Serviced Area
- Road
- Municipal Boundary
- Lot Boundary
- Trail
- Parcels
- Wetland
- Waterbody: Permanent
- Stream: Permanent

Sources:

1. Ministry of Natural Resources, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

Datum: North American 1983 CSRS

Coord. System: NAD 1983 CSRS UTM Zone 17N

N

0 100 200 300 400 500 600 700 800

Metres

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Client

TOWN OF GRAND VALLEY

Figure Title

HYDROGEOLOGY REVIEW

GRAND VALLEY WATER SUPPLY SYSTEM

Drawn	Checked	Date	Figure No.
CD	DH	2019/01/31	1
Scale		Project No.	
1:10,000		300040938	

File Path: \\Elmo\gis\Project\300\040938_GrandValley\2019 Hydrogeology Figures\040938 HG New Water Well Locations.mxd Print Date: 2019/01/31 Time: 10:24 AM

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Appendix A

Well Water Records

Ontario — Ministry of the Environment and Climate Change

Measurements recorded in: [X] Metric [ ] Imperial

Well Tag No. *(Place Sticker and/or Print Below)*

Tag#: A 222614

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	[ ] Well Constructed by Well Owner
Town of Grand Valley			

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
5 Main St W	Grand Valley	ON	L9W5S6	5199285652

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
173353 Main St N	East Luther	Pt 31	III

County/District/Municipality	City/Town/Village	Province	Postal Code
Dufferin	Grand Valley	Ontario	L9W5S6

UTM Coordinates Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83 17	554911	4861626		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
Brown	Clay	Stones		0	6.1
Grey	Clay	Stones		6.1	14.0
Brown	Clay	Stones		14.0	17.6
Grey	Clay	Stones		17.6	21.3
Brown	Clay	Stones		21.3	27.1
Grey	Limestone			27.1	57.0
Brown	Limestone			57.0	97.0
Grey	Limestone			97.0	127.4
Blue	Shale			127.4	130.4

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	7.6	Bentonite Hole Plug	0.2

Results of Well Yield Testing

After test of well yield, water was: [X] Clear and sand free [ ] Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft): 30

Pumping rate (l/min / GPM): 114

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 28.35

If flowing give rate (l/min / GPM):

Recommended pump depth (m/ft):

Recommended pump rate (l/min / GPM):

Well production (l/min / GPM):

Disinfected? [X] Yes [ ] No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	21.09	0	28.35
1	23.87	1	25.27
2	25.12	2	24.68
3	25.85	3	23.94
4	26.17	4	23.48
5	26.49	5	23.15
10	27.12	10	22.51
15	27.45	15	22.25
20	27.64	20	22.10
25	27.77	25	22.04
30	27.90	30	21.94
40	28.09	40	21.81
50	28.24	50	21.73
60	28.35	60	21.67

Method of Construction

[ ] Cable Tool [ ] Diamond [X] Rotary (Conventional) [ ] Jetting [ ] Rotary (Reverse) [ ] Driving [ ] Boring [ ] Digging [ ] Air percussion [ ] Other, specify

Well Use

[ ] Public [ ] Commercial [ ] Not used [ ] Domestic [ ] Municipal [ ] Dewatering [ ] Livestock [X] Test Hole [ ] Monitoring [ ] Irrigation [ ] Cooling & Air Conditioning [ ] Industrial [ ] Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
16.0	Steel	0.5	+0.6	28.9
15.6	Open Hole		28.9	130.4

Status of Well

[ ] Water Supply [ ] Replacement Well [X] Test Hole [ ] Recharge Well [ ] Dewatering Well [ ] Observation and/or Monitoring Hole [ ] Alteration (Construction) [ ] Abandoned, Insufficient Supply [ ] Abandoned, Poor Water Quality [ ] Abandoned, other, specify [ ] Other, specify

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

Water Details

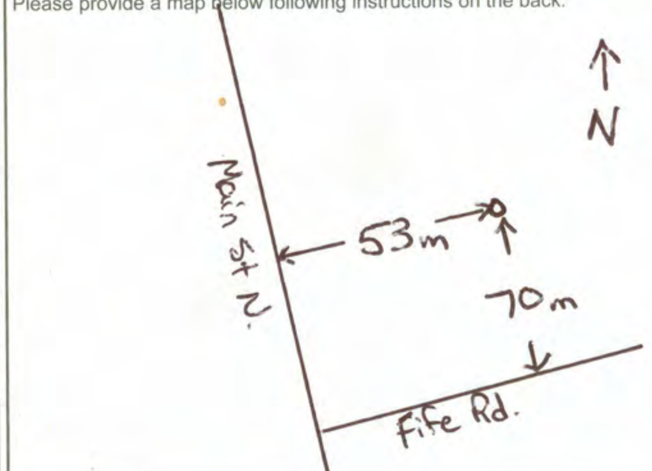
Water found at Depth	Kind of Water
29.0-97.0 (m/ft) [ ] Gas	[ ] Fresh [X] Untested [ ] Other, specify
(m/ft) [ ] Gas	[ ] Fresh [ ] Untested [ ] Other, specify
(m/ft) [ ] Gas	[ ] Fresh [ ] Untested [ ] Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	7.6	25.0
7.6	28.9	20.0
28.9	130.4	15.6

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Well Initiatives Limited	7221

Business Address (Street Number/Name)	Municipality
15 Townline	Orangeville

Province	Postal Code	Business E-mail Address
ON	L9W3R4	info@wellinitiatives.com

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
5198468289	Philipp Blek.

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
3922	[signature]	20180131

Well owner's information package delivered	Date Package Delivered	Date Work Completed
[ ] Yes [ ] No	YYYYMMDD	20180123

Ministry Use Only

Audit No. Z272638

Received

0506E (2014/11) **Ministry's Copy**

Ontario Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* A236803

Well Record

Regulation 903 Ontario Water Resources Act

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
Town of Grand Valley			

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
5 Main St. W	Grand Valley	Ont	L9W5S6	5199285652

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Side Rd-28-29 and Amaranth St	East Luther	29	2

County/District/Municipality	City/Town/Village	Province	Postal Code
Dufferin	Grandvalley	Ontario	L9W5S6

UTM Coordinates Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83 17	559394	4960344		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (ft) From	To
Br	clay	stones	Hard	0	6
grey	clay	stones	Hard	6	61
grey	clay		Hard	61	86
grey	Limestone		Med	86	157
Br	Limestone		Med	157	361
grey	Limestone		Med	361	415
Bl	shale		soft	415	418

Annular Space

Depth Set at (ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (ft³)
0	20	Holeplug	6.8
20	87	Bentonite	

Method of Construction

☐ Cable Tool ☐ Diamond ☑ Rotary (Conventional) ☐ Jetting ☐ Rotary (Reverse) ☐ Driving ☐ Boring ☐ Digging ☐ Air percussion ☐ Other, specify

Well Use

☐ Public ☐ Commercial ☐ Not used ☐ Domestic ☐ Municipal ☐ Dewatering ☐ Livestock ☑ Test Hole ☐ Monitoring ☐ Irrigation ☐ Cooling & Air Conditioning ☐ Industrial ☐ Other, specify

Construction Record - Casing

Inside Diameter (in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (in)	Depth (ft) From	To
6 5/8	steel	.188	+3	87
6 3/8	Open		87	418

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

Status of Well

☐ Water Supply ☐ Replacement Well ☑ Test Hole ☐ Recharge Well ☐ Dewatering Well ☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Results of Well Yield Testing

After test of well yield, water was: ☑ Clear and sand free ☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (ft): 100

Pumping rate (GPM): 180

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (ft): 54

If flowing give rate (l/min / GPM):

Recommended pump depth (m/ft):

Recommended pump rate (l/min / GPM):

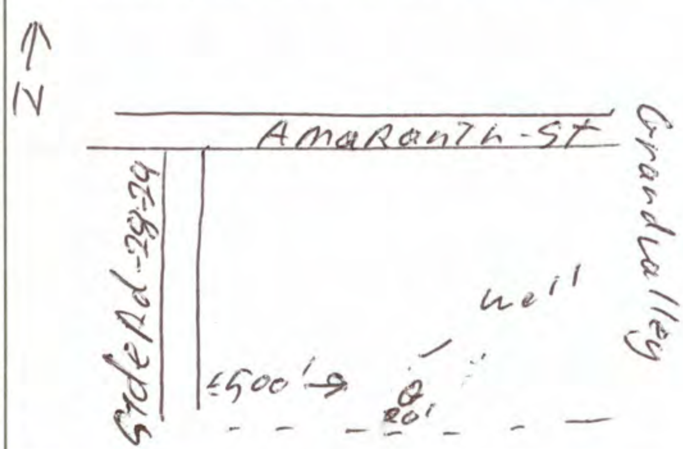
Well production (l/min / GPM):

Disinfected? ☑ Yes ☐ No

Draw Down Time (min)	Water Level (ft)	Recovery Time (min)	Water Level (ft)
Static Level	25.8		54.0
1	39.4	1	43.8
2	41.0	2	42.9
3	41.3	3	42.1
4	43.3	4	41.6
5	43.8	5	40.7
10	46.1	10	38.6
15	47.7	15	36.9
20	48.9	20	35.7
25	49.8	25	34.8
30	50.7	30	34.3
40	52.1	40	32.8
50	53.1	50	31.9
60	54.0	60	31.3

Map of Well Location

Please provide a map below following instructions on the back.



Water Details

Water found at Depth (ft)	Kind of Water
90	☐ Fresh ☑ Untested ☐ Gas ☐ Other, specify
278	☐ Fresh ☑ Untested ☐ Gas ☐ Other, specify
344	☐ Fresh ☑ Untested ☐ Gas ☐ Other, specify

Hole Diameter

Depth (ft) From	To	Diameter (in)
0	20	10
20	87	8 3/4
+3	418	6 3/8

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Well Initiatives	7221

Business Address (Street Number/Name)	Municipality
15 Townline Orangeville	

Province	Postal Code	Business E-mail Address
On	L9W3R4	info@wellinitiatives.com

Bus. Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
5199468299	Fenton Doug

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
T-2003	Doug Fenton	20180131

Comments:

Well owner's information package delivered ☐ Yes ☐ No

Date Package Delivered Y Y Y Y M M D D

Date Work Completed 20180115

Ministry Use Only Audit No. Z272635 Received

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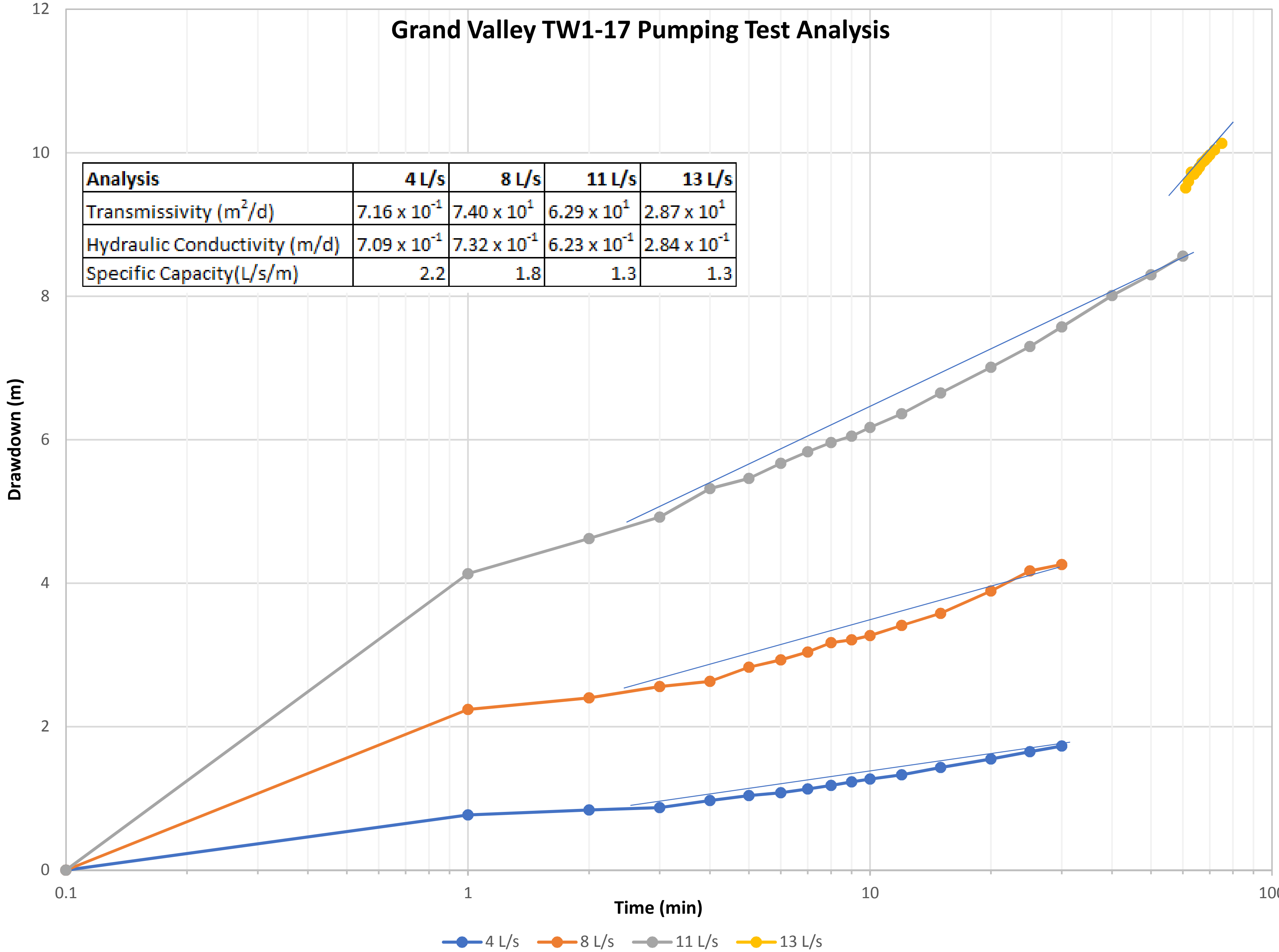
Appendix B

Pumping Test Results

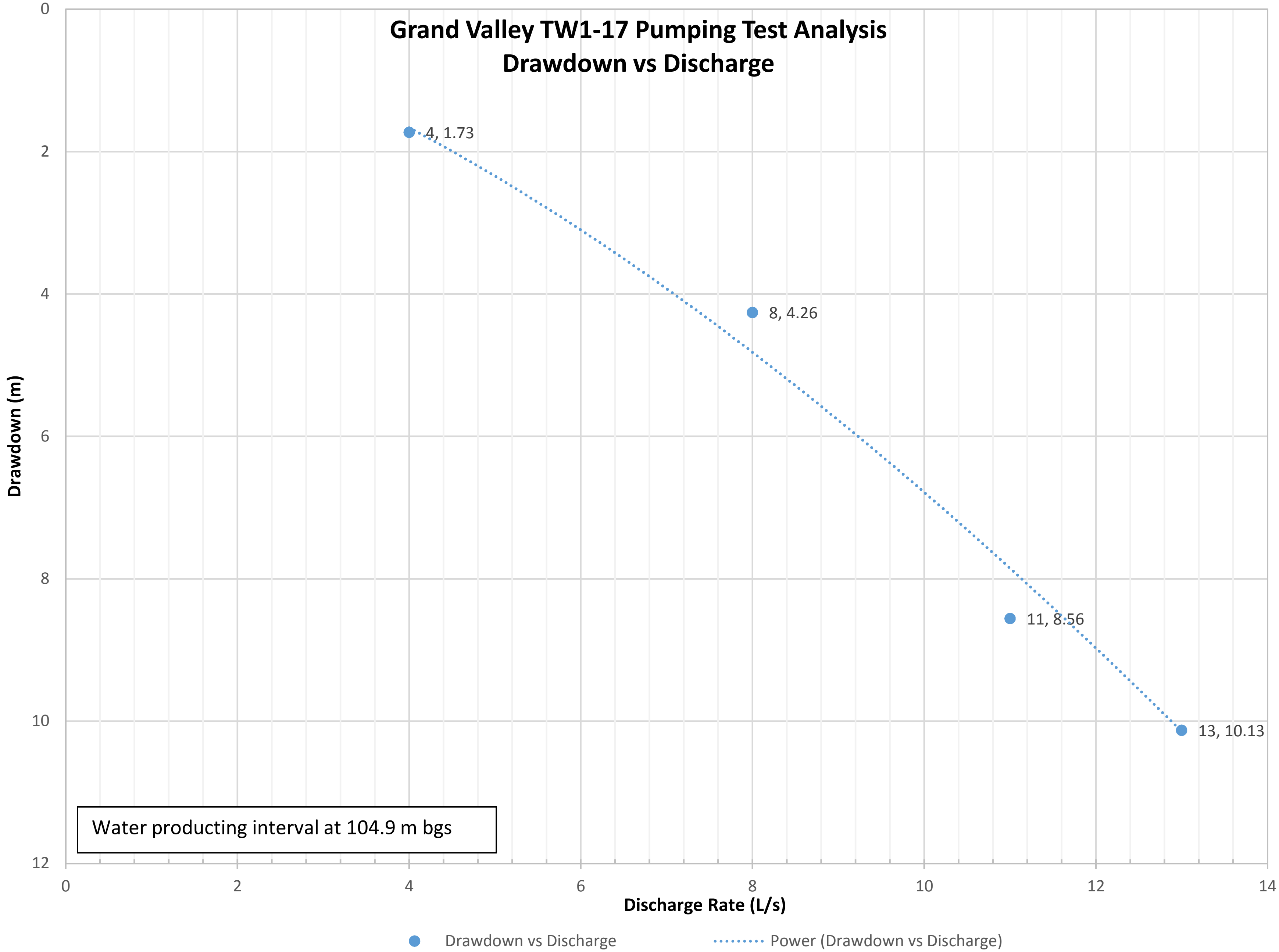
Appendix B



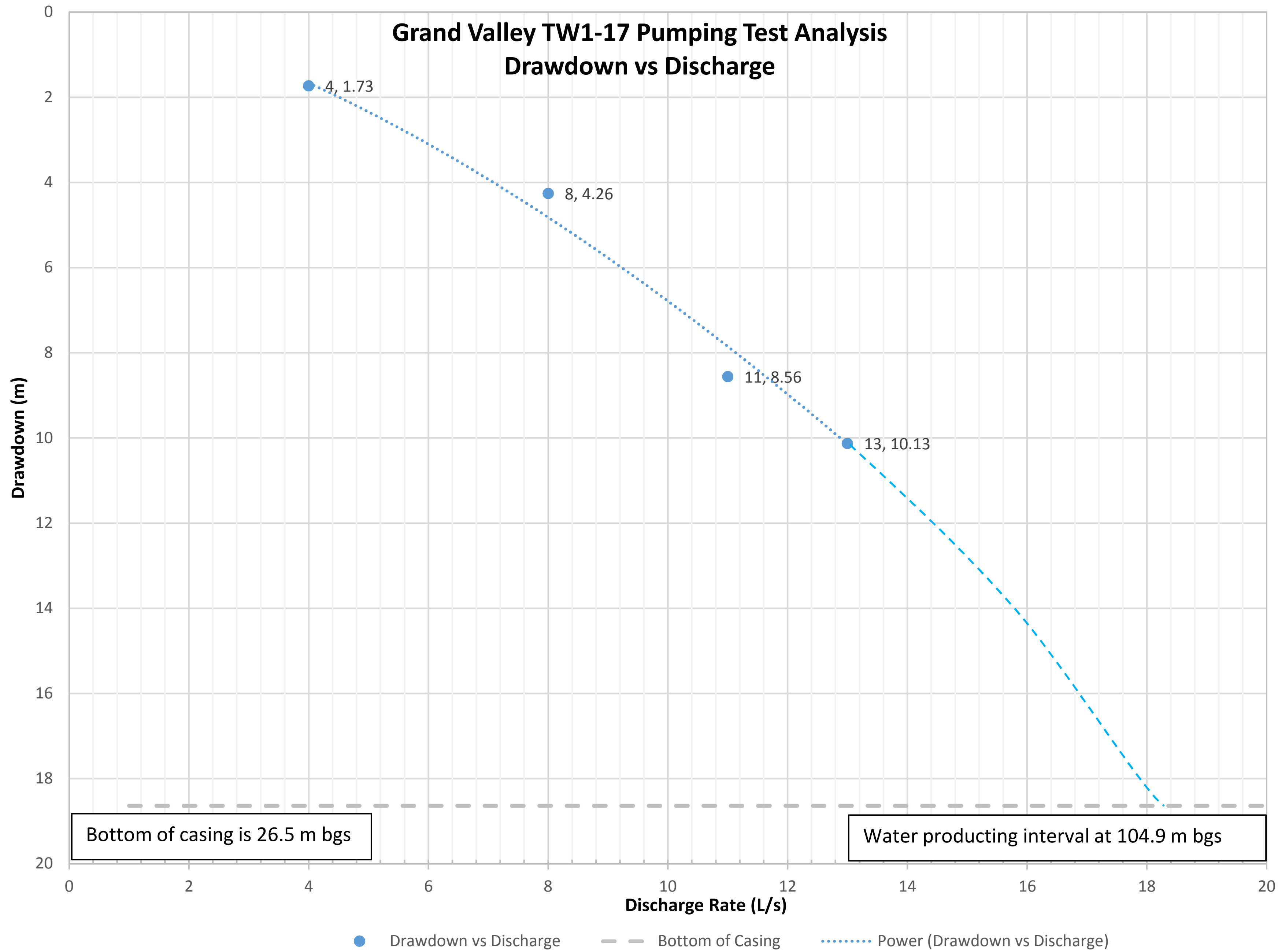
Analysis	4 L/s	8 L/s	11 L/s	13 L/s
Transmissivity (m^2/d)	7.16×10^{-1}	7.40×10^{1}	6.29×10^{1}	2.87×10^{1}
Hydraulic Conductivity (m/d)	7.09×10^{-1}	7.32×10^{-1}	6.23×10^{-1}	2.84×10^{-1}
Specific Capacity(L/s/m)	2.2	1.8	1.3	1.3

Burnside
File:P:\300040938 - Grand Valley Servicing Master Plan\Aquifer Analysis\Grand Valley TW1-17 Aquifer Test Data\Drawdown vs Time
Date:1/23/2018

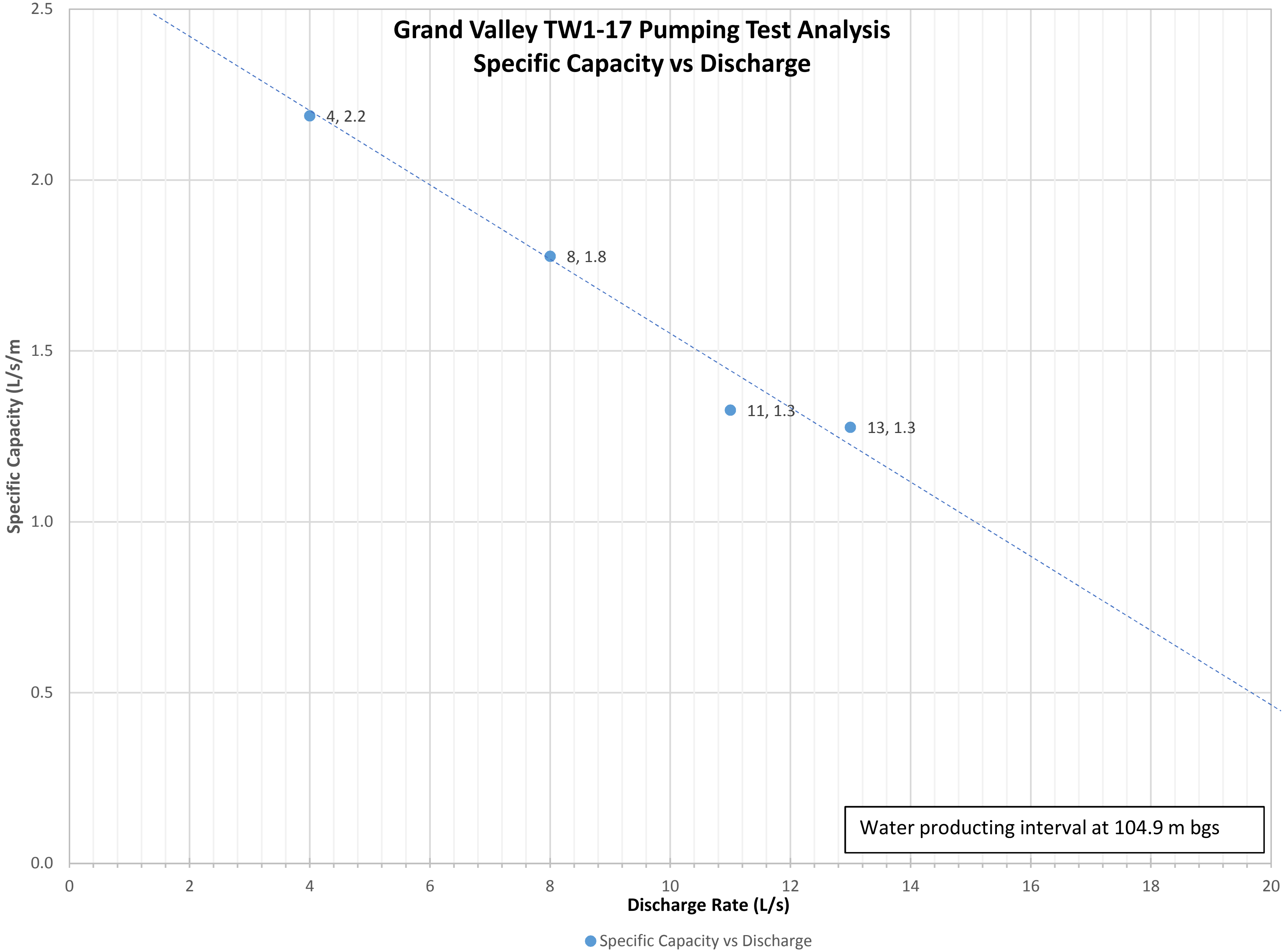
Town of Grand Valley
Grand Valley Master Plan EA
TW1-17 Pumping Test Analysis



Grand Valley TW1-17 Pumping Test Analysis
Drawdown vs Discharge
Drawdown (m)
Discharge Rate (L/s)
0
2
4
6
8
10
12
14
4, 1.73
8, 4.26
11, 8.56
13, 10.13
Water producting interval at 104.9 m bgs
Drawdown vs Discharge
Power (Drawdown vs Discharge)



Grand Valley TW1-17 Pumping Test Analysis
Drawdown vs Discharge
4, 1.73
8, 4.26
11, 8.56
13, 10.13
Drawdown (m)
Discharge Rate (L/s)
Bottom of casing is 26.5 m bgs
Water producing interval at 104.9 m bgs
Drawdown vs Discharge
Bottom of Casing
Power (Drawdown vs Discharge)
0
2
4
6
8
10
12
14
16
18
20



Burnside
File:P:\300040938 - Grand Valley Servicing Master Plan\Aquifer Analysis\Grand Valley TW1-17 Aquifer Test Data\Drawdown vs Specific Capacity
Date:1/23/2018

Town of Grand Valley
Grand Valley Master Plan EA
TW1-17 Pumping Test Analysis

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Appendix C

Laboratory Certificates of Analysis

Appendix C

Site Location: GRAND VALLEY
Your C.O.C. #: n/a

Attention: Dave Hopkins

R J Burnside & Associates Ltd
292 Speedvale Ave W
Unit 20
Guelph, ON
N1H 1C4

Report Date: 2018/01/25
Report #: R4950876
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B813292
Received: 2018/01/18, 16:11

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity	1	N/A	2018/01/22	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2018/01/23	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2018/01/22	CAM SOP-00463	EPA 325.2 m
Conductivity	1	N/A	2018/01/22	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2018/01/22	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	1	N/A	2018/01/25	CAM SOP 00102/00408/00447	SM 2340 B
Lab Filtered Metals Analysis by ICP	1	2018/01/23	2018/01/24	CAM SOP-00408	EPA 6010D m
Ion Balance (% Difference)	1	N/A	2018/01/25		
Anion and Cation Sum	1	N/A	2018/01/25		
Total Ammonia-N	1	N/A	2018/01/24	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	1	N/A	2018/01/23	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	1	N/A	2018/01/22	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	1	N/A	2018/01/22	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2018/01/25		
Sat. pH and Langelier Index (@ 4C)	1	N/A	2018/01/25		
Sulphate by Automated Colourimetry	1	N/A	2018/01/22	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	1	N/A	2018/01/25		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam’s profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Site Location: GRAND VALLEY
Your C.O.C. #: n/a

<u>Attention: Dave Hopkins</u>

R J Burnside & Associates Ltd
292 Speedvale Ave W
Unit 20
Guelph, ON
N1H 1C4

Report Date: 2018/01/25
Report #: R4950876
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B813292
Received: 2018/01/18, 16:11

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ashton Gibson, Project Manager
Email: AGibson@maxxam.ca
Phone# (905) 817-5700
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B813292
Report Date: 2018/01/25

R J Burnside & Associates Ltd
Site Location: GRAND VALLEY
Sampler Initials: WIL

RESULTS OF ANALYSES OF WATER

Maxxam ID		FYA606		
Sampling Date		2018/01/17 14:25		
COC Number		n/a		
	UNITS	WELL #A236803	RDL	QC Batch
Calculated Parameters				
Anion Sum	me/L	7.23	N/A	5360844
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	220	1.0	5360840
Calculated TDS	mg/L	400	1.0	5360847
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.7	1.0	5360840
Cation Sum	me/L	7.23	N/A	5360844
Hardness (CaCO3)	mg/L	300	1.0	5360842
Ion Balance (% Difference)	%	0.0100	N/A	5360843
Langelier Index (@ 20C)	N/A	0.645		5360845
Langelier Index (@ 4C)	N/A	0.397		5360846
Saturation pH (@ 20C)	N/A	7.28		5360845
Saturation pH (@ 4C)	N/A	7.53		5360846
Inorganics				
Total Ammonia-N	mg/L	0.17	0.050	5363552
Conductivity	umho/cm	690	1.0	5362762
Dissolved Organic Carbon	mg/L	0.54	0.50	5362780
Orthophosphate (P)	mg/L	ND	0.010	5362754
pH	pH	7.92		5362763
Dissolved Sulphate (SO4)	mg/L	110	1.0	5362753
Alkalinity (Total as CaCO3)	mg/L	220	1.0	5362760
Dissolved Chloride (Cl)	mg/L	21	1.0	5362752
Nitrite (N)	mg/L	ND	0.010	5362744
Nitrate (N)	mg/L	ND	0.10	5362744
Nitrate + Nitrite (N)	mg/L	ND	0.10	5362744

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B813292
Report Date: 2018/01/25

R J Burnside & Associates Ltd
Site Location: GRAND VALLEY
Sampler Initials: WIL

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		FYA606	FYA606		
Sampling Date		2018/01/17 14:25	2018/01/17 14:25		
COC Number		n/a	n/a		
	UNITS	**WELL #A236803**	**WELL #A236803 Lab-Dup**	**RDL**	**QC Batch**
Metals					
Dissolved Calcium (Ca)	mg/L	66	66	0.05	5365670
Dissolved Copper (Cu)	mg/L	ND	ND	0.02	5365670
Dissolved Iron (Fe)	mg/L	ND	ND	0.02	5365670
Dissolved Magnesium (Mg)	mg/L	33	33	0.05	5365670
Dissolved Manganese (Mn)	mg/L	ND	ND	0.01	5365670
Dissolved Potassium (K)	mg/L	2	2	1	5365670
Dissolved Sodium (Na)	mg/L	27	27	0.5	5365670
Dissolved Zinc (Zn)	mg/L	0.01	0.01	0.01	5365670

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B813292
Report Date: 2018/01/25

R J Burnside & Associates Ltd
Site Location: GRAND VALLEY
Sampler Initials: WIL

TEST SUMMARY

Maxxam ID: FYA606
Sample ID: WELL #A236803
Matrix: Water

Collected: 2018/01/17
Shipped:
Received: 2018/01/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5362760	N/A	2018/01/22	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5360840	N/A	2018/01/23	Automated Statchk
Chloride by Automated Colourimetry	KONE	5362752	N/A	2018/01/22	Alina Dobreanu
Conductivity	AT	5362762	N/A	2018/01/22	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5362780	N/A	2018/01/22	Nimarta Singh
Hardness (calculated as CaCO3)		5360842	N/A	2018/01/25	Automated Statchk
Lab Filtered Metals Analysis by ICP	ICP	5365670	2018/01/23	2018/01/24	Azita Fazaeli
Ion Balance (% Difference)	CALC	5360843	N/A	2018/01/25	Automated Statchk
Anion and Cation Sum	CALC	5360844	N/A	2018/01/25	Automated Statchk
Total Ammonia-N	LACH/NH4	5363552	N/A	2018/01/24	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5362744	N/A	2018/01/23	Chandra Nandlal
pH	AT	5362763	N/A	2018/01/22	Surinder Rai
Orthophosphate	KONE	5362754	N/A	2018/01/22	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5360845	N/A	2018/01/25	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5360846	N/A	2018/01/25	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5362753	N/A	2018/01/22	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	5360847	N/A	2018/01/25	Automated Statchk

Maxxam ID: FYA606 Dup
Sample ID: WELL #A236803
Matrix: Water

Collected: 2018/01/17
Shipped:
Received: 2018/01/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Lab Filtered Metals Analysis by ICP	ICP	5365670	2018/01/23	2018/01/24	Azita Fazaeli

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GENERAL COMMENTS

Results relate only to the items tested.

Maxxam Job #: B813292
Report Date: 2018/01/25

R J Burnside & Associates Ltd
Site Location: GRAND VALLEY
Sampler Initials: WIL

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5362744	C_N	Matrix Spike	Nitrite (N)	2018/01/23		NC	%	80 - 120
			Nitrate (N)	2018/01/23		104	%	80 - 120
5362744	C_N	Spiked Blank	Nitrite (N)	2018/01/23		99	%	80 - 120
			Nitrate (N)	2018/01/23		105	%	80 - 120
5362744	C_N	Method Blank	Nitrite (N)	2018/01/23	ND, RDL=0.010		mg/L	
			Nitrate (N)	2018/01/23	ND, RDL=0.10		mg/L	
5362744	C_N	RPD	Nitrite (N)	2018/01/23	0.046		%	20
			Nitrate (N)	2018/01/23	0.87		%	20
5362752	ADB	Matrix Spike	Dissolved Chloride (Cl)	2018/01/22		91	%	80 - 120
5362752	ADB	Spiked Blank	Dissolved Chloride (Cl)	2018/01/22		102	%	80 - 120
5362752	ADB	Method Blank	Dissolved Chloride (Cl)	2018/01/22	ND, RDL=1.0		mg/L	
5362752	ADB	RPD	Dissolved Chloride (Cl)	2018/01/22	0.30		%	20
5362753	DRM	Matrix Spike	Dissolved Sulphate (SO4)	2018/01/22		116	%	75 - 125
5362753	DRM	Spiked Blank	Dissolved Sulphate (SO4)	2018/01/22		104	%	80 - 120
5362753	DRM	Method Blank	Dissolved Sulphate (SO4)	2018/01/22	ND, RDL=1.0		mg/L	
5362753	DRM	RPD	Dissolved Sulphate (SO4)	2018/01/22	7.3		%	20
5362754	ADB	Matrix Spike	Orthophosphate (P)	2018/01/22		106	%	75 - 125
5362754	ADB	Spiked Blank	Orthophosphate (P)	2018/01/22		100	%	80 - 120
5362754	ADB	Method Blank	Orthophosphate (P)	2018/01/22	ND, RDL=0.010		mg/L	
5362754	ADB	RPD	Orthophosphate (P)	2018/01/22	4.4		%	25
5362760	SAU	Spiked Blank	Alkalinity (Total as CaCO3)	2018/01/22		97	%	85 - 115
5362760	SAU	Method Blank	Alkalinity (Total as CaCO3)	2018/01/22	ND, RDL=1.0		mg/L	
5362760	SAU	RPD	Alkalinity (Total as CaCO3)	2018/01/22	2.7		%	20
5362762	SAU	Spiked Blank	Conductivity	2018/01/22		100	%	85 - 115
5362762	SAU	Method Blank	Conductivity	2018/01/22	ND, RDL=1.0		umho/cm	
5362762	SAU	RPD	Conductivity	2018/01/22	0.24		%	25
5362763	SAU	Spiked Blank	pH	2018/01/22		101	%	98 - 103
5362763	SAU	RPD	pH	2018/01/22	0.78		%	N/A
5362780	NS3	Matrix Spike	Dissolved Organic Carbon	2018/01/22		92	%	80 - 120
5362780	NS3	Spiked Blank	Dissolved Organic Carbon	2018/01/22		95	%	80 - 120
5362780	NS3	Method Blank	Dissolved Organic Carbon	2018/01/22	ND, RDL=0.50		mg/L	
5362780	NS3	RPD	Dissolved Organic Carbon	2018/01/22	0.054		%	20
5363552	COP	Matrix Spike	Total Ammonia-N	2018/01/24		98	%	75 - 125
5363552	COP	Spiked Blank	Total Ammonia-N	2018/01/24		99	%	80 - 120
5363552	COP	Method Blank	Total Ammonia-N	2018/01/24	ND, RDL=0.050		mg/L	
5363552	COP	RPD	Total Ammonia-N	2018/01/24	5.9		%	20
5365670	AFZ	Matrix Spike [FYA606-01]	Dissolved Calcium (Ca)	2018/01/24		NC	%	80 - 120
			Dissolved Copper (Cu)	2018/01/24		104	%	80 - 120
			Dissolved Iron (Fe)	2018/01/24		104	%	80 - 120
			Dissolved Magnesium (Mg)	2018/01/24		NC	%	80 - 120
			Dissolved Manganese (Mn)	2018/01/24		104	%	80 - 120
			Dissolved Potassium (K)	2018/01/24		105	%	80 - 120
			Dissolved Sodium (Na)	2018/01/24		NC	%	80 - 120
			Dissolved Zinc (Zn)	2018/01/24		106	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5365670	AFZ	Spiked Blank	Dissolved Calcium (Ca)	2018/01/24		100	%	80 - 120
			Dissolved Copper (Cu)	2018/01/24		100	%	80 - 120
			Dissolved Iron (Fe)	2018/01/24		100	%	80 - 120
			Dissolved Magnesium (Mg)	2018/01/24		98	%	80 - 120
			Dissolved Manganese (Mn)	2018/01/24		101	%	80 - 120
			Dissolved Potassium (K)	2018/01/24		100	%	80 - 120
			Dissolved Sodium (Na)	2018/01/24		101	%	80 - 120
			Dissolved Zinc (Zn)	2018/01/24		103	%	80 - 120
5365670	AFZ	Method Blank	Dissolved Calcium (Ca)	2018/01/24	ND, RDL=0.05		mg/L	
			Dissolved Copper (Cu)	2018/01/24	ND, RDL=0.02		mg/L	
			Dissolved Iron (Fe)	2018/01/24	ND, RDL=0.02		mg/L	
			Dissolved Magnesium (Mg)	2018/01/24	ND, RDL=0.05		mg/L	
			Dissolved Manganese (Mn)	2018/01/24	ND, RDL=0.01		mg/L	
			Dissolved Potassium (K)	2018/01/24	ND,RDL=1		mg/L	
			Dissolved Sodium (Na)	2018/01/24	ND, RDL=0.5		mg/L	
			Dissolved Zinc (Zn)	2018/01/24	ND, RDL=0.01		mg/L	
5365670	AFZ	RPD [FYA606-01]	Dissolved Calcium (Ca)	2018/01/24	0.091		%	25
			Dissolved Copper (Cu)	2018/01/24	NC		%	25
			Dissolved Iron (Fe)	2018/01/24	NC		%	25
			Dissolved Magnesium (Mg)	2018/01/24	0.40		%	25
			Dissolved Manganese (Mn)	2018/01/24	NC		%	25
			Dissolved Potassium (K)	2018/01/24	0.58		%	25
			Dissolved Sodium (Na)	2018/01/24	0.30		%	25
			Dissolved Zinc (Zn)	2018/01/24	4.0		%	25

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix K

Blue Sky Energy Engineering & Consulting Inc.
Proposed Interim Effluent Requirements for the Grand Valley WWTP Technical Memorandum
& Associated Email Correspondence with the MECP

Memorandum

Blue Sky Energy Engineering & Consulting Inc. | Profound Engineering

To: Barb Slattery, EA Coordinator, MECP

CC: Mohammad Sajjad Khan, Ph.D., P.Eng., Surface Water Specialist, MECP
Jane Wilson, Town of Grand Valley
Gord Feniak, R.J. Burnside & Associates Ltd.

From: Melody Johnson, M.A.Sc., P.Eng. and Mike Hulley, Ph.D., P.Eng.

Date: February 6, 2019

Subject Proposed Interim Effluent Requirements for the Grand Valley WWTP

---

1. Introduction

R.J. Burnside & Associates Ltd. (RJB) have been retained by the Town of Grand Valley (Town) to complete a water supply and sewage servicing Master Plan (MP). As part of the MP study, an assimilative capacity study (ACS) was completed to determine effluent requirements for the Grand Valley WWTP upgraded and expanded to meet long-term servicing needs. Effluent limits for a future expansion to a rated capacity of 2,131 m^3/d were approved by MECP on December 18, 2018.

In addition to identifying the preferred solution to provide long-term wastewater servicing in the Town, the MP also identified a preferred short-term solution to meet interim growth pressures within the community. The short-term solution involves the construction of an equalization tank at the WWTP to address peak flow capacity limitations, which will allow the liquid treatment train to be re-rated to an ADF capacity of 1,555 m^3/d.

It is therefore necessary to confirm effluent requirements for the interim re-rated capacity of 1,555 m^3/d. The objectives of this memorandum are to summarize and provide the rationale for the selection of proposed effluent objectives and limits for the interim capacity increase of the Grand Valley WWTP to meet short-term wastewater servicing needs.

2. Development of Proposed Interim Effluent Requirements

2.1 Approved Effluent Limits for an ADF of 2,131 m^3/d.

Table 1 presents the approved effluent objectives and limits for the Grand Valley WWTP when operating at an ADF capacity of 2,131 m^3/d. The email approval of these effluent requirements, received from MECP on December 18, 2018, is included in Attachment 1.

Table 1 – Approved Effluent Limits for an ADF of 2,131 m^3/d

Effluent Parameters	Effluent Limits (1)		Effluent Objectives
	Average Concentrations (mg/L)	Average Loadings (kg/d)	Average Concentrations (mg/L)
$cBOD_5$	10.0	21.3	8.0
TSS	10.0	21.3	8.0
TP	0.10	0.21	0.09
TAN			
Winter (Dec 1 – Mar 31)	4.0	8.52	3.0
Spring (Apr 1 – May 31)	1.0	2.13	0.8
Summer (Jun 1 – Sep 31)	0.7	1.49	0.5
Fall (Oct 1 – Nov 30)	1.0	2.13	0.8
E. coli (2)	200 cfu/100 mL	n/a	100 cfu/100 mL
pH (3)	6.0 – 9.5		6.5 – 8.5

Notes:

1. All limits based on monthly average values, unless otherwise noted.
2. Based on monthly geometric mean density.
3. Any single grab.

2.2 Proposed Interim Effluent Requirements

For the purposes of developing effluent requirements for the Grand Valley WWTP at the interim capacity of 1,555 m^3/d, the following approach was used:

- The approved $cBOD_5$, TSS, and TAN concentration limits and objectives for an ADF of 2,131 m^3/d are equal to those specified in the existing Certificate of Approval (CofA) No. 9706-7KWQ57 for the current rated capacity of 1,244 m^3/d. Therefore, the same concentration limits and objectives are proposed for the interim capacity of 1,555 m^3/d, with loading limits calculated accordingly.
- The approved TP loading limit of 0.21 kg/d (Table 1) was used to develop a proposed interim TP concentration limit of 0.135 mg/L (Table 2). This is less than the current ECA concentration limit of 0.15 mg/L, and slightly higher than the approved concentration limit of 0.10 mg/L for an ADF of 2,131 m^3/d. The CORMIX model that was developed and validated using an analytical solution as part of the ACS study was used to estimate the downstream TP concentrations at the proposed interim TP limit and ADF. Modelling output is included in Attachment 2, and shows:
  - The mixing zone length and shape are essentially identical to those modelled for the approved future TP limit of 0.10 mg/L at 2,131 m^3/d; and,

- While TP concentrations are higher in the near field, the far field (>500 m) and fully mixed concentrations are consistent with those approved for the future TP limit of 0.10 mg/L at 2,131 m^3/d.

- The objectives and limits for monthly geometric mean density for E. coli and single grab sample pH that have been approved for an ADF of 2,131 m^3/d are also being proposed for the interim capacity of 1,555 m^3/d.

In summary, the proposed effluent limits for the interim ADF capacity of 1,555 m^3/d result in loading limits that are equivalent to or less than those approved for the ultimate ADF capacity of 2,131 m^3/d. The proposed effluent limits and objectives are presented in Table 2.

Table 2 – Proposed Effluent Requirements for an ADF of 1,555 m^3/d

Effluent Parameters	Effluent Limits [1]		Effluent Objectives
	Average Concentrations (mg/L)	Average Loadings (kg/d)	Average Concentrations (mg/L)
$cBOD_5$	10.0	15.6	8.0
TSS	10.0	15.6	8.0
TP	0.135	0.21	0.11
TAN			
Winter (Dec 1 – Mar 31)	4.0	6.22	3.0
Spring (Apr 1 – May 31)	1.0	1.56	0.8
Summer (Jun 1 – Sep 31)	0.7	1.09	0.5
Fall (Oct 1 – Nov 30)	1.0	2.56	0.8
E. coli [2]	200 cfu/100 mL	n/a	100 cfu/100 mL
pH [3]	6.0 – 9.5		6.5 – 8.5

Notes:
1. All limits based on monthly average values, unless otherwise noted.
2. Based on monthly geometric mean density.
3. Any single grab.

3. Closure

Effluent requirements have been proposed for an interim capacity increase of the Grand Valley WWTP to 1,555 m^3/d. The proposed limits and objectives were developed based on the previously approved effluent limits and objectives for the ultimate WWTP expansion to 2,131 m^3/d.

Attachment A

MECP Approval of Effluent Requirements for the Grand Valley WWTP Operating at an Average Day Flow of 2,131 m^3/d

Melody Johnson

From: Melody Johnson
Sent: February 6, 2019 1:11 PM
To: Melody Johnson
Subject: FW: Town of Grand Valley Assimilative Capacity Study (Dec 18, 2018 report)

From: Khan, Mohammad Sajjad (MECP) <mohammad.khan@ontario.ca>
Sent: December-18-18 3:47 PM
To: rw2 <robertwalton@xplornet.ca>
Cc: Slattery, Barbara (MECP) <barbara.slattery@ontario.ca>; Jane Wilson <jwilson@townofgrandvalley.ca>; Michael Hulley <Michael.Hulley@rmc.ca>; Jeff Paznar (Jeff.Paznar@rjburnside.com) <Jeff.Paznar@rjburnside.com>; Serwotka, Carola (MECP) <Carola.Serwotka@ontario.ca>; Mark Anderson (manderson@grandriver.ca) <manderson@grandriver.ca>
Subject: Town of Grand Valley Assimilative Capacity Study (Dec 18, 2018 report)

Hello Rob,

I have completed my review of the revised assimilative capacity study report of December 18, 2018, and all supporting information. The study was found satisfactory. The following effluent criteria at an average daily discharge rate of 2,131 m^3/d are acceptable to me.

Effluent Parameters	Effluent Limits[1]		Effluent Objectives
	Average concentrations (mg/L)	Average loadings (kg/d)	Average concentrations (mg/L)
$cBOD_5$	10.0	21.3	8.0
Total Suspended Solids	10.0	21.3	8.0
Total Phosphorus	0.10	0.21	0.09
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	8.52	3.0
Spring (Apr 1 – May 31)	1.0	2.13	0.8
Summer (Jun 1 – Sep 31)	0.7	1.49	0.5
Fall (Oct 1 – Nov 30)	1.0	2.13	0.8
E coli	200 cfu/100 mL[2]	N/A	100 cfu/100 mL
pH	6.0-9.5		6.5-8.5

Notes:
1. Based on monthly average
2. Based on monthly geometric mean density

With regards,

Sajjad

==
Mohammad Sajjad Khan, Ph.D., P.Eng.
Surface Water Specialist, West Central Region
Ontario Ministry of the Environment, Coservation and Parks
119 King Street West, 12th Floor, Hamilton ON L8P 4Y7
Tel: 905 521-7607; Fax: 905 521-7820
E-mail: mohammad.khan@ontario.ca
==

From: rw2 [mailto:robertwalton@xplornet.ca]
Sent: December 17, 2018 12:06 PM
To: Khan, Mohammad Sajjad (MECP)
Cc: Slattery, Barbara (MECP); Jane Wilson
Subject: Town of Grand Valley Assimilative Capacity Study

Hi again Sajjad,

We had a project planning meeting this morning. The plan was to have the Master Plan EA completed for Council Approval on January 8. We have adjusted this date to January 22 but it is still important that we get your response asap. As per you previous email you suggested the end of the year and this will work for our revised schedule if there are not a lot of comments.

Please keep in touch if you have questions or if you anticipate any change in schedule.

Yours truly,

Robert Walton, P.Eng.
rw2 Engineering Ltd.
226-234-8067

Sent from my BlackBerry — the most secure mobile device — via the TELUS Network

Attachment B

Updated CORMIX Modelling for an Average Day Flow of 1,555 m^3/d

Table B.1 – Comparison of CORMIX Results – Peak TP Concentrations in the Mixing Zone Downstream of Grand Valley WWTP at Proposed Interim and Approved Ultimate Effluent Limits

Distance Down Stream (m)	Proposed Interim Effluent Limits ADF = 1555 m^3/d – TP = 0.135 mg/L		Approved Ultimate Effluent Limits ADF = 2131 m^3/d – TP = 0.10 mg/L	
	Peak TP in Mixing Zone (mg/L)	Mixing Zone Width (m)	Peak TP in Mixing Zone (mg/L)	Mixing Zone Width (m)
0	0.135	0.45	0.100	0.45
10	0.110	0.52	0.086	0.57
25	0.085	2.24	0.078	2.2
50	0.072	3.77	0.068	3.73
100	0.066	5.85	0.063	5.79
200	0.062	8.52	0.060	8.44
300	0.061	10.54	0.059	10.44
500	0.059	13.76	0.058	13.64
750	0.058	16.92	0.057	16.72
1000	0.058	19.57	0.057	19.43
1050	0.057	20	0.057	20

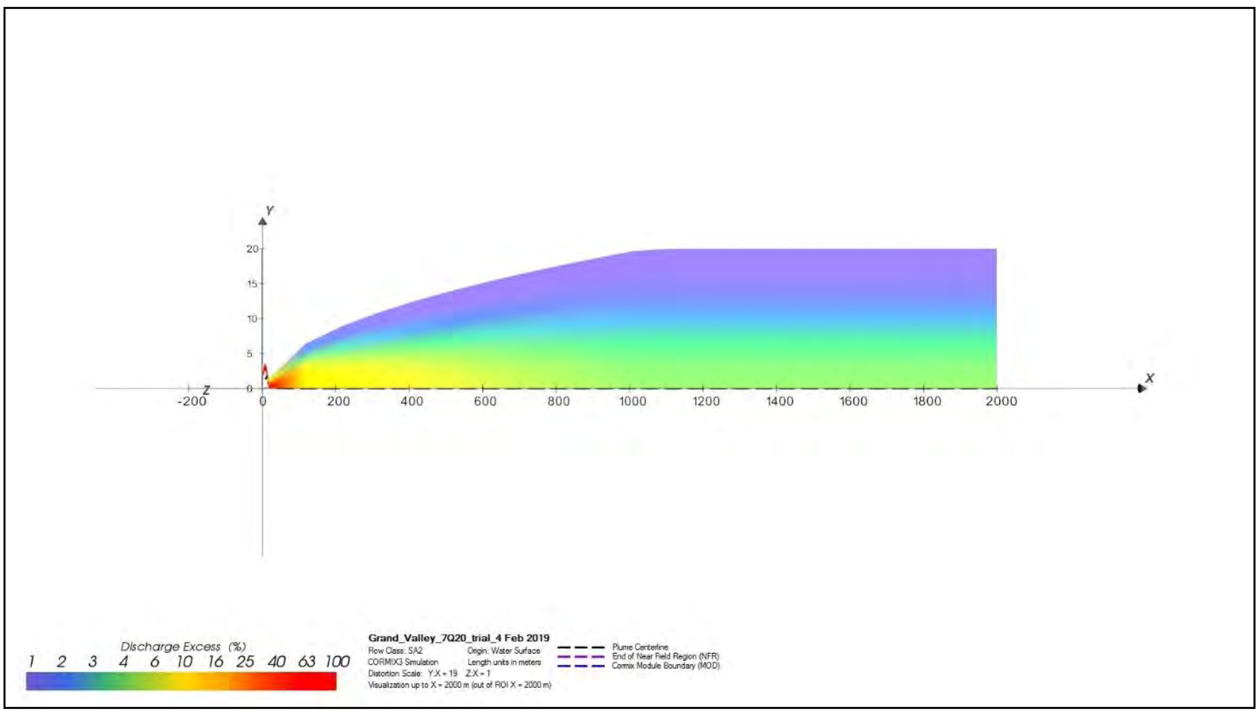

Figure B.1 – CORMIX Results Downstream of the Grand Valley WWTP at the Interim ADF of 1,555 m^3/d and Proposed TP Limit of 0.135 mg/L

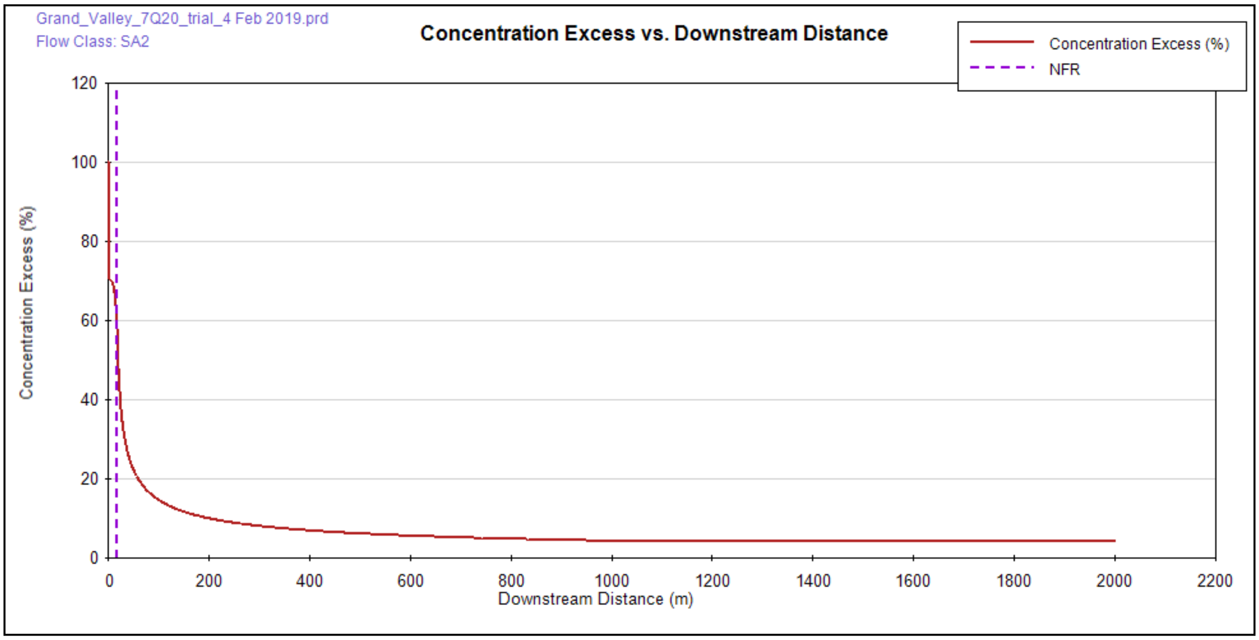

Figure B.2 – Concentration Excess of TP vs. Downstream Distance from the Grand Valley WWTP at the Interim ADF of 1,555 m^3/d and Proposed TP Limit of 0.135 mg/L

Ministry of the Environment, Conservation and Parks
Drinking Water and Environmental Compliance Division
West Central Region

119 King Street West
12th Floor
Hamilton, Ontario L8P 4Y7
Tel.: 905 521-7640
Fax: 905 521-7820

Ministère de l'Environnement de la Protection de la nature et des Parcs
Division de la conformité en matière d'eau potable et d'environnement
Direction régionale du Centre-Ouest

119 rue King Ouest
12e étage
Hamilton (Ontario) L8P 4Y7
Tél. : 905 521-7640
Téléc. : 905 521-7820

Ontario

February 8, 2019

Ms. Melody Johnson
BLUE SKY Energy Engineering & Consulting Inc.

Dear Ms. Johnson:

RE: Interim effluent objectives and limits for the Grand Valley WWTP

As requested, Sajjad Khan reviewed your February 6th memo. MECP recently approved effluent criteria for a rated capacity of 2,131 m^3/d to meet longterm wastewater servicing needs. To meet interim growth pressures within the community, the Town is proposing to construct an equalization tank on-site at the WWTP to address peak flow capacity limitations, which will allow the liquid treatment train to be re-rated to an average daily flow capacity of 1,555 m^3/d. You have proposed effluent criteria for the interim re-rated capacity of 1,555 m^3/d for MECP's consideration.

The supporting calculations and rationales for the effluent criteria proposed for an interim capacity increase, have been reviewed and found to be satisfactory. The following effluent criteria for a rated capacity of 1,555 m^3/d are acceptable. Please note there was an error in loading calculation for total ammonia nitrogen for Fall, the correct value should be 1.56 kg/d instead of 2.56 kg/d. The table below reflects the correct number.

Effluent Parameters	Effluent Limits(1)		Effluent Objectives
	Average concentrations (mg/L)	Average loadings (kg/d)	Average concentrations (mg/L)
$cBOD_5$	10.0	15.6	8.0
Total Suspended Solids	10.0	15.6	8.0
Total Phosphorus	0.135	0.21	0.11
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	6.22	3.0
Spring (Apr 1 – May 31)	1.0	1.56	0.8
Summer (Jun 1 – Sep 31)	0.7	1.09	0.5
Fall (Oct 1 – Nov 30)	1.0	1.56	0.8
E coli (2)	200 cfu/100 mL	N/A	100 cfu/100 mL
pH (3)	6.0-9.5		6.5-8.5

Notes:
(1) Based on monthly average, unless otherwise noted
(2) Based on monthly geometric mean density
(3) Any single grab sample

Should you require any clarifications, please do not hesitate to contact Sajjad directly either by calling (905) 521-7607 or by email at mohammad.khan@ontario.ca

With regards,

Barbara Slattery
EA/Planning Coordinator

Cc Carola Serwatka, GDO
Mark Anderson, GRCA

Appendix L

Profound Engineering's December 2018 Technical Memorandum

Water Supply and Sewage Servicing Master Plan: Assimilative Capacity Assessment

Shannon Glassford

From: Jeff Paznar
Sent: Monday, January 21, 2019 2:44 PM
To: Shannon Glassford
Subject: FW: Town of Grand Valley Assimilative Capacity Study (Dec 18, 2018 report)

From: Khan, Mohammad Sajjad (MECP) <mohammad.khan@ontario.ca>
Sent: Tuesday, December 18, 2018 3:47 PM
To: rw2 <robertwalton@xplornet.ca>
Cc: Slattery, Barbara (MECP) <barbara.slattery@ontario.ca>; Jane Wilson <jwilson@townofgrandvalley.ca>; Michael Hulley (Michael.Hulley@rmc.ca) <Michael.Hulley@rmc.ca>; Jeff Paznar <Jeff.Paznar@rjburnside.com>; Serwotka, Carola (MECP) <Carola.Serwotka@ontario.ca>; Mark Anderson (manderson@grandriver.ca) <manderson@grandriver.ca>
Subject: Town of Grand Valley Assimilative Capacity Study (Dec 18, 2018 report)

Hello Rob,

I have completed my review of the revised assimilative capacity study report of December 18, 2018, and all supporting information. The study was found satisfactory. The following effluent criteria at an average daily discharge rate of 2,131 m^3/d are acceptable to me.

Effluent Parameters	Effluent Limits[1]		Effluent Objectives
	Average concentrations (mg/L)	Average loadings (kg/d)	Average concentrations (mg/L)
$cBOD_5$	10.0	21.3	8.0
Total Suspended Solids	10.0	21.3	8.0
Total Phosphorus	0.10	0.21	0.09
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	8.52	3.0
Spring (Apr 1 – May 31)	1.0	2.13	0.8
Summer (Jun 1 – Sep 31)	0.7	1.49	0.5
Fall (Oct 1 – Nov 30)	1.0	2.13	0.8
E coli	200 cfu/100 mL[2]	N/A	100 cfu/100 mL
pH	6.0-9.5		6.5-8.5

Notes:
1. Based on monthly average
2. Based on monthly geometric mean density

With regards,

Sajjad

==
Mohammad Sajjad Khan, Ph.D., P.Eng.
Surface Water Specialist, West Central Region
Ontario Ministry of the Environment, Coservation and Parks
119 King Street West, 12th Floor, Hamilton ON L8P 4Y7
Tel: 905 521-7607; Fax: 905 521-7820
E-mail: mohammad.khan@ontario.ca
==

From: rw2 [mailto:robertwalton@xplornet.ca]
Sent: December 17, 2018 12:06 PM
To: Khan, Mohammad Sajjad (MECP)
Cc: Slattery, Barbara (MECP); Jane Wilson
Subject: Town of Grand Valley Assimilative Capacity Study

Hi again Sajjad,

We had a project planning meeting this morning. The plan was to have the Master Plan EA completed for Council Approval on January 8. We have adjusted this date to January 22 but it is still important that we get your response asap. As per you previous email you suggested the end of the year and this will work for our revised schedule if there are not a lot of comments.

Please keep in touch if you have questions or if you anticipate any change in schedule.

Yours truly,

Robert Walton, P.Eng.
rw2 Engineering Ltd.
226-234-8067

Sent from my BlackBerry — the most secure mobile device — via the TELUS Network

December 18th, 2018

Water Supply and Sewage Servicing Master Plan
Town of Grand Valley

Technical Memorandum

Assimilative Capacity Assessment

1 INTRODUCTION

1.1 Background

Profound Engineering was retained by Burnside and Associates to complete an assimilative capacity assessment of the Grand River in the vicinity of the existing wastewater treatment plant (WPCP) discharge for the Grand Valley facility. This assessment was completed in support of a water supply and sewage servicing master plan and addresses a proposed increase in in the Grand Valley WPCP average daily flow from 1,244 m^3/d to an anticipated future average daily flow of 2,131 m^3/d. The Grand Valley WPCP operates under CofA 9706-7KWQ57 which identifies compliance and design objectives for final effluent quality (Table 1).

Table 1. Grand Valley Effluent Compliance and Objective Limits

Effluent Parameter	Effluent Compliance Limits[1]		Effluent Objective Limits
	Average Concentration (mg/L)	Average Loading (kg/d)	Average Concentration (mg/L)
$cBOD_5$	10.0	12.4	8.0
Total Suspended Solids	10.0	12.4	8.0
Total Phosphorus	0.15	0.19	0.13
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	4.98	3.0
Spring (Apr 1 – May 31)	1.0	1.24	0.8
Summer (Jun 1 – Sep 31)	0.7	0.87	0.6
Fall (Oct 1 – Nov 30)	1.0	1.24	0.8
E coli	200 cfu/100 mL[2]	N/A	100 cfu/100 mL[2]
pH	6.0-9.5		6.5-8.5

Notes:
1. Based on monthly average.
2. Based on monthly geometric mean density.

The discussion provided below includes an assessment of the ambient water quality and current conditions in the Grand River near the Grand Valley WPCP, a summary of low-flow conditions, a mixing zone analysis and the development of proposed effluent objectives and limits for future flow conditions.

1.2 Objectives

The objectives of this assessment are as follows:

- Define ambient water quality and verify low-flow conditions for design purposes.

- Complete an assessment of assimilative capacity of the receiving water for key water quality parameters included $cBOD_5$, un-ionized ammonia, total ammonia, total phosphorus, total suspended solids, *E coli* and nitrate.
- Complete a mixing zone analysis.
- Develop recommendations for effluent limits for a future average daily flow of 2,131 m^3/d.

2 AMBIENT CONDITIONS

2.1 Water Quality

Representative background water quality was defined by examining water quality in the vicinity of the Grand Valley WPCP effluent discharge. For analysis purposes, the 75th percentile threshold was applied to characterize ambient conditions, or in the case of dissolved oxygen, the 25th percentile, as recommended by the MOE (MOE, 1994). For each water quality parameter, with the exception of nitrate, a comparison of representative ambient water quality with Provincial Water Quality Objectives (PWQO) was complete in order to establish the appropriate MOE policy to apply for assimilative capacity assessment, either Policy I or Policy II. Policy I corresponds to areas where the ambient concentration is less than the PWQO, while Policy 2 corresponds to areas where the ambient concentration is greater than the PWQO. If Policy I applies, future water concentrations must be maintained at or below the PWQO, while if Policy II applies, all practical measures shall be taken to upgrade the water quality to the Objectives. For nitrate, since there is no PWQO, Canadian Water Quality Guideline (CWQG) was applied.

For the purposes of this analysis, ambient water quality was derived from two sources:

- the Provincial Water Quality Monitoring Network station at Leggatt (PWQMN station 16018409002), upstream of the Grand Valley WPCP outfall, and
- Recent monitoring completed by the Grand River Conservation Authority, near Leggatt, GRCA Monitoring Site 1357002.

Data obtained from the PWQMN station at Leggatt was collected from 1977 through 2016, while the GRCA data spanned 2015 and 2016. In some cases, Method Detection Limits, MDL, differed between GRCA and PWQMN monitoring information and in order to combine the monitoring results, statistical methods recommended by the USGS (Helsel and Hirsch, 2002) were applied.

2.1.1 Total Phosphorus

The MOE PWQO for total phosphorus is 0.03 mg/L. A summary of ambient total phosphorus concentrations is provided in table 2. Both PWQMN (1997 through 2016) and GRCA (2015 and 2016) were combined for this assessment. All results were above MDL's allowing for a combined data set. In general, with respect to total phosphorus, the Grand River near Grand Valley is MOE Policy I during the winter and fall, and MOE Policy II during the spring and summer. As such, all practical measures will be necessary to reduce effluent total phosphorus concentrations during the spring and summer, and if feasible, current allowable total phosphorus loadings must be maintained or reduced.

Table 2. Ambient Total Phosphorus 1977-2016

Month	Mean TP (mg/L)	Median TP (mg/L)	75th Percentile TP (mg/L)	Number of Observations
January	*0.031*	0.020	0.026	22
February	*0.034*	0.025	*0.039*	24
March	*0.043*	0.027	*0.054*	27
April	*0.034*	0.025	*0.043*	32
May	0.024	0.020	0.023	29
June	*0.031*	0.028	*0.035*	31
July	*0.042*	*0.037*	*0.053*	34
August	*0.038*	*0.034*	*0.044*	38
September	*0.031*	*0.030*	*0.034*	33
October	0.023	0.019	0.022	33
November	0.024	0.019	0.027	25
December	*0.033*	0.017	0.021	19
Annual	***0.032***	**0.024**	***0.036***	**347**

2.1.2 Un-ionized Ammonia

The percentage of un-ionized ammonia in aqueous solution varies with temperature and pH, with percentages increasing with increasing temperature and pH. Table 3, 4, 5 and 6 provide a summary of ambient temperature, pH, total ammonia and un-ionized ammonia, respectively. Un-ionized ammonia was derived from synoptic measurements of field pH, field temperature and laboratory total ammonia analysis results. The threshold PWQO for un-ionized ammonia is 0.02 mg/L as N. For ambient temperature and pH (Tables 3 and 4, respectively), monitoring information from PWQMN and GRCA were combined yielding a 1977 through 2016 dataset. Since the PWMN dataset included single monthly measurements, while the GRCA included multiple measurements per month, single monthly averages of GRCA results were applied in order to combine datasets.

Table 3. Ambient Temperature 1977-2016

Month	Mean Temp (°C)	Median Temp (°C)	75th Percentile Temp (°C)	Number of Observations
January	0.7	0.5	1.0	18
February	0.8	0.7	1.2	19
March	2.4	1.9	3.2	26
April	7.9	6.7	11.9	31
May	14.8	14.7	17.5	29
June	19.9	19.9	21.5	31
July	22.7	22.6	24.7	33
August	21.1	21.4	22.3	35
September	17.1	16.3	19.3	33
October	9.5	9.7	11.3	33
November	3.7	3.4	5.9	27
December	1.5	1.0	1.4	19
Annual	**11.6**	**11.8**	**19.5**	**334**

Table 4. Ambient pH 1977-2016

Month	Mean pH	Median pH	75th Percentile pH	Number of Observations
January	7.51	7.71	8.03	12
February	7.77	7.75	7.85	14
March	7.64	7.59	7.90	12
April	8.11	8.01	8.20	21
May	8.27	8.30	8.35	19
June	8.25	8.17	8.38	20
July	8.39	8.36	*8.56*	21
August	8.36	8.36	8.50	21
September	8.53	8.54	*8.81*	19
October	8.28	8.34	8.40	18
November	8.08	8.19	8.26	15
December	8.07	8.20	8.30	9
Annual	**8.16**	**8.20**	**8.38**	**201**

The PWQO for pH states that the pH should be maintained within the range of 6.5 and 8.5 to protect aquatic life. Based on the summary provided in Table 4, ambient pH is highest in the summer months, with 75th percentile levels exceeding 8.81 in September. Presumably, this peak is related to increases in aquatic plant densities during the summer months. With the exception of July and September, the Grand River is Policy 1 with respect to pH.

For total ammonia (Table 5) all GRCA total ammonia results were reported as below MDL of 0.05 mg/L. For the GRCA 2015-2016 dataset, a total 23 samples were collected and analysed, all reporting less than MDL. In order to determine if these results could be incorporated into the overall total ammonia assessment, a review of the distribution of total ammonia results from the PWQMN dataset was completed and is summarized in Figure 1. The PWQMN dataset include limited total ammonia results for 1994 through 1997 and a more complete dataset from 2007 through 2016. A *t*-test of means for the lumped PWQMN results for the period 1994-1997 and the PWQMN results for 2007-2016 indicated that the means were significantly different at the 95% level, and therefore only the 2007-2016 monitoring results were assessed.

Figure 1 illustrates the fitted frequency distribution of the total ammonia results for the PWQMN dataset (post 2007). Several probability distributions were evaluated; however, both the Log-Normal and the Log-Pearson Type III provided a reasonable fit. As illustrated, the GRCA dataset MDL of 0.05 mg/L has a return frequency of approximately 1:6, or an exceedance probability of approximately 16%. Assuming the GRCA dataset is comparable to the PWQMN dataset, the likelihood of obtaining 23 results at or below this threshold MDL would be less than 2%, leading to the conclusion that the analytical methods are sufficiently different and the results cannot be combined. Therefore, the total ammonia results presented in Table 5, and the ambient unionized ammonia results presented in Table 6, correspond to only the PWQMN dataset.

Table 5. Ambient Total Ammonia 2007-2016

<table>
<tr><th>Month</th><th>Mean TAN (mg/L as N)</th><th>Median TAN (mg/L as N)</th><th>75th Percentile TAN (mg/L as N)</th><th>Number of Observations</th></tr>
<tr><td>January</td><td rowspan="3">0.084</td><td rowspan="3">0.045</td><td rowspan="3">0.063</td><td rowspan="2">0</td></tr>
<tr><td>February</td></tr>
<tr><td>March</td><td>5</td></tr>
<tr><td>April</td><td>0.042</td><td>0.038</td><td>0.056</td><td>12</td></tr>
<tr><td>May</td><td>0.031</td><td>0.023</td><td>0.043</td><td>10</td></tr>
<tr><td>June</td><td>0.037</td><td>0.030</td><td>0.044</td><td>12</td></tr>
<tr><td>July</td><td>0.035</td><td>0.029</td><td>0.038</td><td>12</td></tr>
<tr><td>August</td><td>0.029</td><td>0.030</td><td>0.039</td><td>12</td></tr>
<tr><td>September</td><td>0.029</td><td>0.026</td><td>0.037</td><td>12</td></tr>
<tr><td>October</td><td>0.020</td><td>0.022</td><td>0.029</td><td>10</td></tr>
<tr><td>November</td><td>0.023</td><td>0.018</td><td>0.029</td><td>10</td></tr>
<tr><td>December</td><td>0.039</td><td>0.039</td><td>0.058</td><td>2</td></tr>
<tr><td>Annual</td><td>0.034</td><td>0.027</td><td>0.042</td><td>98</td></tr>
</table>

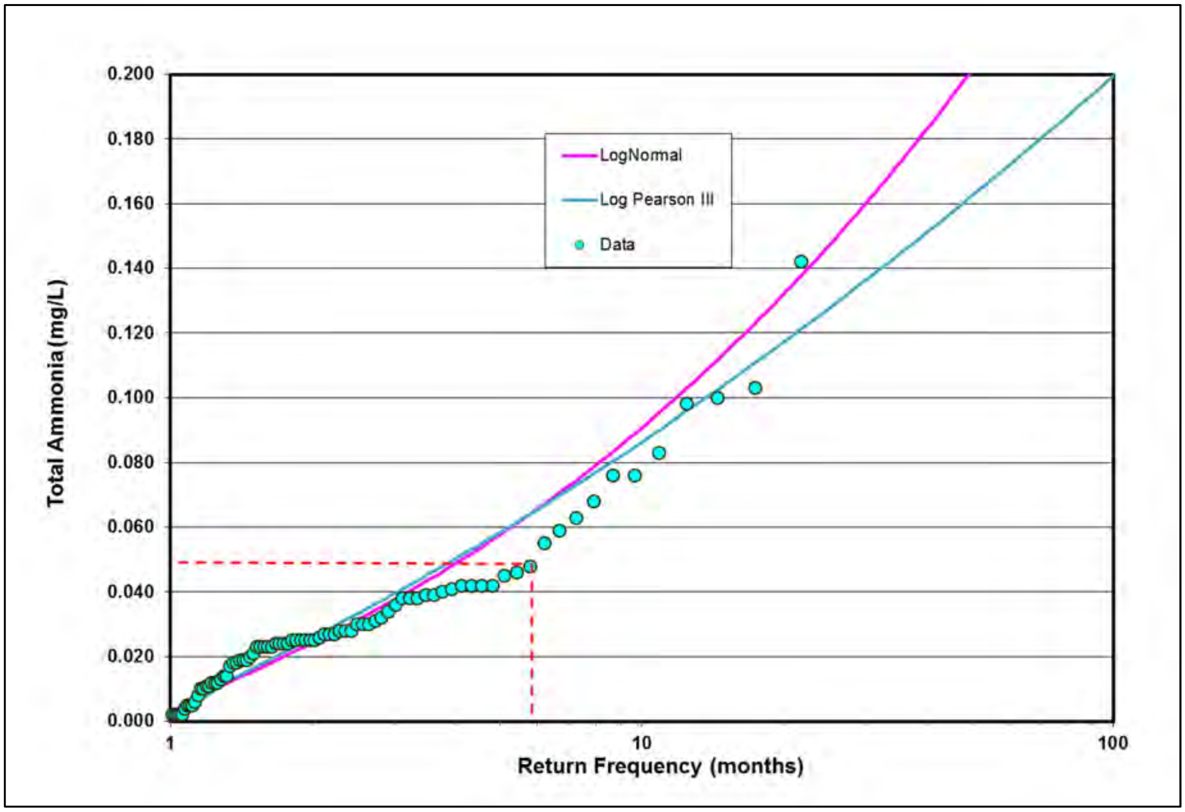

Figure 1. PWQMN at Leggatt Total Ammonia Frequency Distribution 1977-2015

Ambient total ammonia is highest during the spring; however, relatively few measurements are available for the winter months.

Table 6. Ambient Un-ionized 2007-2016

Month	Mean UIA (mg/L as N)	Median UIA (mg/L as N)	75th Percentile UIA (mg/L as N)	Number of Observations
January	0.000	0.000	0.000	0
February				0
March				4
April	0.001	0.001	0.001	10
May	0.002	0.002	0.002	8
June	0.004	0.004	0.005	10
July	0.005	0.005	0.006	8
August	0.003	0.002	0.004	8
September	0.005	0.002	0.003	8
October	0.001	0.001	0.001	7
November	0.000	0.000	0.001	7
December				0
Annual	**0.001**	**0.001**	**0.003**	**70**

Ambient un-ionized ammonia is highest during the summer, however, remains below the PWQO threshold of 0.016 mg/L as N. The Grand River is therefore MOE Policy I with respect to un-ionized ammonia.

2.1.3 Dissolved Oxygen and $cBOD_5$

Ambient dissolved oxygen was evaluated by reviewing long term PWQMN monitoring results and recent continuous monitoring results collected by GRCA. Since low concentrations are indications of degraded water quality, the 25th percentile was applied for comparison with PWQO's. The PWQO threshold for dissolved oxygen in warm water fisheries is 47% saturation. At 5ºC the PWQO is 6 mg/L, while above 20ºC the PWQO is 4 mg/L. A summary of historical PWQMN and recent GRCA monitoring is provided in Table 7, while time-series plots of continuous dissolved oxygen monitoring for 2015 and 2016 are provided in Figures 2 and 3, respectively. For both long-term and continuous dissolved oxygen monitoring, the Grand River may be considered MOE Policy I with respect to dissolved oxygen.

No recent (post 1992) PWQMN $cBOD_5$ measurements are available, however, the 75th percentile cBOD for $cBOD_5$ monitoring results prior to 1992 is 1.13 mg/L. A 2003 field program completed by RJ Burnside and Associates (RJB, 2003) measured $cBOD_5$ concentrations ranging from approximately 0.5 to 1.7 mg/L. Therefore, based available monitoring information, a conservative estimate of ambient $cBOD_5$ concentration is 2.0 mg/L.

Table 7. Ambient Dissolved Oxygen 1977-2016

Month	Mean DO (mg/L)	Median DO (mg/L)	25th Percentile DO (mg/L)	Number of Observations
January	6.9	7.0	10.2	22
February	22.3	12.0	10.9	24
March	11.8	11.8	10.5	28
April	11.9	11.6	11.1	30
May	10.9	12.1	10.4	28
June	9.8	11.0	8.8	30
July	8.9	10.0	8.3	32
August	9.2	9.1	8.7	34
September	10.1	9.3	9.7	31
October	11.8	10.1	11.1	32
November	12.8	11.7	12.3	26
December	12.6	13.2	11.9	19
Annual	**11.4**	**11.0**	**12.4**	**336**

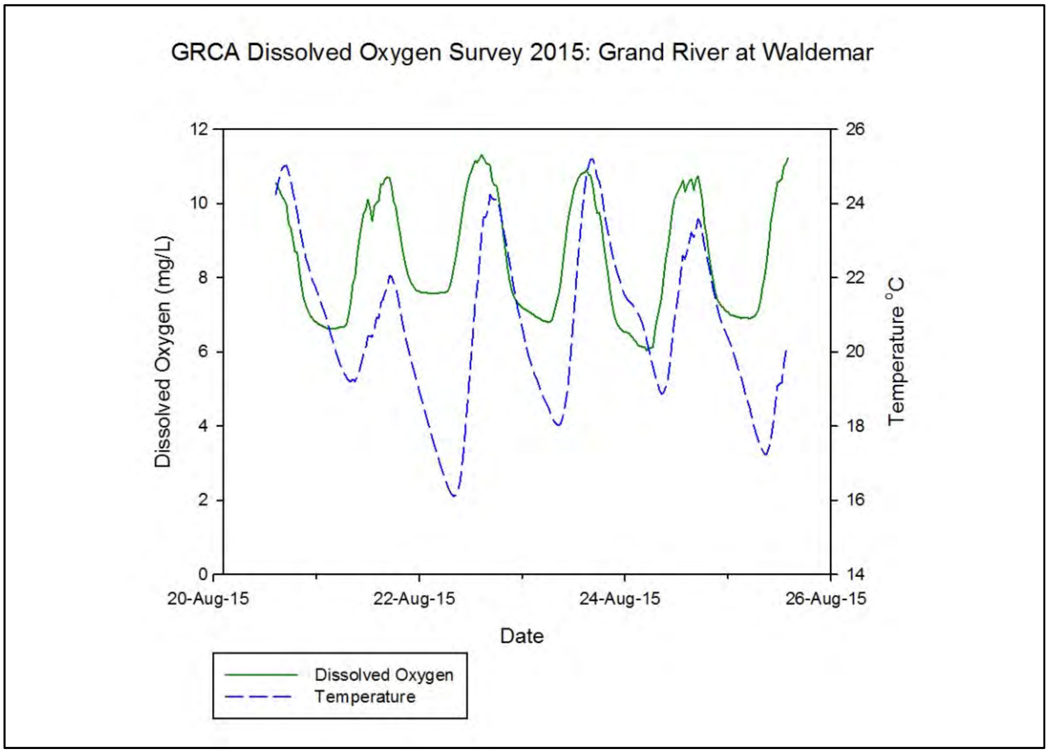

Figure 2. Diurnal Dissolved Oxygen: August 2015

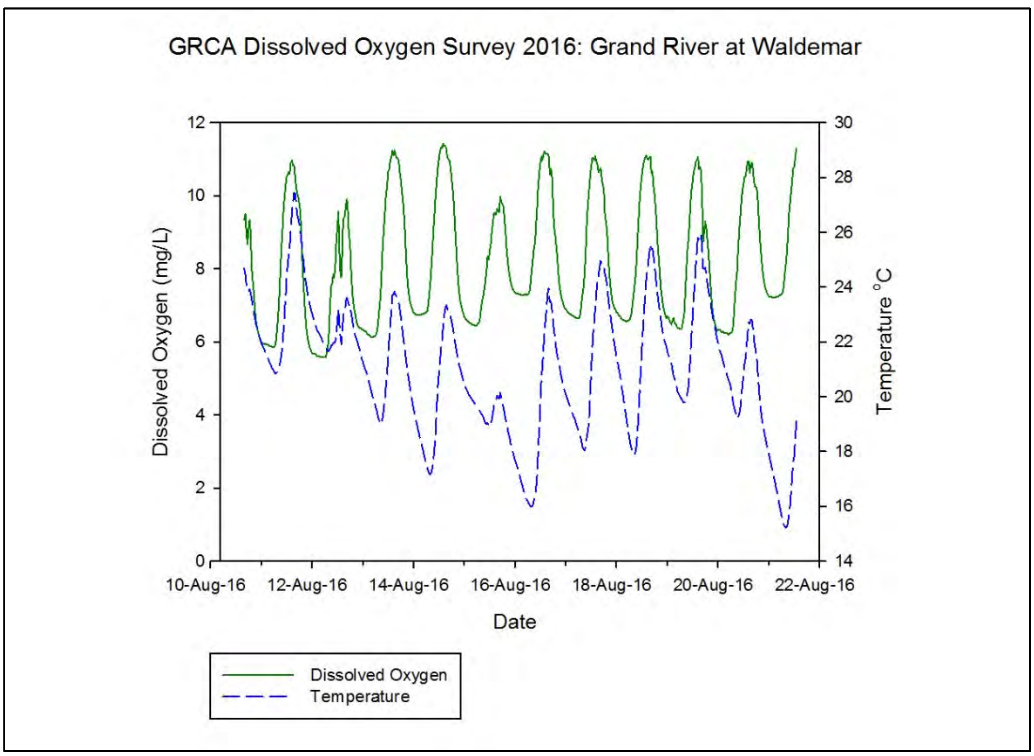

Figure 3. Diurnal Dissolved Oxygen: August 2016

The PWQMN dissolved oxygen measurements are typically collected during the day and may not reflect minimum dissolved oxygen levels, particularly if aquatic plant respiration is a significant factor influencing ambient dissolved oxygen levels. An indication of diurnal variability in dissolved oxygen is provided by GRCA's continuous monitoring results for 2015 and 2016 (Figures 1 and 2). These results indicate that dissolved oxygen varies from above 10 mg/L during the day to approximately 6 mg/L during the pre-dawn hours, where aquatic plant respiration would contribute to minimum dissolved oxygen levels. During the same monitoring period, relatively large fluctuations in ambient temperature were observed, ranging from approximately 15^{o}C at night to above 26^{o}C during the mid-afternoon. As illustrated, aquatic plant respiration does reduce dissolved oxygen concentrations during the night, however, levels remain above PWQO warm water thresholds, confirming that the MOE Policy I assumption for dissolved oxygen is appropriate.

2.1.4 *E. coli*

No PWQMN *E.coli* data are available post-1995 upstream of the Grand Valley WPCP discharge location, and only a few post-1995 measurements are available from the downstream PWQMN dataset (Station 16018406702), collected during the summer of 2005. Additional *E.coli* data are available from 2003 and 2006 R.J. Burnside led field programs. Lumped geometric mean concentrations exceed the PWQO of 100 cfu/100mL for June and September, while 75th percentile concentrations exceed this threshold from May through September. Although monitoring results are limited, it is reasonable to assume the receiver is MOE Policy II from May through September and MOE Policy I the remainder of the year.

2.1.5 Suspended Solids

There are no PWQO values for total suspended solids (TSS), however, a review of recommended TSS guidelines for the protection of aquatic life (EPA, 2003) indicate that a 30-day average concentration of 30 mg/L is a reasonable threshold. A statistical summary of seasonal TSS concentrations in the Grand River upstream of Grand Valley, provided below as Table 8, indicates that 75th percentile ambient TSS concentrations are less than this threshold for all months, with the exception of spring. Since the exceedance is marginal (31.1 vs. 30 mg/L) and the 75th percentile is based on single grab samples, rather than 30-day averages, the exceedance is deemed insignificant. Both PWQMN and GRCA datasets were applied for this TSS assessment.

Table 8. Ambient Total Suspended Solids 1977-2016

Season	Mean TSS (mg/L)	Median TSS (mg/L)	75th Percentile TSS (mg/L)	Number of Observations
Winter	10.3	3.4	10.5	6
Spring	19.1	4.4	31.3	16
Summer	10.0	6.0	11.7	22
Fall	7.1	4.0	7.2	17
Annual	**8.3**	**5.0**	**7.6**	**61**

2.1.6 Nitrate

There is no PWQO value for nitrate, however, there is a Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. The CWQG is 3.0 mg/L as N (CCME, 2012). A summary of PWQMN ambient nitrate concentrations in the Grand River upstream of Grand Valley is provided below as Table 9. As with other historical water quality measurements, only limited results are available during the winter. Despite the winter data limitations, all 75th percentile nitrate concentrations fall below the 3.0 mg/L as N CWQG threshold, indicating that assimilative capacity is available for nitrate.

Table 9. Ambient Total Nitrate as N 1977-2014

Month	Mean Nitrate (mg/L)	Median Nitrate (mg/L)	75th Percentile Nitrate (mg/L)	Number of Observations
January February March	0.93	0.93	1.05	4
April	0.96	1.02	1.09	10
May	0.67	0.32	1.05	7
June	0.45	0.21	0.41	10
July	0.34	0.10	0.17	8
August	0.32	0.21	0.42	8
September	0.19	0.08	0.15	7
October	0.91	1.10	1.41	7
November December	1.18	0.88	1.84	7
Annual	**0.64**	**0.40**	**1.08**	**175**

The GRCA monitoring information for nitrate was reviewed and determined to be unsuitable for inclusion in the above summary. Of the 24 GRCA nitrate samples, 12 of 24 (50%) reported nitrate concentrations of below the MDL of 0.1 mg/L. All of the samples reporting nitrate concentrations of less than the MDL were collected in 2015. The remaining 12 samples, all collected during 2016, reported concentrations in excess of 1.0 mg/L. A frequency plot of the 12 samples (blue symbols) over the MDL is provided as Figure 4 below. The recommended approach by USGS (Helsel and Hirsch, 2002) involves using the fitted frequency distribution to estimate reasonable values for all samples below MDL. Following this approach yields estimates in excess of the MDL as illustrated in Figure 4 below (yellow symbols). In light of this discrepancy, the GRCA nitrate monitoring results for 2015 and 2016 were not included in the final assessment.

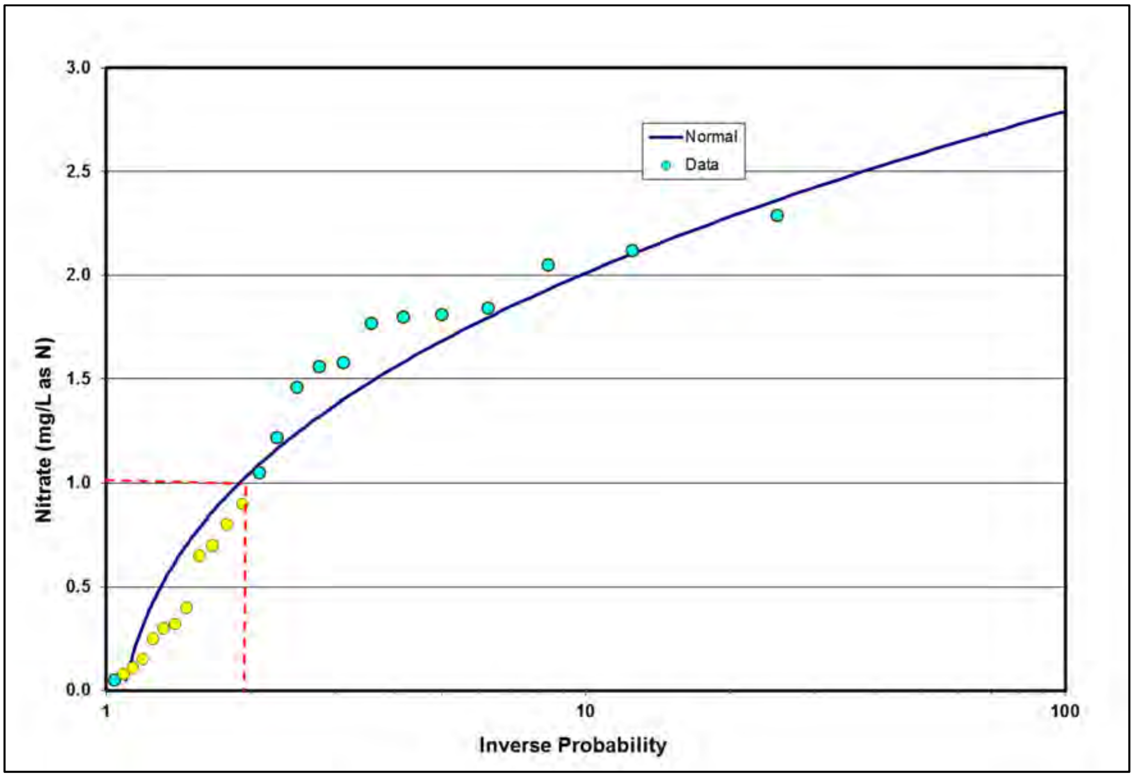

Figure 4. Frequency Distribution for Nitrate: GRCA 2015-2016

2.2 Flow

Conventional low-flow frequency analysis for estimation of 7Q20 flow is not appropriate at this location due to flow regulation. An initial 7Q20 flow target of 0.42 m^3/s was derived from a 1986 reservoir yield study, and re-confirmed by GRCA in 2004 and again in 2016 (GRCA, 2016). In support of this assimilative capacity assessment, the most recent GRCA publication (2016) addressing low flow in the Grand River near Grand Valley, authored by D. Boyd and S. Shifflett, was reviewed and highlights are provided below:

- Low flow upstream of the Grand Valley WPCP is controlled by the Luther Dam discharge.
- Luther Dam was constructed in 1953 for the purpose of low flow augmentation.
- A review of reservoir yield, combined with external base flow tributary to Grand Valley, results in a sustainable annual low flow target of 0.42 m^3/s. This value was adopted by GRCA in 2004.
- A brief assessment of potential climate change impacts indicate that the accepted low flow target of 0.42 m^3/s can be maintained in a future climate.

- A frequency assessment of historical low flow information demonstrates that the 0.42 m^3/s low flow target is a reasonable approximation of the 7Q20 flow.
- Following an assessment of measurement and estimation uncertainty, GRCA recommended a 7Q20 flow of 0.4 m^3/s.

Therefore, for the purposes of the current assimilation capacity assessment, GRCA's recommended 7Q20 of 0.4 m^3/s was adopted.

3 DETERMINATION OF EFFLUENT LIMITS

3.1 Effluent $cBOD_5$

For the expanded WPCP, it is proposes to maintain the existing $cBOD_5$ compliance limit of 10 mg/L and the existing design objective of 8 mg/L. The potential impact on instream dissolved oxygen was evaluated using the Streeter Phelps equation. The Alabama Department of Environmental Management, ADEM, developed a straightforward spreadsheet solution of the Streeter Phelps equation and this public-domain tool was applied for the current application (ADEM, 2001). In addition to carbonaceous biological oxygen demand, the ADEM model also addresses nitrogenous oxygen demand and sediment oxygen demand. A summary of key model inputs are provided below.

Channel Description: The physical characteristics of the channel, including reach lengths, bottom slopes and channel width were defined using a HEC-RAS model provided by GRCA. Although the HEC-RAS model was designed for flood analysis, there were multiple cross-sections included in the model that provided a general indication of the low-flow channel shape and approximate slope. A total of 20 kilometers of river length, downstream of the WPCP were modelled.

Velocity and Depth: Reach depth and velocities were defined by applying the 7Q20 of 0.4 m^3/s to the HEC-RAS model.

River Re-aeration: Re-aeration was estimated using the Tsivoglou and Neal equation as recommended by ADEM (ADEM, 2001) and the US EPA (EPA, 1985). Numerous approaches are available for estimation of re-aeration, however, the Tsivoglou and Neal equation provides a simple empirical approach, suitable for shallow streams and relies only on velocity and slope. Estimated re-aeration rates range from 3.1 to 6.1 d^{-1}, which compare favourably with previous estimates for this location in the Grand River (XCG, 2013).

Ambient Water Quality: Ambient water quality was defined as 75th percentile summer conditions as presented in Section 2. Important parameter assignments include $cBOD_5$ at 2.0 mg/L, Ammonia Nitrogen at 0.035 mg/L as N, dissolved oxygen at 8.5mg/L, and temperature of 24.8 ^oC.

Sediment Oxygen Demand: A literature value of 0.5 g/m^2 SOD was applied and was obtained from a recent USGS study of SOD for a range of streams and land uses (Foster, King and Graham, 2016).

Effluent Water Quality: Effluent water quality was defined according to the existing CofA compliance limits provided as Table 1. Importantly, effluent dissolved oxygen was assumed to be 0 mg/L to provide a conservative estimate water quality impacts.

Numerous model runs were completed in order to assess parameter sensitivity and an illustration of typical model results for summer low flow conditions is provided in Figure 5. As illustrated, the peak dissolved oxygen deficit is less than 1.0 mg/L. Since the Grand River is MOE Policy II with respect to Dissolved Oxygen, these model results demonstrate that the existing compliance limit and design objective, of 10 and 8 mg/L $cBOD_5$, respectively, are appropriate for future WPCP effluent.

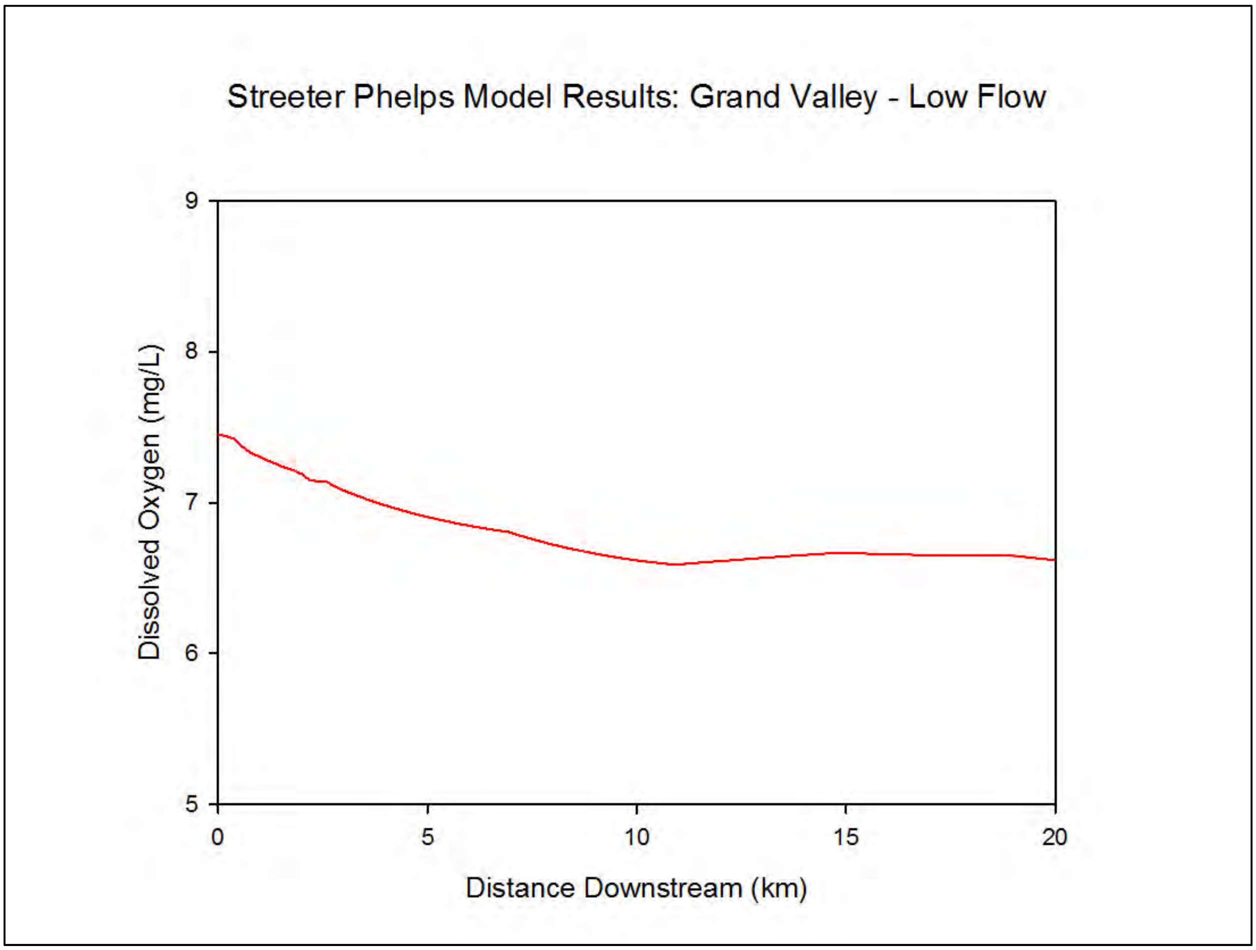

Figure 5. Streeter-Phelps Dissolved Oxygen Solution for Summer Low Flow Conditions

3.2 Effluent Total Suspended Solids

For the expanded WPCP, maintaining the existing TSS compliance limit of 10 mg/L and the existing design objective of 8 mg/L, is proposed. Although there is no PWQO or CWQG for TSS, all 75th percentile concentrations are below the EPA's threshold of 30 mg/L. At the design flow of 2,131 m^3/d and the current CofA TSS compliance limit of 10 mg/L, the ambient TSS concentration would marginally increase (less than 1%) during the winter, and actually improve during the summer (approximately 3%). Therefore, it is proposed that the existing compliance limit of 10 mg/L and the design objective of 8 mg/L be maintained for the proposed WPCP expansion.

3.3 Effluent Total Phosphorus

As discussed in Section 2, the Grand River in the vicinity of the Grand Valley WPCP outfall is MOE Policy II with respect to total phosphorus and no assimilative capacity is available in the receiver. Furthermore, for a MOE Policy II receiver, MOE policy states: "*Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives*." The existing CofA compliance limit for total phosphorus is 0.15 mg/L, and the corresponding loading limit is 0.19 kg/d. To maintain this loading limit at future flow conditions would require reducing the compliance limit from 0.15 mg/L to 0.09 mg/L, which is approaching the practical limit achievable using best available technology. A more practical effluent target would be 0.10 mg/L.

An important consideration in this analysis is the relative impact associated with a future total phosphorus load if the existing compliance concentration is maintained for future conditions. Under existing conditions, total phosphorus river load downstream of the WPCP, for peak ambient total phosphorus conditions (July) and low flow, would be 2.05 kg/d, or 1.87 kg/d upstream plus 0.19 WPCP load. Assuming the compliance concentration is maintained for future conditions, the peak ambient total phosphorus load downstream of the WPCP would increase to 2.19 kg/d, or 1.87 kg/d upstream plus 0.32 WPCP load, an increase of approximately 7%.

A final evaluation of all practical treatment alternatives is required in order to determine what final effluent compliance limit for total phosphorus is appropriate. In support of that effort, a summary of total phosphorus loading downstream of the WPCP for peak ambient total phosphorus conditions (July), 7Q20 low flow, and a range of effluent compliance limits, is provided in Table 10 below. A compliance total phosphorus limit of 0.10 mg/L is approaching practical limits that would be achievable. The total increase in downstream load associated with this limit is approximately 1.6%. It is proposed that this marginal increase is acceptable and consistent with MOE Policy and the future limit for total phosphorus should be 0.10 mg/L.

Table 10. 75th Percentile Total Phosphorus Loading Downstream of the WPCP for Future Conditions

Scenario	Proposed Effluent TP limit (mg/L)	Downstream TP Load (kg/d)	Increase Relative to Existing Conditions (%)
Maintain Existing CofA Concentration Limit	0.15	2.19	6.8
Practical Limit for Effluent Phosphorus	0.10	2.08	1.6
Maintain Existing CofA Loading Limit	0.09	2.05	0.0

3.4 Effluent Total Ammonia

Evaluation of effluent ammonia requires an assessment of both effluent toxicity and in-stream PWQO compliance.

3.4.1 Effluent Toxicity

The currently accepted un-ionized ammonia limit for effluent toxicity is 0.1 mg/L as N. Monthly 75th percentile ammonia dissociation constants for the WPCP effluent were derived previously (XCG, 2013) using historical effluent monitoring results. These dissociation ratios, combined with the existing CofA TAN limits, were applied to evaluate effluent toxicity for future conditions. The resultant effluent un-ionized ammonia concentrations are summarized in Table 11. In addition to the effluent dissociation constant established in 2003, Table 11 also includes estimates of the minimum and maximum dissociation constant based on 2013 through 2016 effluent monitoring results. As indicated, if the maximum dissociation constant derived from the 2013-2016 effluent monitoring was greater than the 2003 dissociation estimate, it was applied for the final estimation of effluent un-ionized ammonia. In most cases, the recent effluent monitoring is consistent with the 2003 assessment. As illustrated, end-of-pipe un-ionized ammonia is consistently above the toxicity threshold of 0.1 mg/L.

Table 11. Estimated End-of-Pipe Un-ionized Ammonia

Month	Effluent TAN (mg/L as N)	Dissociation Constant (%) (XCG, 2003)	Dissociation Constant (%) 2013-2016 Monitoring	Effluent Un-Un-Ionized Ammonia (mg/L as N)
January	4.0	0.9	0.2 – 0.4	0.036
February	4.0	0.9	0.1 – 0.3	0.036
March	4.0	0.9	0.1 – 0.9	*0.036**
April	1.0	1.4	0.1 – 0.6	0.014
May	1.0	1.4	0.2 – 1.0	0.014
June	0.7	1.8	0.2 – 1.4	0.013
July	0.7	1.8	0.3 – 1.5	0.013
August	0.7	1.8	0.3 – 1.6	0.013
September	0.7	1.8	0.3 – 2.6	*0.018**
October	1.0	1.2	0.1 – 1.8	*0.018**
November	1.0	1.2	0.4 – 0.9	0.012
December	1.0	0.9	0.1 – 0.6	0.009

**Maximum dissociation constant based on 2013-2016 effluent monitoring results.*

3.4.2 Un-Ionized Ammonia in-Stream

The in-stream ammonia dissociation constants, and ambient TAN, were derived from synoptic measurements of TAN, pH and Temperature and are presented in Table 11. PWQMN monitoring information for pH and temperature was spare for the early 2000's, and some infilling of monitoring results for that period from PWQMN 16018406702 (Grand River at 13th Ln, NW of Marsville) was completed. Despite this, water quality sampling during the winter months was limited and it was necessary to lump January through March, and November and December results. Estimates of un-ionized ammonia concentrations were generated using the TAN limits as defined in the existing CofA and are summarized in Table 12. As illustrated, monthly un-ionized concentrations remain at or below the PWQO threshold of 0.016 mg/L as N for all months of the year.

Table 12. In-Stream Un-Ionized Ammonia Downstream of WPCP

Month	75th Percentile Ambient TAN (mg/L as N)	Effluent TAN (mg/L as N)	Mass Balance TAN (mg/L as N)	Dissociation Constant (%)	Downstream Un-Ionized Ammonia (mg/L as N)
January February March	0.063	4.0	0.29	1.1%	0.003
April	0.056	1.0	0.11	3.7%	0.004
May	0.043	1.0	0.10	7.2%	0.007
June	0.044	0.7	0.08	10.1%	0.008
July	0.038	0.7	0.08	17.7%	0.013
August	0.039	0.7	0.08	13.0%	0.014
September	0.037	0.7	0.08	20.7%	0.015
October	0.029	1.0	0.08	4.8%	0.004
November	0.029	1.0	0.08	2.6%	0.002
December	0.058	1.0	0.09	1.8%	0.002

3.5 Effluent *E. coli*

As discussed in Section 2, the Grand River near Grand Valley is considered MOE Policy II with respect to *E.coli*, and therefore, the effluent should not further degrade the quality of the water. A compliance limit of 200 cfu/100 mL and a design objective of 100 cfu/100 mL are proposed.

4 MIXING ZONE ASSESSMENT

4.1 Approach

The expert system mixing model CORMIX version 11 GTH (Advanced Hydraulic Tools) was applied for development of mixing zone downstream of the proposed discharge. In addition, an analytical solution of the two-dimensional advective-dispersive transport equation was developed for comparison purposes and is provided in Appendix A.

Key parameter assignments for the CORMIX model are summarized in Table 13. Numerous model runs were completed to establish parameter sensitivity and representative model results are provided in Figures 6 and 7, and in Table 14. Figure 6 illustrates a plan view of the CORMIX results, while Figure 7 illustrates a plot of the maximum plume concentration relative to downstream distance. Table 14 provides a summary of the plume width, which is approximately equivalent to the distance between the right bank and a location instream encompassing approximately 75% of the plume mass. Minimum dilution, or the maximum effluent concentration downstream, is also summarized in Table 14.

In Figure 6, the x-axis represents the right bank distance downstream, while the y-axis represents the lateral distance, perpendicular to the right bank. As illustrated in Figure 6, the resultant plume hugs the right bank, however, there is a near field region (less than 5 m) where the effluent remains separated from the bank. As illustrated in Figure 7, near completely mixed conditions are achieved within 1000 m of the discharge, which is consistent with the analytical solution provided in Appendix A. In addition, the CORMIX results confirm that the discharge is vertically completely mixed.

Table 13. CORMIX Model Summary

CORMIX Block	Parameter	Value
Ambient	Average Channel Depth	0.15 m
	Depth at Discharge	0.13 m
	Channel Velocity	0.133 m/s
	Water Temperature	22 ^{o}C
	Manning's *n*	0.15
	Flow	0.4 m^3/s
	Channel Width	20 m
Discharge	CORMIX Model	CORMIX3 Surface Discharge
	Configuration	Flush
	Bank	Right
	Slope	5%
	Width	1m
	Depth	0.06 m
	Depth at Bank	0.07 m
	Flow	0.0247 m^3/s

Table 14. CORMIX results: Plume Width

Distance Downstream (m)	Peak Plume Effluent Concentration (%)	Plume Width (m)	Zone of Passage (m)
0	100.0	0.0	20.0
10	70.2	0.6	19.4
25	50.3	2.2	17.8
50	26.9	3.7	16.3
100	17.7	5.8	14.2
200	12.2	8.4	11.6
300	9.9	10.4	9.6
500	7.6	13.6	6.4
750	6.2	16.7	3.3
1000	5.2	19.4	0.6
1077	5.2	20.0	0.0

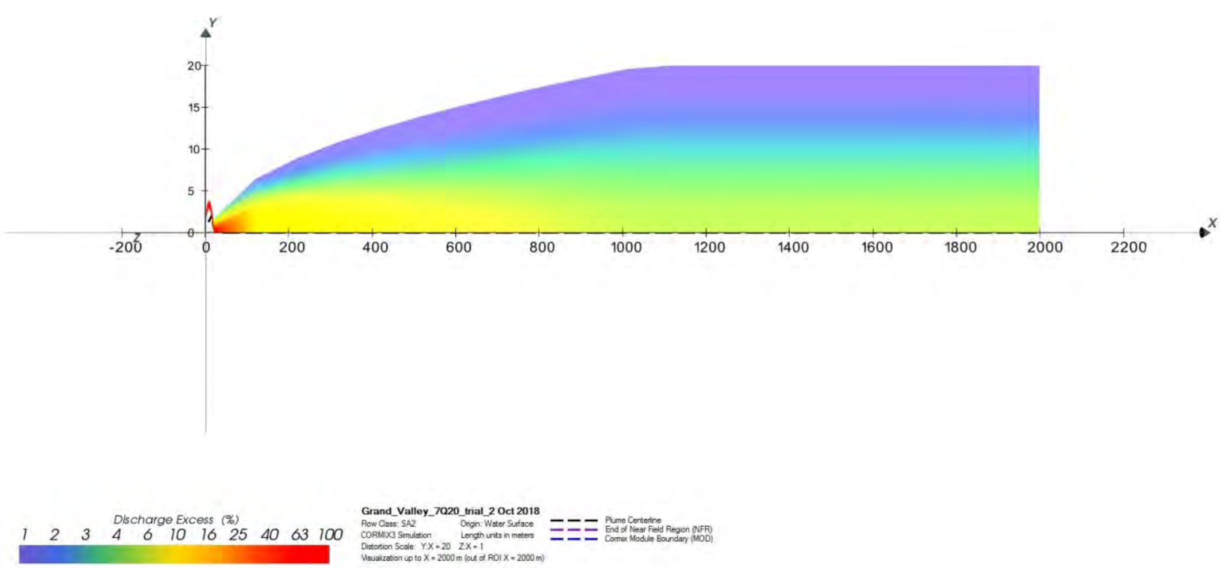

Figure 6. Representative CORMIX Results for Mixing Zone

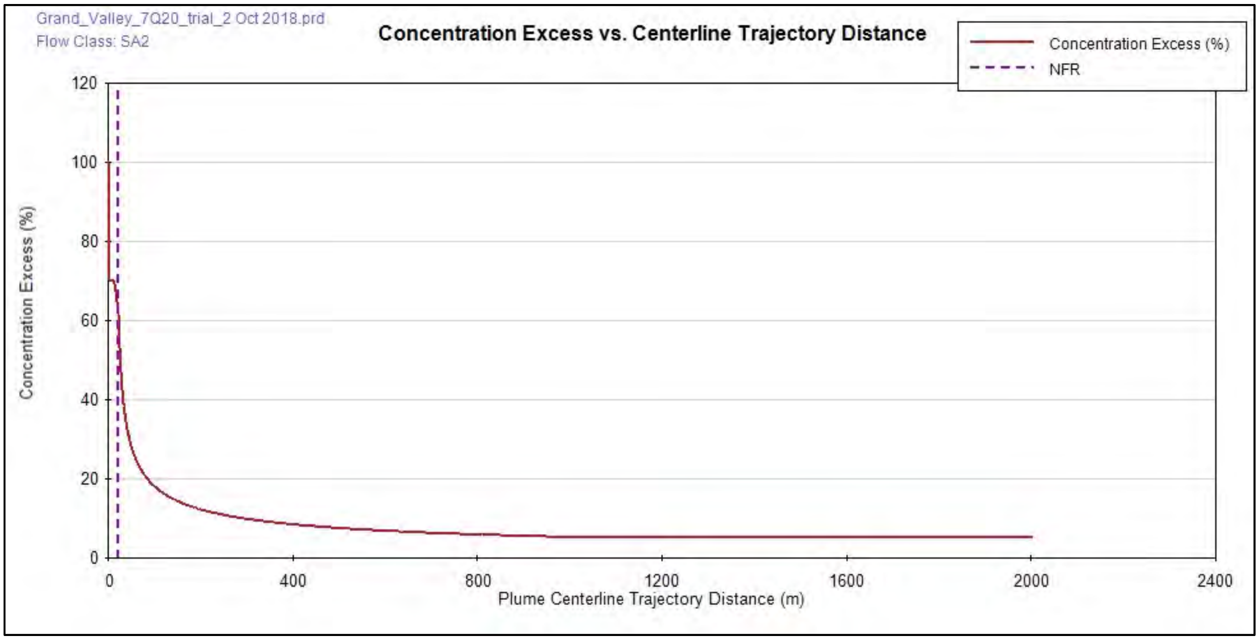

Figure 7. CORMIX Results for Maximum Plume Concentration (% Effluent)

4.2 Mixing Zone

The CORMIX results summarised above were applied to establish plume characteristics for dissolved oxygen, total phosphorus, and un-ionized ammonia and the results are summarized in Tables 15 through 17. Table 15 presents the dissolved oxygen summary for summer conditions and assumes a conservative effluent dissolved oxygen concentration of 0.0 mg/L. PWQO standards are achieved within 50 m of the discharge, and an adequate zone of passage (Table 14) is available upstream of 50 m.

Table 15. CORMIX Results: Dissolved Oxygen (Ambient = 8.3 mg/L minimum summer 75th Percentile DO)

Distance Downstream (m)	Minimum Dissolved Oxygen Concentrations for Summer (mg/L)
0	0.0
10	2.4
25	3.9
50	5.7
100	6.6
200	7.2
300	7.4
500	7.6
750	7.7
1000	7.8
1077	7.8

Table 16 presents the total phosphorus results summary for summer. The Grand River is MOE Policy 2 with respect to total phosphorus and the peak summer 75th percentile concentration is 0.054 mg/L. An effluent TP limit of 0.10 mg/L is recommended and would result in marginal increase in downstream total phosphorus loading (approximately 1%), while the existing effluent TP limit of 0.15 mg/L would represent an increase at completely mixed conditions of approximately 3%.

Table 16. CORMIX Results: Total Phosphorus

Distance Downstream (m)	Maximum TP Concentrations for Summer (mg/L)		
	Effluent TP 0.15 mg/L	Effluent TP 0.10 mg/L	Effluent TP 0.09 mg/L
0	0.150	0.100	0.090
10	0.122	0.086	0.079
25	0.105	0.078	0.073
50	0.084	0.068	0.065
100	0.073	0.063	0.061
200	0.067	0.060	0.059
300	0.065	0.059	0.058
500	0.062	0.058	0.057
750	0.061	0.057	0.056
1000	0.060	0.057	0.056
1077	0.060	0.057	0.056

Table 17 presents the mixing zone un-ionized results summary by month. For all months, the threshold PWQO un-ionized ammonia concentration of 0.016 mg/L is achieved within 750. At 750 m, the zone of passage (Table 14) is greater than 3 m, or approximately 15% of the channel width.

Table 17. CORMIX Results: Un-ionized Ammonia

Distance Downstream (m)	**Un-ionized Ammonia (mg/L as N)**									
Month	Jan-Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proposed Effluent TAN Limit	4.0	1.0	1.0	0.7	0.7	0.7	0.7	1.0	1.0	1.0
0	***0.044***	***0.037***	***0.072***	***0.071***	***0.124***	***0.091***	***0.145***	***0.048***	***0.026***	***0.018***
10	***0.031***	***0.027***	***0.052***	***0.051***	***0.089***	***0.066***	***0.105***	***0.034***	***0.019***	0.013
25	***0.024***	0.011	***0.039***	***0.039***	***0.069***	***0.050***	***0.080***	***0.026***	0.014	0.010
50	0.014	0.013	***0.017***	***0.025***	***0.043***	***0.032***	***0.050***	0.016	0.009	0.006
100	0.009	0.009	0.013	***0.018***	***0.030***	***0.022***	***0.035***	0.011	0.006	0.004
200	0.007	0.007	0.011	0.014	***0.020***	***0.017***	***0.027***	0.008	0.004	0.003
300	0.006	0.006	0.009	0.012	***0.017***	0.015	***0.023***	0.007	0.004	0.003
500	0.004	0.005	0.008	0.010	0.015	0.012	***0.019***	0.005	0.003	0.002
750	0.004	0.004	0.007	0.009	0.014	0.011	***0.017***	0.005	0.003	0.002
1000	0.003	0.004	0.007	0.008	0.013	0.010	0.016	0.004	0.002	0.002
1077	0.003	0.004	0.007	0.008	0.013	0.010	0.015	0.004	0.002	0.002

5 SUMMARY

A summary of the assimilative capacity assessment of the Grand River near Grand Valley are as follows:

- The Grand River is MOE Policy II with respect to total phosphorus and *E. coli* and MOE Policy I with respect to dissolved oxygen and un-ionized ammonia.
- The required effluent total phosphorus compliance limit to maintain the existing loading is 0.09 mg/L.
- A recommended effluent total phosphorus limit, that is both technically and economically achievable and that results in only a marginal increase in downstream loading, is 0.1 mg/L.
- Although no PWQO is available for TSS, nitrates and $cBOD_5$, ambient concentrations are generally within acceptable limits as defined by other jurisdictions or by CCME guidelines.
- A review of the low flow assessment completed by the GRCA demonstrates that 0.4 m^3/s is a reasonable approximation of 7Q20 flow and is suitable for assimilative capacity assessment.
- Results of a desk-top Streeter-Phelps dissolved oxygen model indicate that the existing CofA limits for $cBOD_5$ and TAN are appropriate for future WPCP flow conditions.

- For completely mixed conditions the existing CofA limits for TAN are suitable for future WPCP flow conditions. For the summer months of July through September, near completely mixed conditions are required in order to achieve the PWQO target for un-ionized ammonia of 0.016 mg/L.
- The results of mixing zone model indicate that PWQO un-ionized ammonia concentrations will be achieved within 750 m of the WPCP discharge for future WPCP flow and existing CofA compliance TAN limits.

A summary of recommended effluent compliance and objective limits is provided in Table 17.

Table 17. Grand Valley Effluent Recommended Compliance and Objective Limits

Effluent Parameter	Effluent Compliance Limits[1]		Effluent Objective Limits
	Average Concentration (mg/L)	Average Loading (kg/d)	Average Concentration (mg/L)
$cBOD_5$	10.0	21.3	8.0
Total Suspended Solids	10.0	21.3	8.0
Total Phosphorus	0.10	0.21	0.09
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	8.52	3.0
Spring (Apr 1 – May 31)	1.0	2.13	0.8
Summer (Jun 1 – Sep 31)	0.7	1.49	0.5
Fall (Oct 1 – Nov 30)	1.0	2.13	0.8
E coli	200 cfu/100 mL[2]	N/A	100 cfu/100 mL[2]
pH	6.0-9.5		6.5-8.5

Notes:
1. Based on monthly average.
2. Based on monthly geometric mean density.

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Appendix A: 2-D Analytical Approximation of Mixing Zone

An analytical approximation of the two-dimensional advective-dispersive transport equation (equation A-1 below) was developed for comparison purposes. Key model assignments are summarized in Table A-1.

$$v\frac{\partial C}{\partial x} = E\left[\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial y^2}\right] - kC \pm S \quad \text{[A-1]}$$

Where:

C = Concentration of contaminate (mg/L)
E = Dispersion coefficient (m^2/s)
v = Velocity (m/s)
k = Decay constant (s^{-1})
S = Sources and sinks (mg/L/s)

The dispersion coefficient in Equation A-1, *E*, was approximated using an empirical relationship using an approach recommended by Fischer (Fischer et al., 1979) and is presented below as Equation 2.

$$E \cong 0.6d\sqrt{gdS} = 0.6du \quad \text{[2]}$$

Where:

d = Channel depth (m)
g = Gravitational constant (m/s^2)
S = Average channel slope (m/m)
u = Channel shear velocity (m/s)

A centre-channel discharge was assumed and plume superposition was applied to address channel boundaries as discussed in Fischer et al. (Fischer et al. 1979). Importantly, this mixing zone solution is an approximation of actual conditions and requires several assumptions to be valid, including:

- Effluent is completely mixed vertically.
- Momentum of effluent flow can be ignored.
- Steady state conditions have been achieved.
- The channel is rectangular, with constant width.
- Effluent discharge is introduced in the center of the channel.

Key parameter assignments for the mixing zone solution are summarized in Table 13. Average slope and velocity were defined using GRCA's HEC-RAS model. The discharge was assumed to be a right-bank ditch, perpendicular to the river.

Table A-1. Grand River Mixing Zone Model Parameter Assignments

Parameter	Value
Channel Width	20.0 m
Average Channel Depth - Low-Flow	0.15 m
WPCP Flow	2,131 m^3/d
River Low-Flow	0.4 m^3/s
Average Channel Slope	0.001 m/m
Shear velocity	0.038 m/s (Equation 2)
Dispersion Coefficient	0.003 m^2/s (Equation 2)

Model results are summarised in Figure A-1. In general, completely mixed conditions are achieved at a downstream distance of approximately 1000 m. At a distance of 50 m, the maximum effluent mass fraction is approximately 14%, while at a distance of 100 m, the effluent mass fraction is less than 11%.

x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	100.0	51.7	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	72.4	51.4	18.5	3.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	51.2	43.1	25.8	11.0	3.3	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	41.8	37.3	26.5	15.0	6.8	2.4	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	36.2	33.2	25.7	16.8	9.2	4.3	1.7	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	32.4	30.2	24.6	17.5	10.8	5.9	2.8	1.1	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	29.5	27.9	23.5	17.7	11.9	7.1	3.8	1.8	0.8	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	27.3	26.0	22.5	17.6	12.5	8.1	4.7	2.5	1.2	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	25.6	24.5	21.6	17.4	12.9	8.8	5.5	3.2	1.7	0.8	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	24.1	23.2	20.7	17.1	13.1	9.3	6.2	3.8	2.1	1.1	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	22.9	22.1	20.0	16.8	13.2	9.7	6.7	4.3	2.6	1.4	0.8	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	21.8	21.1	19.3	16.5	13.3	10.0	7.1	4.8	3.0	1.8	1.0	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	20.9	20.3	18.6	16.2	13.2	10.3	7.5	5.2	3.4	2.1	1.2	0.7	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
26	20.1	19.5	18.1	15.8	13.2	10.4	7.8	5.5	3.7	2.4	1.5	0.8	0.5	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
28	19.3	18.9	17.5	15.5	13.1	10.5	8.0	5.9	4.1	2.7	1.7	1.0	0.6	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0
30	18.7	18.3	17.1	15.2	13.0	10.6	8.2	6.1	4.4	3.0	1.9	1.2	0.7	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0
32	18.1	17.7	16.6	14.9	12.9	10.6	8.4	6.4	4.6	3.2	2.1	1.4	0.8	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0
34	17.6	17.2	16.2	14.6	12.7	10.6	8.5	6.6	4.9	3.4	2.4	1.5	1.0	0.6	0.3	0.2	0.1	0.1	0.0	0.0	0.0
36	17.1	16.7	15.8	14.4	12.6	10.6	8.6	6.7	5.1	3.7	2.6	1.7	1.1	0.7	0.4	0.2	0.1	0.1	0.0	0.0	0.0
38	16.6	16.3	15.5	14.1	12.5	10.6	8.7	6.9	5.3	3.9	2.8	1.9	1.2	0.8	0.5	0.3	0.2	0.1	0.0	0.0	0.0
40	16.2	15.9	15.1	13.9	12.3	10.6	8.7	7.0	5.4	4.1	2.9	2.0	1.4	0.9	0.6	0.3	0.2	0.1	0.1	0.0	0.0
42	15.8	15.5	14.8	13.6	12.2	10.5	8.8	7.1	5.6	4.2	3.1	2.2	1.5	1.0	0.7	0.4	0.2	0.1	0.1	0.0	0.0
44	15.5	15.2	14.5	13.4	12.0	10.5	8.8	7.2	5.7	4.4	3.3	2.4	1.6	1.1	0.7	0.5	0.3	0.2	0.1	0.1	0.0
46	15.1	14.9	14.2	13.2	11.9	10.4	8.8	7.3	5.8	4.5	3.4	2.5	1.8	1.2	0.8	0.5	0.3	0.2	0.1	0.1	0.0
48	14.8	14.6	14.0	13.0	11.8	10.3	8.8	7.4	5.9	4.7	3.6	2.6	1.9	1.3	0.9	0.6	0.4	0.2	0.1	0.1	0.0
50	14.5	14.3	13.7	12.8	11.6	10.3	8.9	7.4	6.0	4.8	3.7	2.8	2.0	1.4	1.0	0.7	0.4	0.3	0.2	0.1	0.1
52	14.3	14.0	13.5	12.6	11.5	10.2	8.8	7.5	6.1	4.9	3.8	2.9	2.1	1.5	1.1	0.7	0.5	0.3	0.2	0.1	0.1
54	14.0	13.8	13.3	12.4	11.4	10.2	8.8	7.5	6.2	5.0	3.9	3.0	2.3	1.6	1.2	0.8	0.5	0.4	0.2	0.1	0.1
56	13.8	13.6	13.1	12.3	11.3	10.1	8.8	7.5	6.3	5.1	4.0	3.1	2.4	1.7	1.3	0.9	0.6	0.4	0.3	0.2	0.1
58	13.6	13.4	12.9	12.1	11.1	10.0	8.8	7.5	6.3	5.2	4.1	3.2	2.5	1.8	1.3	0.9	0.7	0.4	0.3	0.2	0.1
60	13.3	13.1	12.7	12.0	11.0	9.9	8.8	7.6	6.4	5.3	4.2	3.3	2.6	1.9	1.4	1.0	0.7	0.5	0.3	0.2	0.1
62	13.2	13.0	12.5	11.8	10.9	9.9	8.7	7.6	6.4	5.3	4.3	3.4	2.7	2.0	1.5	1.1	0.8	0.5	0.4	0.2	0.2
64	13.0	12.8	12.3	11.7	10.8	9.8	8.7	7.6	6.5	5.4	4.4	3.5	2.8	2.1	1.6	1.2	0.8	0.6	0.4	0.3	0.2
66	12.8	12.6	12.2	11.5	10.7	9.7	8.7	7.6	6.5	5.4	4.5	3.6	2.8	2.2	1.7	1.2	0.9	0.6	0.4	0.3	0.2
68	12.6	12.4	12.0	11.4	10.6	9.7	8.7	7.6	6.5	5.5	4.5	3.7	2.9	2.3	1.7	1.3	0.9	0.7	0.5	0.3	0.2
70	12.5	12.3	11.9	11.3	10.5	9.6	8.6	7.6	6.6	5.6	4.6	3.8	3.0	2.4	1.8	1.4	1.0	0.7	0.5	0.4	0.2
72	12.3	12.1	11.7	11.2	10.4	9.5	8.6	7.6	6.6	5.6	4.7	3.8	3.1	2.4	1.9	1.4	1.1	0.8	0.6	0.4	0.3
74	12.2	12.0	11.6	11.0	10.3	9.5	8.6	7.6	6.6	5.6	4.7	3.9	3.1	2.5	1.9	1.5	1.1	0.8	0.6	0.4	0.3
76	12.1	11.9	11.5	10.9	10.2	9.4	8.5	7.6	6.6	5.7	4.8	4.0	3.2	2.6	2.0	1.6	1.2	0.9	0.6	0.5	0.3
78	11.9	11.7	11.4	10.8	10.1	9.4	8.5	7.6	6.6	5.7	4.8	4.0	3.3	2.6	2.1	1.6	1.2	0.9	0.7	0.5	0.3
80	11.8	11.6	11.2	10.7	10.1	9.3	8.4	7.6	6.6	5.7	4.9	4.1	3.3	2.7	2.1	1.7	1.3	1.0	0.7	0.5	0.4
82	11.7	11.5	11.1	10.6	10.0	9.2	8.4	7.5	6.6	5.8	4.9	4.1	3.4	2.8	2.2	1.7	1.3	1.0	0.8	0.6	0.4
84	11.6	11.4	11.0	10.5	9.9	9.2	8.4	7.5	6.7	5.8	5.0	4.2	3.5	2.8	2.3	1.8	1.4	1.1	0.8	0.6	0.4
86	11.5	11.3	10.9	10.4	9.8	9.1	8.3	7.5	6.7	5.8	5.0	4.2	3.5	2.9	2.3	1.8	1.4	1.1	0.8	0.6	0.5
88	11.4	11.2	10.8	10.4	9.8	9.1	8.3	7.5	6.7	5.8	5.0	4.3	3.6	2.9	2.4	1.9	1.5	1.2	0.9	0.7	0.5
90	11.3	11.1	10.7	10.3	9.7	9.0	8.3	7.5	6.7	5.9	5.1	4.3	3.6	3.0	2.4	2.0	1.5	1.2	0.9	0.7	0.5
92	11.2	11.0	10.6	10.2	9.6	9.0	8.2	7.5	6.7	5.9	5.1	4.4	3.7	3.0	2.5	2.0	1.6	1.2	1.0	0.7	0.5
94	11.1	10.9	10.6	10.1	9.6	8.9	8.2	7.4	6.7	5.9	5.1	4.4	3.7	3.1	2.5	2.1	1.6	1.3	1.0	0.8	0.6
96	11.1	10.8	10.5	10.0	9.5	8.9	8.2	7.4	6.7	5.9	5.1	4.4	3.8	3.1	2.6	2.1	1.7	1.3	1.0	0.8	0.6
98	11.0	10.7	10.4	10.0	9.4	8.8	8.1	7.4	6.7	5.9	5.2	4.5	3.8	3.2	2.6	2.2	1.7	1.4	1.1	0.8	0.6
100	10.9	10.7	10.3	9.9	9.4	8.8	8.1	7.4	6.7	5.9	5.2	4.5	3.8	3.2	2.7	2.2	1.8	1.4	1.1	0.9	0.7
102	10.8	10.6	10.3	9.8	9.3	8.7	8.1	7.4	6.7	5.9	5.2	4.5	3.9	3.3	2.7	2.2	1.8	1.5	1.2	0.9	0.7
104	10.8	10.5	10.2	9.8	9.3	8.7	8.0	7.4	6.6	5.9	5.2	4.6	3.9	3.3	2.8	2.3	1.9	1.5	1.2	0.9	0.7
106	10.7	10.5	10.1	9.7	9.2	8.6	8.0	7.3	6.6	5.9	5.2	4.6	3.9	3.4	2.8	2.3	1.9	1.5	1.2	1.0	0.8
108	10.6	10.4	10.1	9.6	9.2	8.6	8.0	7.3	6.6	5.9	5.3	4.6	4.0	3.4	2.9	2.4	2.0	1.6	1.3	1.0	0.8
110	10.6	10.3	10.0	9.6	9.1	8.6	7.9	7.3	6.6	6.0	5.3	4.6	4.0	3.4	2.9	2.4	2.0	1.6	1.3	1.0	0.8
112	10.5	10.3	9.9	9.5	9.1	8.5	7.9	7.3	6.6	6.0	5.3	4.7	4.0	3.5	2.9	2.5	2.0	1.7	1.3	1.1	0.8
114	10.5	10.2	9.9	9.5	9.0	8.5	7.9	7.3	6.6	6.0	5.3	4.7	4.1	3.5	3.0	2.5	2.1	1.7	1.4	1.1	0.9
250	8.7	8.5	8.2	7.9	7.6	7.2	6.9	6.6	6.2	5.8	5.5	5.1	4.8	4.4	4.1	3.7	3.4	3.1	2.8	2.5	2.3
500	7.8	7.6	7.3	7.1	6.9	6.7	6.4	6.2	6.0	5.7	5.5	5.2	5.0	4.8	4.5	4.3	4.1	3.8	3.6	3.4	3.2
1000	7.1	6.9	6.8	6.6	6.5	6.3	6.1	6.0	5.8	5.7	5.5	5.3	5.2	5.0	4.8	4.7	4.5	4.3	4.2	4.0	3.9
2000	6.6	6.5	6.4	6.3	6.2	6.1	5.9	5.8	5.7	5.6	5.5	5.4	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.3

Figure A-1. Analytical Approximation of the Mixing Zone Solution (Percentage Effluent)

September 11th, 2017

Water Supply and Sewage Servicing Master Plan
Town of Grand Valley

Technical Memorandum

Assimilative Capacity Assessment

DRAFT

1 INTRODUCTION

1.1 Background

Profound Engineering was retained by Burnside and Associates to complete an assimilative capacity assessment of the Grand River in the vicinity of the existing wastewater treatment plant (WPCP) discharge for the Grand Valley facility. This assessment was completed in support of a water supply and sewage servicing master plan and addresses a proposed increase in in the Grand Valley WPCP average daily flow from 1,244 m^3/d to an anticipated future average daily flow of 2,547 m^3/d. The Grand Valley WPCP operates under CofA 9706-7KWQ57 which identifies compliance and design objectives for final effluent quality (Table 1).

Table 1. Grand Valley Effluent Compliance and Objective Limits

Effluent Parameter	Effluent Compliance Limits[1]		Effluent Objective Limits
	Average Concentration (mg/L)	Average Loading (kg/d)	Average Concentration (mg/L)
$cBOD_5$	10.0	12.4	8.0
Total Suspended Solids	10.0	12.4	8.0
Total Phosphorus	0.15	0.19	0.13
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	4.98	3.0
Spring (Apr 1 – May 31)	1.0	1.24	0.8
Summer (Jun 1 – Sep 31)	0.7	0.87	0.6
Fall (Oct 1 – Nov 30)	1.0	1.24	0.8
E coli	200 cfu/100 mL[2]	N/A	100 cfu/100 mL[2]
pH	6.0-9.5		6.5-8.5

Notes:
1. Based on monthly average.
2. Based on monthly geometric mean density.

The discussion provided below includes an assessment of the ambient water quality and current conditions in the Grand River near the Grand Valley WPCP, a summary of low-flow conditions, a mixing zone analysis and the development of proposed effluent objectives and limits for future flow conditions.

1.2 Objectives

The objectives of this assessment are as follows:

- Define ambient water quality and verify low-flow conditions for design purposes.

- Complete an assessment of assimilative capacity assessment of the receiving water for key water quality parameters included $cBOD_5$, un-ionized ammonia, total ammonia, total phosphorus, total suspended solids, *E coli* and nitrate.
- Complete a mixing zone analysis.
- Develop recommendations for effluent limits for a future average daily flow of 2,547 m^3/d.

2 AMBIENT CONDITIONS

2.1 Water Quality

Representative background water quality was defined by examining water quality in the vicinity of the Grand Valley WPCP effluent discharge. For analysis purposes, the 75th percentile threshold was applied to characterize ambient conditions, or in the case of dissolved oxygen, the 25th percentile, as recommended by the MOE (MOE, 1994). For each water quality parameter, with the exception of nitrate, a comparison of representative ambient water quality with Provincial Water Quality Objectives (PWQO) was complete in order to establish the appropriate MOE policy to apply for assimilative capacity assessment, either Policy I or Policy II. Policy I corresponds to areas where the ambient concentration is less than the PWQO, while Policy 2 corresponds to areas where the ambient concentration is greater than the PWQO. If Policy I applies, future water concentrations must be maintained at or below the PWQO, while if Policy II applies, all practical measures shall be taken to upgrade the water quality to the Objectives. For nitrate, since there is no PWQO, Canadian Water Quality Guideline (CWQG) was applied.

For the purposes of this analysis, ambient water quality was derived from Provincial Water Quality Monitoring Network (PWQMN) station at Leggatt, upstream of the Grand Valley WPCP outfall, as well as recent monitoring completed by the Grand River Conservation Authority, GRCA. Data obtained from the PWQMN station at Leggatt was collected from 1977 through 2015, while the GRCA data spanned 2015 and 2016. In some cases, combining GRCA and PWQMN monitoring information was not possible since different Method Detection Limits were applied.

2.1.1 Total Phosphorus

The MOE PWQO for total phosphorus is 0.3 mg/L. A summary of ambient total phosphorus concentrations is provided in table 2. In general, with respect to total phosphorus, the Grand River near Grand Valley is MOE Policy I during the winter and fall, and MOE Policy II during the spring and summer. As such, all practical measures will be necessary to reduce effluent total phosphorus concentrations during the spring and summer, and if feasible, current allowable total phosphorus loadings must be maintained or reduced.

Table 2. Ambient Total Phosphorus 1977-2015

Month	Mean TP (mg/L)	75th Percentile TP (mg/L)	Number of Observations
January	<u>*0.033*</u>	0.027	20
February	<u>*0.032*</u>	<u>*0.035*</u>	20
March	<u>*0.041*</u>	<u>*0.054*</u>	23
April	<u>*0.032*</u>	<u>*0.041*</u>	28
May	0.024	0.023	29
June	<u>*0.031*</u>	<u>*0.035*</u>	30
July	<u>*0.042*</u>	<u>*0.054*</u>	33
August	<u>*0.038*</u>	<u>*0.047*</u>	34
September	<u>*0.031*</u>	<u>*0.033*</u>	28
October	0.024	0.023	27
November	0.025	0.028	24
December	<u>*0.033*</u>	0.021	19
Annual	<u>***0.032***</u>	<u>***0.036***</u>	**315**

2.1.2 Un-ionized Ammonia

The percentage of un-ionized ammonia in aqueous solution varies with temperature and pH, with percentages increasing with increasing temperature and pH. Table 3, 4, 5 and 6 provide a summary of ambient temperature, pH, total ammonia and un-ionized ammonia, respectively. Un-ionized ammonia was derived from synoptic measurements of field pH, field temperature and laboratory total ammonia analysis results. The threshold PWQO for un-ionized ammonia is 0.02 mg/L as N.

Table 3. Ambient Temperature 1977-2015

Month	Mean Temp (^{o}C)	75th Percentile Temp (^{o}C)	Number of Observations
January	0.7	1.0	16
February	0.9	1.3	16
March	2.1	2.5	22
April	8.2	12.0	28
May	14.8	17.5	29
June	19.9	21.6	30
July	22.8	24.8	32
August	21.1	22.3	31
September	16.3	18.0	28
October	9.0	10.9	27
November	3.8	5.9	26
December	1.5	1.4	19
Annual	**11.6**	**19.4**	**304**

Table 4. Ambient pH 1977-2015

Month	Mean pH	75th Percentile pH	Number of Observations
January	7.44	8.09	10
February	7.77	7.89	11
March	7.61	7.80	11
April	8.07	8.18	18
May	8.27	8.35	19
June	8.25	8.39	20
July	8.39	8.58	21
August	8.34	8.50	20
September	8.51	*8.75*	18
October	8.26	8.40	16
November	8.08	8.28	15
December	8.07	8.30	9
Annual	**8.15**	**8.38**	**304**

The PWQO for pH states that the pH should be maintained within the range of 6.5 and 8.5 to protect aquatic life. Based on the summary provided in Table 4, ambient pH is highest in the summer months, with 75th percentile levels exceeding 8.7 in September. Presumably, this peak is related to increases in aquatic plant densities during the summer months. With the exception of September, the Grand River is Policy 1 with respect to pH.

Table 5. Ambient Total Ammonia 1977-2015

Month	Mean TAN (mg/L as N)	75th Percentile TAN (mg/L as N)	Number of Observations
January	0.036	0.050	0
February			
March			4
April	0.042	0.056	8
May	0.032	0.032	8
June	0.040	0.041	9
July	0.035	0.035	7
August	0.023	0.030	8
September	0.027	0.033	7
October	0.020	0.025	6
November	0.028	0.038	6
December			0
Annual	**0.032**	**0.039**	**41**

Ambient total ammonia is highest during the spring; however, relatively few measurements are available for the winter months.

Table 6. Ambient Un-ionized 1977-2015

Month	Mean UIA (mg/L as N)	75th Percentile UIA (mg/L as N)	Number of Observations
January	0.007	N/A	1
February	0.002	N/A	1
March	0.000	0.000	4
April	0.001	0.001	9
May	0.002	0.002	9
June	0.004	0.005	10
July	0.005	0.006	10
August	0.003	0.004	10
September	0.005	0.003	10
October	0.001	0.001	9
November	0.000	0.001	7
December	0.000	0.000	2
Annual	**0.001**	**0.003**	**82**

Ambient un-ionized ammonia is highest during the summer, however, remains below the PWQO threshold of 0.02 mg/L as N. The Grand River is therefore MOE Policy I wither respect to un-ionized ammonia.

2.1.3 Dissolved Oxygen and $cBOD_5$

Ambient dissolved oxygen was evaluated by reviewing long term PWQMN monitoring results and recent continuous monitoring results collected by GRCA. Since low concentrations are indications of degraded water quality, the 25th percentile was applied for comparison with PWQO's. The PWQO threshold for dissolved oxygen in warm water fisheries is 47% saturation. At 5^oC the PWQO is 6 mg/L, while above 20^oC the PWQO is 4 mg/L. A summary of historical PWQMN monitoring is provided in Table 7, while time-series plots of continuous dissolved oxygen monitoring for 2015 and 2016 are provided in Figures 1 and 2, respectively. For both long-term and continuous dissolved oxygen monitoring, the Grand River may be considered MOE Policy I with respect to dissolved oxygen.

No recent (post 1992) PWQMN $cBOD_5$ measurements are available, however, the 75th percentile cBOD for $cBOD_5$ monitoring results prior to 1992 is 1.13 mg/L. A 2003 field program completed by RJ Burnside and Associates (RJB, 2003) measured $cBOD_5$ concentrations ranging from approximately 0.5 to 1.7 mg/L. Therefore, based available monitoring information, a conservative estimate of ambient $cBOD_5$ concentration is 2.0 mg/L.

Table 7. Ambient Dissolved Oxygen 1977-2015

Month	Mean DO (mg/L)	25th Percentile DO (mg/L)	Number of Observations
January	11.81	10.28	20
February	11.55	10.87	20
March	11.44	10.25	22
April	11.69	11.04	27
May	10.94	10.38	28
June	9.79	8.83	30
July	8.87	8.28	32
August	9.26	8.73	31
September	10.17	9.67	27
October	11.89	11.20	27
November	12.82	12.25	26
December	12.57	11.90	19
Annual	**10.92**	**9.70**	**309**

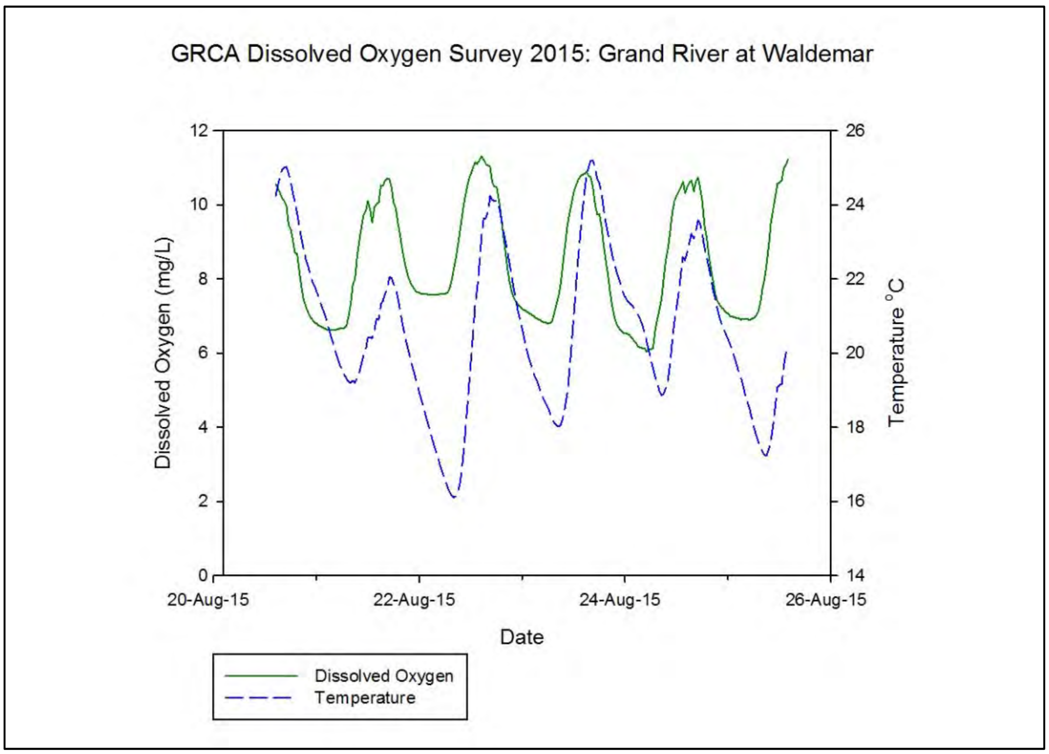

Figure 1. Diurnal Dissolved Oxygen: August 2015

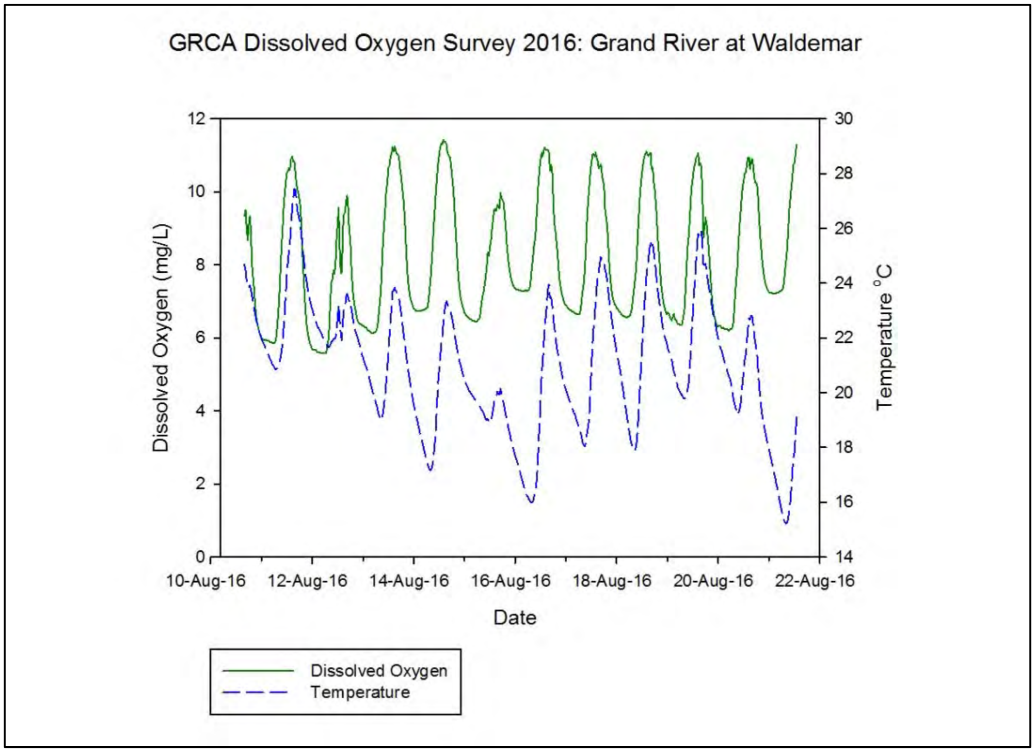

Figure 2. Diurnal Dissolved Oxygen: August 2016

The PWQMN dissolved oxygen measurements are typically collected during the day and may not reflect minimum dissolved oxygen levels, particularly if aquatic plant respiration is a significant factor influencing ambient dissolved oxygen levels. An indication of diurnal variability in dissolved oxygen is provided by GRCA's continuous monitoring results for 2015 and 2016 (Figures 1 and 2). These results indicate that dissolved oxygen varies from above 10 mg/L during the day to approximately 6 mg/L during the pre-dawn hours, where aquatic plant respiration would contribute to minimum dissolved oxygen levels. During the same monitoring period, relatively large fluctuations in ambient temperature were observed, ranging from approximately 15^{o}C at night to above 26^{o}C during the mid-afternoon. As illustrated, aquatic plant respiration does reduce dissolved oxygen concentrations during the night, however, levels remain above PWQO warm water thresholds, confirming that the MOE Policy I assumption for dissolved oxygen is appropriate.

2.1.4 *E. coli*

No PWQMN *E.coli* data are available post-1995 upstream of the Grand Valley WPCP discharge location, and only a few post-1995 measurements are available from the downstream PWQMN dataset (Station 16018406702), collected during the summer of 2005. Additional *E.coli* data are available from 2003 and 2006 R.J. Burnside led field programs. Lumped geometric mean concentrations exceed the PWQO of 100 cfu/100mL for June and September, while 75th percentile concentrations exceed this threshold from May through September.

Although monitoring results are limited, it is reasonable to assume the receiver is MOE Policy II from May through September and MOE Policy I the remainder of the year.

2.1.5 Suspended Solids

There are no PWQO values for total suspended solids (TSS), however, a review of recommended TSS guidelines for the protection of aquatic life (EPA, 2003) indicate that a 30-day average concentration of 30 mg/L is a reasonable threshold. A statistical summary of TSS concentrations in the Grand River upstream of Grand Valley, provided below as Table 8, indicates that 75th percentile ambient TSS concentrations are less than this threshold for all months. However, concentrations are generally higher during the spring.

Table 8. Ambient Total Suspended Solids 1990-2015

Month	Mean TSS (mg/L)	75th Percentile TSS (mg/L)	Number of Observations
January	3.9	4.6	3
February	3.1	3.6	3
March	12.3	14.3	6
April	16.2	23.6	10
May	8.3	6.3	10
June	10.1	7.7	10
July	9.9	17.6	9
August	9.0	8.1	15
September	7.8	7.8	12
October	4.1	5.5	10
November	9.2	5.4	7
December	2.4	2.6	2
Annual	**8.9**	**7.7**	**97**

2.1.6 Nitrate

There is no PWQO value for nitrate, however, there is a Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. The CWQG is 2.93 mg/L as N (CCME, 2012). A summary of ambient nitrate concentrations in the Grand River upstream of Grand Valley is provided below as Table 9. As with other historical water quality measurements, only limited results are available during the winter. Despite the winter data limitations, all 75th percentile nitrate concentrations fall below the 2.93 mg/L as N CWQG threshold, indicating that assimilative capacity is available for nitrate.

Table 9. Ambient Total Nitrate as N 1977-2015

Month	Mean TSS (mg/L)	75th Percentile TSS (mg/L)	Number of Observations
January	0.89	1.16	2
February	0.64	N/A	1
March	0.86	0.98	5
April	0.78	1.14	9
May	0.65	0.89	8
June	0.23	0.37	10
July	0.26	0.11	10
August	0.27	0.36	10
September	0.16	0.13	9
October	0.72	1.10	9
November	1.11	1.45	8
December	0.53	0.57	2
Annual	**0.53**	**0.87**	**83**

2.2 Flow

Conventional low-flow frequency analysis for estimation of 7Q20 flow is not appropriate at this location due to flow regulation. An initial 7Q20 flow target of 0.42 m^3/s was derived from a 1986 reservoir yield study, and re-confirmed by GRCA in 2004 and again in 2016 (GRCA, 2016). In support of this assimilative capacity assessment, the most recent GRCA publication (2016) addressing low flow in the Grand River near Grand Valley, authored by D. Boyd and S. Shifflett, was reviewed and highlights are provided below:

- Low flow upstream of the Grand Valley WPCP is controlled by the Luther Dam discharge.
- Luther Dam was constructed in 1953 for the purpose of low flow augmentation.
- A review of reservoir yield, combined with external base flow tributary to Grand Valley, results in a sustainable annual low flow target of 0.42 m^3/s. This value was adopted by GRCA in 2004.
- A brief assessment of potential climate change impacts indicate that the accepted low flow target of 0.42 m^3/s can be maintained in a future climate.
- A frequency assessment of historical low flow information demonstrates that the 0.42 m^3/s low flow target is a reasonable approximation of the 7Q20 flow.
- Following an assessment of measurement and estimation uncertainty, GRCA recommended a 7Q20 flow of 0.4 m^3/s.

Therefore, for the purposes of the current assimilation capacity assessment, GRCA's recommended 7Q20 of 0.4 m^3/s was adopted.

3 DETERMINATION OF EFFLUENT LIMITS

3.1 Effluent $cBOD_5$

For the expanded WPCP, it is proposes to maintain the existing $cBOD_5$ compliance limit of 10 mg/L and the existing design objective of 8 mg/L. The potential impact on instream dissolved oxygen was evaluated using the Streeter Phelps equation. The Alabama Department of Environmental Management, ADEM, developed a straightforward spreadsheet solution of the Streeter Phelps equation and this public-domain tool was applied for the current application (ADEM, 2001). In addition to carbonaceous biological oxygen demand, the ADEM model also addresses nitrogenous oxygen demand. A summary of key model inputs are provided below.

Channel Description: The physical characteristics of the channel, including reach lengths, bottom slopes and channel width were defined using a HEC-RAS model provided by GRCA. Although the HEC-RAS model was designed for flood analysis, there were multiple cross-sections included in the model that provided a general indication of the low-flow channel shape and approximate slope. A total of 20 kilometers of river length, downstream of the WPCP were modelled.

Velocity and Depth: Reach depth and velocities were defined by applying the 7Q20 of 0.4 m^3/s to the HEC-RAS model.

River Re-aeration: Re-aeration was estimated using the Tsivoglou and Neal equation as recommended by ADEM (ADEM, 2001) and the US EPA (EPA, 1985). Numerous approaches are available for estimation of re-aeration, however, the Tsivoglou and Neal equation provides a simple empirical approach, suitable for shallow streams and relies only on velocity and slope. Estimated re-aeration rates range from 3.1 to 6.1 d^{-1}, which compare favourably with previous estimates for this location in the Grand River (XCG, 2013).

Ambient Water Quality: Ambient water quality was defined as 75th percentile summer conditions as presented in Section 2. Important parameter assignments include $cBOD_5$ at 2.0 mg/L, Ammonia Nitrogen at 0.06 mg/L as N, and dissolved oxygen at 8.5mg/L.

Effluent Water Quality: Effluent water quality was defined according to the existing CofA compliance limits provided as Table 1. Importantly, effluent dissolved oxygen was assumed to be 0 mg/L to provide a conservative estimate water quality impacts.

Numerous model runs were completed in order to assess parameter sensitivity and an illustration of typical model results for summer low flow conditions is provided in Figure 3. As illustrated, the peak dissolved oxygen deficit is less than 0.2 mg/L. Since the Grand River is MOE Policy II with respect to Dissolved Oxygen, these model results demonstrate that the existing compliance limit and design objective, of 10 and 8 mg/L $cBOD_5$, respectively, are appropriate for future WPCP effluent.

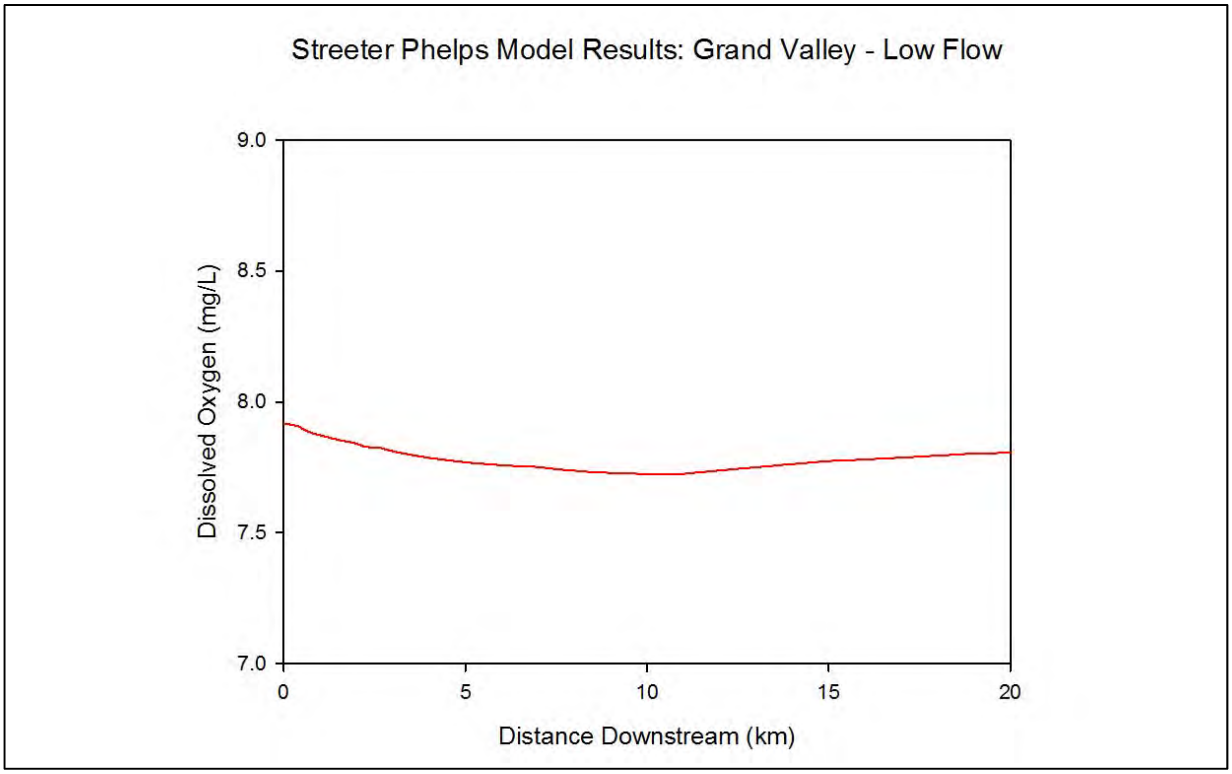

Figure 3. Streeter-Phelps Dissolved Oxygen Solution for Summer Low Flow Conditions

3.2 Effluent Total Suspended Solids

For the expanded WPCP, maintaining the existing TSS compliance limit of 10 mg/L and the existing design objective of 8 mg/L, is proposed. Although there is no PWQO or CWQG for TSS, all 75th percentile concentrations are below the EPA's threshold of 30 mg/L. At the design flow of 2,547 m^3/d and the current CofA TSS compliance limit of 10 mg/L, the ambient TSS concentration would marginally increase (less than 2%) during the winter, and actually improve during the summer (approximately 4%). Therefore, it is proposed that the existing compliance limit of 10 mg/L and the design objective of 8 mg/L be maintained for the proposed WPCP expansion.

3.3 Effluent Total Phosphorus

As discussed in Section 2, the Grand River in the vicinity of the Grand Valley WPCP outfall is MOE Policy II with respect to total phosphorus and no assimilative capacity is available in the receiver. Furthermore, for a MOE Policy II receiver, MOE policy states: "*Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives*." The existing CofA compliance limit for total phosphorus is 0.15 mg/L, and the corresponding loading limit is 0.19 kg/d. To maintain this loading limit at future flow conditions would require reducing the compliance limit from 0.15 mg/L to 0.073 mg/L, which may be difficult to achieve using best available technology.

An important consideration in this analysis is the relative impact associated with a future total phosphorus load if the existing compliance concentration is maintained for future conditions. Under existing conditions, total phosphorus river load downstream of the WPCP, for peak ambient total phosphorus conditions (July) and low flow, would be 2.05 kg/d, or 1.87 kg/d upstream plus 0.19 WPCP load. Assuming the compliance concentration is maintained for future conditions, the peak ambient total phosphorus load downstream of the WPCP would increase to 2.25 kg/d, or 1.87 kg/d upstream plus 0.38 WPCP load, an increase of less than 10%.

A final evaluation of all practical treatment alternatives is required in order to determine what final effluent compliance limit for total phosphorus is appropriate. In support of that effort, a summary of total phosphorus loading downstream of the WPCP for peak ambient total phosphorus conditions (July), 7Q20 low flow, and a range of effluent compliance limits, is provided in Table 10 below. A compliance total phosphorus limit of 0.10 mg/L is approaching practical limits that would be achievable. The total increase in downstream load associated with this limit is approximately 3.3%. It is proposed that this marginal increase is acceptable and consistent with MOE Policy and the future CofA for total phosphorus should be 0.1 mg/L.

Table 10. 75th Percentile Total Phosphorus Loading Downstream of the WPCP for Future Conditions

Scenario	Proposed Effluent TP limit (mg/L)	Downstream TP Load (kg/d)	Increase Relative to Existing Conditions (%)
Maintain Existing CofA Concentration Limit	0.15	2.25	9.5
Practical Limit for Effluent Phosphorus	0.10	2.12	3.3
Maintain Existing CofA Loading Limit	0.07	2.05	0.0

3.4 Effluent Total Ammonia

Evaluation of effluent ammonia requires an assessment of both effluent toxicity and in-stream PWQO compliance.

3.4.1 Effluent Toxicity

The currently accepted un-ionized ammonia limit for effluent toxicity is 0.1 mg/L as N. Monthly 75th percentile ammonia dissociation constants for the WPCP effluent were derived previously (XCG, 2013) using historical effluent monitoring results. These dissociation ratios, combined with the existing CofA TAN limits, were applied to evaluate effluent toxicity for future conditions. The resultant effluent un-ionized ammonia concentrations are summarized in Table 11. As illustrated, end-of-pipe un-ionized ammonia is consistently above the toxicity threshold of 0.1 mg/L

Table 11. Estimated End-of-Pipe Un-ionized Ammonia

Month	Effluent TAN (mg/L as N)	Dissociation Constant (%) (XCG, 2003)	Effluent Un-Un-Ionized Ammonia (mg/L as N)
January	4.0	0.9	0.036
February	4.0	0.9	0.036
March	4.0	0.9	0.036
April	1.0	1.4	0.014
May	1.0	1.4	0.014
June	0.7	1.8	0.013
July	0.7	1.8	0.013
August	0.7	1.8	0.013
September	0.7	1.8	0.013
October	1.0	1.2	0.012
November	1.0	1.2	0.012
December	1.0	0.9	0.009

3.4.2 Un-Ionized Ammonia in-Stream

The in-stream ammonia dissociation constants, and ambient TAN, were derived from synoptic measurements of TAN, pH and Temperature and are presented in Table 12. Limited water quality sampling during the winter months required lumping January through March, and November and December results. Estimates of un-ionized ammonia concentrations were generated using the TAN limits as defined in the existing CofA and are summarized in Table 12. As illustrated, monthly un-ionized concentrations remain below the PWQO threshold of 0.02 mg/L as N for all months of the year.

Table 12. In-Stream Un-Ionized Ammonia Downstream of WPCP

Month	75th Percentile Ambient TAN (mg/L as N)	Effluent TAN (mg/L as N)	Mass Balance TAN (mg/L as N)	Dissociation Constant (%)	Downstream Un-Ionized Ammonia (mg/L as N)
January	0.050	4.0	0.32	1.1%	0.004
February		4.0	0.27		0.002
March		4.0	0.27		0.002
April	0.056	1.0	0.12	3.2%	0.004
May	0.032	1.0	0.10	6.9%	0.007
June	0.041	0.7	0.09	9.8%	0.008
July	0.035	0.7	0.08	17.5%	0.014
August	0.030	0.7	0.08	12.9%	0.010
September	0.033	0.7	0.08	16.1%	0.013
October	0.025	1.0	0.09	4.7%	0.004
November	0.038	1.0	0.10	2.5%	0.003
December		1.0	0.07	1.8%	0.001

3.5 Effluent *E. coli*

As discussed in Section 2, the Grand River near Grand Valley is considered MOE Policy II with respect to *E.coli,* and therefore, the effluent should not further degrade the quality of the water. A compliance limit of 200 cfu/100 mL and a design objective of 100 cfu/100 mL are proposed.

4 MIXING ZONE ASSESSMENT

4.1 Approach

An analytical solution of the two-dimensional advective-dispersive transport equation (Equation 1) was developed to define the approximate mixing zone downstream of the Grand River WPCP discharge. The results are applied to un-ionized ammonia, using the existing CofA compliance limits and future conditions.

$$v\frac{\partial C}{\partial x} = E\left[\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial y^2}\right] - kC \pm S \quad [1]$$

Where:

C = Concentration of contaminate (mg/L)
E = Dispersion coefficient (m^2/s)

v = Velocity (m/s)
k = Decay constant (s^{-1})
S = Sources and sinks (mg/L/s)

The dispersion coefficient in Equation 1, E, was approximated using an empirical relationship using an approach recommended by Fischer (Fischer et al., 1979) and is presented below as Equation 2.

$$E \cong 0.6d\sqrt{gdS} = 0.6du \quad [2]$$

Where:

d = Channel depth (m)
g = Gravitational constant (m/s^2)
S = Average channel slope (m/m)
u = Channel shear velocity (m/s)

A centre-channel discharge was assumed and plume superposition was applied to address channel boundaries as discussed in Fischer et al. (Fischer et al. 1979). Importantly, this mixing zone solution is an approximation of actual conditions and requires several assumptions to be valid, including:

- Effluent is completely mixed vertically.
- Momentum of effluent flow can be ignored.
- Steady state conditions have been achieved.
- The channel is rectangular, with constant width.
- Effluent discharge is introduced in the center of the channel.

Key parameter assignments for the mixing zone solution are summarized in Table 13. Average slope and velocity were defined using GRCA's HEC-RAS model.

Table 13. Grand River Mixing Zone Model Parameter Assignments

Parameter	Value
Channel Width	20.0 m
Average Channel Depth - Low-Flow	0.15 m
WPCP Flow	2,547 m^3/d
River Low-Flow	0.4 m^3/s
Average Channel Slope	0.001 m/m
Shear velocity	0.038 m/s (Equation 2)
Dispersion Coefficient	0.003 m^2/s (Equation 2)

4.2 Mixing Zone

The mixing zone solution is presented in Figure 4 below. The assumed center-channel discharge location corresponds to zero mixing, or 100% effluent as illustrated, while completely mixed conditions are achieved approximately 1,500 m downstream. As expected, peak effluent impacts, and minimum dilution occurs in the centre of the channel moving downstream, and a 10% effluent concentration, or a 90% dilution is achieved approximately 675 m downstream for the discharge.

x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.6	11.0	35.1	51.7	35.1	11.0	1.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.3	1.7	6.4	16.9	30.1	36.6	30.1	16.9	6.4	1.7	0.3	0.0	0.0	0.0	0.0	0.0
75	0.0	0.0	0.0	0.1	0.3	1.2	3.8	9.4	17.8	26.2	29.8	26.2	17.8	9.4	3.8	1.2	0.3	0.1	0.0	0.0	0.0
100	0.0	0.0	0.1	0.2	0.8	2.3	5.5	10.8	17.6	23.5	25.8	23.5	17.6	10.8	5.5	2.3	0.8	0.2	0.1	0.0	0.0
125	0.0	0.0	0.2	0.5	1.4	3.3	6.7	11.5	17.0	21.4	23.1	21.4	17.0	11.5	6.7	3.3	1.4	0.5	0.2	0.0	0.0
150	0.1	0.1	0.3	0.9	2.1	4.2	7.5	11.8	16.3	19.8	21.1	19.8	16.3	11.8	7.5	4.2	2.1	0.9	0.3	0.1	0.1
175	0.2	0.2	0.6	1.3	2.7	4.9	8.1	11.9	15.7	18.5	19.5	18.5	15.7	11.9	8.1	4.9	2.7	1.3	0.6	0.2	0.2
200	0.3	0.4	0.8	1.7	3.2	5.5	8.4	11.8	15.1	17.4	18.3	17.4	15.1	11.8	8.4	5.5	3.2	1.7	0.8	0.4	0.3
225	0.5	0.6	1.1	2.1	3.7	5.9	8.7	11.7	14.5	16.5	17.2	16.5	14.5	11.7	8.7	5.9	3.7	2.1	1.1	0.6	0.5
250	0.7	0.9	1.4	2.5	4.1	6.2	8.8	11.5	14.0	15.7	16.3	15.7	14.0	11.5	8.8	6.2	4.1	2.5	1.4	0.9	0.7
275	0.9	1.1	1.7	2.8	4.4	6.5	8.9	11.4	13.5	15.0	15.6	15.0	13.5	11.4	8.9	6.5	4.4	2.8	1.7	1.1	0.9
300	1.2	1.4	2.0	3.1	4.7	6.7	8.9	11.2	13.1	14.4	14.9	14.4	13.1	11.2	8.9	6.7	4.7	3.1	2.0	1.4	1.2
325	1.5	1.7	2.3	3.4	5.0	6.8	8.9	11.0	12.7	13.9	14.3	13.9	12.7	11.0	8.9	6.8	5.0	3.4	2.3	1.7	1.5
350	1.7	2.0	2.6	3.7	5.2	7.0	8.9	10.8	12.4	13.4	13.8	13.4	12.4	10.8	8.9	7.0	5.2	3.7	2.6	2.0	1.7
375	2.0	2.2	2.9	3.9	5.4	7.1	8.9	10.6	12.0	13.0	13.3	13.0	12.0	10.6	8.9	7.1	5.4	3.9	2.9	2.2	2.0
400	2.3	2.5	3.2	4.2	5.5	7.1	8.8	10.4	11.7	12.6	12.9	12.6	11.7	10.4	8.8	7.1	5.5	4.2	3.2	2.5	2.3
425	2.6	2.8	3.4	4.4	5.7	7.2	8.8	10.2	11.5	12.3	12.5	12.3	11.5	10.2	8.8	7.2	5.7	4.4	3.4	2.8	2.6
450	2.8	3.0	3.6	4.6	5.8	7.2	8.7	10.1	11.2	11.9	12.2	11.9	11.2	10.1	8.7	7.2	5.8	4.6	3.6	3.0	2.8
475	3.1	3.3	3.9	4.8	5.9	7.3	8.6	9.9	10.9	11.6	11.9	11.6	10.9	9.9	8.6	7.3	5.9	4.8	3.9	3.3	3.1
500	3.3	3.5	4.1	4.9	6.0	7.3	8.6	9.8	10.7	11.4	11.6	11.4	10.7	9.8	8.6	7.3	6.0	4.9	4.1	3.5	3.3
525	3.6	3.8	4.3	5.1	6.1	7.3	8.5	9.6	10.5	11.1	11.3	11.1	10.5	9.6	8.5	7.3	6.1	5.1	4.3	3.8	3.6
550	3.8	4.0	4.5	5.2	6.2	7.3	8.4	9.5	10.3	10.9	11.0	10.9	10.3	9.5	8.4	7.3	6.2	5.2	4.5	4.0	3.8
575	4.0	4.2	4.6	5.4	6.3	7.3	8.4	9.4	10.1	10.6	10.8	10.6	10.1	9.4	8.4	7.3	6.3	5.4	4.6	4.2	4.0
600	4.2	4.4	4.8	5.5	6.4	7.3	8.3	9.2	10.0	10.4	10.6	10.4	10.0	9.2	8.3	7.3	6.4	5.5	4.8	4.4	4.2
625	4.4	4.5	5.0	5.6	6.4	7.3	8.3	9.1	9.8	10.2	10.4	10.2	9.8	9.1	8.3	7.3	6.4	5.6	5.0	4.5	4.4
650	4.6	4.7	5.1	5.7	6.5	7.4	8.2	9.0	9.6	10.1	10.2	10.1	9.6	9.0	8.2	7.4	6.5	5.7	5.1	4.7	4.6
675	4.8	4.9	5.2	5.8	6.5	7.4	8.2	8.9	9.5	9.9	10.0	9.9	9.5	8.9	8.2	7.4	6.5	5.8	5.2	4.9	4.8
700	4.9	5.0	5.4	5.9	6.6	7.4	8.1	8.8	9.4	9.7	9.8	9.7	9.4	8.8	8.1	7.4	6.6	5.9	5.4	5.0	4.9
725	5.1	5.2	5.5	6.0	6.6	7.4	8.1	8.7	9.2	9.6	9.7	9.6	9.2	8.7	8.1	7.4	6.6	6.0	5.5	5.2	5.1
750	5.2	5.3	5.6	6.1	6.7	7.4	8.0	8.6	9.1	9.4	9.5	9.4	9.1	8.6	8.0	7.4	6.7	6.1	5.6	5.3	5.2
775	5.3	5.4	5.7	6.2	6.7	7.4	8.0	8.6	9.0	9.3	9.4	9.3	9.0	8.6	8.0	7.4	6.7	6.2	5.7	5.4	5.3
800	5.5	5.6	5.8	6.2	6.8	7.4	8.0	8.5	8.9	9.2	9.3	9.2	8.9	8.5	8.0	7.4	6.8	6.2	5.8	5.6	5.5
825	5.6	5.7	5.9	6.3	6.8	7.4	7.9	8.4	8.8	9.1	9.2	9.1	8.8	8.4	7.9	7.4	6.8	6.3	5.9	5.7	5.6
850	5.7	5.8	6.0	6.4	6.8	7.4	7.9	8.4	8.7	9.0	9.1	9.0	8.7	8.4	7.9	7.4	6.8	6.4	6.0	5.8	5.7
875	5.8	5.9	6.1	6.4	6.9	7.4	7.9	8.3	8.6	8.9	8.9	8.9	8.6	8.3	7.9	7.4	6.9	6.4	6.1	5.9	5.8
900	5.9	6.0	6.2	6.5	6.9	7.4	7.8	8.2	8.6	8.8	8.9	8.8	8.6	8.2	7.8	7.4	6.9	6.5	6.2	6.0	5.9
1000	6.2	6.3	6.4	6.7	7.0	7.4	7.7	8.0	8.3	8.5	8.5	8.5	8.3	8.0	7.7	7.4	7.0	6.7	6.4	6.3	6.2
1500	7.1	7.1	7.1	7.2	7.3	7.4	7.5	7.6	7.6	7.7	7.7	7.7	7.6	7.6	7.5	7.4	7.3	7.2	7.1	7.1	7.1
2000	7.3	7.3	7.3	7.3	7.3	7.4	7.4	7.4	7.4	7.5	7.5	7.5	7.4	7.4	7.4	7.4	7.3	7.3	7.3	7.3	7.3
2500	7.3	7.3	7.3	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.3	7.3	7.3

10.0 5.0 1.0 0.1

Figure 4. Mixing Zone Model Results (percentage effluent)

4.3 Mixing Zone Results for un-ionized Ammonia

The mixing zone model results presented in Figure 4 were applied to establish at what point downstream of the WPCP discharge the PWQO un-ionized ammonia concentration is achieved (0.02 mg/L). For this assessment, the existing CofA TAN compliance limits were applied, in combination with 75th Percentile ambient water quality conditions. As illustrated, the PWQO is achieved in all cases within 500 m of the outfall. Warmer temperatures and higher pH contribute to a longer un-ionized ammonia mixing zone during the summer months. Despite exceedances of the PWQO in the center of the channel, the mixing zone model results indicate that PWQO is maintained along either bank for a minimum of 25% of the total cross-section.

Table 13. Downstream Location Where PWQO Unionized Ammonia Achieved at Centre Channel

Month	75th Percentile Ambient TAN (mg/L as N)	Effluent TAN (mg/L as N)	Dissociation Constant (%)	Downstream Location Where PWQO Achieved (m)
January	0.050	4.0	1.1%	30
February		4.0		30
March		4.0		30
April	0.056	1.0	3.2%	15
May	0.032	1.0	6.9%	90
June	0.041	0.7	9.8%	105
July	0.035	0.7	17.5%	420
August	0.030	0.7	12.9%	170
September	0.033	0.7	16.1%	320
October	0.025	1.0	4.7%	35
November	0.038	1.0	2.5%	10
December		1.0	1.8%	1

5 SUMMARY

A summary of the assimilative capacity assessment of the Grand River near Grand Valley are as follows:

- The Grand River is MOE Policy II with respect to total phosphorus and *E. coli* and MOE Policy I with respect to dissolved oxygen and un-ionized ammonia.
- The required effluent total phosphorus compliance limit to maintain the existing loading is 0.7 mg/L, approximately 50% of the current compliance limit, however, at a proposed limit of 0.1 mg/L, total phosphorus loading for future conditions is only 3.3 % greater than existing conditions.

- Although no PWQO is available for TSS, nitrates and $cBOD_5$, ambient concentrations are generally within acceptable limits as defined by other jurisdictions or by CCME guidelines.
- A review of the low flow assessment completed by the GRCA demonstrates that 0.4 m^3/s is a reasonable approximation of 7Q20 flow and is suitable for assimilative capacity assessment.
- Results of a desk-top Streeter-Phelps dissolved oxygen model indicate that the existing CofA limits for $cBOD_5$ and TAN are appropriate for future WPCP flow conditions.
- For completely mixed conditions, the existing CofA limits for TAN are suitable for future WPCP flow conditions.
- The results of mixing zone model indicate that PWQO un-ionized ammonia concentrations will be achieved with 500 m of the WPCP discharge for future WPCP flow and existing CofA compliance TAN limits.

A summary of recommended effluent compliance and objective limits is provided in Table 14.

Table 14. Grand Valley Effluent Recommended Compliance and Objective Limits

Effluent Parameter	Effluent Compliance Limits[1]		Effluent Objective Limits
	Average Concentration (mg/L)	Average Loading (kg/d)	Average Concentration (mg/L)
$cBOD_5$	10.0	24.6	8.0
Total Suspended Solids	10.0	24.6	8.0
Total Phosphorus	0.10	0.25	0.08
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	9.83	3.0
Spring (Apr 1 – May 31)	1.0	2.46	0.8
Summer (Jun 1 – Sep 31)	0.7	1.72	0.6
Fall (Oct 1 – Nov 30)	1.0	2.46	0.8
E coli	200 cfu/100 mL[2]	N/A	100 cfu/100 mL[2]
pH	6.0-9.5		6.5-8.5

Notes:
1. Based on monthly average.
2. Based om monthly geometric mean density.

6 REFERENCES

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EPA, 1985, *Rates, Constants and Kinetics Formulations in Surface Water Quality Modeling, Second Edition, Environmental Research laboratory*, Athens, GA.

Fischer, H.B., E.J List, R.C.Y. Koh, J. Imberger, and N.H. Brooks, 1979, Mixing in Inland and Coastal Waters, Academic Press, New York.

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US EPA, 2003, *Developing Water Quality Criteria for Suspended And Bedded Sediments (Sabs) Potential Approaches*, U.S. EPA Science Advisory Board Consultation, Office of Water, Office of Science and Technology.

XCG, 2013, Assimilative Capacity Study Of The Grand River For The Grand Valley WPCP, File No.: 3-252-46-01.

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May 16, 2018

Mr. Jeff Paznar
R. J. Burnsides and Associates

Re: Assimilative Capacity Study to support Grand Valley Master Plan

Staff have completed the review of the Grand Valley Water Pollution Control Plant's (WPCP) assimilative capacity Study of September 11th, 2017, prepared by Profound Engineering to support the direction of the Town's Master Plan EA. A number of things have been determined to be unsatisfactory resulting with the recommendation that they be acted upon and a revised ACS be submitted which addresses the following:

(1) A mixing zone analysis was completed using a 2-D advection-diffusion equation where outfall was considered at the centre of the river. This analytical solution is applicable at a location where full vertical mixing occurs but not at the outfall. Also this equation does not have the capacity of considering outfall configurations (i.e., type of outfall, its alignment with the river, boundary interactions etc.). Moreover, the location of the outfall considered for this analysis was not correct. The exiting outfall (a rock lined surface ditch) is on the right bank of the river (looking downstream) not at the centre of the river. It is recommended that a standard mixing zone model be used to complete near-field mixing analysis at the correct location of the outfall and its configuration.

(2) The proposed total phosphorus (TP) criteria (concentration of 0.1 mg/L and loading of 0.25 kg/d) violates Policy 2 criteria of the receiving waters. Policy 2 states, *"Expansion of existing discharges to Policy 2 receivers will only be permitted if the concentration and total load of the Policy 2 contaminant to the receiving stream is not increased."* The proposed loading criterion (TP 0.25 kg/d) violates the Policy 2 provision as it exceeds the current loading of 0.19 kg/d. Accordingly, the effluent criterion for TP needs to be revised so that both concentration and loading satisfy the Policy 2 provision.

(3) The total ammonia nitrogen (TAN) concentration as proposed would be acutely lethal when pH is higher (undiluted end-of-pipe concentration). Both provincial and federal regulations require that the end-of-pipe concentration must be non-lethal. Please see the attached table which was developed in consideration of an effluent temperature of 15.6 degree Celsius and pH of 9, which demonstrates

that at higher pH and average effluent temperature, the end-of-pipe ammonia concentrations would be acutely lethal.

	Proposed TAN (mg/L)	Effluent temperature (^{0}C)	Effluent pH	pKa	f	End-of-pipe unionized NH_3-N (mg/L)	Maximum unionized NH3-N for effluent toxicity (mg/L)*
Winter	4	15.6	9	9.544	0.222	0.711	0.10
Spring	1	15.6	9	9.544	0.222	0.178	0.10
Summer	0.7	15.6	9	9.544	0.222	0.124	0.10
Fall	1	15.6	9	9.544	0.222	0.178	0.10

* This 0.1 mg/L toxicity threshold data was provided by the consultant in the report

(4) Using the federal guideline for release of ammonia in wastewater effluents and considering effluent pH of 9.5, indicates that the maximum allowable TAN in the effluent would be 1.13 mg/L. (https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/guideline-release-ammonia-wastewater-effluents/guide.html)

(5) Please propose a revised effluent criterion for TAN considering provincial and federal regulations so that end-of-pipe ammonia concentrations in the discharge are not acutely lethal. Please consult 2009 federal strategies and 2012 federal regulation on municipal waste waters. Links for both documents are provided here.
https://www.ccme.ca/en/resources/water/municipal_wastewater_effluent.html;
http://laws-lois.justice.gc.ca/PDF/SOR-2012-139.pdf

(6) The mixing zone for TAN should not be more than 100m long, and concentrations of un-ionized ammonia nitrogen (NH_3 - N) at any point along the boundary of the mixing zone should be less than or equal 0.016 mg/L. If necessary, the outfall may require reconfiguration to meet this policy objective.

(7) Dissolved oxygen analysis in the receiving water was completed considering only the carbonaceous and nitrogenous oxygen demands. Please expand this analysis to account for algal respiration and sediment oxygen demands. It has been indicated in the report that the study reach has a HEC-RAS model developed by Grand River Conservation Authority (GRCA), that model can be used seamlessly for dissolved oxygen analysis and has an advantage over the Streeter Phelps equation used in this analysis. Please consider representing dissolved oxygen concentrations using different colours along the river reach to more easily understand the results.

(8) Similarly, please consider representing the mixing zone analysis results for TAN and TP graphically and geospatially so that the results can be easily seen and understood.

(9) Please include a section in the report that analyzes the performance of the existing plant. Please include statistics (mean, median, minimum, maximum, 25th and 75th percentiles, standard deviations etc.) of all effluent parameters monitored to date under environmental compliance approval (ECA). This information will be helpful for approving the rerating of the plant (from 1,244 m^3/d to 2,547 m^3/d).

(10) Please submit all monitoring data collected under ECA in excel spreadsheet format (a soft copy along with the revised report).

(11) Please use collected effluent temperature and pH data to verify the dissociation constants used to calculate un-ionized ammonia from total ammonia.

(12) Please provide the justification (i.e. the reference) for the statement made on page 12 in s. 3.4.1 of the subject report: "The currently accepted un-ionized ammonia limit for effluent toxicity is 0.1 mg/L as N."

The report stated that there was no provincial or federal water quality guidelines for total suspended solids (TSS), which is not correct. There is a Canadian Water Quality Guideline (CWQG) for TSS, which allows a maximum average increase of TSS of 5 mg/L from background levels for longer term exposures. (http://st-ts.ccme.ca/en/index.html?lang=en&factsheet=218)

(13) It was noted that average values of some ambient water quality parameters for some months were higher than the 75th percentile, which suggests that average calculations were influenced by extreme values (outliers). Please include median as an additional statistic in the water quality tables to better characterize background data.

(14) Please indicate the distance of the upstream PWQMN station #16018409002 in river kilometres from the Grand Valley WPCP outfall.

(15) Please note, the Canadian water quality guideline for the nitrate ion for long-term protection of aquatic life is 3.0 mg/L as nitrogen and not 2.93 mg/L as stated in the report.

(16) Please note, the provincial water quality objective (PWQO) for un-ionized ammonia is 0.02 mg/L while for un-ionized ammonia-nitrogen that value should be 0.016 mg/L and not 0.02 mg/L.

(17) For dissolved oxygen analysis, receiving water ammonia nitrogen concentration was chosen as 0.06 mg/L as N, which does not match with the values provided in Table 5.

(18) In Table 9 there is a typo, TSS should be Nitrate-N

(19) Also, please address all the comments provided on water quality data by GRCA in their November 15, 2017 memo.

In the interest of efficiency, discussion of these technical points should be with:

Mohammad Sajjad Khan, Ph.D., P.Eng.
Surface Water Specialist/Hydrologist, West Central Region
Ontario Ministry of the Environment and Climate Change
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Tel: 905 521-7607; Fax: 905 521-7820
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If I can be of any service to facilitate moving forward on this file, please do not hesitate to contact me either at (905) 521-7864 or at Barbara.slattery@ontario.a

With best regards,

EA/Planning Coordinator

cc Mr. M. Anderson, Grand River Conservation Authority (via Email only)

August 23rd, 2018

Water Supply and Sewage Servicing Master Plan
Town of Grand Valley

Technical Memorandum

Assimilative Capacity Assessment

1 INTRODUCTION

1.1 Background

Profound Engineering was retained by R.J.Burnside and Associates Ltd. on behalf of the Town of Grand Valley to complete an assimilative capacity assessment of the Grand River in the vicinity of the existing wastewater pollution control plant (WPCP) discharge for the Town of Grand Valley facility. This assessment was completed in support of a water supply and sewage servicing master plan and addresses a proposed increase in the Grand Valley WPCP average daily flow from 1,244 m^3/d to an anticipated future average daily flow of 2,547 m^3/d. The Grand Valley WPCP operates under CofA 9706-7KWQ57 which identifies compliance and design objectives for final effluent quality (Table 1).

Table 1. Grand Valley Effluent Compliance and Objective Limits

Effluent Parameter	Effluent Compliance Limits[1]		Effluent Objective Limits
	Average Concentration (mg/L)	Average Loading (kg/d)	Average Concentration (mg/L)
$cBOD_5$	10.0	12.4	8.0
Total Suspended Solids	10.0	12.4	8.0
Total Phosphorus	0.15	0.19	0.13
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	4.98	3.0
Spring (Apr 1 – May 31)	1.0	1.24	0.8
Summer (Jun 1 – Sep 31)	0.7	0.87	0.6
Fall (Oct 1 – Nov 30)	1.0	1.24	0.8
E coli	200 cfu/100 mL[2]	N/A	100 cfu/100 mL[2]
pH	6.0-9.5		6.5-8.5

Notes:
1. Based on monthly average.
2. Based on monthly geometric mean density.

The discussion provided below includes an assessment of the ambient water quality and current conditions in the Grand River near the Grand Valley WPCP, a summary of low-flow conditions, a mixing zone analysis and the development of proposed effluent objectives and limits for future flow conditions.

1.2 Objectives

The objectives of this assessment are as follows:

- Define ambient water quality and verify low-flow conditions for design purposes.

- Complete an assessment of assimilative capacity of the receiving water for key water quality parameters included $cBOD_5$, un-ionized ammonia, total ammonia, total phosphorus, total suspended solids, *E coli* and nitrate.
- Complete a mixing zone analysis.
- Develop recommendations for effluent limits for a future average daily flow of 2,547 m^3/d.

2 AMBIENT CONDITIONS

2.1 Water Quality

Representative background water quality was defined by examining water quality in the vicinity of the Grand Valley WPCP effluent discharge. For analysis purposes, the 75th percentile threshold was applied to characterize ambient conditions, or in the case of dissolved oxygen, the 25th percentile, as recommended by the MOE (MOE, 1994). For each water quality parameter, with the exception of nitrate, a comparison of representative ambient water quality with Provincial Water Quality Objectives (PWQO) was complete in order to establish the appropriate MOE policy to apply for assimilative capacity assessment, either Policy I or Policy II. Policy I corresponds to areas where the ambient concentration is less than the PWQO, while Policy 2 corresponds to areas where the ambient concentration is greater than the PWQO. If Policy I applies, future water concentrations must be maintained at or below the PWQO, while if Policy II applies, all practical measures shall be taken to upgrade the water quality to the Objectives. For nitrate, since there is no PWQO, Canadian Water Quality Guideline (CWQG) was applied.

For the purposes of this analysis, ambient water quality was derived from two sources:

- the Provincial Water Quality Monitoring Network station at Leggatt (PWQMN station 16018409002), upstream of the Grand Valley WPCP outfall, and
- Recent monitoring completed by the Grand River Conservation Authority, near Leggatt, GRCA Monitoring Site 1357002.

Data obtained from the PWQMN station at Leggatt was collected from 1977 through 2016, while the GRCA data spanned 2015 and 2016. In some cases, Method Detection Limits(MDL), differed between GRCA and PWQMN monitoring information and in order to combine the monitoring results, statistical methods recommended by the USGS (Helsel and Hirsch, 2002) were applied.

2.1.1 Total Phosphorus

The MOE PWQO for total phosphorus is 0.03 mg/L. A summary of ambient total phosphorus concentrations is provided in table 2. Both PWQMN (1997 through 2016) and GRCA (2015 and 2016) were combined for this assessment. All results were above MDL's allowing for a combined data set. In general, with respect to total phosphorus, the Grand River near Grand Valley is MOE Policy I during the winter and fall, and MOE Policy II during the spring and summer. As such, all practical measures will be necessary to reduce effluent total phosphorus concentrations during the spring and summer, and if feasible, current allowable total phosphorus loadings must be maintained or reduced.

Table 2. Ambient Total Phosphorus 1977-2016

Month	Mean TP (mg/L)	Median TP (mg/L)	75th Percentile TP (mg/L)	Number of Observations
January	*0.031*	0.020	0.026	22
February	*0.034*	0.025	*0.039*	24
March	*0.043*	0.027	*0.054*	27
April	*0.034*	0.025	*0.043*	32
May	0.024	0.020	0.023	29
June	*0.031*	0.028	*0.035*	31
July	*0.042*	*0.037*	*0.053*	34
August	*0.038*	*0.034*	*0.044*	38
September	*0.031*	*0.030*	*0.034*	33
October	0.023	0.019	0.022	33
November	0.024	0.019	0.027	25
December	*0.033*	0.017	0.021	19
Annual	***0.032***	**0.024**	***0.036***	**347**

2.1.2 Un-ionized Ammonia

The percentage of un-ionized ammonia in aqueous solution varies with temperature and pH, with percentages increasing with increasing temperature and pH. Table 3, 4, 5 and 6 provide a summary of ambient temperature, pH, total ammonia and un-ionized ammonia, respectively. Un-ionized ammonia was derived from synoptic measurements of field pH, field temperature and laboratory total ammonia analysis results. The threshold PWQO for un-ionized ammonia is 0.02 mg/L as N. For ambient temperature and pH (Tables 3 and 4, respectively), monitoring information from PWQMN and GRCA were combined yielding a 1977 through 2016 dataset. Since the PWMN dataset included single monthly measurements, while the GRCA included multiple measurements per month, single monthly averages of GRCA results were applied in order to combine datasets.

Table 3. Ambient Temperature 1977-2016

Month	Mean Temp (^oC)	Median Temp (^oC)	75th Percentile Temp (^oC)	Number of Observations
January	0.7	0.5	1.0	18
February	0.8	0.7	1.2	19
March	2.4	1.9	3.2	26
April	7.9	6.7	11.9	31
May	14.8	14.7	17.5	29
June	19.9	19.9	21.5	31
July	22.7	22.6	24.7	33
August	21.1	21.4	22.3	35
September	17.1	16.3	19.3	33
October	9.5	9.7	11.3	33
November	3.7	3.4	5.9	27
December	1.5	1.0	1.4	19
Annual	**11.6**	**11.8**	**19.5**	**334**

Table 4. Ambient pH 1977-2016

Month	Mean pH	Median pH	75th Percentile pH	Number of Observations
January	7.51	7.71	8.03	12
February	7.77	7.75	7.85	14
March	7.64	7.59	7.90	12
April	8.11	8.01	8.20	21
May	8.27	8.30	8.35	19
June	8.25	8.17	8.38	20
July	8.39	8.36	*8.56*	21
August	8.36	8.36	8.50	21
September	8.53	8.54	*8.81*	19
October	8.28	8.34	8.40	18
November	8.08	8.19	8.26	15
December	8.07	8.20	8.30	9
Annual	**8.16**	**8.20**	**8.38**	**201**

The PWQO for pH states that the pH should be maintained within the range of 6.5 and 8.5 to protect aquatic life. Based on the summary provided in Table 4, ambient pH is highest in the summer months, with 75th percentile levels exceeding 8.81 in September. Presumably, this peak is related to increases in aquatic plant densities during the summer months. With the exception of July and September, the Grand River is Policy 1 with respect to pH.

For total ammonia (Table 5) all GRCA total ammonia results were reported as below MDL of 0.05 mg/L. For the GRCA 2015-2016 dataset, a total 23 samples were collected and analysed, all reporting less than MDL. In order to determine if these results could be incorporated into the overall total ammonia assessment, a review of the distribution of total ammonia results from the PWQMN dataset was completed and is summarized in Figure 1. The PWQMN dataset include limited total ammonia results for 1994 through 1997 and a more complete dataset from 2007 through 2016. A *t*-test of means for the lumped PWQMN results for the period 1994-1997 and the PWQMN results for 2007-2016 indicated that the means were significantly different at the 95% level, and therefore only the 2007-2016 monitoring results were assessed.

Figure 1 illustrates the fitted frequency distribution of the total ammonia results for the PWQMN dataset (post 2007). Several probability distributions were evaluated; however, both the Log-Normal and the Log-Pearson Type III provided a reasonable fit. As illustrated, the GRCA dataset MDL of 0.05 mg/L has a return frequency of approximately 1:6, or an exceedance probability of approximately 16%. Assuming the GRCA dataset is comparable to the PWQMN dataset, the likelihood of obtaining 23 results at or below this threshold MDL would be less than 2%, leading to the conclusion that the analytical methods are sufficiently different and the results cannot be combined. Therefore, the total ammonia results presented in Table 5, and the ambient unionized ammonia results presented in Table 6, correspond to only the PWQMN dataset.

Table 5. Ambient Total Ammonia 2007-2016

<table>
<tr><th>Month</th><th>Mean TAN (mg/L as N)</th><th>Median TAN (mg/L as N)</th><th>75th Percentile TAN (mg/L as N)</th><th>Number of Observations</th></tr>
<tr><td>January</td><td rowspan="3">0.036</td><td rowspan="3">0.034</td><td rowspan="3">0.050</td><td rowspan="2">0</td></tr>
<tr><td>February</td></tr>
<tr><td>March</td><td>4</td></tr>
<tr><td>April</td><td>0.045</td><td>0.035</td><td>0.058</td><td>8</td></tr>
<tr><td>May</td><td>0.032</td><td>0.023</td><td>0.032</td><td>8</td></tr>
<tr><td>June</td><td>0.041</td><td>0.031</td><td>0.049</td><td>9</td></tr>
<tr><td>July</td><td>0.038</td><td>0.031</td><td>0.045</td><td>7</td></tr>
<tr><td>August</td><td>0.025</td><td>0.024</td><td>0.038</td><td>8</td></tr>
<tr><td>September</td><td>0.028</td><td>0.026</td><td>0.037</td><td>7</td></tr>
<tr><td>October</td><td>0.021</td><td>0.025</td><td>0.028</td><td>6</td></tr>
<tr><td>November</td><td rowspan="2">0.028</td><td rowspan="2">0.024</td><td rowspan="2">0.036</td><td>6</td></tr>
<tr><td>December</td><td>0</td></tr>
<tr><td>Annual</td><td>0.033</td><td>0.027</td><td>0.039</td><td>41</td></tr>
</table>

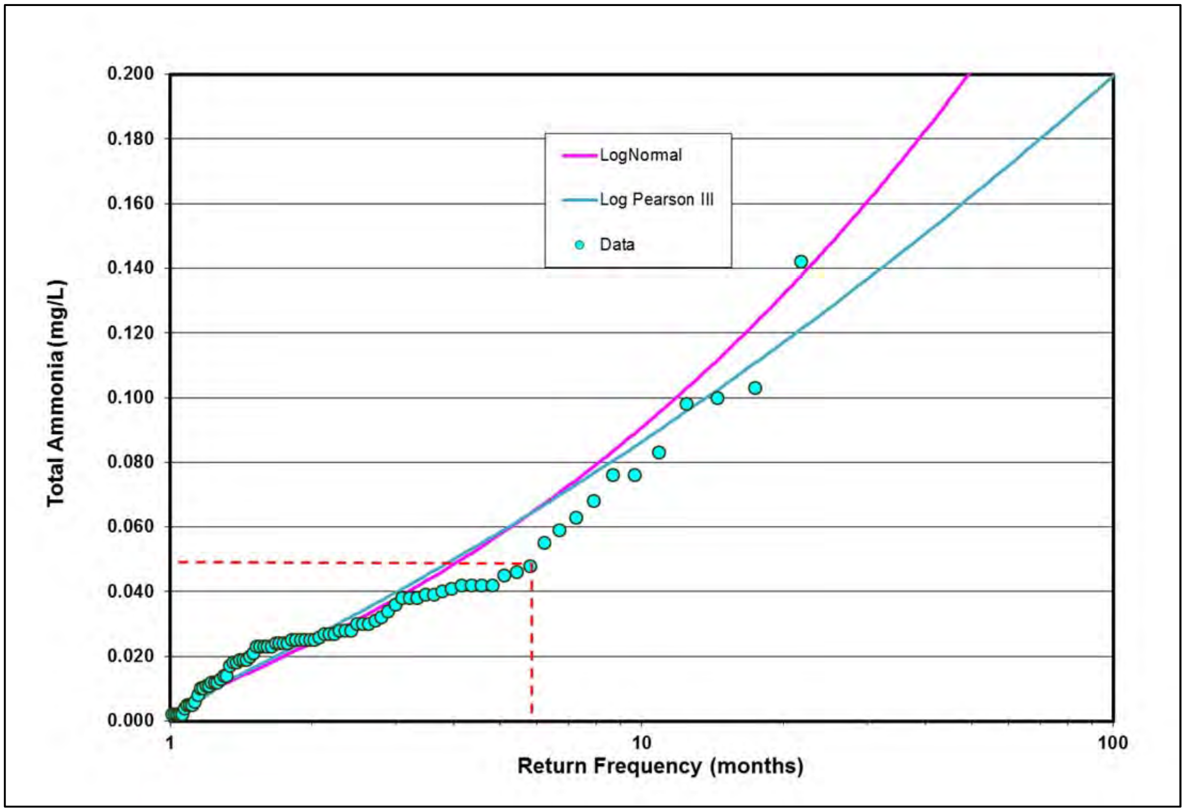

Figure 1. PWQMN at Leggatt Total Ammonia Frequency Distribution 1977-2015

Ambient total ammonia is highest during the spring; however, relatively few measurements are available for the winter months.

Table 6. Ambient Un-ionized 2007-2016

Month	Mean UIA (mg/L as N)	Median UIA (mg/L as N)	75th Percentile UIA (mg/L as N)	Number of Observations
January	0.001	0.001	0.001	0
February				0
March				4
April	0.001	0.001	0.001	10
May	0.002	0.002	0.002	8
June	0.004	0.004	0.005	10
July	0.005	0.005	0.006	8
August	0.003	0.002	0.004	8
September	0.005	0.002	0.003	8
October	0.001	0.001	0.001	7
November	0.000	0.000	0.001	7
December				0
Annual	**0.001**	**0.001**	**0.003**	**70**

Ambient un-ionized ammonia is highest during the summer, however, remains below the PWQO threshold of 0.016 mg/L as N. The Grand River is therefore MOE Policy I with respect to un-ionized ammonia.

2.1.3 Dissolved Oxygen and $cBOD_5$

Ambient dissolved oxygen was evaluated by reviewing long term PWQMN monitoring results and recent continuous monitoring results collected by GRCA. Since low concentrations are indications of degraded water quality, the 25th percentile was applied for comparison with PWQO's. The PWQO threshold for dissolved oxygen in warm water fisheries is 47% saturation. At 5^{o}C the PWQO is 6 mg/L, while above 20^{o}C the PWQO is 4 mg/L. A summary of historical PWQMN and recent GRCA monitoring is provided in Table 7, while time-series plots of continuous dissolved oxygen monitoring for 2015 and 2016 are provided in Figures 2 and 3, respectively. For both long-term and continuous dissolved oxygen monitoring, the Grand River may be considered MOE Policy I with respect to dissolved oxygen.

No recent (post 1992) PWQMN $cBOD_5$ measurements are available, however, the 75th percentile cBOD for $cBOD_5$ monitoring results prior to 1992 is 1.13 mg/L. A 2003 field program completed by RJ Burnside and Associates (RJB, 2003) measured $cBOD_5$ concentrations ranging from approximately 0.5 to 1.7 mg/L. Therefore, based available monitoring information, a conservative estimate of ambient $cBOD_5$ concentration is 2.0 mg/L.

Table 7. Ambient Dissolved Oxygen 1977-2016

Month	Mean DO (mg/L)	Median DO (mg/L)	25th Percentile DO (mg/L)	Number of Observations
January	6.9	7.0	10.2	22
February	22.3	12.0	10.9	24
March	11.8	11.8	10.5	28
April	11.9	11.6	11.1	30
May	10.9	12.1	10.4	28
June	9.8	11.0	8.8	30
July	8.9	10.0	8.3	32
August	9.2	9.1	8.7	34
September	10.1	9.3	9.7	31
October	11.8	10.1	11.1	32
November	12.8	11.7	12.3	26
December	12.6	13.2	11.9	19
Annual	**11.4**	**11.0**	**12.4**	**336**

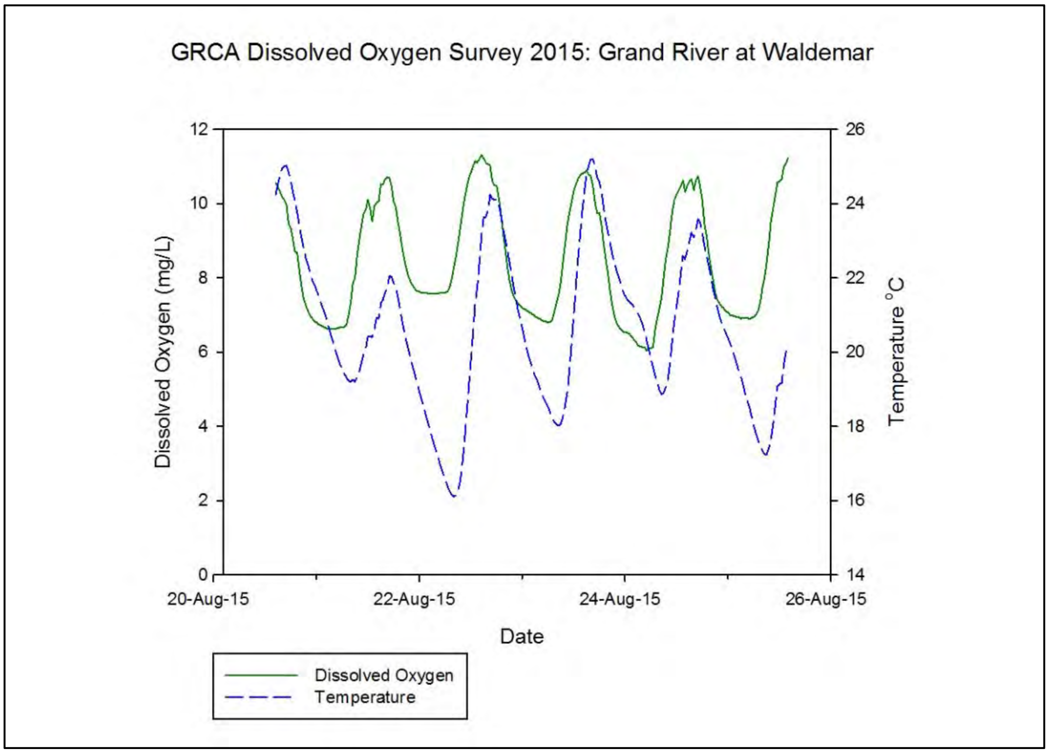

Figure 2. Diurnal Dissolved Oxygen: August 2015

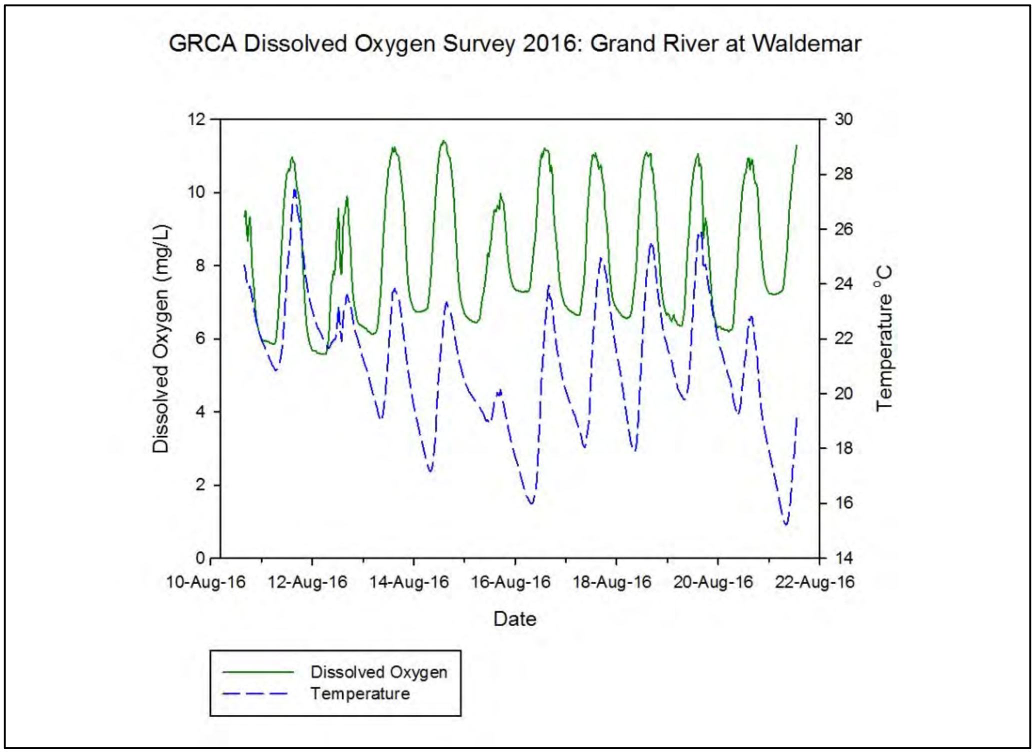

Figure 3. Diurnal Dissolved Oxygen: August 2016

The PWQMN dissolved oxygen measurements are typically collected during the day and may not reflect minimum dissolved oxygen levels, particularly if aquatic plant respiration is a significant factor influencing ambient dissolved oxygen levels. An indication of diurnal variability in dissolved oxygen is provided by GRCA's continuous monitoring results for 2015 and 2016 (Figures 1 and 2). These results indicate that dissolved oxygen varies from above 10 mg/L during the day to approximately 6 mg/L during the pre-dawn hours, where aquatic plant respiration would contribute to minimum dissolved oxygen levels. During the same monitoring period, relatively large fluctuations in ambient temperature were observed, ranging from approximately 15^{o}C at night to above 26^{o}C during the mid-afternoon. As illustrated, aquatic plant respiration does reduce dissolved oxygen concentrations during the night, however, levels remain above PWQO warm water thresholds, confirming that the MOE Policy I assumption for dissolved oxygen is appropriate.

2.1.4 *E. coli*

No PWQMN *E.coli* data are available post-1995 upstream of the Grand Valley WPCP discharge location, and only a few post-1995 measurements are available from the downstream PWQMN dataset (Station 16018406702), collected during the summer of 2005. Additional *E.coli* data are available from 2003 and 2006 R.J. Burnside led field programs. Lumped geometric mean concentrations exceed the PWQO of 100 cfu/100mL for June and September, while 75th percentile concentrations exceed this threshold from May through September. Although monitoring results are limited, it is reasonable to assume the receiver is MOE Policy II from May through September and MOE Policy I the remainder of the year.

2.1.5 Suspended Solids

There are no PWQO values for total suspended solids (TSS), however, a review of recommended TSS guidelines for the protection of aquatic life (EPA, 2003) indicate that a 30-day average concentration of 30 mg/L is a reasonable threshold. A statistical summary of seasonal TSS concentrations in the Grand River upstream of Grand Valley, provided below as Table 8, indicates that 75th percentile ambient TSS concentrations are less than this threshold for all months, with the exception of spring. Since the exceedance is marginal (31.1 vs. 30 mg/L) and the 75th percentile is based on single grab samples, rather than 30-day averages, the exceedance is deemed insignificant. Both PWQMN and GRCA datasets were applied for this TSS assessment.

Table 8. Ambient Total Suspended Solids 1977-2016

Season	Mean TSS (mg/L)	Median TSS (mg/L)	75th Percentile TSS (mg/L)	Number of Observations
Winter	10.3	3.4	10.5	6
Spring	19.1	4.4	31.3	16
Summer	10.0	6.0	11.7	22
Fall	7.1	4.0	7.2	17
Annual	**8.3**	**5.0**	**7.6**	**61**

2.1.6 Nitrate

There is no PWQO value for nitrate, however, there is a Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. The CWQG is 3.0 mg/L as N (CCME, 2012). A summary of PWQMN ambient nitrate concentrations in the Grand River upstream of Grand Valley is provided below as Table 9. As with other historical water quality measurements, only limited results are available during the winter. Despite the winter data limitations, all 75th percentile nitrate concentrations fall below the 3.0 mg/L as N CWQG threshold, indicating that assimilative capacity is available for nitrate.

Table 9. Ambient Total Nitrate as N 1977-2014

Month	Mean Nitrate (mg/L)	Median Nitrate (mg/L)	75th Percentile Nitrate (mg/L)	Number of Observations
January February March	0.93	0.93	1.05	4
April	0.96	1.02	1.09	10
May	0.67	0.32	1.05	7
June	0.45	0.21	0.41	10
July	0.34	0.10	0.17	8
August	0.32	0.21	0.42	8
September	0.19	0.08	0.15	7
October	0.91	1.10	1.41	7
November December	1.18	0.88	1.84	7
Annual	**0.64**	**0.40**	**1.08**	**175**

The GRCA monitoring information for nitrate was reviewed and determined to be unsuitable for inclusion in the above summary. Of the 24 GRCA nitrate samples, 12 of 24 (50%) reported nitrate concentrations of below the MDL of 0.1 mg/L. All of the samples reporting nitrate concentrations of less than the MDL were collected in 2015. The remaining 12 samples, all collected during 2016, reported concentrations in excess of 1.0 mg/L. A frequency plot of the 12 samples (blue symbols) over the MDL is provided as Figure 4 below. The recommended approach by USGS (Helsel and Hirsch, 2002) involves using the fitted frequency distribution to estimate reasonable values for all samples below MDL. Following this approach yields estimates in excess of the MDL as illustrated in Figure 4 below (yellow symbols). In light of this discrepancy, the GRCA nitrate monitoring results for 2015 and 2016 were not included in the final assessment.

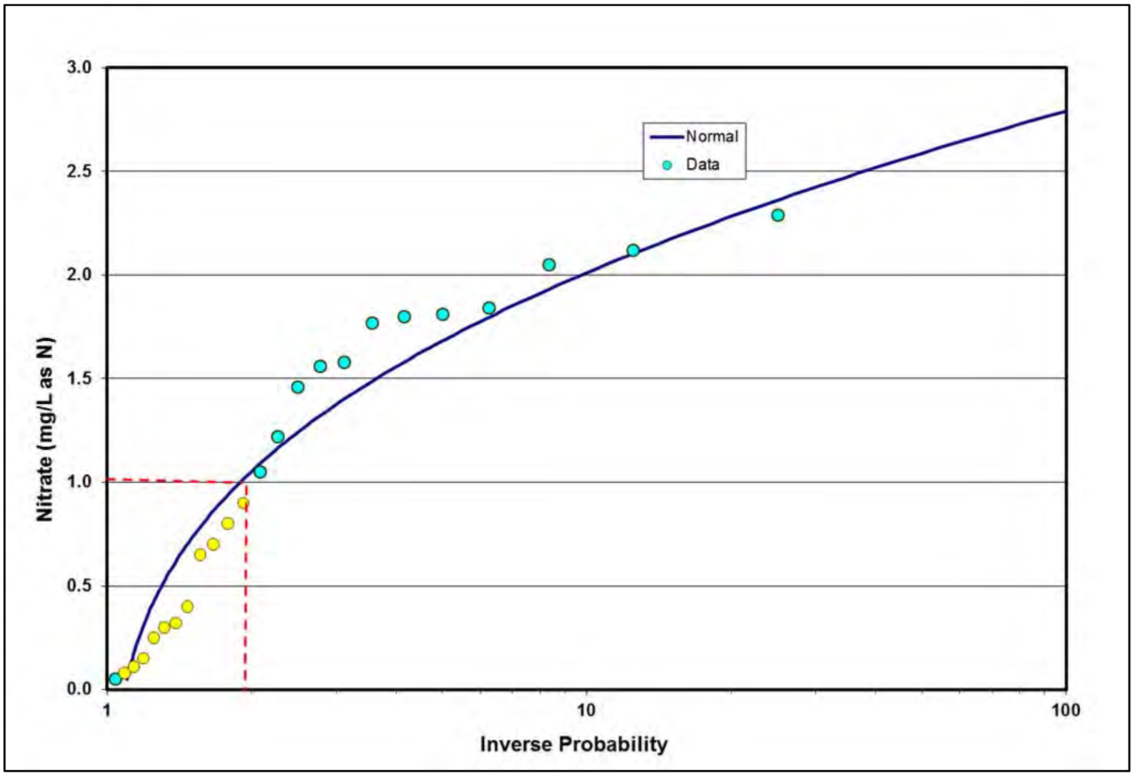

Figure 4. Frequency Distribution for Nitrate: GRCA 2015-2016

2.2 Flow

Conventional low-flow frequency analysis for estimation of 7Q20 flow is not appropriate at this location due to flow regulation. An initial 7Q20 flow target of 0.42 m^3/s was derived from a 1986 reservoir yield study, and re-confirmed by GRCA in 2004 and again in 2016 (GRCA, 2016). In support of this assimilative capacity assessment, the most recent GRCA publication (2016) addressing low flow in the Grand River near Grand Valley, authored by D. Boyd and S. Shifflett, was reviewed and highlights are provided below:

- Low flow upstream of the Grand Valley WPCP is controlled by the Luther Dam discharge.
- Luther Dam was constructed in 1953 for the purpose of low flow augmentation.
- A review of reservoir yield, combined with external base flow tributary to Grand Valley, results in a sustainable annual low flow target of 0.42 m^3/s. This value was adopted by GRCA in 2004.
- A brief assessment of potential climate change impacts indicate that the accepted low flow target of 0.42 m^3/s can be maintained in a future climate.
- A frequency assessment of historical low flow information demonstrates that the 0.42 m^3/s low flow target is a reasonable approximation of the 7Q20 flow.
- Following an assessment of measurement and estimation uncertainty, GRCA recommended a 7Q20 flow of 0.4 m^3/s.

Therefore, for the purposes of the current assimilation capacity assessment, GRCA's recommended 7Q20 of 0.4 m^3/s was adopted.

3 DETERMINATION OF EFFLUENT LIMITS

3.1 Effluent $cBOD_5$

For the expanded WPCP, it is proposes to maintain the existing $cBOD_5$ compliance limit of 10 mg/L and the existing design objective of 8 mg/L. The potential impact on instream dissolved oxygen was evaluated using the Streeter Phelps equation. The Alabama Department of Environmental Management, ADEM, developed a straightforward spreadsheet solution of the Streeter Phelps equation and this public-domain tool was applied for the current application (ADEM, 2001). In addition to carbonaceous biological oxygen demand, the ADEM model also addresses nitrogenous oxygen demand and sediment oxygen demand. A summary of key model inputs are provided below.

Channel Description: The physical characteristics of the channel, including reach lengths, bottom slopes and channel width were defined using a HEC-RAS model provided by GRCA. Although the HEC-RAS model was designed for flood analysis, there were multiple cross-sections included in the model that provided a general indication of the low-flow channel shape and approximate slope. A total of 20 kilometers of river length, downstream of the WPCP were modelled.

Velocity and Depth: Reach depth and velocities were defined by applying the 7Q20 of 0.4 m^3/s to the HEC-RAS model.

River Re-aeration: Re-aeration was estimated using the Tsivoglou and Neal equation as recommended by ADEM (ADEM, 2001) and the US EPA (EPA, 1985). Numerous approaches are available for estimation of re-aeration, however, the Tsivoglou and Neal equation provides a simple empirical approach, suitable for shallow streams and relies only on velocity and slope. Estimated re-aeration rates range from 3.1 to 6.1 d^{-1}, which compare favourably with previous estimates for this location in the Grand River (XCG, 2013).

Ambient Water Quality: Ambient water quality was defined as 75th percentile summer conditions as presented in Section 2. Important parameter assignments include $cBOD_5$ at 2.0 mg/L, Ammonia Nitrogen at 0.035 mg/L as N, dissolved oxygen at 8.3mg/L, and temperature of 24.8 ^oC.

Plant Respiration: Plant respiration is not included in the conventional Streeter Phelps solution of dissolved Oxygen, however, to assess minimum dissolved oxygen levels during periods of high respiration; the applied re-aeration coefficient was reduced by 20% and the minimum ambient dissolved oxygen, as measured during the 2015 and 2016 continuous dissolved oxygen surveys (Figures 2 and 3), of 6.0 mg/L was applied.

Sediment Oxygen Demand: A literature value of 0.5 g/m^2 SOD was applied and was obtained from a recent USGS study of SOD for a range of streams and land uses (Foster, King and Graham, 2016).

Effluent Water Quality: Effluent water quality was defined according to the existing CofA compliance limits provided as Table 1. Importantly, effluent dissolved oxygen was assumed to be 0 mg/L to provide a conservative estimate water quality impacts.

Numerous model runs were completed in order to assess parameter sensitivity and two illustrative results are provided below in Figures 5 and 6. Figure 5 illustrates typical model results for summer low flow conditions and 25th percentile ambient dissolved oxygen, while Figure 6 illustrates an approximation of minimum dissolved oxygen estimates for periods of high plan respiration. As illustrated, the maximum peak dissolved oxygen deficit is less than 1.0 mg/L. Since the Grand River is MOE Policy II with respect to Dissolved Oxygen, these model results demonstrate that the existing compliance limit and design objective, of 10 and 8 mg/L $cBOD_5$, respectively, are appropriate for future WPCP effluent.

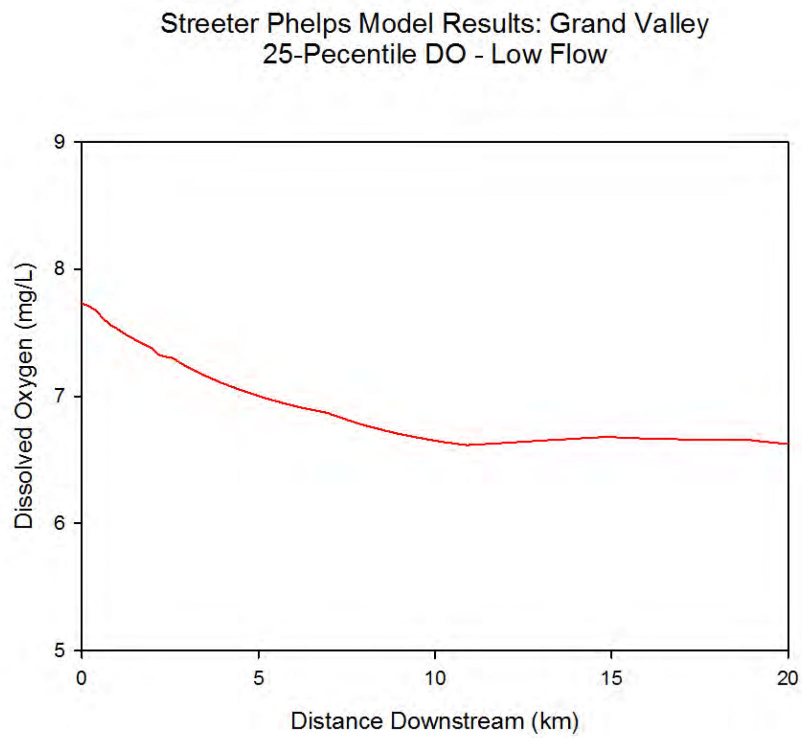

Figure 5. Streeter-Phelps Dissolved Oxygen Solution for Summer Low Flow Conditions

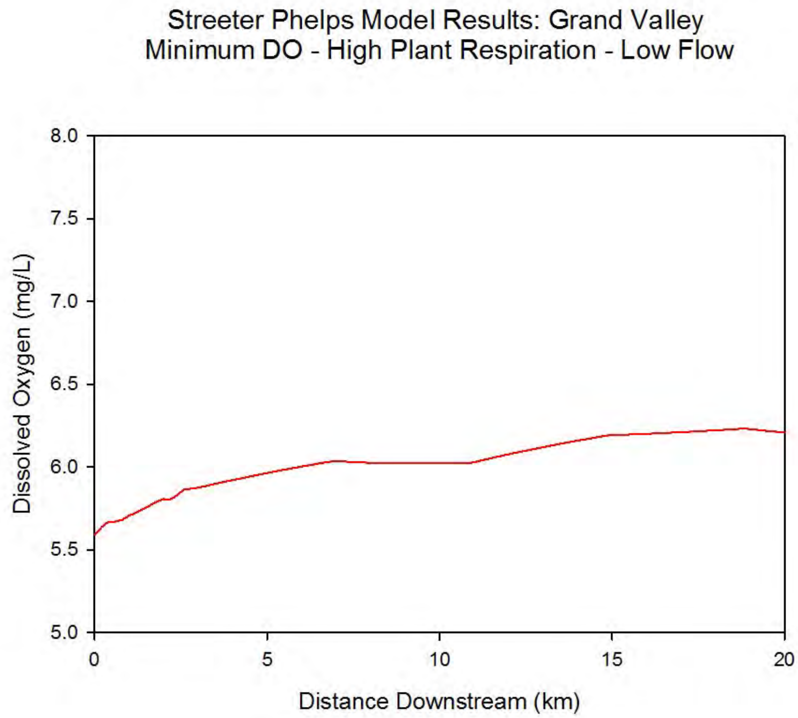

Figure 6. Streeter-Phelps Dissolved Oxygen Solution for Minimum Dissolved Oxygen and Active Plant Respiration - Summer Low Flow Conditions

3.2 Effluent Total Suspended Solids

For the expanded WPCP, maintaining the existing TSS compliance limit of 10 mg/L and the existing design objective of 8 mg/L, is proposed. Although there is no PWQO or CWQG for TSS, all 75^{th} percentile concentrations are below the EPA's threshold of 30 mg/L. At the design flow of 2,547 m^3/d and the current CofA TSS compliance limit of 10 mg/L, the ambient TSS concentration would marginally increase (less than 2%) during the winter, and actually improve during the summer (approximately 4%). Therefore, it is proposed that the existing compliance limit of 10 mg/L and the design objective of 8 mg/L be maintained for the proposed WPCP expansion.

3.3 Effluent Total Phosphorus

As discussed in Section 2, the Grand River in the vicinity of the Grand Valley WPCP outfall is MOE Policy II with respect to total phosphorus and no assimilative capacity is available in the receiver. Furthermore, for a MOE Policy II receiver, MOE policy states: "*Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives*." The existing CofA compliance limit for total phosphorus is 0.15 mg/L, and the corresponding loading limit is 0.19 kg/d. To maintain this loading limit at future flow conditions would require reducing the compliance limit from 0.15 mg/L to 0.073 mg/L, which may be difficult to achieve using best available technology.

An important consideration in this analysis is the relative impact associated with a future total phosphorus load if the existing compliance concentration is maintained for future conditions. Under existing conditions, total phosphorus river load downstream of the WPCP, for peak ambient total phosphorus conditions (July) and low flow, would be 2.05 kg/d, or 1.87 kg/d upstream plus 0.19 WPCP load. Assuming the compliance concentration is maintained for future conditions, the peak ambient total phosphorus load downstream of the WPCP would increase to 2.25 kg/d, or 1.87 kg/d upstream plus 0.38 WPCP load, an increase of less than 10%.

A final evaluation of all practical treatment alternatives is required in order to determine what final effluent compliance limit for total phosphorus is appropriate. In support of that effort, a summary of total phosphorus loading downstream of the WPCP for peak ambient total phosphorus conditions (July), 7Q20 low flow, and a range of effluent compliance limits, is provided in Table 10 below. A compliance total phosphorus limit of 0.10 mg/L is approaching practical limits that would be achievable. The total increase in downstream load associated with this limit is approximately 3.3%. It is proposed that this marginal increase is acceptable and consistent with MOE Policy and the future limit for total phosphorus should be 0.1 mg/L.

Table 10. 75th Percentile Total Phosphorus Loading Downstream of the WPCP for Future Conditions

Scenario	Proposed Effluent TP limit (mg/L)	Downstream TP Load (kg/d)	Increase Relative to Existing Conditions (%)
Maintain Existing CofA Concentration Limit	0.15	2.25	9.5
Practical Limit for Effluent Phosphorus	0.10	2.12	3.3
Maintain Existing CofA Loading Limit	0.07	2.05	0.0

3.4 Effluent Total Ammonia

Evaluation of effluent ammonia requires an assessment of both effluent toxicity and in-stream PWQO compliance.

3.4.1 Effluent Toxicity

The currently accepted un-ionized ammonia limit for effluent toxicity at end-of-pipe is 0.1 mg/L as N. Monthly 75th percentile ammonia dissociation constants for the WPCP effluent were derived previously (XCG, 2013) using historical effluent monitoring results. These dissociation ratios, combined with the existing CofA TAN limits, were applied to evaluate effluent toxicity for future conditions. The resultant effluent un-ionized ammonia concentrations are summarized in Table 11. In addition to the effluent dissociation constant established in 2003,

Table 11 also includes estimates of the minimum and maximum dissociation constant based on 2013 through 2016 effluent monitoring results. As indicated, if the maximum dissociation constant derived from the 2013-2016 effluent monitoring was greater than the 2003 dissociation estimate, it was applied for the final estimation of effluent un-ionized ammonia. In most cases, the recent effluent monitoring is consistent with the 2013 assessment results. As illustrated, end-of-pipe un-ionized ammonia is consistently below the toxicity threshold of 0.1 mg/L based on the existing CofA TAN limits.

Table 11. Estimated End-of-Pipe Un-ionized Ammonia

Month	Effluent TAN (mg/L as N)	Dissociation Constant (%) (XCG, 2013)	Dissociation Constant (%) 2013-2016 Monitoring	Effluent Un-Un-Ionized Ammonia (mg/L as N)
January	4.0	0.9	0.2 – 0.4	0.036
February	4.0	0.9	0.1 – 0.3	0.036
March	4.0	0.9	0.1 – 0.9	*0.036**
April	1.0	1.4	0.1 – 0.6	0.014
May	1.0	1.4	0.2 – 1.0	0.014
June	0.7	1.8	0.2 – 1.4	0.013
July	0.7	1.8	0.3 – 1.5	0.013
August	0.7	1.8	0.3 – 1.6	0.013
September	0.7	1.8	0.3 – 2.6	*0.018**
October	1.0	1.2	0.1 – 1.8	*0.018**
November	1.0	1.2	0.4 – 0.9	0.012
December	1.0	0.9	0.1 – 0.6	0.009

**Maximum dissociation constant based on 2013-2016 effluent monitoring results.*

3.4.2 Un-Ionized Ammonia in-Stream

The in-stream ammonia dissociation constants, and ambient TAN, were derived from synoptic measurements of TAN, pH and temperature and are presented in Table 12. PWQMN monitoring information for pH and temperature was sparse for the early 2000's, and some infilling of monitoring results for that period from PWQMN 16018406702 (Grand River at 13th Ln, NW of Marsville) was completed. Despite this, water quality sampling during the winter months was limited and it was necessary to lump January through March, and November and December results. Estimates of un-ionized ammonia concentrations were generated using the TAN limits as defined in the existing CofA and are summarized in Table 12. As illustrated, monthly un-ionized concentrations remain at or below the PWQO threshold of 0.016 mg/L as N for all months of the year.

Table 12. In-Stream Un-Ionized Ammonia Downstream of WPCP for Future Conditions

Month	75th Percentile Ambient TAN (mg/L as N)	Effluent TAN (mg/L as N)	Mass Balance TAN (mg/L as N)	Dissociation Constant (%)	Downstream Un-Ionized Ammonia (mg/L as N)
January February March	0.063	4.0	0.32	1%	0.003
April	0.056	1.0	0.12	5%	0.006
May	0.043	1.0	0.10	8%	0.009
June	0.044	0.7	0.09	13%	0.011
July	0.038	0.7	0.0	17%	0.014
August	0.039	0.7	0.08	16%	0.013
September	0.037	0.7	0.08	20%	0.016
October	0.029	1.0	0.09	5%	0.005
November	0.029	1.0	0.10	3%	0.003
December	0.058	1.0	0.07	2%	0.002

3.5 Effluent *E. coli*

As discussed in Section 2, the Grand River near Grand Valley is considered MOE Policy II with respect to *E.coli,* and therefore, the effluent should not further degrade the quality of the water. A compliance limit of 200 cfu/100 mL and a design objective of 100 cfu/100 mL are proposed.

4 MIXING ZONE ASSESSMENT

4.1 Approach

The expert system mixing model CORMIX version 11 GTH (Advanced Hydraulic Tools) was applied for development of mixing zone downstream of the proposed discharge. In addition, an analytical solution of the two-dimensional advective-dispersive transport equation was developed for comparison purposes and is provided in Appendix A.

Key parameter assignments for the CORMIX model are summarized in Table 13. Numerous model runs were completed to establish parameter sensitivity and representative model results are provided in Figures 6 and 7, and in Table 14. Figure 6 illustrates a plan view of the CORMIX results, while Figure 7 illustrates a plot of the maximum plume concentration relative to downstream distance. Table 14 provides a summary of the plume width, which is approximately equivalent to the distance between the right bank and a location instream encompassing approximately 75% of the plume mass. Minimum dilution, or the maximum effluent concentration downstream, is also summarized in Table 14.

In Figure 6, the x-axis represents the right bank distance downstream, while the y-axis represents the lateral distance, perpendicular to the right bank. As illustrated in Figure 6, the resultant plume hugs the right bank, however, there is a near field region (less than 25 m) where the effluent remains separated from the bank. As illustrated in Figure 7, near completely mixed conditions are achieved within 2000 m of the discharge, which is consistent with the analytical solution provided in Appendix A. In addition, the CORMIX results confirm that the discharge is vertically completely mixed.

Table 13. CORMIX Model Summary

CORMIX Block	Parameter	Value
Ambient	Average Channel Depth	0.15 m
	Depth at Discharge	0.13 m
	Channel Velocity	0.133 m/s
	Water Temperature	22 ^{o}C
	Manning's *n*	0.06
	Flow	0.4 m^3/s
	Channel Width	20 m
Discharge	CORMIX Model	CORMIX3 Surface Discharge
	Configuration	Flush
	Bank	Right
	Slope	1%
	Width	1m
	Depth	0.06 m
	Depth at Bank	0.07 m
	Flow	0.029 m^3/s

Table 14. CORMIX results: Plume Width

Distance Downstream (m)	Peak Plume Effluent Concentration (%)	Plume Width (m)	Zone of Passage (m)
0	100.0	0.0	20.0
10	65.7	0.6	15.0
25	58.8	0.7	19.3
50	43.4	3.1	16.9
100	30.2	4.5	15.5
200	21.6	6.3	13.7
500	14.0	9.8	10.2
1000	9.9	13.8	6.2
1500	8.1	16.9	3.1
2000	7.0	19.5	0.5
3000	6.8	20.0	0.0
4000	6.8	20.0	0.0

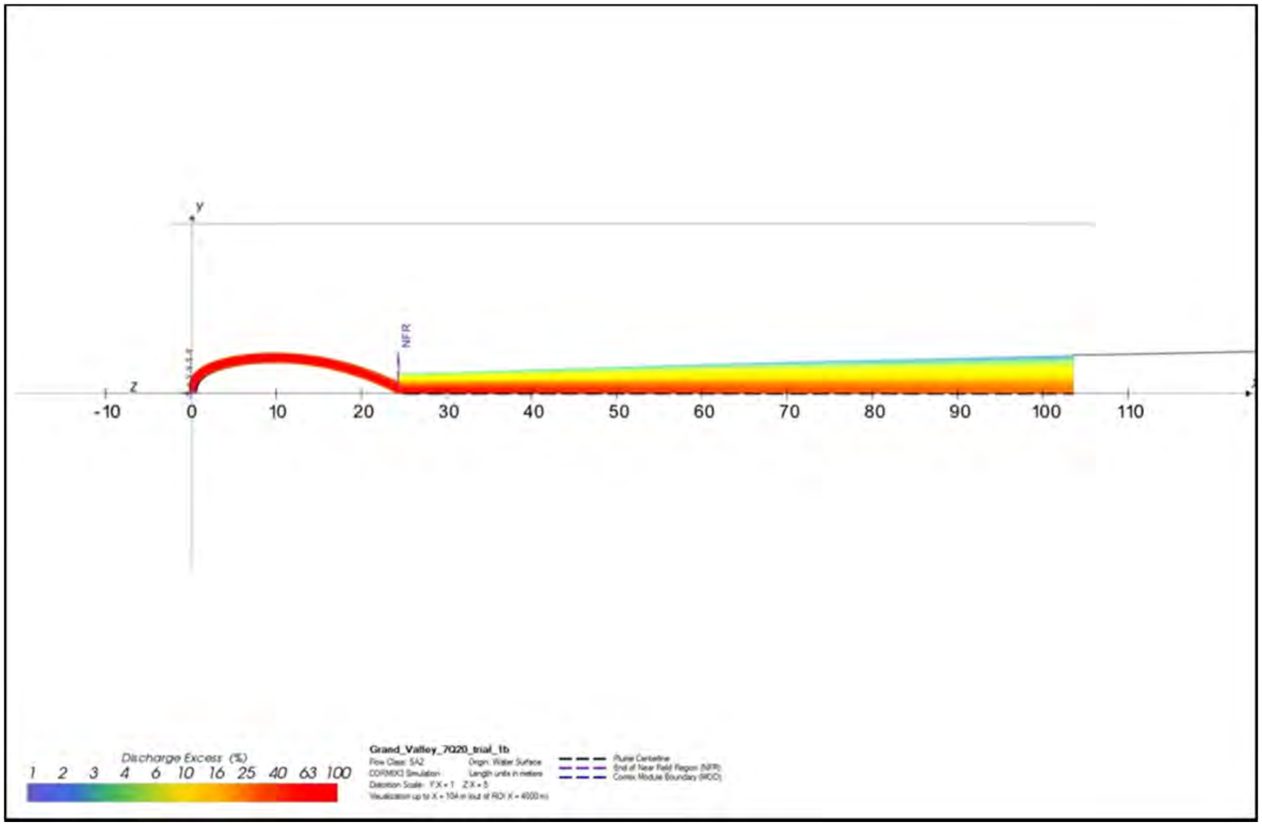

Figure 6. Representative CORMIX Results for Near Field

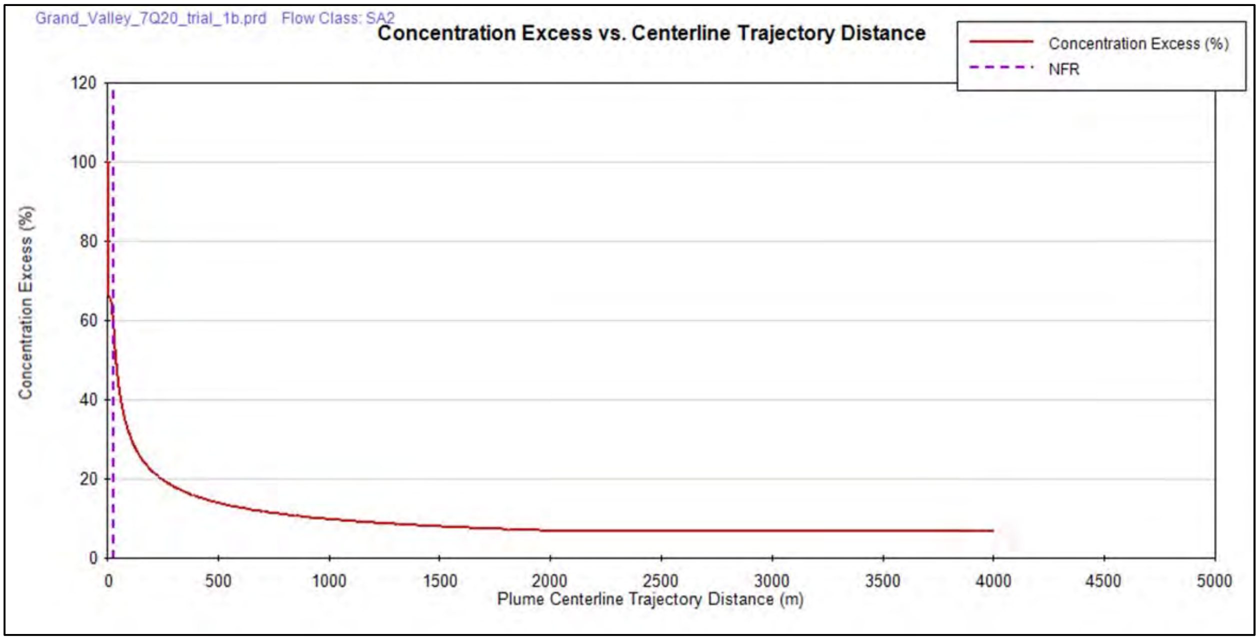

Figure 7. CORMIX Results for Maximum Plume Concentration (% Effluent)

4.2 Mixing Zone

The CORMIX results summarised above were applied to establish plume characteristics for dissolved oxygen, total phosphorus, and un-ionized ammonia and the results are summarized in Tables 15 through 17. Table 15 presents the dissolved oxygen summary for summer conditions and assumes a conservative effluent dissolved oxygen concentration of 0.0 mg/L. PWQO standards are achieved within 50 m of the discharge, and an adequate zone of passage (Table 14) is available upstream of 50 m.

Table 15. CORMIX Results: Dissolved Oxygen

Distance Downstream (m)	Minimum Dissolved Oxygen Concentrations for Summer (mg/L)
0	0.0
25	3.7
50	5.2
100	6.4
200	7.1
500	7.8
1000	8.2
1500	8.4
2000	8.5
3000	8.5
4000	8.5

Table 16 presents the total phosphorus results summary for summer. The Grand River is MOE Policy 2 with respect to total phosphorus and the peak summer 75th percentile concentration is 0.054 mg/L. An effluent TP limit of 0.07 would maintain the current approved effluent loading, while an effluent TP limit of 0.10 mg/L would represent an increase at completely mixed conditions of only 3%.

Table 16. CORMIX Results: Total Phosphorus

Distance Downstream (m)	Maximum TP Concentrations for Summer (mg/L)		
	Effluent TP 0.15 mg/L	Effluent TP 0.10 mg/L	Effluent TP 0.07 mg/L
0	0.150	0.100	0.070
25	0.110	0.081	0.063
50	0.096	0.074	0.061
100	0.083	0.068	0.059
200	0.075	0.064	0.057
500	0.067	0.060	0.056
1000	0.063	0.059	0.056
1500	0.062	0.058	0.055
2000	0.061	0.057	0.055
3000	0.061	0.057	0.055
4000	0.061	0.057	0.055

Table 17 presents the mixing zone un-ionized results summary by month. For all months, with the exception of August and September, the threshold PWQO un-ionized ammonia concentration of 0.016 mg/L is achieved within 500 m. At 500 m, the zone of passage (Table 14) is greater than 50% of the channel width. For the summer months of July through September relatively high 75th percentile ammonia dissociation constants ranging from 16 to 20% results in the mixing zone extending as far as 2,000 m downstream.

Table 17. CORMIX Results: Un-ionized Ammonia

Distance Downstream (m)	Un-ionized Ammonia (mg/L as N)									
Month	Jan-Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proposed Effluent TAN Limit	4.0	1.0	1.0	0.7	0.7	0.7	0.7	1.0	1.0	1.0
0	***0.068***	***0.050***	***0.055***	***0.088***	***0.103***	***0.114***	***0.140***	***0.051***	***0.027***	***0.022***
25	***0.040***	***0.031***	***0.034***	***0.054***	***0.063***	***0.070***	***0.085***	***0.031***	0.016	0.013
50	***0.030***	***0.023***	***0.026***	***0.041***	***0.048***	***0.053***	***0.065***	***0.023***	0.012	0.010
100	***0.021***	***0.017***	***0.019***	***0.030***	***0.036***	***0.039***	***0.047***	0.016	0.009	0.008
200	0.016	0.013	0.015	***0.023***	***0.027***	***0.030***	***0.036***	0.012	0.006	0.006
500	0.010	0.009	0.011	***0.017***	***0.020***	***0.021***	***0.026***	0.008	0.004	0.004
1000	0.008	0.007	0.009	0.014	0.016	***0.017***	***0.021***	0.006	0.003	0.003
1500	0.006	0.007	0.008	0.012	0.014	0.015	***0.018***	0.005	0.003	0.003
2000	0.006	0.006	0.007	0.011	0.013	0.014	***0.017***	0.005	0.003	0.003
3000	0.006	0.006	0.007	0.011	0.013	0.014	0.016	0.005	0.003	0.003
4000	0.006	0.006	0.007	0.011	0.013	0.014	0.016	0.005	0.003	0.003

5 SUMMARY

A summary of the assimilative capacity assessment of the Grand River near Grand Valley are as follows:

- The Grand River is MOE Policy II with respect to total phosphorus and *E. coli* and MOE Policy I with respect to dissolved oxygen and un-ionized ammonia.
- The required effluent total phosphorus compliance limit to maintain the existing loading is 0.7 mg/L, approximately 50% of the current compliance limit, however, at a proposed limit of 0.1 mg/L, total phosphorus loading for future conditions is only 3 % greater than existing conditions.
- Although no PWQO is available for TSS, nitrates and $cBOD_5$, ambient concentrations are generally within acceptable limits as defined by other jurisdictions or by CCME guidelines.
- A review of the low flow assessment completed by the GRCA demonstrates that 0.4 m^3/s is a reasonable approximation of 7Q20 flow and is suitable for assimilative capacity assessment.
- Results of a desk-top Streeter-Phelps dissolved oxygen model indicate that the existing CofA limits for $cBOD_5$ and TAN are appropriate for future WPCP flow conditions.
- With the exception of July, for completely mixed conditions the existing CofA limits for TAN are suitable for future WPCP flow conditions. For the summer months of July through September, near completely mixed conditions are required in order to achieve the PWQO target for un-ionized ammonia of 0.016 mg/L.

- With the exception of August and September, the results of mixing zone model indicate that PWQO un-ionized ammonia concentrations will be achieved with 500 m of the WPCP discharge for future WPCP flow and existing CofA compliance TAN limits. For August and September, approximately 2,000 m is required in order to achieve the PWQO target.

A summary of recommended effluent compliance and objective limits is provided in Table 18.

Table 18. Grand Valley Effluent Recommended Compliance and Objective Limits

Effluent Parameter	Effluent Compliance Limits[1]		Effluent Objective Limits
	Average Concentration (mg/L)	Average Loading (kg/d)	Average Concentration (mg/L)
$cBOD_5$	10.0	24.6	8.0
Total Suspended Solids	10.0	24.6	8.0
Total Phosphorus	0.10	0.25	0.08
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	9.83	3.0
Spring (Apr 1 – May 31)	1.0	2.46	0.8
Summer (Jun 1 – Sep 31)	0.7	1.52	0.5
Fall (Oct 1 – Nov 30)	1.0	2.46	0.8
E coli	200 cfu/100 mL[2]	N/A	100 cfu/100 mL[2]
pH	6.0-9.5		6.5-8.5

Notes:
1. Based on monthly average.
2. Based on monthly geometric mean density.

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Appendix A: 2-D Analytical Approximation of Mixing Zone

An analytical approximation of the two-dimensional advective-dispersive transport equation (equation A-1 below) was developed for comparison purposes. Key model assignmens are summarized in Table A-1.

$$v\frac{\partial C}{\partial x} = E\left[\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial y^2}\right] - kC \pm S \qquad \text{[A-1]}$$

Where:

C = Concentration of contaminate (mg/L)
E = Dispersion coefficient (m^2/s)
v = Velocity (m/s)
k = Decay constant (s^{-1})
S = Sources and sinks (mg/L/s)

The dispersion coefficient in Equation A-1, E, was approximated using an empirical relationship using an approach recommended by Fischer (Fischer et al., 1979) and is presented below as Equation 2.

$$E \cong 0.6d\sqrt{gdS} = 0.6du \qquad \text{[2]}$$

Where:

d = Channel depth (m)
g = Gravitational constant (m/s^2)
S = Average channel slope (m/m)
u = Channel shear velocity (m/s)

A centre-channel discharge was assumed and plume superposition was applied to address channel boundaries as discussed in Fischer et al. (Fischer et al. 1979). Importantly, this mixing zone solution is an approximation of actual conditions and requires several assumptions to be valid, including:

- Effluent is completely mixed vertically.
- Momentum of effluent flow can be ignored.
- Steady state conditions have been achieved.
- The channel is rectangular, with constant width.
- Effluent discharge is introduced in the center of the channel.

Key parameter assignments for the mixing zone solution are summarized in Table 13. Average slope and velocity were defined using GRCA's HEC-RAS model. The discharge was assumed to be a right-bank ditch, perpendicular to the river.

Table A-1. Grand River Mixing Zone Model Parameter Assignments

Parameter	Value
Channel Width	20.0 m
Average Channel Depth - Low-Flow	0.15 m
WPCP Flow	2,547 m^3/d
River Low-Flow	0.4 m^3/s
Average Channel Slope	0.001 m/m
Shear velocity	0.038 m/s (Equation 2)
Dispersion Coefficient	0.003 m^2/s (Equation 2)

Model results are summarised in Figure A-1. In general, completely mixed conditions are achieved at a downstream distance of approximately 2000 m. At a distance of 50 m, the maximum effluent mass fraction is approximately 20%, while at a distance of 100 m, the effluent mass fraction is less than 15%.

x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	100.0	69.4	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	97.2	69.1	24.8	4.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	68.7	57.9	34.7	14.8	4.5	1.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	56.1	50.1	35.6	20.1	9.1	3.3	0.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	48.6	44.6	34.5	22.5	12.4	5.7	2.2	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	43.5	40.6	33.1	23.5	14.6	7.9	3.7	1.5	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	39.7	37.5	31.6	23.8	16.0	9.6	5.1	2.4	1.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	36.7	35.0	30.2	23.7	16.8	10.8	6.3	3.4	1.6	0.7	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	34.4	32.9	29.0	23.4	17.4	11.8	7.4	4.2	2.2	1.1	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	32.4	31.2	27.8	23.0	17.7	12.5	8.3	5.0	2.9	1.5	0.7	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	30.7	29.7	26.8	22.6	17.8	13.1	9.0	5.8	3.5	1.9	1.0	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	29.3	28.4	25.9	22.2	17.8	13.5	9.6	6.4	4.0	2.4	1.3	0.7	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
24	28.1	27.3	25.0	21.7	17.8	13.8	10.1	7.0	4.5	2.8	1.6	0.9	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
26	27.0	26.3	24.3	21.3	17.7	14.0	10.5	7.4	5.0	3.2	1.9	1.1	0.6	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0
28	26.0	25.4	23.6	20.9	17.6	14.1	10.8	7.9	5.5	3.6	2.3	1.4	0.8	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0
30	25.1	24.5	22.9	20.4	17.4	14.2	11.1	8.2	5.8	4.0	2.6	1.6	0.9	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0
32	24.3	23.8	22.3	20.1	17.3	14.3	11.3	8.5	6.2	4.3	2.9	1.8	1.1	0.7	0.4	0.2	0.1	0.1	0.0	0.0	0.0
34	23.6	23.1	21.8	19.7	17.1	14.3	11.4	8.8	6.5	4.6	3.2	2.1	1.3	0.8	0.5	0.3	0.1	0.1	0.0	0.0	0.0
36	22.9	22.5	21.2	19.3	16.9	14.3	11.6	9.0	6.8	4.9	3.4	2.3	1.5	0.9	0.6	0.3	0.2	0.1	0.0	0.0	0.0
38	22.3	21.9	20.8	19.0	16.7	14.2	11.7	9.2	7.1	5.2	3.7	2.5	1.7	1.1	0.7	0.4	0.2	0.1	0.1	0.0	0.0
40	21.8	21.4	20.3	18.6	16.5	14.2	11.8	9.4	7.3	5.5	3.9	2.8	1.9	1.2	0.8	0.5	0.3	0.2	0.1	0.0	0.0
42	21.2	20.9	19.9	18.3	16.4	14.1	11.8	9.6	7.5	5.7	4.2	3.0	2.0	1.4	0.9	0.5	0.3	0.2	0.1	0.1	0.0
44	20.8	20.4	19.5	18.0	16.2	14.1	11.9	9.7	7.7	5.9	4.4	3.2	2.2	1.5	1.0	0.6	0.4	0.2	0.1	0.1	0.0
46	20.3	20.0	19.1	17.7	16.0	14.0	11.9	9.8	7.8	6.1	4.6	3.4	2.4	1.6	1.1	0.7	0.5	0.3	0.2	0.1	0.1
48	19.9	19.6	18.8	17.5	15.8	13.9	11.9	9.9	8.0	6.3	4.8	3.5	2.6	1.8	1.2	0.8	0.5	0.3	0.2	0.1	0.1
50	19.5	19.2	18.4	17.2	15.6	13.8	11.9	10.0	8.1	6.4	5.0	3.7	2.7	1.9	1.3	0.9	0.6	0.4	0.2	0.1	0.1
52	19.2	18.9	18.1	17.0	15.5	13.7	11.9	10.0	8.2	6.6	5.1	3.9	2.9	2.1	1.5	1.0	0.7	0.4	0.3	0.2	0.1
54	18.8	18.5	17.8	16.7	15.3	13.6	11.9	10.1	8.3	6.7	5.3	4.0	3.0	2.2	1.6	1.1	0.7	0.5	0.3	0.2	0.1
56	18.5	18.2	17.5	16.5	15.1	13.5	11.8	10.1	8.4	6.8	5.4	4.2	3.2	2.3	1.7	1.2	0.8	0.5	0.4	0.2	0.1
58	18.2	17.9	17.3	16.3	15.0	13.5	11.8	10.1	8.5	7.0	5.6	4.3	3.3	2.5	1.8	1.3	0.9	0.6	0.4	0.3	0.2
60	17.9	17.7	17.0	16.1	14.8	13.4	11.8	10.2	8.6	7.1	5.7	4.5	3.4	2.6	1.9	1.4	1.0	0.7	0.4	0.3	0.2
62	17.7	17.4	16.8	15.9	14.7	13.3	11.8	10.2	8.6	7.2	5.8	4.6	3.6	2.7	2.0	1.5	1.0	0.7	0.5	0.3	0.2
64	17.4	17.2	16.6	15.7	14.5	13.2	11.7	10.2	8.7	7.2	5.9	4.7	3.7	2.8	2.1	1.6	1.1	0.8	0.5	0.4	0.2
66	17.2	16.9	16.3	15.5	14.4	13.1	11.7	10.2	8.7	7.3	6.0	4.8	3.8	2.9	2.2	1.6	1.2	0.9	0.6	0.4	0.3
68	17.0	16.7	16.1	15.3	14.2	13.0	11.6	10.2	8.8	7.4	6.1	4.9	3.9	3.1	2.3	1.7	1.3	0.9	0.6	0.4	0.3
70	16.8	16.5	15.9	15.1	14.1	12.9	11.6	10.2	8.8	7.5	6.2	5.0	4.0	3.2	2.4	1.8	1.4	1.0	0.7	0.5	0.3
72	16.6	16.3	15.8	15.0	14.0	12.8	11.5	10.2	8.8	7.5	6.3	5.1	4.1	3.3	2.5	1.9	1.4	1.0	0.7	0.5	0.4
74	16.4	16.1	15.6	14.8	13.9	12.7	11.5	10.2	8.9	7.6	6.4	5.2	4.2	3.4	2.6	2.0	1.5	1.1	0.8	0.6	0.4
76	16.2	15.9	15.4	14.7	13.7	12.7	11.4	10.2	8.9	7.6	6.4	5.3	4.3	3.5	2.7	2.1	1.6	1.2	0.9	0.6	0.4
78	16.0	15.8	15.3	14.5	13.6	12.6	11.4	10.2	8.9	7.7	6.5	5.4	4.4	3.5	2.8	2.2	1.7	1.2	0.9	0.7	0.5
80	15.9	15.6	15.1	14.4	13.5	12.5	11.3	10.1	8.9	7.7	6.6	5.5	4.5	3.6	2.9	2.3	1.7	1.3	1.0	0.7	0.5
82	15.7	15.4	15.0	14.3	13.4	12.4	11.3	10.1	8.9	7.7	6.6	5.5	4.6	3.7	3.0	2.3	1.8	1.4	1.0	0.8	0.5
84	15.6	15.3	14.8	14.1	13.3	12.3	11.3	10.1	8.9	7.8	6.7	5.6	4.7	3.8	3.0	2.4	1.9	1.4	1.1	0.8	0.6
86	15.4	15.2	14.7	14.0	13.2	12.3	11.2	10.1	8.9	7.8	6.7	5.7	4.7	3.9	3.1	2.5	1.9	1.5	1.1	0.8	0.6
88	15.3	15.0	14.5	13.9	13.1	12.2	11.2	10.1	8.9	7.8	6.8	5.7	4.8	3.9	3.2	2.6	2.0	1.6	1.2	0.9	0.7
90	15.2	14.9	14.4	13.8	13.0	12.1	11.1	10.0	9.0	7.9	6.8	5.8	4.9	4.0	3.3	2.6	2.1	1.6	1.2	0.9	0.7
92	15.1	14.8	14.3	13.7	12.9	12.0	11.1	10.0	9.0	7.9	6.8	5.8	4.9	4.1	3.3	2.7	2.1	1.7	1.3	1.0	0.7
94	15.0	14.7	14.2	13.6	12.8	12.0	11.0	10.0	9.0	7.9	6.9	5.9	5.0	4.2	3.4	2.8	2.2	1.7	1.3	1.0	0.8
96	14.8	14.5	14.1	13.5	12.8	11.9	11.0	10.0	9.0	7.9	6.9	5.9	5.0	4.2	3.5	2.8	2.3	1.8	1.4	1.1	0.8
98	14.7	14.4	14.0	13.4	12.7	11.8	10.9	10.0	8.9	7.9	6.9	6.0	5.1	4.3	3.5	2.9	2.3	1.9	1.5	1.1	0.9
100	14.6	14.3	13.9	13.3	12.6	11.8	10.9	9.9	8.9	7.9	7.0	6.0	5.2	4.3	3.6	3.0	2.4	1.9	1.5	1.2	0.9
102	14.5	14.2	13.8	13.2	12.5	11.7	10.8	9.9	8.9	8.0	7.0	6.1	5.2	4.4	3.7	3.0	2.5	2.0	1.6	1.2	0.9
104	14.5	14.1	13.7	13.1	12.4	11.7	10.8	9.9	8.9	8.0	7.0	6.1	5.3	4.5	3.7	3.1	2.5	2.0	1.6	1.3	1.0
106	14.4	14.0	13.6	13.0	12.4	11.6	10.8	9.9	8.9	8.0	7.0	6.1	5.3	4.5	3.8	3.1	2.6	2.1	1.7	1.3	1.0
108	14.3	14.0	13.5	13.0	12.3	11.5	10.7	9.8	8.9	8.0	7.1	6.2	5.3	4.6	3.8	3.2	2.6	2.1	1.7	1.3	1.1
110	14.2	13.9	13.4	12.9	12.2	11.5	10.7	9.8	8.9	8.0	7.1	6.2	5.4	4.6	3.9	3.2	2.7	2.2	1.8	1.4	1.1
112	14.1	13.8	13.4	12.8	12.2	11.4	10.6	9.8	8.9	8.0	7.1	6.2	5.4	4.7	3.9	3.3	2.7	2.2	1.8	1.4	1.1
114	14.0	13.7	13.3	12.7	12.1	11.4	10.6	9.8	8.9	8.0	7.1	6.3	5.5	4.7	4.0	3.4	2.8	2.3	1.8	1.5	1.2
250	11.7	11.4	11.0	10.6	10.2	9.7	9.3	8.8	8.3	7.9	7.4	6.9	6.4	5.9	5.5	5.0	4.6	4.2	3.8	3.4	3.0
500	10.4	10.2	9.9	9.6	9.3	9.0	8.7	8.3	8.0	7.7	7.4	7.0	6.7	6.4	6.1	5.8	5.5	5.2	4.9	4.6	4.3
2000	8.9	8.7	8.6	8.4	8.3	8.1	8.0	7.8	7.7	7.5	7.4	7.2	7.0	6.9	6.7	6.6	6.4	6.3	6.1	6.0	5.8
5000	7.8	7.8	7.7	7.6	7.5	7.4	7.4	7.3	7.2	7.1	7.0	6.9	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.3	6.2

Figure A-1. Analytical Approximation of the Mixing Zone Solution (Percentage Effluent)

August 2018 Summary of Grand Valley ACS Update

A brief summary of the ACS revisions completed to address reviewer comments is provided below. Reviewer comments are presented in italics, while the summary response is listed as "ACS Update".

4. Review of MOECC Comments on Draft ACS (Letter of May 16, 2018)

4.1. DO Modeling

MOECC had cited concerns with the mixing zone analysis and specifically with respect to Dissolved Oxygen (DO). Mark Anderson confirmed that the GRCA has not identified DO to be a parameter of concern in this stretch of the Grand River. Following a discussion, Sajjad requested that modelling of the DO concentration downstream be updated utilizing a Streeter Phelps approximation by including allowances for plant respiration and sediment effects. Estimated DO concentrations in the mixing zone will be developed to determine near-zone effects of the effluent discharge on DO concentrations in the vicinity of the outfall. This updated modelling will be incorporated into the final ACS.

ACS Update

The Streeter-Phelps DO model has revised and now includes Sediment Oxygen Demand. Plant photosynthesis and respiration were assumed equivalent in order to apply a steady-state Streeter Phelps solution for low-flow and 25-percentile DO. Additional runs were completed for minimum ambient DO based on continuous DO monitoring results to demonstrate that DO impacts were acceptable. Finally, CORMIX mixing zone model results were applied to establish DO concentrations in the mixing zone. A conservative effluent DO of 0 mg/L was applied for this analysis.

4.2. Total Phosphorus

MOECC requested that the ACS include the total length of the mixing zone and the concentrations of Phosphorus in the mixing zone.

There was a lengthy discussion about phosphorus loadings and in particular the requirements of Policy B-1-5. Although the policy is clear in saying that in Policy 2 areas the concentration and total load of a contaminant cannot be increased, the policy goes on to recognize that under circumstances strict compliance may not be feasible. This question of feasibility is consistent with the issues raised in an Auditor General's Report entitled "Chasing Zero". It was agreed that the municipality could apply for a deviation in total load as described in B-1-5.

It was pointed out that increases in concentration will not be constant, but will vary depending on time of year. The deviation request is to describe flow variation under different flow conditions and to consider the length of the mixing zone.

ACS Update
The CORMIX mixing zone model results were applied to establish TP concentrations in the mixing zone. Maximum increases, relative to existing conditions, in downstream TP were derived in terms of both concentration and loading. In both cases, maximum increases were marginal (3%). It is acknowledged that an application for a deviation in total load as described in B-1-5 may be required.

4.3. Mixing Zone

Sajjad noted that the 2-D advective-diffusion equation used in the mixing zone analysis is not acceptable for this application. MOECC recommend that the Town complete a mixing zone analysis with CORMIX modelling software or by completing a dye study. Sajjad noted that utilizing CORMIX modelling will provide greater flexibility in terms of evaluating the impact of alternative flow scenarios, whereas the dye testing provides only a "snap-shot" of mixing conditions at the time of the test. The Town will review these options and select a preferred method for the revised mixing zone analysis.

Should CORMIX be used, the model will be configured for a shoreline discharge, which is consistent with the existing outfall configuration.

ACS Update
The expert system mixing model CORMIX version 11(GTH - Advanced Hydraulic Tools) was applied for development of mixing zone downstream of the proposed discharge. A shoreline surface discharge was modelled. In addition, an analytical solution of the two-dimensional advective-dispersive transport equation was developed for comparison purposes.

4.4. Effluent Toxicity

For TAN near field conditions (<100 m) and far field conditions (>100 m) will be examined.

The pH and temperatures, and associated dissociation constants that should be used to estimate un-ionized ammonia concentrations at end-of-pipe were discussed. Sajjad agreed that historical WPCP effluent pH and temperature data will be used to develop historical dissociation constants. A variety of scenarios will be considered to estimate end-of-pipe un-ionized ammonia, including historical 75th percentile, 95th percentile, and maximum dissociation constants.

ACS Update
In addition to the 2003 estimates of effluent dissociation constants, a review of the 2013 through 2016 effluent monitoring results was completed. For a conservative estimate of

effluent toxicity, on a monthly basis, the maximum of either the historical 2003 dissociation constant, or the dissociation constant derived from recent (2013-2016) effluent monitoring results was applied.

4.5. GRCA ACS Comments

The Town reviewed and accepted the comments provided by the GRCA. Mark required that the Town use the GRCA collected field data as well as discussing method to deal with censored data. The GRCA comments will be addressed in the final ACS.

<u>ACS Update</u>
In order to address the censored GRCA results, recommended statistical approaches described by USGS (Helsel and Hirsch, 2002) were applied. Where possible, a combined GRCA and PWQMN dataset was developed and applied. In addition, since the previous ACS was completed, more recent PWQMN monitoring information is available and these results were incorporated into the updated report.

August 23rd, 2018

Water Supply and Sewage Servicing Master Plan
Town of Grand Valley

Technical Memorandum

<u>Assimilative Capacity Assessment</u>

1 INTRODUCTION

1.1 Background

Profound Engineering was retained by R.J.Burnside and Associates Ltd. on behalf of the Town of Grand Valley to complete an assimilative capacity assessment of the Grand River in the vicinity of the existing wastewater pollution control plant (WPCP) discharge for the Town of Grand Valley facility. This assessment was completed in support of a water supply and sewage servicing master plan and addresses a proposed increase in the Grand Valley WPCP average daily flow from 1,244 m^3/d to an anticipated future average daily flow of 2,547 m^3/d. The Grand Valley WPCP operates under CofA 9706-7KWQ57 which identifies compliance and design objectives for final effluent quality (Table 1).

Table 1. Grand Valley Effluent Compliance and Objective Limits

Effluent Parameter	Effluent Compliance Limits[1]		Effluent Objective Limits
	Average Concentration (mg/L)	Average Loading (kg/d)	Average Concentration (mg/L)
$cBOD_5$	10.0	12.4	8.0
Total Suspended Solids	10.0	12.4	8.0
Total Phosphorus	0.15	0.19	0.13
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	4.98	3.0
Spring (Apr 1 – May 31)	1.0	1.24	0.8
Summer (Jun 1 – Sep 31)	0.7	0.87	0.6
Fall (Oct 1 – Nov 30)	1.0	1.24	0.8
E coli	200 cfu/100 mL[2]	N/A	100 cfu/100 mL[2]
pH	6.0-9.5		6.5-8.5

Notes:
1. Based on monthly average.
2. Based on monthly geometric mean density.

The discussion provided below includes an assessment of the ambient water quality and current conditions in the Grand River near the Grand Valley WPCP, a summary of low-flow conditions, a mixing zone analysis and the development of proposed effluent objectives and limits for future flow conditions.

1.2 Objectives

The objectives of this assessment are as follows:

- Define ambient water quality and verify low-flow conditions for design purposes.

- Complete an assessment of assimilative capacity of the receiving water for key water quality parameters included $cBOD_5$, un-ionized ammonia, total ammonia, total phosphorus, total suspended solids, *E coli* and nitrate.
- Complete a mixing zone analysis.
- Develop recommendations for effluent limits for a future average daily flow of 2,547 m^3/d.

2 AMBIENT CONDITIONS

2.1 Water Quality

Representative background water quality was defined by examining water quality in the vicinity of the Grand Valley WPCP effluent discharge. For analysis purposes, the 75th percentile threshold was applied to characterize ambient conditions, or in the case of dissolved oxygen, the 25th percentile, as recommended by the MOE (MOE, 1994). For each water quality parameter, with the exception of nitrate, a comparison of representative ambient water quality with Provincial Water Quality Objectives (PWQO) was complete in order to establish the appropriate MOE policy to apply for assimilative capacity assessment, either Policy I or Policy II. Policy I corresponds to areas where the ambient concentration is less than the PWQO, while Policy 2 corresponds to areas where the ambient concentration is greater than the PWQO. If Policy I applies, future water concentrations must be maintained at or below the PWQO, while if Policy II applies, all practical measures shall be taken to upgrade the water quality to the Objectives. For nitrate, since there is no PWQO, Canadian Water Quality Guideline (CWQG) was applied.

For the purposes of this analysis, ambient water quality was derived from two sources:

- the Provincial Water Quality Monitoring Network station at Leggatt (PWQMN station 16018409002), upstream of the Grand Valley WPCP outfall, and
- Recent monitoring completed by the Grand River Conservation Authority, near Leggatt, GRCA Monitoring Site 1357002.

Data obtained from the PWQMN station at Leggatt was collected from 1977 through 2016, while the GRCA data spanned 2015 and 2016. In some cases, Method Detection Limits(MDL), differed between GRCA and PWQMN monitoring information and in order to combine the monitoring results, statistical methods recommended by the USGS (Helsel and Hirsch, 2002) were applied.

2.1.1 Total Phosphorus

The MOE PWQO for total phosphorus is 0.03 mg/L. A summary of ambient total phosphorus concentrations is provided in table 2. Both PWQMN (1997 through 2016) and GRCA (2015 and 2016) were combined for this assessment. All results were above MDL's allowing for a combined data set. In general, with respect to total phosphorus, the Grand River near Grand Valley is MOE Policy I during the winter and fall, and MOE Policy II during the spring and summer. As such, all practical measures will be necessary to reduce effluent total phosphorus concentrations during the spring and summer, and if feasible, current allowable total phosphorus loadings must be maintained or reduced.

Table 2. Ambient Total Phosphorus 1977-2016

Month	Mean TP (mg/L)	Median TP (mg/L)	75th Percentile TP (mg/L)	Number of Observations
January	*0.031*	0.020	0.026	22
February	*0.034*	0.025	*0.039*	24
March	*0.043*	0.027	*0.054*	27
April	*0.034*	0.025	*0.043*	32
May	0.024	0.020	0.023	29
June	*0.031*	0.028	*0.035*	31
July	*0.042*	*0.037*	*0.053*	34
August	*0.038*	*0.034*	*0.044*	38
September	*0.031*	*0.030*	*0.034*	33
October	0.023	0.019	0.022	33
November	0.024	0.019	0.027	25
December	*0.033*	0.017	0.021	19
Annual	***0.032***	**0.024**	***0.036***	**347**

2.1.2 Un-ionized Ammonia

The percentage of un-ionized ammonia in aqueous solution varies with temperature and pH, with percentages increasing with increasing temperature and pH. Table 3, 4, 5 and 6 provide a summary of ambient temperature, pH, total ammonia and un-ionized ammonia, respectively. Un-ionized ammonia was derived from synoptic measurements of field pH, field temperature and laboratory total ammonia analysis results. The threshold PWQO for un-ionized ammonia is 0.02 mg/L as N. For ambient temperature and pH (Tables 3 and 4, respectively), monitoring information from PWQMN and GRCA were combined yielding a 1977 through 2016 dataset. Since the PWMN dataset included single monthly measurements, while the GRCA included multiple measurements per month, single monthly averages of GRCA results were applied in order to combine datasets.

Table 3. Ambient Temperature 1977-2016

Month	Mean Temp (^oC)	Median Temp (^oC)	75th Percentile Temp (^oC)	Number of Observations
January	0.7	0.5	1.0	18
February	0.8	0.7	1.2	19
March	2.4	1.9	3.2	26
April	7.9	6.7	11.9	31
May	14.8	14.7	17.5	29
June	19.9	19.9	21.5	31
July	22.7	22.6	24.7	33
August	21.1	21.4	22.3	35
September	17.1	16.3	19.3	33
October	9.5	9.7	11.3	33
November	3.7	3.4	5.9	27
December	1.5	1.0	1.4	19
Annual	**11.6**	**11.8**	**19.5**	**334**

Table 4. Ambient pH 1977-2016

Month	Mean pH	Median pH	75th Percentile pH	Number of Observations
January	7.51	7.71	8.03	12
February	7.77	7.75	7.85	14
March	7.64	7.59	7.90	12
April	8.11	8.01	8.20	21
May	8.27	8.30	8.35	19
June	8.25	8.17	8.38	20
July	8.39	8.36	*8.56*	21
August	8.36	8.36	8.50	21
September	8.53	8.54	*8.81*	19
October	8.28	8.34	8.40	18
November	8.08	8.19	8.26	15
December	8.07	8.20	8.30	9
Annual	**8.16**	**8.20**	**8.38**	**201**

The PWQO for pH states that the pH should be maintained within the range of 6.5 and 8.5 to protect aquatic life. Based on the summary provided in Table 4, ambient pH is highest in the summer months, with 75th percentile levels exceeding 8.81 in September. Presumably, this peak is related to increases in aquatic plant densities during the summer months. With the exception of July and September, the Grand River is Policy 1 with respect to pH.

For total ammonia (Table 5) all GRCA total ammonia results were reported as below MDL of 0.05 mg/L. For the GRCA 2015-2016 dataset, a total 23 samples were collected and analysed, all reporting less than MDL. In order to determine if these results could be incorporated into the overall total ammonia assessment, a review of the distribution of total ammonia results from the PWQMN dataset was completed and is summarized in Figure 1. The PWQMN dataset include limited total ammonia results for 1994 through 1997 and a more complete dataset from 2007 through 2016. A *t*-test of means for the lumped PWQMN results for the period 1994-1997 and the PWQMN results for 2007-2016 indicated that the means were significantly different at the 95% level, and therefore only the 2007-2016 monitoring results were assessed.

Figure 1 illustrates the fitted frequency distribution of the total ammonia results for the PWQMN dataset (post 2007). Several probability distributions were evaluated; however, both the Log-Normal and the Log-Pearson Type III provided a reasonable fit. As illustrated, the GRCA dataset MDL of 0.05 mg/L has a return frequency of approximately 1:6, or an exceedance probability of approximately 16%. Assuming the GRCA dataset is comparable to the PWQMN dataset, the likelihood of obtaining 23 results at or below this threshold MDL would be less than 2%, leading to the conclusion that the analytical methods are sufficiently different and the results cannot be combined. Therefore, the total ammonia results presented in Table 5, and the ambient unionized ammonia results presented in Table 6, correspond to only the PWQMN dataset.

Table 5. Ambient Total Ammonia 2007-2016

<table>
<tr><th>Month</th><th>Mean TAN (mg/L as N)</th><th>Median TAN (mg/L as N)</th><th>75th Percentile TAN (mg/L as N)</th><th>Number of Observations</th></tr>
<tr><td>January</td><td rowspan="3">0.036</td><td rowspan="3">0.034</td><td rowspan="3">0.050</td><td rowspan="2">0</td></tr>
<tr><td>February</td></tr>
<tr><td>March</td><td>4</td></tr>
<tr><td>April</td><td>0.045</td><td>0.035</td><td>0.058</td><td>8</td></tr>
<tr><td>May</td><td>0.032</td><td>0.023</td><td>0.032</td><td>8</td></tr>
<tr><td>June</td><td>0.041</td><td>0.031</td><td>0.049</td><td>9</td></tr>
<tr><td>July</td><td>0.038</td><td>0.031</td><td>0.045</td><td>7</td></tr>
<tr><td>August</td><td>0.025</td><td>0.024</td><td>0.038</td><td>8</td></tr>
<tr><td>September</td><td>0.028</td><td>0.026</td><td>0.037</td><td>7</td></tr>
<tr><td>October</td><td>0.021</td><td>0.025</td><td>0.028</td><td>6</td></tr>
<tr><td>November</td><td rowspan="2">0.028</td><td rowspan="2">0.024</td><td rowspan="2">0.036</td><td>6</td></tr>
<tr><td>December</td><td>0</td></tr>
<tr><td>Annual</td><td>0.033</td><td>0.027</td><td>0.039</td><td>41</td></tr>
</table>

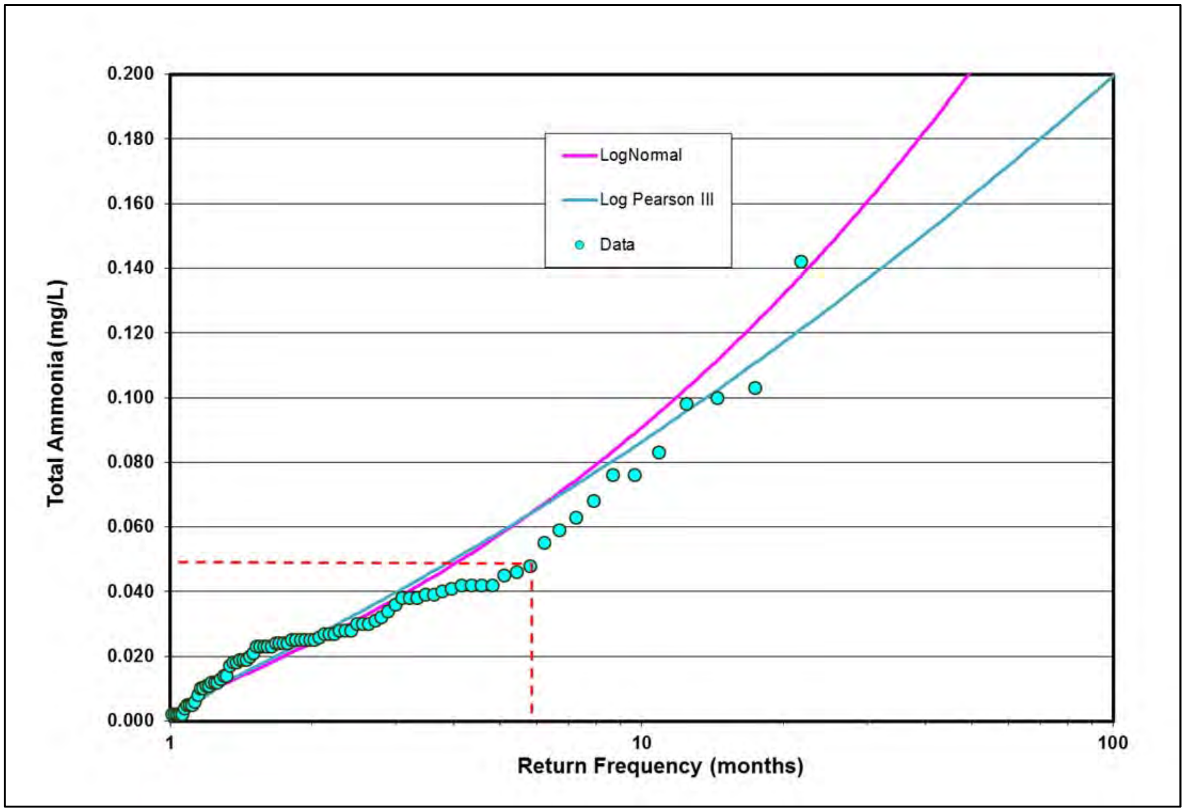

Figure 1. PWQMN at Leggatt Total Ammonia Frequency Distribution 1977-2015

Ambient total ammonia is highest during the spring; however, relatively few measurements are available for the winter months.

Table 6. Ambient Un-ionized 2007-2016

Month	Mean UIA (mg/L as N)	Median UIA (mg/L as N)	75th Percentile UIA (mg/L as N)	Number of Observations
January	0.001	0.001	0.001	0
February				0
March				4
April	0.001	0.001	0.001	10
May	0.002	0.002	0.002	8
June	0.004	0.004	0.005	10
July	0.005	0.005	0.006	8
August	0.003	0.002	0.004	8
September	0.005	0.002	0.003	8
October	0.001	0.001	0.001	7
November	0.000	0.000	0.001	7
December				0
Annual	**0.001**	**0.001**	**0.003**	**70**

Ambient un-ionized ammonia is highest during the summer, however, remains below the PWQO threshold of 0.016 mg/L as N. The Grand River is therefore MOE Policy I with respect to un-ionized ammonia.

2.1.3 Dissolved Oxygen and $cBOD_5$

Ambient dissolved oxygen was evaluated by reviewing long term PWQMN monitoring results and recent continuous monitoring results collected by GRCA. Since low concentrations are indications of degraded water quality, the 25th percentile was applied for comparison with PWQO's. The PWQO threshold for dissolved oxygen in warm water fisheries is 47% saturation. At 5^{o}C the PWQO is 6 mg/L, while above 20^{o}C the PWQO is 4 mg/L. A summary of historical PWQMN and recent GRCA monitoring is provided in Table 7, while time-series plots of continuous dissolved oxygen monitoring for 2015 and 2016 are provided in Figures 2 and 3, respectively. For both long-term and continuous dissolved oxygen monitoring, the Grand River may be considered MOE Policy I with respect to dissolved oxygen.

No recent (post 1992) PWQMN $cBOD_5$ measurements are available, however, the 75th percentile cBOD for $cBOD_5$ monitoring results prior to 1992 is 1.13 mg/L. A 2003 field program completed by RJ Burnside and Associates (RJB, 2003) measured $cBOD_5$ concentrations ranging from approximately 0.5 to 1.7 mg/L. Therefore, based available monitoring information, a conservative estimate of ambient $cBOD_5$ concentration is 2.0 mg/L.

Table 7. Ambient Dissolved Oxygen 1977-2016

Month	Mean DO (mg/L)	Median DO (mg/L)	25th Percentile DO (mg/L)	Number of Observations
January	6.9	7.0	10.2	22
February	22.3	12.0	10.9	24
March	11.8	11.8	10.5	28
April	11.9	11.6	11.1	30
May	10.9	12.1	10.4	28
June	9.8	11.0	8.8	30
July	8.9	10.0	8.3	32
August	9.2	9.1	8.7	34
September	10.1	9.3	9.7	31
October	11.8	10.1	11.1	32
November	12.8	11.7	12.3	26
December	12.6	13.2	11.9	19
Annual	**11.4**	**11.0**	**12.4**	**336**

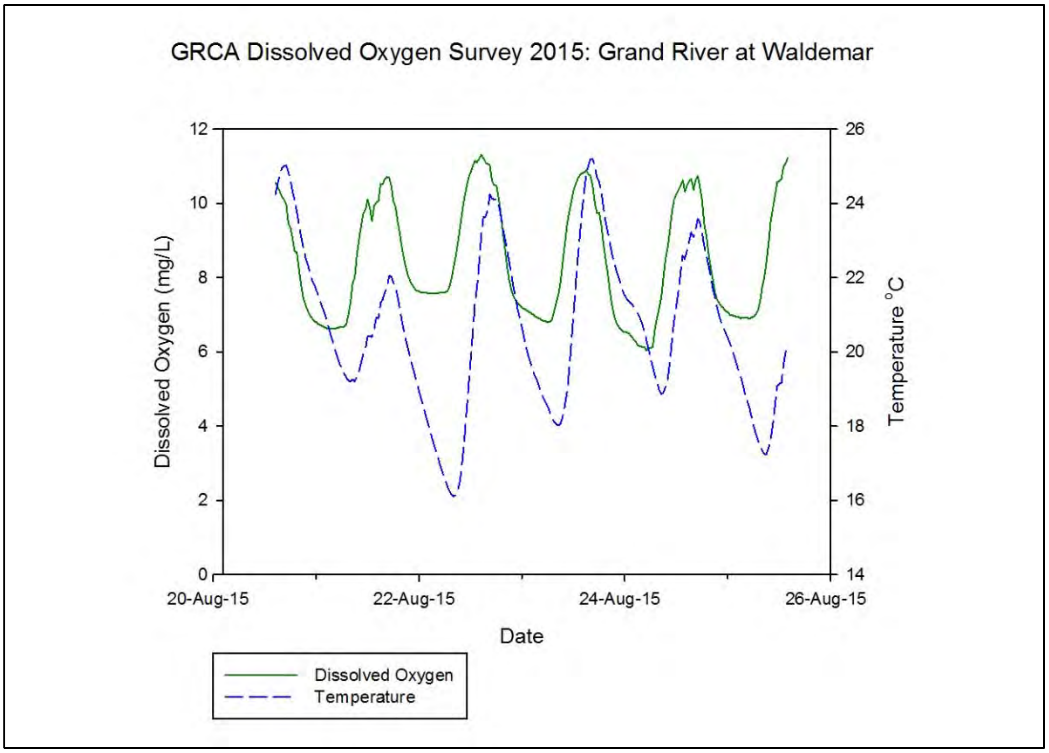

Figure 2. Diurnal Dissolved Oxygen: August 2015

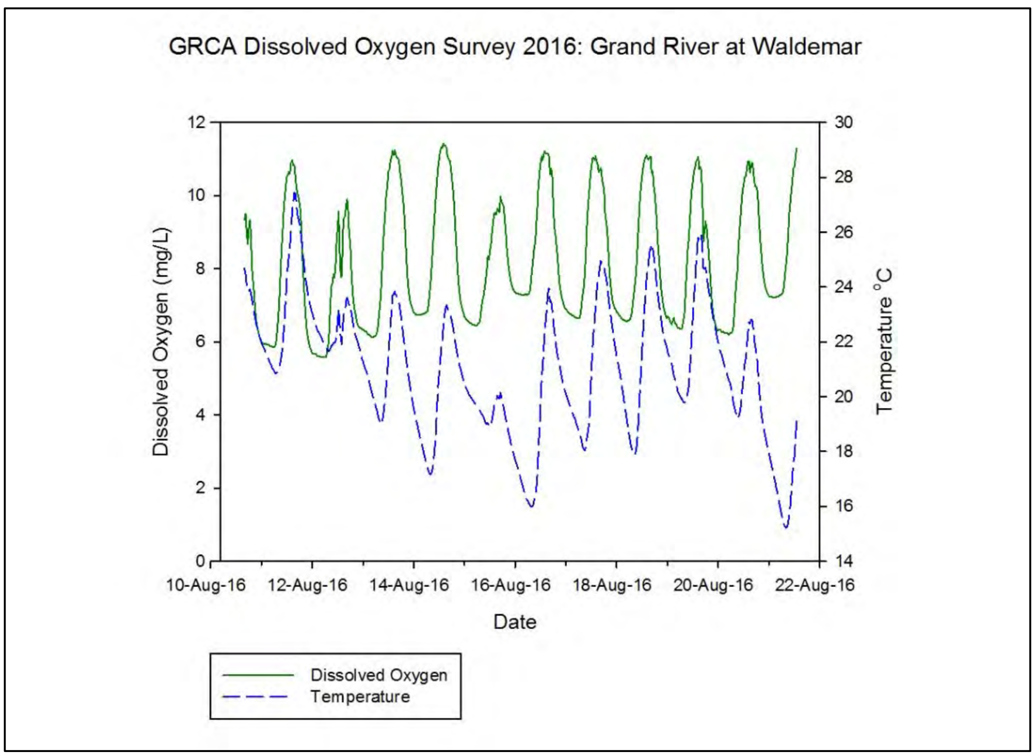

Figure 3. Diurnal Dissolved Oxygen: August 2016

The PWQMN dissolved oxygen measurements are typically collected during the day and may not reflect minimum dissolved oxygen levels, particularly if aquatic plant respiration is a significant factor influencing ambient dissolved oxygen levels. An indication of diurnal variability in dissolved oxygen is provided by GRCA's continuous monitoring results for 2015 and 2016 (Figures 1 and 2). These results indicate that dissolved oxygen varies from above 10 mg/L during the day to approximately 6 mg/L during the pre-dawn hours, where aquatic plant respiration would contribute to minimum dissolved oxygen levels. During the same monitoring period, relatively large fluctuations in ambient temperature were observed, ranging from approximately 15^{o}C at night to above 26^{o}C during the mid-afternoon. As illustrated, aquatic plant respiration does reduce dissolved oxygen concentrations during the night, however, levels remain above PWQO warm water thresholds, confirming that the MOE Policy I assumption for dissolved oxygen is appropriate.

2.1.4 *E. coli*

No PWQMN *E.coli* data are available post-1995 upstream of the Grand Valley WPCP discharge location, and only a few post-1995 measurements are available from the downstream PWQMN dataset (Station 16018406702), collected during the summer of 2005. Additional *E.coli* data are available from 2003 and 2006 R.J. Burnside led field programs. Lumped geometric mean concentrations exceed the PWQO of 100 cfu/100mL for June and September, while 75^{th} percentile concentrations exceed this threshold from May through September. Although monitoring results are limited, it is reasonable to assume the receiver is MOE Policy II from May through September and MOE Policy I the remainder of the year.

2.1.5 Suspended Solids

There are no PWQO values for total suspended solids (TSS), however, a review of recommended TSS guidelines for the protection of aquatic life (EPA, 2003) indicate that a 30-day average concentration of 30 mg/L is a reasonable threshold. A statistical summary of seasonal TSS concentrations in the Grand River upstream of Grand Valley, provided below as Table 8, indicates that 75^{th} percentile ambient TSS concentrations are less than this threshold for all months, with the exception of spring. Since the exceedance is marginal (31.1 vs. 30 mg/L) and the 75^{th} percentile is based on single grab samples, rather than 30-day averages, the exceedance is deemed insignificant. Both PWQMN and GRCA datasets were applied for this TSS assessment.

Table 8. Ambient Total Suspended Solids 1977-2016

Season	Mean TSS (mg/L)	Median TSS (mg/L)	75^{th} Percentile TSS (mg/L)	Number of Observations
Winter	10.3	3.4	10.5	6
Spring	19.1	4.4	31.3	16
Summer	10.0	6.0	11.7	22
Fall	7.1	4.0	7.2	17
Annual	**8.3**	**5.0**	**7.6**	**61**

2.1.6 Nitrate

There is no PWQO value for nitrate, however, there is a Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. The CWQG is 3.0 mg/L as N (CCME, 2012). A summary of PWQMN ambient nitrate concentrations in the Grand River upstream of Grand Valley is provided below as Table 9. As with other historical water quality measurements, only limited results are available during the winter. Despite the winter data limitations, all 75th percentile nitrate concentrations fall below the 3.0 mg/L as N CWQG threshold, indicating that assimilative capacity is available for nitrate.

Table 9. Ambient Total Nitrate as N 1977-2014

Month	Mean Nitrate (mg/L)	Median Nitrate (mg/L)	75th Percentile Nitrate (mg/L)	Number of Observations
January February March	0.93	0.93	1.05	4
April	0.96	1.02	1.09	10
May	0.67	0.32	1.05	7
June	0.45	0.21	0.41	10
July	0.34	0.10	0.17	8
August	0.32	0.21	0.42	8
September	0.19	0.08	0.15	7
October	0.91	1.10	1.41	7
November December	1.18	0.88	1.84	7
Annual	**0.64**	**0.40**	**1.08**	**175**

The GRCA monitoring information for nitrate was reviewed and determined to be unsuitable for inclusion in the above summary. Of the 24 GRCA nitrate samples, 12 of 24 (50%) reported nitrate concentrations of below the MDL of 0.1 mg/L. All of the samples reporting nitrate concentrations of less than the MDL were collected in 2015. The remaining 12 samples, all collected during 2016, reported concentrations in excess of 1.0 mg/L. A frequency plot of the 12 samples (blue symbols) over the MDL is provided as Figure 4 below. The recommended approach by USGS (Helsel and Hirsch, 2002) involves using the fitted frequency distribution to estimate reasonable values for all samples below MDL. Following this approach yields estimates in excess of the MDL as illustrated in Figure 4 below (yellow symbols). In light of this discrepancy, the GRCA nitrate monitoring results for 2015 and 2016 were not included in the final assessment.

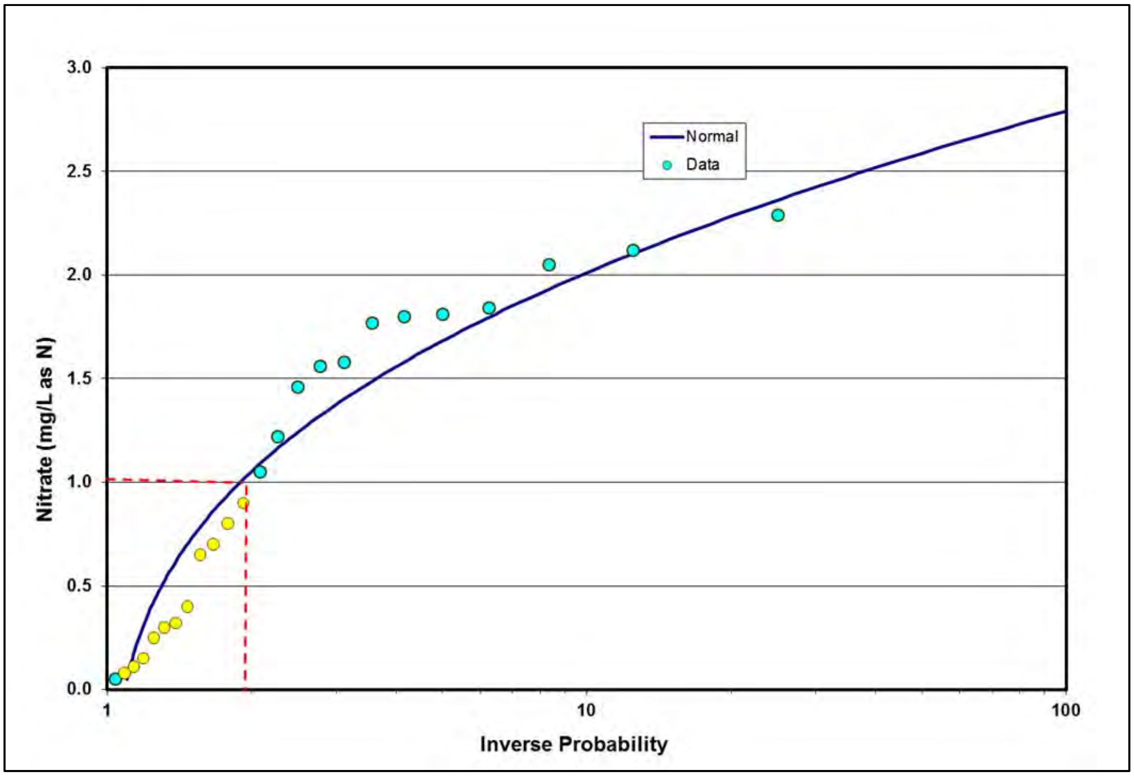

Figure 4. Frequency Distribution for Nitrate: GRCA 2015-2016

2.2 Flow

Conventional low-flow frequency analysis for estimation of 7Q20 flow is not appropriate at this location due to flow regulation. An initial 7Q20 flow target of 0.42 m^3/s was derived from a 1986 reservoir yield study, and re-confirmed by GRCA in 2004 and again in 2016 (GRCA, 2016). In support of this assimilative capacity assessment, the most recent GRCA publication (2016) addressing low flow in the Grand River near Grand Valley, authored by D. Boyd and S. Shifflett, was reviewed and highlights are provided below:

- Low flow upstream of the Grand Valley WPCP is controlled by the Luther Dam discharge.
- Luther Dam was constructed in 1953 for the purpose of low flow augmentation.
- A review of reservoir yield, combined with external base flow tributary to Grand Valley, results in a sustainable annual low flow target of 0.42 m^3/s. This value was adopted by GRCA in 2004.
- A brief assessment of potential climate change impacts indicate that the accepted low flow target of 0.42 m^3/s can be maintained in a future climate.
- A frequency assessment of historical low flow information demonstrates that the 0.42 m^3/s low flow target is a reasonable approximation of the 7Q20 flow.
- Following an assessment of measurement and estimation uncertainty, GRCA recommended a 7Q20 flow of 0.4 m^3/s.

Therefore, for the purposes of the current assimilation capacity assessment, GRCA's recommended 7Q20 of 0.4 m^3/s was adopted.

3 DETERMINATION OF EFFLUENT LIMITS

3.1 Effluent $cBOD_5$

For the expanded WPCP, it is proposes to maintain the existing $cBOD_5$ compliance limit of 10 mg/L and the existing design objective of 8 mg/L. The potential impact on instream dissolved oxygen was evaluated using the Streeter Phelps equation. The Alabama Department of Environmental Management, ADEM, developed a straightforward spreadsheet solution of the Streeter Phelps equation and this public-domain tool was applied for the current application (ADEM, 2001). In addition to carbonaceous biological oxygen demand, the ADEM model also addresses nitrogenous oxygen demand and sediment oxygen demand. A summary of key model inputs are provided below.

Channel Description: The physical characteristics of the channel, including reach lengths, bottom slopes and channel width were defined using a HEC-RAS model provided by GRCA. Although the HEC-RAS model was designed for flood analysis, there were multiple cross-sections included in the model that provided a general indication of the low-flow channel shape and approximate slope. A total of 20 kilometers of river length, downstream of the WPCP were modelled.

Velocity and Depth: Reach depth and velocities were defined by applying the 7Q20 of 0.4 m^3/s to the HEC-RAS model.

River Re-aeration: Re-aeration was estimated using the Tsivoglou and Neal equation as recommended by ADEM (ADEM, 2001) and the US EPA (EPA, 1985). Numerous approaches are available for estimation of re-aeration, however, the Tsivoglou and Neal equation provides a simple empirical approach, suitable for shallow streams and relies only on velocity and slope. Estimated re-aeration rates range from 3.1 to 6.1 d^{-1}, which compare favourably with previous estimates for this location in the Grand River (XCG, 2013).

Ambient Water Quality: Ambient water quality was defined as 75th percentile summer conditions as presented in Section 2. Important parameter assignments include $cBOD_5$ at 2.0 mg/L, Ammonia Nitrogen at 0.035 mg/L as N, dissolved oxygen at 8.3mg/L, and temperature of 24.8 ^oC.

Plant Respiration: Plant respiration is not included in the conventional Streeter Phelps solution of dissolved Oxygen, however, to assess minimum dissolved oxygen levels during periods of high respiration; the applied re-aeration coefficient was reduced by 20% and the minimum ambient dissolved oxygen, as measured during the 2015 and 2016 continuous dissolved oxygen surveys (Figures 2 and 3), of 6.0 mg/L was applied.

Sediment Oxygen Demand: A literature value of 0.5 g/m^2 SOD was applied and was obtained from a recent USGS study of SOD for a range of streams and land uses (Foster, King and Graham, 2016).

Effluent Water Quality: Effluent water quality was defined according to the existing CofA compliance limits provided as Table 1. Importantly, effluent dissolved oxygen was assumed to be 0 mg/L to provide a conservative estimate water quality impacts.

Numerous model runs were completed in order to assess parameter sensitivity and two illustrative results are provided below in Figures 5 and 6. Figure 5 illustrates typical model results for summer low flow conditions and 25th percentile ambient dissolved oxygen, while Figure 6 illustrates an approximation of minimum dissolved oxygen estimates for periods of high plan respiration. As illustrated, the maximum peak dissolved oxygen deficit is less than 1.0 mg/L. Since the Grand River is MOE Policy II with respect to Dissolved Oxygen, these model results demonstrate that the existing compliance limit and design objective, of 10 and 8 mg/L $cBOD_5$, respectively, are appropriate for future WPCP effluent.

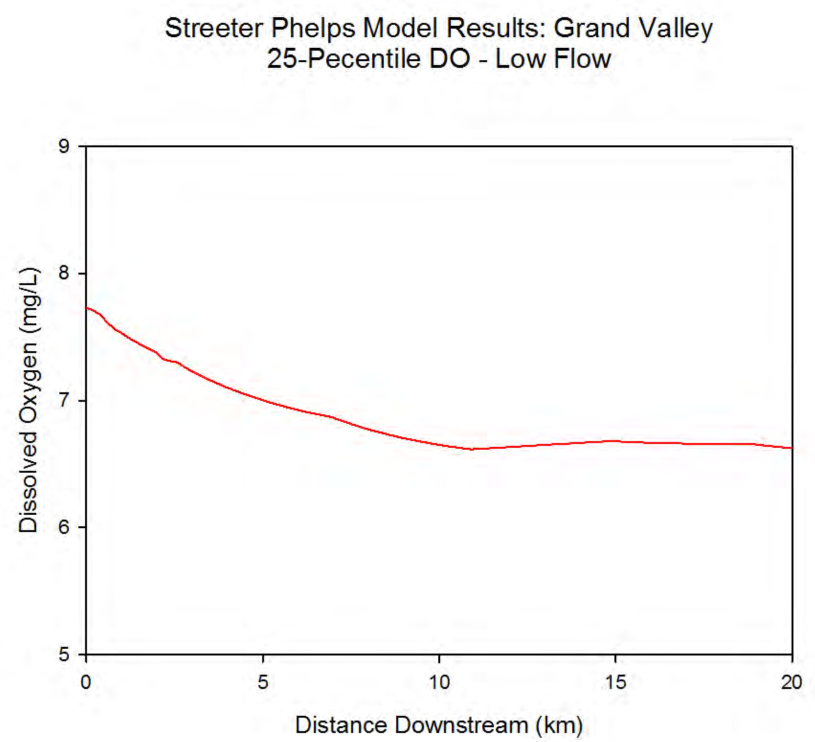

Figure 5. Streeter-Phelps Dissolved Oxygen Solution for Summer Low Flow Conditions

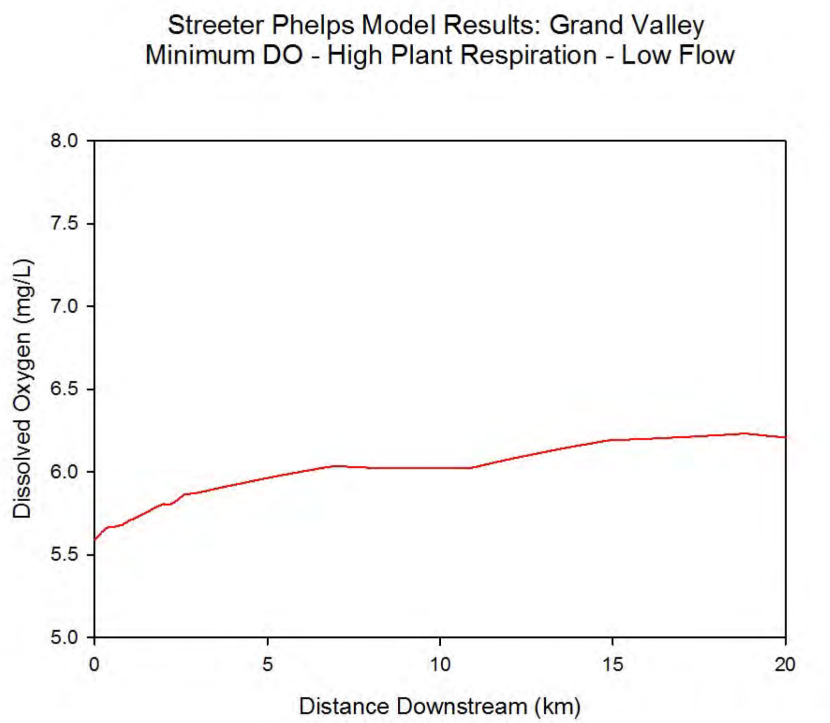

Figure 6. Streeter-Phelps Dissolved Oxygen Solution for Minimum Dissolved Oxygen and Active Plant Respiration - Summer Low Flow Conditions

3.2 Effluent Total Suspended Solids

For the expanded WPCP, maintaining the existing TSS compliance limit of 10 mg/L and the existing design objective of 8 mg/L, is proposed. Although there is no PWQO or CWQG for TSS, all 75th percentile concentrations are below the EPA's threshold of 30 mg/L. At the design flow of 2,547 m^3/d and the current CofA TSS compliance limit of 10 mg/L, the ambient TSS concentration would marginally increase (less than 2%) during the winter, and actually improve during the summer (approximately 4%). Therefore, it is proposed that the existing compliance limit of 10 mg/L and the design objective of 8 mg/L be maintained for the proposed WPCP expansion.

3.3 Effluent Total Phosphorus

As discussed in Section 2, the Grand River in the vicinity of the Grand Valley WPCP outfall is MOE Policy II with respect to total phosphorus and no assimilative capacity is available in the receiver. Furthermore, for a MOE Policy II receiver, MOE policy states: "*Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives*." The existing CofA compliance limit for total phosphorus is 0.15 mg/L, and the corresponding loading limit is 0.19 kg/d. To maintain this loading limit at future flow conditions would require reducing the compliance limit from 0.15 mg/L to 0.073 mg/L, which may be difficult to achieve using best available technology.

An important consideration in this analysis is the relative impact associated with a future total phosphorus load if the existing compliance concentration is maintained for future conditions. Under existing conditions, total phosphorus river load downstream of the WPCP, for peak ambient total phosphorus conditions (July) and low flow, would be 2.05 kg/d, or 1.87 kg/d upstream plus 0.19 WPCP load. Assuming the compliance concentration is maintained for future conditions, the peak ambient total phosphorus load downstream of the WPCP would increase to 2.25 kg/d, or 1.87 kg/d upstream plus 0.38 WPCP load, an increase of less than 10%.

A final evaluation of all practical treatment alternatives is required in order to determine what final effluent compliance limit for total phosphorus is appropriate. In support of that effort, a summary of total phosphorus loading downstream of the WPCP for peak ambient total phosphorus conditions (July), 7Q20 low flow, and a range of effluent compliance limits, is provided in Table 10 below. A compliance total phosphorus limit of 0.10 mg/L is approaching practical limits that would be achievable. The total increase in downstream load associated with this limit is approximately 3.3%. It is proposed that this marginal increase is acceptable and consistent with MOE Policy and the future limit for total phosphorus should be 0.1 mg/L.

Table 10. 75th Percentile Total Phosphorus Loading Downstream of the WPCP for Future Conditions

Scenario	Proposed Effluent TP limit (mg/L)	Downstream TP Load (kg/d)	Increase Relative to Existing Conditions (%)
Maintain Existing CofA Concentration Limit	0.15	2.25	9.5
Practical Limit for Effluent Phosphorus	0.10	2.12	3.3
Maintain Existing CofA Loading Limit	0.07	2.05	0.0

3.4 Effluent Total Ammonia

Evaluation of effluent ammonia requires an assessment of both effluent toxicity and in-stream PWQO compliance.

3.4.1 Effluent Toxicity

The currently accepted un-ionized ammonia limit for effluent toxicity at end-of-pipe is 0.1 mg/L as N. Monthly 75th percentile ammonia dissociation constants for the WPCP effluent were derived previously (XCG, 2013) using historical effluent monitoring results. These dissociation ratios, combined with the existing CofA TAN limits, were applied to evaluate effluent toxicity for future conditions. The resultant effluent un-ionized ammonia concentrations are summarized in Table 11. In addition to the effluent dissociation constant established in 2003,

Table 11 also includes estimates of the minimum and maximum dissociation constant based on 2013 through 2016 effluent monitoring results. As indicated, if the maximum dissociation constant derived from the 2013-2016 effluent monitoring was greater than the 2003 dissociation estimate, it was applied for the final estimation of effluent un-ionized ammonia. In most cases, the recent effluent monitoring is consistent with the 2013 assessment results. As illustrated, end-of-pipe un-ionized ammonia is consistently below the toxicity threshold of 0.1 mg/L based on the existing CofA TAN limits.

Table 11. Estimated End-of-Pipe Un-ionized Ammonia

Month	Effluent TAN (mg/L as N)	Dissociation Constant (%) (XCG, 2013)	Dissociation Constant (%) 2013-2016 Monitoring	Effluent Un-Un-Ionized Ammonia (mg/L as N)
January	4.0	0.9	0.2 – 0.4	0.036
February	4.0	0.9	0.1 – 0.3	0.036
March	4.0	0.9	0.1 – 0.9	*0.036* *
April	1.0	1.4	0.1 – 0.6	0.014
May	1.0	1.4	0.2 – 1.0	0.014
June	0.7	1.8	0.2 – 1.4	0.013
July	0.7	1.8	0.3 – 1.5	0.013
August	0.7	1.8	0.3 – 1.6	0.013
September	0.7	1.8	0.3 – 2.6	*0.018* *
October	1.0	1.2	0.1 – 1.8	*0.018* *
November	1.0	1.2	0.4 – 0.9	0.012
December	1.0	0.9	0.1 – 0.6	0.009

**Maximum dissociation constant based on 2013-2016 effluent monitoring results.*

3.4.2 Un-Ionized Ammonia in-Stream

The in-stream ammonia dissociation constants, and ambient TAN, were derived from synoptic measurements of TAN, pH and temperature and are presented in Table 12. PWQMN monitoring information for pH and temperature was sparse for the early 2000's, and some infilling of monitoring results for that period from PWQMN 16018406702 (Grand River at 13th Ln, NW of Marsville) was completed. Despite this, water quality sampling during the winter months was limited and it was necessary to lump January through March, and November and December results. Estimates of un-ionized ammonia concentrations were generated using the TAN limits as defined in the existing CofA and are summarized in Table 12. As illustrated, monthly un-ionized concentrations remain at or below the PWQO threshold of 0.016 mg/L as N for all months of the year.

Table 12. In-Stream Un-Ionized Ammonia Downstream of WPCP for Future Conditions

Month	75th Percentile Ambient TAN (mg/L as N)	Effluent TAN (mg/L as N)	Mass Balance TAN (mg/L as N)	Dissociation Constant (%)	Downstream Un-Ionized Ammonia (mg/L as N)
January February March	0.063	4.0	0.32	1%	0.003
April	0.056	1.0	0.12	5%	0.006
May	0.043	1.0	0.10	8%	0.009
June	0.044	0.7	0.09	13%	0.011
July	0.038	0.7	0.0	17%	0.014
August	0.039	0.7	0.08	16%	0.013
September	0.037	0.7	0.08	20%	0.016
October	0.029	1.0	0.09	5%	0.005
November	0.029	1.0	0.10	3%	0.003
December	0.058	1.0	0.07	2%	0.002

3.5 Effluent *E. coli*

As discussed in Section 2, the Grand River near Grand Valley is considered MOE Policy II with respect to *E.coli,* and therefore, the effluent should not further degrade the quality of the water. A compliance limit of 200 cfu/100 mL and a design objective of 100 cfu/100 mL are proposed.

4 MIXING ZONE ASSESSMENT

4.1 Approach

The expert system mixing model CORMIX version 11 GTH (Advanced Hydraulic Tools) was applied for development of mixing zone downstream of the proposed discharge. In addition, an analytical solution of the two-dimensional advective-dispersive transport equation was developed for comparison purposes and is provided in Appendix A.

Key parameter assignments for the CORMIX model are summarized in Table 13. Numerous model runs were completed to establish parameter sensitivity and representative model results are provided in Figures 6 and 7, and in Table 14. Figure 6 illustrates a plan view of the CORMIX results, while Figure 7 illustrates a plot of the maximum plume concentration relative to downstream distance. Table 14 provides a summary of the plume width, which is approximately equivalent to the distance between the right bank and a location instream encompassing approximately 75% of the plume mass. Minimum dilution, or the maximum effluent concentration downstream, is also summarized in Table 14.

In Figure 6, the x-axis represents the right bank distance downstream, while the y-axis represents the lateral distance, perpendicular to the right bank. As illustrated in Figure 6, the resultant plume hugs the right bank, however, there is a near field region (less than 25 m) where the effluent remains separated from the bank. As illustrated in Figure 7, near completely mixed conditions are achieved within 2000 m of the discharge, which is consistent with the analytical solution provided in Appendix A. In addition, the CORMIX results confirm that the discharge is vertically completely mixed.

Table 13. CORMIX Model Summary

CORMIX Block	Parameter	Value
Ambient	Average Channel Depth	0.15 m
	Depth at Discharge	0.13 m
	Channel Velocity	0.133 m/s
	Water Temperature	22 ^{o}C
	Manning's *n*	0.06
	Flow	0.4 m^3/s
	Channel Width	20 m
Discharge	CORMIX Model	CORMIX3 Surface Discharge
	Configuration	Flush
	Bank	Right
	Slope	1%
	Width	1m
	Depth	0.06 m
	Depth at Bank	0.07 m
	Flow	0.029 m^3/s

Table 14. CORMIX results: Plume Width

Distance Downstream (m)	Peak Plume Effluent Concentration (%)	Plume Width (m)	Zone of Passage (m)
0	100.0	0.0	20.0
10	65.7	0.6	15.0
25	58.8	0.7	19.3
50	43.4	3.1	16.9
100	30.2	4.5	15.5
200	21.6	6.3	13.7
500	14.0	9.8	10.2
1000	9.9	13.8	6.2
1500	8.1	16.9	3.1
2000	7.0	19.5	0.5
3000	6.8	20.0	0.0
4000	6.8	20.0	0.0

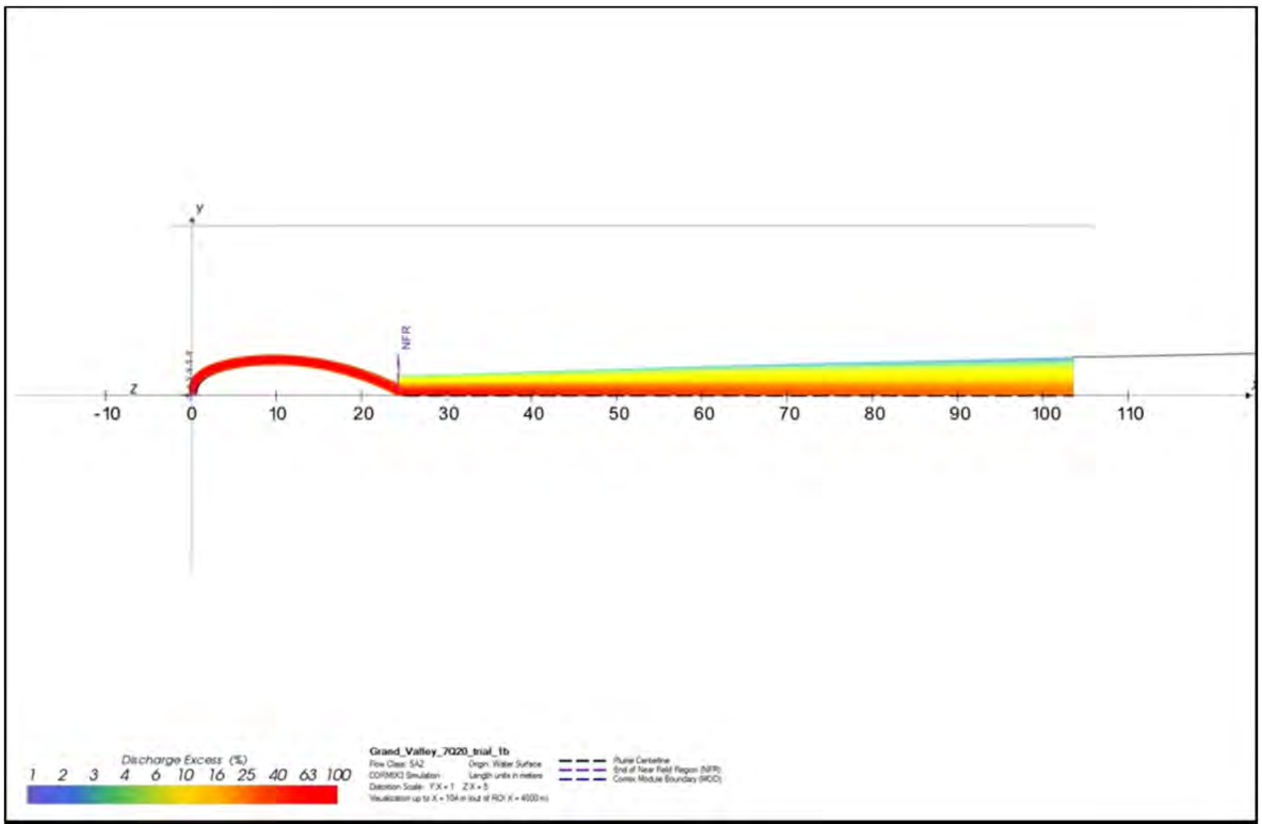

Figure 6. Representative CORMIX Results for Near Field

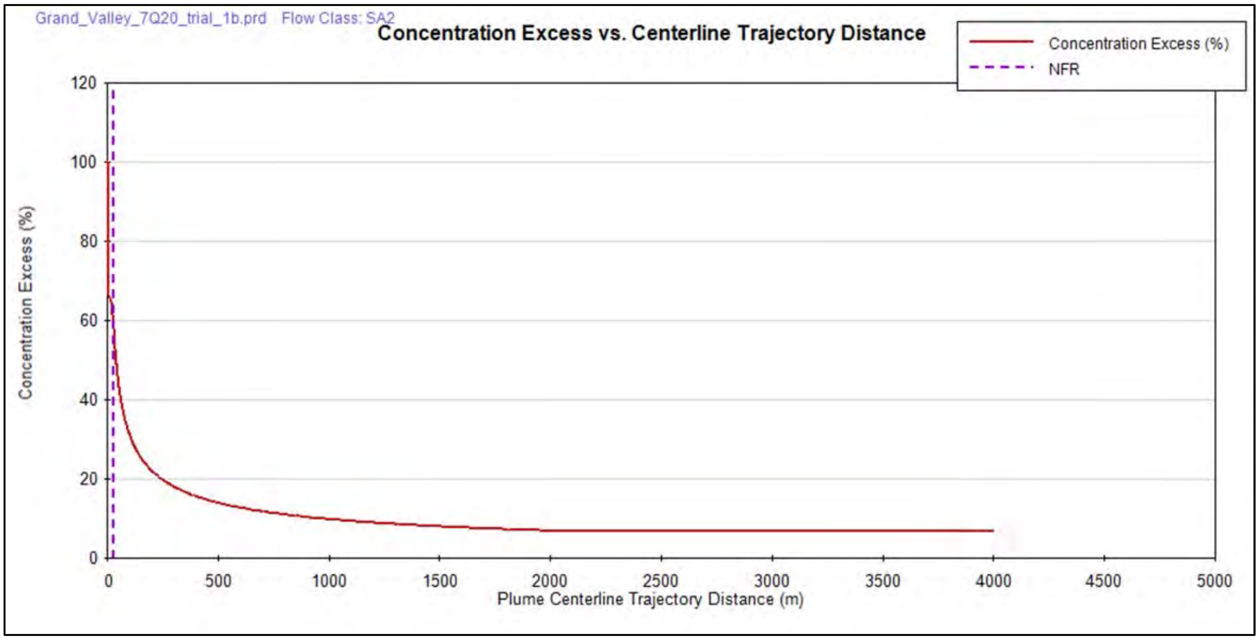

Figure 7. CORMIX Results for Maximum Plume Concentration (% Effluent)

4.2 Mixing Zone

The CORMIX results summarised above were applied to establish plume characteristics for dissolved oxygen, total phosphorus, and un-ionized ammonia and the results are summarized in Tables 15 through 17. Table 15 presents the dissolved oxygen summary for summer conditions and assumes a conservative effluent dissolved oxygen concentration of 0.0 mg/L. PWQO standards are achieved within 50 m of the discharge, and an adequate zone of passage (Table 14) is available upstream of 50 m.

Table 15. CORMIX Results: Dissolved Oxygen

Distance Downstream (m)	Minimum Dissolved Oxygen Concentrations for Summer (mg/L)
0	0.0
25	3.7
50	5.2
100	6.4
200	7.1
500	7.8
1000	8.2
1500	8.4
2000	8.5
3000	8.5
4000	8.5

Table 16 presents the total phosphorus results summary for summer. The Grand River is MOE Policy 2 with respect to total phosphorus and the peak summer 75th percentile concentration is 0.054 mg/L. An effluent TP limit of 0.07 would maintain the current approved effluent loading, while an effluent TP limit of 0.10 mg/L would represent an increase at completely mixed conditions of only 3%.

Table 16. CORMIX Results: Total Phosphorus

Distance Downstream (m)	Maximum TP Concentrations for Summer (mg/L)		
	Effluent TP 0.15 mg/L	Effluent TP 0.10 mg/L	Effluent TP 0.07 mg/L
0	0.150	0.100	0.070
25	0.110	0.081	0.063
50	0.096	0.074	0.061
100	0.083	0.068	0.059
200	0.075	0.064	0.057
500	0.067	0.060	0.056
1000	0.063	0.059	0.056
1500	0.062	0.058	0.055
2000	0.061	0.057	0.055
3000	0.061	0.057	0.055
4000	0.061	0.057	0.055

Table 17 presents the mixing zone un-ionized results summary by month. For all months, with the exception of August and September, the threshold PWQO un-ionized ammonia concentration of 0.016 mg/L is achieved within 500 m. At 500 m, the zone of passage (Table 14) is greater than 50% of the channel width. For the summer months of July through September relatively high 75th percentile ammonia dissociation constants ranging from 16 to 20% results in the mixing zone extending as far as 2,000 m downstream.

Table 17. CORMIX Results: Un-ionized Ammonia

Distance Downstream (m)	Un-ionized Ammonia (mg/L as N)									
Month	Jan-Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proposed Effluent TAN Limit	4.0	1.0	1.0	0.7	0.7	0.7	0.7	1.0	1.0	1.0
0	***0.068***	***0.050***	***0.055***	***0.088***	***0.103***	***0.114***	***0.140***	***0.051***	***0.027***	***0.022***
25	***0.040***	***0.031***	***0.034***	***0.054***	***0.063***	***0.070***	***0.085***	***0.031***	0.016	0.013
50	***0.030***	***0.023***	***0.026***	***0.041***	***0.048***	***0.053***	***0.065***	***0.023***	0.012	0.010
100	***0.021***	***0.017***	***0.019***	***0.030***	***0.036***	***0.039***	***0.047***	0.016	0.009	0.008
200	0.016	0.013	0.015	***0.023***	***0.027***	***0.030***	***0.036***	0.012	0.006	0.006
500	0.010	0.009	0.011	***0.017***	***0.020***	***0.021***	***0.026***	0.008	0.004	0.004
1000	0.008	0.007	0.009	0.014	0.016	***0.017***	***0.021***	0.006	0.003	0.003
1500	0.006	0.007	0.008	0.012	0.014	0.015	***0.018***	0.005	0.003	0.003
2000	0.006	0.006	0.007	0.011	0.013	0.014	***0.017***	0.005	0.003	0.003
3000	0.006	0.006	0.007	0.011	0.013	0.014	0.016	0.005	0.003	0.003
4000	0.006	0.006	0.007	0.011	0.013	0.014	0.016	0.005	0.003	0.003

5 SUMMARY

A summary of the assimilative capacity assessment of the Grand River near Grand Valley are as follows:

- The Grand River is MOE Policy II with respect to total phosphorus and *E. coli* and MOE Policy I with respect to dissolved oxygen and un-ionized ammonia.
- The required effluent total phosphorus compliance limit to maintain the existing loading is 0.7 mg/L, approximately 50% of the current compliance limit, however, at a proposed limit of 0.1 mg/L, total phosphorus loading for future conditions is only 3 % greater than existing conditions.
- Although no PWQO is available for TSS, nitrates and $cBOD_5$, ambient concentrations are generally within acceptable limits as defined by other jurisdictions or by CCME guidelines.
- A review of the low flow assessment completed by the GRCA demonstrates that 0.4 m^3/s is a reasonable approximation of 7Q20 flow and is suitable for assimilative capacity assessment.
- Results of a desk-top Streeter-Phelps dissolved oxygen model indicate that the existing CofA limits for $cBOD_5$ and TAN are appropriate for future WPCP flow conditions.
- With the exception of July, for completely mixed conditions the existing CofA limits for TAN are suitable for future WPCP flow conditions. For the summer months of July through September, near completely mixed conditions are required in order to achieve the PWQO target for un-ionized ammonia of 0.016 mg/L.

- With the exception of August and September, the results of mixing zone model indicate that PWQO un-ionized ammonia concentrations will be achieved with 500 m of the WPCP discharge for future WPCP flow and existing CofA compliance TAN limits. For August and September, approximately 2,000 m is required in order to achieve the PWQO target.

A summary of recommended effluent compliance and objective limits is provided in Table 18.

Table 18. Grand Valley Effluent Recommended Compliance and Objective Limits

Effluent Parameter	Effluent Compliance Limits[1]		Effluent Objective Limits
	Average Concentration (mg/L)	Average Loading (kg/d)	Average Concentration (mg/L)
$cBOD_5$	10.0	24.6	8.0
Total Suspended Solids	10.0	24.6	8.0
Total Phosphorus	0.10	0.25	0.08
Total Ammonia Nitrogen			
Winter (Dec 1 – Mar 31)	4.0	9.83	3.0
Spring (Apr 1 – May 31)	1.0	2.46	0.8
Summer (Jun 1 – Sep 31)	0.7	1.52	0.5
Fall (Oct 1 – Nov 30)	1.0	2.46	0.8
E coli	200 cfu/100 mL[2]	N/A	100 cfu/100 mL[2]
pH	6.0-9.5		6.5-8.5

Notes:
1. Based on monthly average.
2. Based on monthly geometric mean density.

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Appendix A: 2-D Analytical Approximation of Mixing Zone

An analytical approximation of the two-dimensional advective-dispersive transport equation (equation A-1 below) was developed for comparison purposes. Key model assignmens are summarized in Table A-1.

$$v\frac{\partial C}{\partial x} = E\left[\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial y^2}\right] - kC \pm S \qquad \text{[A-1]}$$

Where:

C = Concentration of contaminate (mg/L)
E = Dispersion coefficient (m^2/s)
v = Velocity (m/s)
k = Decay constant (s^{-1})
S = Sources and sinks (mg/L/s)

The dispersion coefficient in Equation A-1, E, was approximated using an empirical relationship using an approach recommended by Fischer (Fischer et al., 1979) and is presented below as Equation 2.

$$E \cong 0.6d\sqrt{gdS} = 0.6du \qquad \text{[2]}$$

Where:

d = Channel depth (m)
g = Gravitational constant (m/s^2)
S = Average channel slope (m/m)
u = Channel shear velocity (m/s)

A centre-channel discharge was assumed and plume superposition was applied to address channel boundaries as discussed in Fischer et al. (Fischer et al. 1979). Importantly, this mixing zone solution is an approximation of actual conditions and requires several assumptions to be valid, including:

- Effluent is completely mixed vertically.
- Momentum of effluent flow can be ignored.
- Steady state conditions have been achieved.
- The channel is rectangular, with constant width.
- Effluent discharge is introduced in the center of the channel.

Key parameter assignments for the mixing zone solution are summarized in Table 13. Average slope and velocity were defined using GRCA's HEC-RAS model. The discharge was assumed to be a right-bank ditch, perpendicular to the river.

Table A-1. Grand River Mixing Zone Model Parameter Assignments

Parameter	Value
Channel Width	20.0 m
Average Channel Depth - Low-Flow	0.15 m
WPCP Flow	2,547 m^3/d
River Low-Flow	0.4 m^3/s
Average Channel Slope	0.001 m/m
Shear velocity	0.038 m/s (Equation 2)
Dispersion Coefficient	0.003 m^2/s (Equation 2)

Model results are summarised in Figure A-1. In general, completely mixed conditions are achieved at a downstream distance of approximately 2000 m. At a distance of 50 m, the maximum effluent mass fraction is approximately 20%, while at a distance of 100 m, the effluent mass fraction is less than 15%.

x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	100.0	69.4	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	97.2	69.1	24.8	4.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	68.7	57.9	34.7	14.8	4.5	1.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	56.1	50.1	35.6	20.1	9.1	3.3	0.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	48.6	44.6	34.5	22.5	12.4	5.7	2.2	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	43.5	40.6	33.1	23.5	14.6	7.9	3.7	1.5	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	39.7	37.5	31.6	23.8	16.0	9.6	5.1	2.4	1.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	36.7	35.0	30.2	23.7	16.8	10.8	6.3	3.4	1.6	0.7	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	34.4	32.9	29.0	23.4	17.4	11.8	7.4	4.2	2.2	1.1	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	32.4	31.2	27.8	23.0	17.7	12.5	8.3	5.0	2.9	1.5	0.7	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	30.7	29.7	26.8	22.6	17.8	13.1	9.0	5.8	3.5	1.9	1.0	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	29.3	28.4	25.9	22.2	17.8	13.5	9.6	6.4	4.0	2.4	1.3	0.7	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
24	28.1	27.3	25.0	21.7	17.8	13.8	10.1	7.0	4.5	2.8	1.6	0.9	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
26	27.0	26.3	24.3	21.3	17.7	14.0	10.5	7.4	5.0	3.2	1.9	1.1	0.6	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0
28	26.0	25.4	23.6	20.9	17.6	14.1	10.8	7.9	5.5	3.6	2.3	1.4	0.8	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0
30	25.1	24.5	22.9	20.4	17.4	14.2	11.1	8.2	5.8	4.0	2.6	1.6	0.9	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0
32	24.3	23.8	22.3	20.1	17.3	14.3	11.3	8.5	6.2	4.3	2.9	1.8	1.1	0.7	0.4	0.2	0.1	0.1	0.0	0.0	0.0
34	23.6	23.1	21.8	19.7	17.1	14.3	11.4	8.8	6.5	4.6	3.2	2.1	1.3	0.8	0.5	0.3	0.1	0.1	0.0	0.0	0.0
36	22.9	22.5	21.2	19.3	16.9	14.3	11.6	9.0	6.8	4.9	3.4	2.3	1.5	0.9	0.6	0.3	0.2	0.1	0.0	0.0	0.0
38	22.3	21.9	20.8	19.0	16.7	14.2	11.7	9.2	7.1	5.2	3.7	2.5	1.7	1.1	0.7	0.4	0.2	0.1	0.1	0.0	0.0
40	21.8	21.4	20.3	18.6	16.5	14.2	11.8	9.4	7.3	5.5	3.9	2.8	1.9	1.2	0.8	0.5	0.3	0.2	0.1	0.0	0.0
42	21.2	20.9	19.9	18.3	16.4	14.1	11.8	9.6	7.5	5.7	4.2	3.0	2.0	1.4	0.9	0.5	0.3	0.2	0.1	0.1	0.0
44	20.8	20.4	19.5	18.0	16.2	14.1	11.9	9.7	7.7	5.9	4.4	3.2	2.2	1.5	1.0	0.6	0.4	0.2	0.1	0.1	0.0
46	20.3	20.0	19.1	17.7	16.0	14.0	11.9	9.8	7.8	6.1	4.6	3.4	2.4	1.6	1.1	0.7	0.5	0.3	0.2	0.1	0.1
48	19.9	19.6	18.8	17.5	15.8	13.9	11.9	9.9	8.0	6.3	4.8	3.5	2.6	1.8	1.2	0.8	0.5	0.3	0.2	0.1	0.1
50	19.5	19.2	18.4	17.2	15.6	13.8	11.9	10.0	8.1	6.4	5.0	3.7	2.7	1.9	1.3	0.9	0.6	0.4	0.2	0.1	0.1
52	19.2	18.9	18.1	17.0	15.5	13.7	11.9	10.0	8.2	6.6	5.1	3.9	2.9	2.1	1.5	1.0	0.7	0.4	0.3	0.2	0.1
54	18.8	18.5	17.8	16.7	15.3	13.6	11.9	10.1	8.3	6.7	5.3	4.0	3.0	2.2	1.6	1.1	0.7	0.5	0.3	0.2	0.1
56	18.5	18.2	17.5	16.5	15.1	13.5	11.8	10.1	8.4	6.8	5.4	4.2	3.2	2.3	1.7	1.2	0.8	0.5	0.4	0.2	0.1
58	18.2	17.9	17.3	16.3	15.0	13.5	11.8	10.1	8.5	7.0	5.6	4.3	3.3	2.5	1.8	1.3	0.9	0.6	0.4	0.3	0.2
60	17.9	17.7	17.0	16.1	14.8	13.4	11.8	10.2	8.6	7.1	5.7	4.5	3.4	2.6	1.9	1.4	1.0	0.7	0.4	0.3	0.2
62	17.7	17.4	16.8	15.9	14.7	13.3	11.8	10.2	8.6	7.2	5.8	4.6	3.6	2.7	2.0	1.5	1.0	0.7	0.5	0.3	0.2
64	17.4	17.2	16.6	15.7	14.5	13.2	11.7	10.2	8.7	7.2	5.9	4.7	3.7	2.8	2.1	1.6	1.1	0.8	0.5	0.4	0.2
66	17.2	16.9	16.3	15.5	14.4	13.1	11.7	10.2	8.7	7.3	6.0	4.8	3.8	2.9	2.2	1.6	1.2	0.9	0.6	0.4	0.3
68	17.0	16.7	16.1	15.3	14.2	13.0	11.6	10.2	8.8	7.4	6.1	4.9	3.9	3.1	2.3	1.7	1.3	0.9	0.6	0.4	0.3
70	16.8	16.5	15.9	15.1	14.1	12.9	11.6	10.2	8.8	7.5	6.2	5.0	4.0	3.2	2.4	1.8	1.4	1.0	0.7	0.5	0.3
72	16.6	16.3	15.8	15.0	14.0	12.8	11.5	10.2	8.8	7.5	6.3	5.1	4.1	3.3	2.5	1.9	1.4	1.0	0.7	0.5	0.4
74	16.4	16.1	15.6	14.8	13.9	12.7	11.5	10.2	8.9	7.6	6.4	5.2	4.2	3.4	2.6	2.0	1.5	1.1	0.8	0.6	0.4
76	16.2	15.9	15.4	14.7	13.7	12.7	11.4	10.2	8.9	7.6	6.4	5.3	4.3	3.5	2.7	2.1	1.6	1.2	0.9	0.6	0.4
78	16.0	15.8	15.3	14.5	13.6	12.6	11.4	10.2	8.9	7.7	6.5	5.4	4.4	3.5	2.8	2.2	1.7	1.2	0.9	0.7	0.5
80	15.9	15.6	15.1	14.4	13.5	12.5	11.3	10.1	8.9	7.7	6.6	5.5	4.5	3.6	2.9	2.3	1.7	1.3	1.0	0.7	0.5
82	15.7	15.4	15.0	14.3	13.4	12.4	11.3	10.1	8.9	7.7	6.6	5.5	4.6	3.7	3.0	2.3	1.8	1.4	1.0	0.8	0.5
84	15.6	15.3	14.8	14.1	13.3	12.3	11.3	10.1	8.9	7.8	6.7	5.6	4.7	3.8	3.0	2.4	1.9	1.4	1.1	0.8	0.6
86	15.4	15.2	14.7	14.0	13.2	12.3	11.2	10.1	8.9	7.8	6.7	5.7	4.7	3.9	3.1	2.5	1.9	1.5	1.1	0.8	0.6
88	15.3	15.0	14.5	13.9	13.1	12.2	11.2	10.1	8.9	7.8	6.8	5.7	4.8	3.9	3.2	2.6	2.0	1.6	1.2	0.9	0.7
90	15.2	14.9	14.4	13.8	13.0	12.1	11.1	10.0	9.0	7.9	6.8	5.8	4.9	4.0	3.3	2.6	2.1	1.6	1.2	0.9	0.7
92	15.1	14.8	14.3	13.7	12.9	12.0	11.1	10.0	9.0	7.9	6.8	5.8	4.9	4.1	3.3	2.7	2.1	1.7	1.3	1.0	0.7
94	15.0	14.7	14.2	13.6	12.8	12.0	11.0	10.0	9.0	7.9	6.9	5.9	5.0	4.2	3.4	2.8	2.2	1.7	1.3	1.0	0.8
96	14.8	14.5	14.1	13.5	12.8	11.9	11.0	10.0	9.0	7.9	6.9	5.9	5.0	4.2	3.5	2.8	2.3	1.8	1.4	1.1	0.8
98	14.7	14.4	14.0	13.4	12.7	11.8	10.9	10.0	8.9	7.9	6.9	6.0	5.1	4.3	3.5	2.9	2.3	1.9	1.5	1.1	0.9
100	14.6	14.3	13.9	13.3	12.6	11.8	10.9	9.9	8.9	7.9	7.0	6.0	5.2	4.3	3.6	3.0	2.4	1.9	1.5	1.2	0.9
102	14.5	14.2	13.8	13.2	12.5	11.7	10.8	9.9	8.9	8.0	7.0	6.1	5.2	4.4	3.7	3.0	2.5	2.0	1.6	1.2	0.9
104	14.5	14.1	13.7	13.1	12.4	11.7	10.8	9.9	8.9	8.0	7.0	6.1	5.3	4.5	3.7	3.1	2.5	2.0	1.6	1.3	1.0
106	14.4	14.0	13.6	13.0	12.4	11.6	10.8	9.9	8.9	8.0	7.0	6.1	5.3	4.5	3.8	3.1	2.6	2.1	1.7	1.3	1.0
108	14.3	14.0	13.5	13.0	12.3	11.5	10.7	9.8	8.9	8.0	7.1	6.2	5.3	4.6	3.8	3.2	2.6	2.1	1.7	1.3	1.1
110	14.2	13.9	13.4	12.9	12.2	11.5	10.7	9.8	8.9	8.0	7.1	6.2	5.4	4.6	3.9	3.2	2.7	2.2	1.8	1.4	1.1
112	14.1	13.8	13.4	12.8	12.2	11.4	10.6	9.8	8.9	8.0	7.1	6.2	5.4	4.7	3.9	3.3	2.7	2.2	1.8	1.4	1.1
114	14.0	13.7	13.3	12.7	12.1	11.4	10.6	9.8	8.9	8.0	7.1	6.3	5.5	4.7	4.0	3.4	2.8	2.3	1.8	1.5	1.2
250	11.7	11.4	11.0	10.6	10.2	9.7	9.3	8.8	8.3	7.9	7.4	6.9	6.4	5.9	5.5	5.0	4.6	4.2	3.8	3.4	3.0
500	10.4	10.2	9.9	9.6	9.3	9.0	8.7	8.3	8.0	7.7	7.4	7.0	6.7	6.4	6.1	5.8	5.5	5.2	4.9	4.6	4.3
2000	8.9	8.7	8.6	8.4	8.3	8.1	8.0	7.8	7.7	7.5	7.4	7.2	7.0	6.9	6.7	6.6	6.4	6.3	6.1	6.0	5.8
5000	7.8	7.8	7.7	7.6	7.5	7.4	7.4	7.3	7.2	7.1	7.0	6.9	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.3	6.2

Figure A-1. Analytical Approximation of the Mixing Zone Solution (Percentage Effluent)