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ASSIMILATIVE CAPACITY STUDY OF THE GRAND RIVER IN THE VICINITY OF A PROPOSED WWTP IN WALDEMAR, ON

SUMMARY DOCUMENT

Prepared for:

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1. INTRODUCTION

Sarah Properties Ltd. is proposing the construction of a new sewage treatment system in Waldemar with dry ditch discharge and subsequent discharge to the ultimate receiver, the Grand River. It is anticipated that the sewage treatment facility will have an average day flow (ADF) capacity of 552 m^3/d.

A critical component of this study is the completion of an assimilative capacity assessment of the receiving water body, in this case the Grand River. An assimilative capacity assessment requires that both water quality and quantity be evaluated. To-date, a number of memoranda, technical memoranda, and other documents have been prepared and circulated as part of this assignment. The Ontario Ministry of the Environment and Climate Change (MOECC) requested that a summary document be prepared that includes all documentation and correspondence prepared throughout the duration of this study.

The intent of this document is to present a summary of the technical assessment of the assimilative capacity of the Grand River, correspondence between the project team and the MOECC, and proposed effluent requirements for a new wastewater treatment plan (WWTP) in Waldemar, ON.

This document provides a summary of all work completed on this assessment to-date. All previously submitted memoranda, technical memoranda, and pertinent correspondence including meeting notes, letters and emails, as well as additional supporting technical information are included as appendices.

2. REVIEW OF ACTIVITIES COMPLETED TO-DATE

2.1 Ambient Conditions and Proposed Study Methodology

XCG prepared and submitted a memorandum dated May 15, 2015 which presented the preliminary results of ambient conditions in the vicinity of the proposed WWTP in Waldemar, Ontario. The document summarized available water quality data used for the purposes of developing ambient conditions, including Provincial Water Quality Monitoring Network (PWQMN) and Grand River Conservation Authority (GRCA) data. The document also identified the proposed equivalent 7Q20 flow to be used for the purposes of completing the Assimilative Capacity Study (ACS). Because the Grand River is a regulated stream, the proposed equivalent 7Q20 flow was proposed to be 0.4 m^3/s, which was documented in the Grand River Watershed Water Management Plan (2014), co-authored by the MOECC and GRCA. A copy of this memorandum can be found in Appendix A.

A meeting was then held on May 19, 2015 to discuss the results of the preliminary results of the ambient conditions. Representatives from MOECC and GRCA were in attendance, and a copy of the meeting notes can be found in Appendix B. GRCA indicated that additional monitoring data were available, and it was agreed that this information would be incorporated into the review of ambient conditions. MOECC raised concerns with respect to the proposed equivalent 7Q20 flow value proposed, suggesting that the value be reduced from the proposed value of 0.4 m^3/s to 0.08 m^3/s. MOECC and GRCA agreed to discuss the low flow value, and provide XCG with a 7Q20 value to be used for the purposes of completing the ACS.

A memorandum outlining the updated review of ambient conditions was prepared by XCG and submitted to MOECC for review on October 30, 2015. A copy of this memorandum is provided in Appendix C. This memorandum incorporated the additional water quality data provided by GRCA. In terms of the proposed 7Q20 flow, no additional guidance had been provided by MOECC. As such, the proposed value remained unchanged at 0.4 m^3/s.

A conference call meeting was then held on November 25, 2015 to discuss the updated memorandum. Minutes of this meeting are provided in Appendix C. At that time, MOECC agreed that an equivalent 7Q20 value of 0.4 m^3/s is reasonable for the Grand River in the vicinity of the proposed discharge. Subsequent to the meeting, both MOECC and GRCA approved the proposed assimilative capacity assessment methodology which follows the MOECC's "Green Book" and incorporated the following:

- Utilizing the equivalent 7Q20 flow value of 0.4 m^3/s for mass balance calculations;
- Utilizing 75th percentile values for ambient water concentrations for key parameters for mass balance calculations; and
- Assuming the upstream Grand Valley WPCP is continuously discharging at its current ECA rated ADF capacity and effluent compliance limits.

2.2 Assimilative Capacity Study

An Assimilative Capacity Study (ACS) report was submitted to MOECC on March 29, 2016 for review. The report included mass balance and mixing zone analyses, and recommended effluent objectives for the new proposed WWTP in Waldemar, ON. Because the design ADF of the WWTP had not yet been finalized, proposed effluent requirements were developed for

two flow scenarios (namely 451 m^3/d and 552 m^3/d) which spanned the range of anticipated potential WWTP design ADF values. The ACS report is provided in Appendix D.

Subsequently, MOECC issued a letter dated April 28, 2016, which provided comments on the ACS report. XCG prepared a response to these comments in a letter dated July 7, 2016, which included an update to the mixing zone analysis. Copies of these letters are provided in Appendix E. At that time, it was agreed that a follow-up meeting would be held to discuss the ACS report, MOECC's comments, XCG's responses, and any outstanding questions or concerns related to the receiver study.

A meeting was held on August 15, 2016, with representatives from MOECC, GRCA, the Township of Amaranth-East Gary, XCG, Sarah Properties Ltd., and ASI Group. Meeting notes are provided in Appendix F. During that meeting, the Policy 2 status of the Grand River with respect to total phosphorus was discussed. Post-meeting, it was determined that a Policy 2 Deviation Request, if required, would follow the process outlined in Appendix C of MOECC's "Green Book" and that the process would be driven and overseen by MOECC's Approvals Branch and, possibly, Policy Branch. It was also agreed at that time that effluent requirements would be evaluated for one flow scenario only, namely a design ADF of 552 m^3/d. It was noted that if the final design ADF is less than 552 m^3/d, the concentration objectives and limits would remain unchanged, but that the loading limits would decrease accordingly. Should the final design ADF be greater than 552 m^3/d, an updated ACS would be submitted to obtain agreement from MOECC for effluent requirements for this higher design flow value. Finally, post-meeting, MOECC requested that estimates of unionized ammonia, TP and temperature within the mixing zone be developed.

As a follow-up to the meeting, XCG prepared a letter dated September 23, 2016 which provided a clear summary of the PWQMN data used as part of this study, estimates of unionized ammonia, TP and temperature within the mixing zone, and a summary table clearly outlining the proposed effluent objectives and limits based on a design ADF capacity of 552 m^3/d. A copy of this letter is provided in Appendix F. The proposed effluent objectives and limits remained unchanged from those presented in the March 2016 ACS report for this design ADF value.

Subsequently, MOECC requested via email on December 1, 2016 that dissolved oxygen (DO) modelling be conducted to estimate the impact of the proposed discharge on DO concentrations in the receiver. A copy of this email chain can be found in Appendix F. The results of this analysis are presented in Section 2.3. A summary of the proposed effluent requirements for a WWTP design ADF of 552 m^3/d is presented in Table 2.1.

Table 2.1 Proposed Effluent Compliance Objectives and Limits for a Design ADF of 552 m³/d

Effluent Parameter	Concentration		Loading Limit (kg/d)
	Objective (mg/l)	Limit (mg/L)	
$cBOD_5$	8.0	10.0	5.52
Total Suspended Solids	8.0	10.0	5.52
Total Phosphorus	0.08	0.10	0.055
Total Ammonia Nitrogen			
Winter (Dec - Feb)	3.0	3.8	2.1
Spring (Mar - May)	2.5	3.3	1.8
Summer (Jun - Sep)	1.0	1.8	1.0
Fall (Oct - Nov)	1.6	2.4	1.3

Notes:

E.coli effluent objective and limit of less than 100 organisms per 100 mL based on monthly geometric mean values.

Above concentration limits based on monthly average values. Loading limits based on annual average values and a design ADF of 552 m^3/d.

2.3 Dissolved Oxygen Modelling

The goal of this assessment was to determine the approximate impact on in-stream dissolved oxygen levels associated with the proposed Waldemar WWTP discharge, during summer low flow conditions. To achieve this, a straightforward Streeter-Phelps dissolved oxygen model, developed by the Alabama Department of Environmental Management (ADEM, 2001) was applied. Details of the analysis are provided in Appendix G.

A plot of dissolved oxygen downstream of the proposed Waldemar WWTP discharge is provided in Figure 2.1 below. Results with and without the additional effluent are included. As illustrated, the dissolved oxygen impact associated with the WWTP discharge is marginal. The initial drop in dissolved oxygen within the first few hundred meters of the discharge is not a result of the effluent loading, but rather is a result of either an under-estimation of re-aeration rate constants, or an over-estimation of in-stream BOD and nitrogen.

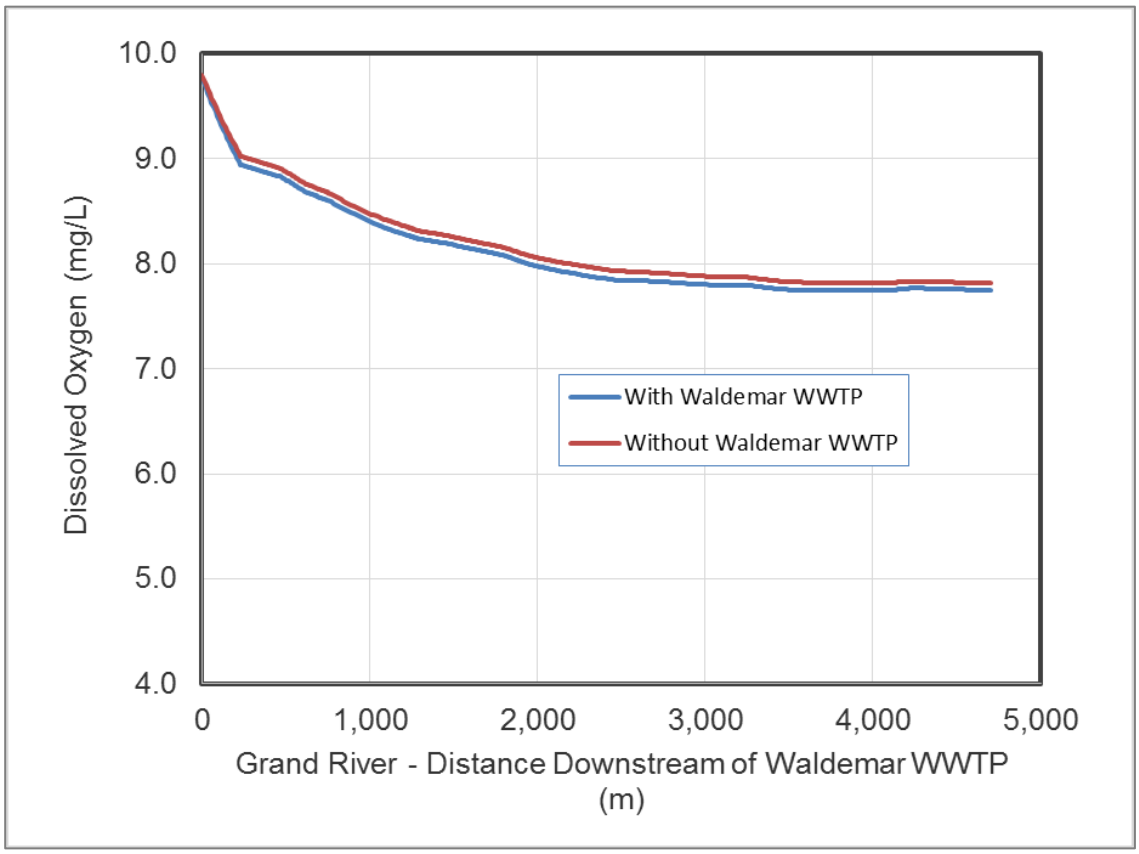

Figure 2.1 Projected DO Concentrations in the Receiver both with and without Proposed WWTP Discharge

As a result, the DO modelling indicates that the proposed Waldemar WWTP effluent discharge will not have a significant impact on in-stream DO levels in the Grand River. As such, no modifications to the proposed effluent requirements for $cBOD_5$ are recommended.

3. SUMMARY

To-date, the following activities have been completed:

- A review of ambient water quality and flows in the Grand River in the vicinity of the proposed outfall.
- Preparation of an Assimilative Capacity Study document that presented proposed effluent requirements for the proposed WWTP.
- Follow-up activities to respond to MOECC's review comments and concerns, including additional mixing zone and DO modelling.

Based on the results of the above tasks, proposed effluent compliance limits and objectives for a new WWTP in the vicinity of Waldemar, ON have been developed and are presented in Table 3.1.

It is acknowledged that the concentration objectives and limits would apply to a new WWTP facility with a design ADF capacity of 552 m^3/d or less. Should the proposed design ADF capacity for the new WWTP increase to a value greater than 552 m^3/d, or should the proposed discharge location change, it is acknowledged that the ACS would need to be updated and resubmitted to MOECC for review and comment.

Table 3.1 Proposed Effluent Compliance Objectives and Limits for a Design ADF of 552 m^3/d

Effluent Parameter	Concentration		Loading Limit (kg/d)
	Objective (mg/l)	Limit (mg/L)	
$cBOD_5$	8.0	10.0	5.52
Total Suspended Solids	8.0	10.0	5.52
Total Phosphorus	0.08	0.10	0.055
Total Ammonia Nitrogen			
Winter (Dec - Feb)	3.0	3.8	2.1
Spring (Mar - May)	2.5	3.3	1.8
Summer (Jun - Sep)	1.0	1.8	1.0
Fall (Oct - Nov)	1.6	2.4	1.3

Notes:

E.coli effluent objective and limit of less than 100 organisms per 100 mL based on monthly geometric mean values.

Above concentration limits based on monthly average values. Loading limits based on annual average values and a design ADF of 552 m^3/d.

APPENDIX A
MEMORANDUM – SUMMARY OF PRELIMINARY RESULTS OF AMBIENT CONDITIONS

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Date:	May 15, 2015	**XCG File No.: 3-3756-01-01**
To:	Lindsey Burzese (MOECC), Andrew Herreman (GRCA)	
cc:	Walter Broos (Sarah Properties Ltd.), Lindsay Wolfenberg (ASI)	
From:	Carla Fernandes (XCG)	
Re:	Summary of Preliminary Results of Ambient Conditions in the Vicinity of the Proposed WWTP in Waldemar, Ontario	

1. INTRODUCTION

Sarah Properties Ltd. is proposing the construction of a new sewage treatment system in Waldemar with dry ditch discharge and subsequent discharge to the ultimate receiver, the Grand River. It is anticipated that the sewage treatment facility will have an average day flow (ADF) capacity of 300 m^3/d and will provide tertiary level treatment.

A critical component of this study is the completion of an assimilative capacity assessment of the receiving water body, in this case the Grand River. An assimilative capacity assessment requires that both water quality and quantity be evaluated. The intent of this memorandum is to provide a discussion piece between the project team, the Ministry of the Environment and Climate Change (MOECC), and the Grand River Conservation Authority (GRCA). This memorandum includes a preliminary assessment of the ambient water quality and current conditions in the Grand River in the vicinity of the proposed WWTP discharge location.

2. WATER QUALITY SUMMARY

Ideally, in establishing ambient water quality for a receiver, there are recent data available at a location in the vicinity of the discharge location. In the case of the Assimilative Capacity Assessment in support of the proposed Wastewater Treatment Plant (WWTP) in Waldemar, various data sources have been considered to establish the ambient water quality and are identified in Table 1. Figure 1 presents the water quality stations in the vicinity of the proposed discharge location and other points of interest for this study.

Data from each PWQMN station collected during the period from 1994 to 1996 was compared for each parameter of interest. A strong consistency in water quality was observed for each parameter. As such, it can be reasonably assumed that the water quality upstream and downstream of the proposed discharge location does not differ significantly. Therefore, data collected from PWQMN Station 16018406702 (downstream) will be used for the purposes of this study, as it provides current data, while PWQMN Station 16018403902 (upstream) is dated with a period of record ending in 2006.

Table 1 Table of Data Sources for Ambient Water Quality

Source	Distance From Proposed Discharge Location	Period of Record	Parameters of Interest
PWQMN Station 16018403902	3.0 km	1972 - 2006	DO, pH, water temperature, TP, TSS, TAN, NO_3
PWQMN Station 16018406702	3.6 km	1975 - 1996	DO, pH, water temperature, TP, TSS, TAN, NO_3
		2007 - 2014	DO, pH, water temperature, TP, TSS, TAN, NO_3
GRCA Data Collected at PWQMN Station 16018406702	3.6 km	2004 - 2006	pH, water temperature, TP, TSS, NH_3, NO_3

Figure 1 Location Map Identifying Points of Interest

Where possible, ambient water quality conditions for parameters of interest were characterized on a seasonal basis as follows:

Winter: January – March
Spring: April – June
Summer: July – September
Fall: October – December

For the preliminary analysis, water quality data from PWQMN Station 16018406702 and the GRCA samples collected at this same location were examined. The seasonal 75th percentile concentrations were calculated. The resultant 75th percentile, observed ranges, associated policy designation (if any), and comments are shown in Table 2 for each parameter of interest.

Table 2 Water Quality Summary

Parameter	Percentile / Value Presented	Value / Range	Policy Status / Comments
Total Phosphorous (mg/L) Winter Spring Summer Fall Overall	75th percentile	 0.062 0.027 0.036 0.022 0.031	Policy 2 for total phosphorous in the Grand River near the proposed WWTP discharge location.
BOD_5 (mg/L)	n/a	No data	No recent BOD_5 data were available, however it is expected that the BOD_5 concentration would be less than 2 mg/L.
Dissolved Oxygen (mg/L)	Overall range of recorded values	5.80 – 17.00	In total there were 373 discrete observations of dissolved oxygen; the range of these values are presented in the second column. All of the observations were well above the PWQO, based on temperature. Based on these observations the receiver is Policy 1 with respect to dissolved oxygen.
E. coli (cfu/100mL)	75th percentile	0 - 1	Based on 5 analysis results from samples collected by the GRCA in 2005, the receiver appears to be Policy 1 with respect to *E. coli*. It is expected that the proposed WWTP will meet the PWQO for effluent bacteriological quality.
pH Winter Spring Summer Fall Overall	75th percentile	 7.98 8.45 8.60 8.40 8.47	The majority of recorded pH values fall within the acceptable PWQO range of 6.5 – 8.5, however approximately 20% of the results exceed a pH value of 8.5. Exceedances primarily occurred between May and October and may be a result of aquatic life, primarily plant, activity.
Unionized NH_3 (ug/L-NH_3) Winter Spring Summer Fall Overall	75th percentile	 0.94 3.76 5.98 0.99 3.80	Policy 1 for unionized ammonia in the Grand River near the proposed WWTP discharge location.
Nitrate (mg/L-NO_3) Winter Spring Summer Fall Overall	75th percentile	 5.89 5.76 1.86 7.18 5.36	There is no PWQO for nitrate, however there is a Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. Historically, all observations of nitrate have remained below the CWQG of 13 mg/L-NO_3.
Total Suspended Solids (mg/L) Winter Spring Summer Fall Overall	75th percentile	 33.0 6.00 10.0 6.75 9.00	There are no criteria for TSS however, the observed concentrations are generally high.

3. GRAND RIVER FLOWS

Typically for assimilative capacity analyses, the 7Q20 stream flow represents an appropriate design-case estimate. At the location of the proposed sewage treatment facility discharge, low flow is governed by outflows from an upstream reservoir. It is proposed that a low flow value of 0.40 m^3/s be used in this analysis. This flow was provided by the GRCA and is documented in the Grand River Watershed Water Management Plan (2014) as the design 7Q20 equivalent flow to be used for WWTPs discharging to the regulated river system near the Leggatt stream gauge.

4. SUMMARY OF AMBIENT CONDITIONS

- Water quality data applicable to the study area have been identified.
- A 7Q20 flow value of 0.40 m^3/s is proposed for use in the determination of effluent limits, as presented in the Grand River Watershed Water Management Plan (2014), approved by the MOECC and the GRCA.
- The receiver appears to be Policy 1 for dissolved oxygen and unionized ammonia, and Policy 2 for TP.

5. PROPOSED METHODOLOGY

It is proposed that recommended effluent limits be developed for the proposed facility by completing a seasonal mass balance analysis using the proposed sewage treatment facility ADF of 300 m^3/d, the ambient water quality data, and low flow value. As part of this mass balance assessment, impacts of loadings from the upstream Grand Valley WPCP will be considered as part of the analysis. The mass balance model will be used to ensure that the end-of-pipe water quality is non-acutely lethal and that fully mixed concentrations are lower than PWQO values.

APPENDIX B
MEETING NOTES – MAY 19, 2015 MEETING WITH MOECC AND GRCA

ASI Water

Project:	Waldemar Development: Assimilative Capacity Study Meeting with the MOECC and GRCA
Meeting Date:	Tuesday, May 19, 2015 1:00 PM
Location:	MOECC Hamilton Office 119 King Street West, 12th Floor
Attendees:	Gary Tomlinson (GT), Ministry of the Environment and Climate Change (MOECC) Craig Fowler (CF), MOECC Barbara Slaughtery (BS), MOECC Andrew Herreman (AH), Grand River Conservation Authority (GRCA) Mark Anderson (MA), GRCA Sandra Cooke (SC), GRCA Walter Broos (WB), Sarah Properties Ltd. Lindsay Wolfenberg (LW), ASI Group (ASI) John Levie (JL), ASI Mike Hulley (MH), XCG Consultants Ltd. (XCG) Melody Johnson (MJ), XCG Carla Fernandes (CMF), XCG
Regrets:	Lindsey Burzese (LB), MOECC
Notes By:	Carla Fernandes, XCG Lindsay Wolfenberg, ASI

Item	Action
1. Introductions	
• Meeting attendees introduced themselves and provided job title and description of project involvement.	Info

Item	Action
2. Project Background	
• MA and CF raised questions around the calculated ADF for 300 m3/day. This calculation was based on 2 ppl/household. Since this is not a retirement community, would like to see the ADF re-calculated to better represent the population per household as well as address any potential infiltration into the collection pipes.	ASI
• LW discussed that CF had raised questions during the December 2014 MOECC meeting about possible issues around two-tier sewage treatment existing in the same residential area. LW noted that the modularity of the wastewater treatment plant provides the option to potentially include the neighbouring residence. WB is receptive to this idea. CF said he would like to see the ADF reflect the inclusion of the neighbouring properties. LW will provide two ADF numbers, one exclusive of the neighbouring properties and one inclusive of the neighbouring properties.	ASI
• LW discussed the preferred treated effluent discharge location and route. CF had questions around the treated effluent being accessible to the pubic (discharged to a ditch to flow into the Grand River vs an outfall pipe). JL noted that this would trigger dry ditch effluent criteria which ASI is comfortable meeting. CF noted that the Township will need to review and comment on the proposed discharge location. WB and ASI will discuss the proposed discharge location with the Township.	ASI and WB
• MA – Who will own the WWTP? WB responded that the ownership of the plant still needs to be discussed with the Township to determine if they want to take on the ownership or if they would prefer to enter into an MRA with the WWTP owner (Condo Corporation) and the contracted operator.	
3. Preliminary Results of Ambient Water Quality in the Grand River	
• Water quality data were reviewed for two Provincial Water Quality Management Network (PWQMN) stations – one upstream (Station 16018403902) and one downstream (Station 16018406702) of the proposed discharge location. CMF noted that ambient conditions were determined based on the downstream PWQMN station as it has recent data available while the upstream station is outdated with a period of record ending in 2006.	Info
- MA agreed with this rationale.	Info

Item	Action
- SC noted that some of the data collected from the downstream PWQMN station is outdated and the dataset should be truncated as appropriate. It was suggested that the analysis include data from 1996 to 2015 for nitrogen parameters, as the method of analysis for nitrogen species was changed in 1996. XCG will revise findings accordingly.	XCG
- SC noted that there are limitations to PWQMN data and these should be noted in the report.	Info
• CMF provided a summary of ambient water quality.	Info
- The Grand River is Policy 2 with respect to total phosphorus (TP).	Info
- No recent BOD_5 data were available, however it is expected that the ambient BOD_5 concentration would be less than 2 mg/L.	Info
- The Grand River is Policy 1 with respect to dissolved oxygen (DO). MA commented that the PWQMN data is not continuous and therefore may not capture the lowest concentration experienced diurnally. MA will provide XCG with continuous DO data from one week in June 2004 and one week in August 2004 to include in the water quality analysis. These data indicated DO concentrations, considered in conjunction with 75th percentile temperature data, are greater than the PWQO values (4 mg/L to 7 mg/L, varying with temperature) over the two-week monitoring period. Post-meeting note: MA provided CMF with the continuous DO data in an email dated May 19, 2015.	MA (completed 19-May-15)
- The Grand River is Policy 1 with respect to *E. coli*. The data presented were in terms of cfu/100 mL. MA noted that these units may not be correct and that he would provide confirmation regarding the correct units. CF noted that *E. coli* should be presented in terms of geometric mean.	MA
- pH generally falls within the acceptable Provincial Water Quality Objective (PWQO) range of 6.5 to 8.5.	Info
- The Grand River is Policy 1 with respect to unionized ammonia.	Info
- Nitrate has historically remained significantly below the Canadian Water Quality Guideline (CWQG) of 13 mg/L-NO_3.	Info
- CF commented that there is a CWQG for total suspended solids (TSS) and should be considered in this analysis.	Info
• Water quality was summarized by season: Winter (January-March), Spring (April-June), Summer (July-September), and Fall (October-December).	Info

Item	Action
- SC commented that seasons should be redefined as follows: Winter (December-February), Spring (March-May), Summer (June-September), and Fall (October-November). XCG agreed to this adjustment and will update analysis accordingly.	XCG
4. Grand River 7Q20 Flow Value	
• CMF proposed that a 7Q20 flow value of 0.4 m^3/s for the Grand River in the vicinity of the proposed discharge be used for this analysis. This value was provided by the GRCA and is documented in the Grand River Watershed Water Management Plan (2014) as the design 7Q20 equivalent flow to be used for WWTPs discharging to the regulated river system near the Leggatt stream gauge. This document was approved by the GRCA and MOECC in 2014.	Info
• CMF noted that LB had indicated prior to the meeting that a low flow value of 0.08 m^3/s should be applied to this study, however the rationale was not provided. CF noted that the rationale was not known to him and this topic should be further discussed with LB directly.	Info
• SC noted that the GRCA conducted an in-depth analysis to determine a 7Q20 flow of 0.4 m^3/s. It was also noted that Willow Brook flows into the Grand River downstream of the Grand Valley WPCP contributing additional flow to the River prior to the proposed discharge location.	Info
• SC commented that the GRCA has prepared a draft Reservoir Reliability Study Report. She will advise whether or not it can be shared with XCG at this time for consideration in this study.	SC
• It was agreed that the MOECC and GRCA would collaborate and provide XCG with a 7Q20 flow value for use in the assimilative capacity study in support of the proposed WWTP in Waldemar.	MOECC/ GRCA
5. Proposed Assimilative Capacity Assessment Methodology	
• CMF proposed that a seasonal mass balance analysis using the identified 7Q20, proposed sewage treatment facility average day flow, and the ambient water quality data be completed to develop recommended effluent limits for the proposed facility. As part of this mass balance assessment, impacts of loadings from the upstream Grand Valley WPCP would be considered. The mass balance model would be used to ensure that the end-of-pipe water quality is non-acutely lethal and that fully mixed concentrations are lower than the PWQO values.	Info

Item	Action
• SC and CF requested that a mixing zone analysis be conducted to determine contaminant plume length. MOECC would then comment regarding whether or not the plume is reasonable in length. XCG agreed to complete this assessment on behalf of Sarah Properties Ltd.	XCG

APPENDIX C
UPDATED ANALYSIS AMBIENT CONDITIONS – MEMORANDUM AND MEETING NOTES

XCG CONSULTANTS LTD.
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2620 Bristol Circle, Suite 300, Oakville, Ontario, Canada L6H 6Z7

Date:	October 30, 2015	**XCG File No.: 3-3756-01-01**
To:	Lindsey Burzese, Ministry of the Environment (MOECC) Andrew Herreman, Grand River Conservation Authority (GRCA)	
cc:	Walter Broos, Sarah Properties Ltd. Lindsay Wolfenberg, ASI Group (ASI)	
From:	Carla Fernandes, XCG Consultants Ltd. (XCG)	
Re:	Summary of Preliminary Results of Ambient Conditions in the Vicinity of the Proposed WWTP in Waldemar, Ontario	

1. INTRODUCTION

Sarah Properties Ltd. is proposing the construction of a new sewage treatment system in Waldemar with dry ditch discharge and subsequent discharge to the ultimate receiver, the Grand River. It is anticipated that the sewage treatment facility will have an average day flow (ADF) capacity between 450 m^3/d and 552 m^3/d, based on the selected design scenario, and will provide tertiary level treatment.

A critical component of this study is the completion of an assimilative capacity assessment of the receiving water body, in this case the Grand River. An assimilative capacity assessment requires that both water quality and quantity be evaluated. This memorandum includes a preliminary assessment of the ambient water quality and current conditions in the Grand River in the vicinity of the proposed Wastewater Treatment Plant (WWTP) discharge location and incorporates comments received from the MOECC and GRCA. As such, this document will provide the framework for discussion between the project team, the MOECC, and the GRCA regarding completion of this assimilative capacity assessment.

2. WATER QUALITY SUMMARY

Ideally, in establishing ambient water quality for a receiver, there are recent data available at a location in the vicinity of the discharge location. In the case of the Assimilative Capacity Assessment in support of the proposed WWTP in Waldemar, various data sources have been considered to establish the ambient water quality and are identified in Table 1. Figure 1 presents the water quality stations in the vicinity of the proposed discharge location and other points of interest for this study.

Monitoring information from each Provincial Water Quality Monitoring Network (PWQMN) station, collected during the period from 1994 to 1996 was evaluated for each parameter of interest. A strong consistency in water quality was observed for each parameter. Therefore, it can be reasonably assumed that the water quality upstream and downstream of the proposed discharge location does not differ significantly. Therefore, data collected from PWQMN Station 16018406702 (downstream) will be used for the purposes of this study, as it provides current data, while data from PWQMN Station 16018403902 (upstream) is dated with a period of record ending in 2006.

Table 1 Table of Data Sources for Ambient Water Quality

Source	Distance From Proposed Discharge Location	Period of Record	Parameters of Interest
PWQMN Station 16018403902	3.0 km	1972 - 2006	DO, pH, water temperature, TP, TSS, TAN, NO_3
PWQMN Station 16018406702	3.6 km	1975 - 1996	DO, pH, water temperature, TP, TSS, TAN, NO_3
		2007 - 2014	DO, pH, water temperature, TP, TSS, TAN, NO_3
GRCA Data Collected at PWQMN Station 16018406702	3.6 km	2004 - 2006	pH, water temperature, TP, TSS, NH_3, NO_3
GRCA Data Collected Near PWQMN Station 16018406902	3.0 km	June 2004 August 2004	DO

Figure 1 Location Map Identifying Points of Interest

Where possible, ambient water quality conditions for parameters of interest were characterized on a seasonal basis as follows, with seasons defined as advised by the GRCA:

Winter: December – February
Spring: March – May
Summer: June – September
Fall: October – November

For the preliminary analysis, water quality data from PWQMN Station 16018406702 and the GRCA samples collected at the same location were examined. The seasonal 75th percentile concentrations were calculated. The resultant 75th percentile, observed ranges, associated policy designation (if any), and comments are shown in Table 2 for each parameter of interest.

Table 2 Water Quality Summary

Parameter	Statistic	Value / Range	Policy Status / Comments
Total Phosphorous (mg/L) Winter Spring Summer Fall Overall	75th percentile	 0.032 0.037 0.036 0.022 0.031	Policy 2 for total phosphorous in the Grand River near the proposed WWTP discharge location.
BOD_5 (mg/L)	n/a	No data	No recent BOD_5 data were available, however it is expected that the BOD_5 concentration would be less than 2 mg/L.
Dissolved Oxygen (mg/L)	Overall range of recorded values	5.80 – 17.00	In total there were 373 discrete observations and 1,424 continuous observations of dissolved oxygen; the range of these values are as presented. All of the observations were well above the PWQO, based on temperature. Based on these observations the receiver is Policy 1 with respect to DO.
E. coli (cfu/100mL)	75th percentile	0 - 1	Based on 5 analysis results from samples collected by the GRCA in 2005, the receiver appears to be Policy 1 with respect to *E. coli*. It is expected that the proposed WWTP will adhere to the PWQO for effluent bacteriological quality.
pH Winter Spring Summer Fall Overall	75th percentile	 8.28 8.38 8.60 8.41 8.47	The majority of recorded pH values fall within the acceptable PWQO range of 6.5 – 8.5, however approximately 20% of the results exceed a pH value of 8.5. Exceedances primarily occurred between May and October and may be a result of aquatic life, primarily plant activity.
Unionized NH_3 (mg/L-NH_3) Winter Spring Summer Fall Overall	75th percentile	 No data 0.002 0.005 0.004 0.004	The dataset was truncated to exclude ammonia water quality data from and prior to 1996 because the analysis method for nitrogen species was changed in 1996. Policy 1 for unionized ammonia in the Grand River near the proposed WWTP discharge location.
Nitrate (mg/L-NO_3) Winter Spring Summer Fall Overall	75th percentile	 No data 1.53 0.73 0.94 1.22	The dataset was truncated to exclude ammonia water quality data from and prior to 1996 because the analysis method for nitrogen species was changed in 1996. There is no PWQO for nitrate, however there is a Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. Historically, all observations of nitrate have remained below the CWQG of 13 mg/L-NO_3.
Total Suspended Solids (mg/L) Winter Spring Summer Fall Overall	75th percentile	 13.1 10.5 10.0 5.4 9.0	There are no criteria for TSS however, the observed concentrations are generally high.

3. GRAND RIVER FLOWS

Typically for assimilative capacity analyses, the 7Q20 stream flow represents an appropriate design-case estimate. At the location of the proposed sewage treatment facility discharge, low flow is governed by outflows from an upstream reservoir. The Grand River Watershed Water Management Plan (GRCA, 2014) identifies a 7Q20 equivalent value of 0.40 m^3/s be used for WWTPs discharging to the regulated river system near the Leggatt stream gauge. As such, it is proposed that a 7Q20 value of 0.40 m^3/s be used in this analysis.

The MOECC has recommended a 7Q20 value of 0.08 m^3/s to be applied in this assimilative capacity assessment with the possibility of considering flow from Willow Brook which discharges upstream of the proposed WWTP effluent discharge location. Flows associated with Willow Brook would then be considered in addition to the 7Q20 flow value of 0.08 m^3/s.

4. SUMMARY OF AMBIENT CONDITIONS

- Water quality data applicable to the study area have been identified.
- The receiver appears to be Policy 1 for dissolved oxygen and unionized ammonia, and Policy 2 for TP.
- Based on the findings of the Grand River Watershed Water Management Plan (2014) the Grand River 7Q20 value in the vicinity of the proposed WWTP discharge is 0.40 m^3/s. It is proposed that this value is applied to the assimilative capacity assessment with consideration given to reserve capacity.

5. PROPOSED METHODOLOGY

It is proposed that recommended effluent limits be developed for the proposed facility by completing a seasonal mass balance analysis using the proposed sewage treatment facility ADF between 450 m^3/d and 552 m^3/d, based on the selected design scenario, the ambient water quality data, and low flow value. As part of this mass balance assessment, impacts of loadings from the upstream Grand Valley WPCP will be considered. The mass balance model will be used to ensure that the end-of-pipe water quality is non-acutely lethal and that fully mixed concentrations are consistent with MOECC policy.

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XCG File No.: 3-3756-01-01

Project: Waldemar Development: Assimilative Capacity Study
Conference Call with the MOECC and GRCA

Meeting Date: Wednesday, November 25, 2015
10:00 AM

Attendees: Lindsey Burzese (LB), Ministry of the Environment and Climate Change (MOECC)
Gary Tomlinson (GT), MOECC
Craig Fowler (CF), MOECC
Barbara Slaughtery (BS), MOECC
Andrew Herreman (AH), Grand River Conservation Authority (GRCA)
Mark Anderson (MA), GRCA
Walter Broos (WB), Sarah Properties Ltd.
Lindsay Wolfenberg (LW), ASI Group (ASI)
John Levie (JL), ASI
Mike Hulley (MH), XCG Consultants Ltd. (XCG)
Melody Johnson (MJ), XCG
Carla Fernandes (CMF), XCG

Regrets: Sandra Cooke (SC), GRCA

Notes By: Carla Fernandes, XCG
Lindsay Wolfenberg, ASI

Item	Action
1. **Project Background and Status**	
• WB reviewed the project status including meetings and reports that have been completed to date. This included meetings with Council, servicing reports, hydro reports, financial reports, etc.	Info
– During meetings, Council showed a positive interest in the project since this development would add approximately 20-25% to the current tax base for the area.	
Post-meeting note: Christine Gervais (CG) (Township of Amaranth & Township of East Garafraxa) noted that it is more accurate to say, "Council showed a positive interest in the proposal to develop the subject lands as those lands have been designated for future development for some time but there has been no mention from Council that it was based on the tax revenue that it	

Item	Action
would generate and there has been no commitment on Council's part on this development."	
– Reports completed to date include: Planning Justification Report, Functional Servicing Report, Preliminary Stormwater Report, Hydrogeological Study, Geotechnical Study, Financial Impact Assessment, among others.	
• LW provided a brief overview of the project including design flows, the proposed wastewater treatment technology (membrane treatment), and proposed discharge location. During the last meeting on May 19, 2015, MA and CF had raised questions around the average day flow (ADF) being calculated based on 2 people per household as well as address infiltration. Prior to the meeting, ASI had re-calculated the ADF to be 450 m^3/d based on 3 people per household and infiltration.	Info
• LW summarized the questions raised by CF during the December 2014 meeting about possible issues around two-tier sewage treatment existing in the same residential area. Prior to the meeting, ASI provided an additional ADF calculation of 552 m^3/d for the potential to tie in existing surrounding properties to the proposed wastewater treatment plant (WWTP). This calculation included 3 people per household and infiltration.	Info
2. **Previous Meeting Notes**	
• No comments were received on the meeting notes from the previous project meeting held on May 19, 2015, therefore the meeting notes are approved and final.	Info
3. **Preliminary Results of Ambient Water Quality Analysis**	
• CMF provided a brief summary of the revised preliminary results of the Grand River water quality in the vicinity of the proposed discharge. She noted that comments received on the water quality summary at the project meeting held on May 19, 2015 were addressed in the revised memorandum dated October 30, 2015.	Info
• CMF noted that based on 75th percentile values calculated from the data available from PWQMN station 16018406702 (downstream of the Grand Valley Water Pollution Control Plant (WPCP)), the Grand River is Policy 1 with respect to dissolved oxygen, unionized ammonia, and *E. coli* and Policy 2 with respect to total phosphorus (TP).	Info

Item	Action
• MA provided written comments via email prior to the conference call. His comments primarily requested that more detail be provided regarding the statistical summary of ambient water quality and provided suggestions to do so. CMF acknowledged these comments and noted that they will be addressed in the assimilative capacity assessment report.	Info
• No other comments on the ambient water quality were received.	Info
4. **Grand River 7Q20 Equivalent Flow Value**	
• CMF proposed that a 7Q20 equivalent flow value of 0.4 m^3/s for the Grand River in the vicinity of the proposed WWTP discharge be used for the assimilative capacity assessment. This value is documented in the Grand River Watershed Water Management Plan (2014) as the design 7Q20 equivalent flow to be used for WWTPs discharging to the regulated river system near the Leggatt stream gauge. This document was approved by the GRCA and MOECC in 2014.	Info
• MA commented that the GRCA conducted a rigorous analysis to determine that the equivalent 7Q20 in this reach of the Grand River is 0.4 m^3/s. Since the Grand River is a regulated system with flow augmentation provided by Luther Marsh, as required, the GRCA is confident that low flows of 0.4 m^3/s can be maintain year-round.	Info
• LB agreed that a 7Q20 equivalent value of 0.4 m^3/s is reasonable for this reach of the Grand River.	Info
5. **Proposed Assimilative Capacity Assessment Approach**	
• CMF proposed that a seasonal mass balance analysis using the identified equivalent 7Q20, seasonal ambient water quality data, the existing Grand Valley WPCP Environmental Compliance Approval (ECA) rated ADF and effluent compliance limits, and the proposed WWTP ADF be completed to develop recommended effluent limits for the proposed facility. The mass balance model will be used to ensure that the end-of-pipe water quality is non-acutely lethal and fully mixed concentrations meet the PWQO, for parameters identified as Policy 1.	Info
• LB recommended a 7Q20 value of 0.08 m^3/s be applied for this study. Reasons for this decrease from the equivalent value of 0.4 m^3/s included existing uses such as the assimilative capacity used by other dischargers, other point-source impacts water takings, reserve capacity for future uses.	Info

Item	Action
• MH acknowledged these considerations however stated that it was unclear as to how such a significant reduction could be calculated. He noted that, typically, assimilative capacity is determined based on existing conditions and not reserved for future users, as this is difficult to quantify unless such users are clearly known. Rather, future users are required to design facilities based on the existing conditions at the time of design.	Info
• CMF assured that many of the factors identified by LB are already taken into consideration in the proposed mass balance approach to determine limits for the proposed facility. As part of this mass balance assessment, impacts of loadings from the upstream Grand Valley WPCP will be included in estimating the ambient water quality upstream of the proposed WWTP discharge location.	Info
• The rationale for a 7Q20 value of 0.08 m^3/s was not understood by XCG and as such was not agreed upon.	Info
• MH and CMF noted that the proposed methodology is consistent with the approach outlined in the MOECC "Green Book" for deriving receiving-water based, point-source effluent requirements for Ontario water and that several levels of conservatism are incorporated into XCG's proposed approach for determining effluent limits: - Ambient flow being applied is the 7Q20 equivalent, the minimum 7 day average flow with a recurrence period of 20 years (i.e. a 5% chance of there being inadequate streamflow to meet the minimum acceptable dilution in any given year). - Ambient water concentrations for key parameters being applied to the mass balance are 75th percentile values. - It will be assumed that the upstream Grand Valley WPCP is continuously discharging at the current ECA rated ADF capacity and effluent compliance limits. - Ambient water quality used for this study is based on data collected at PWQMN station 16018406702 which is located downstream of the Grand Valley WPCP. As such, the ambient water quality considered for this project already includes current and historical contributions from the Grand Valley WPCP.	Info
• LB requested that the proposed approach be submitted to the MOECC in writing. It was agreed that the approach, as discussed during the conference call, would be detailed in the meeting notes for this conference call. This request is satisfied in the statements below:	XCG (Completed 30-Nov-15)

Item	Action
– The equivalent 7Q20 in the vicinity of the proposed WWTP that will be applied to the mass balance is 0.4 m^3/s. The ambient water quality concentrations that will be applied are those presented in the ambient conditions memorandum prepared by XCG and dated October 30, 2015, as these were reviewed during the meeting and no comments were made. - To recommend effluent compliance limits for the proposed WWTP, a mass balance approach will be applied. The mass of a particular constituent (e.g. TP) in the ambient water (calculated using 75th percentile concentrations, based on data collected from PWQMN station 16018406702, multiplied by the equivalent 7Q20 of 0.4 m^3/s experienced in the Grand River in the vicinity of the proposed WWTP discharge) will be added to the mass of that same constituent discharged into the Grand River from the Grand Valley WPCP (calculated by multiplying the rated ADF and effluent compliance limit identified in the existing ECA for the Grand Valley WPCP). The sum of these masses provides a conservative estimate of the constituent's mass in the Grand River at the location of the proposed WWTP discharge. - The combined ambient mass will then be used in conjunction with the proposed WWTP ADF to recommend reasonable effluent compliance limits.	
• All parties acknowledged the time constraints of this project and agreed to review the meeting notes and the written summary of proposed assimilative capacity assessment methodology described herein and provide approval of the proposed approach and comments on the meeting notes by December 11th, 2015. **Post-meeting note:** The MOECC and GRCA approved the proposed assimilative capacity assessment methodology described herein. LB noted in her comments that the mass balance will have to demonstrate that the full discharge is feasible and will dictate the level of treatment required. She also commented that the receiver is Policy 2 with respect to TP and as such, a very high level of treatment will be required, likely in combination with offsetting, as loadings are still an issue down the system and into the reservoir. This will have to be discussed further with the MOECC as it is the MOECC that is the governing authority.	All (Completed 15-Dec-15)
• XCG will address all comments received by December 11th, 2015 and issue the meeting notes as final, indicating that the contents of the meeting notes are approved by all parties.	XCG (Completed 18-Dec-15)

Item	Action
6. **Other Business**	
• BS inquired about the approvals required for the development, the status of these approvals, and the approval authority. WB responded that full approvals are required for the development, including zoning. The applications have been submitted to the Township of Amaranth (Township). The Township had requested WB to provide more detail on the supply of water, which is in the process of being re-submitted. The Functional Servicing Report has been started but can only be completed to a point without knowing if effluent can be discharged to surface or will require a subsurface bed. An Official Plan Amendment will be required. Intention for development is to follow the intensification guidelines set out by the Province. The County is the approval authority. **Post-meeting note:** CG commented that although the County is the approval authority for the Official Plan Amendment application, the Township is the approval authority for the subdivision and rezoning applications.	Info
• WB commented that the WWTP will either be freehold by the Township or held by a condominium corporation for the development. At this point, the Township has reserved the right to defer this decision. WB mentioned that the Class Environmental Assessment will be commencing shortly.	Info
• LW discussed the preferred treated effluent discharge location and route. CF had questions around the treated effluent being accessible to the pubic (discharged to a ditch to flow into the Grand River versus an outfall pipe). JL noted that this would trigger dry ditch effluent criteria which ASI is comfortable meeting. CF noted that the Township will need to review and comment on the proposed discharge location. WB and ASI will discuss the proposed discharge location with the Township.	ASI / WB
• LB had some concerns regarding the use of a storm water ditch that runs between two homes for treated effluent being discharged to the Grand River. LB expressed concerns with shoreline discharge versus outfall discharge and also how TP will be handled since the Grand River is a Policy 2 receiver. LB suggested the review of various discharge options (pipe, diffuser, etc.) and commented that the MOECC would like to see some kind of offsetting for TP.	Info

Item	Action
Post-meeting note: LB re-iterated that an open discharge alongside residences is not appropriate, nor is a discharge that will follow the shoreline. The MOECC, as the approving authority, will consider this when reviewing the proposed discharge strategy.	
• LW commented that various elements will be considered including an outfall into the river. The WWTP will be designed to meet dry ditch criteria.	Info
• LB raised concerns about the potential impact of effluent discharge proximal to a well of unknown status.	Info
• LW commented that the nearby homeowners have not been approached yet. ASI wanted to ensure that surface water discharge was possible before fully examining the discharge location and consulting with homeowners.	Info
• AH noted that an Environmental Impact Study may be required for the outfall. If an outfall pipe into the river is deemed the preferred method of discharge, the design will need to meet the GRCA permit requirements for construction in a watercourse.	Info

Any errors, omissions, or discrepancies should be reported to Carla Fernandes.

APPENDIX D
ASSIMILATIVE CAPACITY STUDY REPORT
DATED MARCH 29, 2016

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XCG File No.: 3-3756-01-01
March 29, 2016

ASSIMILATIVE CAPACITY STUDY OF THE GRAND RIVER IN THE VICINITY OF A PROPOSED WWTP IN WALDEMAR, ON

Prepared for:

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Appendix A Mixing Zone Analysis Figures

1. INTRODUCTION

1.1 Background

Sarah Properties Ltd. is proposing the construction of a new sewage treatment system in Waldemar with dry ditch discharge and subsequent discharge to the ultimate receiver, the Grand River. It is anticipated that the sewage treatment facility will have an average day flow (ADF) capacity between 451 m^3/d and 552 m^3/d, based on the selected design scenario, and will provide tertiary level treatment.

A critical component of this study is the completion of an assimilative capacity assessment of the receiving water body, in this case the Grand River. An assimilative capacity assessment requires that both water quality and quantity be evaluated. The intent of this technical memorandum is to present proposed effluent requirements for a new wastewater treatment plan (WWTP) in Waldemar, ON.

This technical memorandum includes an assessment of the ambient water quality and current conditions in the Grand River in the vicinity of the proposed WWTP discharge location and the development of proposed effluent objectives and limits for the new WWTP in Waldemar, ON.

1.2 Objectives

The objectives of this analysis are to:

- characterize ambient water quality parameters and to determine critical low flows as well as impacts of the upstream Grand Valley Water Pollution Control Plant (WPCP);
- conduct an assimilative capacity assessment of the receiving waters;
- conduct mixing zone analysis; and
- formulate reasonable recommendations for effluent limits for the new proposed WWTP in Waldemar, ON.

2. AMBIENT CONDITIONS

2.1 Water Quality

Representative background water quality can be defined by examining water quality in the vicinity of the Grand Valley WPCP effluent discharge. For analysis purposes, the 75th percentile threshold is applied to characterize ambient conditions, as recommended by the Ministry of the Environment and Climate Change (MOECC). The MOECC states, "Normally the 75th percentile is used to determine background quality…".[1] The receiving water quality is assigned Policy 1 if the ambient concentration is less than the Provincial Water Quality Objective (PWQO) and Policy 2 if the ambient concentration exceeds the PWQO. The implication of being a Policy 1 or Policy 2 receiver is described briefly below.

- **Policy 1:** In areas which have water quality better than the Provincial Water Quality Objectives, water quality shall be maintained at or above the Objectives.
- **Policy 2:** 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.

Ideally, in establishing ambient water quality for a receiver, there are recent data available at a location in the vicinity of the discharge location. In the case of the Assimilative Capacity Assessment in support of the proposed WWTP in Waldemar, various data sources have been considered to establish the ambient water quality and are identified in Table 1. Figure 1 presents the water quality stations in the vicinity of the proposed discharge location and other points of interest for this study.

Data from each PWQMN station collected during the period from 1994 to 1996 was compared for each parameter of interest. A strong consistency in water quality was observed for each parameter. As such, it can be reasonably assumed that the water quality upstream and downstream of the proposed discharge location does not differ significantly. Therefore, data collected from PWQMN Station 16018406702 (downstream) will be used for the purposes of this study, as it provides current data, while PWQMN Station 16018403902 (upstream) is dated with a period of record ending in 2006.

[1] Ministry of Environment and Energy, *Water Management: Policies, Guidelines, Provincial Water Quality Objectives.* July 1994 (MOE Blue Book).

Table 1 Table of Data Sources for Ambient Water Quality

Source	Distance From Proposed Discharge Location	Period of Record	Parameters of Interest
PWQMN Station 16018403902 (Upstream)	3.0 km	1972 - 2006	DO, pH, water temperature, TP, TSS, TAN, NO_3
PWQMN Station 16018406702 (Downstream)	3.6 km	1975 - 1996	DO, pH, water temperature, TP, TSS, TAN, NO_3
		2007 - 2014	DO, pH, water temperature, TP, TSS, TAN, NO_3
GRCA Data Collected at PWQMN Station 16018406702 (Downstream)	3.6 km	2004 - 2006	pH, water temperature, TP, TSS, NH_3, NO_3, *E. coli*

Figure 1 Location Map Identifying Points of Interest

Where possible, ambient water quality conditions for parameters of interest were characterized on a seasonal basis as follows, with seasons defined as advised by the GRCA:

- Winter: December – February
- Spring: March – May
- Summer: June – September
- Fall: October – November

2.1.1 Total Phosphorus

The MOE PWQO state that, as an interim guideline for streams and rivers, total phosphorus (TP) should not exceed 0.03 mg/L to prevent excessive plant growth. The statistical summary of the total phosphorus concentration data is shown in Table 2. Most seasons are at or above the Policy 2 threshold. For characterization, the annual value for TP of 0.031 mg/L was used to represent ambient conditions. This concentration exceeds the PWQO and therefore the receiver is MOE Policy 2 in the vicinity of the proposed WWTP with respect to TP. This means that a Policy 2 deviation will be required for the proposed WWTP.

Table 2 Summary of Grand River Total Phosphorus Near Proposed Outfall

Season	Median TP (mg/L)	75th Percentile TP (mg/L)	Number of Observations
Winter (Dec - Feb)	0.030	0.032	57
Spring (Mar - May)	0.025	0.037	115
Summer (Jun - Sep)	0.024	0.033	164
Fall (Oct - Nov)	0.014	0.020	67
Annual	**0.022**	**0.031**	**403**

2.1.2 Un-ionized Ammonia

The percentage of un-ionized ammonia in aqueous solution varies depending on the temperature and pH of the water. The 75th percentile concentrations of ammonia, pH, and temperature are summarized in Table 3, Table 4, and Table 5, respectively.

Table 3 Summary of Grand River Ammonia Data Near Outfall

Season	Median Ammonia (mg/L)	75th Percentile Ammonia (mg/L)	Number of Observations
Winter (Dec - Feb)	0.032 (1)	0.058 (1)	No Data
Spring (Mar - May)	0.032	0.058	28
Summer (Jun - Sep)	0.032	0.050	48
Fall (Oct - Nov)	0.028	0.050	20

Notes:
1. No data were available for winter. Therefore, winter ammonia concentrations assumed to be equivalent to spring (Mar - May) concentrations.

The PWQMN dataset for ammonia showed an increasing trend. To remove the trend, all data prior to 1997 was truncated, as per GRCA's comment, and the statistics shown in Table 3 were generated. As a result of truncation, no data was available for winter (Dec - Feb). Therefore it was assumed that winter concentrations would be equivalent to those observed in spring (Mar - May).

Table 4 Summary of Grand River pH Field Data Near Outfall

Season	Median pH	75th Percentile pH	Number of Observations
Winter (Dec - Feb)	7.99	8.28	25
Spring (Mar - May)	8.17	8.38	49
Summer (Jun - Sep)	8.39	8.55	87
Fall (Oct - Nov)	8.31	8.40	33

The PWQO for pH states that the pH should be maintained within the range of 6.5 and 8.5 to protect aquatic life; and both alkaline and acid water may cause irritation to anyone using the water from recreational purposes. Based on the data presented in Table 4, the Grand River is Policy 1 with respect to pH during all seasons with the exception summer (June - September). Higher pH during these months may be a result of aquatic life activity.

Table 5 Summary of Grand River Temperature Near Outfall

Season	Median Temperature (°C)	75th Percentile Temperature (°C)	Number of Observations
Winter (Dec - Feb)	0.55	1.00	48
Spring (Mar - May)	7.50	13.4	102
Summer (Jun - Sep)	20.5	23.0	158
Fall (Oct - Nov)	7.70	10.1	65

In order to determine the 75th percentile in-stream un-ionized ammonia, it is first necessary to calculate the unionized ammonia concentration for days in which synoptic measurements of ammonia, pH, and temperature are available.

As mentioned above, the ammonia data showed an increasing trend and, as such, only the data collected after 1997 was used to calculate unionized ammonia with synoptic measurements of pH and temperature. Seasonal unionized concentrations are shown in Table 6. It should be noted that no data were for available for winter. Concentrations in winter are expected to be similar to those observed in spring. Based on the data provided, the receiver is Policy 1 with respect to unionized ammonia.

Table 6 Summary of Grand River Unionized Ammonia Near Outfall

Season	Median Unionized Ammonia (mg/L)	75th Percentile Unionized Ammonia (mg/L)	Number of Observations
Winter (Dec - Feb)	0.001 (1)	0.002 (1)	No Data
Spring (Mar - May)	0.001	0.002	27
Summer (Jun - Sep)	0.003	0.006	42
Fall (Oct - Nov)	0.001	0.001	15

Notes:
1. Assumed to be equivalent to spring concentrations.

2.1.3 Dissolved Oxygen and Biological Oxygen Demand (BOD_5)

For dissolved oxygen (DO), low concentrations are indications of degraded water quality; therefore, 25th percentiles are typically used, rather than 75th percentiles, to characterize ambient conditions. The PWQO for DO ranges from 5 to 8 mg/L for a warm water fishery based on temperature; cooler temperatures have a higher PWQO than warmer temperatures.

The Grand River is Policy 1 with regard to DO for a warm water fishery, based on the PWQMN data. The monthly statistics are shown in Table 7.

Table 7 Summary of Grand River Dissolved Oxygen Near Outfall

Season	Median DO (mg/L)	25th Percentile DO (mg/L)	Number of Observations
Winter (Dec - Feb)	12.8	12.2	55
Spring (Mar - May)	12.2	11.2	98
Summer (Jun - Sep)	10.6	9.8	156
Fall (Oct - Nov)	12.4	11.5	64

The DO concentrations reported in Table 7 show that the 25th percentile concentrations and the minimum observed concentrations are higher than the PWQO for DO in all seasons. Therefore, based on the available instantaneous DO data, the Grand River in the vicinity of the proposed outfall is MOE Policy 1 with respect to DO. In spite of this, the possibility does exist that aquatic plant respiration may result in lower instantaneous DO concentrations, particularly during the late summer and early fall.

The available BOD_5 measurements from the PWQMN were quite dated (period of record 1978 - 1981), and the reported annual 75th percentile BOD_5 concentration was 1.2 mg/L. Based on the available data, a conservative estimate of ambient BOD_5 concentrations is 1.5 mg/L.

2.1.4 E.coli

The *E.coli* data from the PWQMN dataset was limited, with a total of 5 results from samples collected by the GRCA in 2005. Based on these data, the receiver appears to be Policy 1 with respect to *E.coli*, with all five samples results less than 1 cfu/100mL. Total Suspended Solids

2.1.5 TSS

There are no PWQO values for total suspended solids (TSS). Reported PWQMN TSS concentrations were available over the period 1975 to 2015, however the results from 1984 to 1986 were excluded as they were several orders of magnitude higher than concentrations reported both before and after that period. Generally, TSS concentrations are elevated in the spring and summer. A statistical summary of TSS concentrations is provided in Table 8.

Table 8 Summary of Grand River TSS Near Outfall

Season	Median TSS (mg/L)	75th Percentile TSS (mg/L)	Number of Observations
Winter (Dec - Feb)	3.0	5.4	28
Spring (Mar - May)	3.3	9.7	83
Summer (Jun - Sep)	4.7	8.0	123
Fall (Oct - Nov)	2.0	3.9	48
Annual	**3.6**	**8.0**	**282**

2.1.6 Nitrate

While there is no PWQO for nitrate, there is a Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. The CWQG is 2.93 mg/L-N. The dataset was truncated to exclude nitrate water quality data from and prior to 1996 because the analysis method for nitrogen species was changed in 1996. The 75th percentile concentration for nitrate was well below the CWQG of 2.93 mg/L-N on both a seasonal and annual basis. This indicates that the Grand River has ample assimilative capacity for nitrate at this location. A statistical summary of nitrate concentrations is provided in Table 9.

Table 9 Summary of Grand River Nitrate Near Proposed Outfall

Season	Mean Nitrate (mg/L-N)	75th Percentile Nitrate (mg/L-N)	Number of Observations
Winter (Dec - Feb)	No data	No data	No data
Spring (Mar - May)	1.12	1.53	28
Summer (Jun - Sep)	0.33	0.47	50
Fall (Oct - Nov)	0.58	1.23	20
Annual	**0.52**	**1.00**	**98**

2.2 Grand River Flows

Typically for assimilative capacity analyses, the 7Q20 stream flow represents an appropriate design-case estimate. At the location of the proposed sewage treatment facility discharge, low flow is governed by outflows from an upstream reservoir. It was proposed that a low flow value of 0.40 m^3/s be used in this analysis. This flow was provided by the GRCA and is documented in the Grand River Watershed Water Management Plan (2014) as the design 7Q20 equivalent flow to be used for WWTPs discharging to the regulated river system near the Leggatt stream gauge. During a conference call held on November 25, 2015, both the MOECC and GRCA agreed that a low flow value of 0.40 m^3/s should be used for the assimilative capacity assessment of the Grand River in the vicinity of the newly proposed WWTP.

3. DETERMINATION OF EFFLUENT LIMITS

3.1 Effluent $cBOD_5$

At a design flow of 552 m^3/d, a conservative estimated background BOD_5 concentration of 1.5 mg/L, and a cBOD5 concentration effluent limit of 10 mg/L, the ambient BOD_5 concentration would increase marginally by 10 percent. Given the Policy 1 status of the receiver in terms of DO, it is proposed that a cBOD5 compliance limit of 10 mg/L and design objective of 8 mg/L be used for the proposed WWTP for both design ADF scenarios (451 m^3/d and 552 m^3/d).

3.2 Effluent Total Suspended Solids

Total suspended solids concentrations are high in the receiver with a 75th percentile value of 8.0 mg/L on an annual basis. At a design flow of 552 m^3/d and a TSS concentration effluent limit of 10 mg/L, the ambient TSS concentration would increase marginally by less than 2 percent. Therefore, it is proposed that a TSS compliance limit of 10 mg/L and design objective of 8 mg/L be used for the proposed WWTP for both design ADF scenarios (451 m^3/d and 552 m^3/d).

3.3 Effluent Total Phosphorus

As indicated in Table 2, the Grand River in the vicinity of the proposed outfall is MOECC Policy 2 with respect to total phosphorus and therefore has no available capacity for TP assimilation; however, for a MOECC Policy 2 receiver, "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." Approval of a new point-source discharge with an effluent TP concentration in excess of the PWQO of 0.030 mg/L will require a Policy 2 deviation.

To address the Policy 2 status of the receiver, it is proposed that the new WWTP be designed to provide a level of treatment consistent with Limit of Technology (LoT) for phosphorus removal. It is therefore proposed that the new WWTP have an effluent TP limit of 0.10 mg/L and objective of 0.08 mg/L for both design ADF scenarios (451 m^3/d and 552 m^3/d). At the design 7Q20 flow of 0.40 m^3/s, and assuming the facility is operating at an ADF of 552 m^3/d and the TP limit of 0.10 mg/L, the WWTP effluent would result in an increase in the receiver TP concentration of approximately 0.0016 mg/L, or approximately a 5% increase over the annual 75th percentile background concentration of 0.031 mg/L.

3.4 Effluent Total Ammonia

For ammonia limits, it was assumed that current MOECC policy requiring a non-toxic effluent would apply. Extensive research by the US EPA and others has demonstrated that a non-toxic limit for un-ionized ammonia ranges between 0.1 and 0.5 mg/L depending on the fish species of interest. Therefore, a conservative non-toxic limit for un-ionized ammonia in the Grand Valley WPCP effluent is 0.1 mg/L-NH_3.

In the recently released federal Wastewater Systems Effluent Regulations under the Fisheries Act, effluent toxicity limits are set to 1.25 mg/L for un-ionized ammonia (at 15ºC). The assumption of un-ionized toxicity at 0.1 mg/L, as discussed above, is more stringent and thus the effluent limits discussed below are more conservative than required and complies with the new federal regulation.

For the proposed effluent limits to be acceptable, the resultant unionized ammonia concentration in the effluent stream (based on the proposed effluent limit) must be less than or equal to 0.1 mg/L at end-of-pipe and the receiver unionized ammonia concentration (based on fully mixed conditions between the effluent and the receiver) must be less than or equal to the PWQO of 0.02 mg/L.

The percentage of un-ionized ammonia in aqueous solution varies depending on the temperature and pH of the water. The seasonal end-of-pipe effluent dissociation ratios were estimated based on assumed effluent quality from the new WWTP. As a conservative measure and based on experience at other similar treatment facilities in Ontario, a pH of 8.0 was used for all seasons and seasonal temperatures of 12ºC, 14ºC, 22ºC and 18ºC were used for Winter, Spring, Summer and Fall, respectively.

In order to determine the in stream un-ionized ammonia concentrations, it was necessary to calculate the seasonal 75th percentile ammonia dissociation ratios based on synoptic measurements of pH and temperature (taken at the same time). The seasons applied for the analysis align with those previously defined.

To ensure a conservative evaluation of fully mixed conditions within the receiver, the impacts of the upstream Grand Valley WPCP on receiver water quality were also considered. To accomplish this, it was assumed that the Grand Valley WPCP would be operating at its rated capacity of 1,244 m3/d and at its ECA total ammonia nitrogen (TAN) limit of: 4.0 mg/L from December 1 to March 31, 1.0 mg/L from April 1 to May 31, 0.7 mg/L from June 1 to September 30, and 1.0 mg/L from October 1 to November 30. This additional TAN loading was used to develop an adjusted background unionized ammonia concentration. Because the month of March has been included in the definition of Spring for this study, it was assumed that the Grand Valley WPCP would be discharging effluent at a TAN concentration of 4.0 mg/L for both the Winter and Spring seasons.

The dissociation ratios, proposed effluent ammonia concentrations, and resultant unionized ammonia concentrations are shown in Table 10 and Table 11 for both the end-of-pipe and fully mixed receiver conditions, respectively.

The compliance limits for TAN are recommended to be 3.8 mg/L for Winter (December to February), 3.3 mg/L for Spring (March - May), 1.8 mg/L for Summer (June - September) and 2.4 mg/L for Fall (October - November). Meeting end-of-pipe non-toxicity requirements limits the recommended TAN limits, therefore the proposed effluent TAN limits are the same for both design ADF scenarios (451 m^3/d and 552 m^3/d).

Table 10 End of Pipe Effluent Un-ionized Ammonia Data Summary

Discharge Period	Proposed TAN Limit (mg/L-N)	Estimated Dissociation Ratio (1)	Un-ionized ammonia at End-of-Pipe (mg/L-NH_3)
Winter	3.8	0.0212	0.098
Spring	3.3	0.0247	0.099
Summer	1.8	0.0438	0.096
Fall	2.4	0.0331	0.096

Notes:
1. Based on conservative estimates of plant effluent pH and seasonal temperatures, as specified in text above.

Table 11 Fully Mixed Receiver Un-ionized Ammonia Data Summary

Discharge Period	Proposed TAN Limit (mg/L-N)	Adjusted Receiver Background TAN (mg/L-N) (2)	75th Percentile Dissociation Ratio (3)	Fully Mixed Un-ionized Ammonia (mg/L-NH_3) (4)
Winter (1)	3.8	0.1945	0.0524	0.016
Spring	3.3	0.1945	0.0524	0.015
Summer	1.8	0.0726	0.1114	0.013
Fall	2.4	0.0830	0.0378	0.005

Notes:
1. Background receiver TAN concentrations and dissociation ratios were not available for the winter period. Therefore, the values from Spring were assumed for Winter conditions.
2. Adjusted receiver background TAN concentration based on the background 75th percentile TAN concentrations, the 7Q20 flow of 0.4 m3/s for all seasons, and the Grand Valley WPCP operating at its rated capacity of 1,244 m3/d and at its current TAN limits of 4.0 mg/L Winter / Spring, 0.7 mg/L Summer, and 1.0 mg/L Fall.
3. 75th percentile dissociation ratio in the receiver based on background water quality data in terms of synoptic pH and temperature data.
4. Fully mixed un-ionized ammonia concentration based on a new WWTP design ADF of 552 m^3/d.

3.5 Effluent E.coli

The receiver is MOE Policy 1 with respect to *E.coli*. A compliance limit of 200 cfu/100 mL and design objective of 100 cfu/100 mL is proposed for both design ADF scenarios (451 m^3/d and 552 m^3/d).

4. MIXING ZONE ANALYSIS

4.1 Introduction and Methodology

An analysis was conducted to define the low-flow mixing zone in the Grand River near Marsville for two proposed WPCP effluent scenarios, namely 451 m^3/d and 552 m^3/d. The general approach involved application of an analytical solution of the two-dimensional adjective dispersive transport equation (Equation [1]) for steady state conditions[2].

$$v\frac{\partial C}{\partial x} = E\left[\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial y^2}\right] - kC \pm S \qquad [1]$$

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, E, can be approximated using an empirical relationship presented below as Equation [2][3].

$$E \cong 0.6d\sqrt{gdS} = 0.6du \qquad [2]$$

Where:

d = Channel depth (m)
g = Gravitational constant (m/s^2)
S = Average channel slope (m/m)
u = Channel shear velocity (m/s)

Plume superposition was applied to address channel boundaries. Assumptions included that effluent is completely mixed vertically, average flow and average depth can be applied with Manning's equation to estimate depth for low-flow conditions, momentum of effluent can be ignored, steady-state conditions have been achieved, the channel is rectangular with a constant width of 20 m, and effluent is introduced in the center of the channel.

A summary of key parameters used in the analysis are presented in Table 12.

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[2] Fischer, H.B., List, E.J., Koh, R.Y., Imberger, J., and Brooks, N.H., "Mixing in Inland And Coastal Waters", Academic Press, New York, 1979.
[3] Ibid.

Table 12 Key Parameter Values for Mixing Zone Analysis

Parameter	Variable	Value	Units
Channel Width	w	20.0	m
Average Channel Depth - Low-Flow	d	0.30	m
WPCP Flow	Qe	451 or 552	m^3/d
River Low-Flow	Qr	0.4	m^3/s
Average Channel Slope	S	0.001	m/m
Shear velocity	u	0.054	m/s
Dispersion Coefficient	Et	0.010	m^2/s

4.2 Results

The estimated mixing zones corresponding to Scenarios 1 (451 m^3/d) and 2 (552 m^3/d) are provided as Figures A1 and A2 in Appendix A, respectively. Illustrative plume cross-sections for each scenario are provided in Figures A3 and A4 in Appendix A, respectively. For each Scenario, completely mixed conditions are achieved within approximately 250 m downstream of the source. Effluent concentrations are greater than 5% for a relatively small area (2 m in width and from 12 to 20 m in length) immediately downstream of the source for each scenario. Completely mixed concentrations for Scenario 1 and 2 are 1.3% and 1.6%, respectively.

5. SUMMARY

- It was found that the Grand River in the vicinity of the proposed outfall is MOE Policy 2 for total phosphorus, and pH in the summer season. All other parameters were MOE Policy 1 or did not have a PWQO.
- Design equivalent 7Q20 flows for all seasons in the vicinity of the proposed outfall were set to 0.4 m^3/s as per the Grand River Watershed Water Management Plan (2014).
- As a conservative approach, proposed effluent limits for the new proposed WWTP were generated based on the available assimilative capacity in the Grand River and an ADF of 552 m^3/d from a new WPCP. The proposed compliance limits and design objectives are shown in Table 13 and Table 14, respectively. Loading limits have been defined for both ADF scenarios (451 m^3/d and 552 m^3/d).
- A Policy 2 deviation with respect to phosphorus will be required for approval of this new point-source discharge. The proposed TP limit and objective are consistent with providing Limit of Technology for phosphorus removal. Mixing zones length was found to be reasonable in extent.

Proposed effluent compliance limits and objectives are presented in Table 13 and Table 14, respectively.

Table 13 Proposed Effluent Compliance Limits

Effluent Parameter	Average Concentration (mg/L)	Average Waste Loading (kg/d)	
		Design ADF of 451 m^3/d	Design ADF of 552 m^3/d
$cBOD_5$	10.0	4.51	5.52
Total Suspended Solids	10.0	4.51	5.52
Total Phosphorus	0.10	0.045	0.055
Total Ammonia Nitrogen			
Winter (Dec - Feb)	3.8	1.7	2.1
Spring (Mar - May)	3.3	1.5	1.8
Summer (Jun - Sep)	1.8	0.8	1.0
Fall (Oct - Nov)	2.4	1.1	1.3
Notes: *E.coli* less than 200 organisms per 100 mL.			

Table 14 Proposed Effluent Objectives

Effluent Parameter	Average Concentration (mg/L)
$cBOD_5$	8.0
Total Suspended Solids	8.0
Total Phosphorus	0.08
Total Ammonia Nitrogen	
Winter (Dec - Feb)	3.0
Spring (Mar - May)	2.5
Summer (Jun - Sep)	1.0
Fall (Oct - Nov)	1.6

Notes:
E.coli less than 100 organisms per 100 mL

APPENDIX A
MIXING ZONE ANALYSIS FIGURES

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
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	5.8	13.6	5.8	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.7	6.3	9.6	6.3	1.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	2.5	5.9	7.9	5.9	2.5	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.0	2.9	5.5	6.8	5.5	2.9	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.1	0.4	1.3	3.1	5.1	6.1	5.1	3.1	1.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.2	0.6	1.5	3.1	4.8	5.6	4.8	3.1	1.5	0.6	0.2	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.1	0.2	0.7	1.7	3.2	4.6	5.1	4.6	3.2	1.7	0.7	0.2	0.1	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.1	0.3	0.9	1.8	3.1	4.3	4.8	4.3	3.1	1.8	0.9	0.3	0.1	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.1	0.4	1.0	1.9	3.1	4.1	4.5	4.1	3.1	1.9	1.0	0.4	0.1	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.1	0.2	0.5	1.1	2.0	3.1	4.0	4.3	4.0	3.1	2.0	1.1	0.5	0.2	0.1	0.0	0.0	0.0
22	0.0	0.0	0.0	0.1	0.3	0.6	1.2	2.0	3.0	3.8	4.1	3.8	3.0	2.0	1.2	0.6	0.3	0.1	0.0	0.0	0.0
24	0.0	0.0	0.0	0.1	0.3	0.7	1.3	2.1	3.0	3.7	3.9	3.7	3.0	2.1	1.3	0.7	0.3	0.1	0.0	0.0	0.0
26	0.0	0.0	0.1	0.2	0.4	0.7	1.3	2.1	2.9	3.5	3.8	3.5	2.9	2.1	1.3	0.7	0.4	0.2	0.1	0.0	0.0
28	0.0	0.0	0.1	0.2	0.4	0.8	1.4	2.1	2.8	3.4	3.6	3.4	2.8	2.1	1.4	0.8	0.4	0.2	0.1	0.0	0.0
30	0.0	0.0	0.1	0.2	0.5	0.8	1.4	2.1	2.8	3.3	3.5	3.3	2.8	2.1	1.4	0.8	0.5	0.2	0.1	0.0	0.0
32	0.0	0.1	0.1	0.2	0.5	0.9	1.4	2.1	2.7	3.2	3.4	3.2	2.7	2.1	1.4	0.9	0.5	0.2	0.1	0.1	0.0
34	0.0	0.1	0.1	0.3	0.5	0.9	1.5	2.1	2.7	3.1	3.3	3.1	2.7	2.1	1.5	0.9	0.5	0.3	0.1	0.1	0.0
36	0.1	0.1	0.2	0.3	0.6	1.0	1.5	2.1	2.7	3.1	3.2	3.1	2.7	2.1	1.5	1.0	0.6	0.3	0.2	0.1	0.1
38	0.1	0.1	0.2	0.3	0.6	1.0	1.5	2.1	2.6	3.0	3.1	3.0	2.6	2.1	1.5	1.0	0.6	0.3	0.2	0.1	0.1
40	0.1	0.1	0.2	0.4	0.7	1.0	1.5	2.1	2.6	2.9	3.0	2.9	2.6	2.1	1.5	1.0	0.7	0.4	0.2	0.1	0.1
42	0.1	0.1	0.2	0.4	0.7	1.1	1.5	2.1	2.5	2.9	3.0	2.9	2.5	2.1	1.5	1.1	0.7	0.4	0.2	0.1	0.1
44	0.1	0.2	0.3	0.4	0.7	1.1	1.6	2.0	2.5	2.8	2.9	2.8	2.5	2.0	1.6	1.1	0.7	0.4	0.3	0.2	0.1
46	0.1	0.2	0.3	0.5	0.7	1.1	1.6	2.0	2.4	2.7	2.8	2.7	2.4	2.0	1.6	1.1	0.7	0.5	0.3	0.2	0.1
48	0.2	0.2	0.3	0.5	0.8	1.1	1.6	2.0	2.4	2.7	2.8	2.7	2.4	2.0	1.6	1.1	0.8	0.5	0.3	0.2	0.2
50	0.2	0.2	0.3	0.5	0.8	1.2	1.6	2.0	2.4	2.6	2.7	2.6	2.4	2.0	1.6	1.2	0.8	0.5	0.3	0.2	0.2
52	0.2	0.2	0.3	0.5	0.8	1.2	1.6	2.0	2.3	2.6	2.7	2.6	2.3	2.0	1.6	1.2	0.8	0.5	0.3	0.2	0.2
54	0.2	0.3	0.4	0.6	0.8	1.2	1.6	2.0	2.3	2.5	2.6	2.5	2.3	2.0	1.6	1.2	0.8	0.6	0.4	0.3	0.2
56	0.2	0.3	0.4	0.6	0.9	1.2	1.6	2.0	2.3	2.5	2.6	2.5	2.3	2.0	1.6	1.2	0.9	0.6	0.4	0.3	0.2
58	0.3	0.3	0.4	0.6	0.9	1.2	1.6	1.9	2.2	2.5	2.5	2.5	2.2	1.9	1.6	1.2	0.9	0.6	0.4	0.3	0.3
60	0.3	0.3	0.4	0.6	0.9	1.2	1.6	1.9	2.2	2.4	2.5	2.4	2.2	1.9	1.6	1.2	0.9	0.6	0.4	0.3	0.3
62	0.3	0.3	0.5	0.7	0.9	1.2	1.6	1.9	2.2	2.4	2.4	2.4	2.2	1.9	1.6	1.2	0.9	0.7	0.5	0.3	0.3
64	0.3	0.4	0.5	0.7	0.9	1.2	1.6	1.9	2.2	2.3	2.4	2.3	2.2	1.9	1.6	1.2	0.9	0.7	0.5	0.4	0.3
66	0.4	0.4	0.5	0.7	0.9	1.2	1.6	1.9	2.1	2.3	2.4	2.3	2.1	1.9	1.6	1.2	0.9	0.7	0.5	0.4	0.4
68	0.4	0.4	0.5	0.7	1.0	1.3	1.6	1.9	2.1	2.3	2.3	2.3	2.1	1.9	1.6	1.3	1.0	0.7	0.5	0.4	0.4
70	0.4	0.4	0.6	0.7	1.0	1.3	1.6	1.8	2.1	2.2	2.3	2.2	2.1	1.8	1.6	1.3	1.0	0.7	0.6	0.4	0.4
72	0.4	0.5	0.6	0.8	1.0	1.3	1.6	1.8	2.1	2.2	2.3	2.2	2.1	1.8	1.6	1.3	1.0	0.8	0.6	0.5	0.4
74	0.4	0.5	0.6	0.8	1.0	1.3	1.6	1.8	2.0	2.2	2.2	2.2	2.0	1.8	1.6	1.3	1.0	0.8	0.6	0.5	0.4
76	0.5	0.5	0.6	0.8	1.0	1.3	1.5	1.8	2.0	2.2	2.2	2.2	2.0	1.8	1.5	1.3	1.0	0.8	0.6	0.5	0.5
78	0.5	0.5	0.6	0.8	1.0	1.3	1.5	1.8	2.0	2.1	2.2	2.1	2.0	1.8	1.5	1.3	1.0	0.8	0.6	0.5	0.5
80	0.5	0.5	0.6	0.8	1.0	1.3	1.5	1.8	2.0	2.1	2.2	2.1	2.0	1.8	1.5	1.3	1.0	0.8	0.6	0.5	0.5
82	0.5	0.6	0.7	0.8	1.0	1.3	1.5	1.8	2.0	2.1	2.1	2.1	2.0	1.8	1.5	1.3	1.0	0.8	0.7	0.6	0.5
84	0.5	0.6	0.7	0.8	1.0	1.3	1.5	1.8	1.9	2.1	2.1	2.1	1.9	1.8	1.5	1.3	1.0	0.8	0.7	0.6	0.5
86	0.6	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.1	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.6	0.6
88	0.6	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.1	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.6	0.6
90	0.6	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.0	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.6	0.6
92	0.6	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.0	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.6
94	0.6	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.0	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.6
96	0.7	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.8	1.9	2.0	1.9	1.8	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.7
98	0.7	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.8	1.9	1.9	1.9	1.8	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.7
100	0.7	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.8	1.9	1.9	1.9	1.8	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.7
102	0.7	0.7	0.8	1.0	1.1	1.3	1.5	1.7	1.8	1.9	1.9	1.9	1.8	1.7	1.5	1.3	1.1	1.0	0.8	0.7	0.7
104	0.7	0.8	0.8	1.0	1.1	1.3	1.5	1.6	1.8	1.9	1.9	1.9	1.8	1.6	1.5	1.3	1.1	1.0	0.8	0.8	0.7
106	0.7	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.8	1.8	1.9	1.8	1.8	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.7
108	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.8	1.8	1.9	1.8	1.8	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
110	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
112	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
114	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
116	0.8	0.8	0.9	1.0	1.2	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.2	1.0	0.9	0.8	0.8
250	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2
500	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
750	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
1000	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3

Figure A.1 Concentration Plume (Effluent %) for Scenario 1 Effluent Conditions (451 m³/d)

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
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	7.1	16.7	7.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.1	7.7	11.8	7.7	2.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	3.1	7.2	9.6	7.2	3.1	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.2	3.5	6.7	8.3	6.7	3.5	1.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.6	3.8	6.3	7.4	6.3	3.8	1.6	0.5	0.1	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.2	0.7	1.9	3.8	5.9	6.8	5.9	3.8	1.9	0.7	0.2	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.1	0.3	0.9	2.1	3.9	5.6	6.3	5.6	3.9	2.1	0.9	0.3	0.1	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.1	0.4	1.1	2.3	3.8	5.3	5.9	5.3	3.8	2.3	1.1	0.4	0.1	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.1	0.2	0.5	1.2	2.4	3.8	5.0	5.6	5.0	3.8	2.4	1.2	0.5	0.2	0.1	0.0	0.0	0.0
20	0.0	0.0	0.0	0.1	0.2	0.6	1.3	2.4	3.7	4.8	5.3	4.8	3.7	2.4	1.3	0.6	0.2	0.1	0.0	0.0	0.0
22	0.0	0.0	0.0	0.1	0.3	0.7	1.5	2.5	3.7	4.6	5.0	4.6	3.7	2.5	1.5	0.7	0.3	0.1	0.0	0.0	0.0
24	0.0	0.0	0.1	0.1	0.4	0.8	1.5	2.5	3.6	4.5	4.8	4.5	3.6	2.5	1.5	0.8	0.4	0.1	0.1	0.0	0.0
26	0.0	0.0	0.1	0.2	0.4	0.9	1.6	2.6	3.6	4.3	4.6	4.3	3.6	2.6	1.6	0.9	0.4	0.2	0.1	0.0	0.0
28	0.0	0.0	0.1	0.2	0.5	1.0	1.7	2.6	3.5	4.2	4.5	4.2	3.5	2.6	1.7	1.0	0.5	0.2	0.1	0.0	0.0
30	0.0	0.0	0.1	0.3	0.6	1.0	1.7	2.6	3.4	4.1	4.3	4.1	3.4	2.6	1.7	1.0	0.6	0.3	0.1	0.0	0.0
32	0.0	0.1	0.1	0.3	0.6	1.1	1.8	2.6	3.4	3.9	4.2	3.9	3.4	2.6	1.8	1.1	0.6	0.3	0.1	0.1	0.0
34	0.1	0.1	0.2	0.3	0.7	1.2	1.8	2.6	3.3	3.8	4.0	3.8	3.3	2.6	1.8	1.2	0.7	0.3	0.2	0.1	0.1
36	0.1	0.1	0.2	0.4	0.7	1.2	1.8	2.6	3.2	3.7	3.9	3.7	3.2	2.6	1.8	1.2	0.7	0.4	0.2	0.1	0.1
38	0.1	0.1	0.2	0.4	0.8	1.2	1.9	2.5	3.2	3.7	3.8	3.7	3.2	2.5	1.9	1.2	0.8	0.4	0.2	0.1	0.1
40	0.1	0.1	0.3	0.5	0.8	1.3	1.9	2.5	3.1	3.6	3.7	3.6	3.1	2.5	1.9	1.3	0.8	0.5	0.3	0.1	0.1
42	0.1	0.2	0.3	0.5	0.8	1.3	1.9	2.5	3.1	3.5	3.6	3.5	3.1	2.5	1.9	1.3	0.8	0.5	0.3	0.2	0.1
44	0.1	0.2	0.3	0.5	0.9	1.3	1.9	2.5	3.0	3.4	3.6	3.4	3.0	2.5	1.9	1.3	0.9	0.5	0.3	0.2	0.1
46	0.2	0.2	0.3	0.6	0.9	1.4	1.9	2.5	3.0	3.3	3.5	3.3	3.0	2.5	1.9	1.4	0.9	0.6	0.3	0.2	0.2
48	0.2	0.2	0.4	0.6	0.9	1.4	1.9	2.5	2.9	3.3	3.4	3.3	2.9	2.5	1.9	1.4	0.9	0.6	0.4	0.2	0.2
50	0.2	0.3	0.4	0.6	1.0	1.4	1.9	2.4	2.9	3.2	3.3	3.2	2.9	2.4	1.9	1.4	1.0	0.6	0.4	0.3	0.2
52	0.2	0.3	0.4	0.7	1.0	1.4	1.9	2.4	2.9	3.2	3.3	3.2	2.9	2.4	1.9	1.4	1.0	0.7	0.4	0.3	0.2
54	0.3	0.3	0.5	0.7	1.0	1.5	1.9	2.4	2.8	3.1	3.2	3.1	2.8	2.4	1.9	1.5	1.0	0.7	0.5	0.3	0.3
56	0.3	0.3	0.5	0.7	1.1	1.5	1.9	2.4	2.8	3.1	3.1	3.1	2.8	2.4	1.9	1.5	1.1	0.7	0.5	0.3	0.3
58	0.3	0.4	0.5	0.8	1.1	1.5	1.9	2.4	2.7	3.0	3.1	3.0	2.7	2.4	1.9	1.5	1.1	0.8	0.5	0.4	0.3
60	0.4	0.4	0.5	0.8	1.1	1.5	1.9	2.4	2.7	3.0	3.0	3.0	2.7	2.4	1.9	1.5	1.1	0.8	0.5	0.4	0.4
62	0.4	0.4	0.6	0.8	1.1	1.5	1.9	2.3	2.7	2.9	3.0	2.9	2.7	2.3	1.9	1.5	1.1	0.8	0.6	0.4	0.4
64	0.4	0.5	0.6	0.8	1.1	1.5	1.9	2.3	2.6	2.9	2.9	2.9	2.6	2.3	1.9	1.5	1.1	0.8	0.6	0.5	0.4
66	0.4	0.5	0.6	0.9	1.2	1.5	1.9	2.3	2.6	2.8	2.9	2.8	2.6	2.3	1.9	1.5	1.2	0.9	0.6	0.5	0.4
68	0.5	0.5	0.6	0.9	1.2	1.5	1.9	2.3	2.6	2.8	2.9	2.8	2.6	2.3	1.9	1.5	1.2	0.9	0.6	0.5	0.5
70	0.5	0.5	0.7	0.9	1.2	1.5	1.9	2.3	2.6	2.7	2.8	2.7	2.6	2.3	1.9	1.5	1.2	0.9	0.7	0.5	0.5
72	0.5	0.6	0.7	0.9	1.2	1.5	1.9	2.2	2.5	2.7	2.8	2.7	2.5	2.2	1.9	1.5	1.2	0.9	0.7	0.6	0.5
74	0.5	0.6	0.7	0.9	1.2	1.6	1.9	2.2	2.5	2.7	2.7	2.7	2.5	2.2	1.9	1.6	1.2	0.9	0.7	0.6	0.5
76	0.6	0.6	0.7	1.0	1.2	1.6	1.9	2.2	2.5	2.6	2.7	2.6	2.5	2.2	1.9	1.6	1.2	1.0	0.7	0.6	0.6
78	0.6	0.6	0.8	1.0	1.2	1.6	1.9	2.2	2.4	2.6	2.7	2.6	2.4	2.2	1.9	1.6	1.2	1.0	0.8	0.6	0.6
80	0.6	0.7	0.8	1.0	1.3	1.6	1.9	2.2	2.4	2.6	2.6	2.6	2.4	2.2	1.9	1.6	1.3	1.0	0.8	0.7	0.6
82	0.6	0.7	0.8	1.0	1.3	1.6	1.9	2.2	2.4	2.5	2.6	2.5	2.4	2.2	1.9	1.6	1.3	1.0	0.8	0.7	0.6
84	0.7	0.7	0.8	1.0	1.3	1.6	1.9	2.1	2.4	2.5	2.6	2.5	2.4	2.1	1.9	1.6	1.3	1.0	0.8	0.7	0.7
86	0.7	0.7	0.9	1.0	1.3	1.6	1.9	2.1	2.3	2.5	2.5	2.5	2.3	2.1	1.9	1.6	1.3	1.0	0.9	0.7	0.7
88	0.7	0.8	0.9	1.1	1.3	1.6	1.9	2.1	2.3	2.5	2.5	2.5	2.3	2.1	1.9	1.6	1.3	1.1	0.9	0.8	0.7
90	0.7	0.8	0.9	1.1	1.3	1.6	1.9	2.1	2.3	2.4	2.5	2.4	2.3	2.1	1.9	1.6	1.3	1.1	0.9	0.8	0.7
92	0.8	0.8	0.9	1.1	1.3	1.6	1.8	2.1	2.3	2.4	2.5	2.4	2.3	2.1	1.8	1.6	1.3	1.1	0.9	0.8	0.8
94	0.8	0.8	0.9	1.1	1.3	1.6	1.8	2.1	2.3	2.4	2.4	2.4	2.3	2.1	1.8	1.6	1.3	1.1	0.9	0.8	0.8
96	0.8	0.8	1.0	1.1	1.3	1.6	1.8	2.1	2.2	2.4	2.4	2.4	2.2	2.1	1.8	1.6	1.3	1.1	1.0	0.8	0.8
98	0.8	0.9	1.0	1.1	1.3	1.6	1.8	2.0	2.2	2.3	2.4	2.3	2.2	2.0	1.8	1.6	1.3	1.1	1.0	0.9	0.8
100	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.3	2.4	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
102	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.3	2.3	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
104	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.3	2.3	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
106	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.3	2.3	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
108	0.9	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.3	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	0.9
110	1.0	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.3	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	1.0
112	1.0	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.2	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	1.0
114	1.0	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.2	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	1.0
116	1.0	1.0	1.1	1.2	1.4	1.6	1.8	1.9	2.1	2.2	2.2	2.2	2.1	1.9	1.8	1.6	1.4	1.2	1.1	1.0	1.0
250	1.5	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.5
500	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
750	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
1000	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6

Figure A.2 Concentration Plume (Effluent %) for Scenario 2 Effluent Conditions (552 m³/d)

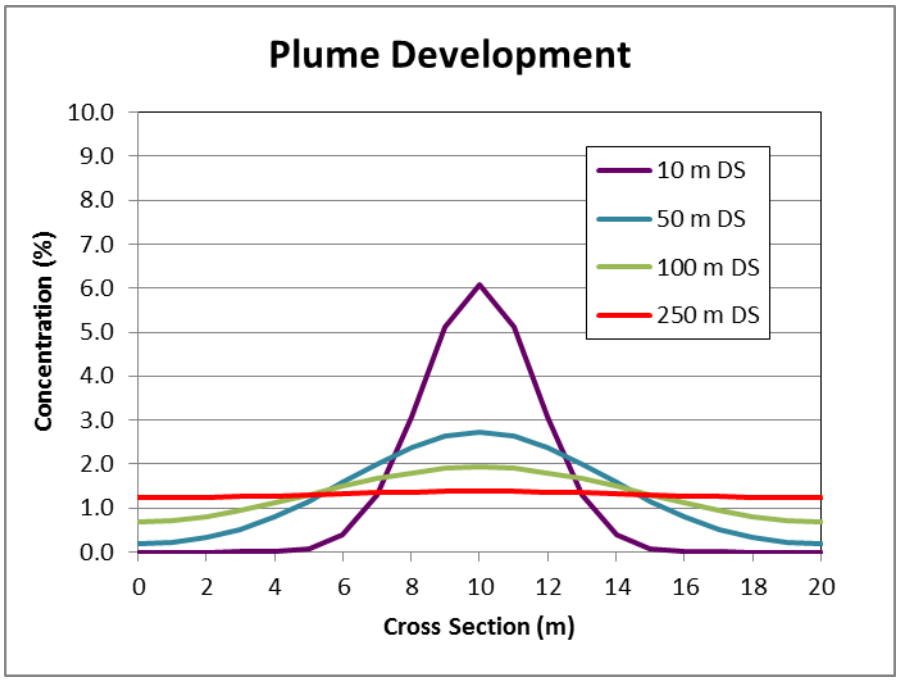

Figure A.3 Plume Cross-Sections (Effluent %) for Scenario 1 Effluent Conditions (451 m^3/d)

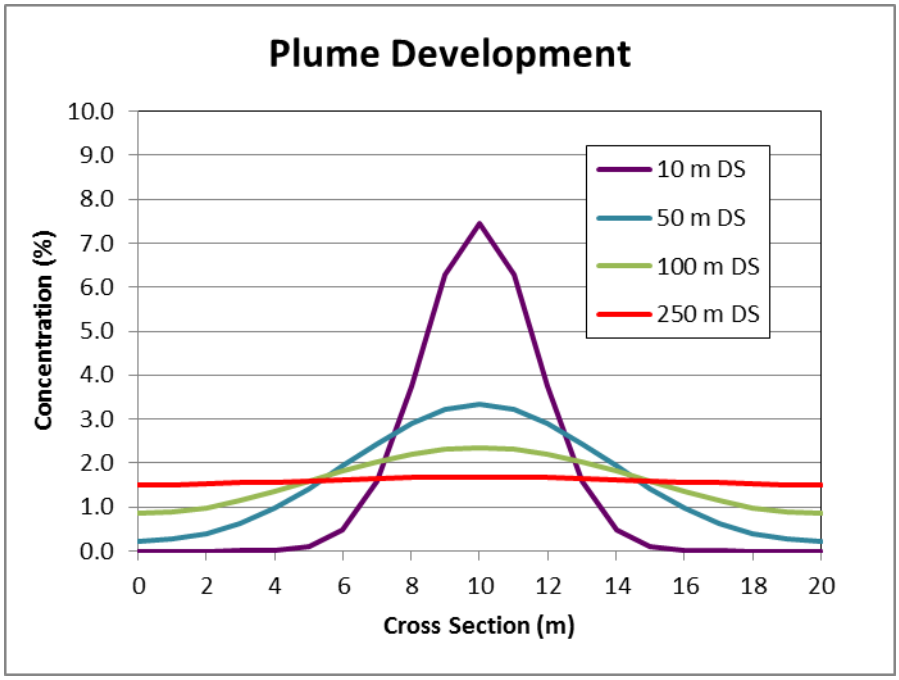

Figure A.4 Plume Cross-Sections (Effluent %) for Scenario 2 Effluent Conditions (552 m^3/d)

APPENDIX E
COMMENTS ON ACS FROM MOECC (APRIL 2016) AND XCG RESPONSES (JULY 2016)

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April 28, 2016

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RE: Sarah Properties Proposed Wastewater Treatment Plant in Waldemar

We have completed our review of the *Assimilative Capacity Study of the Grand River in the Vicinity of a proposed WWTP in Waldemar, ON*., dated March 2016. This ACS is being done to support the proposal by Sarah Properties for a large residential development to be serviced by a wastewater treatment plant that includes a dry-ditch discharge to the Grand River. In order to meet the sewage flow that will be generated by residents of the proposed subdivision along with the possibility of providing servicing to existing development in Waldemar, the proposed wastewater treatment plant has been based on an average daily flow between 451 m^3/day and 552 m^3/day.

Comments and Recommendations

The purpose of this review was to evaluate the proposed assimilative capacity study and indicate additional work that is required. The following comments are based on information presented in the subject report.

1. Recognizing that the final design for the treatment system is still to be determined, an assimilative capacity can't be fully evaluated or deemed acceptable until a design flow has been finalized.

2. Clarification needs to be provided on what period the data is from for determining ambient water quality conditions for each parameter as the discussion regarding 1996-1998 data confounds the understanding. Using PWQMN Station 16018406702 to represent background water quality conditions is reasonable which would negate the need to statistically correlate data that is dated and from different stations. Water chemistry data collected more than 5 years ago is not reflective of current conditions. If recent data (2014-2016) is not available, a monitoring plan should begin soon to establish background conditions.

3. If total phosphorous is a Policy 2 parameter, obtaining a deviation is unlikely. Therefore, a level of treatment is required to ensure concentrations and loadings that do not further degrade the receiver. Further discussion of the proposed effluent limit of 0.1 mg/L is required to determine if improvements can be made.

4. The Canadian Water Quality Guideline for total particulate matter which speaks to total suspended solids should be used for evaluating potential impacts related to this parameter.

5. Absolute values in discussing changes to background concentrations (Section 3) need to be used for the assessment. Discussing changes in relative percentages is not useful.

6. E. coli was determined to be a Policy 1 parameter. A compliance limit of 200 CFU/100 mL is not appropriate when the PWQO is 100 CFU/100 mL (based on a geometric mean of a minimum of five samples).

7. The mixing zone analysis assumes steady state conditions and that the effluent is introduced into the centre of the channel. However, it appears that the discharge will be a shoreline discharge. Clarification should be provided as to the type of outlet and the mixing zone analysis should reflect the approach to be used. The suitability of a dry ditch discharge in terms of location and possible receptors has not been agreed upon to date.

We would also like to take this opportunity to reiterate the following additional matters:

- Given the timing and delegation of planning approval to Dufferin County, have formal planning applications been made for subdivision approval to the County?
- Has a decision been made whether this development will be freehold or condominium tenure form? Tenure form has significant ramifications as a wastewater treatment plant for a freehold residential development will require municipal assumption, ownership and operation. We have not received any direct indication from the Township of their willingness to become owner/operators of a wastewater treatment plant. Conversely, if the development is to be condominium ownership, a municipal responsibility agreement (with adequate financial assurance) will need to be entered into by the developer and the Township.
- The development of a wastewater treatment facility to service residential development is a Schedule “C” undertaking under the MCEA. As such, an EA study is required with the developer as the proponent. Integrating the EA with the required planning approvals is provided for in Section 2.9 of the MCEA and is highly recommended.
- We recall the comment having been made that the existing water supply servicing Waldemar will need to be upgraded/expanded if it is to provide water to this development. This may also require an EA under the MCEA depending on what is needed to provide more water. It would make sense for this work to be undertaken together given all of the interdependencies that stem from the development proposal.

We note that you have also been provided with comments from the GRCA noting some concerns with this initial ACS. It may be beneficial to all parties to convene a meeting to discuss both the ACS and the broader servicing-related issues. To accommodate all parties, a meeting at the ministry's Guelph District Office is offered for consideration.

Should you have questions or wish to discuss these comments, please contact me at 905 578-4952 or at Barbara.slattery@ontario.ca

Yours truly,

Barbara Slattery
EA/Planning Coordinator

cc. Sandra Cooke, Mark Anderson, GRCA (via email only)
Christine Gervais, Township Planner (via email only)
Wendy Wingate, MOECC (via email only)
Lindsay Wolfenberg, ASI (via email only)
Laura Daly, MAH (via email only)

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July 7, 2016 **XCG File No.: 3-3756-01-01**

Ms. Barbara Slattery
EA/Planning Coordinator
Ministry of the Environment and Climate Change
119 King Street West, 12th Floor
Hamilton, Ontario L8P 4Y7

Re: Sarah Properties Proposed Wastewater Treatment Plant in Waldemar

Dear Ms. Slattery:

We are in receipt of your letter dated April 28, 2016 that provides the Ministry of the Environment and Climate Change's (MOECC's) comments from your review of the "Assimilative Capacity Study of the Grand River in the Vicinity of a Proposed WWTP in Waldemar, ON," dated March 2016 along with questions regarding the status of the development application process.

This letter provides our responses to the MOECC's comments and questions.

1. ASSIMILATIVE CAPACITY STUDY COMMENTS

Below, please find each of your comments related to the Assimilative Capacity Study (ACS) along with our response to each.

MOECC Comment No. 1: *Recognizing that the final design for the treatment system is still to be determined, an assimilative capacity can't be fully evaluated or deemed acceptable until a design flow has been finalized.*

Response: At this time, we propose that the ACS be evaluated against the higher design average day flow (ADF) value of 552 m^3/d to develop effluent concentration and loading limits. These loading limits would then be the maximum allowable loadings to the Grand River from the proposed Wastewater Treatment Plant (WWTP).

Should the final design ADF capacity of the WWTP be less than 552 m^3/d, the effluent concentration limits would remain the same as those defined for 552 m^3/d, and the loading limits reduced accordingly. In this way, the total loadings to the Grand River will not exceed the maximum allowable loadings defined as part of this ACS study.

MOECC Comment No. 2: *Clarification needs to be provided on what period the data is from for determining ambient water quality conditions for each parameter as the discussion regarding 1996-1998 data confounds the understanding. Using PWQMN Station 16018406702 to represent background water quality conditions is reasonable which would negate the need to statistically correlate data that is dated and from different stations. Water chemistry data collected more than 5 years ago is not reflective of current conditions. If recent data (2014-2016) is not available, a monitoring plan should begin soon to establish background conditions.*

Response: The PWQMN Station No. 16018406702 has a recent period of record of only 7 years (2007 to 2014). Previous data from this station (1975 to 1996) was not considered complete, as there was a ten year gap (1997 to 2006). As such, the data from PWQMN Station 16018403902 (period of record 1972 to 2006) was used to supplement the data from the other PWQMN station. This provides a continuous period of record that spans over 35 years. Comments received from the Grand River Conservation Authority (GRCA) were incorporated into the ACS report dated March 2016.

Please note that the data used to develop ambient water quality for all parameters of interest was defined in our draft memorandum dated May 15, 2015 and updated final memorandum dated October 30, 2015. The ambient water quality data was subsequently discussed during a meeting held on November 25, 2015. No concerns regarding the proposed development of ambient water quality values were raised by the MOECC at that time.

At this time, we do not feel there is a need to conduct any receiver monitoring. The background water quality dataset used to support this ACS, which spans 1972 to 2014, provides sufficient data to establish background conditions.

MOECC Comment No. 3: *If total phosphorous is a Policy 2 parameter, obtaining a deviation is unlikely. Therefore, a level of treatment is required to ensure concentrations and loadings that do not further degrade the receiver. Further discussion of the proposed effluent limit of 0.1 mg/L is required to determine if improvements can be made.*

Response: It was understood by all parties that the receiver was Policy 2 with respect to phosphorus, and this fact was discussed during the meeting held on November 25, 2016. The meeting notes state that "the receiver is Policy 2 with respect to TP and as such, a very high level of treatment will be required, likely in combination with offsetting, as loadings are still an issue down the system and into the reservoir. This will have to be discussed further with the MOECC as it is the MOECC that is the governing authority."

We therefore understand that a Policy 2 deviation request will need to be submitted. We would be happy to discuss the required level of treatment with respect to TP in the context of available treatment technologies and other options available to reduce loadings to the receiver.

MOECC Comment No. 4: *The Canadian Water Quality Guideline for total particulate matter which speaks to total suspended solids should be used for evaluating potential impacts related to this parameter.*

Response: The Canadian Water Quality Guideline for suspended sediments is a maximum increase of 25 mg/L from background levels for any short-term exposure, and 5 mg/L for longer term exposure. Based on the proposed TSS concentration limit of 10 mg/L and the equivalent 7Q20 flow of 0.4 m^3/s, the proposed discharge (based on an ADF of 552 m^3/d) would increase TSS by 0.16 mg/L over background levels, which is well below the maximum increase for longer term exposure of 5 mg/L.

MOECC Comment No. 5: *Absolute values in discussing changes to background concentrations (Section 3) need to be used for the assessment. Discussing changes in relative percentages is not useful.*

Response: Table 1 below provides absolute values for the increases to background concentrations for $cBOD_5$, TSS, and TP. Note that the un-ionized ammonia concentrations at

fully mixed conditions are defined in the ACS Report, and are below the PWQO of 0.02 mg/L for all seasons.

Table 1 Changes to Background Concentrations Based on Proposed Effluent Limits and WWTP ADF of 552 m3/d

Parameter	Background Value (1) (mg/L)	Fully-Mixed Concentration Downstream of Proposed WWTP (mg/L)	% Increase from Background Value
$cBOD_5$	1.5 mg/L	1.66 mg/L	10.7%
TSS	8.0 mg/L	8.16 mg/L	2.0%
TP	0.031 mg/L	0.0326 mg/L	5.2%

Notes:

1. Annual 75th percentile background values for TSS and TP. Available data for cBOD5 was limited. Reported annual 75th percentile value was 1.2 mg/L, therefore a conservative estimate of 1.5 mg/L was used.

MOECC Comment No. 6: *E. coli was determined to be a Policy 1 parameter. A compliance limit of 200 CFU/100 mL is not appropriate when the PWQO is 100 CFU/100 mL (based on a geometric mean of a minimum of five samples).*

Response: Acknowledged. We propose revised *E. coli* objective and limit of 100 CFU/100 mL (based on geometric mean).

MOECC Comment No. 7: *The mixing zone analysis assumes steady state conditions and that the effluent is introduced into the centre of the channel. However, it appears that the discharge will be a shoreline discharge. Clarification should be provided as to the type of outlet and the mixing zone analysis should reflect the approach to be used. The suitability of a dry ditch discharge in terms of location and possible receptors has not been agreed upon to date.*

Response: We have updated the mixing zone assessment to reflect the proposed shoreline discharge. Please see Attachment 1 to this letter. The results indicate that, for Scenarios 1 (451 m^3/d) and 2 (552 m^3/d), completely mixed conditions are achieved within approximately 250 metres downstream of the source. Effluent concentrations are greater than 5% for a relatively small area (2 metres in width and less than 100 metres in length) immediately downstream of the source for each scenario. Completely mixed concentrations for Scenario 1 and 2 are 1.3% and 1.6%, respectively.

2. STATUS OF THE DEVELOPMENT APPLICATION PROCESS

XCG is not currently involved in the development application process for the proposed residential development. Sarah Properties Ltd. has provided responses to the MOECC's questions regarding the status of this process, which have been summarized below:

Table 2 Status of the Development Application Process

MOECC Question / Comment	Response from Sarah Properties Ltd.
Given the timing and delegation of planning approval to Dufferin County, have formal planning applications been made for subdivision approval to the County?	Formal planning applications have been submitted. Completed reports include: Archaeological Assessment, Minimum Distance Separation, Tree Inv. & Preservation Plan, Functional Servicing Report, Environmental Site Assessment, Traffic Study, Financial Impact Assessment, Planning Report, Geotechnical Report, Hydrogeological Report and Water Supply Report.
Has a decision been made whether this development will be freehold or condominium tenure form? Tenure form has significant ramifications as a wastewater treatment plant for a freehold residential development will require municipal assumption, ownership and operation. We have not received any direct indication from the Township of their willingness to become owner/operators of a wastewater treatment plant. Conversely, if the development is to be condominium ownership, a municipal responsibility agreement (with adequate financial assurance) will need to be entered into by the developer and the Township.	The Township of Amaranth will determine the ownership of the wastewater treatment facility after the planning process has been completed. In any case, the houses in the subdivision will be freehold.
The development of a wastewater treatment facility to service residential development is a Schedule "C" undertaking under the MCEA. As such, an EA study is required with the developer as the proponent. Integrating the EA with the required planning approvals is provided for in Section 2.9 of the MCEA and is highly recommended.	The wastewater treatment EA will be integrated with the required planning approvals.
We recall the comment having been made that the existing water supply servicing Waldemar will need to be upgraded/expanded if it is to provide water to this development. This may also require an EA under the MCEA depending on what is needed to provide more water. It would make sense for this work to be undertaken together given all of the interdependencies that stem from the development proposal.	Agreed, the water supply EA will run concurrently with the wastewater treatment EA.

3. CLOSURE

We would like to thank you for providing your comments related to the proposed WWTP in the vicinity of Waldemar, Ontario. As suggested in your April 28, 2016 letter, a meeting between all parties, including Sarah Properties Ltd., ASI Group, MOECC, XCG and GRCA would provide an opportunity to discuss the responses we have provided above, as well as define next steps. We will be in contact with you to schedule this meeting.

In the meantime, should you have any questions or concerns, please do not hesitate to contact the undersigned.

Yours very truly,

XCG CONSULTING LIMITED

Melody Johnson, M.A.Sc., P.Eng.
Senior Project Manager

cc: Sandra Cooke and Mark Anderson, GRCA
Lindsay Wolfenberg, ASI
Wendy Wingate, MOECC
Laura Daly, MAH
Walter Broos, Sharah Properties Ltd.
Mike Newbigging, XCG
Christine Gervais, Township Planner

Attachment: Grand River at Marsville, Mixing Zone Assessment

GRAND RIVER AT MARSVILLE, MIXING ZONE ASSESSMENT

Grand River at Marsville
Mixing Zone Assessment
February 2016, Revised May 2016

1. *Objective*

The objective was to define the low-flow mixing zone in the Grand River near Marsville, for two proposed WPCP effluent scenarios: 451 and 552 m^3/d.

2. *Approach*

The general approach involved application of an analytical solution of the two-dimensional advective dispersive transport equation (Equation [1]) for steady state conditions (Fischer et al., 1979).

$$v\frac{\partial C}{\partial x} = E\left[\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial y^2}\right] - kC \pm S \qquad [1]$$

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, E, can be approximated using an empirical relationship presented below as Equation [2] (Fischer et al., 1979).

$$E \cong 0.6d\sqrt{gdS} = 0.6du \qquad [2]$$

Where:

d = Channel depth (m)
g = Gravitational constant (m/s^2)
S = Average channel slope (m/m)
u = Channel shear velocity (m/s)

Plume superposition was applied to address channel boundaries.

3. *Assumptions*

Important assumptions include:

- Effluent is completely mixed vertically.

- Average flow and average depth can be applied, with Manning's equation to estimate depth for low-flow conditions.
- Momentum of effluent flow can be ignored.
- Steady state conditions have been achieved.
- The channel is rectangular, constant width (20 m) and uniform.
- Shoreline effluent discharge is assumed.

4. *Parameter Summary*

A summary of key parameter assignments is provided in Table 1.

Key parameter Assignments

Parameter	Variable	Value	Units
Channel Width	*w*	20.0	m
Average Channel Depth - Low-Flow	*d*	0.30	m
WPCP Flow	*Qe*	451-552	m^3/d
River Low-Flow	*Qr*	0.4	m^3/s
Average Channel Slope	*S*	0.001	m/m
Shear velocity	*u*	0.054	m/s
Dispersion Coefficient	*Et*	0.010	m^2/s

5. *Results*

The estimated mixing zones corresponding to Scenarios 1 (451 m^3/d) and 2 (552 m^3/d) are provided as Figures 1 and 2, respectively. Illustrative plume cross-sections for each scenario are provided in Figures 3 and 4, respectively. For each Scenario, completely mixed conditions are achieved within (approximately) 250 m downstream of the source. Effluent concentrations are greater than 5% for a relatively small area (2m in width and less than 100 m in length) immediately downstream of the source for each scenario. Completely mixed concentrations for Scenario 1 and 2 are 1.3 and 1.6%, respectively.

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
2	27.2	11.6	0.9	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
4	19.2	12.6	3.5	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	0.0
6	15.7	11.8	5.0	1.2	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	0.0	0.0	0.0
8	13.6	11.0	5.8	2.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	12.2	10.3	6.1	2.6	0.8	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	0.0	0.0
12	11.1	9.6	6.3	3.1	1.1	0.3	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
14	10.3	9.1	6.3	3.4	1.5	0.5	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
16	9.6	8.6	6.3	3.7	1.7	0.7	0.2	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
18	9.1	8.2	6.2	3.9	2.0	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	0.0	0.0	0.0
20	8.6	7.9	6.1	4.0	2.2	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	0.0	0.0	0.0
22	8.2	7.6	6.0	4.1	2.4	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	0.0	0.0	0.0
24	7.9	7.3	5.9	4.1	2.5	1.3	0.6	0.2	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
26	7.5	7.1	5.8	4.2	2.6	1.5	0.7	0.3	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
28	7.3	6.8	5.7	4.2	2.7	1.6	0.8	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	7.0	6.6	5.6	4.2	2.8	1.7	0.9	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	6.8	6.4	5.5	4.2	2.9	1.8	1.0	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	6.6	6.3	5.4	4.2	3.0	1.9	1.1	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	6.4	6.1	5.3	4.2	3.0	2.0	1.2	0.6	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	6.2	6.0	5.2	4.2	3.0	2.0	1.2	0.7	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	6.1	5.8	5.1	4.1	3.1	2.1	1.3	0.8	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	5.9	5.7	5.0	4.1	3.1	2.1	1.4	0.8	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	5.8	5.6	5.0	4.1	3.1	2.2	1.4	0.9	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	5.7	5.5	4.9	4.1	3.1	2.2	1.5	0.9	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	5.6	5.4	4.8	4.0	3.1	2.3	1.5	1.0	0.6	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	5.4	5.3	4.7	4.0	3.2	2.3	1.6	1.0	0.6	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	5.3	5.2	4.7	4.0	3.2	2.3	1.6	1.1	0.7	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	5.2	5.1	4.6	3.9	3.2	2.4	1.7	1.1	0.7	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	5.1	5.0	4.6	3.9	3.2	2.4	1.7	1.2	0.7	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	5.1	4.9	4.5	3.9	3.2	2.4	1.8	1.2	0.8	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	5.0	4.8	4.4	3.8	3.2	2.4	1.8	1.2	0.8	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	4.9	4.8	4.4	3.8	3.1	2.5	1.8	1.3	0.8	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	4.8	4.7	4.3	3.8	3.1	2.5	1.8	1.3	0.9	0.6	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66	4.7	4.6	4.3	3.8	3.1	2.5	1.9	1.3	0.9	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
68	4.7	4.6	4.2	3.7	3.1	2.5	1.9	1.4	0.9	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70	4.6	4.5	4.2	3.7	3.1	2.5	1.9	1.4	1.0	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72	4.5	4.4	4.1	3.7	3.1	2.5	1.9	1.4	1.0	0.7	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	4.5	4.4	4.1	3.6	3.1	2.5	1.9	1.4	1.0	0.7	0.4	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
76	4.4	4.3	4.0	3.6	3.1	2.5	2.0	1.5	1.0	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
78	4.4	4.3	4.0	3.6	3.1	2.5	2.0	1.5	1.1	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
80	4.3	4.2	4.0	3.6	3.1	2.5	2.0	1.5	1.1	0.8	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
82	4.3	4.2	3.9	3.5	3.0	2.5	2.0	1.5	1.1	0.8	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
84	4.2	4.1	3.9	3.5	3.0	2.5	2.0	1.6	1.1	0.8	0.5	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
86	4.2	4.1	3.8	3.5	3.0	2.5	2.0	1.6	1.2	0.8	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
88	4.1	4.0	3.8	3.4	3.0	2.5	2.0	1.6	1.2	0.9	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
90	4.1	4.0	3.8	3.4	3.0	2.5	2.0	1.6	1.2	0.9	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
92	4.0	3.9	3.7	3.4	3.0	2.5	2.1	1.6	1.2	0.9	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
94	4.0	3.9	3.7	3.4	3.0	2.5	2.1	1.6	1.2	0.9	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
96	3.9	3.9	3.7	3.3	3.0	2.5	2.1	1.6	1.3	0.9	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
98	3.9	3.8	3.6	3.3	2.9	2.5	2.1	1.7	1.3	0.9	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
100	3.9	3.8	3.6	3.3	2.9	2.5	2.1	1.7	1.3	1.0	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
102	3.8	3.7	3.6	3.3	2.9	2.5	2.1	1.7	1.3	1.0	0.7	0.5	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
104	3.8	3.7	3.5	3.3	2.9	2.5	2.1	1.7	1.3	1.0	0.7	0.5	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0
106	3.7	3.7	3.5	3.2	2.9	2.5	2.1	1.7	1.3	1.0	0.7	0.5	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0
108	3.7	3.6	3.5	3.2	2.9	2.5	2.1	1.7	1.3	1.0	0.8	0.5	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
110	3.7	3.6	3.5	3.2	2.9	2.5	2.1	1.7	1.4	1.0	0.8	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
112	3.6	3.6	3.4	3.2	2.8	2.5	2.1	1.7	1.4	1.1	0.8	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
114	3.6	3.6	3.4	3.2	2.8	2.5	2.1	1.7	1.4	1.1	0.8	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
116	3.6	3.5	3.4	3.1	2.8	2.5	2.1	1.7	1.4	1.1	0.8	0.6	0.4	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0
250	2.6	2.5	2.5	2.4	2.2	2.1	1.9	1.8	1.6	1.4	1.2	1.1	0.9	0.8	0.6	0.5	0.4	0.3	0.3	0.2	0.2
500	2.2	2.1	2.0	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.5	0.4
1000	1.9	1.9	1.8	1.7	1.7	1.6	1.6	1.5	1.4	1.4	1.3	1.2	1.2	1.1	1.0	1.0	0.9	0.9	0.8	0.8	0.7
2000	1.7	1.7	1.7	1.6	1.6	1.5	1.5	1.4	1.4	1.3	1.3	1.3	1.2	1.2	1.1	1.1	1.0	1.0	1.0	0.9	0.9

Figure 1. Concentration Plume (Effluent %) for Scenario 1 Effluent Conditions (451 m^3/d)

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
2	33.3	14.2	1.1	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	0.0	0.0	0.0	0.0
4	23.6	15.4	4.3	0.5	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
6	19.2	14.5	6.2	1.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	16.7	13.5	7.1	2.4	0.5	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	0.0
10	14.9	12.6	7.5	3.2	1.0	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	0.0	0.0
12	13.6	11.8	7.7	3.8	1.4	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	0.0	0.0	0.0
14	12.6	11.1	7.7	4.2	1.8	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	0.0	0.0
16	11.8	10.6	7.7	4.5	2.1	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	0.0	0.0	0.0
18	11.1	10.1	7.6	4.7	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	0.0	0.0	0.0
20	10.5	9.7	7.5	4.9	2.7	1.2	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	0.0	0.0
22	10.0	9.3	7.4	5.0	2.9	1.4	0.6	0.2	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
24	9.6	9.0	7.2	5.1	3.1	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	0.0	0.0	0.0
26	9.2	8.7	7.1	5.1	3.2	1.8	0.9	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	0.0
28	8.9	8.4	7.0	5.1	3.4	1.9	1.0	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	8.6	8.1	6.8	5.2	3.5	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	0.0	0.0	0.0
32	8.3	7.9	6.7	5.2	3.5	2.2	1.2	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	8.1	7.7	6.6	5.1	3.6	2.3	1.3	0.7	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	7.9	7.5	6.5	5.1	3.7	2.4	1.4	0.8	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	7.6	7.3	6.4	5.1	3.7	2.5	1.5	0.8	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	7.4	7.1	6.3	5.1	3.8	2.6	1.6	0.9	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	7.3	7.0	6.2	5.0	3.8	2.6	1.7	1.0	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	7.1	6.8	6.1	5.0	3.8	2.7	1.8	1.1	0.6	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	6.9	6.7	6.0	5.0	3.8	2.7	1.8	1.1	0.6	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	6.8	6.6	5.9	4.9	3.8	2.8	1.9	1.2	0.7	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	6.7	6.4	5.8	4.9	3.9	2.8	1.9	1.2	0.7	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	6.5	6.3	5.7	4.9	3.9	2.9	2.0	1.3	0.8	0.5	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	6.4	6.2	5.6	4.8	3.9	2.9	2.1	1.4	0.8	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	6.3	6.1	5.6	4.8	3.9	2.9	2.1	1.4	0.9	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	6.2	6.0	5.5	4.7	3.9	3.0	2.1	1.5	0.9	0.6	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	6.1	5.9	5.4	4.7	3.9	3.0	2.2	1.5	1.0	0.6	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	6.0	5.8	5.4	4.7	3.9	3.0	2.2	1.6	1.0	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	5.9	5.7	5.3	4.6	3.8	3.0	2.3	1.6	1.1	0.7	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66	5.8	5.6	5.2	4.6	3.8	3.0	2.3	1.6	1.1	0.7	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
68	5.7	5.6	5.2	4.6	3.8	3.0	2.3	1.7	1.1	0.7	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70	5.6	5.5	5.1	4.5	3.8	3.1	2.3	1.7	1.2	0.8	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72	5.6	5.4	5.0	4.5	3.8	3.1	2.4	1.7	1.2	0.8	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
74	5.5	5.4	5.0	4.4	3.8	3.1	2.4	1.8	1.3	0.8	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
76	5.4	5.3	4.9	4.4	3.8	3.1	2.4	1.8	1.3	0.9	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
78	5.3	5.2	4.9	4.4	3.8	3.1	2.4	1.8	1.3	0.9	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
80	5.3	5.2	4.8	4.3	3.7	3.1	2.4	1.9	1.3	0.9	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
82	5.2	5.1	4.8	4.3	3.7	3.1	2.5	1.9	1.4	1.0	0.6	0.4	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
84	5.1	5.0	4.7	4.3	3.7	3.1	2.5	1.9	1.4	1.0	0.7	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
86	5.1	5.0	4.7	4.2	3.7	3.1	2.5	1.9	1.4	1.0	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
88	5.0	4.9	4.6	4.2	3.7	3.1	2.5	1.9	1.5	1.0	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
90	5.0	4.9	4.6	4.2	3.7	3.1	2.5	2.0	1.5	1.1	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
92	4.9	4.8	4.6	4.2	3.6	3.1	2.5	2.0	1.5	1.1	0.8	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
94	4.9	4.8	4.5	4.1	3.6	3.1	2.5	2.0	1.5	1.1	0.8	0.5	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
96	4.8	4.7	4.5	4.1	3.6	3.1	2.5	2.0	1.5	1.1	0.8	0.6	0.4	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
98	4.8	4.7	4.4	4.1	3.6	3.1	2.5	2.0	1.6	1.2	0.8	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
100	4.7	4.6	4.4	4.0	3.6	3.1	2.5	2.0	1.6	1.2	0.9	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
102	4.7	4.6	4.4	4.0	3.6	3.1	2.6	2.1	1.6	1.2	0.9	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
104	4.6	4.5	4.3	4.0	3.6	3.1	2.6	2.1	1.6	1.2	0.9	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
106	4.6	4.5	4.3	4.0	3.5	3.1	2.6	2.1	1.6	1.2	0.9	0.7	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
108	4.5	4.5	4.3	3.9	3.5	3.1	2.6	2.1	1.6	1.3	0.9	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
110	4.5	4.4	4.2	3.9	3.5	3.0	2.6	2.1	1.7	1.3	1.0	0.7	0.5	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0
112	4.5	4.4	4.2	3.9	3.5	3.0	2.6	2.1	1.7	1.3	1.0	0.7	0.5	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0
114	4.4	4.4	4.2	3.9	3.5	3.0	2.6	2.1	1.7	1.3	1.0	0.7	0.5	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0
116	4.4	4.3	4.1	3.8	3.5	3.0	2.6	2.1	1.7	1.3	1.0	0.7	0.5	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0
250	3.2	3.1	3.0	2.9	2.7	2.6	2.4	2.2	1.9	1.7	1.5	1.3	1.1	0.9	0.8	0.6	0.5	0.4	0.3	0.3	0.2
500	2.7	2.6	2.5	2.4	2.3	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5
1000	2.3	2.3	2.2	2.1	2.1	2.0	1.9	1.8	1.8	1.7	1.6	1.5	1.4	1.4	1.3	1.2	1.1	1.1	1.0	0.9	0.9
2000	2.1	2.1	2.0	2.0	1.9	1.9	1.8	1.8	1.7	1.7	1.6	1.5	1.5	1.4	1.4	1.3	1.3	1.2	1.2	1.1	1.1

Figure 2. Concentration Plume (Effluent %) for Scenario 2 Effluent Conditions (552 m^3/d)

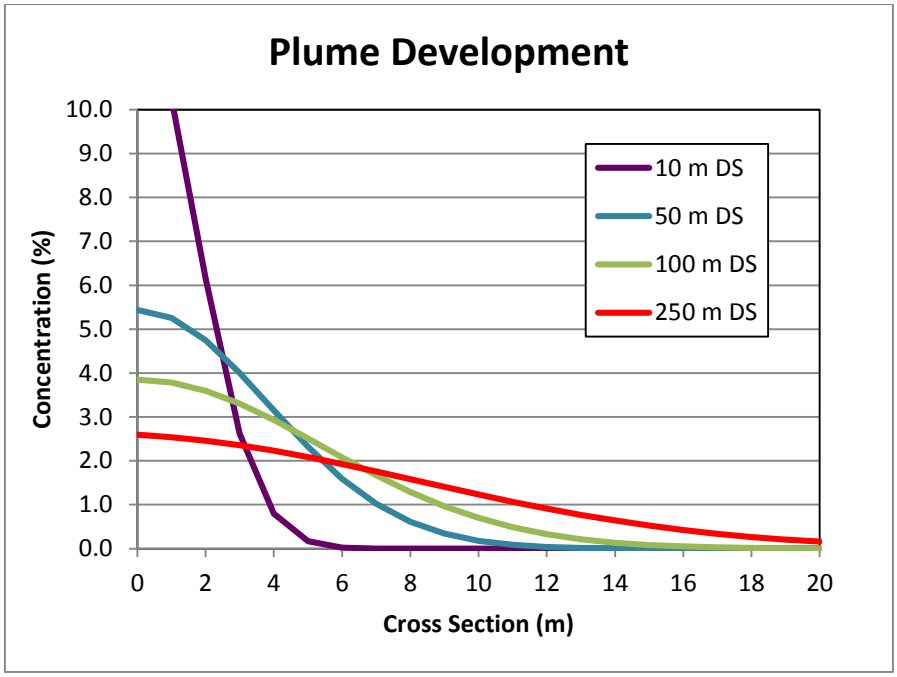

Figure 3. Plume Cross-Sections (Effluent %) for Scenario 1 Effluent Conditions (451 m^3/d)

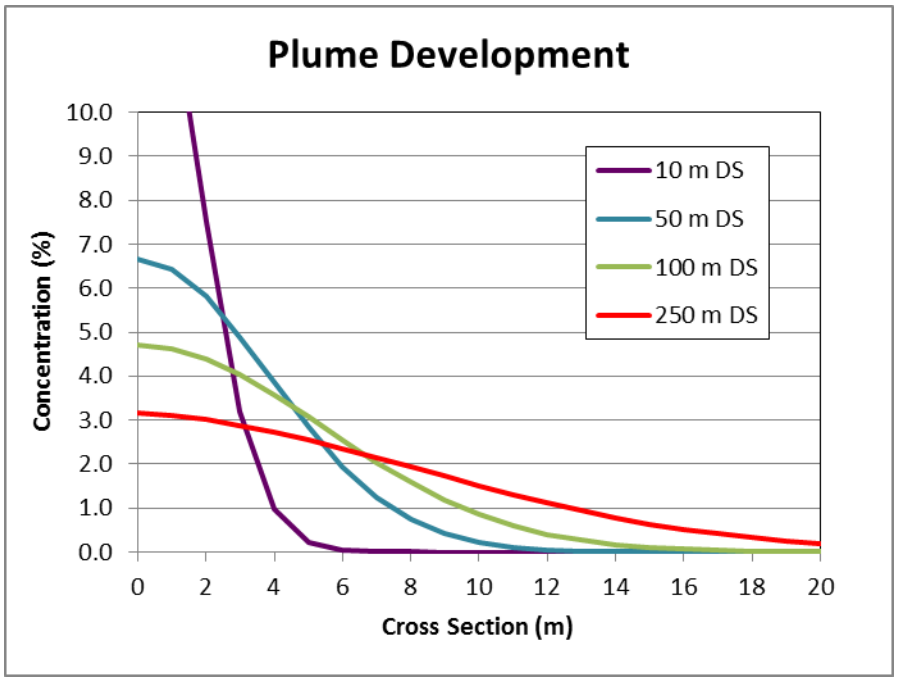

Figure 4. Plume Cross-Sections (Effluent %) for Scenario 2 Effluent Conditions (552 m^3/d)

APPENDIX F
MEETING NOTES – AUGUST 15, 2016 MEETING WITH MOECC AND GRCA AND FOLLOW-UP CORRESPONDENCE

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XCG File No.: 3-3756-01-01

Project:	Waldemar Development: Assimilative Capacity Study Meeting with the MOECC and GRCA
Meeting Date:	Monday, August 15, 2016 1:00 PM
Attendees:	Craig Fowler (CF), MOECC Barbara Slattery (BS), MOECC Kevin Noll (KN), MOECC Wendy Wingate (WW), MOECC Gord Feniak (GF), R.J. Burnside & Associates Ltd. (RJB) Mark Anderson (MA), Grand River Conservation Authority (GRCA) Walter Broos (WB), Sarah Properties Ltd. Lindsay Wolfenberg (LW), ASI Group (ASI) Mike Hulley (MH), XCG Consultants Ltd. (XCG) Melody Johnson (MJ), XCG
Regrets:	Christine Gervais (CG), Township of Amaranth-East Gary (Township) Gary Tomlinson (GT), MOECC Sandra Cooke (SC), GRCA
Notes By:	Melody Johnson Walter Broos
Status:	Sept 9, 2016 (Draft), Sept 23, 2016 (Comments by – none received), Nov 29, 2016 (Final)

Item	Action
1. **Project Background and Status**	
• WB provided a brief background of the proposed development and the on-going application process:	Info
– Class EA for the wastewater treatment facility is underway. CC Tatham & Associates have been retained to complete the Class EA. BS noted that the MOECC has not yet received a Notice of Commencement for this study.	
– Formal planning applications have been submitted, and a number of supporting reports have been completed (these are outlined in XCG's July 7, 2016 letter).	

Item	Action
• LW provided a brief overview of the wastewater treatment facility technology (membrane treatment), and proposed discharge location. It was noted that the option of surface water discharge is being investigated first to determine its feasibility. As such, the ongoing Assimilative Capacity Study (ACS) was initiated to determine if a new point source discharge to the Grand River would be approved by MOECC.	Info
• MJ provided an overview of the status of the ACS. Through consultation with the MOECC and GRCA, agreement was reached regarding the equivalent 7Q20 flow to be used as the basis for the study. An ACS report was submitted to MOECC on March 29, 2016 for MOECC review, and comments were received from MOECC on April 28, 2016. XCG issued a letter responding to those comments on July 7, 2016.	Info
• The purpose of the meeting, therefore, was to discuss XCG's responses to the MOECC's comments, and determine required next steps for this study.	Info
• During the last meeting on May 19, 2015, MA and CF had raised questions around the average day flow (ADF) being calculated based on two people per household as well as address infiltration. Prior to the meeting, ASI had re-calculated the ADF to be 450 m^3/d based on three people per household and infiltration.	Info
• LW summarized the questions raised by CF during the December 2014 meeting about possible issues around two-tier sewage treatment existing in the same residential area. Prior to the meeting, ASI provided an additional ADF calculation of 552 m^3/d for the potential to tie in existing surrounding properties to the proposed wastewater treatment plant (WWTP). This calculation included 3 people per household and infiltration.	Info
2. **Review of MOECC Comments and Team's Response**	
• MOECC Comment: *Recognizing that the final design for the treatment system is still to be determined, an assimilative capacity can't be fully evaluated or deemed acceptable until a design flow has been finalized.*	Info
– Two potential design flows were presented in the ACS report (451 m^3/d and 552 m^3/d). XCG has suggested that the higher value (552 m^3/d) be used for the purposes of developing effluent requirements for the new treatment facility. In this way, should the final design value be less than 552 m^3/d, the effluent concentration limits would remain the same as those defined for 552 m^3/d, and the loading limits reduced accordingly. MOECC and GRCA agreed with this approach.	

Item	Action
– CF requested clarification regarding the difference between the two design values, and why they are much higher than the design flow discussed at the beginning of this project (300 m^3/d). LW indicated that the design flows were updated during the project to increase the persons per unit value to 3 PPU from 2 PPU, and to include an allowance for infiltration, resulting in an ADF value of 451 m^3/d for the new development. To address MOECC's concerns regarding a "two-tier" sewage treatment system (with existing residential units remaining on septic systems), an allowance was added to the design ADF to include tie-in of existing properties to the new treatment system, yielding a design ADF of 552 m^3/d.	Info
• MOECC Comment: *Clarification needs to be provided on what period the data is from for determining ambient water quality conditions for each parameter as the discussion regarding 1996-1998 data confounds the understanding. Using PWQMN Station 16018406702 to represent background water quality conditions is reasonable which would negate the need to statistically correlate data that is dated and from different stations. Water chemistry data collected more than 5 years ago is not reflective of current conditions. If recent data (2014-2016) is not available, a monitoring plan should begin soon to establish background conditions.*	Info
– MJ indicated that the dataset used for the assessment of background water quality was based on data spanning the 1975 to 2015 collected at the downstream PWQMN station (no. 16018406702). MJ acknowledged that the response in XCG's July 7, 2016 needs to be revised to provide further clarity.	
– CF suggested utilizing the last 5 years' worth of monitoring data to assess ambient conditions. MA indicated that this would likely not provide sufficient data points for an accurate analysis.	
– MA asked if there were any trends observed in any of the background water quality data over time that would support truncating the data set to provide a more accurate representation of current ambient conditions. MH indicated that a visual assessment of the data was done for all parameters, and that no trends were observed. XCG will conduct a statistical analysis of the background TP to confirm that there are no trends.	XCG

Item	Action
– MA indicated that the PWQMN laboratory may have been under-reporting total phosphorus concentrations since November 2012 after changing analytical methods. MA also noted that around 1995 to 1996, changes were also made to ammonia analyses. XCG will consider these items in their statistical evaluation of the background water quality data.	XCG
• MOECC Comment: *If total phosphorous is a Policy 2 parameter, obtaining a deviation is unlikely. Therefore, a level of treatment is required to ensure concentrations and loadings that do not further degrade the receiver. Further discussion of the proposed effluent limit of 0.1 mg/L is required to determine if improvements can be made*.	Info
– MJ noted that, due to the ambient water quality and the effluent quality achievable by the proposed treatment technology (MBR), the proposed discharge would increase instream TP concentrations. As such, it does not meet the Policy 2 requirements, and it is understood that a deviation request would need to be approved for the discharge to be approved.	
– CF indicated that, in principle, he is not against the proposed effluent TP concentration limit of 0.10 mg/L and objective of 0.08 mg/L, but requested that a review be completed to determine if there are any supplemental treatment technologies that could be used to further reduce the effluent TP concentration. MJ noted that the proposed concentration objective of 0.08 mg/L is based on equipment supplier guarantees, but that MBR technologies have been capable of achieving lower average effluent TP concentrations. However, the design of the system must be such that it can consistently meet the design objective and, therefore, introduces conservatism into the design.	
– CF noted that he is unaware of any Policy 2 deviation requests being made or granted in MOECC's West Central Region over the past 25 to 30 years, aside from one temporary deviation.	
– **After meeting note**: CF indicated that there exists a formal process to apply for a Policy 2 Deviation contained in Appendix C of the MOECC "Green Book." The process is not driven by or overseen by Technical Services; rather, approval would need to come from the Regional Director, Approvals Branch and possibly Policy Branch.	

Item	Action
– MJ and LW noted that the MBR treatment system being proposed is considered to be current "best available treatment" for phosphorus removal, and as such, would meet one of the pre-requisites for a deviation request to be considered.	Info
– MA noted that GRCA's concern relates to the downstream Bellwood reservoir, which becomes eutrophic during the summer months. Any additional phosphorus loading would not help conditions in the reservoir and, as such, GRCA would like to see any possible measures to be implemented to limit phosphorus loading to the Grand River (such as storm water treatment).	
– CF asked if phosphorus offsetting had been considered. GF noted that this would be difficult for a private developer to implement. MA noted that this approach has not yet been implemented in the GRCA to-date.	
• The remaining MOECC comments, and XCG's responses, were discussed. No issues were raised.	Info
3. **Status of the Development Application Process**	
• WB indicated that OPA, Re-zoning and Draft Plan applications have been submitted. In addition, 11 reports have been completed as outlined in XCG's July 7, 2016 letter.	Info
• The Class EA for the wastewater treatment facility will be completed by C.C. Tatham & Associates Ltd.	Info
4. **Other Business**	
• MJ asked if MOECC's Technical Services area would consider providing a letter stating their position with respect to proposed effluent requirements outside of the Class EA process. In this way, the MOECC's decision can be used to help guide the Class EA process. MJ noted that, if as part of the Class EA study it is determined that the design ADF is some value greater than 552 m^3/d, an updated ACS would be submitted at that time. BS indicated that she foresees no reason why the MOECC wouldn't be able to provide their opinion regarding the ACS prior to the official start of the Class EA study.	Info

Item	Action
5. **Next Steps**	
• XCG to prepare a letter for MOECC that includes the following:	XCG
– Clear summary of PWQMN and other data used to develop ambient conditions, along with a statistical analysis of the data to identify TP concentration trends, if any, over the course of the data set.	
– Estimates of unionized ammonia and TP concentrations within the mixing zone. **After meeting note**: CF also requested that temperature effects within the mixing zone be evaluated.	
– A summary table clearly outlining the proposed effluent objectives and limits based on an ADF of 552 m^3/d.	
• ASI to conduct a high-level assessment of the potential to provide seasonal discharge to address eutrophication in the downstream Bellwood reservoir.	ASI
• ASI to investigate the potential to provide additional treatment step(s) downstream or in combination with the proposed MBR system that may be capable of further reducing effluent TP concentrations.	ASI

Any errors, omissions, or discrepancies should be reported to Melody Johnson.

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September 23, 2016 **XCG File No.: 3-3756-01-01**

Ms. Barbara Slattery
EA/Planning Coordinator
Ministry of the Environment and Climate Change
119 King Street West, 12th Floor
Hamilton, Ontario L8P 4Y7

Re: Sarah Properties Proposed Wastewater Treatment Plant in Waldemar, Ontario

Dear Ms. Slattery:

As per our meeting on August 15, 2016, below please find additional clarification and information regarding the *Assimilative Capacity Study of the Grand River in the Vicinity of a Proposed WWTP in Waldemar, ON*, the Ministry of the Environment and Climate Change's (MOECC's) comments in a letter dated April 28, 2016, and our response letter dated July 7, 2016. Items addressed include:

- Providing a clear summary of the Provincial Water Quality Monitoring Network (PWQMN) data used to develop ambient conditions;
- Estimates of unionized ammonia, total phosphorus (TP), and temperature within the mixing zone;
- A summary table clearly outlining the proposed effluent objectives and limits based on a design average day flow (ADF) capacity of 552 m^3/d.

The above items are discussed in more detail in the following sections.

1. PWQMN DATA USED TO DEVELOP AMBIENT CONDITIONS

As part of our ACS, PWQMN data used to develop ambient conditions in the Grand River in the vicinity of Waldemar were as follows:

- PWQMN Station No. 16018406702, located approximately 3.6 km downstream of the proposed discharge location.
  - These data span the periods 1975, 1978 to 1996, inclusive, and 2004 to 2014, inclusive (providing 31 years' worth of data).
  - Parameter concentrations available over that period include: dissolved oxygen (DO), temperature, ammonia (total and unionized), pH, total phosphorus (TP), and total suspended solids (TSS).
- Additional data provided by Grand River Conservation Authority (GRCA).
  - These data span 2015. The samples from this data set were collected at the location of PWQMN Station No. 16018406702.
  - Parameter concentrations available over that period include: ammonia (total and unionized), TP, TSS.

- Ammonia (total and unionized) data were truncated to remove data prior to 1997 to eliminate an increasing trend in the data. This was based on input received from the Grand River Conservation Authority (GRCA).
- For all other parameters, all available data were used to determine ambient conditions.

During the August 15, 2016 meeting, MOECC raised concerns regarding the long period of record of the background water quality data set, since it is possible that data collected five or more years ago may not be representative of existing conditions in the receiver. As noted above, the ammonia data set was truncated to include only data from 1997 to 2015 to eliminate an increasing trend in the data.

To address the MOECC's concern regarding the remaining data set, a statistical analysis was conducted to determine if there were any trends in a representative parameter (in this case, chosen to be TP) over the period of record. No significant trends were observed, indicating that background water quality data over the entire period of record is suitable for determining ambient water quality. See Attachment 1 for details of the statistical assessment.

2. ADDITIONAL MIXING ZONE ANALYSIS

As requested during the August 15, 2016 meeting, additional mixing zone analyses were conducted to estimate the thermal impacts of effluent as well as to estimate the concentrations of unionized ammonia and TP within the mixing zone. The basis for these analyses was the previously developed 2-dimensional mixing-zone analysis, as presented in our July 7, 2016 letter. All analyses below were based on an equivalent receiver 7Q20 flow of 0.4 m^3/s and the proposed facility design ADF of 552 m^3/d.

Thermal Impacts

Estimates of in-stream temperature were generated for winter and summer conditions for a range of ambient and effluent temperatures.

Based on the results of the analysis, the largest anticipated in-stream difference in temperature is 1.5^{o}C for summer and 7.3^{o}C for winter, located at a downstream distance of 1.0 m from the discharge point. Temperature differences of 1°C or more were limited to a region less than 1 m wide by 5 m long in summer, and 2 m wide and 42 m long in winter. The "worst-case" conditions for both summer and winter are presented in detail in Attachment 2.

Unionized Ammonia

Estimates of in-stream unionized ammonia concentrations were generated for winter and summer conditions, using the "worst-case" thermal impacts developed above and effluent total ammonia concentration (TAN) limits equivalent to the proposed effluent limits of 1.8 mg/L in summer and 3.8 mg/L in winter. In-stream pH and ambient TAN concentrations were assumed to be the 75th percentile of background water quality values.

The maximum anticipated unionized ammonia concentrations exceed the Provincial Water Quality Objective (PWQO) threshold of 0.02 mg/L for a region less than 3 m from the shore, and no farther than 100 m downstream based on summer conditions. For winter conditions, this mixing zone is considerably smaller and is confined to 1 m from the shore and 3 m downstream of the discharge location. Details of this analysis are presented in Attachment 3.

Total Phosphorus

Estimates of in-stream TP concentrations were generated based on ambient TP concentrations of 0.031 mg/L, the 75th percentile value of background concentration values. Because the ambient TP concentration exceeds the PWQO of 30 µg/L, the extent of the mixing zone cannot be defined in terms of size of the plume where the TP concentration is greater than the PWQO. However, the results indicate that the TP concentration in the mixing zone is 10 percent higher or more than the ambient TP concentration (i.e. >0.034 mg/L) for a region less than 4 m from the shore, and no farther downstream than 112 m.

3. SUMMARY OF PROPOSED EFFLUENT REQUIREMENTS

As request during the August 15, 2016 meeting, Table 1 presents the proposed effluent concentration objectives and limits, as well as the proposed loading limits, for all parameters of interest based on a design ADF value of 552 m^3/d. As agreed-to with the MOECC, should the final design ADF value be less than 552 m^3/d, the concentration objectives and limits as proposed in Table 1 would remain unchanged, however the loading limits would be reduced accordingly.

Table 1 Proposed Effluent Compliance Objectives and Limits for a Design ADF of 552 m^3/d

Effluent Parameter	Concentration		Loading Limit (kg/d)
	Objective (mg/l)	Limit (mg/L)	
$cBOD_5$	8.0	10.0	5.52
Total Suspended Solids	8.0	10.0	5.52
Total Phosphorus	0.08	0.10	0.055
Total Ammonia Nitrogen			
Winter (Dec - Feb)	3.0	3.8	2.1
Spring (Mar - May)	2.5	3.3	1.8
Summer (Jun - Sep)	1.0	1.8	1.0
Fall (Oct - Nov)	1.6	2.4	1.3

Notes:

E.coli effluent objective and limit of less than 100 organisms per 100 mL based on monthly geometric mean values.

Above concentration limits based on monthly average values. Loading limits based on annual average values and a design ADF of 552 m^3/d.

4. CLOSURE

We trust the above addresses all of your outstanding concerns related to the *Assimilative Capacity Study of the Grand River in the Vicinity of a Proposed WWTP in Waldemar, ON*, dated March 2016 and all follow-up correspondence. While we understand that the Policy 2 status of the receiver with respect to TP would necessitate approval of a Policy 2 Deviation Request before a new discharge could be approved, we understand that this Request is not required for Technical Support Section of West Central Region to complete their review of the above-noted ACS, and the effluent objectives and limits as proposed.

Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Yours very truly,

XCG CONSULTANTS LTD.

Melody Johnson, M.A.Sc., P.Eng.
Senior Project Manager

cc: Craig Fowler, MOECC
Wendy Wingate, MOECC
Sandra Cook and Mark Anderson, GRCA
Lindsay Wolfenberg, ASI
Walter Broos, Sarah Properties Ltd.
Christine Gervais, Township Planner
Mike Newbigging, XCG

Attachments: Attachment 1 – Trend Assessment
Attachment 2 - Thermal Impacts In Mixing Zone
Attachment 3 - Unionized Ammonia Concentrations In Mixing Zone
Attachment 4 – TP Concentrations in Mixing Zone

ATTACHMENT 1 – TREND ASSESSMENT

Trend Assessment

A seasonal and annual trend assessment was completed for Total Phosphorus for PWQMN Station 16018406702. A non-parametric slope, β, as defined by Theil (1950) and Sen (1968), was applied to address any serial autocorrelation, and trend was assessed using a modified Mann-Kendal test for trend, similar to an approach defined by Yue and Wang (2004). However, rather than a single pre-whitening process, an iterative approach as described by Zhang et al. (2010) was applied. Assuming a 95% confidence limit, a Mann-Kendall tau statistic of greater than 1.96 or less than -1.96, would indicate a significant trend. In this case, no significant trends were observed.

A summary of the results is provided in Table 1 below, and time series plots of the seasonal averaged total phosphorus monitoring results are provided in Figures 1 through 5.

Table 1 Non-Parametric Trend Assessment Summary

Season	Mann-Kendall tau Statistic	Significant at 95%
Spring	-0.82	No
Summer	0.80	No
Fall	-0.71	No
Winter	-0.86	No
Annual	-0.65	No

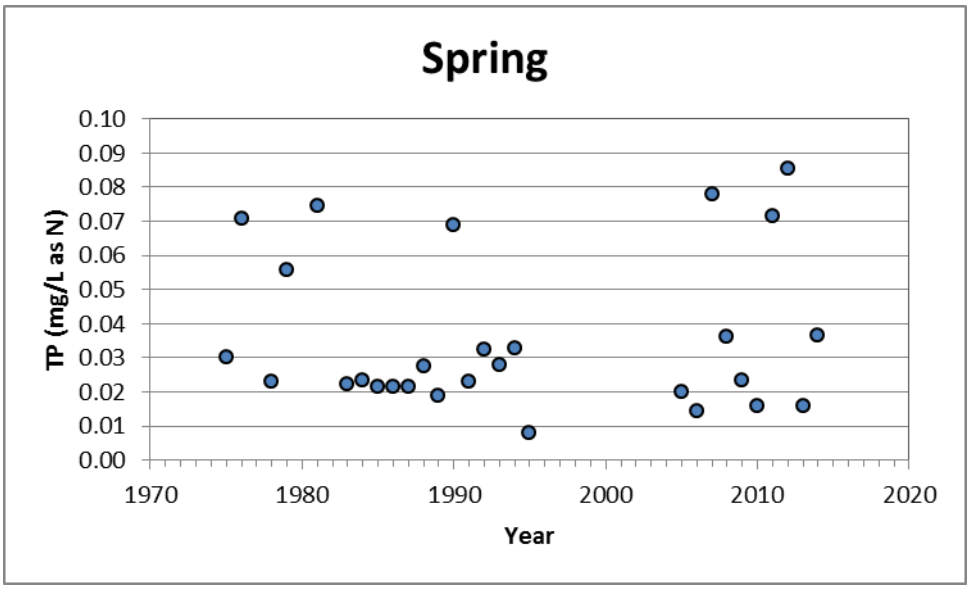

Figure 1 Spring Average TP Monitoring Results for PWQMN Station 16018406702

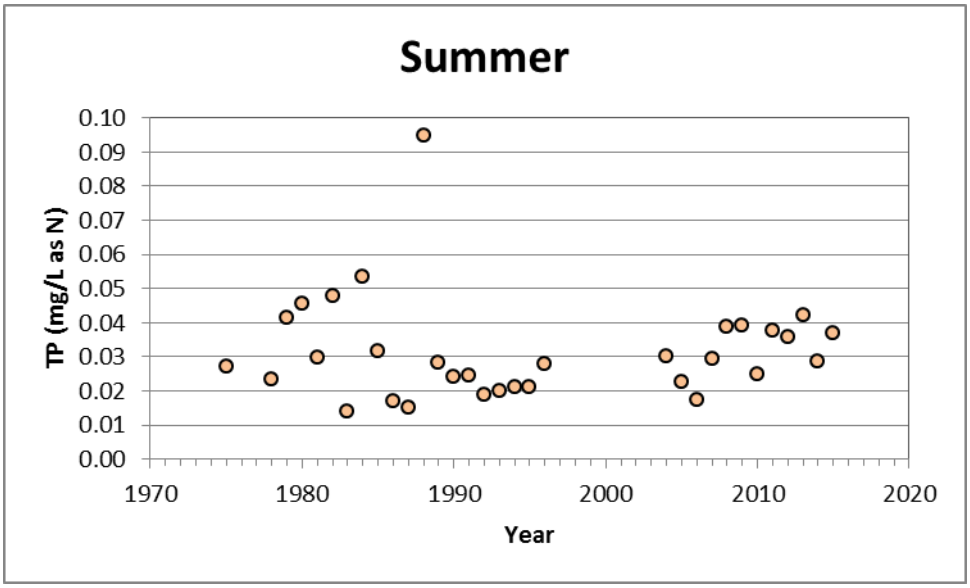

Figure 2 Summer TP Monitoring Results for PWQMN Station 16018406702

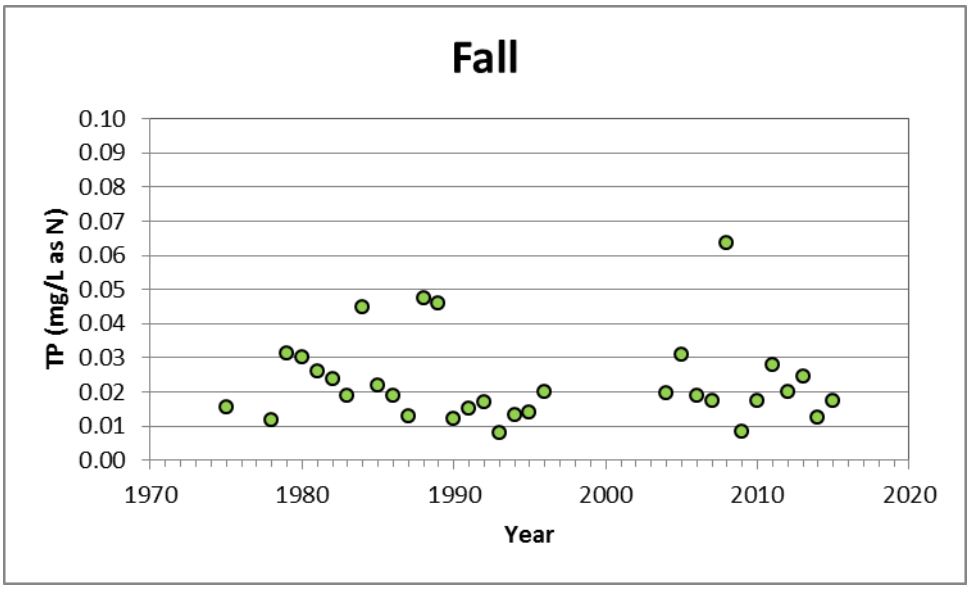

Figure 3 Fall Average TP Monitoring Results for PWQMN Station 16018406702

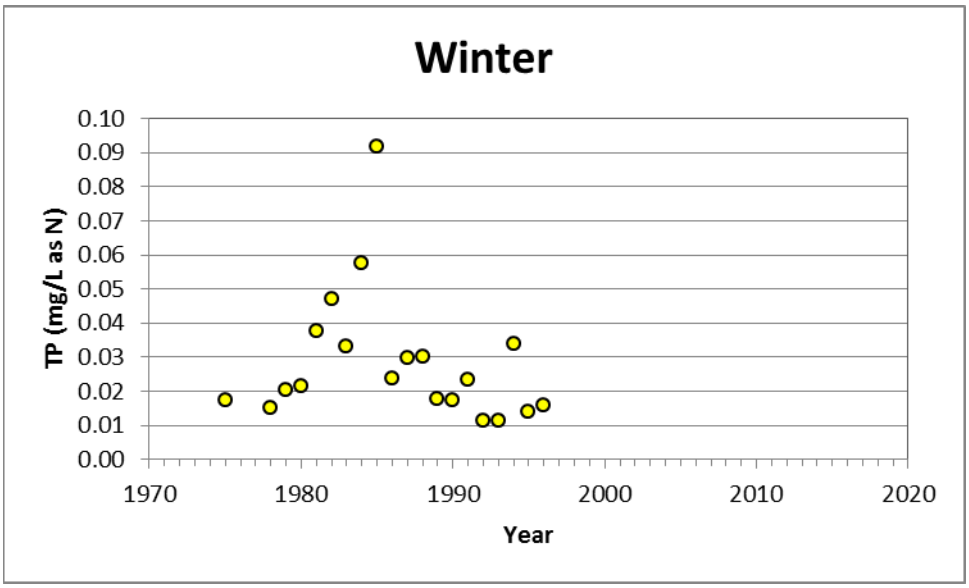

Figure 4 Winter Average TP Monitoring Results for PWQMN Station 16018406702

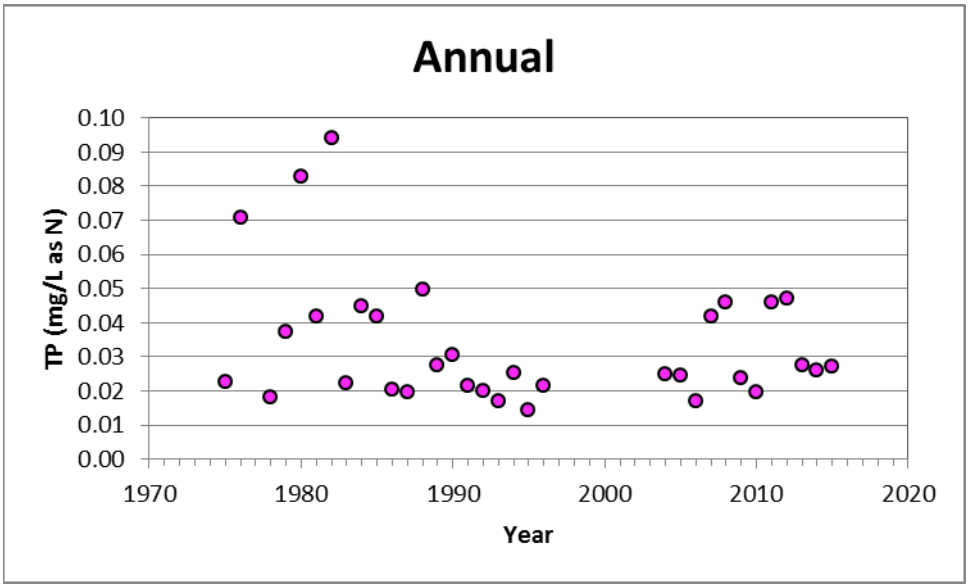

Figure 5 Annual Average TP Monitoring Results for PWQMN Station 16018406702

References:

Theil H (1950) A rank-invariant method of linear and polynomial regression analysis. Parts 1, 2, and 3. Proceedings of the Royal Netherlands Academy of Sciences, **53**: 386-392, 521-525, and 1397-1412.

Sen PK (1968) Estimates of the regression coefficient based on Kendall's tau. Journal of the American Statistical Association. 63: 1379-1389.

Yue S and Wang C (2004) The Mann-Kendall test modified for effective sample size to detect trend in serially correlated hydrological series. Water Resources Management, 18: 201-218.

Zhang Z, Dehoff AD, Pody RD, and Balay JW (2010) Detection of streamflow change in the Susquehanna River basin. Water Resources Management, 26(10): 1947-1964.

ATTACHMENT 2

THERMAL IMPACTS IN MIXING ZONE

Thermal Impacts

Using the results of the 2-dimensional mixing-zone analysis, estimates of in-stream temperature were generated for summer and winter conditions for a range of ambient and effluent temperatures. Figures 6 and 7 present the results for the anticipated worst case conditions. In each of Figures 6 and 7, the column headings represent lateral distance from discharge, while the left most column represents the longitudinal distance downstream. Figures 6 and 7 illustrate the results corresponding to median ambient temperature and expected high effluent temperature for summer and winter, respectively. Assumed temperatures are summarised in Table 2. The largest anticipated increase in in-stream temperature, at a downstream distance of 1.0 m from the discharge point, is also presented in Table 2.

Table 2 Assumed Temperature

Season	River Ambient Temperature ºC	Effluent Temperature ºC	Largest in-Stream Difference ºC
Summer	20.5	25.0	1.5
Winter	0.55	16.0	7.3

x/y (m)	0	1	2	3	4	5	6	7	8	9	10
0	25.0	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
1	22.6	20.9	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
2	22.0	21.1	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
4	21.6	21.2	20.7	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
6	21.4	21.2	20.8	20.6	20.5	20.5	20.5	20.5	20.5	20.5	20.5
8	21.2	21.1	20.8	20.6	20.5	20.5	20.5	20.5	20.5	20.5	20.5
10	21.2	21.1	20.8	20.6	20.5	20.5	20.5	20.5	20.5	20.5	20.5
12	21.1	21.0	20.8	20.7	20.6	20.5	20.5	20.5	20.5	20.5	20.5
14	21.1	21.0	20.8	20.7	20.6	20.5	20.5	20.5	20.5	20.5	20.5
16	21.0	21.0	20.8	20.7	20.6	20.5	20.5	20.5	20.5	20.5	20.5
18	21.0	21.0	20.8	20.7	20.6	20.5	20.5	20.5	20.5	20.5	20.5
20	21.0	20.9	20.8	20.7	20.6	20.6	20.5	20.5	20.5	20.5	20.5
22	21.0	20.9	20.8	20.7	20.6	20.6	20.5	20.5	20.5	20.5	20.5
24	20.9	20.9	20.8	20.7	20.6	20.6	20.5	20.5	20.5	20.5	20.5
26	20.9	20.9	20.8	20.7	20.6	20.6	20.5	20.5	20.5	20.5	20.5
28	20.9	20.9	20.8	20.7	20.7	20.6	20.5	20.5	20.5	20.5	20.5
30	20.9	20.9	20.8	20.7	20.7	20.6	20.5	20.5	20.5	20.5	20.5
32	20.9	20.9	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
34	20.9	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
36	20.9	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
38	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
40	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
42	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
44	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
46	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.6	20.5	20.5	20.5
48	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.6	20.5	20.5	20.5
50	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.6	20.5	20.5	20.5

Figure 6 Estimated In-stream Temperature for Summer Conditions

x/y (m)	0	1	2	3	4	5	6	7	8	9	10
0	16.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
1	7.8	1.9	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
2	5.7	2.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
4	4.2	2.9	1.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
6	3.5	2.8	1.5	0.8	0.6	0.6	0.6	0.6	0.6	0.6	0.6
8	3.1	2.6	1.6	0.9	0.6	0.6	0.6	0.6	0.6	0.6	0.6
10	2.9	2.5	1.7	1.0	0.7	0.6	0.6	0.6	0.6	0.6	0.6
12	2.7	2.4	1.7	1.1	0.8	0.6	0.6	0.6	0.6	0.6	0.6
14	2.5	2.3	1.7	1.2	0.8	0.6	0.6	0.6	0.6	0.6	0.6
16	2.4	2.2	1.7	1.2	0.9	0.7	0.6	0.6	0.6	0.6	0.6
18	2.3	2.1	1.7	1.3	0.9	0.7	0.6	0.6	0.6	0.6	0.6
20	2.2	2.0	1.7	1.3	1.0	0.7	0.6	0.6	0.6	0.6	0.6
22	2.1	2.0	1.7	1.3	1.0	0.8	0.6	0.6	0.6	0.6	0.6
24	2.0	1.9	1.7	1.3	1.0	0.8	0.7	0.6	0.6	0.6	0.6
26	2.0	1.9	1.6	1.3	1.0	0.8	0.7	0.6	0.6	0.6	0.6
28	1.9	1.8	1.6	1.3	1.1	0.8	0.7	0.6	0.6	0.6	0.6
30	1.9	1.8	1.6	1.3	1.1	0.9	0.7	0.6	0.6	0.6	0.6
32	1.8	1.8	1.6	1.3	1.1	0.9	0.7	0.6	0.6	0.6	0.6
34	1.8	1.7	1.6	1.3	1.1	0.9	0.8	0.7	0.6	0.6	0.6
36	1.8	1.7	1.6	1.3	1.1	0.9	0.8	0.7	0.6	0.6	0.6
38	1.7	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.6	0.6	0.6
40	1.7	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.6	0.6	0.6
42	1.7	1.6	1.5	1.3	1.1	1.0	0.8	0.7	0.6	0.6	0.6
44	1.6	1.6	1.5	1.3	1.1	1.0	0.8	0.7	0.6	0.6	0.6
46	1.6	1.6	1.5	1.3	1.1	1.0	0.8	0.7	0.6	0.6	0.6
48	1.6	1.6	1.5	1.3	1.1	1.0	0.8	0.7	0.7	0.6	0.6
50	1.6	1.5	1.4	1.3	1.1	1.0	0.9	0.7	0.7	0.6	0.6

Figure 7 Estimated In-stream Temperature for Winter Conditions

ATTACHMENT 3

UNIONIZED AMMONIA CONCENTRATIONS IN MIXING ZONE

Unionized Ammonia In Mixing Zone

Maximum anticipated unionized ammonia concentrations in the mixing zone, for summer and winter conditions, are presented in Figures 8 and 9, respectively. In each of Figures 8 and 9, the column headings represent lateral distance from discharge, while the left most column represents the longitudinal distance downstream. Since unionized ammonia concentrations increase with increasing temperature, pH, and ambient total ammonia levels, 75th percentile values where applied for all ambient conditions. A summary of parameter assignments for this analysis is provided in Table 3. Since considerable more information is required to model in-stream pH, in order to simplify the analysis, effluent pH was assumed equal to 75th percentile ambient levels. Application of effluent pH results in end-of-pipe unionized ammonia concentrations of less than 0.1 mg/L.

Table 3 Unionized Ammonia Parameterization

Season	Temperature ºC		pH		Total Ammonia as N (mg/L)	
	River	Effluent	River	Effluent	River	Effluent
Summer	23	25	8.55	8.55	0.05	1.80
Winter	1.0	16	8.28	8.28	0.06	3.80

As illustrated in Figure 8, for summer conditions, unionized ammonia concentrations exceed the PWQO threshold of 0.02 mg/L for a region less than 3 m from the shore, and no farther downstream than 100 m. For winter conditions, Figure 9, this mixing zone is considerably smaller and is confined to 1 m from the shore and 3 m downstream.

x/y (m)	0	1	2	3	4	5	6	7	8	9	10
0	0.302	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
1	0.138	0.030	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
2	0.098	0.045	0.010	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
4	0.071	0.048	0.019	0.009	0.008	0.007	0.007	0.007	0.007	0.007	0.007
6	0.059	0.046	0.024	0.011	0.008	0.007	0.007	0.007	0.007	0.007	0.007
8	0.052	0.043	0.026	0.014	0.009	0.008	0.007	0.007	0.007	0.007	0.007
10	0.047	0.041	0.027	0.016	0.010	0.008	0.008	0.007	0.007	0.007	0.007
12	0.044	0.039	0.028	0.017	0.011	0.008	0.008	0.007	0.007	0.007	0.007
14	0.041	0.037	0.028	0.018	0.012	0.009	0.008	0.008	0.007	0.007	0.007
16	0.039	0.036	0.028	0.019	0.013	0.010	0.008	0.008	0.007	0.007	0.007
18	0.037	0.034	0.028	0.020	0.014	0.010	0.008	0.008	0.008	0.007	0.007
20	0.035	0.033	0.027	0.020	0.015	0.011	0.009	0.008	0.008	0.007	0.007
22	0.034	0.032	0.027	0.021	0.015	0.011	0.009	0.008	0.008	0.008	0.007
24	0.033	0.031	0.027	0.021	0.016	0.012	0.009	0.008	0.008	0.008	0.007
26	0.032	0.030	0.026	0.021	0.016	0.012	0.010	0.008	0.008	0.008	0.007
28	0.031	0.030	0.026	0.021	0.016	0.013	0.010	0.009	0.008	0.008	0.008
30	0.030	0.029	0.026	0.021	0.017	0.013	0.010	0.009	0.008	0.008	0.008
32	0.029	0.028	0.025	0.021	0.017	0.013	0.011	0.009	0.008	0.008	0.008
34	0.029	0.028	0.025	0.021	0.017	0.013	0.011	0.009	0.008	0.008	0.008
36	0.028	0.027	0.025	0.021	0.017	0.014	0.011	0.009	0.008	0.008	0.008
38	0.028	0.027	0.024	0.021	0.017	0.014	0.011	0.010	0.009	0.008	0.008
40	0.027	0.026	0.024	0.021	0.017	0.014	0.012	0.010	0.009	0.008	0.008
42	0.027	0.026	0.024	0.021	0.017	0.014	0.012	0.010	0.009	0.008	0.008
44	0.026	0.025	0.023	0.021	0.017	0.015	0.012	0.010	0.009	0.008	0.008
46	0.026	0.025	0.023	0.021	0.018	0.015	0.012	0.010	0.009	0.008	0.008
48	0.025	0.025	0.023	0.020	0.018	0.015	0.012	0.011	0.009	0.008	0.008
50	0.025	0.024	0.023	0.020	0.018	0.015	0.013	0.011	0.009	0.009	0.008
52	0.025	0.024	0.023	0.020	0.018	0.015	0.013	0.011	0.010	0.009	0.008
54	0.024	0.024	0.022	0.020	0.018	0.015	0.013	0.011	0.010	0.009	0.008
56	0.024	0.024	0.022	0.020	0.018	0.015	0.013	0.011	0.010	0.009	0.008
58	0.024	0.023	0.022	0.020	0.018	0.015	0.013	0.011	0.010	0.009	0.008
60	0.023	0.023	0.022	0.020	0.018	0.015	0.013	0.011	0.010	0.009	0.008
62	0.023	0.023	0.022	0.020	0.018	0.015	0.013	0.012	0.010	0.009	0.008
64	0.023	0.023	0.021	0.020	0.018	0.015	0.013	0.012	0.010	0.009	0.009
66	0.023	0.022	0.021	0.020	0.018	0.015	0.013	0.012	0.010	0.009	0.009
68	0.023	0.022	0.021	0.019	0.018	0.015	0.014	0.012	0.010	0.009	0.009
70	0.022	0.022	0.021	0.019	0.017	0.015	0.014	0.012	0.011	0.009	0.009
72	0.022	0.022	0.021	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
74	0.022	0.022	0.021	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
76	0.022	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
78	0.022	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
80	0.021	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
82	0.021	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
84	0.021	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
86	0.021	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
88	0.021	0.020	0.020	0.019	0.017	0.016	0.014	0.013	0.011	0.010	0.009
90	0.021	0.020	0.020	0.018	0.017	0.016	0.014	0.013	0.011	0.010	0.009
92	0.020	0.020	0.019	0.018	0.017	0.016	0.014	0.013	0.011	0.010	0.009
94	0.020	0.020	0.019	0.018	0.017	0.016	0.014	0.013	0.011	0.010	0.010
96	0.020	0.020	0.019	0.018	0.017	0.016	0.014	0.013	0.011	0.010	0.010
98	0.020	0.020	0.019	0.018	0.017	0.016	0.014	0.013	0.012	0.010	0.010
100	0.020	0.020	0.019	0.018	0.017	0.016	0.014	0.013	0.012	0.011	0.010

Figure 8 Mixing Zone Unionized Ammonia Concentrations (mg/L) for Summer Conditions

x/y (m)	0	1	2	3	4	5	6	7	8	9	10
0	0.202	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1	0.054	0.007	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
2	0.033	0.012	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
4	0.021	0.013	0.004	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
6	0.017	0.012	0.005	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001
8	0.014	0.011	0.006	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001
10	0.012	0.010	0.006	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001
12	0.011	0.010	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.001
14	0.010	0.009	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.001
16	0.010	0.009	0.006	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.001
18	0.009	0.008	0.006	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001
20	0.009	0.008	0.006	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001
22	0.008	0.008	0.006	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001
24	0.008	0.007	0.006	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001
26	0.008	0.007	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001
28	0.007	0.007	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001
30	0.007	0.007	0.006	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001
32	0.007	0.007	0.006	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001
34	0.007	0.006	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001
36	0.007	0.006	0.005	0.004	0.003	0.003	0.002	0.001	0.001	0.001	0.001
38	0.006	0.006	0.005	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.001
40	0.006	0.006	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001
42	0.006	0.006	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001
44	0.006	0.006	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001
46	0.006	0.006	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001
48	0.006	0.006	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001
50	0.006	0.005	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001

Figure 9 Mixing Zone Unionized Ammonia Concentrations (mg/L) for Winter Conditions

ATTACHMENT 4

TP CONCENTRATIONS IN MIXING ZONE

TP Concentrations in Mixing Zone

Maximum anticipated TP concentrations in the mixing zone are presented in Figures 10. In Figure 10, the column headings represent lateral distance from discharge, while the left most column represents the longitudinal distance downstream. Ambient TP concentrations were based on the overall 75th percentile values of background water quality data (31 µg/L), and it was assumed that the effluent TP is equivalent to the proposed limit of 0.10 mg/L (100 µg/L).

Because the ambient TP concentration exceeds the PWQO of 30 µg/L, the extent of the mixing zone cannot be defined in terms of size of the plume where the TP concentration is greater than the PWQO. However, the results indicate that the TP concentration in the mixing zone is 10 percent higher or more than the ambient TP concentration for a region less than 4 m from the shore, and no farther downstream than 112 m.

x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	100.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
2	53.982	40.785	31.755	31.011	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
4	47.251	41.604	33.946	31.349	31.018	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
6	44.269	40.982	35.250	32.024	31.140	31.011	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
8	42.491	40.282	35.893	32.683	31.378	31.055	31.005	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
10	41.278	39.664	36.191	33.210	31.669	31.144	31.022	31.002	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
12	40.382	39.138	36.310	33.607	31.963	31.267	31.056	31.009	31.001	31.000	31.000	31.000	31.000	31.000	31.000	31.000
14	39.686	38.689	36.333	33.898	32.234	31.412	31.108	31.022	31.004	31.000	31.000	31.000	31.000	31.000	31.000	31.000
16	39.125	38.303	36.302	34.109	32.473	31.564	31.174	31.044	31.009	31.001	31.000	31.000	31.000	31.000	31.000	31.000
18	38.661	37.967	36.242	34.262	32.679	31.715	31.252	31.073	31.018	31.004	31.001	31.000	31.000	31.000	31.000	31.000
20	38.268	37.673	36.165	34.370	32.854	31.860	31.336	31.111	31.031	31.007	31.001	31.000	31.000	31.000	31.000	31.000
22	37.929	37.412	36.080	34.446	33.001	31.995	31.424	31.154	31.048	31.013	31.003	31.001	31.000	31.000	31.000	31.000
24	37.634	37.179	35.991	34.497	33.125	32.120	31.512	31.203	31.070	31.021	31.005	31.001	31.000	31.000	31.000	31.000
26	37.374	36.969	35.901	34.529	33.229	32.234	31.599	31.255	31.095	31.031	31.009	31.002	31.000	31.000	31.000	31.000
28	37.142	36.779	35.813	34.548	33.315	32.337	31.684	31.309	31.124	31.044	31.014	31.004	31.001	31.000	31.000	31.000
30	36.934	36.606	35.726	34.555	33.387	32.430	31.765	31.365	31.155	31.059	31.020	31.006	31.002	31.000	31.000	31.000
32	36.745	36.447	35.641	34.554	33.446	32.513	31.841	31.420	31.189	31.076	31.028	31.009	31.003	31.001	31.000	31.000
34	36.574	36.301	35.559	34.547	33.496	32.588	31.914	31.476	31.224	31.095	31.037	31.013	31.004	31.001	31.000	31.000
36	36.417	36.166	35.481	34.535	33.536	32.655	31.982	31.530	31.260	31.116	31.047	31.017	31.006	31.002	31.000	31.000
38	36.272	36.041	35.405	34.519	33.569	32.714	32.046	31.583	31.297	31.138	31.059	31.023	31.008	31.003	31.001	31.000
40	36.139	35.924	35.332	34.499	33.595	32.767	32.105	31.634	31.334	31.162	31.072	31.029	31.011	31.004	31.001	31.000
42	36.015	35.815	35.262	34.478	33.617	32.815	32.160	31.684	31.372	31.186	31.086	31.037	31.014	31.005	31.002	31.001
44	35.900	35.713	35.195	34.455	33.633	32.857	32.212	31.732	31.409	31.211	31.101	31.045	31.018	31.007	31.002	31.001
46	35.792	35.617	35.131	34.431	33.646	32.894	32.259	31.777	31.445	31.237	31.117	31.054	31.023	31.009	31.003	31.001
48	35.691	35.527	35.069	34.406	33.655	32.928	32.303	31.821	31.481	31.263	31.134	31.063	31.028	31.011	31.004	31.002
50	35.596	35.442	35.009	34.380	33.661	32.957	32.344	31.862	31.517	31.289	31.151	31.074	31.034	31.014	31.006	31.002
52	35.507	35.362	34.952	34.354	33.665	32.983	32.382	31.902	31.551	31.315	31.169	31.085	31.040	31.018	31.007	31.003
54	35.423	35.285	34.897	34.327	33.667	33.006	32.417	31.939	31.584	31.341	31.187	31.096	31.047	31.021	31.009	31.004
56	35.343	35.213	34.844	34.301	33.666	33.026	32.449	31.975	31.617	31.367	31.206	31.108	31.054	31.025	31.011	31.005
58	35.268	35.144	34.794	34.274	33.664	33.044	32.479	32.008	31.648	31.393	31.225	31.121	31.062	31.029	31.013	31.006
60	35.196	35.078	34.744	34.248	33.661	33.060	32.506	32.040	31.679	31.418	31.244	31.134	31.070	31.034	31.016	31.007
62	35.128	35.016	34.697	34.221	33.657	33.073	32.531	32.070	31.708	31.443	31.263	31.147	31.078	31.039	31.019	31.008
64	35.063	34.956	34.651	34.195	33.651	33.085	32.555	32.099	31.737	31.468	31.282	31.161	31.087	31.045	31.022	31.010
66	35.001	34.898	34.607	34.170	33.644	33.095	32.576	32.126	31.764	31.492	31.301	31.175	31.096	31.050	31.025	31.012
68	34.942	34.844	34.565	34.144	33.637	33.104	32.596	32.151	31.790	31.516	31.320	31.189	31.106	31.057	31.029	31.014
70	34.885	34.791	34.524	34.119	33.629	33.111	32.614	32.175	31.815	31.538	31.339	31.203	31.116	31.063	31.033	31.016
72	34.831	34.741	34.484	34.094	33.621	33.117	32.631	32.198	31.839	31.561	31.357	31.217	31.126	31.070	31.037	31.018
74	34.779	34.692	34.445	34.070	33.612	33.122	32.646	32.220	31.863	31.583	31.376	31.232	31.136	31.076	31.041	31.021
76	34.729	34.646	34.408	34.046	33.602	33.126	32.660	32.240	31.885	31.604	31.394	31.246	31.147	31.084	31.046	31.024
78	34.681	34.601	34.372	34.022	33.593	33.129	32.673	32.259	31.906	31.625	31.412	31.260	31.157	31.091	31.050	31.027
80	34.634	34.557	34.336	33.999	33.582	33.131	32.685	32.277	31.927	31.645	31.430	31.275	31.168	31.099	31.055	31.030
82	34.590	34.516	34.302	33.976	33.572	33.132	32.696	32.294	31.947	31.664	31.447	31.289	31.179	31.106	31.061	31.033
84	34.547	34.475	34.269	33.953	33.562	33.133	32.706	32.310	31.965	31.683	31.464	31.303	31.190	31.114	31.066	31.037
86	34.506	34.436	34.237	33.931	33.551	33.133	32.715	32.325	31.983	31.702	31.481	31.317	31.201	31.122	31.072	31.040
88	34.466	34.399	34.206	33.910	33.540	33.133	32.723	32.339	32.001	31.719	31.498	31.331	31.212	31.130	31.077	31.044
90	34.428	34.362	34.176	33.888	33.529	33.132	32.730	32.352	32.017	31.737	31.514	31.345	31.223	31.139	31.083	31.048
92	34.391	34.327	34.146	33.867	33.518	33.131	32.737	32.365	32.033	31.753	31.530	31.359	31.234	31.147	31.089	31.052
94	34.355	34.293	34.118	33.847	33.507	33.129	32.743	32.376	32.048	31.770	31.545	31.372	31.245	31.156	31.095	31.056
96	34.320	34.260	34.090	33.827	33.496	33.126	32.748	32.387	32.063	31.785	31.560	31.385	31.256	31.164	31.102	31.061
98	34.286	34.228	34.063	33.807	33.484	33.124	32.753	32.398	32.076	31.800	31.575	31.399	31.267	31.173	31.108	31.065
100	34.254	34.197	34.036	33.787	33.473	33.121	32.758	32.408	32.090	31.815	31.589	31.412	31.278	31.181	31.114	31.070
102	34.222	34.167	34.011	33.768	33.462	33.118	32.761	32.417	32.102	31.829	31.603	31.424	31.289	31.190	31.121	31.074
104	34.191	34.137	33.986	33.750	33.451	33.114	32.765	32.426	32.114	31.843	31.617	31.437	31.300	31.199	31.128	31.079
106	34.162	34.109	33.961	33.731	33.440	33.110	32.768	32.434	32.126	31.856	31.630	31.449	31.310	31.207	31.134	31.084
108	34.133	34.081	33.937	33.713	33.429	33.106	32.770	32.441	32.137	31.869	31.643	31.462	31.321	31.216	31.141	31.089
110	34.105	34.054	33.914	33.696	33.418	33.102	32.772	32.448	32.147	31.881	31.656	31.474	31.331	31.225	31.148	31.094
112	34.078	34.028	33.891	33.678	33.407	33.098	32.774	32.455	32.157	31.893	31.669	31.485	31.342	31.233	31.155	31.099
114	34.052	34.003	33.869	33.661	33.396	33.093	32.775	32.461	32.167	31.905	31.681	31.497	31.352	31.242	31.162	31.105
116	34.026	33.978	33.848	33.644	33.385	33.089	32.776	32.467	32.176	31.916	31.692	31.508	31.362	31.251	31.168	31.110
250	33.189	33.143	33.076	32.988	32.883	32.762	32.628	32.485	32.337	32.189	32.043	31.902	31.771	31.649	31.540	31.443
500	32.830	32.776	32.716	32.651	32.581	32.508	32.431	32.351	32.269	32.185	32.100	32.016	31.933	31.851	31.772	31.696
1000	32.616	32.570	32.523	32.473	32.423	32.371	32.319	32.265	32.211	32.157	32.102	32.047	31.993	31.939	31.885	31.833
2000	32.465	32.431	32.396	32.360	32.324	32.288	32.251	32.214	32.177	32.140	32.102	32.065	32.027	31.990	31.953	31.916

Figure 10 Maximum Anticipated TP Concentrations In The Mixing Zone

From:	Fowler, Craig (MOECC)
To:	Melody Johnson; Slattery, Barbara (MOECC)
Cc:	Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca); Andrea Dwight; Michael Newbigging
Subject:	RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC"s outstanding comments
Date:	Monday, December 05, 2016 7:38:37 AM
Attachments:	image002.jpg

Sounds good Melody. Thanks.

Craig

From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: December 4, 2016 8:05 PM
To: Fowler, Craig (MOECC); Slattery, Barbara (MOECC)
Cc: Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca); Andrea Dwight; Michael Newbigging
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Craig,

Thank you for clarifying that MOECC wishes to see the results of DO modelling to determine impacts, if any, of the proposed discharge on DO concentrations in the receiver. We have contacted GRCA to obtain any data they have available regarding stream cross section and/or slope in the vicinity of the proposed outfall. Once we obtain this information, we will proceed with a desk-top modelling exercise and summarize these results for MOECC's review.

Upon completion of the modelling, we will also prepare a consolidated document that summarizes a timeline of this study, key results of our data analysis, and the proposed effluent objectives and limits for a new WWTP in the vicinity of Waldemar, ON. We will ensure all memoranda, reports, and correspondence related to this study are appended to the summary report.

To clarify the process we have followed for this study, our approach (as documented in our ACS report dated March 29, 2016) follows the standard procedure we have used for other, similar studies in Ontario. BOD and DO were addressed in the ACS report (Sections 2.13 and 3.1); based on our technical evaluation of ambient water quality, proposed discharge volume, and proposed effluent cBOD limit of 10 mg/L, no formal DO modelling was recommended at that time. Written comments regarding the ACS report that we received from MOECC, and issues raised by MOECC and GRCA during our August 2016 meeting, did not identify DO as an item of concern. Now that this concern has been raised, we are more than willing to conduct the required follow-up work to ensure MOECC is satisfied with the technical aspects of our ACS.

As noted above, we will be submitting a consolidated document to you once the DO modelling activities are complete. At that time, provided there are no outstanding concerns, we understand that a formal response will be provided by Barb Slattery on behalf of the MOECC.

Thanks,

Melody Johnson, M.A.Sc., P.Eng., Senior Consultant
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From: Fowler, Craig (MOECC) [mailto:Craig.Fowler2@ontario.ca]
Sent: December 1, 2016 9:18 AM
To: Melody Johnson <melody@bskyeng.com>; Slattery, Barbara (MOECC) <barbara.slattery@ontario.ca>
Cc: Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>; wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca) <Michael.Hulley@rmc.ca>; Andrea Dwight <Andrea@bskyeng.com>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Melody,

I'm not sure what you mean by requirements that need to be met with respect to the proposed effluent objectives and limits. Outside of the finalized ACS, I can't think of any other requirements relating to the assessment of the receiver. In principle, the proposed objectives/limits have been accepted, but the assessment will need to include a discussion of CBOD/DO. I take responsibility for not clearly communicating the need to evaluate the potential impacts related to CBOD/DO. To be fair, the ministry's role is to review the proposal, not to prescribe what is required particularly with completing an ACS, which is where the consultants expertise factors in. Submitting parts of an assessment piecemeal and asking what is required essentially means to me "Is this the bare minimum that is acceptable?" Where there are obvious omissions then my role is to provide feedback and I have erred in this regard, but the study with respect to this parameter could've also been raised by those involved completing the study. The fact that DO concentrations demonstrate desirable background water quality does not exclude it from the assessment, so yes CBOD/DO (depending what side of the coin you wish to discuss) modelling will be required.

In terms of receiving a formal response I think I addressed that yesterday. I would like to see a final report that has all of the information in one document.

If there are any questions or concerns remaining, I suggest that we have a teleconference.

Regards,

Craig Fowler, M.Sc.| Surface Water Specialist | Technical Support Section| Ministry of the Environment and Climate Change| 119 King St. West, 12th Floor, Hamilton, Ontario, L8P 4Y7 | ph: 905-521-7823 | fax: 905-521-7820 | craig.fowler2@ontario.ca

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From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: November 30, 2016 10:31 AM
To: Fowler, Craig (MOECC); Slattery, Barbara (MOECC)
Cc: Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca); Andrea Dwight
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Craig,

I apologize if my email wasn't clear. We understood that your concerns would be related to the potential for DO sag in the receiver. However, my intention was to point out that this issue had not been raised before, and also to indicate that the background DO concentrations are quite high – thus, potentially the reason that this was not raised as an item of concern by MOECC or GRCA up to this point.

At this time, we are looking for clear direction from MOECC regarding what requirements need to be met to obtain agreement with respect to the proposed effluent objectives and limits for a new WWTP in the vicinity of Waldemar. Will DO modelling be required before a formal response will be provided by MOECC?

Thanks,

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From: Fowler, Craig (MOECC) [mailto:Craig.Fowler2@ontario.ca]
Sent: November 30, 2016 8:42 AM
To: Melody Johnson <melody@bskyeng.com>; Slattery, Barbara (MOECC) <barbara.slattery@ontario.ca>
Cc: Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>; wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca) <Michael.Hulley@rmc.ca>; Andrea Dwight <Andrea@bskyeng.com>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Melody,

Let me clarify, I wasn't referring to the policy status with respect to dissolved oxygen, but rather the potential/resulting concentrations of DO in the river from the discharge. More specifically, what is the effect of the oxygen-demanding substances in the discharge on DO and the minimum concentration of DO i.e. sag point that could be expected within the river/mixing zone.

Anything formal will come from Barb Slattery as she is the point of contact for the EA process. That said, before anything formal comes from the ministry I think it is appropriate to have a final and complete report that has incorporated the various revisions/updates and would ultimately be what is deemed acceptable.

Regards,

Craig Fowler, M.Sc.| Surface Water Specialist | Technical Support Section| Ministry of the Environment and Climate Change| 119 King St. West, 12th Floor, Hamilton, Ontario, L8P 4Y7 | ph: 905-521-7823 | fax: 905-521-7820 | craig.fowler2@ontario.ca

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From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: November 30, 2016 8:07 AM
To: Fowler, Craig (MOECC); Slattery, Barbara (MOECC)
Cc: Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca); Andrea Dwight
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Craig,

Thank you for your note.

Per our records, DO was not discussed at our August 15th meeting, nor do we remember it being raised as an item of concern by MOECC or GRCA. (See the last page of the attached meeting notes – phosphorus and temperature in the mixing zone were discussed.) The Grand River was determined to be Policy 1 with respect to DO in the vicinity of the proposed outfall. For your ease of reference, below please find the summary of background DO concentrations in the receiver that was included in our ACS report.

Table 7 Summary of Grand River Dissolved Oxygen Near Outfall

Season	Median DO (mg/L)	25th Percentile DO (mg/L)	Number of Observations
Winter (Dec - Feb)	12.8	12.2	55
Spring (Mar - May)	12.2	11.2	98
Summer (Jun - Sep)	10.6	9.8	156
Fall (Oct - Nov)	12.4	11.5	64

We trust that the above addresses concerns related to DO.

Will the MOECC be issuing a formal letter stating that the proposed effluent limits have been deemed acceptable?

Thanks,

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From: Fowler, Craig (MOECC) [mailto:Craig.Fowler2@ontario.ca]
Sent: November 28, 2016 9:55 AM
To: Melody Johnson <melody@bskyeng.com>; Slattery, Barbara (MOECC) <barbara.slattery@ontario.ca>
Cc: Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>; wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca) <Michael.Hulley@rmc.ca>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Melody,

I find the report acceptable in terms of the parameters that were discussed, proposed effluent limits, and the resulting water quality changes within the mixing zone. After the meeting Aug 14/16 I thought I had also mentioned looking at dissolved oxygen and if I remember correctly CVC had also mentioned temperature (which has been addressed) and dissolved oxygen at some point as well.

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From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: November 28, 2016 8:34 AM
To: Fowler, Craig (MOECC); Slattery, Barbara (MOECC)
Cc: Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca)
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Craig / Barbara:

Has the MOECC completed the review of our letter dated September 23, 2016? Craig, we did receive your follow-up question re: mixing zone (see email chain below), however we have yet to receive a formal response from MOECC. Please let us know the anticipated timing for the review comments at your earliest convenience. For your ease of reference, I have attached the letter to this email.

As we had discussed during our last meeting, we would like to obtain the MOECC's agreement, in principle, to the proposed effluent requirements for a new WWTP in Waldemar, ON operating at a rated ADF capacity of 552 m3/d. This information will then be used to assess alternatives and develop treatment options for consideration as part of the on-going Class EA process.

Thanks, and have a great day.

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From: Melody Johnson
Sent: October 3, 2016 8:24 AM
To: 'Fowler, Craig (MOECC)' <Craig.Fowler2@ontario.ca>
Cc: Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>; wbroos@rogers.com; lwolfenberg@asi-group.com; Slattery, Barbara (MOECC) <barbara.slattery@ontario.ca>; Michael Hulley (Michael.Hulley@rmc.ca) <Michael.Hulley@rmc.ca>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Craig,

The mixing zone is normally defined as the point at which PWQO's are achieved. In the case of a Policy 2 parameter, PWQO will never be achieved, and an alternative boundary is required.

In light of this, we chose to define the extent of the zone within which the total phosphorus concentration is >10% above ambient concentrations. This is a reasonable threshold for defining the boundary at which effluent impact on phosphorus concentration is marginal. The modelled concentrations of TP within the receiver, using the ambient value of 30 ug/L as a "baseline", are presented in Figure 10 of our September 23, 2016 letter.

Let me know if you have any other comments or concerns.

Thanks,

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From: Fowler, Craig (MOECC) [mailto:Craig.Fowler2@ontario.ca]
Sent: September 30, 2016 9:22 AM
To: Melody Johnson <melody@bskyeng.com>
Cc: Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>; wbroos@rogers.com; lwolfenberg@asi-group.com; Slattery, Barbara (MOECC) <barbara.slattery@ontario.ca>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Melody,

I have one question regarding the section on total phosphorus. How does the ambient concentration exceeding the PWQO prevent the definition of the mixing zone? If the ambient concentration is above the PWQO then that is the baseline used for the assessment and it will be lower than the sewage discharge. My understanding is that the PWQO shouldn't factor into the mixing zone analysis.

Regards,

Craig Fowler, M.Sc.| Surface Water Specialist | Technical Support Section| Ministry of the Environment and Climate Change| 119 King St. West, 12th Floor, Hamilton, Ontario, L8P 4Y7 | ph: 905-521-7823 | fax: 905-521-7820 | craig.fowler2@ontario.ca

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From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: September 28, 2016 8:31 AM
To: Slattery, Barbara (MOECC)
Cc: Fowler, Craig (MOECC); Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Thanks for the update. We look forward to hearing from MOECC.

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From: Slattery, Barbara (MOECC) [mailto:barbara.slattery@ontario.ca]
Sent: September 28, 2016 8:27 AM
To: Melody Johnson <melody@bskyeng.com>
Cc: Fowler, Craig (MOECC) <Craig.Fowler2@ontario.ca>; Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hello Melody, your letter/report is in the queue for review and I hope to be able to get back to you with any comments, suggestions etc. that we will have by this time next month.

From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: September 23, 2016 10:27 AM
To: Slattery, Barbara (MOECC); Fowler, Craig (MOECC); Wingate, Wendy (MOECC); scooke@grandriver.ca; Mark Anderson; lwolfenberg@asi-group.com; wbroos@rogers.com; cgervais@amaranth-eastgary.ca; Michael Newbigging
Cc: Michael Hulley
Subject: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

All:

Attached please find a letter that addresses the comments raised by MOECC during our meeting held on August 15, 2016. Should you have any questions or concerns related to the attached, please do not hesitate to contact me.

Thanks, and have a great weekend.

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APPENDIX G
DISSOLVED OXYGEN MODELLING

Assessment of In-stream Dissolved Oxygen Impacts Associated with the Proposed Waldemar WWTP Discharge

1. Overview of In-stream Dissolved Oxygen Assessment

The goal of this assessment was to determine the approximate impact on in-stream dissolved oxygen levels associated with the proposed Waldemar WWTP discharge, during summer low flow conditions. To achieve this, a straightforward Streeter-Phelps dissolved oxygen model, developed by the Alabama Department of Environmental Management (ADEM, 2001) was applied. In addition, the hydrodynamics of the Grand River near Waldemar were defined using GRCA's hydrodynamic river model, which is based on the U.S. Corps of Engineers HEC-RAS model. A brief summary of the approach, parameter assignments, and results are provided below. In general, results indicate that the proposed Waldemar WWTP discharge will have no significant impact on in-stream dissolved oxygen levels.

2. Methodology

ADEM's dissolved oxygen model combines oxygen demand associated with organic nitrogen, sediments, and biochemical oxygen demand, with re-aeration, to estimate in-stream dissolved oxygen under steady-state conditions. Model application requires discretization of the river, downstream of the waste discharge, into reasonably homogenous reaches, with reach specific velocity, depth, and re-aeration. Reach definition downstream was based on GRCA's HEC-RAS model discretization. GRCA's HEC-RAS model defines reaches based on cross-section geometry and slope over a distance of about 4.5 km downstream of the Waldemar WWTP, reach lengths vary from 60 m to about 320 m. A low flow of 0.4 m^3/s was applied to the HEC-RAS model, and site-specific velocity and depth were extracted from the HEC-RAS results for use in ADEM's dissolved oxygen model.

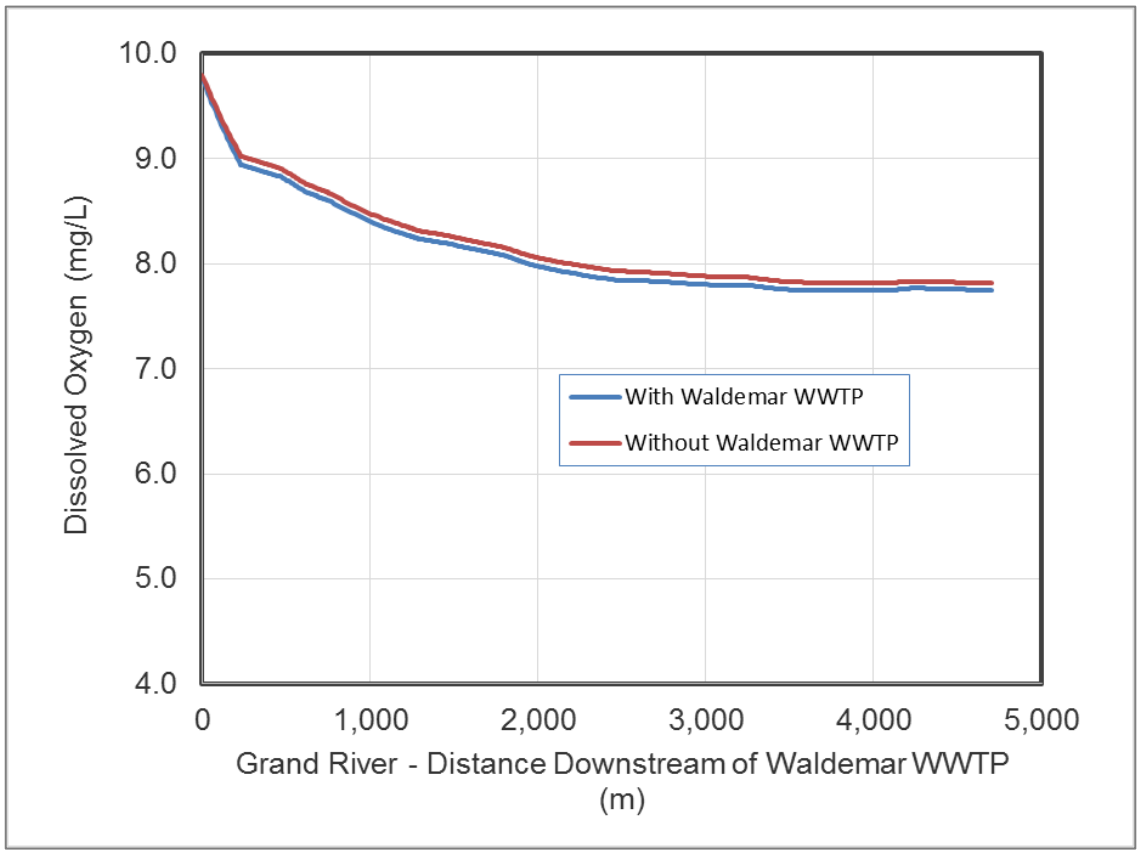
Re-aeration is a critical factor in any dissolved oxygen model, and in this application, reach-specific re-aeration rate constants were defined using an empirical model as recommended by USGS (Melching and Flores, 1999). In general, velocity, flow and river bed slope are used as a basis for estimation of individual re-aeration constants, that are in-turn used in ADEM's dissolved oxygen model.

Ambient water quality was defined according to 75th percentile water quality, as summarized in XCG's recent Assimilative Capacity Assessment (XCG, 2016). Total ammonia, temperature and dissolved oxygen (25th percentile) concentrations were 0.05 mg/L, $23^{o}C$, and 9.8 mg/L, respectively. In-stream BOD was not addressed in the recent assimilative capacity assessment, and was assumed to be 3 mg/L for this analysis.

Effluent quality was defined according to recommended effluent limits presented in the recent assimilative capacity assessment (XCG, 2016). Effluent BOD and total ammonia were defined as 10 mg/L and 1.8 mg/L, respectively.

3. Results

A plot of dissolved oxygen downstream of the proposed Waldemar WWTP discharge is provided below. Results with and without the additional effluent are included. As illustrated, the dissolved oxygen impact associated with the WWTP discharge is marginal. The initial drop in dissolved oxygen within the first few hundred meters of the discharge is not a result of the effluent loading, but rather is a result of either an under-estimation of re-aeration rate constants, or an over-estimation of in-stream BOD and nitrogen.



4. Conclusion

The proposed Waldemar WWTP effluent will have no significant impact on in-stream dissolved oxygen levels in the Grand River.