

APPENDIX - R (RAMARA)

GENIVAR CONSULTANTS LP (FORMERLY JAGGER HIMS) TECHNICAL MEMORANDUMS

Ramara Surface Water (Lagoon City and South Ramara):

- Technical Memorandum M1 - Drinking Water Issues Evaluation

Ramara Groundwater:

- Technical Memorandum M2 - Drinking Water Issues Evaluation

DILLON CONSULTING LIMITED: WELL HEAD TIME OF TRAVEL CAPTURE ZONE PEER REVIEW EVALUATION RESULTS

- Dillon Consulting Limited WHPA Peer Review Report Memo
- Wellhead Time of Travel Capture Zone Peer Review Evaluation Results
 - Table 1: Bayshore Village
 - Table 2: Val Harbour Subdivision

W.F. BAIRD & ASSOCIATES COASTAL ENGINEERS LTD. (BAIRD 2010D)

Ramara:

Surface Water Vulnerability Analysis for LSRCA, Township of Ramara Intakes – Lagoon City and South Ramara

Date: July 23, 2010
To: Don Goodyear, P.Geo. – South Georgian Bay Lake Simcoe Protection Region
From: Sarah Dignard/Colleen Barfoot/Lloyd Lemon, P.Geo.
Project No.: 071948.08
Subject: Drinking Water Issues Evaluation – Ramara Surface Water
Township of Ramara – Lagoon City/Brechin WTP and South Ramara WTP

OBJECTIVE:

To document the Drinking Water Issues Evaluation for the surface water supply for the Township of Ramara in the South Georgian Bay Lake Simcoe Source Protection Region.

OVERVIEW:

Work has been completed to meet the requirements of Technical Rules 114 through 117 of the Technical Rules: Assessment Report, *Clean Water Act, 2006* as provided by the Ontario Ministry of the Environment on December 12, 2008 and as amended in November 2009. The Drinking Water Issues Evaluation portion focuses on identifying recurring water quality impacts or situations with a possibility of impacting drinking water sources in the short-term. This work results in a preliminary list of identified issues.

The approach for the Drinking Water Issues Evaluation is described in more detail in “Technical Memorandum A5 - Drinking Water Issues Evaluation Methods”. The steps included:

- Step 1:** Assemble Available Data
- Step 2:** Review Data and Identify Drinking Water Issues
- Step 3:** Evaluate Drinking Water Issues
- Step 4:** Identify Contributing Area for Drinking Water Issues
- Step 5:** Prepare List of Drinking Water Issues

Municipal Surface Water Intake and Supply**Lagoon City/Brechin Water Treatment Plant**

The Lagoon City/Brechin Water Treatment Plant draws raw water from Lake Simcoe. The treatment process consists of pre-chlorination, coagulation with alum, flocculation, and filtration through sand and granular activated carbon and post-chlorination with sodium hypochlorite.

Three vertical turbine pumps draw water from Lake Simcoe to a low lift pumping station, located at the WTP. The intake pipe into Lake Simcoe is 485 m with a diameter of 300 mm. The total depth at the intake is assumed to be 4.5 m for this study.. The rated capacity for the Lagoon City/Brechin WTP is 4000 m³/day.

The water intake line is equipped with manually cleaned screens. Raw water is pre-chlorinated with sodium hypochlorite and injected with alum at the low lift pumping station well. The low lift pumping station also contains a plasma sparker for zebra mussel control. This sparker is utilized in the summer months when activity is increased.

Water is pumped into the flocculation tank before passing through two filter adsorbers. The filter media consist of granular activated carbon and sand. The filtered water is then injected with sodium hypochlorite prior to discharge to the clear well. The treated water is stored in a 1,091 m³ clear well located under the WTP. The treated water is then fed to the distribution system by five vertical turbine pumps. The water distribution system includes a 945 m³ elevated water reservoir located in Brechin.

Continuous on-line water quality analyzers monitor the free chlorine residual, pH and turbidity of each filter's effluent and of the treated water before it enters the distribution system. The analyzers are logged continuously by the paperless chart recorder and have alarm set points to notify the operators of adverse water quality results

South Ramara Water Treatment Plant

The South Ramara Water Treatment Plant (WTP) serves the communities of Heritage Farms and Mara Shore Estate. The water supply source for South Ramara is Lake Simcoe. A redwood intake crib is located approximately 80 m from shore in 2.7 m of water. A 150 mm diameter intake pipe connects it to an on-shore low-lift pumping station. The intake is equipped with a chlorine injection line and diffuser for zebra mussel control. The chlorine feed system was connected in the spring of 2001. The rated capacity for the Heritage Farm WTP is 387 m³/day.

Two package water treatment units are utilized in parallel. Treatment consists of a flocculation tank, settling tank and mixed media filter. Raw water is injected with alum and sodium hypochlorite. The filters consist of granular activated carbon (GAC), sand, and gravel.

Treated water is injected with sodium hypochlorite for primary disinfection and discharged to the two above ground clear wells that are operated in series, with a total volume of 170 m³. Treated water is pumped to the distribution system by two high lift pumps.

Continuous on-line water quality analyzers monitor the free chlorine residual, pH, and turbidity of each filter's effluent and of the treated water before it enters the distribution system. The analyzers are logged continuously by the paperless chart recorder and have alarm set points to notify the operators of adverse water quality results.

Step 1: Assemble Available Data

The data sources that were reviewed to identify potential issues included:

- Heritage Farm WTP Annual Municipal Water Supply Quality Data (2002-2007);
- Lagoon City WTP Annual Municipal Water Supply Quality Data (2001-2007);
- Lagoon City WTP Water Chemistry Data (2001);
- Heritage Farm WTP Water Chemistry Data (2001);
- Lagoon City Source Water Assessment Survey (2006);
- South Ramara Source Water Assessment Survey (2006);
- Operator Interview.

Mr. Dave Stephen, Manager of Environmental Services for the Township of Ramara, was interviewed to obtain operator insight into potential issues identified in the published data as well as identifying potential issues that may not have been identified in published data.

Step 2: Review Data and Identify Drinking Water Issues

Tables M1-1 and M1-2 have been prepared to document a series of potential issues from the raw and treated water at the Lagoon City/Brechin and South Ramara Water Treatment Plants in the Township of Ramara, as identified from various data sources. Tables M1-1 and M1-2 are designed to document:

- 1) The source reports or data that result in the identification of a parameter as a potential Drinking Water Issue;
- 2) Results of comparison of observed parameter concentrations to relevant benchmarks and situations where:
 - a. Parameter concentrations exceed the primary benchmark established by the Ontario Drinking Water Quality Standard (ODWQS);
 - b. Parameter concentrations exceed a locally established benchmark value (typically a background concentration);
 - c. Parameter concentrations exceed the established method detection limit (MDL) [typically applied for organic chemical parameters];
- 3) Professional judgment on the reliability of the data based on the number of measurements and the relative consistency of the observed occurrence;
- 4) The nature of observed trends in parameter concentrations;
- 5) Input from local System Operators and other Stakeholders as to the significance of the parameter as a Drinking Water Issue;
- 6) Whether treatment is in place for the observed parameters and its effectiveness; and
- 7) The nature of the source of the parameter listed as a potential issue.

Trends were determined through graphing selected parameters of the municipal water supply system water quality data. Selected parameters listed on the preliminary list of drinking water threats for each well have been assessed graphically for trends. The available data has been provided between 2002 and 2007 for the South Ramara WTP, and between 2001 and 2007 for the Lagoon City/Brechin Water Treatment Plant.

Step 3: Evaluate Drinking Water Issues

Tables M1-1 and M1-2 have been developed to identify Drinking Water Issues in accordance with the “Decision Process for Identification and Evaluation of Drinking Water Issues” as presented in Figure A5-1 of the “Technical Memorandum A5 - Drinking Water Issues Evaluation Methods”.

The positive or negative responses entered in Tables M1-1 and M1-2 correspond to the steps in the decision process. Professional judgment was built into the decision process in the evaluation of data reliability to identify anomalous conditions and in the consideration of operational insights. Trend analysis was used to identify parameters that are projected to exceed the ODWQS within approximately 50 years. Tables M1-1 and M1-2 also allow for the identification of the source of the potential Drinking Water Issue, whether treatment is in place, and its effectiveness.

For the Lagoon City/Brechin and South Ramara Water Treatment Plants, all of the parameters identified in Tables M1-1 and M1-2 are not considered to be Drinking Water Issues. Parameters that were removed from consideration include:

- Coliforms and E.Coli are typically absent but can be observed on rare occasions in low numbers. The presence of coliforms and E.Coli in the raw water is not persistent or indicative of deterioration of raw water quality. Treatment is in place and is effective.
- Although the water quality data is not available for these parameters, cryptosporidium and giardia cysts have been identified in Lake Simcoe as a potential concern. These parameters are not considered to be Drinking Water Issues as they will be treated effectively and in accordance with Safe Drinking Water Act regulations.

- Aluminum concentrations exceed ODWQS objectives in the treated water at both water treatment plants and are considered to be residual from the use of a coagulant during the treatment process and not related to raw water quality. Planned optimizations of the treatment process should help to maintain aluminum concentrations at safe levels.
- Hardness is a naturally occurring parameter that is not considered to result in the deterioration of the water quality to limit use as a source of drinking water.
- Organic nitrogen concentrations occasionally exceed ODWQS. This parameter is not considered to result in the deterioration of the water quality to limit drinking water use.
- Concentrations of sodium are consistently less than the ODWQS value of 200 mg/L in the raw and treated water at the Lagoon City/Brechin and Heritage Farm WTP. The sodium concentration data displays either constant or reducing trends. Sodium is therefore not considered to be a Drinking Water Issue at these locations but should be closely monitored. Concentrations have exceeded the guideline of 20 mg/L. Sodium is a concern at 20 mg/L as the Medical Officer of Health is to advise individuals on low-sodium diets. Observed concentrations of sodium are variable and the source has not been confirmed, but is typically related to winter de-icing or septic system effluents from water softeners. Reduction of sodium use in the contributing watershed would be beneficial to the drinking water quality.
- Trihalomethanes are present in treated water at the Lagoon City/Brechin WTP in trace concentrations and are a byproduct of disinfection by chlorination. Concentrations are typically well below ODWQS values. Although it displays an increasing trend, concentrations are not projected to exceed ODWQS values within 50 years. Tests are currently being conducted in order to optimize the coagulation process and reduce the concentrations of byproducts.

Step 4: Identifying Contributing Area for Drinking Water Issues

No parameters were identified as Drinking Water Issues at the Lagoon City/Brechin and South Ramara WTP.

Step 5: Prepare List of Drinking Water Issues

No parameters were identified as Drinking Water Issues at the Lagoon City/Brechin and South Ramara WTP.

LAL/SJD:Inc

Date: July 26, 2010
To: Don Goodyear, P.Geo. – South Georgian Bay Lake Simcoe Protection Region
From: Sarah Dignard/Lloyd Lemon, P.Geo.
Project No.: 071948.08
Subject: Drinking Water Issues Evaluation – Ramara Groundwater
Township of Ramara

OBJECTIVE:

To document the Drinking Water Issues Evaluation for the groundwater supply for the Township of Ramara in the South Georgian Bay Lake Simcoe Source Protection Region.

OVERVIEW:

Work has been completed to meet the requirements of Technical Rules 114 through 117 of the Technical Rules: Assessment Report, *Clean Water Act, 2006* as provided by the Ontario Ministry of the Environment on December 12, 2008 and as amended in November 2009. The Drinking Water Issues Evaluation portion focuses on identifying recurring water quality impacts or situations with a possibility of impacting drinking water sources in the short-term. This work results in a preliminary list of identified issues to be evaluated.

The approach for the Drinking Water Issues Evaluation is described in more detail in “Technical Memorandum A5 - Drinking Water Issues Evaluation Methods”. The steps included:

- Step 1:** Assemble Available Data
- Step 2:** Review Data and Identify Potential Drinking Water Issues
- Step 3:** Evaluate Drinking Water Issues
- Step 4:** Identify Contributing Area for Drinking Water Issues
- Step 5:** Prepare List of Drinking Water Issues

Municipal Wells and Aquifers

The Township of Ramara Water Supply consists of several individual water works, including the groundwater wells at the Bayshore Village Well Supply, the Davy Drive Well Supply, the Park Lane Well Supply, as well as the Val Harbour Well Supply. It also includes two water treatment plants with surface water intakes in Lake Simcoe at Lagoon City and South Ramara, which are discussed in detail in separate technical memoranda. Additionally, the Township of Ramara receives some water from the Washago Water Treatment Plant in the Township of Severn. Groundwater is typically obtained from a fractured bedrock system without the protection of significant and continuous overburden cover.

Bayshore Village Well Supply

The Bayshore Village Well Supply serves the Bayshore Village residential community, which currently consists of approximately 750 residents in the Township of Ramara. The Well Supply consists of three deep wells, a building housing chlorination equipment, three high lift pumps, metering equipment, a treated water reservoir, and an emergency generator. Well #3 uses a 409 L/min, 7.5 hp submersible pump set in a 205 mm diameter steel casing at a depth of 11.9 m. Well #4 uses a 1682 L/min, 7.5 hp

submersible pump set in a 203 mm diameter steel casing at a depth of 11 m. Well #5 uses a 500 L/min, 7.5 hp submersible pump set in a 203 mm steel casing at a depth of 13.1m. Raw water is injected with sodium hypochlorite for disinfection. The distribution system services 348 residential lots and a system capacity of 1,243.8 m³/day. The Bayshore Village wells are typically screened into a mixture of fractured bedrock and overburden material.

Davy Drive Well Supply

The Davy Drive Well Supply supplies water to the Riverleigh Woods Subdivision located on Lot 17, Concession 7, which consisted of 42 residential lots in 2007 with a total estimated population of 100 residents. The Well Supply consists of three wells which are located in and in proximity to the Water Works building. Well #1 is 152 mm in diameter and 75 m deep, with a 127 mm steel casing to a depth of 6.7 m. It uses a 65 m³/d, 1.5 HP Goulds submersible pump installed at a depth of 61 m. Well #2 is 150 mm in diameter and 76 m deep, with a 152 mm diameter steel casing to a depth of 6.7 m. It uses a 33 m³/d, 1.5 HP Berkeley submersible pump installed at a depth of 6.7 m. Well #3 is 152 mm in diameter and 60 m deep, with a 152 mm diameter steel casing sleeve to a depth of 9.1 m. It uses a 65 L/min, 1.0 HP Goulds pump installed at a depth of 30 m. In 2007, Well #2 and Well #3 were used for the majority of the water taking with Well #1 used as a stand-by well. The treatment process includes the injection of potassium permanganate for iron and manganese oxidation, green sand filters and sodium hypochlorite disinfection. A fourth well is also present but was not in use in 2007. The system capacity is 75.7 m³/day. The Davy Drive wells are typically screened within a granite formation.

Park Lane Well Supply

The Park Lane Well Supply supplies water to the Park Lane Subdivision which consists of 19 lots, with an estimated population of 42 residents. The Well supply consists of two wells located in and in proximity to the Water Works building. Well #1 utilizes a 68 L/min, 1.5 HP Goulds submersible pump installed at a depth of 45.7m, with a 165 m steel casing sleeve to a depth of 45.7 m. Well #2 utilizes a 66 L/min, ¾ HP Goulds submersible pump installed at a depth of 20.0 m, with a 165 mm steel casing sleeve to a depth of 12 m. The treatment process includes the injection of sodium hypochlorite for iron oxidation and primary disinfection, potassium permanganate for iron and manganese oxidation and green sand filters.

Val Harbour Well Supply

The Val Harbour Well Supply supplies water to the Val Harbour Subdivision which consists of 74 residential lots with a total estimated population of approximately 148 residents. The Well Supply consists of two wells. Well #1 utilizes a 45 L/min submersible pump installed at a depth of 16.7 m, with a 150 mm steel casing sleeve to a depth of 16.7 m. Well #2 utilizes a 127 L/min submersible pump installed at a depth of 11.9 m, with a 150 mm steel casing sleeve. A capped third well is used for static water level monitoring but is not connected to the Water Works. There are plans to connect the third well to the system in the near future to serve as an additional water source. The treatment process includes the injection of sodium hypochlorite for primary and secondary disinfection.

Step 1: Assemble Available Data

The data sources that were reviewed to identify potential issues included:

- The Corporation of the Township of Ramara Bayshore Village Water Works Annual Report, (2003, 2004, 2005, 2006, 2007);
- The Corporation of the Township of Ramara Davy Drive Water Works Annual Report, (2003, 2004, 2005, 2006, 2007);
- The Corporation of the Township of Ramara Park Lane Water Works Annual Report, (2003, 2004, 2005, 2006, 2007);

- The Corporation of the Township of Ramara Val Harbour Water Works Annual Report, (2003, 2004, 2005, 2006, 2007);
- Township of Ramara Raw Water Data, Bayshore Village (2003, 2004, 2005, 2006, 2007);
- Township of Ramara Raw Water Data, Davy Dr. (2003, 2005, 2006, 2007);
- Township of Ramara Raw Water Data, Park Lane (2003, 2004, 2005, 2006, 2007);
- Township of Ramara, Raw Water Data, Val Harbour (2003, 2004, 2005, 2006, 2007);
- Township of Ramara, Water Quality Laboratory Certificates, Bayshore Village (2003, 2004, 2005, 2006, 2007);
- Township of Ramara, Water Quality Laboratory Certificates, Davy Drive (2003, 2004, 2005, 2006, 2007);
- Township of Ramara, Water Quality Laboratory Certificates, Park Lane (2003, 2004, 2005, 2006, 2007);
- Township of Ramara, Water Quality Laboratory Certificates, Val Harbour (2003, 2004, 2005, 2006, 2007);
- Township of Ramara, Environmental Services Report (2007);
- C.C. Tatham and Associates Ltd., Source Protection Pre-Screening Survey Township of Ramara; Final Report (2006);
- Township of Ramara, Bayshore Village Water Works Amended Certificate of Approval (2006);
- Township of Ramara, Davy Drive Water Works Amended Certificate of Approval (2005);
- Township of Ramara, Park Lane Water Works Amended Certificate of Approval (2005);
- Township of Ramara, Val Harbour Water Works Amended Certificate of Approval (2005);
- Township of Ramara, Bayshore Village Water Works Permit to Take Water (2004);
- Township of Ramara, Davy Drive Water Works Permit to Take Water (2003);
- Township of Ramara, Val Harbour Water Works Permit to Take Water (2001); and
- Operator Interview.

Mr. Dave Stephen, Manager of Environmental Services for the Township of Ramara was interviewed to obtain operator insight into potential issues identified in the published data as well as identifying potential issues that may not have been identified in published data to date.

Step 2: Review Data and Identify Potential Drinking Water Issues

A set of tables have been prepared to document a series of potential issues from the raw and treated water at the Township of Ramara as identified from various data sources. The tables are as follows:

Table Number	Township of Ramara Water Works	Water Type	Water Source
M2-1A	Bayshore Village	Raw	Well #3
M2-1B			Well #4
M2-1C			Well #5
M2-1D		Treated*	
M2-2A	Davy Drive	Raw	Well #1

Table Number	Township of Ramara Water Works	Water Type	Water Source
M2-2B	Davy Drive		Well #2
M2-2C			Well #3
M2-2D			Well #4
M2-2E			Treated*
M2-3A	Park Lane	Raw	Well #1
M2-3B			Well #2
M2-3C		Treated*	
M2-4A	Val Harbour	Raw	Well #1
M2-4B			Well #2
M2-4C		Treated*	

* The treated water data collected may reflect the use of any or all wells in that particular water system.

The tables are designed to document:

- 1) The source reports or data that result in the identification of a parameter as a potential Drinking Water Issue;
- 2) Results of comparison of observed parameter concentrations to relevant benchmarks and situations where:
 - a. Parameter concentrations exceed the primary benchmark established by the Ontario Drinking Water Quality Standard (ODWQS);
 - b. Parameter concentrations exceed a locally established benchmark value (typically a background concentration);
 - c. Parameter concentrations exceed the established method detection limit (MDL) [typically applied for organic chemical parameters];
- 3) Professional judgment on the reliability of the data based on the number of measurements and the relative consistency of the observed occurrence;
- 4) The nature of observed trends in parameter concentrations;
- 5) Input from local System Operators and other Stakeholders as to the significance of the parameter as a Drinking Water Issue;
- 6) Whether treatment is in place for the observed parameters and its effectiveness; and
- 7) The nature of the source of the parameter listed as a potential issue.

Trends were determined through graphing municipal water supply system water quality data. Parameters listed on the preliminary list of drinking water threats for each well have been assessed graphically for trends. The available data has been provided between 1998 and 2007.

Step 3: Evaluate Drinking Water Issues

The M2 series of tables have been developed to identify Drinking Water Issues in accordance with the “Decision Process for Identification and Evaluation of Drinking Water Issues” as presented in Figure A5-1 of “Technical Memorandum A5 - Drinking Water Issues Evaluation Methods”.

The positive or negative responses entered in the M2 series of tables correspond to the steps in the decision process. Professional judgment was built into the decision process in the evaluation of data

reliability to identify anomalous conditions and in the consideration of operational insights. Trend analysis was used to identify parameters that are projected to exceed the ODWQS within approximately 50 years. The M2 series of tables also allow for the identification of the source of the potential Drinking Water Issue, whether treatment is in place, and its effectiveness.

For each of the water supply systems, all of the parameters identified in the M2 tables are not considered to be Drinking Water Issues. Parameters common to most systems in the Township of Ramara that were removed from consideration include:

- Coliforms and E.Coli are typically absent but can be observed on rare occasions in low numbers. The presence of coliforms and E.Coli in the raw water is not persistent or indicative of deterioration of raw water quality. Disinfection is in place and is effective.
- Organic parameters, such as bromodichloromethane, bromoform, chloroform, dibromochloromethane and trihalomethanes, are present in trace concentrations in treated water as byproducts of disinfection by chlorination. Concentrations are typically well below ODWQS values and do not display increasing trends.
- Other organic parameters present in trace concentration, such as benzene, methane, dioxin and furan are not considered to represent Drinking Water Issues as: they were not consistently measured above the detection limit in other samples; concentrations are well below ODWQS values; and do not display increasing trends. The sources of these parameters are not known.
- Colour, dissolved organic carbon, dissolved solids, hardness and sulphate have occasionally exceeded aesthetic or operational objectives. Most of these are considered to be naturally-occurring parameters and none display increasing trends. These parameters are not considered to result in the deterioration of the water quality for use as a source of drinking water.
- Concentrations of iron, manganese, and turbidity have occasionally exceeded aesthetic or operational objectives. These parameters are considered to be naturally-occurring and are not likely to result in the deterioration of the water quality for use as a drinking water source. Treatment of these parameters is provided at Davy Drive and Park Lane in the form of green sand filtration.
- Organic nitrogen concentrations occasionally exceed ODWQS aesthetic objectives. This parameter is not considered to result in the deterioration of the water quality for use as a drinking water source.
- Lead concentrations have exceeded ODWQS objectives under circumstances that are considered to be anomalous at Bayshore Village and Davy Drive Well Supplies. Concentrations have consistently shown to be under ODWQS objectives during other sampling events and are not increasing. This parameter is therefore not considered to result in the deterioration of the water quality for use as a source of drinking water.
- Concentrations of sodium are consistently less than the ODWQS value of 200 mg/L in the raw and treated water from the Township of Ramara wells. The sodium concentration data usually displays no discerning trend, or an increasing trend in the case of Wells #4 and #5 at Bayshore Village. Concentrations are not expected to exceed the ODWQS value within the next 50 years. Sodium is therefore not considered to be a Drinking Water Issue at these locations but should be closely monitored. Concentrations have exceeded the guideline of 20 mg/L. Sodium is a concern at 20 mg/L as the Medical Officer of Health is to advise individuals on low-sodium diets. Observed concentrations of sodium are variable and the source has not been confirmed, but is typically related to winter de-icing or septic system effluents from water softeners. Reduction of sodium use in the contributing watershed would be beneficial to the drinking water quality.

Step 4: Identifying Contributing Area for Drinking Water Issues

No parameters were identified as Drinking Water Issues at the Township of Ramara groundwater wells.

Step 5: Prepare List of Drinking Water Issues

No parameters were identified as Drinking Water Issues at the Township of Ramara groundwater wells.

LAL/SJD:nah

Table M2-1B

Evaluation of Drinking Water Issues

Municipality: Township of Ramara
 Community: Bayshore Village
 Drinking Water Source: Well #4
 Issues Review Date: February 27 2009

Information Sources:
 Watershed Characterization: Annual Water Quality Reports: 1998-2007
 Interview (person/title/date): Dave Stephen / Manager of Environmental Services / May 13, 2009

Parameter	Identified From						Compare Water Quality Data to Benchmarks				Confirm Data Reliability						Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment							
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Confirm Presence						Trend Reviewed	Increasing	Reducing	Constant/Uncertain			Will Exceed ODWQS within 50 Years	Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation					
												Sufficient Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance													Data Reliable				
Pathogens																																		
Coliforms				Y				Y				Y				Y					Y				N				NO			Y	Y	Y
E. Coli				Y				Y						Y	Y						Y				N				NO			Y	Y	Y
Chemicals																																		
Colour				Y				Y				Y				N		Y						Y			N		NO	Y				
Dissolved Organic Carbon				Y				Y				Y				N		Y						Y			N		NO	Y				
Hardness				Y				Y				Y			Y									Y			N		NO	Y				
Iron				Y				Y				Y				N		Y						Y			N		NO	Y				
Lead				Y				Y				Y			Y									Y			N		NO	Y				
Organic Nitrogen				Y				Y				Y		Y		N		Y						Y			N		NO			Y		
Manganese				Y				Y				Y				N		Y						Y			N		NO	Y				
Sodium				Y						Y		Y	Y			N		Y	Y					N			N		NO				Y	

Table M2-2B

Evaluation of Drinking Water Issues

Municipality: Township of Ramara
Community: Davy Drive
Drinking Water Source: Well #2
Issues Review Date: March 2 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 1998-2007
Interview (person/title/date): Dave Stephen / Manager of Environmental Services / May 13, 2009

Table with 26 columns: Parameter, Identified From (8 sub-columns), Compare Water Quality Data to Benchmarks (4 sub-columns), Confirm Data Reliability (7 sub-columns), Evaluate Trends (5 sub-columns), Operational Consideration, Drinking Water Issue, Source of Issue (5 sub-columns), Treatment. Rows include Pathogens (Coliforms), Chemicals (2,4-dichlorophenol, Colour, Hardness, Iron, Lead, Manganese, Sodium).

Table M2-2C

Evaluation of Drinking Water Issues

Municipality: Township of Ramara
Community: Davy Drive
Drinking Water Source: Well #3
Issues Review Date: March 2 2009

Information Sources:
 Watershed Characterization:
 Annual Water Quality Reports: 1998-2007
 Interview (person/title/date): Dave Stephen / Manager of Environmental Services / May 13, 2009

Parameter	Identified From						Compare Water Quality Data to Benchmarks				Confirm Data Reliability						Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue					Treatment			
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Confirm Presence						Trend Reviewed	Increasing	Reducing	Constant/Uncertain			Will Exceed ODWQS within 50 Years	Natural	Threat			In Place	Effective Mitigation		
												Sufficient Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance									Data Reliable	Threat (Known)				Threat (Unknown)	
Pathogens																																
Coliforms				Y			Y				Y			Y	N	Y			Y		N	NO						Y	Y	Y		
E.Coli				Y			Y				Y		Y	Y	N	Y			Y		N	NO						Y	Y	Y		
Chemicals																																
Colour				Y			Y				Y			Y	N	Y			Y		N	NO	Y									
Hardness				Y			Y				Y	Y			N	Y			Y		N	NO	Y									
Iron				Y			Y				Y	Y			N	Y			Y		N	NO	Y						Y	Y		
Manganese				Y			Y				Y	Y			N	Y			Y		N	NO	Y						Y	Y		
Sodium				Y					Y		Y	Y			N	Y			Y		N	NO			Y			Y				

Table M2-2D

Evaluation of Drinking Water Issues

Municipality: Township of Ramara
Community: Davy Drive
Drinking Water Source: Well #4
Issues Review Date: March 2 2009

Information Sources: Watershed Characterization:
 Annual Water Quality Reports: 1998-2007
 Interview (person/title/date): Dave Stephen / Manager of Environmental Services / May 13, 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability						Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue				Treatment					
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Confirm Presence						Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation					
												Sufficient Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance													Data Reliable				
Chemicals																																		
Colour				Y				Y				Y	Y				N	Y				Y	N					NO						
Iron				Y				Y				Y	Y				N	Y				Y	N					NO					Y	Y



July 29, 2010

Lake Simcoe Region Conservation Authority
120 Bayview Parkway
Newmarket, Ontario
L3Y 4X1

Attention: Mr. Don Goodyear, Source Protection Manager

WHPA Peer Review Report

Dear Mr. Goodyear:

Dillon Consulting Limited (Dillon) was retained by the Lake Simcoe Region Conservation Authority (LSRCA) to conduct Peer Reviews of well head protection area (WHPA) mapping for 86 municipal groundwater systems. These systems are located in the South Georgian Bay Lake Simcoe Source Protection Region. External management of the project was conducted by Mr. Dave Ketcheson, P.Eng of Azimuth Environmental Consulting Inc. The results of the peer review are issued in the form of digital spreadsheet files that are attached to this letter. The project scope and peer review methodology is summarized in the letter herein.

PROJECT SCOPE

LSRCA retained Dillon to conduct a 'high level' peer review of the WHPAs that were largely delineated as part of previous WHPA or regional groundwater studies, at a time prior to the finalization of the Director Rules. In general, WHPA delineation was based on an assortment of different model types, including fixed radius, 2-D analytical solutions and numerical 3-D flow modeling. In general, more sophisticated models were applied to those systems where more data was available. The focus of the peer review was on whether the methodologies were consistent with those outlined in the Director Rules, rather than a more traditional technical modeling critique. Evaluations also identified critical issues or deficiencies that would have implications on subsequent steps in the source protection process, so that these may be addressed as part of the Assessment Report. The review also identifies long-term opportunities for improvement in subsequent rounds of the process, recognizing the various levels of effort applied in WHPA delineation across the region (i.e., analytical vs. numerical methods), and the availability of data in the various WHPA settings.

Peer reviewers were Rob Kell, M.A.Sc., P.Eng, P.Geo.; Jeff Hachey, M.Sc. and Darin Burr, M.Sc. P.Geo, all hydrogeologists with Dillon.

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130
Dufferin Avenue
London, Ontario
Canada
N6A 5R2
Mail: Box 426
London, Ontario
Canada
N6A 4W7
Telephone
(519) 438-6192
Fax
(519) 672-8209

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Evaluation of the WHPAs was performed in a systematic fashion following a “score card” approach. The score card contained both objective and subjective criteria that were evaluated for each system. This template approach enabled reviewers to maintain a level of consistency during the reviews, and was suited to the “high level” nature of the evaluation. The criteria that were evaluated is listed below:

Objective Criteria	Subjective Criteria
Was modeled pumping rate appropriate?	Complexity of geological Setting
Were approved models and methods used?	Appropriateness of Flow Model
	Reasonableness of input parameters
	Adequate incorporation of natural flow field
	Model Calibration
	Incorporation of Uncertainty

For each criterion, a score between 1 and 10 was awarded. In general, a score <5 for any of the criteria would be given if a critical concern was identified that would either significantly affect the reliability of the WHPAs, or is a contravention of the elements of the Directors Rules. An exception for this rule would be the evaluation of the uncertainty criterion. Failure to adequately incorporate uncertainty into the model results was not deemed a requirement of the Director Rules and therefore would not necessarily cause the system to “fail”. Details on conditions that would cause an unacceptable evaluation at the criteria level are presented in the score card sheets.

All systems were given a “pass”, “fail” or “conditional pass” result, depending upon the analysis results. A “pass” ranking was given for those systems where the methodology was generally consistent with the Director Rules, and no critical deficiencies were noted. A “conditional pass” was granted, where the potential for considerable uncertainty in the results existed, but either little data was available to improve the accuracy of the results, or it was the reviewer’s opinion that the uncertainty on the results would not significantly alter the enumeration of land parcels that may contain significant threats.



Following criteria scoring, the individual scores were weighted, and summed to produce an overall system score (between 1 and 10) for the WHPA delineation. Higher the score, the more favorable are the results of the evaluation. Please note that this scoring is a relative ranking between the systems, and is not to be interpreted as any type of marking. For example, a score of 6 does not mean a 60% mark, but rather is a system whose delineated WHPAs are deemed more conservatively robust (in lieu of available data) than a system that receives a score of 5. Theoretically, a system evaluated via fixed radius that is very conservative could receive a higher system score than a detailed numerical model result that is not conservative, as the risk of under-representing the area where significant threats may be lower.

RESULTS

The results of the evaluation are presented on digital Excel™ spreadsheets for each system, and are grouped by township or separated municipality name. Rationale for the individual criteria evaluations, along with the criterion scores, overall system scores and recommendations for future improvement are presented on the individual sheets.

LIMITATIONS

This report was prepared exclusively for the purposes, project and site location(s) outlined in the report. The report is based on information provided to, or obtained by Dillon Consulting Limited ("Dillon") as indicated in the report, and applies solely to site conditions existing at the time of the assessment. Although a reasonable assessment was conducted by Dillon, Dillon's assessment was by no means exhaustive and can not be construed as a certification or acceptance of the reviewed reports. Rather, Dillon's report represents a reasonable review of available information within an agreed work scope, schedule and budget. Further review and updating of the peer review reports will be required as local and site conditions, and the regulatory and planning frameworks, change over time.

This report was prepared by Dillon for the sole benefit of our Client. The material in it reflects Dillon's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Lake Simcoe Region Conservation Authority
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CLOSURE

We appreciate the opportunity to work with LSCRCA on this assignment. If you have any questions about this report, please contact the undersigned.

Yours sincerely,

DILLON CONSULTING LIMITED


Darin Burr, M.Sc., P.Geo.
Project Manager

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Encl.

Table 1: BAYSHORE VILLAGE - WELL HEAD TIME OF TRAVEL CAPTURE ZONE PEER REVIEW EVALUATION RESULTS

GENERAL					
System Name:	Bayshore Village Well Supply				
Reviewed Report:	North Simcoe Groundwater Study, WHPA-Township of Ramara, Appendix H				
Terms of Reference:	Ontario Ministry of the Environment and Energy, 2001; Groundwater Studies, 2001/2002, Technical Terms of Reference, November 2001.				
Model Type:	US EPA WhAEM2000				
Score:	6.9				
Pass:	Yes				
Critique Ref:	Group 1 Peer Review Score Card Results_030210				
System Characteristics					
Hydrogeological Complexity	Low, confined bedrock aquifer. Aquifer is bedrock and confined overlying sand and gravel				
Spatial variability in Aquifer Vulnerability	Low				
Known water Quality Issues	None				
EVALUATION RESULTS					
Criterion		Awarded Score	General Comments	Comments / Recommendations	
				Critical Deficiencies	Long-term opportunities
Objective Criteria					
1. Were reasonable pumping rates used and documented?		10	Modelled at average permitted rate for each well	None	Should pumping regime change, then model should be updated.
2. Were rule-approved models and methods used?		Pass	2-D Analytical Solution deemed adequate as little information is available, and complexity is Low.	None	Perform continuous updating and verification of the model data
Subjective Criteria					
3a. Is geological setting complex?	10	8	Low to Medium complexity. Aquifer is confined, and aquitard is relatively continuous. Surface water is nearby; however, system is reported to be non-GUDI.	None	
3b. Is Geological Model / Understanding Adequate for assessment method selected?	10	5	Model based primarily on water well records and geological mapping. Few high quality data points available. Confined nature of system and low pumping rate allows a simple conceptual model to be adequate. Lower score reflective of lack of high quality data points	None	
4. Is Flow Model Complexity Appropriate?	10	7	Yes - 2D analytical flow model used, however, considering predictable groundwater flow direction, and confined nature of aquifer, model is deemed adequate.	None	
5. Are model input parameters (recharge, porosity, K) reasonable?	5	6	Generally yes - K values are based on pumping tests. Recharge is low, which is conservative. Porosity is considered high. Lower score is given because of potentially non-conservative porosity (10%) given to fractured rock	None	

6. Was natural flow field adequately incorporated into model? (Numerical Model)	10	N/A		None	
7. Was natural flow field adequately incorporated into model? (Analytical Model)	10	8	Yes - Analytical model results use natural flow field as input. Capture zones are well oriented in direction of natural gradient. No boundary condition effects applicable for this model solution		
8. Was the Model Calibrated?	5	7	2-D Analytical model cannot be calibrated; however, actual data (potentiometric surface) is used in analysis.	None	
9. Was Uncertainty considered in the analysis?	5	7	Uncertainty was used to calculate all capture zones. Method included increasing width and length of capture zones by 20% to account for variations in K, and the direction of capture zone by 5 degrees to account for changes in flow field	None	
10. What is the Uncertainty?		High	Designation not provided in report, but Dillon recommends that it be assessed as high	None	

Table 2: VAL HARBOUR - WELL HEAD TIME OF TRAVEL CAPTURE ZONE PEER REVIEW EVALUATION RESULTS

GENERAL					
System Name:	Val Harbour Subdivision				
Reviewed Report:	North Simcoe Groundwater Study, WHPA-Township of Ramara, Appendix H; Capture Zone and Equipotential Surface Review (Golder, 2010)				
Terms of Reference:	Ontario Ministry of the Environment and Energy, 2001; Groundwater Studies, 2001/2002, Technical Terms of Reference, November 2001.				
Model Type:	US EPA WhAEM2000				
Score:	7.9				
Pass:	Yes				
Critique Ref:	Sent to Client_Peer Review Score Card Results_051410_3				
System Characteristics					
Hydrogeological Complexity	Low, limestone bedrock aquifer confined by till				
Spatial variability in Aquifer Vulnerability	Low - low vulnerability extending over small capture zone				
Known water Quality Issues	None				
EVALUATION RESULTS					
Criterion		Awarded Score	General Comments	Comments / Recommendations	
				Critical Deficiencies	Long-term opportunities
Objective Criteria					
1. Were reasonable pumping rates used and documented?		7	Wells 1 and 2 were modelled at 10 and 19 m3/day, respectively, which is equivalent to the 2002 average pumping rate of 29 m3/day. The depth of the wells is roughly 20 m. No documentation on whether this rate meets future demands, so lower score given, but overall is deemed acceptable	None	Determine committed population requirements to ensure that it is within permitted rate. Confirm with municipality that modelled rates represent likely conditions. Should pumping regime change, then model should be updated.
2. Were rule-approved models and methods used?		Pass	2-D Analytical Solution is permitted by technical rules	None	Perform continuous updating and verification of the model data
Subjective Criteria					
3a. Is geological setting complex?	10	9	Low complexity. Bedrock aquifer confined by approximately 17 m of clay till under artesian conditions. Well depths are generally 20m. Low pumping rates, and reasonably predictable natural gradient as a result of nearby Lake Simcoe suggest that capture zones are reliable.	None	
3b. Is Geological Model / Understanding Adequate for assessment method selected?	10	7	Model based primarily on water well records and geological mapping. Confined nature of system and low pumping rate allows a simple conceptual model to be adequate. Close proximity of surface water (Lake Simcoe) increases predictability of natural gradients. It is noted that there are few wells upgradient of system, which adds some uncertainty for the direction of the capture zone.	None	Confirm regional gradient in confined aquifer
4. Is Flow Model Complexity Appropriate?	10	7	Yes - 2D analytical flow model used, however, considering predictable groundwater flow direction resulting from close proximity of Lake Simcoe (constant head) to the south and relatively uniform topographical slope to the northeast, and confined nature of aquifer, model is deemed adequate.	None	Update capture zones using 3-D numerical calibrated model
5. Are model input parameters (recharge, porosity, K) reasonable?	5	8	Generally yes - K values are based on an pumping tests, and porosity is reasonable. Recharge (35 mm/year) is considered conservative.	None	

6. Was natural flow field adequately incorporated into model? (Numerical Model)	10	N/A		None	
7. Was natural flow field adequately incorporated into model? (Analytical Model)	10	8	Generally Yes - Analytical model results use natural flow field as input. The accuracy of this model type is highly dependant on correctly mapping gradient directions, which are fairly predictable in this setting considering the proximity of Lake Simcoe, and generally even topography slope. No boundary condition effects applicable for this model solution	None	Confirm regional gradient conditions in aquifer. Currently, there are few wells upgradient of system in the vicinity of capture zones..
8. Was the Model Calibrated?	5	7	2-D Analytical model cannot be calibrated; however, actual data (potentiometric surface) is used in analysis.	None	
9. Was Uncertainty considered in the analysis?	5	10	Uncertainty incorporated into all capture zones. Uncertainty was incorporated into model by adding shape factors which increased the length and width of the capture zone by 20 percent, and adjusted the angle by 5 degrees. Report states that capture zones reach recharge area within 255 days.	None	
10. What is the Uncertainty?		High	Designation not provided in report, but Dillon recommends that it be assessed as high	None	