DRINKING WATER SOURCE PROTECTION

ACT FOR CLEAN WATER

Thames-Sydenham and Region Source Protection Committee

Upper Thames River Source Protection Area

Assessment Report

Appendices

Approved

September 16, 2015

St. Clair Conservation

Lower Thames Conservation

UPPER THAMES RIVER CONSERVATION AUTHORITY

Ontario

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Appendix 2 – Section Summaries

This section is no longer part of the Assessment Report. Section Summaries will be updated to reflect the updates to the Assessment Report and will be available on the web site.

Appendix 3 – System Summaries

This section is no longer part of the Assessment Report. System Summaries will be updated to include policy summaries and will be available on the web site.

Appendix 4 – Assessment Report Consultation

Assessment Report Consultation Plan

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

Thames-Sydenham and Region
Source Protection Region

Assessment Report Consultation Plan

June 10, 2011

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1 Background

The Clean Water Act requires the completion of Assessment Reports which will contain the science on which the Source Protection Plan will be based. These reports will identify vulnerable areas, assess the vulnerability of those areas, identify water quality issues related to the water sources and assess the risks to the water systems. General Regulation 287/07 under the Clean Water Act requires consultation on the Assessment Report.

Work on the components of the Assessment Report (AR) is being undertaken by various leads through partnerships involving system operating authority and CA staff. The following table summarizes the various projects and the systems included in those projects. It is generally anticipated that the work on the systems within a project will be completed together and this will determine when the work from a system can begin the peer review and consultation processes. Peer review involves the review of the work for technical completeness and whether it meets provincial rules and guidance. It is generally accepted that only the vulnerability assessment requires peer review due to the highly technical nature of this work. Upon completion of the peer review, stakeholder consultation on the delineation and vulnerability assessment of the vulnerable areas can be initiated. When the other components of the Assessment Report are complete consultation on those parts can be initiated. The regulations also require that the specific consultation be undertaken on the draft and proposed Assessment Reports.

Table 1 - Assessment Report technical studies

Ground-water		Surface Water	
Projects	**Systems**	**Projects**	**Systems**
Perth	Stratford St Marys West Perth -Mitchell Perth East -Shakespeare (& Milverton)* Perth South - St Pauls, Sebringville*	Essex Chatham Kent	Wallaceburg Wheatley South Chatham Kent/Chatham
London-Middlesex	City of London - Fanshawe, Hyde Park Thames Centre - Thorndale, Dorchester Kilworth Heights Subdivision, Melrose, Mount Brydges Birr	West Elgin	West Elgin
Oxford	Woodstock, Innerkip Ingersoll, Beachville-Loweville Mount Elgin* Embro, Lakeside* Thamesford Tavistock, Hickson-King*	Southern Lake Huron	LAWSS* Petrolia*
Chatham-Kent	Ridgetown Highgate		
GUDI Studies	St. Marys Oxford (Thamesford, Woodstock) City of London (Fanshawe) Thames Centre (Dorchester) Middlesex Centre (Kilworth Heights Subdivision) Chatham-Kent (Highgate)	IPZ-3 Studies	LAWSS, Petrolia Wallaceburg, Wheatley, Erie Beach West Elgin Lake St. Clair intakes (Essex Region SPA)

Municipalities identified with an asterisk (*) include vulnerable areas from water systems in neighbouring municipalities
Note: Milverton is outside of the TSR SP Region but included in the technical study

The Assessment Reports are to be submitted to the MOE one year from the approval of the Terms of Reference (April 20, 2010). MOE has accepted that it is unlikely that all work on the Assessment Report will be completed by the due date in the larger and more complex regions. They have therefore accepted that some components of the Assessment Report will be identified as data gaps at the time of submission of the first Assessment Report. There is an expectation that work would continue on those gaps in parallel with work on the Source Protection Plans. The remaining aspects would be expected to be submitted sufficiently in advance of the due date of the Source Protection Plan to allow for the approval of that work prior to the completion of the Source Protection Plan. Those aspects of the Assessment Report which we expect cannot be completed prior to the submission of the Assessment Report are identified in Phase 4 in the following table.

Due to the size and complexity of the AR it is not adequate to await its completion prior to initiation of consultation. Instead, a phased approach to consultation is proposed and described in the consultation plan. This Consultation Plan outlines the planned consultation on the Assessment Report in the Thames-Sydenham and Region.

2 Purpose

This consultation plan is intended to:

- Describe the consultation on the vulnerability assessment work including vulnerability zones (the lines on the map); Issues and Threats; Risk Assessment; and Tier 1 Water Budget.
- Meet the requirements of the Clean Water Act and related regulations and rules.
- Allow adequate opportunity for stakeholder input into the technical work comprising the Assessment Report.
- Increase the local community awareness of the Source Protection Planning process

3 Consultation Overview

In order to allow for adequate stakeholder engagement in the development of the Assessment Report a phased approach to consultation is planned. These phases allow multiple opportunities for stakeholders to be involved in the consultation process. The phases will allow multiple times and locations to be involved. The phases align with the availability of technical reports. The phases are also intended to target local information at the local communities. The 4 phases of consultation are described in the following table

Table 2 - Consultation phases

Phase	Description	Anticipated consultation
1. Vulnerability Assessment (Draft)	• WHPA –A, B, C, D delineations • IPZ -1, 2 delineations • Vulnerability scores • List of activities which would be threats with a given vulnerability score	• Dependant on completion of work by consultants • Dependant on completion of peer review including possible revisions as a result of peer review comments • Local targets (systems or groups of nearby systems) • Municipal information packages
2. Issues and Threats (Final Draft)	• Vulnerable areas from previous consultation • HVA, SGRA • IPZ3 (preliminary)	• Local targets • Municipal consultation

	• Issues • Conditions • Significant Risks (preliminary)	
3. Assessment Report	• Proposed draft containing all aspects of the Assessment Report except for those identified in Phase 4 below.	• Regional open houses/public meeting • Internet posting and notices • Municipal and First Nations consultation required
4. After submission of the first Assessment Report	• Tier 3 Water Budget – SGRA Vulnerability Assessment • Significant Risks - Refinements based on site specific Risk Assessment • IPZ 3 vulnerability assessment • GUDI based WHPAs (WHPA E and F) • Prior to completion of SP Plan	• Consultation on the additional components • Consultation on the proposed AR – required regional open houses/ public meeting • Municipal and First Nations consultation required

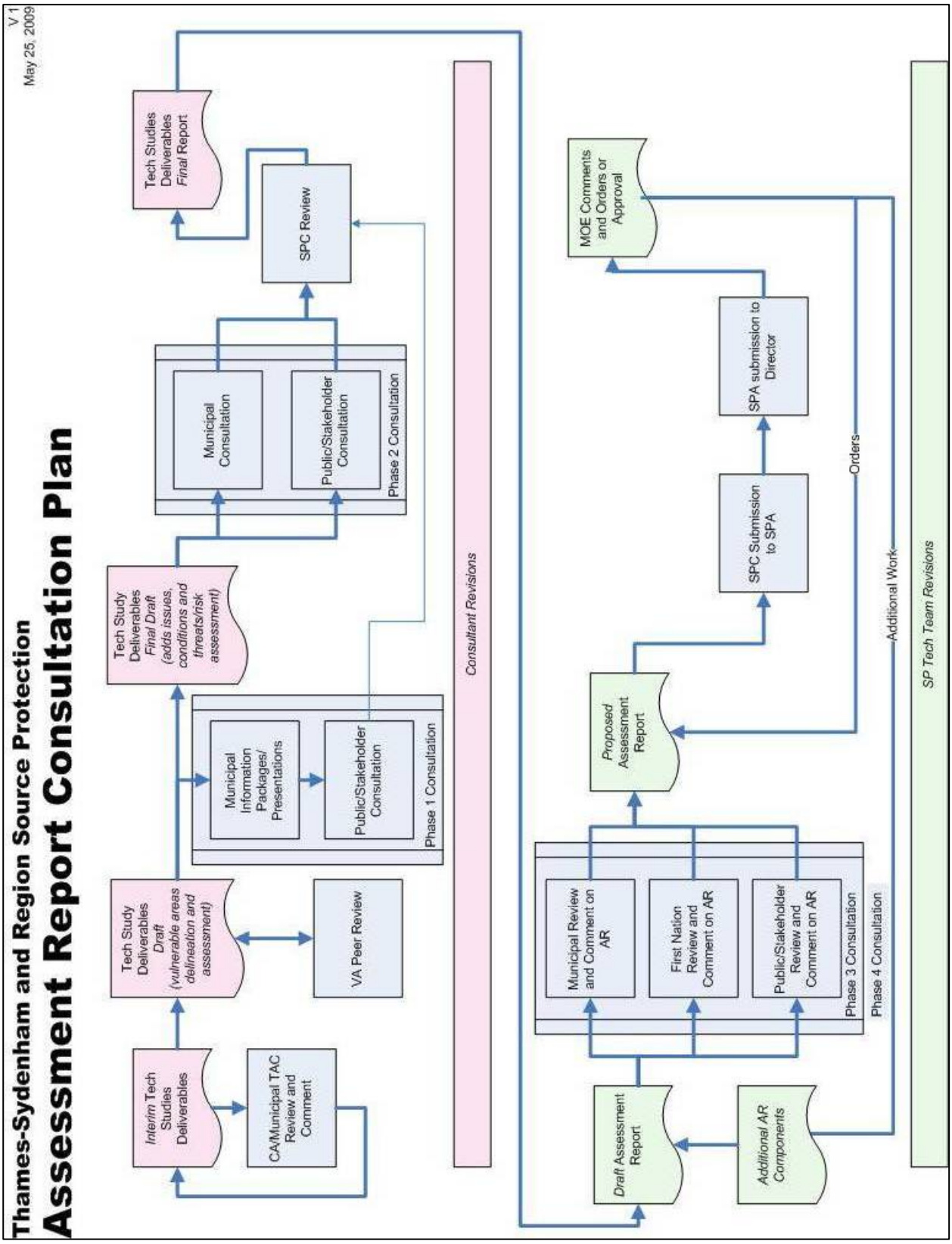

Figure 1 - Consultation plan overview

4 Target Audiences

4.1 Municipalities which do not include lands within vulnerable areas

While these municipalities are not directly impacted by some aspects of the Source Protection planning process, it is important to maintain a flow of information to ensure they understand the process and the scope of the impacts in the region. Information will be made available to these municipalities on a regular basis. The focus on the municipalities outside of vulnerable areas will be on the process and to work ahead.

4.2 Municipalities which include jurisdiction within vulnerable areas

These municipalities need to be kept current and engaged with the Source Protection planning Process. Their participation will include all four phases of the consultation process. Significant effort will be focused on engaging those communities containing Wellhead Protection Areas (WHPA) and Intake Protection Zones which are likely to be the focus of many of the policies of the Source Protection Plans.

4.3 Land owners within vulnerable areas

These landowners may or may not be impacted by the Source Protection planning process. They will be included in all four phases of consultation. The early phases of the consultation are intended to allow these landowners to determine how closely they should remain involved in the Source Protection Planning process.

4.4 Landowners that are or could be a significant risk

At this point, these landowners have not been identified. They will be included in consultation in phase 1 as they are within the vulnerable areas. Specific efforts will be made to directly engage them in Phase 2 and 3 of the consultation. The regulation requires that landowners who are known to be involved in an activity which poses a significant risk to municipal drinking water source be contacted as part of the consultation on the Assessment Report.

4.5 First Nations

At this point, no First Nation Systems are part of the Source Protection Plan. Efforts will continue to involve First Nations in initiating technical studies. Once a system is identified, formal consultation on the vulnerability assessment will commence. Until this time, First Nation Communities will be kept informed of the Source Protection planning process.

4.6 General Public

The general public outside of vulnerable zones will be kept informed about the Source Protection planning process. It is important that all landowners have an opportunity to understand the process and to determine that, in fact, their properties lie outside of a vulnerable zone and therefore, are not directly impacted by this process.

5 Approaches to Consultation

5.1 Phase 1 – September 2009 – August 2010

Phase I involves consultation on the identification of vulnerable areas and a general overview of threats and issues. The key messages to be communicated will include details regarding the planning process to date, local vulnerable areas and scores, the science behind the vulnerability mapping and the next steps.

5.1.1 Municipalities which do not include lands within a vulnerable area

- distribution of updates and other printed material
- invitations to public meetings held throughout the region

5.1.2 Municipalities which include jurisdiction within a vulnerable area

- letter and package of information to municipality which includes maps of vulnerable areas
- meeting with municipal staff/council as required

5.1.3 Land owners within a vulnerable area

- A series of public meetings will be held as outlined in Appendix C. The meetings will each be held from 3:00 – 7:00 as an open house format. A 10 minute presentation will be available throughout the meeting as required.

5.1.4 First Nations (not within a vulnerable area)

- general distribution of tabloid
- public meetings

5.1.5 General Public

- invitation through newspapers for public meeting
- media articles
- general distribution of tabloid
- response to requests for information/presentations

5.2 Phase 2 – November 2009 – August 2010

Phase 2 Consultation involves the results of issues evaluation, threats assessment and the Tier 1 Water Budget. The key messages to be communicated will include details regarding the planning process to date, how threats are determined, the science behind the threats assessment and the next steps.

5.2.1 Municipalities which do not include a vulnerable area

- distribution of updates and other printed material
- invitations to public meetings held throughout the region

5.2.2 Municipalities which include jurisdiction within a vulnerable area

- letter and package of information to municipality which includes maps of vulnerable areas
- meeting with municipal staff/council as required

5.2.3 Land owners within a vulnerable area:

- A series of public meetings will be held as outlined in Appendix C. The meetings will each be held from 3:00 – 7:00 as an open house format. A 10 minute presentation will be available throughout the meeting as required.

5.2.4 Landowners that are or could be a significant risk

- direct mail followed with a kitchen table meetings with any landowner who is a significant risk, when information becomes available

5.2.5 First Nations not a vulnerable area

- general distribution of tabloid
- public meetings

5.2.6 General Public

- invitation through newspapers for public meeting
- media articles
- general distribution of tabloid
- response to requests for information/presentations

5.3 Phase 3 – August 2010

Phase Three involves the formal consultation for the draft proposed Assessment Report includes public meetings held throughout the region, as shown in Appendix C. These sessions are timed to satisfy the requirements of the regulation. Dates are set based on the previous consultation phases and completion of technical studies. The key messages communicated include details regarding the process for establishing the

Assessment Report and the consultation that has taken place to date. Additional local consultation was undertaken as required.

5.4 Phase 4 – June 2011

Phase four involves consultation of parts of the Assessment Report which were not available when the proposed AR was consulted on. Location and dates of consultation are based on a due date for the updates. This is in June 2011.

Phase 4 will include local consultation on those aspects of the Assessment Report that have a local impact. Consultation is mainly on the updates and amendments to the Assessment Report. There will also be a general Source Protection Area focus similar to that undertaken in phase three above.

5.5 Use of Website

The website www.sourcewaterprotection.on.ca will be used extensively for the purpose of extending the consultation beyond the public meetings. A description of the process, vulnerability maps and scores, materials used in the consultation as well as the draft assessment report will be available on-line. The web site will describe options for submitting comments as well as the ability to provide comments on-line. Comments collected through the consultation will be posted on the web site as well as forming part of the submission to the MOE with the proposed Assessment Report.

5.6 Distribution of Report and Other Materials

The web site will include access to interactive mapping products through a geoportal. It will also include the availability of documents. The web site will be promoted as the primary method of accessing the documents and mapping products. CDs will also be made available to those who request them. Printed copies of the reports will be made available for review at CA offices and at the public meetings. Various summary products will be available for the public at the public meetings.

6 Appendices

Appendix A – LTVSPA Assessment Report Consultation Schedule

Appendix B – SCRSPA Assessment Report Consultation Schedule

Appendix C – UTRSPA Assessment Report Consultation Schedule

Note: When included as part of the Assessment Report for a Source Protection Area only the appropriate schedule is included

Appendix C – UTRSPA Assessment Report Consultation Schedule

Table 3 Upper Thames River Source Protection Area Phase 1 and Phase 2 Consultation Schedule

No.	PHASE 1 Meeting Date	PHASE 2 Meeting Date	Meeting Location	IPZ/WHPA	# of parcels in IPZ-1 or WHPA A	# of parcels in IPZ-1 and 2 or WHPA- A, B, C, D	Methods of Notification
1	Oct. 21, 2009 3:00 – 7:00	Nov. 24, 2009 3:00 – 7:00	Sherwood Branch library, Meeting Room A, Sherwood Forest Mall, 1225 Wonderland Rd. North, London (Phase 1); St. Aidan's Anglican Church at 1246 Oxford St. West, London (Phase 2)	Fanshawe*	7	9	ad in paper website
				Hyde Park	7	3084	ad in paper direct mail website
				Birr	15	18	ad in paper direct mail website
				Melrose	18	34	ad in paper direct mail website
2	Nov. 24, 2009 3:00 – 7:00	Nov. 24, 2009 3:00 – 7:00	St. Aidan's Anglican Church 1246 Oxford St. West, London	Kilworth Heights *	3	60	ad in paper direct mail website
3	Sept. 29, 2009 3:00 – 7:00	Nov. 25, 2009 3:00 – 7:00	Rotary Complex, Tim Taylor Lounge, 353 McCarthy Rd, Stratford	Stratford	130	1530	ad in paper direct mail website
				Shakespeare	24	24	ad in paper direct mail website
				Sebringville	18	32	ad in paper direct mail website
				St. Pauls	17	17	ad in paper direct mail website
4	Sept. 30, 2009 3:00 – 7:00	Nov. 26, 2009 3:00 – 7:00	West Perth Public Library, Meeting Room, 105 St. Andrew St., Mitchell	Mitchell	54	453	ad in paper direct mail website
5	May 4, 2010 3:00 – 7:00	May 4, 2010 3:00 – 7:00	Embro Legion 138 Huron St., Embro	Embro	28	109	ad in paper direct mail website
6	May 5, 2010 3:00 – 7:00	May 5, 2010 3:00 – 7:00	Tavistock & District Recreation Centre, Arena Hall 1 Adam St., Tavistock	Lakeside	13	20	ad in paper direct mail website
				Tavistock	29	1127	ad in paper direct mail website

No.	PHASE 1 Meeting Date	PHASE 2 Meeting Date	Meeting Location	IPZ/WHPA	# of parcels in IPZ-1 or WHPA A	# of parcels in IPZ-1 and 2 or WHPA- A, B, C, D	Methods of Notification
7	May 12, 2010 3:00 – 7:00	May 12, 2010 3:00 – 7:00	Thorndale Public Library, Meeting Room 21790 Fairview Rd., Thorndale	Thorndale	27	90	ad in paper direct mail website
8	May 13, 2010 3:00 – 7:00	May 13, 2010 3:00 – 7:00	Dorchester Arena, Lions Room 2066 Dorchester Rd., Dorchester	Dorchester*	8	471	ad in paper direct mail website
9	May 18, 2010 3:00 – 7:00	May 18, 2010 3:00 – 7:00	Thamesford Library, Beaty Room, 165 Dundas St.,Thamesford	Thamesford	26	108	ad in paper direct mail website
				Beachville	10	103	ad in paper direct mail website
10	May 19, 2010 3:00 – 7:00	May 19, 2010 3:00 – 7:00	Ingersoll Town Hall, Council Chambers, 130 Oxford St., Ingersoll	Ingersoll	68	2279	ad in paper direct mail website
11	May 31, 2010 3:00 – 7:00	May 31, 2010 3:00 – 7:00	Woodstock Community Complex, Goff Hall, 381 Finkle St., Woodstock	Woodstock Wells 6, 7 & 9	44 (Total for all Woodstock Supply wells)	5223	ad in paper direct mail website
12	June 2, 2010 3:00 – 7:00	June 2, 2010 3:00 – 7:00	Innerkip Community Centre & Library 695566 Oxford Road 5, Innerkip	Hickson	13	82	ad in paper direct mail website
				Innerkip	3	66	ad in paper direct mail website
13	June 28, 2010 3:00 – 7:00	June 28, 2010 3:00 – 7:00	Mount Elgin & District Community Centre 333204 Plank Line, Mount Elgin	Mount Elgin	29	86	ad in paper direct mail website
14	July 5, 2010 3:00 – 7:00	July 5, 2010 3:00 – 7:00	Woodstock Community Complex, Goff Hall, 381 Finkle St., Woodstock	Woodstock Supply Wells located in South-West Oxford Township	44 (Total for all Woodstock Supply wells)	459	ad in paper direct mail website
15	July 29, 2010 3:00 – 7:00	July 29, 2010 3:00 – 7:00	Community Centre Hall, Pyramid Recreation Centre,	St. Marys*			ad in paper direct mail website

No.	PHASE 1 Meeting Date	PHASE 2 Meeting Date	Meeting Location	IPZ/WHPA	# of parcels in IPZ-1 or WHPA A	# of parcels in IPZ-1 and 2 or WHPA- A, B, C, D	Methods of Notification
			317 James St., S., St. Marys				
16	August 4, 2010 3:00 – 7:00	August 4, 2010 3:00 – 7:00	Community Centre Hall, Pyramid Recreation Centre, 317 James St., S., St. Marys	St. Marys*			ad in paper direct mail website

*GUDI systems

Table 4 Upper Thames River Source Protection Area Phase 3 Consultation Schedule

No.	PHASE 3 Meeting Date	Meeting Location	IPZ/WHPA	Methods of Notification
1	August 9, 2010 3:00 – 7:00	Stratford Rotary Complex, Community Hall D, 353 McCarthy Road, Stratford	All UTRSPA WHPA	ad in paper direct mail website
2	August 12, 2010 3:00 – 7:00	Woodstock Community Complex, Goff Hall, 381 Finkle Street, Woodstock	All UTRSPA WHPA	ad in paper direct mail website
3	August 16, 2010 3:00 – 7:00	Dorchester Arena, Community Centre Auditorium, 2066 Dorchester Rd., Dorchester	All UTRSPA WHPA	ad in paper direct mail website

Table 5 Upper Thames River Source Protection Area Phase 4 Consultation Schedule

No.	PHASE 4 Meeting Date	Meeting Location	IPZ/WHPA	Methods of Notification
1	July 25, 2011 3:00 – 7:00	Thamesford Library, Beaty Room, 165 Dundas Street, Thamesford	All UTRSPA WHPA	ad in paper direct mail website
2	July 27, 2011 3:00 – 7:00	Pyramid Rec. Centre, community Centre Hall (1/3 Hall), 317 James Street S., Town of St. Marys	All UTRSPA WHPA	ad in paper direct mail website
3	July 28, 2011 3:00 – 7:00	Dorchester Arena, Community Room 1, 2066 Dorchester Rd., Dorchester	All UTRSPA WHPA	ad in paper direct mail website

Summary of Consultation and Comments

Generic Description of Commenter	No.	Comment	Response	Status
CA Staff	1	In the Systems Summaries under Threats and Risk Assessment, I noticed the format for Table 2: number of locations where significant threats would occur is different for the Oxford systems. The Oxford table's include the system name (which was helpful), and the vulnerability scores. The Middlesex and Perth tables don't hav the system name nor vulnerability scores but do include the type of threat (chemical, pathogen DNAPLS).	System summary information obtained from Oxford in a form that is consistent with other system summaries.	**DONE**
CA Staff	2	2 areas we may want to change are changing the font color for main headings Appendix 2 and Appendix 3 - the links do not start until after this title. Also List of maps in sections are not linked as in the St. Clair report.	Will consider different ways of showing the linked text when creating the new CD.	
CA Staff	3	Map 3-4, Colour range for legend category 450 to 500. Very light pink to the point that some monitors don't show, Map 7-1-14, Contents show Mount Elgin but map is Mt Elgin – either needs to be consistent or a period after Mt, Map 7-2-14, Same as Above, Map 7-3-21, Same as above except St Marys	Adjust color scheme in Map 4-3. Map 7-1-14 title to be changed to 'Mount Elgin' not 'Mt Elgin', and same for list of maps. Also make sure 'St. Marys' is used not 'St Marys'.	**DONE**
Town of St. Marys Staff	4	Map in the System summary for St Marys has a Beachville label in the activities related to chemical map.	Correct the map label	**DONE**
CA Staff	5	A calculation error was observed in the managed lands of Woodstock rural WHPA-C. Update the managed lands mapping for this system. The change in calculation affects the map, but not the threats counts. There were no additional significant threats therefore no additional letters needed to be sent.	Update the Woodstock rural wells managed lands map	**DONE**
CA Staff	6	Include maps on Percent Impervious, Managed Land and Livestock Density for HVA and SGRA	Create and include these maps in the proposed AR	**DONE**
CA Staff	7	Need to remove the "O. Reg. 385/08, s. 3." reference from all significant threats tables		**DONE**
CA Staff	8	The Vulnerability Score for Shakespeare was revised between the time the Impervious Surfaces, Managed Lands and Livestock Density maps were started and when the Draft Proposed Assessment Report was posted. This change was not caught before posting. These maps will be updated to reflect the revised Vulnerability Scores. This change removed the need to map a portion of the WHPA-C. It did not alter the Impervious Surface mapping, nor the Managed Land and Livestock Density categories in the WHPA-A and B. Consequently, this change is not anticipated to alter the significant threat counts.	Due to the change in the Shakespeare WHPA vulnerability layer after creating the Percent Impervious, Managed Land and Livestock Density mapping, these maps will have to be revised.	**DONE**
CA Staff	9	The Impervious Surface mapping for Oxford County had one inconsistency when compared to Middlesex and Perth. Oxford County did not include private driveways in the calculations whereas the other 2 counties did. This was noted on the maps themselves but not in the report text. The maps for Oxford will be revised to match the methodology applied to the systems in Middlesex and Perth. Revisions to the report text should no be required. This is not anticipated to alter the significant threat counts.	Impervious surface mapping for all Oxford systems to be revised	**DONE**
CA Staff	10	Some of the Managed Land maps for Oxford County in the Draft Proposed Assessment Report differ from those submitted by the County in their Technical Reports. Upon review of the differences, it was noted that under most circumstances, the differences were a matter of interpretation of which lands were managed. The pAR managed lands mapping for Oxford County should be revised to be consistant with Oxford's technical report mapping.	Managed Lands mapping for Oxford systems (where differences in interpretation are observed) to be revised	**DONE**
CA Staff	11	It was identified that the livestock density lands dpAR mapping was not consistent in some areas with that submitted by Oxford. This is largely attirbuted to the windsheild survey undertaken by Oxford in developing the mapping. The pAR livestock denisty mapping for Oxford County should be revised to be consistant with Oxford's technical report mapping.	Livestock Density mapping for Oxford systems (where differences in interpretation are observed) and methodology text in section 7 to be revised	**DONE**
Proofreader	12	Editorial corrections to be made to sections	Make editorial corrections	**DONE**
Proofreader	13	Editorial corrections to be made to section summaries 1,2,3,4,5,7,8	Make editorial corrections	**DONE**
Proofreader	14	Editorial corrections to be made to system summaries	Make editorial corrections	**DONE**
CA Staff	15	The header in the appendices report needs to be corrected - the "s" is missing from "Thames."	Make editorial corrections	**DONE**
Proofreader	16	Editorial corrections to be made to maps	Make editorial corrections	**DONE**
CA Staff	17	We need to replace the label 'Zorra-Tavistock' with 'East Zorra-Tavistock' on the AR maps.	Make editorial corrections	**DONE**
CA Staff	18	On pg 2 of the section summary 1 under the discussion of the CWA at the bottom of left hand column, it says that the regulations have not yet been introduced. They have now been introduced. In the Glossary, the following links are worth checking as they either didn't link, were to a French site, or didn't seem to give explanation to the glossary term: AOC, DNAPLS, LaMP, PCBs.	Revise last paragraph on page 2 of section summary 1 to read: "Recently, the province has amended O. Reg. 287/07 by providing requirements for the preparation and implementation of source protection plans". Links repaired in glossary.	**DONE**

Generic Description of Commenter	No.	Comment	Response	Status
CA Staff	19	When viewing Melrose WHPA-A map 4-1-6 I noticed that the WHPA-A was round when looking at the map. When looking at the wells there is a separation between them (about 15 metres). Since this is the case the WHPA-A should be slightly oblong. Same applies to the Kilworth-Komoka system.	Make correction in Melrose and Kilworth-Komoka maps (vulnerability, threats, livestock density, managed lands, impervious)	**DONE**
CA Staff	20	In Section 9, grammatical change on last paragraph, line six should read “the Director in the approval” versus “it’s.	Make editorial corrections	**DONE**
CA Staff	21	Delete 'believed to be' replace with 'is' or 'are' in Flagged Parameters appendix	Make editorial corrections	**DONE**
CA Staff	22	In the Flagged Parameters appendix, Thorndale well ecoli found to be caused by a transport pathway: Amour of verbiage on this to be reduced and will add references to the discussions with operators since technical report. Page 9-2 table lists iron is titled Komoka wells in first column and shows Birr on second column, needs to changed.	Make editorial corrections	**DONE**
CA Staff	23	The Thorndale WHPA-A needs to be corrected to be a 100 m circle rather than the 200 m circle. The vulnerability, threats, livestock density, managed lands and impervious layer mapping will need to be revised. The threats counts are not affected since the consultant did the threats analysis based on a correct WHPA-A.	Make correction in Thorndale maps (vulnerability, threats, livestock density, managed lands, impervious)	**DONE**
CA Staff	24	Chris had Ryan create table of contents for the draft CD versions of the system and section summaries, and inserted page numbers in the pdf files for those two appendices. We should do the same for the printed versions (and the CD's again).	Add table of contents to system and section summaries in the InDesign files. Add page numbers (1 of XX) to the Acrobat files once fully assembled.	
CA Staff	25	Since there was the potential for overlapping WHPAs from different Systems, the impervious surface calculations were performed on a System basis. Associated with each grid cell on the map are separately stored values of every system. The largest value of percent impervious was supposed to be copied into another field for display on a unified map. However, Stratford and St Marys were completed after the decision to use individual WHPA maps rather than a unified map. Consequently, that field was not updated. However, the map templates were still displaying that field. As a result, Stratford and St Marys maps included in the assessment report were displaying the values from before the Stratford and St Marys updates.	Revise Stratford and St. Marys impervious surfaces maps	**DONE**
CA Staff	26	As a result of comments received from the peer reviewers staff presented alternative representations of the SGRA to peer reviewers for their input. The peer reviewers supported a revised SGRA product which removed the area identified as fluvial deposits from those which were previously proposed as the SGRA. It is important to note that this results in an overall reduction in the area identified as SGRA and does not add any areas not previously included in the SGRA. It is recommended that the Assessment Report be revised to be consistent with the SGRA mapping accepted by the peer reviewers which will be included in this final T2WB report. Also at the recent peer review meeting the peer reviewers accepted that the groundwater and surface water model calibration in the Middle Thames was adequate for the stress calculations in the T2WB. Although this does not require a change in the results from the work, references in the Assessment Report to the Middle Thames calibration should be revised to reflect the additional calibration work.	revise SGRA mapping to reflect the peer review accepted T2WB work. Revise description of the calibration of the Middle Thames to reflect the additional analysis of the calibration of this subwatershed.	**DONE**
CA Staff	27	On the Impervious Surfaces and Managed Lands / Livestock Density mapping that the outlines on the maps were inconsistent. In some cases the outlines were the WHPAs clipped to Vulnerability >=6 and in some cases it was the Vulnerability Layer clipped to Vulnerability >= 6. Since the calculations were performed on a WHPA basis, I think it more appropriate to use the WHPA outlines. Therefore, all maps were made consistent by using the WHPA outlines.	Revise all impervious, managed lands and livestock density maps so that the outlines are to the WHPA with vulnerability score greater than 6.	**DONE**
MOE	28	On page 5-9, Section 5.4 Issues Evaluation Technical Studies, the second sentence refers to 23 well supply systems. This appears to be a typo based on the number of systems described in other chapters and should be changed to 22. It is recommended to be consistent in the AR.	Sentence revised.	**DONE**
MOE	29	On page 6-2, top of page reference to Map 4-1 should be 4-1-1 through 4-1-23.	Sentence revised.	**DONE**
MOE	30	References to “*Golder and Associates”* should read “Golder Associates”	Reference revised	**DONE**
MOE	31	On page 4-8, 4.3.2 WHPA-A: The last line should read “4-1-1 to 4-1-22”.	Sentence revised.	**DONE**
MOE	32	All maps must clearly show the municipal wells, well numbers, and well field names so that reference to the text of the report is clear.	Maps are edited to show well numbers and well field names on the groundwater vulnerability frames in Maps 4-1-1 to 4-1-23 because these frames show well locations.	**DONE**
MOE	33	Municipal wells must be clearly shown on a map. The Tavistock, Thamesford and Woodstock wells can not be distinguished from each other on the maps	Maps edited by decreasing well symbol size, to help differentiate between wells.	**DONE**
MOE	34	Map 4-1-11 Ingersoll: The adjusted groundwater vulnerability discussed in the text is not reflected on the map	Transport pathway adjustment is now shown on map. Text is revised to indicate the correct vulnerability category adjustment.	**DONE**

Generic Description of Commenter	No.	Comment	Response	Status
MOE	35	Map 4-1-17 Woodstock: The adjusted groundwater vulnerability discussed in the text is not reflected on the map. Only two of three are currently identified.	Transport pathway adjustment is now shown on map. Text is revised to indicate the correct vulnerability category adjustment.	**DONE**
MOE	36	Map 4-1-19 Sebringville: The report indicates that no transport pathways have been identified, but one is shown on the map. This inconsistency should be corrected.	Map is correct. Text is revised.	**DONE**
MOE	37	4-1-21 St. Marys: The legend for transport pathways is unclear where it states "Increased on Level". Any change in the groundwater vulnerability based on a transport pathway (at least 25 are shown) must be documented and explained in the text (only 3 are discussed).	Transport pathway adjustment is now shown on map. Text is revised to indicate the correct vulnerability category adjustment.	**DONE**
MOE	38	Watershed Characterization Maps: These maps are shown at a scale that includes the entire Source Protection Region, which reduces the visibility of the subject Source Protection Area. (e.g. Maps 3, 18 and all others at this scale). Ensure that the maps meet the requirements in technical rule 12 for sizing as much as possible.	WCR was completed for the entire Thames watershed, and scale reflects that.	**No change.**
MOE	39	On page 2-27, Table 2-4 includes the Lake Huron Primary Water Supply System and the Elgin Area Water Supply System as being systems "serving the Upper Thames River SPA, however, the footnotes indicate that both systems are located outside the Upper Thames River SPA. It is not clear why these systems were included in the table. If they do serve some of the population, then the details should be included.	Footnote to the table is revised to indicate that the systems serve the UTRSPA. Text below table still indicates that areas within the UTRSPA are served by these systems.	**DONE**
MOE	40	The AR indicates that this work will be complete in time to include in the proposed AR. The draft proposed AR can only be changed to address comments received in the consultation period. No new information can be added to the proposed AR without an appropriate level of consultation. If new information is to be added to the proposed AR that is not based on comments received in on the draft proposed AR then the SPC should ensure the public and those impacted by the changes have an additional level of consultation so that they are afforded ample opportunity to review the new information. For example the SPC may want to notified those impacted by the new information as they would have been for the draft proposed AR consultation period.	Duplicate of comment 54. Text revised to indicate that this work has not been completed. Therefore this work will be included in an amended AR. Work is noted as a data gap in Section 3.6 and in Section 9.	**DONE**
MOE	41	The statement that indicates the results of the Tier 3 are contingent upon availability of data and funding should be removed. The comments on funding are irrelevant.	Text revised in section 3.4.1. General Note in section 9 left in place.	**DONE**
MOE	42	On page 2-29, Table 2-5 (Watershed Characterization Data Gaps) under the heading Water Quality, there is an entry titled Municipal groundwater well physical and chemical data. The physical data is not a data gap as should be in the First Engineer's Reports.	Text revised to indicate that long term data was not available.	**DONE**
MOE	43	Section 2.0 Watershed Characterization 1a) Page 2-4 Geography, Physiography and Soil Types: "…over which lies the overburden rock formation." A point of clarification, overburden is not a rock formation. 1b) Page 2-5 Topography, Hydrology and Hydrogeology: This section does not provide enough information on these areas given the SPA relies almost solely on groundwater. There should be documentation on the aquifers, water tables and pertinent groundwater flows, regionally and locally for the SPA. 1c) Page 2-20 Municipal Groundwater System Water Quality: This section should clearly reference the standards to which the water quality is being compared (e.g. O. Reg. 169, O. Reg. 170, etc.).	Text to be revised.	**DONE**
MOE	44	Section 4.3.5 Vulnerability Assessment of the WHPA: Where appropriate and beneficial, text in this section relevant to specific wells and/or well fields should reference the appropriate Map, specifically when discussing WHPA delineation and vulnerability scoring	Map references added.	**DONE**
MOE	45	Wells should be numbered on the WHPA maps so that references in the text can be related to the map.	Maps are edited to show well numbers and well field names on the groundwater vulnerability frames in Maps 4-1-1 to 4-1-23 because these frames show well locations.	**DONE**
MOE	46	Where adjustments are made to the groundwater vulnerability within WHPAs, the AR should document the initial and final vulnerability ranking (e.g. from low to medium) and the final groundwater vulnerability should be clearly shown on the associated map.	Text and maps revised	**DONE**
MOE	47	For Woodstock, on page 4-20, the third bullet is unclear. The bullet references well 9+, which is not defined, and suggests that smoothing of contacts between areas of different vulnerability is related to transport pathways. First, what is the connection between an adjustment related to transport pathways and smoothing of lines. Second, what is the justification for smoothing out the vulnerability lines. The comment professional judgement requires that the AR explain the factors considered in making this judgement.	Text revised. Sentence on transport pathway in Well 9 WHPA is separated from the vulnerability smoothing sentence, as they are not related. Additional clarification in professional judgement on contact smoothing is provided in Section 4.3.5.	**DONE**
MOE	48	Page 4-21: Justification should be provided for the selection of a 50 metre buffer around wells as transport pathways.	More details are added to the justification provided under Perth Wells in Section 4.3.5.	**DONE**

Generic Description of Commenter	No.	Comment	Response	Status
MOE	49	Page 4-22: The text for the St. Marys water supply discusses the presence of thee (3) private wells within WHPA-B and that the groundwater vulnerability has been increased based on the presence of these wells. However, the related map shows at least 19 wells in WHPA-B and 3 three wells in each of WHPAs C and D. This inconsistency should be corrected and the justification provided for a 50 m buffer around the wells as transport pathways.	Text revised to describe transport pathways	DONE
MOE	50	Page 4-22: The text for Sebringville indicates that transport pathway features have not yet been located and are not included. However, map 4-1-19 shows an area of increased vulnerability. This inconsistency should be corrected.	Map is correct. Text is revised.	DONE
MOE	51	Page 4-23: For Stratford, a number of private wells are identified as transport pathways resulting in an increase in the groundwater vulnerability. The justification for the increase should be provided. Given there is a municipal monitoring well nearby, a clarification as to why there was no increase associated with that well is recommended.	Text revised. Joe Salter provided info that the municipal monitoring well is inspected weekly as per PTTW. Monitoring well is not considered a transport pathway.	DONE
MOE	52	Page 4-25: …"the vulnerability scoring of these vulnerable areas will be assessed using the methodologies described in the surface water vulnerability section above." The reference pertains to the WHPA E and WHPA-F, yet these areas have not been delineated. It would be more appropriate to suggest that when these areas are delineated, the vulnerability score will be assessed based on the method above.	Text revised.	DONE
MOE	53	MOE has identified activities in the SPA that may have an impact on groundwater vulnerability. In Ingersoll. A number of active below-water quarries that expose aquifers. The sizes of the quarries are relatively large - their impacts to groundwater need to be assessed in the vulnerability assessment and the associated threats that could potentially be occurring at these sites; within HVA and SGRA, not in WHPA. Location: east of Ingersoll. Section in AR: Zorra. -New application in 2010 for a below-water gravel pit that will expose the overburden aquifer; likely within HVA and SGRA, not WHPA. Location: Lot 22, Concession 5, Zorra, County of Oxford.	Oxford confirmed it is not in the WHPA. No adjustments have been made to vulnerability of SGRA. No adjustments can be made to HVAs.	No change.
MOE	54	1a) The Tier 2 Water budget and stress assessment presented in the AR is not complete as it does not comply with the following TR. Drought scenarios are missing as required in TR 34(2d and e) and 35(2f and g). As stated in the AR on page 3-15 "Drought scenarios have yet to be completed and will be incorporated into a subsequent version of this Assessment Report." Conclusions on Tier 2 do not represent the complete analysis.	Duplicate of comment 40. Text revised to indicate that this work has not been completed. Therefore this work will be included in an amended AR. Work is noted as a data gap in Section 3.6 and in Section 9.	DONE
MOE	55	2a) Section 3.3.2 introduces the Tier 1 water budget and indicates that there are 32 subwatersheds in the Thames Sydenham and Region. The technical rules require that the subwatersheds in each source protectio area be identifies, meaning the report must show that there are 11 in the Upper Thames Region source protection area. 2b) Section 3.3.3 introduces the Tier 2 water budget. The technical rules require that the AR document how many subwatersheds (5) in the source protection areas were evaluated at the Tier 2 scale within the boundaries of the Upper Thames Region source protection area	Text revised to indicate the number of subwatersheds in the UTRSPA and the number considered in the Tier 2 work.	DONE
MOE	56	3a) Table 3.6: The table summarizes the groundwater stress assessments for both Tier 1 and Tier 2 evaluations. It would be helpful to have separate tables that show the results of the Tier 1 stress assessment (both surface water and groundwater) (as per technical rule 21) and the results of the Tier 2 stress assessment (groundwater only) (as per technical rule 23) 3b) Map 3-6: It would be helpful to separate this map into two maps – one map showing the Tier 1 stress assessment and a second map showing the Tier 2 stress assessment. Given the requirements of the technical rules, and the consultation requirements, it may be difficult for a reader to understand the different between the two stress levels with the maps combined.	Discussed with MOE. Text added to clearly describe how the results are discussed and demonstrate that the analysis was undertaken and documented in 2 separate reports.	DONE
MOE	57	It would be helpful to have a separate SGRA delineation map and a SGRA groundwater vulnerability map.	Maps 4-2-1 and 4-2-2 provide this info	No change.
MOE	58	MOE has identified a site of historical contamination that may be considered by the SPC in their threats assessment: Woodstock. There was an historical underground storage tank leakage site in the late 90's. Petroleum hydrocarbon related subsurface contamination still exists as of 2010. Impacts include free product LNAPL, soil contamination, and relatively large groundwater plume; within HVA and SGRA, not in WHPA. Location: 16 Ingersoll Road, Woodstock	Add information into Section 6 and summary 6. Would be considered during conditions assessment work	DONE
MOE	59	On page 6-7, Section 6.2, third paragraph, there is mention of a spill at the Mitchell municipal well supply. There is no description of what the product spilled was. If this information is available, it would be helpful to include this additional information, so it is consistent with the other descriptions in this section and how this relates to the threats assessment.	Text in section 6 and summary 6 is revised based on additional limited information available. AR already indicates that further investigation required.	DONE
MOE	60	On page 4-1, the second paragraph references tables for IPZs. There are no IPZs within the Upper Thames River SPA. It is suggested that this is changes to ensure consistent message throughout the AR.	Text is revised.	DONE
MOE	61	It would be helpful for the reader if the tables on pages 3-17 made reference to the Provincial Table of Circumstances (on each table), since the provincial tables provide more detail. This is a local decision on including this reference.	The Provincial Table of Circumstances are the MOE threats tables. These are referred to in Section 7 and in the Appendix 10, threats tables.	No change.
MOE	62	Section 3.0 Water Budget and Water Quantity Stress Assessment Page 3-20: "…SGRAs which are coincident with Highly Vulnerable Aquifers (HVA), will receive a vulnerability score of 6 which can result in a moderate threat, while activities in other SGRAs cannot result in water quality threats due to the vulnerability score being 4 or less." This statement is incomplete as areas with a vulnerability score of 6 may have moderate or low drinking water threats.	Text is revised.	DONE

Generic Description of Commenter	No.	Comment	Response	Status
MOE	63	Section 7, Page 7-12, Chemical Threats Related to the Use of Land for Livestock Grazing, Pasturing or Outdoor Confinement Area or Farm-Animal Yard. It appears as if the NU/acre calculations for grazing & OCA threats uses the vulnerable area in the denominator. Based on the circumstances in the technical rules, the nutrients generated at an annual rate must be determined by the number of NU on the farm divided by the size of the livestock grazing land or pasturing land.	The denominator used in the calculation is correct. The methdology text will be revised.	**DONE**
CA Staff	64	Oxford systems significant threat location counts in the AR are to be made consistent with information in the Oxford technical reports regarding sewer line threats. This will not affect consultation of those affected, as the threat was inventoried by the municipality.	Significant threat locations count in the section 7, Oxford system summaries and section summary 7 are revised.	**DONE**
CA Staff	65	Sewer lines were not reviewed during the threats and risk assessment in the Perth systems studies.	Added as a data gap in Sections 7 and 9.	**DONE**
CA Staff	66	List of references needs to include Tier 1 and Tier 2 reports, and the Watershed Characterization Report	References added.	**DONE**

Upper Thames River SPA
Proposed Assessment Report
Summary of Comments

Generic Description of Commenter	No.	Comment
City of London (letter dated Oct. 25, 2010)	1	The City of London acknowledges or recognizes the following: seamless vulnerability assessment mapping, Great Lakes target policies, WHPA-E for Fanshawe wellfield, Risk Management Official considerations, and financial considerations.

Directions received from Ian Smith, Director, Source Protection Programs Branch, Ministry of Environment, as per letter dated May 10, 2011

No.	Direction	Response	Section	Early Notification Letter No.
Updated Task	WHPA-E studies for GUDI systems	As per the Dillon Consulting Ltd March 2011 and April 2011 reports, and the UTRCA April 2011 report, WHPA-Es were delineated and assessed for the Dorchester, Fanshawe, Thamesford, Woodstock rural and St. Marys well supply systems. The systems did not meet Technical Rule 50 (2) and (3) and therefore WHPA-Fs were not delineated. The Kilworth-Komoka wells were decommissioned in October 2010. Therefore the Kilworth-Komoka and Highgate well systems were removed from the list of GUDI studies in the current ARs. (As well, the MOE directed that the workplans for WHPA-E and WHPA-F for the Highgate system not be included in the Lower Thames Valley AR as information available at this time indicates that the system does not meet the test in Technical Rule 49 (3)). The potential drinking water threat levels (based on vulnerability scores) are shown in new maps which are noted in the AR. Managed lands, livestock density and impervious surfaces maps were revised to include WHPA-E.	Section 4.3.1: Table 4-1, Section 4.3.4: text, Section 4.3.5: text and new Table 4-5, Section 4.3.6, Section 4.6: Table 4-6. New WHPA-E Maps 4-1-2a, 4-1-4a, 4-1-16a, 4-1-17a and 4-1-21a. Revised managed lands, livestock density and impervious maps. New WHPA-E potential threat level maps 7-3-2a, 7-3-4a, 7-3-16a, 7-3-17a, 7-3-21a. Sections 7.2.4, 7.2.6, 7.2.17, 7.2.18, 7.2.22, 7.4, Section 9: Table 9-1. System Summaries for Dorchester, City of London, Thamesford, Woodstock and St. Marys: all figures (except Hyde Park), text on WHPA, vulnerability, threats assessment, peer review, and data gaps. Section Summary 4: text in sections on WHPA, Table 1, and data gaps. Section Summary 7: data gaps. Section Summary 9: Table 1. Appendix 1, Appendix 10, Appendix 12, Appendix 13, List of Maps	(NA)
Amended Task	Sewer Threats consideration in Perth County systems	Additional analysis was done to identify chemical and pathogen type threats from sewer lines, related to 'the establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage', for the Perth, Town of St. Marys and City of Stratford well systems. These types of threats were identified in the WHPA-As of the Mitchell, St. Marys, Shakespeare and Stratford systems and is now reflected in the amended AR. This has resulted in an increase in the number of locations of significant threats. This item is now removed from data gaps sections.	Section 7: Table 7-1, Section 7.2.2: Table 7-7, Section 7.2.19: Table 7-27, Section 7.2.21: Table 7-29, Section 7.2.22: Table 7-30, Section 7.2.24: Table 7-32, Section 7.4. Section 9: Table 9-1. Section Summary 7: Table 3 and data gaps section, Section Summary 9: Table 1. Mitchell, St. Marys, Shakespeare, Stratford System Summaries: Table 2. Appendix 12 (list of references)	(NA)

No.	Direction	Response	Section	Early Notification Letter No.
Amended Task	Pasture and livestock confinement area threats consideration	Additional analysis was done to identify threats related to 'the use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard'. Findings: (1) A field visit was made to a property (that spans the Dorchester WHPA-A and WHPA-B) that was already identified in the proposed AR as a significant threat (related to farm activities). The field visit confirmed that the property is not an animal farm. However another property was identified as having animal farm activities (that spans the WHPA-A and WHPA-B). Therefore the count of significant threats for this well system remains the same. (2) Chemical type threats related to this activity are now identified in the rural Woodstock WHPA-B and Ingersoll WHPA-A (one property in each system's WHPA). One property each were identified at the St. Pauls WHPA-A (chemical and pathogen) and St. Marys WHPA-B (pathogen). For these four systems, the properties on which the activities occur were previously identified to have other significant threats occurring.	(2) Section 7: Table 7-1, Table 7-19, Table 7-26, Table 7-30 and Table 7-31. Ingersoll, System Summary: Table 2. Section Summary 7: Table 3. Appendix 12 (list of references).	(NA)
1	Amend the AR to include the assessment of drought scenerios (2 and 10 year) and a quantification of uncertainty for each of the Tier 2 subwatersheds.	The AR is revised to include the drought scenario output from the most recent version of the Tier 2 water budget report. No additional subwatersheds moved forward to a Tier 3 water budget as a result of drought analysis. The quantification of uncertainty for each of the Tier 2 subwatersheds is now provided in the AR	Drought scenarios described in Section 3.4, 3.3.5 (peer review text), Section 3.4.1, Section 3.6 (Table 3-8), Section 9: Table 9-1. Section Summary 3: data gaps text. Section Summary 9: Table 1	1a
2	Amend the AR to include a table that shows all Permit To Take Water (PTTW) water takings, their proposed use, maximum permitted amount and actual taking with relevant Tier 2 information. Additional details for this direction: Although the AR indicates this information can be found in the reference documents, the Water Budget (WB) Technical Reports are not provided on the SPC website for public access. While the AR Checklist notes that the AR Table 3-1 Groundwater use in the UTRSPA should contain the required Tier 2 WB information, a table footnote states the information is only from Tier 1 WB data. The rationale is provided in the text provided in the AR is not adequate in meeting the legislative requirements for the Tier 2 WB.	This information is included as an appendix in the Tier 2 water budget report, and also in the Tier 1, for surface water permits. The T1 and T2 water budget documents will be available on TSR web site. These are referenced in the amended AR. Table 3-1 was recreated using Tier 2 data.	Section 3.2.5; Table 3-1, Appendix 12 (list of references)	2a

No.	Direction	Response	Section	Early Notification Letter No.
3	Amend the AR to include a table that presents all the updated water demand values for the Tier 2 Water Budget evaluation for the groundwater component. Additional details for this direction: Although the AR Table 3-3 Water Budget Summary was taken from Tier 1 work because Tier 2 analysis was only completed for groundwater systems, it is still a legislative requirement to summarize the Tier 2 Water Budget values for the groundwater.	Updated groundwater demand values for the Tier 2 Water Budget are included in the Tier 2 water budget report, which will be available on TSR web site. These are referenced in the amended AR. Table 3-3 was updated with new information from the T2 water budget and now describes water budget summaries based on the T2 information for all subwatersheds where T2 work was conducted.	Section 3.2.6: Table 3-3	2b
4	Provide an explanation on how the requirements of Technical Rule 46 were applied for the generation of Map 4-2-1 :Significant Groundwater Recharge Areas" in the proposed AR.	Rule 46 allows professional judgment in determining and defining SGRA areas. The mapping was revised, as allowed under this rule, to remove areas which some water budget peer review members felt were groundwater discharge rather than recharge areas in river valley/flood plain areas. The exercise of overlaying the groundwater vulnerability onto the SGRAs creates “overlay artifacts” or “sliver polygons”. This occurs where the boundary of a contiguous groundwater vulnerability area falls close to the boundary of the SGRA. Since the datasets do not perfectly align to each other, the slight gaps and overlaps between the boundaries create small, uniquely valued polygons. In some cases, these polygons will be assigned a Vulnerability Score of 6 (i.e. potential for Low Threats) but have areas less than 1 square meter in size. This should be considered in policy development and/or implementation for these areas.	Section 3.5, Section 4.5 as well as section summaries	2c
5	Amend the AR to separate Tables 3-6 "Groundwater potential for stress (Average Annual Conditions)" and Table 3-7 "Groundwater potential for stress (Maximim Monthly Conditions)" for Tier 1 and Tier 2 results, clearly indicating what boundaries were used for each table. Additional details for this direction: This item is not compliant with the Technical Rules. Given the areas used for Tier 1 and Tier 2 are different, having one table combines different areas and tiers reduces the clarity of the AR.	Tables 3-6 and 3-7 were separated into 3-6a, 3-6b, 3-7a and 3-7b, where 'a' suffix denotes Tier 1 results, 'b' suffix, Tier 2. Results are still only presented for the most advanced analysis (i. e. subwatersheds which moved to Tier 2 do not have the Tier 1 stress assessments included, but rather a reference is made to the Tier 1 water budget report).	Section 3.4: Tables 3-6a, 3-6b, 3 7a, 3-7b.	3

No.	Direction	Response	Section	Early Notification Letter No.
6	Amend the AR to remove references and work plans associated with the confirmation or existing threats (tier 2 risk assessment). Additional details for this direction: References that should be amended include statements on page 7-16, 7-40, and 9-3. As previously communicated, this additional work is considered out of scope for this round of planning as threats verification can be conducted as part of the development of policies in the source protection plan.	The AR is revised to indicate that the tier 2 (site specific) risk assessment, to confirm significant threats, would be conducted while developing source protection plans (2012) if needed.	Section 7.1.5, Section 7.3, Section 9: Table 9-1, Section Summary 7: data gaps, Section Summary 9: Table 1, All system summaries	1b
7	Amend the AR to apply the correct methodology to enumerate threats related to ASM generation and storage. Additional details for this direction: These calculations should be done using parcel specific information. Two different methods were described in the report; one in the introductory section and one in the section that discusses the specific threat. The AR must document clearly what method was used in the actual enumeration of threats. Similar errors were appropriately corrected in the St. Clair and Lower Thames ARs within the Thames-Sydenham and Region Source Protection Region.	The methodology in Section 7.1.1 is revised to better clarify the methods followed in enumerating threats related to 'the storage of agricultural storage material' and 'the use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard'. In determining chemical threats related to 'the use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard', the livestock density calculation is performed on an individual farm parcel rather than the whole of a vulnerable area. This did not result in any changes to maps. It did not result in any additional significant threats.	Section 7.1.1 (subsections 'Mapping of Impervious Area, Managed Lands and Livestock Density', 'Livestock Density', 'Chemical Threats Related to the Use of Land for Livestock Grazing, Pasturing or Outdoor Confinement Area or Farm-Animal Yard', and 'Chemical Threats Related to Agricultural Source Material Storage').	1c
8	Amend the AR to remove the work plan for WHPA E and F delineation and vulnerability assessment for the Kilworth-Komoka Drinking Water System. Additional details for this direction: As per my UAR response letter on December 20, 2010, I understand that the SPC/SPA will not be conducting any further source protection work around the Kilworth-Komoka Subdivision System as it was decommissioned in October 2010. After the Source Protection Plan development is completed, the SPC/SPA must amend the Terms of Reference to address the need to remove this system.	The Kilworth-Komoka wells were decommissioned in October 2010 (information from Municipality of Middlesex Centre). They are therefore removed from the amended AR.	Throughout sections 2 (Table 2-4), 4, 5, 6, 7 and 9, summaries and Maps. The Kilworth-Komoka system summary is removed.	(NA)
9	Amend the AR to remove references to the work plans and further investigation for Conditions Assessment. Additional details for this direction: This includes the reference in Table 9-1 "Work Plan to fill Data and Analysis Gaps". As per my UAR response letter on December 20, 2010, it is my understanding that the SPC will not be proceeding with the work associated with the conditions investigations. The ministry does not expect the SPC/SPAs to conduct a study to identify conditions as it is not necessary to undertake such work for conditions SPC is not aware of or the public has not identified to the SPC.	References to work plans for further investigations towards conditions assessment is removed from the AR.	Section 6.3, Section 9.1: Table 9-1, section summary 6 and 9.	(NA)

No.	Direction	Response	Section	Early Notification Letter No.
10	Amend the AR to remove the workplans for sampling programs to identify issues.	Table 5-7 is moved from Section 5.6 (Work Plan) to Section 5.7 (Data Gaps) to indicate that the source of some of the identified issues is a data gap and how to fill that data gap. Text in Section 5-7 will be added to describe this data gap. Work plans to identify threats related to issues are removed but further clarification is provided: If more information becomes available to the SPC to identify the sources of the issues, and the issues contributing area and activities must be determined, they will be included in a subsequent AR.	Section 5.6: Table 5-7, Section 5.7, Section 7.4, Section 9: Table 9-1. Section Summary 5: data gaps text, Section Summary 7: data gaps text, Section Summary 9: Table 1	(NA)
11	Amend the AR to remove workplans for issues where it has not been determined whether the source of the issues is anthropogenic. Additonal details for this direction: Any issues that do not meet the test in Rule 114 are documented as per Technical Rule 115.1. The Rules do not allow that the AR include work plans to investigate issues. The only situation where a workplan is allowed in the Technical Rules related to issues is if an issue is documented as per Rule 115 and the issue contributing area (Technical Rule 115 (3) and the identification of threats (Technical Rule 115 (4) can not be completed. In such a case, a work plan as per Rule 116 is required. Addtional details for directions 10 and 11: The work plans includes ones indicated in Table 5.7 :Work Plan for Identification of an Area and Activity Contributing to an Issue" and Table 9-1 "Work Plan to fill Data and Analysis Gaps". The Technical Rules allow or require work plans for specific types of work. The identification of issues or the determination if the issue is anthropogenic or not is not one of the allowed work plans. Any future int	Table 5-7 is moved from Section 5.6 (Work Plan) to Section 5.7 (Data Gaps) to indicate that the source of some of the identified issues is a data gap and how to fill that data gap. Text in Section 5-7 will be added to describe this data gap. Work plans to identify threats related to issues are removed but further clarification is provided: If more information becomes available to the SPC to identify the sources of the issues, and the issues contributing area and activities must be determined, they will be included in a subsequent AR.	Section 5.6: Table 5-7, Section 5.7, Section 7.4, Section 9: Table 9-1. Section Summary 5: data gaps text, Section Summary 7: data gaps text, Section Summary 9: Table 1	(NA)
12	Once the AR is revised based on these directions and before resubmitting the amended AR in accordance with the Act, the Source Protection Authority shall consult with the Source Protection Committee and provide proof thereof with the resubmitted AR.	The Source Protection Authority shall consult with the Source Protection Committee before resubmitting the AR.	NA	(NA)
13	Once the AR is revised based on these directions and before resubmitting the amended AR in accordance with the Act, the Source Protection Authority shall consult with those persons or bodies impacted by the changes in an appropriate manner and consider the consultation requirements in section 18 of the CWA for new information included in the AR that forms part of the updated AR workplan and provide proof thereof with the resubmitted AR.	Consultation as per Section 18 of the CWA will be conducted and documented in Appendix 4.	Appendix 4	(NA)

No.	Direction	Response	Section	Early Notification Letter No.
14	The Source Protection Authority shall include with the resubmitted AR a memo or document outlining the changes made to the AR, as per these directions, including chapter references in the AR where changes were made; and	This table of changes made to the AR will be provided to the MOE with the submission of the AR.	NA	(NA)
15	The AR is to be submitted to the ministry in the form of both a hard copy and electronic version for the ministry's review.	Both hard copy and CD (electronic) will be provided to the MOE.	NA	(NA)

OTHER CHANGES TO UPPER THAMES RIVER PROPOSED ASSESSMENT REPORT

No.	Guideline	Description of Change Made	Section/Appendix Changed	Comment made by
1	Consider revising the AR maps to indicate regional fracturing and karst features where they are considered as factors for assessment of groundwater vulnerability.	There is a lack of comprehensive GID based data to map these features. Text edits have been made to indicate that the uncertainty in bedrock fracture was considered in the WHPA delineation of the Oxford systems, and that higher conductivity values were used in the WHPA delineation of the bedrock wells of Stratford and St. Marys.	Section 4.3.5, Appendix 13, system summaries, section summary 4	MOE Minor Supplemental Comment
2	Consider including include both the percent water demand value and corresponding stress category in the same table for each subwatershed evaluated. This should be done to demonstrate both surface water and groundwater results. This information could be provided in a more direct method even though is provided in Table 3-4 “Potential for stress based on *percent water demand* under current and future municipal water demand” and Table 3-5 “Surface water potential for stress based on Tier 1 stress assessment” and explained on page 3-16.	Tables 3-5, 3-6a 3-6b, 3-7a and 3-7b now contain both percent water demand and stress category	Table 3-5	MOE Minor Supplemental Comment
3	Consider revising Tables 3-6 “Groundwater potential for stress (Average Annual Conditions)” and 3-7 “Groundwater potential for stress (Maximum Monthly Conditions)” to change the column heading from “Potential for Stress” to “Percent Water Demand” and to add an additional column to include the stress category assigned based on percent water demand value.Although the information required is presented in the AR and meets the legislative requirements, these changes will clarify the AR for the reader and better align the language with the Technical Rules.	Titles are altered from “Potential for Stress” to “Percent Water Demand” and an additional column was added to include the stress category assigned based on percent water demand value in Tables 3-6a 3-6b, 3-7a and 3-7b	Tables 3-6a 3-6b, 3-7a and 3-7b	MOE Minor Supplemental Comment

No.	Guideline	Description of Change Made	Section/Appendix Changed	Comment made by
4	The statement in section 7.1.4 on page 7-15, “According to Rule 131, activities in vulnerable areas that contribute to drinking water quality issues are deemed significant drinking water threats regardless of assigned vulnerability scores”, can be misleading to the reader. It will help clarify the Technical Rules by indicating that this statement only applies to issues in WHPA and IPZ vulnerable areas for systems in the Terms of Reference (ToR). It may also be helpful to indicate that issues are considered moderate drinking water threats when they are linked to a system not identified in the ToR or are located in a HVA/SGRA area.	These clarifications are provided in the AR: According to Rules 114, 115, 131 and 141, activities or conditions that contribute to drinking water quality issues (known to be partially or wholly due to anthropogenic sources), are deemed significant drinking water threats regardless of assigned vulnerability scores. This applies to intake protection zones and wellhead protection areas only, for drinking water systems identified in the Source Protection Area Terms of Reference. Further, issues in HVAs or SGRAs or those linked to a system not identified in the Terms of Reference may lead to the identification of moderate drinking water threats (not significant threats). Systems not identified in the Terms of Reference may be those included in the source protection planning process through municipal council resolution or by the Minister (MOE).	Section 7.1.4, Section 5.2. Appendix 2: Section Summary 5: Impact of Identifying an Issue, Section Summary 7: Threats Arising from Issues.	MOE Minor Supplemental Comment and MOE Early notification no. 4
5	Consider improving the explanations on the processes for threats and risk assessment, including how the approaches changed over time and how that transitions to current approaches. The report contains protocols for threats and risk assessment that are out-of-date and not consistent with the Technical Rules. Some additional text to describe how this analysis has transitioned to align with the Technical Rules and to generate the current AR results will make it easier for the readier to understand the current threats and risk assessment process	In Section 7, the vulnerability scoring approach and the issues based approach are further clarified. A brief description of the events based approach is provided. Links to the MOE Tables of Threats and MOE Tables of Circumstances are provided. It is clarified that the threats and risk assessment was done according to the latest Technical Rules, the Clean Water Act and its regulations, as well as the TSR local guidance document.	Sections 7.1.1 and 7.1.5	MOE Minor Supplemental Comment

No.	Guideline	Description of Change Made	Section/Appendix Changed	Comment made by
6	Consider the following typographical changes: a. Change the Director's title from "Director of Source Protection Planning" to "Director of Source Protection Programs Branch" on page 1-17. b. Change the description of consultation phases for the draft proposed and proposed from future to past tense in AR Section 1.10. c. Update sentence "Minor changes may be incorporated into report prior to posting the draft proposed Assessment Report for consultation" on page 3-14.	The typographical changes are made in the AR.	Sections 1.10, 3.3.5	MOE Minor Supplemental Comment
7	Issues analysis update: Thamesford issue nitrate to be removed	Nitrate was previously identified in the proposed AR as an issue in the raw (untreated) water of the Thamesford water wells. From the March 2011 Oxford County issues report update for the Thamesford system, nitrate levels in the wells have been decreasing, and since the fall of 2009, they have been consistently below the half MAC (Maximum Acceptable Concentration, for drinking water). The MAC is 10 mg/L for nitrate. It was recommended by Oxford County to remove nitrates as an issue for Thamesford, and this is now reflected in the amended AR.	Section 5.4: Table 5-5, Section 5.5: Table 5-6, Section 5.6: Table 5-7, Thamesford System Summary: Table 1, Section Summary 5: Table 1, Appendix 9 (flagged parameters), Appendix 12 (list of references).	County of Oxford
8	Update AR to include information on the new well in the Dorchester system (Well 3PW-8).	The new Dorchester well 3PW-8 was put into service late summer 2010. The count of wells for the Dorchester system is updated. Pumping rate information (max. annual, avg annual, avg monthly), well screen depths, and source (GUDI) are provided in the current AR. Limited raw water quality data is collected, but for the other municipal wells of the same system, no drinking water quality issues were detected. Note: the planned Oxford wells at Mount Elgin ('Graydon' well) and Woodstock ('Bond' well) are yet to be put into service.	Sections 2.3.6 (Table 2-4), 4.3.4, 4.3.5, Section 5: Table 5-6, Dorchester system summary: system overview, Appendix 9	Municipality of Middlesex Centre

No.	Guideline	Description of Change Made	Section/Appendix Changed	Comment made by
9	Vulnerability score changes due to modified AVI and SWAT scores and other minor adjustments for Oxford well systems WHPA.	The Aquifer Vulnerability Index (AVI) for most Oxford wells (except Ingersoll and Woodstock, which were assessed using SWAT) were modified to reflect the classification thresholds as specified by the Technical Rules. The previous high vulnerability AVI threshold was increased from 24 to 'less than 30', and the medium vulnerability AVI threshold corresponds to 'greater than or equal to 30 and less than or equal to 80'. The other minor adjustments made to the SWAT and AVI vulnerability mapping included filling minor gaps or misalignments, smoothing areas between different vulnerability categories and removing suspect erroneous well records. There are minor changes in mapping and no changes to vulnerability scoring except for the Ingersoll WHPA-C. In this WHPA, the vulnerability scores were previously 2, 4 and 6; they are now 2 and 6 only. Updated vulnerability and risk assessment identified an additional property as a significant threat and a letter was sent to the landowner. The count of significant threat locations for the Ingersoll WHPA is updated to total of 41 (previously 40).	Section 4.3.1: Table 4-1, Section 4: Table 4-4, Section 7: Table 7-6. applicable System Summaries figures, Oxford system maps in Appendix 1, Section 7: Table 7-19. Section summary 7: Table 3, and Ingersoll System Summary Table 2	County of Oxford
10	Minor editorial	Minor editorial changes to be made throughout the AR to reflect that the current AR is the 'Amended Proposed', pagination, spellings, etc.	Throughout the AR	CA Staff

Assessment Report Consultation Plan Addendum

Assessment Report Consultation Plan Addendum

Updated Assessment Reports

A consultation Plan was developed to guide the consultation on the Assessment Reports through their various stages. All Assessment Reports in the Thames-Sydenham and Region were updated in November 14, 2014 along with amendments to the Source Protection Plan. This addendum is intended to describe the consultation on the updated Assessment Reports. The consultation on the Assessment Report followed the approaches to consultation during the previous phases of the Assessment Report development as described in the Assessment Report Consultation plan last updated in June 2011.

Local consultation

The November 2014 updates to the Assessment Reports included updated or new technical work. Local consultation similar to that undertaken in Phase 1 and 2 was planned. This local consultation included:

- Open houses held within or near the areas of new or revised vulnerable areas. Table 1 identifies the local consultation open houses which were held across the region.
- Notices of the open houses placed in papers and on the web site.
- Municipalities notified of the open houses
- Updated vulnerable areas included in Source Protection Plan policy pre-consultation with municipalities.

Table 1 - Local consultation open houses

Date	Location	Primary Discussion Topics
Thursday, August 14 3 pm - 7 pm	Sarnia, Clearwater Arena, lower room	• Event Modelled IPZ-Fuel updates
Tuesday, August 19 3 pm - 7 pm	Wallaceburg Municipal Building	• Event Modelled IPZ-Fuel updates • Event Modelled IPZ-Fertilizer (if interest) • Wallaceburg Nitrate Issue
Thursday, August 21 3 pm - 7 pm	Camlachie Community Centre	• Event Modelled IPZ-Fuel updates • Kettle & Stony Point IPZ (if interest)
Wednesday, September 3 3-7pm	Wheatley Legion	• Event Modelled IPZ-Fuel • Wheatley Microcystin Concern • Updates to SGRA
Wednesday, August 20 3 pm - 7 pm	Oxford County Offices, Woodstock	• Nitrate ICA for Woodstock Tabor wellfield • Vulnerability reductions for Sweaburg • Water Quantity results (if interest)

Assessment Report Consultation

Consultation on the Updated Assessment Report will be undertaken together with the consultation on the Amended Proposed Source Protection Plan. This has the added advantage of providing people with both the areas where policy applies (in the Assessment Reports) and the policies (in the Source Protection Plan) which apply to those areas at the same time. In previous consultation, due to the staged or phased approach this was not possible. The Act and regulations have been interpreted to suggest that consultation on updated and amended Assessment Reports and Source Protection Plans must allow for consultation of those affected by the updates/amendments. In order to accomplish this, the consultation on the draft proposed plan and AR will be followed. The following are included in the consultation on the Amended Propose Source Protection Plan and Updated Assessment Reports:

- posting the Assessment Reports with the Source Protection Plan on the web site
- placing notices in newspapers within the region
- posting the notice on the web site
- notifying municipalities of the posting
- notifying First Nations chiefs of the posting
- notifying people believed to be engaged in significant threat activities
- notifying agencies established under the great lakes water quality agreement, a remedial action plan or lakewide management plan
- providing a comment period of greater than 30 days
- hosting open houses within each Source Protection Area. Table 2 identifies the Assessment Report/Source Protection Plan open houses.

Table 2 - Assessment Report and Source Protection Plan Consultation

Source Protection Area	Date	Location
St Clair Region	Tuesday, January 13, 2015 3:00-7:00pm	St. Clair Region Conservation Authority, 205 Mill Pond Cr., Strathroy
Lower Thames Valley	Wednesday, January 14, 2015 3:00-7:00pm	Lower Thames Valley Conservation Authority Administration Building, 100 Thames Street, Chatham
Upper Thames River	Thursday, January 15, 2015 3:00-7:00pm	Watershed Conservation Centre, Fanshawe Conservation Area, 1424 Clarke Road, London

Updated Assessment Report Consultation Comments

Consultation comments on the updated Assessment Report may be found in the change logs with the related revisions to the document. Change logs, compiled from all Assessment Reports and the Source Protection Plan, are bound separate from this Assessment Report and included as a supplemental document in the Source Protection Plan.

Appendix 5 – Watershed Characterization Summary

This section is bound separately.

Appendix 5 Addendum

Table A5-1: Thames River Fish Species Summary

Species (Common Name)	Species (Scientific Name)	Thames Abundance	Sensitive	Coldwater	Native	Migrant	Target
Alewife	*Alosa pseudoharengus*	Rare		✓		✓	
American brook lamprey	*Lampetra appendix*	Uncommon		✓	✓		
Bigmouth Buffalo	*Ictiobus cyprinellus*	Rare	✓		✓	✓	
Black Buffalo	*Ictiobus niger*	Rare			✓		
Black Bullhead	*Ameiurus melas*	Common			✓		
Black Crappie	*Pomoxis nigromaculatus*	Uncommon			✓		✓
Black Redhorse	*Moxostoma duquesnei*	Uncommon	✓		✓		
Blacknose Dace	*Rhinichthys atratulus*	Abundant			✓		
Blacknose Shiner	*Notropis heterolepis*	Uncommon	✓		✓		
Blackside Darter	*Percina maculata*	Abundant			✓		
Bluegill	*Lepomis macrochirus*	Common			✓		
Bluntnose Minnow	*Pimephales notatus*	Abundant			✓		
Brassy Minnow	*Hybognathus hankinsoni*	Uncommon			✓		
Brindled Madtom	*Noturus miurus*	Rare			✓		
Brook Silverside	*Labidesthes sicculus*	Uncommon			✓		
Brook Stickleback	*Culaea inconstans*	Abundant			✓		
Brook Trout	*Salvelinus fontinalis*	Uncommon	✓	✓	✓	✓	✓
Brown Bullhead	*Ameiurus nebulosus*	Uncommon			✓		
Brown Trout	*Salmo trutta*	Uncommon	✓	✓		✓	✓
Central Mudminnow	*Umbra limi*	Abundant			✓		
Central Stoneroller	*Campostoma anomalum*	Abundant			✓		
Channel Catfish	*Ictalurus punctatus*	Common			✓	✓	✓
Chinook Salmon	*Oncorhynchus tshawytscha*	Rare	✓	✓		✓	✓
Coho Salmon	*Oncorhynchus kisutch*	Rare	✓	✓		✓	✓
Common Carp	*Cyprinus carpio*	Abundant					
Common Shiner	*Luxilus comutus*	Abundant			✓		
Creek Chub	*Semotilus atromaculatus*	Abundant			✓		
Eastern Sand Darter	*Ammocrypta pellucida*	Uncommon	✓		✓		
Emerald Shiner	*Notropis atherinoides*	Common			✓	✓	
Fantail Darter	*Etheostoma flabellare*	Abundant			✓		
Fathead Minnow	*Pimephales promelas*	Abundant			✓		
Freshwater Drum	*Aplodinotus grunniens*	Uncommon			✓	✓	
Ghost Shiner	*Notropis buchanani*	Common			✓		
Gizzard Shad	*Dorosoma cepedianum*	Common			✓	✓	
Golden Redhorse	*Moxostoma erythrurum*	Abundant			✓		
Golden Shiner	*Notemigonus crysoleucas*	Common			✓		
Goldfish	*Carassius auratus*	Uncommon					
Gravel Chub	*Erimystax x-punctata*	Rare	✓		✓		
Greater Redhorse	*Moxostoma valenciennesi*	Common	✓		✓		
Green Sunfish	*Lepomis cyanellus*	Abundant			✓		
Greenside Darter	*Etheostoma blennioides*	Abundant			✓		
Hornyhead Chub	*Nocomis biguttatus*	Abundant			✓		
Iowa Darter	*Etheostoma exile*	Common			✓		
Johnny Darter	*Etheostoma nigrum*	Abundant			✓		
Lake Chubsucker	*Erimyzon sucetta*	Rare	✓		✓		
Largemouth Bass	*Micropterus salmoides*	Abundant			✓		✓
Least Darter	*Etheostoma microperca*	Common			✓		
Logperch	*Percina caprodes*	Common			✓		
Longear Sunfish	*Lepomis megalotis*	Common	✓		✓		
Longnose Dace	*Rhinichthys cataractae*	Common			✓		
Longnose Gar	*Lepisosteus osseus*	Uncommon			✓	✓	
Mimic Shiner	*Notropis volucellus*	Abundant			✓		

Table A5-1: Thames River Fish Species Summary

Species (Common Name)	Species (Scientific Name)	Thames Abundance	Sensitive	Coldwater	Native	Migrant	Target
Mooneye	*Hiodon tergisus*	Uncommon			✓	✓	✓
Mottled Sculpin	*Cottus bairdi*	Uncommon	✓	✓	✓		
Muskellunge	*Esox masquinongy*	Rare	✓		✓	✓	✓
Northern Brook Lamprey	*Ichthyomyzon fossor*	Rare			✓		
Northern Hog Sucker	*Hypentelium nigricans*	Abundant			✓		
Northern Madtom	*Noturus stigmosus*	Rare			✓		
Northern Pike	*Esox lucius*	Common	✓		✓	✓	✓
Northern Redbelly Dace	*Phoxinus eos*	Abundant			✓		
Pearl Dace	*Margariscus margarita*	Uncommon	✓	✓	✓		
Pugnose Minnow	*Opsopoeodus emiliae*	Rare	✓		✓		
Pumpkinseed	*Lepomis gibbosus*	Abundant			✓		
Quillback	*Carpiodes cyprinus*	Uncommon			✓	✓	
Rainbow Darter	*Etheostoma caeruleum*	Uncommon			✓		
Rainbow Trout	*Oncorhynchus mykiss*	Common	✓	✓		✓	✓
Redfin Shiner	*Lythrurus umbratilis*	Uncommon			✓		
River Chub	*Nocomis micropogon*	Common			✓		
River Darter	*Percina shumardi*	Rare			✓		
River Redhorse	*Moxostoma carinatum*	Rare			✓	✓	
Rock Bass	*Ambloplites rupestris*	Abundant			✓		
Rosyface Shiner	*Notropis rubellus*	Abundant			✓		
Round Goby	*Neogobius melanostomus*	Rare					
Sauger	*Sander canadensis*	Rare			✓	✓	✓
Sea Lamprey	*Petromyzon marinus*	Rare		✓		✓	
Shorthead Redhorse	*Moxostoma macrolepidotum*	Common			✓	✓	
Silver Lamprey	*Ichthyomyzon unicuspis*	Rare			✓	✓	
Silver Redhorse	*Moxostoma anisurum*	Common			✓	✓	
Silver Shiner	*Notropis photogenis*	Uncommon			✓		
Smallmouth Bass	*Micropterus dolomieu*	Abundant			✓		✓
Spotfin Shiner	*Cyprinella spiloptera*	Abundant			✓		
Spottail Shiner	*Notropis hudsonius*	Uncommon		✓	✓	✓	
Spotted Sucker	*Minytrema melanops*	Rare	✓		✓		
Stonecat	*Noturus flavus*	Abundant			✓		
Striped Shiner	*Luxilus chrysocephalus*	Abundant			✓		
Tadpole Madtom	*Noturus gyrinus*	Uncommon			✓		
Trout-perch	*Percopsis omiscomaycus*	Uncommon		✓	✓		
Walleye	*Sander vitreus*	Uncommon	✓		✓	✓	✓
White Bass	*Morone chrysops*	Uncommon			✓	✓	✓
White Crappie	*Pomoxis annularis*	Common			✓		✓
White Perch	*Morone americana*	Uncommon				✓	✓
White Sucker	*Catostomus commersoni*	Abundant			✓	✓	
Yellow Bullhead	*Ameiurus natalis*	Common			✓		
Yellow Perch	*Perca flavescens*	Common			✓	✓	✓

With respect to the preceeding table, the terms are described as:

Abundance: Refers to the relative abundance or common occurrence of the species found within the waters of the Thames River watershed based on sampling results. Consideration was given to accurately reflect the species presence within the watershed due to the sampling capture method, effort, and biases, difficulty in capturing certain species and

Abundant: Greater than 50 sample records in the database
Common: Between 15 and 50 sample records in the database
Historical: species that have been previously recorded in the Thames.
Rare: Less than 5 sample records in database
Uncommon: Between 5 and 15 sample records in database

Sensitive: In 2005, Coker and Portt identified sensitive species in the draft "Sensitive Species List for Agricultural Municipal Drain Clean Outs". Sensitive species have specific habitat requirements, and any alterations to their habitat could prove to be detrimental to the species.

Coldwater: Life history information was reviewed in "Morphological and Ecological Characteristics of Canadian Freshwater Fishes" to identify species habitat, including thermal 'preferences'. These species are found in coldwater habitats, defined as having water temperatures of less than 19°C.

Native: A species indigenous to a particular region or area.

Migrant: A species that moves to a riverine area from a lake in order to carry out one of its life history requirements such as spawning.

Target: Indicates if the species is a sportfish and considered a top level predator. Generally speaking, any species that is targeted for angling purposes would be a sportfish. Most sportfish feed on smaller fish, and baitfish can be used when angling for sportfish.

Table A5-2: Thames River Mussel Species Summary

Common Name	Scientific Name	Thames	Native
Black Sandshell	*Ligumia recta*	Live	☑
Creek Heelsplitter	*Lasmigona compressa*	Live	☑
Creeper	*Strophitus undulatus*	Live	☑
Cylindrical Floater (papershell)	*Anodontoides ferussacianus*	Live	☑
Deertoe	*Truncilla truncata*	Live	☑
Elktoe	*Alasmidonta marginata*	Live	☑
Fat Mucket	*Lampsilis siliquoidea*	Live	☑
Fawnsfoot	*Truncilla donaciformis*	Live	☑
Fluted Shell	*Lasmigona costata*	Live	☑
Fragile Papershell	*Leptodea fragilis*	Live	☑
Giant Floater	*Pyganodon grandis*	Live	☑
Hickorynut	*Obovaria olivaria*	Live	☑
Kidneyshell	*Ptychobranchus fasciolaris*	Live	☑
Lilliput Mussel	*Toxolasma parvus*	Live	☑
Mapleleaf	*Quadrula quadrula*	Live	☑
Mucket	*Actinonaias ligamentina*	Live	☑
Mudpuppy Mussel	*Simpsonaias ambigua*	Shells only	☑
Pimpleback	*Quadrula pustulosa*	Live	☑
Pink Heelsplitter	*Potamilus alatus*	Live	☑
Plain Pocketbook	*Lampsilis cardium*	Live	☑
Purple Wartyback	*Cyclonaias tuberculata*	Live	☑
Rainbow	*Villosa iris*	Live	☑
Rayed Bean	*Villosa fabalis*	Live	☑
Round Hickorynut	*Obovaria subrotunda*	Shells only	☑
Round Pigtoe	*Pleurobema sintoxia*	Live	☑
Slippershell Mussel	*Alasmidonta viridis*	Shells only	☑
Snuffbox	*Epioblasma triquetra*	Shells only	☑
Spike	*Elliptio dilatata*	Live	☑
Threehorned Wartyback	*Obliquaria reflexa*	Live	☑
Threeridge	*Amblema plicata*	Live	☑
Wabash Pigtoe	*Fusconaia flava*	Live	☑
Wavy-rayed Lampmussel	*Lampsilis fasciola*	Live	☑
White Heelsplitter	*Lasmigona complanata*	Live	☑
Zebra Mussel	*Dreissena polymorpha*	Live	☐

With respect to the above table, the terms are described as:
Thames: Indicates wether live specimens have been located or relict shells only located.

Native: A species indigenous to a particular region or area.

Table A5-3: Benthic Species in the Thames River and Tributaries (species that are more than 0.05% of the 280,000 organisms sampled in 1997 to 2006)

Taxon Name	Common Name
Glossiphoniidae	Leech
Oligochaeta	Aquatic Worm
Acariformes	Water Mite
Gammaridae	Sideswimmer
Talitridae	Sideswimmer
Daphnidae	Water Flea
Cyclopoida	Fish Lice
Asellidae	Sow Bug
Ostracoda	Seed Shrimp
Dytiscidae	Predacious Diving Beetle
Elmidae	Riffle Beetle
Haliplidae	Crawling Water Beetle
Hydrophilidae	Water Scavenger Beetle
Psephenidae	Water Penny Beetle
Ceratopagonidae	Biting Midge
Chironomidae	Midge
Empididae	Dance Fly
Simuliidae	Black Fly
Tabanidae	Horse Fly
Tipulidae	Crane Fly
Baetidae	Small Mayfly
Caenidae	Crawling Mayfly
Ephemerellidae	Mayfly
Heptageniidae	Stream Mayfly
Leptophlebiidae	Mayfly
Oligoneuridae	Torpedo Mayfly
Tricorythidae	Crawling Mayfly
Corixidae	Water Boatmen
Coenagrionidae	Narrow-winged Damselfly
Leuctridae	Stonefly
Nemouridae	Stonefly
Perlidae	Stonefly
Helicopsychidae	Snail-case Caddisfly
Hydroptilidae	Micro-caddisfly
Hydropsychidae	Net-spinning Caddisfly
Leptoceridae	Long-horned Caddisfly
Lepidostomatidae	Lepistomatid Caddisfly
Philopotamatidae	Finger-net Caddisfly
Sphaeriidae	Fingernail Clam
Valvatidae	Round-mouthed Snail
Lymnaeidae	Pond Snail
Physidae	Pouch Snail
Planorbidae	Orb Snail
Nematoda	Thread Worm
Planaria	Flatworm
Limnephilidae	Northern Caddisfly
Hydrozoa	Hydra
Taeniopterygidae	Stonefly
Capniidae	Stonefly

Table A5-4: Aquatic and Semi-Aquatic Species At Risk in the Thames River Watershed (May 2010)

Common Name	Scientific Name	SARO 2010	COSEWIC 2010	SARA 2010
Fish				
Bigmouth Buffalo	*Ictiobus cyprinellus*	Not at Risk	Not at Risk	No Status
Black Buffalo	*Ictiobus niger*	Data Deficient	Data Deficient	No Status
Black Redhorse	*Moxostoma duquesnei*	Threatened	Threatened	Threatened
Eastern Sand Darter	*Ammocrypta pellucida*	Endangered	Threatened	Threatened
Grass Pickerel	*Esox americanus vermiculatus*	Special Concern	Special Concern	Special Concern
Gravel Chub	*Erimystax x-punctata*	Extirpated	Extirpated	Extirpated
Greenside Darter	*Etheostoma blennioides*	Not at Risk	Not at Risk	No Status
Northern Brook Lamprey	*Ichthyomyzon fossor*	Special Concern	Special Concern	Special Concern
Northern Madtom	*Noturus stigmosus*	Endangered	Endangered	Endangered
Pugnose Minnow	*Opsopoeodus emiliae*	Special Concern	Special Concern	Special Concern
River Redhorse	*Moxostoma carinatum*	Special Concern	Special Concern	Special Concern
Silver Shiner	*Notropis photogenis*	Special Concern	Special Concern	Special Concern
Spotted Sucker	*Minytrema melanops*	Special Concern	Special Concern	Special Concern
Spotted Gar	*Lepisosteus oculatus*	Threatened	Threatened	Threatened
Mussels				
Fawnsfoot	*Truncilla donaciformis*	Endangered	Endangered	Endangered
Kidneyshell	*Ptychobranchus fasciolaris*	Endangered	Endangered	Endangered
Mapleleaf	*Quadrula quadrula*	Threatened	Threatened	Threatened
Mudpuppy Mussel	*Simpsonaias ambigua*	Endangered	Endangered	Endangered
Rainbow	*Villosa iris*	Threatened	Endangered	Endangered
Rayed Bean	*Villosa fabalis*	Endangered	Endangered	Endangered
Round Hickorynut	*Obovaria subrotunda*	Endangered	Endangered	Endangered
Round Pigtoe	*Pleurobema sintoxia*	Endangered	Endangered	Endangered
Snuffbox	*Epioblasma triquetra*	Endangered	Endangered	Endangered
Wavy-rayed Lampmussel	*Lampsilis fasciola*	Endangered	Special Concern	Endangered
Reptiles				
E. Ribbonsnake	*Thamnophis sauritus*	Special Concern	Special Concern	Special Concern
Queensnake	*Regina septemvittata*	Threatened	Endangered	Threatened
Blanding's Turtle	*Emydoidea blandingii*	Threatened	Threatened	Threatened
N. Map Turtle	*Graptemys geographica*	Special Concern	Special Concern	Special Concern
Snapping Turtle	*Chelydra serpentine*	Special Concern	Special Concern	No Status
Spiny Softshell	*Apalone spinifera*	Threatened	Threatened	Threatened
Spotted Turtle	*Clemmys guttata*	Endangered	Endangered	Endangered

A "species at risk" (SAR) is any naturally-occurring plant or animal in danger of extinction or of disappearing from the province. Once classified as "at risk", they are added to the Species at Risk in

Ontario (SARO) List. COSEWIC Status is the status assigned by the Committee on the Status of Endangered Wildlife in Canada for the Species at Risk Act (SARA). These include:

- Extinct (X) – A wildlife species that no longer exists.
- Extirpated (XT) – A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
- Endangered (E) – A wildlife species facing imminent extirpation or extinction
- Threatened (T) – A wildlife species likely to become endangered if limiting factors are not reversed
- Special Concern (SC) – A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

(Source: http://www.mnr.gov.on.ca/en/Business/Species/).

Species at Risk Act (SARA) is a key federal government commitment to prevent wildlife species from becoming extinct and secure the necessary actions for their recovery. It provides for the legal protection of wildlife species and the conservation of their biological diversity.
(Source: http://www.sararegistry.gc.ca/approach/act/default_e.cfm)

Appendix 6 – Conceptual Water Budget

This section is bound separately.

Appendix 7 – Assessment Report Checklist

UTRSPA- Source Protection Assessment Report Content Checklist

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NOTE: This Assessment Report Checklist lists page numbers which are approximate. This is due to formatting and possible changes in page breaks of the Assessment Report during the writing of this checklist. However the Section numbers are accurate.

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NO.	SUMMARY OF LEGISLATIVE REQUIREMENTS	LEGISLATIVE REFERENCE			MINIMUM FORMAT	GUIDANCE	PAGE/MAP NO. IN ASSESSMENT REPORT
		CWA	REG 287/07	TECHNICAL RULES			
	Excerpts listed below are from the Legislative requirements from the Clean Water Act (CWA), Regulation 287/07 and Technical Rules ***(Please refer to actual legislation for detailed wording)***	*Section reference for legislative requirement from its source document. Several requirements have multiple references to section within the CWA, Regulation 287/07 and Technical Rules*			*Minimum requirement for format in AR to meet legislative requirement*	*Additional guidance or linkage to other MOE guidance documents or training that should be considered when compiling the AR*	***To be completed by CA*** *– provide page or map number where legislative requirement is presented in AR*
ALTERNATE METHOD / APPROACH							
i	☐ Alternate method or approach to requirements in the technical rules o Rationale for the departure o Explanation of how the approach is equivalent or better, o A copy of the Director's approval included in the assessment report			15.1, 15.2	Text Copy of letter from Director	In preparing an AR, a SPC may use an alternate method/approach for gathering information or for performing a task that departs from the method/approach prescribed in the Technical Rules under written confirmation from the Director. Rule 15.1 does not relieve the SPC from ensuring that an AR is prepared in accordance with an applicable requirement in the Act, regulations or ToR.	
WATERSHED CHARACTERIZATION COMPONENT							
1	☐ Information sources for data used in developing the AR and the purposes for which it was used			9(2)(a)	Table	For the information contained in the watershed characterization these requirements must be included in the AR	Section 2.2: p. 2-2
2	☐ Methods of analysis applied to data			9(2)(b)	Text		Section 2 (throughout), Appendix 5 (throughout),
3	☐ Limitations in respect of TR 9 (2)(a & b) (information sources and methods of analysis)			9(2)(c)	Text		Section 2.4: p. 2-29

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		CWA	REG 287/07	TECHNICAL RULES			
4	☐ Identify watersheds in the source protection area	15 (2)(a)					Appendix 1: Map 1-1
5	o watershed boundaries			16(1)	Map	May be the same as the source protection area boundary or a different boundary depending on the situation for the SPA.	Appendix 1: Map 1-1
6	o subwatershed areas			16(2)(a)	Map	Subwatershed areas should reflect subwatersheds in the water budget.	Appendix 1: Map 1-1, 1-2
6A	☐ Describe watersheds			2, 16, 17, 18	Text	Where information is available – to align with lines 7-29	Section 2.3.1: p. 2-4, Appendix 5 p. 3
7	☐ Physical geography characterization for every watershed		13(1)(1)				Section 2.3.2: p. 2-4, Appendix 5
8	o the location and types of natural vegetative cover, including wetlands, woodlands and vegetated riparian areas and the percentage of land coverage of each			16(4)	Map Table		Appendix 5: p. 12-13, Map 23a, Map 24 and Map 25a. Section 2.3.2: p. 2-6
9	o location and types of aquatic habitats, including coldwater, mixed, and warm water fisheries, and macroinvertebrate communities			16(5)	Map		Appendix 5: p. 10-11 and 13-15, Section 2.3.2: p. 2-7, Appendix 5 Addendum p. 2-6
10	o a comparison of the communities described for TR 16(5) to similar communities not impacted by anthropogenic factors			16(6)	Text	The intent of this rule is to describe the impact human factors have had on some of the communities listed under 9 and in rule 16(5).	Section 2.3.2: p. 2-10 to 2-12

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		CWA	REG 287/07	TECHNICAL RULES			
11	o a description of the species at risk within the source protection area, if relevant			16(7)	Map Table	Species at risk can not be mapped at a scale that is prohibited by the Species At Risk Act. Mapping of general areas is acceptable but not required.	Appendix 5: Map 29. Appendix 5 Addendum p. 7 to 8, Section 2.3.3 p. 2-12
12	☐ Characterization of surface water and groundwater quality and quantity in watersheds	15 (2)(b)			Text	This is a very high level description and reference to more detailed information in other areas of the AR.	Section 2.3.4, Appendix 5
13	o surface water quality and groundwater quality across watersheds			16(8), 9(3)(a), 18	Text Table Maps	Refer to TR 19 for considerations for assessing water quality	Section 2.3.4: p. 2-18 to 2-22, Appendix 5 p. 21 to 35, Appendix 5 Map 15 and Map 37
14	☐ Human geography characterization		13(1)(1)		Text		Section 2.3.3, Appendix 5
15	o areas of settlement, as defined in the Places to Grow Act, 2005			16(2)(b)	Map	If not defined in the Places To Grow Act, define boundaries based on official plans or other maps of the area.	Appendix 1: Map 1-4
16	o municipal boundaries			16(2)(c)	Map		Appendix 1: Map 1-2
17	o municipal population and population density			16(2)(c)	Table Map	Including high, medium, and low density areas	Section 2.3.3:Table 2-3, Appendix 1: Map 2-1
18	o federal lands			16(2)(e)	Map	Lands owned and regulated by the federal government.	Section 2.3.3: p. 2-14
19	o reserves as defined under the *Indian Act* (Canada), and their population and population density			16(2)(d)	Table Map		Section 2.3.3: p. 2-14

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			CWA	REG 287/07	TECHNICAL RULES			
20		o One or more managed land maps			16(9)	Map	Rules 16(9) and (10) require that one or more maps be developed. See Technical Bulletin for more detail. Only required for the parts of each vulnerable area where the vulnerability score is >4.	Appendix 1: Map 7-2-1 to 7-2-27
21		o One or more livestock density maps			16(10)	Map		Appendix 1: Map 7-2-1 to 7-2-27
22		o One or more percentage impervious surface area maps.			16(11), 17	Table Map	Map must show the 1 km^2 grid, and the percentage impervious area within each grid square. The grid is centred in the SPA unless approved otherwise, but the grid cells are only required where they overlap with vulnerable areas. Note these maps are only required for the parts of each vulnerable area where the vulnerability score is >4.	Appendix 1: Map 7-1-1 to 7-1-25
23	☐ Drinking Water Systems							
24		o drinking water system locations and area served by a system			16(3)(a)	Map Table	This includes any DWS that is listed in rule 3(b). SPCs are not expected to know the locations served by every drinking water system. The watershed characterisation should reflect the knowledge available, how this was determined, and gaps in information as per TR 9(2)	Appendix 1: Map 1-3, Section 2.3.6: Table 2-4 p. 2-24

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		CWA	REG 287/07	TECHNICAL RULES			
25	o drinking water system classification and the number of users served by the system			16(3)(b) & (c)	Table		Section 2.3.6: p. 2-24 to 2-28
26	o the location of surface water intakes and wells that are part of the system			16(3)(d)	Map Table		Appendix 1: Map 4-1-1 to Map 4-1-23
27	o the maximum annual, average annual and average monthly pumping rates of surface water intakes and wells that are part of the system			16(3)(d)	Table		Section 2.3.6: p. 2-24 to 2-28
28	o location of monitoring wells related to the system			16(3)(e)	Map, Table		Appendix 1: Map 4-1-1 to Map 4-1-23
29	☐ Interactions between physical and human geography		13(1)(1)		Text		Section 2: p. 2-15 to 2-18
WATER BUDGET COMPONENT							
30	☐ Information sources for data used in developing the AR and the purposes for which it was used			9(2)(a)	Table	For entire water budget.	Appendix 6: p. 13 to 29
31	☐ Methods of analysis applied to data			9(2)(b)	Text		Section 3.2: p. 3-3 to 3-10
32	☐ Limitations in respect of TR 9 (2)(a & b) (information sources and methods of analysis)			9(2)(c)	Text		Section 3.6: p. 3-22, Appendix 6: p. 217 to 221

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		CWA	REG 287/07	TECHNICAL RULES			
33	☐ Conceptual water budget for every watershed (identify the different ways that water enters and leaves the watershed)	15(2)(c)		9(1)(b), 9(2)(d), 19, 24		TR 24 provides conditions under which an SPC is exempt from completing a separate conceptual water budget, specifically where the same information is included within a tier 1 or 2 water budgets. Refer to MNR's guidance on water budget.	Appendix 6: p. 193 to 212
34	☐ Assessment of physiography		13(1)(1)	19(1)	Map Text	Should include one or more of the following maps and text - physigographic regions - bedrock topography - ground surface topography - hummocky topography The information may already be contained in the watershed characterization and can be referenced if this is the case.	Section 2.3.2 p. 2-4 to 2-6, Appendix 5: Maps 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, Appendix 6: p. 78 to 91

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			CWA	REG 287/07	TECHNICAL RULES			
35		☐ Assessment of geology			19(2)	Map Text	Should include one or more of the following maps and text: - permeability distribution at surface and subsurface influences, runoff and infiltration/recharge trends - cross-sections of watershed scale aquifer units - bedrock geology - surficial geology - overburden thickness - soils The information may already be contained in the watershed characterization and can be referenced if this is the case.	Section 2.3.2 p. 2-4 to 2-6, Appendix 5: Maps 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, Appendix 6: p. 64 to 78
36		☐ Assessment of how land cover across the area affects groundwater and surface water			19(9)	Map Text	Describe land cover (current conditions)	Section 2.3.2: p. 2-4, p. 2-8. Appendix 5 Map 30, Appendix 6: p. 157 to 159
37		☐ For surface water within conceptual water budget						
38		o Assessment of surface water bodies and their flows and water levels	15(2)(c) (ii)		19(3)	Map Table	One or more maps, graphs and tables: - long term monthly flows and annual surface water flows - streamflow gauging stations	Appendix 6: p. 89 to 119.

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				CWA	REG 287/07	TECHNICAL RULES			
39			o Assessment of Aquatic habitat dependant upon water depth, flow & temperature			19(11)	Table Map	One or more maps or tables: - aquatic habitats dependent on water depth, flow and temperature - fisheries - cold water vs. warm water	Section 2.3.2: p. 2-7, Appendix 5 Addendum, Appendix 6: p. 157, 160 to161.
40			o Assessment of surface water control structures including any dams within the meaning of section 1 of the *Lakes and River Improvement Act*, and any plans that govern operations of the structure			19(4)	Map Table Text	How these control structures impact surface water flows; one or more of maps of dams, channel diversions and water crossings. Any plans that govern operations of the structure are not required to be included as part of the AR. A link could be provided for where the operational plan is located, if necessary.	Appendix 6: p. 91 to 96

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				CWA	REG 287/07	TECHNICAL RULES			
41			o Assessment of surface water intakes			19(6)	Table Map	This should include DWSs in addition to those listed within the Watershed Characterization (TR 16(3)(a-d)), which would mean the inclusion of any surface water DWS that takes water for reasons other than drinking water, plus any drinking water system not listed in TR 16(3)(b). SPCs are not expected to know where every drinking water system is located, but should use all available sources of information to identify intakes. Where information is not available, estimates can be made on the numbers of systems and expected takings.	Appendix 6 p. 182-184
42			o Assessment of the maximum, actual and projected amounts of water taken annually from the watershed that require a permit under s. 34 of OWRA o Assessment of the purpose for which water is being taken (TR 19(8))	15(2)(c) (iii)		19(8), 19(10.1)	Table	This row in the checklist combines several similar requirements to report on permitted takings (takings that are authorized with a PTTW). Three types of takings considered on an annual basis: actual, maximum, projected	Appendix 6: p. 161 to 170, p. 183 to 184

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				CWA	REG 287/07	TECHNICAL RULES			
43			o Assessment of the maximum, actual and projected amounts of water taken annually from the watershed that do not require a permit under s.34 of OWRA o Assessment of the purpose for which water is being taken (TR 19(10))	15(2)(c) (iv)		19(10), 19(10.1)	Table	This row in the checklist combines several similar requirements to report on takings that do not need a PTTW – Less than 50,000L per day and exempted takings. Three types of takings considered on an annual basis: actual, maximum, projected	Appendix 6: p. 184 to 192
44		☐ For groundwater within conceptual water budget							
45			o Assessment of groundwater aquifers, their direction of flows, and mapping of the water table and potentiometric surface(s).	15 (2)(c)(ii)		19(5)	Map Text	One or more maps can be used to express this: aquifer extent, water table, potentiometric surface(s), and ground water flow directions. The assessment should include estimates, if possible, of the inputs and outputs of the aquifer within the watershed/ subwatershed	Section 2.3.2 p. 2-5 and 2-6. Appendix 6: p. 123 to 156

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				CWA	REG 287/07	TECHNICAL RULES			
46			o Assessment of wells			19(6)	Table	This should include DWSs in addition to those listed within the Watershed Characterization (TR 16(3)(a-d)), which would mean the inclusion of any surface water DWS that takes water for reasons other than drinking water, plus any DWS not listed in TR 3(b). SPCs are not expected to know where every DWS is located, but should use all available sources of information to identify intakes. Where information is not available, estimates can be made on the numbers of DWS and expected takings. One or more tables and maps can be used to express this: groundwater monitoring locations	Appendix 6: p. 178 to 180, Section 2.3.5: p. 2-22 Section 2.3.6 p. 2-22 to 2-28
47			o Assessment of the maximum, actual and projected amounts of water taken-annually from the watershed that require a permit under s. 34 of OWRA o Assessment of the purpose for which water is being taken (TR 19(8))	15(2)(c) (iii)		19(8), 19(10.1)	Table	This row in the checklist combines several similar requirements to report on permitted takings (takings that are authorized with a PTTW). 3 types of takings considered on an annual basis: actual, maximum, projected	Appendix 6: Tables 53-57, Figures 70, 71, Section 3.6

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				CWA	REG 287/07	TECHNICAL RULES			
48			o Assessment of the maximum, actual and projected amounts of water taken annually from the watershed that do not require a permit under s.34 of OWRA o The purpose for which water is being taken as per (TR 19(10))	15(2)(c) (iv)		19(8), 19(10), 19(10.1)	Table	This row in the checklist combines several similar requirements to report on takings that do not need a PTTW – Less than 50,000L per day and exempted takings. 3 types of takings considered on an annual basis: actual, maximum, projected	Appendix 6: Table 63-66 Section 3.6.5
49		☐ Assessment of the interactions between groundwater and surface water ☐ Description of any interrelationships between the component elements of the conceptual water budget				19(7), 9(2)(d)	Text Map	Where appropriate, reference existing maps in other sections of the AR; must include maps showing: - ground water discharge areas - ground water recharge areas Recommend text describing, where information is available, volumes of water moving through discharge and recharge areas, and the relevance of these areas to other features (i.e. fish habitat)	Appendix 6: Map 24, p. 193 to 201
50		☐ Assessment of the trends related to any items listed in TR 19(3 – 11)				19(12)	Text	At a minimum describe trends in water quantity for surface and ground water.	Appendix 6: p. 193 to 212
51		☐ Climate and climate change							

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				CWA	REG 287/07	TECHNICAL RULES			
52			O Assessment of the climate of the area including historical trends and existing projections related to changes in the climate			19(13)	Text	Assessment of any available information including: - climate stations with average annual precipitation - precipitation distribution - areas for climate stations - metrological zones - evapotranspiration - long term temperature and precipitation trends and averages (historical or projected)	Appendix 6: p. 31 to 64
53			O Potential impacts climate change over the next 25 years will have on conclusions, and list of information sources used for the discussion			9(2)(e)	Text	Based on the information from 19(13) and the analysis undertaken to complete the AR, the understanding of the effects climate change may have on the conclusions of the AR. For example, would the water budget change, would vulnerable areas change? Refer to Technical bulletin "Climate Change and the Director's Technical Rules"	
54	☐ **Tier 1 Water Budget for each subwatershed**			15(2)(c) (i)		20		See below for anticipated minimum format for individual requirements for water budget tiers.	Section 3.2.6, Table 3-2 p. 3-10
54A		☐ Quantify the amount of water that enters and leaves the watershed							

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			CWA	REG 287/07	TECHNICAL RULES			
55		☐ Results of every calculation, assessment and assignment required by Parts III.3, III.4 and IX			9(3)(b)	Text		Section 3
56		☐ Quantify actual amounts of water taken annually and the projected annual takings of water from the watershed that o require a permit under s. 34 of OWRA o do not require a permit ☐ Maximum annual quantity of water that a person is permitted to take under the permit and the purpose for which water is being taken (TR 19(8)) ☐ Annual quantity of water taken and the purpose for which water is being taken for which a permit has not been issued (TR 19(10))	15(2)(c) (iii), 15(2)(c) (iv)		19(8), 19(10), 19(10.1)		If new information is obtained that updates information obtained for the conceptual water budget, this section should describe the updated information and the sources of that new information.	Section 3.2.5, p. 3-5 to 3-8, Table 3-1

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57		☐ subwatersheds delineated and stress levels assigned to <u>surface water</u> subwatersheds			9(1)(c) (v), 9(3)(d), 21, 31, 32	Table Text Map	One or more maps, tables and text to describe the following: - surface water values for supply, demand and reserve and methods used to calculate these values - maximum monthly surface water stress levels with surface water intakes - future maximum monthly surface water stress levels with surface intake systems - table identifying maximum stress levels, municipal systems and decision to advance to tier 2 - documented historical inability to meet demand	Appendix 1: Map 3-1 to Map 3-6, Section 3.2 p. 3-3 to 3-10, Section 3.4 p. 3-14 to 3-20

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58		☐ subwatersheds delineated and stress levels assigned to groundwater subwatersheds			9(1)(c) (v), 9(3)(d), 21, 31, 33	Table Text Map	One or more maps, tables and text to describe the following: - monthly groundwater values for supply, demand and reserve and methods used to calculate these values - maximum monthly groundwater stress levels with water well systems - future maximum monthly surface water stress levels with groundwater systems - annual groundwater stress levels with water well systems - future annual groundwater stress levels with water well systems - table identifying maximum stress levels, municipal systems and decision to advance to tier 2 - documented historical inability to meet demand	Appendix 1: Map 3-1 to Map 3-6, Section 3.3 p. 3-3 to 3-10, Section 3.4 p. 3-14 to 3-20
59		☐ Discussion of uncertainty factors assigned and analysis conducted in TR 36			9(2)(f), 34(2)(f) (ii), 35(2)(h) (ii)	Text		Section 3.4.1: p. 3-20

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60	☐ **If needed: Tier 2 Water Budget**			22, 24	Text	Note: Rule 22 replaced in new TR	
61	☐ Results of every calculation, assessment and assignment required by Parts III.3, III.4 and IX			9(3)(b)	Text		Section 3
62	☐ Discussion of uncertainty factors assigned and analysis conducted in TR 36			9(2)(f), 34(2)(f) (ii), 35(2)(h) (ii)	Text		Section 3.4.1: p. 3-21
63	☐ Quantify actual amounts of water taken annually and the projected annual takings of water from the watershed that o require a permit under s. 34 of OWRA o do not require a permit ☐ maximum annual quantity of water that a person is permitted to take under the permit and the purpose for which water is being taken (TR 19(8)) ☐ annual quantity of water taken and the purpose for which water is being taken for which a permit has not been issued (TR 19(10))	15(2)(c) (iii), 15(2)(c) (iv)		19(8), 19(10), 19(10.1)	Table	If new information is obtained that updates information obtained for the Tier 1 budget, this section should describe the updated information and the sources of that new information.	Section 3.2.5, p. 3-4 to 3-8, Table 3-1

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64		☐ subwatersheds delineated and stress levels for each surface water subwatershed assigned a significant or moderate stress level from Tier 1 and from which an existing or planned Type I, II or III system takes water			9(1)(c) (v), 9(3)(d), 23 – 25, 31, 34	Table Text Map	Include one or more of the following: - Summary table for refined monthly surface water values for supply, demand and reserve and methods to calculate these values - Maximum monthly surface water stress levels with surface intake systems - Future maximum monthly surface water stress levels with surface intake systems - Table with maximum stress levels, municipal systems, and decision to advance to tier 3 - Documented historical inability to meet demand	Appendix 1: Map 3-1 to Map 3-6, Section 3.2 p. 3-3 to 3-10, Section 3.4 p. 3-14 to 3-20

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			CWA	REG 287/07	TECHNICAL RULES			
65		☐ Subwatersheds delineated and stress levels for each groundwater subwatershed assigned a significant or moderate stress level from Tier 1 and from which an existing or planned Type I, II or III system takes water			9(1)(c) (v), 9(3)(d), 23 – 25, 31, 35	Table Text Map	Include one or more of the following: - Summary table for refined monthly groundwater values for supply, demand and reserve and methods to calculate these values - Maximum monthly groundwater stress levels with groundwater well systems - Future maximum monthly groundwater stress levels with groundwater well systems - Annual groundwater stress levels with well systems - Future annual groundwater stress levels with well systems - Table with maximum stress levels, municipal systems and decision to advance to tier 3 - Documented historical inability to meet demand	Appendix 1: Map 3-1 to Map 3-6, Section 3.2 p. 3-3 to 3-10, Section 3.4 p. 3-14 to 3-20

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66	☐ **If needed: Tier 3 Water Budget For Each Local Area** ☐ If information required to delineate a local area or to complete Tier 3 as per TR 29 and 30 cannot be readily ascertained, include 1. a plan with a work schedule to ascertain information necessary to delineate the local area or complete the Tier 3 water budget, and additional work that must be carried out as a result of ascertaining this information; and 2. if, after completing the work the SPC becomes aware that the AR is no longer accurate or complete, an estimate of the date when SPC expects an updated AR and submitted to the Director under section 19 of the Act.			30, 30.1	Text	Include refined integrated understanding in tier 3 water budget, if being undertaken Work with your Liaison Officer to determine date an updated AR will be required.	Section 3.3.4 p. 3-13 Section 9 Table 9-1 p. 9-4
67	☐ Results of every calculation, assessment and assignment required by Parts III.3, III.4 and IX			9(3)(b)	Text		
68	☐ Discussion of uncertainty factors assigned and analysis conducted in TR 108 – 109			9(2)(f)	Text		

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69	☐ Quantify actual amounts of water taken annually and the projected annual takings of water from the watershed that o require a permit under s. 34 of OWRA o do not require a permit ☐ maximum annual quantity of water that a person is permitted to take under the permit and the purpose for which water is being taken (TR 19(8)) ☐ annual quantity of water taken and the purpose for which water is being taken for which a permit has not been issued (TR 19(10))	15(2)(c) (iii), 15(2)(c) (iv)		19(8), 19(10), 19(10.1)		If new information is obtained that updates information obtained for the Tier 2 budget, this section should describe the updated information and the sources of that new information.	
70	☐ Local areas/ IPZ-Q delineated for <u>surface water intakes</u> taking water from a subwatershed identified with a stress level of significant or moderate in tier 2			26, 28, 29, 76-78	Map Table	Water quantity vulnerability maps IPZ-Q	
71	o Risk Levels for each delineated local area – <u>surface water</u>			7(1), 9(1)(c) (vi)), 9(3)(d), 97 – 107	Table Map	Local area risk level (significant, moderate or low)	
72	☐ Local areas/ WHPA-Q2/WHPA-Q2 delineated for <u>groundwater wells</u> taking water from a subwatershed identified with a stress level of significant or moderate in tier 2			27, 28, 29, 53 – 54	Map Table	Water quantity vulnerability maps WHPA Q1 and Q2	

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73	o Risk Levels for each delineated local area – groundwater			7(1), 9(1)(c) (vi)), 9(3)(d), 97 – 107	Table Map	Local area risk level (significant, moderate or low)	
74	☐ Based on information in the water budget describe any existing or anticipated water shortages in the watershed	15(2)(c) (v)			Text	Include the conclusions for this requirement for tier 3, if completed for water budget	
75	☐ **Threats for drinking water – quantity**					Only require threats and issues component when undertaking a tier 3 water budget	
76	☐ List Activities						
77	o List of activities that are or would be drinking water threats (quantity)			110-113, 7(2)	Table Text	Reference list of threats in s.1.1 of regulation 287/07	
78	☐ List circumstances						
79	o List circumstances for significant, moderate and low drinking water threats (quality)		13(1)(3) 13(1)(4) 13(1)(5)		Table Text	Circumstances are required to be listed for (1) prescribed drinking water threats where the tables of drinking water threats are identified by the province; (2) local circumstances for prescribed threats (which were not identified in number 1); and (3) circumstances associated with locally determined drinking water threats that have been approved by the Director.	

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80	☐ Identifying areas where activities or conditions are significant, moderate or low (quantity)						
81	o Areas where activities are or would be <u>significant</u> drinking water threats (existing and future) (quantity)	15(2)(h) (i)		8(3), 9(1)(c)(ix), 127	Map Text		
82	o Areas where activities are or would be <u>moderate</u> drinking water threats (existing and future) (quantity)		13(1)(2) (i)	8(3), 9(1)(c)(ix), 132, 134, 134.1, 134.2	Map Text		
83	o Areas where activities are or would be low drinking water threats (existing and future) (quantity)		13(1)(2) (ii)	8(3), 9(1)(c)(ix), 135, 137	Map Text		
84	☐ Enumeration of significant drinking water threats (quantity)						
85	o Number of locations at which a person is engaging in an activity that is or would be a significant drinking water threat		13(1)(6) (i)	9(1)(e)	Table Text	For considerations in enumerating threats refer to the threats and issues guidance documentation.	

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VULNERABILITY COMPONENT							
86	☐ Information sources for data used in developing the AR and the purposes for which it was used			9(2)(a)	Table	For vulnerability section(s) of AR	Section 4.3.1 p. 4-4, Section 4.4 p. 4-28, Section 4.5 p. 4-32
87	☐ Methods of analysis applied to data			9(2)(b)	Text	For vulnerability section(s) of AR	Section 4.3.2 p. 4-5, Section 4.3.3 p. 4-6, Section 4.3.4 p. 4-7, Section 4.3.5 p. 4-23, Section 4.3.6 p. 4-47, Section 4.4 p. 4-48, Section 4.5 p. 4-52
88	☐ Limitations in respect of TR 9 (2)(a & b) (information sources and methods of analysis)			9(2)(c)	Text	For vulnerability section(s) of AR	Section 4.6: p. 4-54, Section 3.6 p. 3-22
88A	☐ Uncertainty analysis			13 – 14	Text	For vulnerability section(s) of AR	Appendix 13, Section 4.3.6 p. 4-47, Section 4.4.1 p. 4-52, Section 4.5.1 p. 4-54
89	☐ Qualitative description of geophysical and hydrodynamic settings across the source protection area including information to support the delineation of HVA, SGRA, WHPA			5(1)	Text	Preamble/context to vulnerability section of AR	Section 3.2: p. 3-3 to 3-10, Section 3.3: p. 3-10 to 3-12 Section 2: p. 2-4 to 2-6

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90		☐ Groundwater vulnerability assessment across the source protection area			5(2), 37, 38, 38.1, 38.2, 9(1)(c)(i)	Map Text	Indicate which of the four methods was used to determine groundwater vulnerability. Note: If a well in the ToR draws water from a deeper confined or protected aquifer the SPC may choose to use a deep aquifer vulnerability method to assign the groundwater vulnerability. This groundwater vulnerability can be used in assigning the WHPA vulnerability score. If this is the case, the SPC must also use a shallow aquifer groundwater vulnerability method to assign the groundwater vulnerability for the highly vulnerable aquifer (HVA). At this time, the two methods of assigning groundwater vulnerability must be mapped. If an SPC or their representatives have used two different methods of assigning groundwater vulnerability for reasons other than the consideration of a confined or deeper aquifer, and they select one method or a combined method, they are only required to map the chosen method to assign the groundwater vulnerability.	Section 4.3.5 p. 4-23, Section 4.4 p. 4-48, Section 4.5 p. 4-52 Appendix 1 Map 4-1-1 to 4-1-23, Map 4-2-1, Map 4-2-2, Map 4-3-1, Map 4-3-2

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91		☐ **Delineate Highly Vulnerable Aquifers**	15(2)(d)		5(3), 43, 43.1	Map Text		Section 4.4 p. 4-48 Appendix 1 Map 4-3-1, Map 4-3-2
92		o Vulnerability scores for HVA			8(1), 79, 9(1)(c)(iv)	Map Text		Section 4.4 p. 4-52 Appendix 1 Map 4-3-2
93		☐ **Delineate Significant Groundwater Recharge Areas**	15(2)(d)		5(3), 44-46	Map Text	Include one or more of the following as required for the source protection area: - tier 1 SGRA map - refined tier 2 SGRA map - refined tier 3 SGRA map	Section 4.5 p. 4-52 Appendix 1 Map 4-2-1, Map 4-2-2, Map 4-3-1
94		o Vulnerability scores for SGRA			8(1), 9(1)(c)(iv), 80, 81	Map Text		Section 4.5, p. 4-53 Appendix 1 Map 4-2-2

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95		☐ **Delineate Wellhead Protection Areas for drinking water systems in Terms of Reference** ☐ Where information needed to delineate WHPA-E or WHPA-F cannot be ascertained, AR shall include; 1. a plan that includes a work schedule for ascertaining the information necessary, and 2. if necessary, an estimate of the date when the updated AR would be submitted to the Director.	15(2)(e)		5(3), 42, 47 – 54, 50.1	Map Text	Indicate which of the four methods was used for WHPA modelling. Work with your Liaison Officer to determine date an updated AR will be required.	Section 4.3.2 and 4.3.3 p. 4-6-4-7. Appendix 1 Maps 4-1-1 to 4-1-23. Section 4.3.4 p. 7 to 4-23 Section 4.3.5 p. 4-43 to 4-47 Appendix 1 Maps 4-1-2a, 4-1-4a, 4-1-16a, 4-1-17a, 4-1-21a.
96		o Vulnerability scores for WHPA's			8(1), 9(1)(c)(iv), 82 – 84	Map Text		Section 4.3.5 p. 4-40 to 4-47. Appendix 1 Maps 4-1-1 to 4-1-23. Appendix 1 Maps 4-1-2a, 4-1-4a, 4-1-16a, 4-1-17a, 4-1-21a
97		o Identification of transport pathways and elevation of vulnerability due to these pathways			39 – 41	Text Map	Describe why elevated due to transport pathways.	Section 4.3.5: p. 4-27 to 4-40
98		☐ **Delineate Intake Protection zones**			5(4), 9(1)(c)(ii), 55-66, 68 –70	Map Text	For IPZ's work: Reference technical guidance on "How to score IPZ-1,2,3 " TR 55.1: Director by written	Not applicable

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								notice may classify an intake and the written notice shall be included in the AR	
99			o Classification of Intake Type as (A,B,C or D)			9(2)(b), 55	Map Text		Not applicable
100			o Delineate IPZ-1 for drinking water systems in ToR	15(2)(e)		61-64	Map Text	Modification to IPZ-1 is possible if the modification is documented in the AR and a rationale is provided for the modification as per rule 64.	Not applicable
101			o Delineate IPZ-2 for drinking water systems in ToR	15(2)(e)		65,66	Map Text	Brief summary of method used for IPZ-2 delineation.	Not applicable
102			o Identification of the storm sewershed system for IPZ-2 with respect to every stormwater management works that may contribute to the intake			65(2)	Map Text	Brief summary of method used for sewershed system. When delineating the IPZ-2 into a sewershed, the time of travel must be considered.	Not applicable
103			o Identification of transport pathways and incorporation into the IPZ-2 delineation			72-75	Map Text	Can include natural or anthropogenic transport pathways. At the discretion of the SPC, time of travel may be considered when determining the extent of the IPZ-2 into transport pathways other than sewersheds.	Not applicable

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104			o Delineate IPZ-3	15(2)(e)		68-70~~71~~	Map Text	Differences in delineations in rules 68 and 70 depending on type of intake. It is not mandatory to delineate this area for intake covered by rule 68.	Not applicable
105			o Identification of transport pathways and incorporation into the IPZ-3 delineation			72-75	Map Text	Can include natural or anthropogenic transport pathways.	Not applicable
106			o Vulnerability scores for IPZ-1,2, and 3			8(2), 9(1)(c)(iv), 86 – 96	Table Text Map	Documentation of how area vulnerability factors and source vulnerability factors have been determined is required (TR 92, 95). May want to consider including some information in an appendix. No scoring for IPZ-3 for Type A and B systems. Maps for scoring and delineation does not have to be separate – could combine requirements in the same map.	Not applicable
DRINKING WATER THREATS – WATER QUALITY									
107	**Threats Approach**							refer to threats and issues training documentation	
108	☐ **List threats**								

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109		O For each vulnerable area, list of prescribed activities that are or would be drinking water threats	15(2)(g) (i)	1.1	7(3), 118	Table Text	Required to list in the AR those activities prescribed in regulation that are now or could in the future impact the source of drinking water. In AR reference the list of threats in s.1.1 of Regulation 287/07.	Appendix 10 Section 7.2.3 to 7.2.25 (p. 7-22 to 7-40)
110		O For each vulnerable area, list of local activities that are or would be drinking water threats O Hazard rating approved by Director must be listed for each local circumstance	15(2)(g) (i)		7(3), 119 – 122, 125	Table Text	These are locally based activities other than those already listed in regulation as prescribed drinking water threats. Must be listed separately from the prescribed activities. Local activities are those in the opinion of the Director can be added as activities that may be a drinking water threat. Include the Director's opinion letter in your AR or appendix to AR or as directed by the Director.	
111		o List conditions that result from past activities and are drinking water threats (quality)	15(2)(g) (ii)		7(4), 9(3)(c), 126, 139	Table Text	See TR 126 for details on including conditions. Hazard rating must be listed for conditions (see TR 139).	Potential conditions in Section 6.2 p. 6-7.

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112	☐ **List circumstances (threats approach)** o When identifying the circumstances in which an activity is or would be a significant, moderate, or low drinking water threat the AR may refer to the applicable parts of the Table of Drinking Water Threats that makes an activity a significant, moderate or low drinking water threat			118.1		These next three steps require a table or reference to tables of circumstances. It includes existing or future circumstances. Should the province release standard threats tables with a list of circumstances based on vulnerable area, vulnerability score, and whether it is a chemical, pathogen, or DNAPL threat – these tables can be used to meet the requirements of the rules (see row 117). Where the circumstances apply to a new threat, or the circumstance is a new circumstance under a prescribed threat, the SPC must also provide the hazard score provided by the Director when the local threat/circumstance was approved. Circumstances are required to be listed for:	Appendix 10
113	O List circumstances for <u>significant, moderate and low</u> drinking water threats (prescribed circumstances for prescribed threats)		13(1)(3) 13(1)(4) 13(1)(5)		Tables or references to tables	(1) prescribed drinking water threats (where the tables of drinking water threats are identified by the province);	Appendix 10

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114	O List of circumstances for activities that are <u>significant, moderate and low</u> drinking threats (local circumstances for prescribed threats)		13(1)(3) 13(1)(4) 13(1)(5)	As enabled by TR 128, 133, 136	Tables or references to tables	(2) local circumstances for prescribed threats (which were not identified in number 1);	
115	O List of circumstances for activities that are <u>significant, moderate and low</u> drinking water threats (local circumstances for local threats)		13(1)(3) 13(1)(4) 13(1)(5)	As enabled by TR 119-122, 125	Tables or references to tables	(3) circumstances associated with locally determined drinking water threats that have been approved by the Director.	
116	☐ **Identifying areas where activities or conditions are or would be significant, moderate or low (quality) (threats approach)**					These sections require that the SPC produce maps that can be linked to the tables required in rows 113-115 to demonstrate the specific areas where any activity/circumstance is significant, moderate, or low. The maps and tables must allow a landowner to be able to determine whether they are significant, moderate or low, not just that they could be.	See below

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117		O Areas where activities that are or would be significant, moderate and low drinking water threats (existing and future) (quality)	15(2)(h) (i)	13(1)(2) (i), 13(1)(2) (ii)	8(4), 9(1) (c)(ix), 127 - 129, 132 – 137	Map Text Table	Recommendation is to have maps for chemical, pathogenic, and DNAPL threats. Refer to technical bulletins for further advice. May wish to combine with maps for vulnerability scoring greater than 4 (except for DNAPLs in groundwater). The province has set out the circumstances and vulnerability under which an activity is a significant, moderate or low drinking water threat. Explain in text the interpretation of the map of vulnerability scores and the tables of circumstances together that give the areas where activities are significant, moderate or low.	Section 7.2.3 to 7.2.25 (p. 7-22 to 7-40) Appendix 1: Maps 7-3-1 to 7-3-23, Appendix 10
118		O Areas where conditions that result from past activities and listed as drinking water threats are significant, moderate or low	15(2)(h) (ii)	13(1)(2) (iii) and 13(1)(2) (iv)	8(5), 9(1) (c)(x), 138-140, 140.1, 142-143, 142.1	Map Text	May wish to combine with maps for vulnerability scoring greater than 4. Note: changes to TR 138-143	Potential conditions in Section 6.2 p. 6-7.

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119	**Issues Approach**					An issue can be linked to any drinking water system, including private systems within a vulnerable area. It is not limited to municipal systems listed in the ToR. Refer to the technical bulletin on identifying threats. The SPC has flexibility In what they determine is an issue. If the SPC determines something is an issue that does not meet the tests in rule 114, then they are required to document information in the AR as per rule 115.1, If the issue meets the tests in rule 114, then they are required identify this in the AR.	
120	☐ For drinking water issues identified in accordance with TR 114, and for which there are anthropogenic causes, include a description of drinking water issues in each of the vulnerable areas: o List parameter of concern o List the well, intake, or monitoring well at which the issue occurred o Issue Contributing Area o Identification of the drinking water threats (TR 118, 119 or 126) that contribute or may contribute to the parameter or pathogen of concern	15(2)(f)		6, 9(1)(c) (xii), 114-115, 131, 134.1	Text Table Map		
120A	☐ For drinking water issues not identified in accordance with TR 114, the description of the issue shall include o List parameter of concern o Explanation of the nature of the issue and the possible causes of the issue			115.1	Text or Table		Section 5.5 p. 5-10 to 5-13 Section 5.6 p. 5-13 to 5-14 Section 5.7 p. 5-14 to 5-16

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			CWA	REG 287/07	TECHNICAL RULES			
121		O Where information specified by TR 115(3) or (4) cannot be readily ascertained, the AR shall include: 1. a plan and work schedule for ascertaining the information required in subrules 115(3) or (4), including any additional work that must be carried out as a result of ascertaining this information; and 2. if, after completing the work the SPC becomes aware that the AR is no longer accurate or complete, an estimate of the date when the SPC expects an updated AR would be submitted to the Director under section 19 of the Act			116	Text Table	For detailed contents of plan refer to threats and issues training documentation from MOE. Generally, a plan should include the work required as part of the plan, timeline for plan and who will undertake the work. Work with your Liaison Officer to determine date an updated AR will be required.	
122	☐ **List circumstances (issues approach)**							

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		CWA	REG 287/07	TECHNICAL RULES			
123	o List circumstances for significant or moderate drinking water threats (circumstances listed in the Tables of Drinking Water Threats for prescribed threats)		13(1)(3)	131.1, 134.2	Text Table Link to maps of ICA	The identification of threats and circumstances using the issues approach is different than the threats approach. The issues approach does not use the hazard score or align with the vulnerability scoring areas in the Tables of Drinking Water Threats. Instead, any threat (activity or condition) that is located in an issue contributing area, that can be linked to the chemical of concern (the issue) becomes a significant, or moderate threat as per Part XI.5 of the TRs.	
124	o List of circumstances for activities that are <u>significant or moderate</u> drinking threats (for local circumstances for prescribed threats)			131.1, 134.2	Text Table, Link to maps of ICA		
125	o List of circumstances for activities that are <u>significant or moderate</u> drinking water threats (for local circumstances for local threats)			131.1, 134.2	Text Table, Link to maps of ICA		
126	☐ Identifying areas where activities or conditions which are or would be significant and moderate drinking water threats (quality) (issues approach)				Map Text	Under the issues approach threats are either significant or moderate.	
127	o Areas where an activity is or would be a significant and moderate drinking water threat	15(2)(h) (i)		8(4), 9(1) (c)(xi), 131, 131.1 115(3)	Map Text	This is the Issue Contributing Area - Only issues identified under 114(1,2)	
128	o Areas where conditions that result from past activities and listed as drinking water threats are or would be significant and moderate drinking water threats	15(2)(h) (ii)		8(5), 9(1) (c)(x), 141, 142.1 115(3)	Map Text	This is the Issue Contributing Area Note: changes to TR 141 and 142.1	

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			CWA	REG 287/07	TECHNICAL RULES			
129		O Areas, activities or conditions that are located outside SPA boundaries, include a description of the issue and where it may be located			117	Text Map	Include a description of the drinking water issue and identify the SPA in which the SPC believes such activities or conditions may be located.	
130	**Event Based Approach**							
131	☐ **List threats (events based approach)**							
132		O List of drinking water threats that are or would be identified through modelling approach (prescribed threats)	15(2)(g)	1.1	7(3), 9(2)(a-c), 130, 140.1	Text Table	Events based approach applicable to activities as well as conditions Identified through a modelling approach or another method used in accordance with TR 15.1	
133		O List of drinking water threats that are or would be identified through modelling approach (local threats)	15(2)(g)		7(3), 9(2)(a-c), 130, 140.1, 15.1	Text Table	Events based Approach applicable to activities as well as conditions Identified through a modelling approach or another method used in accordance with TR 15.1	
134	☐ **List circumstances (events based approach)**							

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NO.	SUMMARY OF LEGISLATIVE REQUIREMENTS	LEGISLATIVE REFERENCE			MINIMUM FORMAT	GUIDANCE	PAGE/MAP NO. IN ASSESSMENT REPORT
		CWA	REG 287/07	TECHNICAL RULES			
135	O List the circumstances for activities that are prescribed threats and are significant drinking water threats based on modeling within the IPZ (prescribed circumstances for prescribed threats)		13(1)(3)	130 15.1	Text Table	The circumstances under which an activity is significant change as a result of the events bases approach. Two additional circumstances must be added: 1. That the activity must be in the IPZ. 2. Modelling must show the activity can cause an issue at the surface water intake under an extreme event (TR 130). Identified through a modelling approach or another method used in accordance with TR 15.1	
136	O List the circumstances for activities that are prescribed threats and are significant drinking threats based on modeling within the IPZ (local circumstances for prescribed threats)			130 15.1	Text Table		
137	O List the circumstances for activities that are local threats and are significant drinking water threats based on modelling within the IPZ (local threats)			130 15.1	Text Table		
138	☐ Identifying areas where activities or conditions are significant drinking water threats (quality) (events based approach)			8(4), 130	Map Table Text	The area is the location where an activity is carried out.	
139	☐ **Enumerating significant drinking water threats (quality) (all three approaches – threats, issues, events based)**						
140	O Number of locations at which a person is engaging in an activity that is or would be a significant drinking water threat		13(1)(6)(i)	9(1)(e)	Table Text	For considerations in enumerating threats, refer to the threats and issues training from MOE.	Section 7.2.2, Tables 7-5 to 7-8, p. 7-18 to 7-21.
141	O Number of locations at which a condition listed as a significant drinking water threat		13(1)(6)(ii)	9(1)(f)	Table Text		

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		CWA	REG 287/07	TECHNICAL RULES			
OTHER REQUIRED COMPONENTS							
142	☐ How the Great Lakes agreements were considered			9(2)(g)	Text		Section 8: p. 8-1 to 8-9
143	☐ Information sources for data used in developing the AR and the purposes for which it was used		14(1)	9(2)(a)	Table		Section 3.3.1 to 3.3.4 p. 3-10 to 3-13 Section 4.3.1 p. 4-4, Section 4.4 p. 4-48, Section 4.5 p. 4-52, Section 5.4 p. 5-9, Section 6 p.6-2, Section 7 Table 7-1 p. 7-2
144	Methods of analysis applied to data			9(2)(b)	Text		Section 3 p. 3-3 to 3-22, Section 4.3.2 p. 4-5, Section 4.3.3 p. 4-6, Section 4.3.4 p. 4-7, Section 4.3.5 p. 4-23, Section 4.3.6 p. 4-47, Section 4.4 p. 4-48, Section 4.5 p. 4-52 Section 5.3 p. 5-6 to 5-8, Section 6.1 p. 6-3 to 6-7, Section 7.1 p. 7-3 to 7-17
145	☐ Limitations in respect of TR 9 (2)(a & b) (information sources and methods of analysis)			9(2)(c)	Text		Section 3.4.1 p. 3-20. Section 4.6: p. 4-54, Section 3.6 p. 3-22 Section 9: p. 9-1 to 9-5
CONSULTATION REQUIREMENTS							
146	**Draft Assessment Report**					The AR should include text on how the SPC/SPA met the consultation requirements. An appendix to the AR could include examples of notices, letters to FN, municipalities, etc.	Appendix 4 Section 1: p. 1-15 to 1-16.

NO.	SUMMARY OF LEGISLATIVE REQUIREMENTS	LEGISLATIVE REFERENCE			MINIMUM FORMAT	GUIDANCE	PAGE/MAP NO. IN ASSESSMENT REPORT
		CWA	REG 287/07	TECHNICAL RULES			
						Summary of comments considered should be a document separate from the AR.	
147	☐ publish draft on internet		15(1)		Text	Internet posting example – not every posting needed.	Appendix 4
148	☐ make draft available for inspection by public at one or more locations, sufficient public access		15(1)		Text	Summary of posting dates, locations and name of publications.	Appendix 4
149	☐ publish notice in one or more newspapers, sufficient general circulation		15(2)(a)		Text	Summary of posting dates, locations and name of publications.	Appendix 4
150	☐ make notice available for public inspection at one or more locations, sufficient public access		15(2)(b)		Text	Summary of posting dates, locations and name of publications.	Appendix 4
151	☐ contents of notice o view draft on internet o specific during times and locations to inspect draft o date, times and locations of public meetings o submit written comments to SPC by date specified in notice at least 35 days after newspaper notice published		15(3)		Text	Newspaper notice example – not every notice needed. The consultation period is required to be at least 35 calendar days in length.	Appendix 4
152	☐ give copy of notice to o Clerk in each municipality in ToR list o Chief of bands o Every person engaging in activities that are or would be a significant drinking water threat, listed in AR		15(2)(c)		Text	Mailing lists to municipalities, bands, chair other SPCs (ToR linkage), GLs, LaMPs, RAPs. Documentation of notice to every person engaging in activities that are or would	Appendix 4

NO.	SUMMARY OF LEGISLATIVE REQUIREMENTS	LEGISLATIVE REFERENCE			MINIMUM FORMAT	GUIDANCE	PAGE/MAP NO. IN ASSESSMENT REPORT
		CWA	REG 287/07	TECHNICAL RULES			
	o Chair of other SPCs that are listed in matters to discuss in ToR o every person/body established under GLWQA, LaMPs, RAPs					be significant drinking water threats in the AR. When providing a notice to persons engaging in activities that are or would be significant drinking water threats identify to that person why they are receiving the notice (i.e., that they are undertaking an activity that is or could be a significant drinking water threat).	
153	☐ at least one public meeting in the SPA at least 21 days after notice		15(4)		Text	Public meetings – dates, number per SPA	Appendix 4
154	☐ Finalizing proposed AR, consider o written comments submitted to SPC o comments made at public meeting		15(5)		Text	High level summary of comments received and how they impacted AR revisions to develop proposed AR should be developed and forwarded along with the AR to the ministry for consideration – not all individual comments should be submitted to the ministry.	Appendix 4
155	**Proposed Assessment Report**						
156	☐ Submission of proposed AR to SPA with o Summary of unresolved municipal comments o Summary of unresolved first nation concerns	16 (a)	16(1)		Transmittal Letter	Summary of unresolved comments from municipalities and bands must be sent to the ministry along with the AR. SPA should indicate clearly	Appendix 4

NO.	SUMMARY OF LEGISLATIVE REQUIREMENTS	LEGISLATIVE REFERENCE			MINIMUM FORMAT	GUIDANCE	PAGE/MAP NO. IN ASSESSMENT REPORT
		CWA	REG 287/07	TECHNICAL RULES			
						which comments are unresolved in relation to the regulatory requirements for contents of the AR.	
157	☐ SPC provide proposed AR to each municipality ☐ SPC provide proposed AR and summary of unresolved first nation concerns to each band chief	16 (b)	16(1)			Mailing lists for municipalities and bands with an indication of the documentation provided to them.	Appendix 4
158	☐ SPC publish on internet and invite public to provide comments	16(c)			Text	Internet posting example	Appendix 4
159	o Submit comments within 30 days after internet posting		16(2)		Text	The consultation period is required to be at least 30 calendar days in length.	Appendix 4
160	**Proposed AR submission to Director**						Appendix 4
161	☐ SPA submit proposed AR to Director by 1st anniversary after ToR notice of approval posted to EBR		17(2)		Transmittal Letter to accompany AR and supporting documents	Transmittal Letter should include: -sent from the source protection authority to the Director - a reference to any unresolved comments from municipalities and bands - this checklist document with the last column completed that indicates the location or reference in the AR for each regulatory requirement -anticipated need for an updated AR and the timeline anticipated for delivery to the Director -any requested data	Appendix 4

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		CWA	REG 287/07	TECHNICAL RULES			
						requirements.	
162	☐ SPA submit proposed AR to Director with o Comments SPA makes o Summary of unresolved municipal and band comments o Written comments received by the SPA during 30-day consultation period	17(1)	17(1)		Transmittal Letter	Summary of unresolved comments from municipalities and bands – must be an indication of what is unresolved. Written comments received during 30-day consultation period – should be a summary of the comments in addition to hard copies.	Appendix 4
163	o Transmittal letter					This is not a regulatory requirement although it is recommended that the SPA include a letter that is addressed to the Director at MOE that accompanies the submitted AR. This letter can include a high level summary of how the regulatory requirements were met and the authority's comments on the AR.	
164	☐ SPA shall provide SPC with SPA comments on proposed AR and all written comments received during consultation period on proposed AR		17(1)		Text	Indication that SPC was provided with comments (SPA and during consultation period) – may indicate this in the submitted checklist.	Appendix 4

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Glossary/Links

AR	Assessment Report	MOE	Ministry of the Environment
CA	Conservation Authority	RAPs	Remedial Action Plan
CWA	Clean Water Act, 2006 http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_06c22_e.htm	REG	Regulation – General Regulation – 287/07 http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_070287_e.htm
DWS	Drinking water system	SPA	Source Protection Area
EBR	Environmental Bill of Rights – Environmental Registry	SPC	Source Protection Committee
FN	First Nations	Symbology	http://www.ene.gov.on.ca/en/water/cleanwater/cwadocs/MappingSymbology.pdf
GL	Great Lakes	Technical Bulletins	http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php
GLWQA	Great Lakes Water Quality Agreement	ToR	Terms of Reference
ICA	Issue Contributing Area	TR	Technical Rules: Assessment Report, November 16, 2009 http://www.ene.gov.on.ca/en/water/cleanwater/cwadocs/Tech_Rules_For_Assessment_Report_16Nov09.pdf
LaMPs	Lakewide Management Plans		

Appendix 8 – Issues Evaluation Methodology

Thames-Sydenham and Region
Source Protection Region

ISSUES EVALUATION METHODOLOGY

Version 2.0
May 14, 2009

Table of Contents

1. INTRODUCTION

Under the Clean Water Act (2006) Technical Rules (December 2008), the assessment report must identify and describe drinking water quality issues. Identifying issues is a key step in the overall process of protecting drinking water quality. This is because an activity that may contribute to an identified issue is deemed a significant drinking water threat which must be mitigated, through source protection plans, to no longer be a significant threat.

In order to identify issues, the Thames-Sydenham and Region proposes an issues evaluation methodology with three main stages: screening, issue identification and issue description. The first two stages must be done to satisfy the **Rule 114**. The issues also have to be described according to **Rule 115**. The current document is intended to foster discussion on the proposed issues evaluation methodology. The methodology will be finalized upon consideration of comments from consultants and municipality staff working on technical studies in the Region, as well as conservation authority staff. The finalized methodology will serve as a guideline in the determination and description of drinking water quality issues in the Region for the Assessment Report.

The Rule 114 defines a parameter or pathogen being an issue if it is shown to deteriorate or trends towards a deterioration of raw water quality for the purposes of drinking. Hence assessing for the deterioration of the raw water meant for human consumption is an important step in defining issues, which can be accomplished by using a ‘check’ to determine whether a parameter is an issue or not. For treated drinking water, the 'check' is a drinking water standard. For the general health of a watershed and aquatic species in the water bodies, the ‘check’ is an aquatic life water quality objective. Raw water benchmarks for surface and groundwater drinking water sources are yet to be established. While background levels of water constituents may be reviewed, inadequate comprehensive long term (historical) data hinders the assessment of a background level of any contaminant in the raw water. It is important to consult with water treatment plant operating authorities, municipalities, consultants working on the technical studies, conservation authority staff and the Ministry of Environment (MOE) while setting up these 'checks' to identify issues in raw water sources.

Rule 114. *Without limiting the generality of subclause 15(2)(f) of the Act, the description of drinking water issues shall include the following drinking water issues in respect of the quality of water in a vulnerable area:*

Subrule (1) *the presence of a parameter in water at a surface water intake or in a well, including a monitoring well related to a drinking water system to which clause 15(2)(e) of the Act applies, if the parameter is listed in Schedule 1, 2 or 3 of the Ontario Drinking Water Quality Standards or Table 4 of the Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines and*
(a) the parameter is present at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water; or
(b) there is a trend of increasing concentrations of the parameter at the surface water intake, well or monitoring well and a continuation of that trend would result in the deterioration of the quality of the water for use as a source of drinking water;

Subrule (2) *the presence of a pathogen in water at a surface water intake or in a well related to a drinking water system to which clause 15(2)(e) of the Act does apply, if a microbial risk assessment undertaken in respect of the pathogen indicates that*
(a) the pathogen is present at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water, or

(b) there is a trend of increasing concentrations of the pathogen at the surface water intake or well and a continuation of that trend would result in the deterioration of the quality of the water for use as a source of drinking water; and

Subrule (3) *the presence of a parameter in water at a surface water intake or in a well, including a monitoring well related to a drinking water system to which clause 15(2)(e) of the Act does not apply, if the parameter is listed in Schedule 2 or 3 of the Ontario Drinking Water Quality Standards or Table 4 of the Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines and*
(a) the parameter is present at a concentration that may result in the deterioration of the water for use as a source of drinking water, or
(b) there is a trend of increasing concentrations of the parameter at the intake, well or monitoring well and a continuation of that trend would result in the deterioration of the quality of the water for use as a source of drinking water.

Rule 115 requires that an identified water quality issue be 'described', by listing the parameter or pathogen concerned, the intake or well where it has occurred, areas within vulnerable areas where the drinking water threats due to 'prescribed' (see Rule 118) or 'other' (see Rule 119) activities contribute to the issue, and lastly, listing activities, conditions (from past activities) and naturally occurring conditions associated with the issue.

Figure 1 shows the parameters and pathogens to be considered in the identification of drinking water quality issues under the Clean Water Act. Note that it does not include parameters not in Schedule 1, 2, 3 or Table 4.

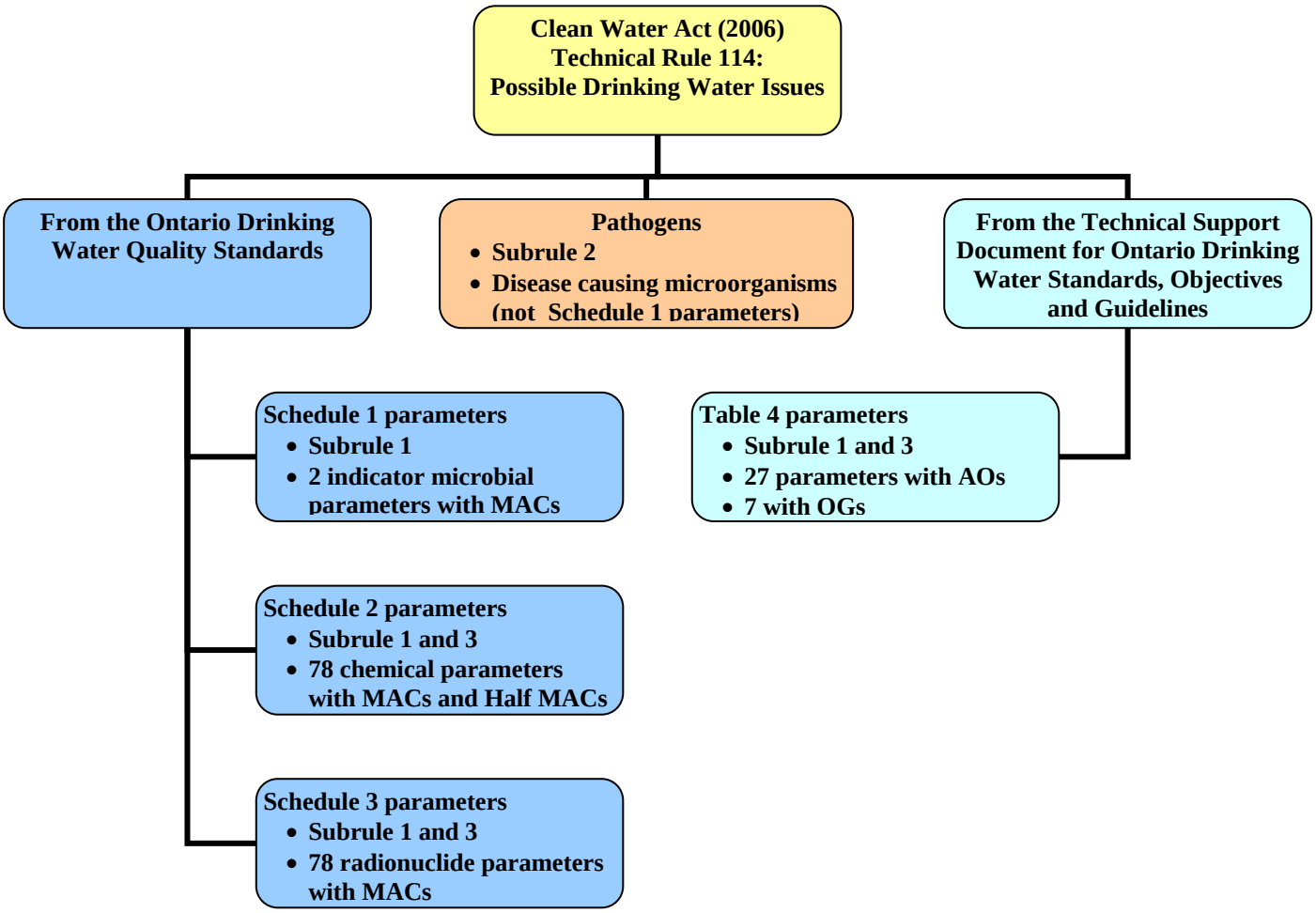

Figure 1: Clean Water Act Technical Rule 114: Possible Drinking Water Quality Issues

The Ontario Drinking Water Standards are human health based criteria established under the Regulation 169/03 under the Safe Drinking Water Act (2002) and are called Maximum Acceptable Concentrations. The Technical Support Document[1] provides criteria for Table 4 parameters to meet aesthetic objectives and plant operational guidelines. The criteria listed below are used to help flag and identify drinking water quality issues with the exception of the microbial parameters as explained in the relevant section.

Maximum Acceptable Concentrations (MACs) are the drinking water standards for chemical, radionuclide and microbial parameters beyond which human health may be adversely affected.

Half MAC is that level at which a Schedule 2 (chemical) parameter in the treated water is flagged for increased sampling and testing requirements under Regulation 170/03 - Section 13-5, Safe Drinking Water Act (2002).

Aesthetic Objectives (AO) are criteria for certain Table 4 parameters at which parameters such as taste and turbidity that may affect the taste, odour or colour of water or interfere with good water quality control practices.

Operational Guidelines (OG) are criteria for certain Table 4 parameters at which parameters such as alkalinity and hardness that may negatively effect the efficient and effective treatment, disinfection and distribution of the water.

2. DATA USED IN THE ISSUES EVALUATION PROCESS

2.1. Data used for Screening

In the screening step, parameters or pathogens are 'flagged' based on certain concerns or previous water quality data review and reports which are described below.

2.1.1. Operating Authority Concerns

Conduct interviews with drinking water systems (DWS) operating authority to note specific concerns in the raw and treated water quality. The consultant/municipality should interview the operating authority (OA), document the outcomes of the interview and have the OA sign the document to confirm the document is an accurate representation of the OA's opinions and concerns. Concerns may include parameters or pathogens that persist even after treatment, or which interfere in the treatment process, or parameters due to past activities that have resulted in increased monitoring at the well or intake.

2.1.2. Thames and St. Clair Watershed Characterization Reports (December 2007)

In the characterization reports, half MAC, MAC, AO and OG were the checks to flag Schedule 2, 3 and Table 4 parameters in raw water to most intakes and some well systems (data from 1990 to 2005, 1 to 12 samples per year). Additional well system data reviewed were annual drinking water system (DWS) reports (data from 2004 to 2006) in which Schedule 2, 3 and Table 4 treated water parameters are checked against the half MAC and parameters flagged. Where data

[1] Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines, Ministry Of Environment, PIBS4449e01 (2003, Revised June 2006)

allowed it, upward trends in some Schedule 2 and 3 and Table 4 parameters are shown in the characterization reports. The weekly raw water microbial indicator data (2003 to 2006) is presented to show ranges of bacteria counts, spikes and seasonal variation and this information must be used as per the issues screening methodology for Schedule 1 parameters.

Where the data is not adequate for the purposes of screening to flag issues, other data where available may be utilised to flag parameters. For example, data available at the time of water quality review for the characterization reports for the West Elgin and Wheatley intakes were laboratory analysis sheets that were reviewed to provide raw water data for years 2001-2003 (West Elgin), and 2000-2002 (Wheatley) while annual DWS reports provided limited treated water data for 2005 (West Elgin), and 2003-2005 (Wheatley).

2.1.3. Annual Drinking Water System (DWS) Reports

The annual DWS reports flag parameters that persist in treated drinking water and where required, additional sampling and testing of raw water for specific parameters is also reported. Schedule 2 (chemical) parameters in treated water that exceed the half MAC are flagged for increased monitoring, under the Regulation 170/03 - Section 13-5, Safe Drinking Water Act (2002). Exceedances of the MAC for Schedule 1, 2 and 3 and some Table 4 parameters are provided in these reports. Summary of additional testing and sampling carried out in accordance with the requirement of a certificate of approval, order or other legal instrument are also provided in the annual reports (these may also be raw water samples). A review of the reports must be done to flag parameters with exceedances of half MAC, MAC, and parameters that undergo extra testing by legal order.

2.1.4. Parameters not listed in Schedules 1, 2, 3 or Table 4

In other source protection regions, there have been suggestions to consider parameters not included in Rule 114 for issues identification. Further clarification from the Ministry of Environment is requested and required before considering parameters not listed in the schedules and table. Any such parameters should be brought to the attention of the SPC immediately.

2.2. Data used for issues identification

In the issues identification step, data to be used to determine if the screened (flagged) parameters are issues are:

2.2.1. Drinking Water Surveillance Program (DWSP)

DWSP is a voluntary program and not all drinking water systems participate in this. This dataset provides raw water Schedule 2, 3 and Table 4 parameter data. Data on the flagged parameters should be reviewed as per the relevant methodology outlined in this document to confirm issues.

2.2.2. Drinking Water Information System (DWIS)

This dataset provides Schedule 1 (indicator microbial) data and some chemical parameter data. Data on the flagged parameters should be reviewed as per the relevant methodology outlined in this document to confirm issues.

2.2.3. Other water treatment plant data for specific flagged parameters

Where limited data is available on flagged parameters or pathogens, laboratory analysis sheets (usually available from the water treatment plant) may be used to help decide on whether they are issues or not. Any other such reliable raw or treated water data (like grab sample data from MOE inspection reports) may be used to further substantiate that a flagged parameter is an issue.

3. ISSUES EVALUATION METHODOLOGY

Figure 2 is a flow chart of the proposed issues evaluation methodology. The data sets are described in the previous section. There are separate screening and issues identification methodologies for pathogens, the different types of parameters grouped as in Rule 114, and parameters not included in Rule 114.

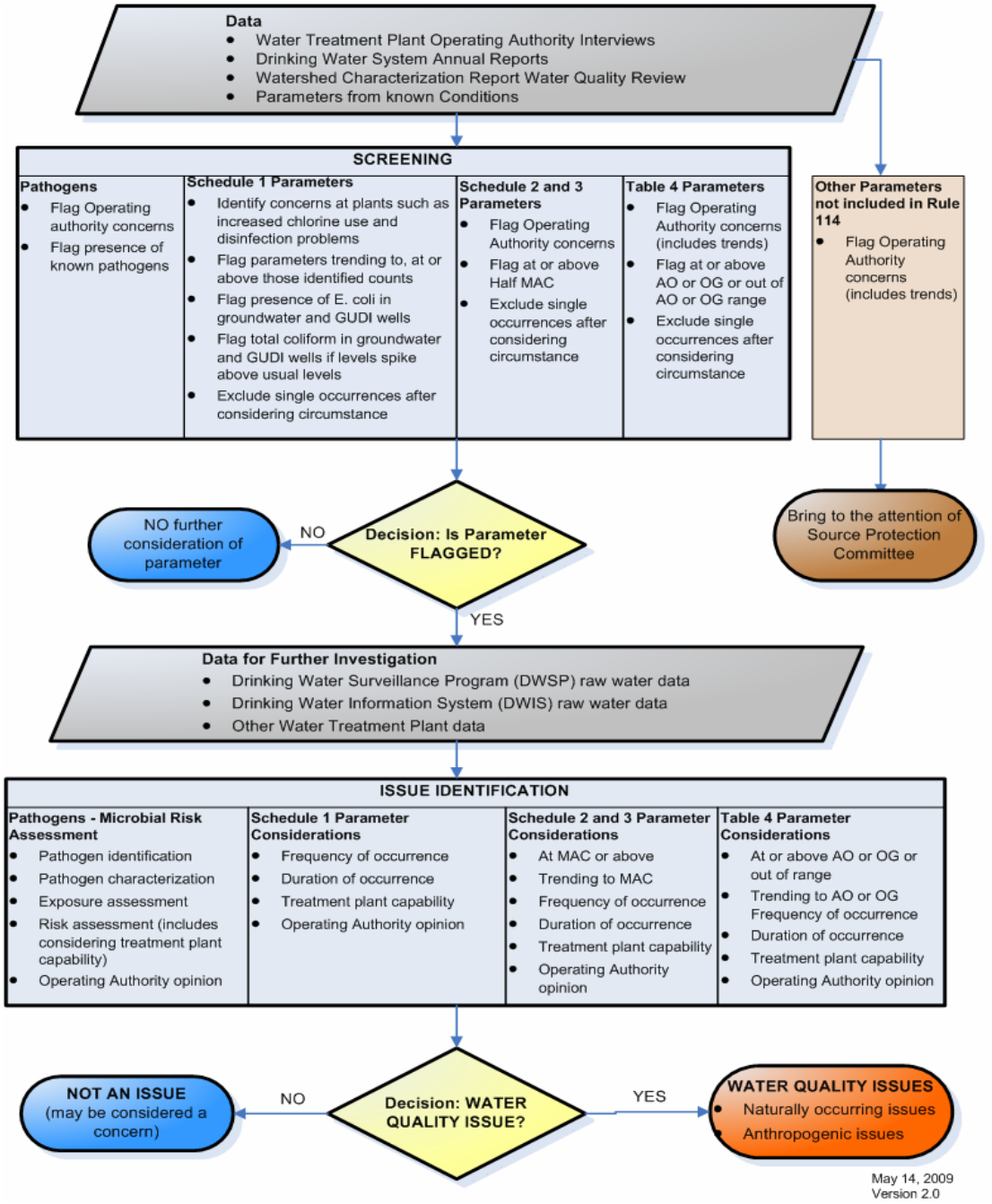

Figure 2: Proposed Issues Evaluation Methodology

3.1. Pathogens

3.1.1. Background

Pathogens are disease-causing bacteria, viruses or protozoa. They can cause severe or fatal waterborne illness in humans. Some are resistant to commonly used disinfectants at water treatment plants. Reliable laboratory detection methods for pathogenic protozoa are yet to be established. There are no established Canadian water quality guidelines for these microbiologic organisms.

It is understood that, under the Clean Water Act (2006), a microbial risk assessment must be done in order to confirm the identification of issues caused by pathogens. The main steps in such a risk assessment are pathogen identification and characterization, exposure assessment and risk characterization[2].

Any pathogens flagged through the pathogen screening process must be brought to the attention of the Thames-Sydenham and Region SPC. The Thames-Sydenham and Region is waiting for direction from the MOE on microbial risk assessment and until such direction is provided, it is suggested to complete the screening step only.

3.1.2. Presence in Raw Water

Pathogens may be found in raw surface water but not in groundwater, unless the groundwater is under the direct influence of surface water sources. Pathogens are not monitored routinely in raw water sources unless a known outbreak of waterborne illness caused by a pathogen or known fecal contamination has occurred. The indicators total coliform and E. coli are used to indicate the possible presence of some pathogens.

The presence of the 'current' bacterial waterborne pathogens (e.g.: Salmonella and Campylobacter) may be associated with the presence of E. coli, a Schedule 1 parameter, but E. coli does not indicate the presence of the 'emerging' bacterial waterborne pathogens (e.g.: Legionella and Helicobacter pylori)[3]. Enteric viruses (such as noroviruses, hepatitis A and rotaviruses) and protozoa (such as Giardia and Cryptosporidium) cause human waterborne illnesses. The presence of E. coli is an indication that enteric viruses or protozoa could also be present; however, because enteric viruses and protozoa are more resistant to disinfection, the absence of E. coli does not necessarily mean that they are also absent[4, 5].

3.1.3. Screening

- Operating Authority concerns must be flagged

[2] Revised Framework for Microbial Risk Assessment. International Life Sciences Institute. 2000. ILSI Press, Washington, D. C., USA

[3] Health Canada (2006) Guidelines for Canadian Drinking Water Quality: Guideline Technical Document — Bacterial Waterborne Pathogens — Current and Emerging Organisms of Concern. Water Quality and Health Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

[4] Health Canada (2004) Guidelines for Canadian Drinking Water Quality: Supporting Documentation — Enteric Viruses. Water Quality and Health Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

[5] Health Canada (2004) Guidelines for Canadian Drinking Water Quality: Supporting Documentation — Protozoa: Giardia and Cryptosporidium. Water Quality and Health Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

- Known presence of a pathogen at a raw water source must be flagged
- Known presence of a pathogen in treated drinking water (some pathogens resist disinfection) must be flagged
- Pathogen causing a past waterborne outbreak linked to the water supply must be flagged
- Single occurrences of pathogen in water samples due to faulty sampling or false laboratory results must be excluded from consideration

3.1.4. Issues Identification

- Microbial risk assessment must be done to confirm that the flagged pathogen is an issue
- The main steps in a microbiological hazard risk assessment are hazard (pathogen) identification, hazard characterization, exposure assessment and risk characterization[6]
- Elements include pathological characteristics, infection mechanisms, resistance to control or treatment, survival, persistence, seasonality, reliability of treatment processes, route of human exposure, exposed population characteristics, treatment, recontamination, infectivity, human dose response data, risk event and magnitude, evaluation of control measures[2]
- The microbial risk assessment takes into consideration the treatment plant disinfection capabilities, i.e. if a pathogen is adequately disinfected at the treatment plant, it may not be considered an issue

3.2. Schedule 1 Parameters

3.2.1. Background

Total coliform and Escherichia coli are the Schedule 1 parameters. They are microbial indicators. Total coliform bacteria are widespread in nature being present in the soil and in the intestines and feces of animals including humans, livestock, poultry and wildlife. For drinking water, total coliform are still the standard test because their presence indicates contamination of a water supply by an outside source. *Escherichia coli* (*E. coli*) is commonly used as an indicator of recent contamination of water by disease-causing bacteria, viruses or protozoa including those that are resistant to commonly used disinfectants. It is found exclusively in the faeces of humans and other animals. A specific strain of E. coli, O157:H7, is pathogenic and is not specifically identified while routinely testing water for Schedule 1 parameters. If however the particular strain is identified, it is examined under the pathogen issues identification methodology. The commonly used unit to enumerate coliform bacteria is counts (of coliform) per 100 mL (of water sample).

3.2.2. Presence in Raw Water

Total coliform is commonly found in raw surface and groundwater sources, at a few orders of magnitude lower in groundwater due to natural geologic protection. E. coli is widely found in surface water sources and rarely present in groundwater. From the municipal raw water quality data review conducted in the Thames-Sydenham and Region watershed characterization report:

- It was observed that the total coliform was present in most raw groundwater sources, ranging from zero to 100 counts/100 mL. Total coliform was also widely present in raw water at surface intakes, ranging from zero to as high as 90,000 counts/100 mL

[6] Revised Framework for Microbial Risk Assessment. International Life Sciences Institute. 2000. ILSI Press, Washington, D. C., USA

- E. coli was found to be absent in nearly all raw groundwater well sources, with a highest count of only 3 per 100 mL in one well. E. coli ranged between zero and 2000 counts/100mL in raw surface water at the intakes

3.2.3. Screening

In the Thames and St. Clair watershed characterization reports, the weekly raw water microbial indicator data (2003 to 2006) is presented to show ranges of bacteria counts and seasonal variation and this information as well as a review of data after 2006 must be used to flag potential issues as per the following criteria:

- Flag concerns and problems at plants due to high counts or trends of total coliform and E. coli in raw surface water and total coliform in groundwater that cause increased chlorine consumption or affect the disinfection capability. This is to be done in consultation with operating authority
- Flag the presence of E. coli (>0 counts/100mL) in raw groundwater and groundwater under the direct influence of surface water (GUDI) wells
- Flag total coliform in groundwater and GUDI wells that spike above usual levels
- Exclude single occurrences of total coliform or E. coli due to faulty sampling or false laboratory result

3.2.4. Issues Identification

The following factors must be considered in determining whether the Schedule 1 parameter is an issue or not:

- Flagged Schedule 1 parameters must be examined for frequency and duration of occurrence, including continuous or repeated occurrence, trends, or frequency of spikes that interfered in treatment processes (for example, a one time spike over 5 years data may not be an issue)
- Consider treatment plant capabilities recognising the multibarrier approach in source water protection (i.e. a parameter might be an issue even if the plant can typically remove or reduce it to acceptable levels, or a parameter might not be an issue if it is adequately treated and there is no evidence of worsening levels)
- Consult operating authority for their opinion on the identified issue

3.3. Schedule 2 And 3 Parameters

3.3.1. Background

Schedule 2 parameters include organic and inorganic chemicals from industrial and agricultural activities as well as municipal waste and natural decomposition of organic matter. Inorganic chemicals include metals and nitrates. Organic chemicals include pesticides (e.g.: atrazine and DDT), polynuclear aromatic hydrocarbons (e.g.: benzo-a-pyrene, chlordane), chlorophenols (e.g.: 2,4-dichlorophenol), volatile organics (e.g.: benzene, vinyl chloride), dioxins and furans (e.g.: 2,3,7,8 TCDD). Schedule 3 parameters, radionuclides, occur naturally or are released during activities like mining or nuclear energy production. Upon ingestion, they may cause cancer or hereditary genetic changes in children[7]. Examples are radium-224, uranium-235 (both natural) and tritium (artificial).

[7] Technical Support Document for the Ontario Drinking Water Standards, Objectives and Guidelines, June 2003 (revised June 2006)

3.3.2. Presence in Raw Water

From the municipal raw water quality data review conducted in the Thames-Sydenham and Region watershed characterization report, certain Schedule 1 inorganic chemicals in the raw source water were found to be close to or above levels at which they could pose a risk to human health. Some of these inorganic chemicals are naturally occurring. In general, Schedule 2 organic chemicals as well as Schedule 3 radionuclides were either detected (and at levels not posing a risk to human health), or below detection levels.

3.3.3. Screening

- Flag operating authority concerns by conducting interviews with drinking water systems (DWS) operating authority to note specific parameters of concern to them in the raw and treated water, including qualitative concerns like nuisance plant growth (algae) at or near the intake (which may lead to flagging a nutrient parameter)
- A review of the annual drinking water system reports must be done to flag parameters with exceedances of half MAC as well as flag parameters that undergo extra testing by legal order
- Use the watershed characterization reports to flag schedule 2 and 3 parameters in raw and treated water at or above the Half MAC
- Make mention of those flagged that are naturally occurring or due to known past activities (conditions)
- A single instance of a parameter at or above Half MAC that is an isolated occurrence, faulty sampling or false laboratory result should be excluded from consideration as an issue

3.3.4. Issues Identification

- Identify, from flagged parameters, those trending to MAC levels and those at MAC levels
- Consider frequency of occurrence (a few times a year, seasonal, continuous presence, etc.) and further upward trending of identified parameters
- Consider treatment plant capabilities recognising the multibarrier approach in source water protection (i.e. a parameter might be an issue even if the plant can typically remove or reduce it to acceptable levels, or a parameter might not be an issue if it is adequately treated and there is no evidence of worsening levels)
- Identify parameters in spills that may have caused the water treatment plant to be shut down
- Obtain operating authority's opinion on identified issues

Note:
Maximum Acceptable Concentrations (MACs): Ontario drinking water standards for chemical, radionuclide and microbial parameters beyond which human health may be adversely affected
Half MAC: The level at which a Schedule 2 (chemical) parameter in the treated water is flagged for increased sampling and testing requirements (under Regulation 170/03 - Section 13-5, Safe Drinking Water Act, 2002)

3.4. Table 4 Parameters

3.4.1. Background

The Table 4 parameters are physical and chemical parameters such as taste and turbidity that may affect the taste, odour or colour of water or interfere with good water quality control practices. Also included are parameters such as alkalinity and aluminum may negatively effect the efficient and effective treatment, disinfection and distribution of the water.

3.4.2. Presence in Raw Water

From the municipal raw water quality data review conducted in the Thames-Sydenham and Region watershed characterization report, certain Table 4 parameters in the raw source water were found to be close to or above levels at which they could affect the aesthetic quality of water or the operation of the water treatment plant. Some of these are naturally occurring.

3.4.3. Screening

- Flag operating authority concerns by conducting interviews with drinking water systems (DWS) operating authority to note specific parameters of concern to them in the raw and treated water, trends of those parameters, and qualitative concerns like taste and odour
- Flag all Table 4 parameters in raw and treated water at or above the respective AO or OG
- A single instance of a parameter above AO or OG should be further checked for isolated occurrence, faulty sampling or false laboratory result
- Flag certain parameters differently
    - The AO of sodium is 200 mg/L, but the local Medical Officer of Health should be notified when sodium exceeds 20 mg/L to inform patients on sodium restricted diets. Flag sodium levels at or above 20 mg/L
    - The parameters 1,2-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dichlorophenol, 2,3,4,6-tetrachlorophenol, 2,4,6-trichlorophenol, 2,4,5-trichlorophenoxy acetic acid, monochlorobenzene and pentachlorophenol have both AOs and MACs; these would be considered under the issues identification process for Schedule 2 parameters using the half MAC (half Ontario treated drinking water standard) and not under the AO
    - Flag parameters pH, alkalinity and hardness at levels outside the OG range
- Flag qualitative and contributing parameters
    - Flag qualitative parameters like taste and odour based on operating authority interview information. Flag parameters that contribute to the Table 4 parameters even if they are not included in Rule 114; for example increased phosphorus levels may have caused algal growth which in turn may cause taste and odour problems at the intake, so flag the parameters of taste and odour and the contributing parameter phosphorus
    - Flag turbidity at or above AO levels for further investigation. Turbidity can significantly interfere with disinfection, be a source of disease-causing organisms and shield pathogenic organisms from the disinfection process; it is also an indicator of treatment efficiency (particularly filters)[8].
    - If trihalomethanes (THMs) are flagged (under the methodology for Schedule 2 parameters), then flag contributing raw water parameters of dissolved organic carbon (DOC) and turbidity, which are Table 4 parameters. Raw water DOC and the organic content in turbidity combine with chlorine disinfectants at the treatment plant to form trihalomethanes (THMs), a by product that deteriorates the quality of drinking water

3.4.4. Issues Identification

- Further investigate flagged parameters for levels or trending to AO or OG levels and their interferences with proper treatment, for example, investigate flagged turbidity for interference with proper disinfection or filtration, or for contributing to flagged levels of THMs

[8] Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines. MOE PIBS 4449e01, June 2003, revised June 2006

- Consider parameters (including those not identified in Rule 114) contributing to flagged Table 4 parameters
- Consider frequency of occurrence (a few times a year, seasonal, continuous presence, etc.) and further upward trending of identified parameters
- Consider treatment plant capabilities recognising the multibarrier approach in source water protection (i.e. a parameter might be an issue even if the plant can typically remove or reduce it to acceptable levels, or a parameter might not be an issue if it is adequately treated and there is no evidence of worsening levels)
- Identify parameters in spills that may have caused the water treatment plant to be shut down
- Obtain operating authority opinion on list of issues

Note:
Aesthetic Objectives (AO): The level at which parameters such as taste and turbidity that may affect the taste, odour or colour of water or interfere with good water quality control practices.
Operational Guidelines (OG): The level at which parameters such as alkalinity and hardness that may negatively effect the efficient and effective treatment, disinfection and distribution of the water.

3.5. Other Parameters

In other source protection regions, there have been suggestions to consider parameters not included in Rule 114 for issues identification. Further clarification from the Ministry of Environment on the consideration of issues arising due to parameters not listed in Rule 114 is requested and required before considering parameters not listed in the schedules and table. Any such 'other' parameters should be brought to the attention of the SPC immediately.

3.6. Deliverables

The deliverables expected upon completion of the issues evaluation methodology are:

1. List of flagged parameters per intake or well or well system (if individual well data is unavailable, report flagged parameters for the well system), identifying those believed to be naturally occurring
2. List of issues with detailed justification for the identification of each issue, noting those believed to be naturally occurring
3. Supporting items, where it is possible, for issue identification such as tables (showing exceedances above the relevant criteria, ranges of flagged parameters), scatter plots (for schedule 1 parameters, can be obtained from watershed characterization report) and time series graphs (showing trends with or without linear regression depending on number of data points)
4. Completed **Appendix A: Issues Evaluation Database**

While the issues evaluation database summarizes the issues evaluation, it is still required to provide deliverables 1, 2 and 3 in a document separate from the completed Appendix A.

Appendix A: Issues Evaluation Database

Field Name	Rule Reference	Description of contents	Field Type	Field Size	Choices
Issue_ID	114 & 115(1), (2)	*A unique identifier of the issue*	AutoNumber	Single (Integer)	N/A
DWS_no	114 & 115(1), (2)	*Drinking Water System number for the well, intake or system*	Text	10	N/A
Intake_Well_Name	114 & 115(1), (2)	*Identify the name or number of the well or intake*	Text	50	N/A
Intake_Well_Desc	114 & 115(1), (2)	*Include a brief description of the well or intake location and identify whether emergency intake or backup well*	Text	250	N/A
Pa_Name	114 & 115(1), (2)	*Name of parameter (e.g.: trichloroethylene) or pathogen (e.g.: Cryptosporidium)*	Text	50	N/A
Type	114 & 115(1), (2)	*Schedule 1, 2, 3 or Table 4 parameter OR pathogen OR 'Other' (not listed in rule 114)*	Text	10	Sched1 Sched2 Sched3 Table4 Pathogen Other
Natural	114 & 115(1), (2)	*Identify whether the parameter is believed to be naturally occurring*	Text	15	Natural Anthropogenic Both?
Description	114 & 115(1), (2)	*Describe briefly the nature of the issue and why it was identified as an issue - E.g.: exceeded drinking water standard several times in past 10 years*	Text	250	N/A
Issue_Status		*Identify whether the parameter was flagged only or has further been identified as an issue*	Text	10	Flagged Issue
Contrib_Area	115 (3)	*Provide a brief description of the area within vulnerable areas thought to be contributing to the issue*	Text	100	N/A
Threat_ID_Plan	116	*If information as per rule 115 (3) and (4) cannot be ascertained, a plan needs to be provided to obtain this information in a subsequent Assessment report. Provide a brief description of how you would propose to identify the area and threats which are contributing to this issue*	Text	250	N/A
SP_Area	117	*Identify the SP Area or areas (outside the SP Area where the issue occurs) in which contributing threats are believed to be located*	Text	20	LTV SCR UTR ER ABMV Other (specify)

Appendix 9 – Issues Evaluation Flagged Parameters

Flagged or Noted Parameters

In the Upper Thames River Source Protection Authority (SPA), the parameters flagged for further investigation as an issue are summarized by drinking water system in the Table A9-1a, 1b and 1c below. The raw (untreated) water quality data is compared to a benchmark and parameters may be flagged if they meet the screening criteria. The benchmarks for chemical, physical and radioactive parameters are generally half the applicable human health based Ontario drinking water standards (Maximum Acceptable Concentrations, or MAC), and the full levels of the aesthetic objectives (AO) and operational guidelines (OG), and any plant operating authority concerns. The table also indicates whether the flagged parameter was later identified as an issue or not. Certain parameters are noted in the table based on comparison to a benchmark, but not flagged for further investigation. No pathogens are flagged or identified as issues in the raw (untreated) source water in the Upper Thames River SPA. See Section 5 Issues Evaluation for identified issues.

Table A9-1a: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Middlesex County and City of London)

System (no. of wells)	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
Birr (1 well)	Fluoride	Fluoride levels range from 1.1 to 1.5 mg/L (data from 2003 to 2008), and are at or below the MAC of 1.5 mg/L. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. The levels at the Birr well are considered to be a naturally elevated in the aquifer, and are generally below the MAC. Therefore, fluoride is not considered an issue, but remains flagged as a natural-based concern.	No
	Sodium	Sodium concentrations range from 34 to 44 mg/L (data from 2003 to 2008) and are above the Ministry of Health notification level of 20 mg/L, but below the AO of 200 mg/L. Sodium is therefore flagged as a concern but not considered an issue. Sodium is considered naturally high in the groundwater.	No
	Turbidity	The identified range of turbidity in the well was 0.21 to 4.2 NTU (data from 2003 to 2008). It is below the AO of 5 NTU. This parameter should continue to be monitored, as there is no filtration incorporated in this water system, and increasing turbidity can ultimately hinder the disinfection process. Middlesex-Centre investigated the turbidity spikes in 2003 by completing a water quality survey of private wells and the production well. The study concluded that elevated turbidity correlated with naturally elevated iron concentrations, silt produced from the aquifer and possibly the presence of iron bacteria. Turbidity is flagged as a concern but not considered an issue.	No
	pH	Based on data from 2001 and 2005, the raw water pH for the Birr well ranges between 8.19 and 8.52, which is near the upper limits of the OG range of 6.5 to 8.5. The measured pH is considered to be influenced by the natural conditions within the aquifer. It is flagged as a concern but not considered an issue as the value is generally within the range of the OG. A representative of the owner has noted that they have no concern with the current pH levels.	No

Table A9-1a: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Middlesex County and City of London)

System (no. of wells)	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
	Total coliform	Total coliform was present in the raw (untreated) well water in 2003 to 2005 and in 2008. The highest concentration recorded was 23 colony forming units (cfu) per 100mL in 2004. However, the 2004 data is believed to be suspect (sampling or analysis error). Other results of samples containing total coliform were reported as being less than 9 cfu per 100mL. The levels reported are low and easily treatable with existing disinfection and therefore this parameter is not identified as an issue, but flagged as a natural based concern.	No
	Iron	Water drawn from the Birr well has historically been high in iron. Iron levels ranged from 0.65 to 2.3 mg/L (data from 2004 to 2008), above the AO of 0.3 mg/L. Recent upgrades to the water system have included an iron sequestering system to specifically deal with the elevated iron levels. The sequestering system is shown to adequately remove iron and hence iron is not considered to be an issue, but flagged as a concern. The source of the iron is deemed to be natural.	No
	Colour	The 2001 Engineer's Report states that the colour of the raw water often exceeds the ODWS aesthetic objective of 5 True Colour Units (TCU). Historical data located in the Appendices of the Engineer's Report indicates that the measured values of the water are in the range of 10 to 11TCU (June 14, 1994). No other data was available outside of the 2001 Engineer's Report. The source of the colour in the water may be attributed to the elevated iron levels in the raw water. Colour is flagged as a concern but not identified as an issue.	No
	Hardness	Hardness levels for the well range between 128 to 200 mg/L (data from 2005 to 2008), and are above the treated water OG of 80 to 100 mg/L. Hardness is naturally high in the aquifer and is considered a natural-based issue.	Yes
Melrose (2 wells)	Fluoride	Fluoride levels ranged between 0.8 to 0.97 mg/L (data from 2003, 2006 and 2007), greater than half of the MAC of 1.5mg/L, but less than the MAC. No rising trends were observed. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride is flagged as a concern collectively in both wells (as data available did not allow for reviewing parameters for each well separately).	No
	Sodium	The Thames Watershed Characterization Report notes sodium levels being above the 20 mg/L Ministry of Health notification limit between 2003 and 2006, ranging from 25 to 29.6 mg/L. Sodium levels did not go above the AO of 200 mg/L. Sodium is therefore flagged as a concern collectively, in both wells (data available did not allow for reviewing parameters separately for each well). The source of the sodium is considered natural to the aquifer.	No

Table A9-1a: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Middlesex County and City of London)

System (no. of wells)	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
	Iron	Water drawn from the Melrose wells has historically been high in iron and above the AO of 0.3 mg/L, ranging between 0.65 and 0.98 mg/L (data from 2004 to 2008). Recent upgrades to the water system have included an aerator for iron oxidization, to specifically deal with the elevated iron concentrations. Iron is flagged as a concern, collectively in both wells (data available did not allow for reviewing parameters separately for each well). The source of iron is considered natural.	No
	Total coliform	Total coliform data of raw (untreated) water of both wells (well no. 2 and no. 3), for the years 2003 to 2006 was reviewed in the Thames Watershed Characterization Report. Also, data from 2007 and 2008 water reports were reviewed. For well no. 2, the levels were 0 to 5 colony forming unit (cfu) per 100 mL. For well no. 3, the levels ranged from 0 to 630 cfu per 100 mL. The levels reported are easily treatable with existing disinfection and therefore this parameter is not identified as an issue, but flagged as a natural based concern.	No
	Hardness	Hardness levels for both wells range between 130 to 240 mg/L (data from 2005 to 2008), and are above the treated water OG of 80 to 100 mg/L. Hardness is naturally high in the aquifer and is therefore considered a natural-based issue in both wells collectively (data available did not allow for reviewing parameters for each well separately).	Yes
	Turbidity	Turbidity ranges between 5.73 to 10.04 NTU (data from 2004 and 2006 to 2008). These levels are above the treated water AO of 5 NTU; turbidity is considered as a natural issue in both wells collectively (data available did not allow for reviewing parameters for each well separately). This parameter should continue to be monitored, as there is no filtration incorporated in this water system, and increasing turbidity can ultimately hinder the disinfection process.	Yes
Dorchester (8 wells)	Sodium	The Thames Watershed Characterization Report and other data note sodium levels being above the 20 mg/L Ministry of Health notification limit. Levels ranged from 29 to 50 mg/L (data from 2003 to 2006). Sodium levels did not go above the AO of 200 mg/L. Sodium is therefore flagged as a concern in all wells collectively (data available did not allow for reviewing parameters for each well separately). The source of the sodium may be natural, anthropogenic or both.	No
	Iron	While there is no data available on iron levels, it is known that iron is naturally present in the aquifer and is removed through the treatment process. Iron is flagged as a concern but not considered an issue.	No

Table A9-1a: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Middlesex County and City of London)

System (no. of wells)	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
	Turbidity	From raw water turbidity data of 2004 to 2008 (data available did not allow for reviewing parameters for each well), turbidity was as high as 3.6 NTU, which is greater than half of the AO of 5 NTU. The operating authority reports that the turbidity spike was the result of an analyzer calibration. Turbidity is sometimes greater than 1 NTU and, therefore, the possibility exists for interference with the disinfection system. The past two years have exhibited turbidity readings no higher than 0.26 NTU. Turbidity is flagged as a naturally occurring concern but not considered to be an issue.	No
	Trihalomethanes (THMs)	From 2003 to 2008, levels of THMs are noted to be above half of the MAC of 0.1 mg/L. The data, ranging from 0.047 to 0.09 mg/L, does not appear to exhibit any consistent trend over time. Data from the Thames Watershed Characterization Report indicates that dissolved organic carbon (DOC) has been reported at elevated concentrations in the raw water. Elevated levels of DOC can cause THM levels to increase as a treatment by-product. THMs are flagged as a concern with a natural origin (because THMs are not introduced as a contaminant, but are produced as a result of a natural condition such as elevated organic carbon) in all wells collectively (data available did not allow for reviewing parameters for each well separately).	No
	Sulphide	Sulphide data was not reviewed but is flagged as an operating authority concern with the bedrock wells. The operating authority has reported that the bedrock water quality is elevated with naturally occurring sulphide.	No
Thorndale (2 wells)	Sodium	From the Thames Watershed Characterization Report and other data, sodium levels are above the 20 mg/L Ministry of Health notification limit. Levels ranged from 28 to 34 mg/L from 2004 to 2007. Sodium levels did not go above the AO of 200 mg/L. The operating authority's representative has indicated that a Sodium Fact Sheet, provided by the Middlesex London Health Unit (MLHU), is annually distributed to all Thorndale water system customers. Sodium is considered naturally high in the groundwater, and is therefore flagged as a natural-based concern in both wells collectively (data available did not allow for reviewing parameters for each well separately).	No
	Iron	Iron levels ranged between 0.4 to 1.03 mg/L, above the 0.3 mg/L AO. The source of the iron is deemed to be natural. Treatment at the well includes an iron sequestering system to specifically treat the elevated iron concentrations. Iron is flagged as a natural based concern in both wells collectively (data available did not allow for reviewing parameters for each well separately).	No

Table A9-1a: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Middlesex County and City of London)

System (no. of wells)	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
	Escherichia coli (E. coli)	Data from 2003 to 2008 was reviewed. *E. coli* was present in the raw (untreated) well water in 2006, 2007 and 2008. *E. coli* ranged from 0 to 2 colony forming units (cfu) per 100 mL in 2006, 0 to 7 cfu per 100 mL in 2007 and 0 to 86 cfu per 100 mL in 2008. The operating authority's representative has indicated that a study conducted in 2009 suggests that the bacteria in the aquifer are likely due to transport pathways to the aquifer. The operating authority confirms that the current disinfection treatment adequately removes the low levels of *E. coli* and total coliform from the water. *E. coli* is flagged as a concern but not identified as an issue.	No
	Total coliform	Data from 2003 to 2008 was reviewed. Total coliform was present in the raw (untreated) well water at least once in each of 2004 to 2008. Total coliform ranged from 0 to 6 colony forming units (cfu) per 100 mL in 2004 to 2007, and from 0 to 118 cfu per 100 mL in 2008. The operating authority's representative has indicated that a study conducted in 2009 suggests that the bacteria in the aquifer are likely due to transport pathways to the aquifer. The operating authority confirms that the current disinfection treatment adequately removes the low levels of *E. coli* and total coliform from the water. Total coliform is flagged as a concern but not identified as an issue.	No
	Fluoride	Fluoride in the raw water ranged between 1.2 and 1.92 mg/L, and has consistently been above the treated drinking water MAC of 1.5 mg/L between 2003 and 2006, and in 2008. In 2007, it was above the half MAC. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride concentrations are considered to be naturally high in the aquifer and is flagged as a concern in both wells collectively (data available did not allow for reviewing parameters for each well separately). A Fluoride Fact Sheet, provided by the Middlesex London Health Unit (MLHU), is distributed annually to all Thorndale water system customers.	Yes
City of London back up wells - Fanshawe wellfield (6 wells)	Sodium	Wells 1, 2, 3 and 6 have a maximum reported sodium concentration of 15.4 mg/L. All reported concentrations occur in 2004 or earlier. In 1997, Well 4 has reported concentrations above the Ministry of Health notification level of 20mg/L. Well 5 had sodium levels above the 20mg/L threshold in 1997, 2001, 2002 and 2004, and data suggests that concentration in trending upwards. Sodium levels in all wells did not go above the AO of 200 mg/L. The source of the sodium may be natural, anthropogenic or both. Sodium is flagged as a concern but not identified as an issue.	No

Table A9-1a: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Middlesex County and City of London)

System (no. of wells)	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
	Iron	Water drawn from the Fanshawe wells has historically been high in iron, with wells 1,4 and 5 iron levels above the AO of 0.3 mg/L in 1994, up to 0.49 mg/L in well 4. Wells 1, 3 and 4 have had iron levels greater than half of the AO 8 times since 2004, but still less than the AO. Wells 2 and 6 have never been reported to be above even half of the AO. There is no specific trend identified in the reported results. Since the iron levels above the AO only occurred in 1994 and these wells are for emergency back up use only, the owner's representative has no concerns with the current iron levels are naturally occurring in the aquifer. Iron is flagged but not identified as an issue.	No
	Total Dissolved Solids (TDS)	The Fanshawe wells 1, 2, 3, 4 and 6 are consistently above half of the TDS AO of 500 mg/L. Well 5 regularly is above the AO, with highest TDS level of 740 mg/L in 2005. The overall average for the wells is below the AO, at 392 mg/L. TDS levels are often naturally elevated in the groundwater aquifer, and reach levels of 1450 mg/L in the watershed. It is likely that the high levels are a result of natural geology and are flagged as a concern. The owner's representative has noted that due to the emergency use nature of the wells, they have no concerns with the levels of TDS.	No
	Turbidity	In Well 3, concentration (7.06 NTU) in 2007 is above the treated water AO of 5 NTU. The source would be iron or dissolved solids naturally occurring in the aquifer. This parameter should continue to be monitored, as there is no filtration incorporated in this water system, and increasing turbidity can ultimately hinder the disinfection process. Turbidity is identified as an issue.	Yes
	Hardness	Hardness levels for all the wells range between 150 to 449 mg/L (data from 1994 to 2008 for all wells except Well 2, for which data was from 2000 to 2008). These levels are above the treated water OG of 80 to 100 mg/L. Well 5 appears to have the highest reported hardness. Hardness is naturally high in the aquifer. Hardness is identified as an issue.	Yes
	Manganese	Concentrations in Wells 2, 3, 4, 5 and 6 are above the treated water AO of 0.05 mg/L at least once between 2000 and 2008, with a high level of 0.27 mg/L in Well 3 in 2005. Concentrations in Well 4 appear to be increasing. Elevated levels are typically due to interaction between the groundwater and manganese mineral deposits. Manganese is identified as an issue.	Yes
	Organic Nitrogen	Concentrations of organic nitrogen are regularly above the 0.15 mg/L treated water OG in all wells between 1994 and 2005. There is no specific trend to the data. Elevated concentrations appear to occur randomly but regularly in all wells, with a high of 1.2 mg/L in Well 3 in 2002. The source of the organic nitrogen could be anthropogenic, natural or both. Organic Nitrogen is identified as an issue.	Yes

Table A9-1a: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Middlesex County and City of London)

System (no. of wells)	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
City of London back up wells – Hyde Park wellfield (1 well)	Sodium	Sodium was tested in 2003 and 2004 and naturally occurring concentrations of 43 and 40.8 mg/L were reported respectively, which are above the Ministry of Health notification level of 20 mg/L. The Thames Watershed Characterization Report notes sodium levels being above the 20 mg/L notification limit once in 2003 and twice in 2004, ranging from 31.9 to 61.5 mg/L. Sodium levels did not go above the AO of 200 mg/L. Sodium is flagged as a concern.	No
	Chloride	Only two samples in 2005 had levels of 130 mg/L, just over half of the AO of 250 mg/L. No upward trend has been identified for chloride. Chloride concentrations are not an issue, but remain flagged as a naturally occurring concern at this time.	No
	Escherichia coli (E. coli)	Bacterial data from 2003 to 2005 and 2007 was available to review *E. coli* levels. *E. coli* occurred once in 2003 and twice in 2004, ranging between 1 and 9 colony forming units (cfu) per 100 mL. No total coliform was detected in these years, indicating possible sampling or analysis error (*E. coli* is a type of coliform bacteria). The *E. coli* levels reported are low and easily treatable with existing chlorine disinfection and therefore this parameter is flagged as a concern but not identified as an issue.	No
	Hardness	The available data (2003 to 2008) indicate that the raw water hardness averaged 360 mg/L and was consistent throughout the data period. The average hardness level at the well exceeds the treated water OG of 80 to 100 mg/L. Hardness is considered naturally high in the groundwater, and is therefore considered a natural-based issue.	Yes
	Total Dissolved Solids (TDS)	Data from 2003 to 2008 show levels of total dissolved solids in the range of 486 to 591 mg/L with the average being 545 mg/L. Although the reported levels of TDS are above the treated water AO of 500 mg/L, they are not substantially over the limit. It is likely that the high levels are a result of natural geology and are identified as a natural-based issue.	Yes

Table A9-1b: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Oxford County)

System	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
Beachville (1 well)	Hardness	The hardness in the Beachville well is around 300 mg/L, above the OG range of 80 to 100 mg/L. The elevated levels are typical of groundwater in that region and are naturally occurring. It does not affect the treatment process and is flagged as a concern only.	No

Table A9-1b: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Oxford County)

System	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
Embro (2 wells)	Fluoride	The treated drinking water MAC for fluoride is 1.5 mg/L. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride levels in both wells are up to 1.3 mg/L. Fluoride does not show an increasing trend and does not affect the treatment process. Fluoride concentrations are considered to be naturally high in the aquifer and are flagged as a concern in both wells.	No
	Iron	The raw (untreated) well water in the system exceeds the AO of 0.3 mg/L for iron. The raw water iron is around 1.0 mg/L in both wells. Iron is removed in the treatment process. Failure of the iron removal would not impact the disinfection process. No increasing trend is evident. Iron is considered to be naturally high in the aquifer and is flagged as a concern in both wells.	No
	Hardness	The Embro wells' hardness concentration is typically around 430 to 470 mg/L, which is above the OG range of 80 to 100 mg/L. Hardness is naturally occurring and does not affect the treatment process. It is flagged as a natural based concern for both wells.	No
	Total Dissolved Solids (TDS)	Total Dissolved Solids (TDS) levels in the Embro wells are above the AO of 500 mg/L, and are around 640 mg/L. TDS does not impact health or the treatment process. No increasing trend is evident in the results. It is flagged as a natural based concern for both wells.	No
	Sodium	Occasionally the Sodium concentration is noted to marginally occur above the Ministry of Health notification level of 20 mg/L however the most recent results are below the level. All results are well below the objective of 200 mg/L. It is naturally occurring. No increasing trend is evident in the results.	No
Hickson (1 well)	Fluoride	The treated drinking water MAC for fluoride is 1.5 mg/L. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride levels in the wells are around 1.2 mg/L. Fluoride does not show an increasing trend and does not affect the treatment process. Fluoride concentrations are considered to be naturally high in the aquifer and are flagged as a concern in the well.	No
	Iron	The raw (untreated) well water in the system exceeds the AO of 0.3 mg/L for iron. The raw water iron is around 0.29 to 0.41 mg/L in both wells. Iron does not impact the disinfection process. No increasing trend is evident. Iron is considered to be naturally high in the aquifer and is flagged as a concern.	No
	Hardness	The hardness concentration is typically around 263 mg/L, which is above the OG range of 80 to 100 mg/L. Hardness is naturally occurring and does not affect the treatment process. It is flagged as a natural concern.	No
	Total coliform	Total coliform were found occasionally at very low levels. Levels ranged between 0 to 23 counts per 100 mL in 2006 to 2009, with only four detections in this time period. Treatment adequately removes these levels of total coliform. It is flagged as a naturally occurring concern only.	No

Table A9-1b: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Oxford County)

System	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
Ingersoll (7 wells)	Fluoride	The treated drinking water MAC for fluoride is 1.5 mg/L. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride levels in all wells range from 1.4 to 2.5 mg/L. Fluoride does not show an increasing trend and does not affect the treatment process. Fluoride concentrations are considered to be naturally high in the aquifer and are flagged as a concern in all wells.	No
	Iron	Iron ranges between 0.35 and 0.58 mg/L at the wells no. 3 (Hamilton Road), 10 (Thompson Road) and 11 (Wallace Line). Iron does not affect treatment and no increasing trend is evident. It is only flagged as a natural based concern.	No
	Hardness	All 7 wells have hardness levels that range from 282 to 492 mg/L, which is higher than the OG range of 80 to 100 mg/L. The hardness is naturally occurring in the groundwater, does not affect the treatment process, and is only flagged as a concern.	No
	Total Dissolved Solids (TDS)	Total Dissolved Solids (TDS) levels are above the AO of 500 mg/L at well no. 2 (Merritt Street), well no. 5 (Canterbury Street), well no. 7 (West Street) and well no. 8 (Dunn's Road). The concentration ranges from 470 to 863 mg/L. TDS does not impact health or the treatment process. No increasing trend is evident in the results, and it is only flagged as a concern.	No
	Organic Nitrogen	Organic Nitrogen levels in the system are above the aesthetic objective of 0.15 mg/L at well no. 5 (Canterbury Street), well no. 8 (Dunn's Road) and well no. 10 (Thompson Road). Concentrations range from 0.16 to 0.31 mg/L. Organic nitrogen can be associated with unpleasant taste and high levels can reduce the effectiveness of chlorine as a disinfectant. It is flagged as a concern.	No
	Tetrachloro-ethylene	In 1993 the Ontario Ministry of the Environment, (MOE) conducted an investigation on a private industrial well located near Thomas and Ingersoll Street for trichloroethylene (TCE) contamination. Traces of the chemical were detected in Well 7 at West Street and traces of tetrachloroethylene were detected at Well 2 at Merritt Street. A clean up and monitoring program has been followed by the industry. No TCE has been detected in samples reviewed for issues evaluation. The industry's consultant provided test results from 2008 and no TCE nor tetrachloroethylene was detected. The affected site is regularly monitored. TCE and tetrachloroethylene are flagged as concerns.	No
	Trichloro-ethylene	In 1993 the Ontario Ministry of the Environment, (MOE) conducted an investigation on a private industrial well located near Thomas and Ingersoll Street for trichloroethylene (TCE) contamination. Traces of the chemical were detected in Well 7 at West Street and traces of tetrachloroethylene were detected at Well 2 at Merritt Street. A clean up and monitoring program has been followed by the industry. No TCE has been detected in samples reviewed for issues evaluation. The industry's consultant provided test results from 2008 and no TCE nor tetrachloroethylene was detected. The affected site is regularly monitored. TCE and tetrachloroethylene are flagged as concerns.	No

Table A9-1b: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Oxford County)			
System	**Flagged or Noted Parameter**	**Brief Description of Screening**	**Identified as an Issue?**
	Colour	The well no. 8 (Dunn's Road well) has color levels of 10 True Colour Units (TCU), which is above the AO of 5 TCU. All other wells have colour levels below the AO. Color is flagged as a concern.	No
	Total coliform	Microbiological results are consistently good and indicate no concerns. There are infrequent, low level positive results for Total Coliform and *E. coli* in the raw water at well no. 5 (Canterbury Street). Treatment adequately removes these levels of total coliform. Total coliform is flagged as a concern.	No
	E. coli	Microbiological results are consistently good and indicate no concerns. There are infrequent, low level positive results for Total Coliform and *E. coli* in the raw water at well no. 5 (Canterbury Street). Treatment adequately removes these levels of E. coli. E. coli is flagged as a concern.	No
	Sodium	The sodium concentration is noted to be above the Ministry of Health notification level of 20 mg/L, with levels of 29 to 97 mg/L in all wells. All results are well below the objective of 200 mg/L. It is naturally occurring. No increasing trend is evident in the results.	No
	Hydrogen Sulphide	All wells in Ingersoll are above the treated water AO of 0.05 mg/L for hydrogen sulphide between 2001 and 2009. Levels are reported as ranging from 0.26 to 6.02 mg/L. It is believed that the levels in Ingersoll source water are significantly higher than some of these results indicate, as the parameter easily volatilizes in air. When not removed from the water prior to disinfection, the hydrogen sulphide can cause significant water quality and treatment issues. The hydrogen sulphide is a naturally occurring parameter in the groundwater. It is flagged as a concern.	Yes
Innerkip (2 wells)	Iron	Iron in the well raw (untreated) water is above the AO of 0.3 mg/L for Iron. The concentration is around 0.97 to 2.13 mg/L. The system has filtration for iron removal, and the iron levels do not interfere with the disinfection process. No increasing trend is evident. Iron is flagged as a natural based concern in both wells.	No
	Hardness	The hardness concentration is typically around 860 mg/L, which is above the OG of 80 to 100 mg/L. This parameter is naturally occurring in the groundwater and does not pose a health risk nor does it impact the treatment process. It is flagged as a natural based concern in both wells.	No
	Total Dissolved Solids (TDS)	Total Dissolved Solids (TDS) levels are above the AO of 500 mg/L and are 1280 to 1370 mg/L. TDS does not impact health or the treatment process. No increasing trend is evident in the results. It is flagged as a natural based concern in both wells.	No
	Sulphate	Sulphates concentrations range from 500 to 720 mg/L, which is above the AO of 500 mg/L. Sulphates are an aesthetic concern and are naturally occurring in the groundwater, and this parameter is flagged as a concern in both wells.	No

Table A9-1b: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Oxford County)

System	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
Lakeside (1 well)	Fluoride	The treated drinking water MAC for fluoride is 1.5 mg/L. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride levels are typically 1.6 mg/L. Fluoride does not show an increasing trend and does not affect the treatment process. Fluoride concentrations are considered to be naturally high in the aquifer and are flagged as a concern in the well.	No
	Iron	Iron in the well raw (untreated) water is above the AO of 0.3 mg/L for Iron. The concentration is around 0.54 mg/L. Treatment at the well includes iron sequestering to control iron levels. The iron levels do not interfere with the disinfection process. No increasing trend is evident. Iron is flagged as a natural based concern.	No
	Hardness	The hardness concentration is typically around 185 mg/L, which is above the OG of 80 to 100 mg/L. This parameter is naturally occurring in the groundwater and does not pose a health risk nor does it impact the treatment process. It is flagged as a natural based concern.	No
	Color	The AO for color is 5 True Color Units (TCU). The source typically has a value of 8 TCU. There is no evidence of upwards trending and the parameter does not impact the treatment process. It is flagged as a natural based concern.	No
	Organic Nitrogen	Organic Nitrogen levels in the system are above the aesthetic objective of 0.15 mg/L at concentrations of 0.28 mg/L. Organic nitrogen can be associated with unpleasant taste and high levels can reduce the effectiveness of chlorine as a disinfectant, however there is no history of unpleasant taste. It is flagged as a concern.	No
Mt. Elgin (1 well)	Fluoride	The treated drinking water MAC for fluoride is 1.5 mg/L. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride levels are typically 1.4 mg/L. Fluoride does not show an increasing trend and does not affect the treatment process. Fluoride concentrations are considered to be naturally high in the aquifer and are flagged as a concern.	No
	Hardness	The hardness concentration is typically around 220 mg/L, which is above the OG of 80 to 100 mg/L. This parameter is naturally occurring in the groundwater and does not pose a health risk nor does it impact the treatment process. It is flagged as a natural based concern.	No
	Sodium	The Sodium concentration is noted to occur marginally above the Ministry of Health notification level of 20 mg/L at levels of 24 mg/L. The results are well below the objective of 200 mg/L. It is naturally occurring. No increasing trend is evident in the results.	No

Table A9-1b: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Oxford County)

System	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
Tavistock (3 wells)	Iron	Iron in each of the wells raw (untreated) water is above the AO of 0.3 mg/L for Iron. The concentration is around 0.6 to 0.9 mg/L. Treatment at the well includes iron sequestering to control iron levels. The iron levels do not interfere with the disinfection process. No increasing trend is evident. Iron is flagged as a natural based concern.	No
	Hardness	The hardness concentration is typically around 280 to 380 mg/L, which is above the OG of 80 to 100 mg/L. This parameter is naturally occurring in the groundwater and does not pose a health risk nor does it impact the treatment process. It is flagged as a natural based concern.	No
	Organic Nitrogen	The organic nitrogen level in the wells is above the AO of 0.15 mg/L, with concentrations of 0.3 mg/L. Organic nitrogen can be associated with unpleasant taste and high levels can reduce the effectiveness of chlorine as a disinfectant. There is no history of objectionable taste that is sometimes associated with organic nitrogen. It is flagged as a concern.	No
	Total coliform	Microbiological results are consistently good in Wells 1 and 3. Well 2, which is a standby well, has occasional low level positive results for Total Coliform in the raw water. Typically this is due to infrequent pumping of the well while it is in standby operation. These levels are adequately removed through existing disinfection. It is flagged as a concern.	No
Thamesford (3 wells)	Fluoride	The treated drinking water MAC for fluoride is 1.5 mg/L. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride levels in well no. 3 ranges from 1.5 to 2.2 mg/L. Fluoride does not show an increasing trend and does not affect the treatment process. Fluoride concentrations are considered to be naturally high in the aquifer and are flagged as a concern in well no. 3.	No
	Hardness	The hardness concentration in all wells is typically around 365 to 550 mg/L, which is above the OG of 80 to 100 mg/L. This parameter is naturally occurring in the groundwater and does not pose a health risk nor does it impact the treatment process. It is flagged as a natural based concern.	No
	TDS	Total Dissolved Solids (TDS) levels are above the AO of 500 mg/L in well no. 3, ranging from 628 to 827 mg/L. TDS does not impact health or the treatment process. No increasing trend is evident in the results. It is flagged as a natural based concern in well no. 3.	No
	Organic Nitrogen	The organic nitrogen level in the wells is above the AO of 0.15 mg/L, with concentrations of 0.16 to 0.19 mg/L in well no. 1 and 3. Organic nitrogen can be associated with unpleasant taste and high levels can reduce the effectiveness of chlorine as a disinfectant. There is no history of objectionable taste that is sometimes associated with organic nitrogen. It is flagged as a concern in well no. 1 and 3.	No
	Total coliform	Microbiological results are consistently good at Wells 1 and 3. Well 2 has occasional low level Total Coliform and *E. coli* results due to being operated infrequently. These levels are adequately removed through existing disinfection. These parameters are flagged as a concern.	No

Table A9-1b: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Oxford County)			
System	**Flagged or Noted Parameter**	**Brief Description of Screening**	**Identified as an Issue?**
	E. coli	Microbiological results are consistently good at Wells 1 and 3. Well 2 has occasional low level Total Coliform and *E. coli* results due to being operated infrequently. These levels are adequately removed through existing disinfection. These parameters are flagged as a concern.	No
	Sodium	The Sodium concentration is noted to occur above the Ministry of Health notification level of 20 mg/L in all wells. In Wells 1 and 2 the concentration ranges from 22 to 27 mg/L and in Well 3 it ranges from 45 to 51 mg/L. The results are well below the objective of 200 mg/L. It is naturally occurring. No increasing trend is evident in the results.	No
	Nitrates	Nitrate is not typically a naturally occurring parameter in groundwater at levels around the MAC of 10 mg/L and may be from anthropogenic sources. The results ranged from 2.65 to 9.76 mg/L in monitoring data from 2000 to 2008 in wells 1 and 2. One result of 10.2 mg/L, above the MAC, was reported in December 2007. The treatment process combines the higher nitrate water with water from Well 3 to control nitrate levels in the distribution system. However nitrate levels in the wells have been decreasing since late 2008. Since the fall of 2009, they have been consistently below the half MAC (Maximum Acceptable Concentration, for drinking water). It was recommended by Oxford County to remove nitrates as an issue for Thamesford, and this is now reflected in the amended Assessment Report.	No
	Manganese	The raw water in Wells 1 and 2 has levels of manganese above the treated water AO of 0.05 mg/L, with concentrations of 0.14 to 0.35 mg/L (data 2001 to 2009). No increasing trend is evident. The treatment facility removes manganese through an oxidation and filtration process. Failure of the filtration could potentially result in decreased clarity of the water, which would impact the effectiveness of the UV disinfection.	Yes
Woodstock (10 wells)	Fluoride	The treated drinking water MAC for fluoride is 1.5 mg/L. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride level in well no. 9 is typically 1.4 mg/L. Fluoride does not show an increasing trend and does not affect the treatment process. Fluoride concentrations are considered to be naturally high in the aquifer and are flagged as a concern in well no. 9. Water from the different wells in the system are blended and the combined fluoride levels are typically 0.2 mg/L.	No
	Iron	Iron at well 6, 7 and 9 are above the iron AO of 0.3 mg/L. The concentration is around 0.6 to 3.8 mg/L. Iron is removed at well 7. Iron does not interfere with the disinfection process. No increasing trend is evident. Iron is flagged as a concern at well no. 6, 7 and 9.	No
	Hardness	The hardness concentration in all wells is typically around 349 to 567 mg/L, which is above the OG of 80 to 100 mg/L. This parameter is naturally occurring in the groundwater and does not pose a health risk nor does it impact the treatment process. It is flagged as a natural based concern in all wells.	No

Table A9-1b: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Oxford County)			
System	**Flagged or Noted Parameter**	**Brief Description of Screening**	**Identified as an Issue?**
	Total Dissolved Solids (TDS)	Total Dissolved Solids (TDS) levels in well no. 6, 7 and 9 are above the AO of 500 mg/L. TDS does not impact health or the treatment process. No increasing trend is evident in the results. It is flagged as a natural based concern in well no. 6, 7 and 9.	No
	Manganese	The concentration of Manganese in Well 7 is equal to the objective of 0.05 mg/L. It is naturally occurring and does not interfere with the disinfection process. Manganese is removed by filtration at well 7. It is flagged as a natural based concern in well no. 7.	No
	Organic Nitrogen	The Organic Nitrogen level in the system is above the aesthetic objective of 0.15 mg/L at wells 6, 7, 8, 9 and 11. Concentrations range from 0.37 to 0.75 mg/L. Organic nitrogen can be associated with unpleasant taste and high levels can reduce the effectiveness of chlorine as a disinfectant. There is no history of objectionable taste that is sometimes associated with organic nitrogen. It is flagged as a concern at well no. 6, 7, 8, 9 and 11.	No
	Hydrogen Sulphide	Wells 7 and 9 are above the treated water AO of 0.05 mg/L for hydrogen sulphide. It is believed that the levels are significantly higher than some of these results indicate, as the parameter easily volatilizes in air. When not removed from the water prior to disinfection, the hydrogen sulphide can cause significant water quality and treatment issues. Well 9 combines with water from other wells prior to entering the distribution system. The hydrogen sulphide is a naturally occurring parameter in the groundwater. It is flagged as a concern in well no. 7 and 9.	No
	Sodium	The Sodium concentration occurs above the Ministry of Health notification level of 20 mg/L in wells 6, 7 and 9. In these wells the concentration ranges from 36 to 53 mg/L, well below the objective of 200 mg/L. It is naturally occurring. No increasing trend is evident in the results. Water from the different wells in the system are blended and the combined sodium levels are typically 10 mg/L.	No
	Nitrates	Nitrate occurs in the Thornton wellfield (Wells 1, 3, 5, 8 and 11) and Tabor wellfield (Wells 2 and 4) of the Woodstock well supply. Nitrate levels in Wells 1, 2, 3, 5, 8 and 11 are routinely above half of the treated water MAC (nitrate MAC is 10 mg/L). In Well 4, the concentration is typically below the half MAC threshold but has occasionally been marginally above the half MAC. In 2008 the concentration ranged from 3.7 to 11.5 mg/L in the raw water. Well 3 typically has the highest nitrate concentrations. Data for all wells is 2001 to 2009. Nitrate is not typically a naturally occurring parameter in groundwater at levels around the MAC and may be from anthropogenic sources.	Yes

Table A9-1c: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Perth County, City of Stratford and Town of St. Marys)

System	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
Mitchell (4 wells)	Sodium	Sodium levels in all wells are above the Ministry of Health notification level of 20 mg/L, going up to 47 mg/L in 2007. Sodium levels did not go above the AO of 200 mg/L. Elevated levels of sodium are naturally occurring in the aquifer.	No
	Iron	As reported in the Thames Watershed Characterization Report, iron levels were 0.44 mg/L and 0.5 mg/L in 2005 and 2006, and therefore above the 0.3 mg/L AO (data available did not allow for reviewing parameters for each well). The iron is deemed to be naturally elevated in the aquifer. Treatment at the wells includes iron sequestering system to specifically treat the elevated iron concentrations. Iron is flagged as a natural based concern in all wells.	No
	Fluoride	Fluoride levels in all wells are above the treated water AO of 1.5 mg/L. Levels ranged from 1.6 to 1.9 mg/L between 2003 and 2008. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride is naturally occurring in the aquifer.	Yes
Shakespeare (1 well)	Iron	As reported in the Thames Watershed Characterization Report, iron levels were 1.05 mg/L and 0.52 mg/L in 2005 and 2006, and therefore above the 0.3 mg/L AO. The iron is deemed to be naturally elevated in the aquifer. Treatment at the well includes an iron sequestering system to specifically treat the elevated iron concentrations. Iron is flagged as a natural based concern.	No
	Fluoride	Fluoride levels are above half of the treated water AO of fluoride but below the AO itself (1.5 mg/L). Levels ranged from 0.8 to 0.92 mg/L between 2003 and 2007. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride is naturally occurring in the aquifer.	No
	Arsenic	In 2005 to 2007, arsenic was detected at levels of 0.012 mg/L, slightly lower than half of the MAC (the MAC being 0.025 mg/L). There is no increasing trend and arsenic is naturally occurring in the aquifer.	No
Sebringville (1 well)	Sodium	Sodium levels in all wells are above the Ministry of Health notification level of 20 mg/L, but below the AO of 200 mg/L. In 2003 to 2006 and in 2008, sodium levels ranged from 26.9 to 31 mg/L. The slightly elevated levels of sodium are naturally occurring in the aquifer.	No
	Iron	From the limited iron data, iron levels are slightly above the OG of 0.3 mg/L, at 0.35 mg/L (in 2005) and 0.4 mg/L (in 2008). There is no specific iron removal treatment for the well, but an operations manager at the Ontario Clean Water Agency (OCWA), who maintains the wells, has indicated that there are no treatment difficulties due to the iron levels, and will continue to monitor iron levels. Iron is flagged as a natural based concern.	Yes

Table A9-1c: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Perth County, City of Stratford and Town of St. Marys)

System	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
	Fluoride	Fluoride levels are above the treated water AO of fluoride, 1.5 mg/L. Levels ranged from 2.06 to 2.74 mg/L between 2003 and 2008. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride is naturally occurring in the aquifer.	Yes
St. Pauls (1 well)	Sodium	Sodium levels in all wells are above the Ministry of Health notification level of 20 mg/L, but below the AO of 200 mg/L. In 2003 to 2006, the Thames Watershed Characterization Report notes that sodium levels ranged from 22.4 to 24.6 mg/L. The slightly elevated levels of sodium are naturally occurring in the aquifer.	No
	Iron	From the limited iron data, iron levels are slightly above the OG of 0.3 mg/L, at 0.5 mg/L (in 2005) and 0.59 mg/L (in 2006). Treatment at the well includes an iron sequestering system to specifically treat the elevated iron concentrations. Iron is flagged as a natural based concern.	No
	Fluoride	Fluoride levels are above the treated water AO of fluoride, 1.5 mg/L. Levels ranged from 1.59 to 1.69 mg/L between 2003 and 2006. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride is naturally occurring in the aquifer.	Yes
Stratford (11 wells)	Sodium	Sodium levels in all wells are above the Ministry of Health notification level of 20 mg/L, but below the AO of 200 mg/L. In 2003 to 2006, the Thames Watershed Characterization Report notes that sodium levels ranged from 17 to 32 mg/L. In 2008, sodium levels ranged between 21 and 26 mg/L for all wells. The slightly elevated levels of sodium are naturally occurring in the aquifer.	No
	Iron	At the Romeo well field (comprised of 6 wells), iron levels are slightly above the OG of 0.3 mg/L, at 0.35 mg/L (in 2005) and 0.34 mg/L (in 2006). Treatment for the Romeo well field includes an iron sequestering system to specifically treat the elevated iron concentrations. Iron is flagged as a natural based concern.	No
	Fluoride	Fluoride levels in all wells are at or above the treated water AO of fluoride, 1.5 mg/L. Levels ranged from 1.5 to 2.6 mg/L between 2004 and 2008. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride is naturally occurring in the aquifer.	Yes
St. Marys (3 wells)	Sodium	For all 3 wells, the sodium levels were less than the Ministry of Health notification level of 20 mg/L in 2003 to 2006. Sodium ranged from 43 to 61 mg/L in 2008. The elevated levels of sodium are naturally occurring in the aquifer, and are below the AO of 200 mg/L.	No

Table A9-1c: Drinking Water Quality Parameters Flagged or Noted in the Upper Thames River Source Protection Area (Perth County, City of Stratford and Town of St. Marys)

System	Flagged or Noted Parameter	Brief Description of Screening	Identified as an Issue?
	Fluoride	For all 3 wells, the fluoride levels ranged from 1.01 to 1.23 (2003 to 2006), 1.09 to 1.2 mg/L (2008). These levels are greater than half of the AO, but less than the AO of 1.5 mg/L. At concentrations between 1.5mg/L and 2.4 mg/L the Ministry of Health and Long-Term Care require that the local Medical Officer of Health is notified to raise awareness to control excessive exposure from other sources. Fluoride is naturally occurring in the aquifer.	No
	Nitrate	Nitrates at the St. Marys Well no. 1 ranged between 0 to 6.1 mg/L from 2000 to 2006, with some of these levels being higher than half of the MAC. No values in this time period went above the full MAC of 10 mg/L. The St. Marys wells are groundwater under the influence of surface water (GUDI) and therefore the source of nitrates may possibly be anthropogenic. Nitrates are flagged as a concern but not identified as an issue.	No
	E. coli	From the raw water quality analysis in the Thames Watershed Characterization Report, the raw (untreated) water drawn from well No. 1 had four occurrences of *E. coli* between 2003 and 2005, with low counts of 1 per 100 mL. The St. Marys wells are groundwater under the influence of surface water (GUDI) and therefore the source of *E. coli* may possibly be anthropogenic. The current disinfection treatment adequately removes *E. coli* and total coliform from the water. It is flagged as a concern but not identified as an issue.	No

Appendix 10 – Threats and Risk Assessment

Threats and Risk Assessment Local Guidance

Thames-Sydenham and Region

Threats and Risk Assessment Local Guidance

Version 1.2
September 09, 2009

1 Table of Contents

1.1 List of Tables

2 Introduction

The Clean Water Act (2006) requires the completion of an Assessment Report and a Source Protection Plan. The Assessment Report is to contain the science behind the plan including:

- delineation of the vulnerable areas,
- assessment of the vulnerability of those areas,
- identification and assessment of drinking water quality issues,
- identification of conditions which may affect drinking water sources,
- identification of threats to drinking water sources,
- assessment of risks to the drinking water sources posed by activities within those vulnerable areas.

The Source Protection Plan is then developed by the Source Protection Committee to reduce the risks that those activities pose to the drinking water sources. The Clean Water Act requires that the Source Protection Committee develop a Terms of Reference which identifies the tasks to complete both the Assessment Report and the Source Protection Plan. This local guidance is intended, along with provincial rules, regulations and the Clean Water Act, to define the deliverables related to Threats and Risk Assessment tasks identified in the Terms of Reference.

This local guidance focuses on the threats and risk assessment portions of the assessment report. It is intended to give clarification and local interpretation of the sections in the Clean Water Act, its regulations and the associated technical rules pertaining to the threats and risk assessment. It must be read in conjunction with the Clean Water Act, its regulations and rules. References to some of those rules on which this local guidance is based are provided within the appendix to this local guidance.

This local guidance is intended to guide the current studies being undertaken by consultants, municipalities and conservation authorities. It will allow those undertaking the work to refine their work plans or develop supplemental work plans and to complete the tasks and deliverables identified in this local guidance. It is not intended to be a comprehensive outline of the work required to satisfy the requirements of the Act, regulations and rules, but must be read in conjunction with the provincial requirements.

This local guidance will allow the current work to proceed to a consistent conclusion so that material can be compiled into the first Assessment Report. In some cases additional work will be required through these studies. An example of this additional work would be site specific investigations to determine the circumstances associated with activities identified as threats.

3 Background

- Ministry Of Environment (MOE) funded municipalities and Conservation Authorities (CAs) to undertake technical studies
- These studies were initially based on agreements and later based on interim MOE source protection guidance.
- The work did not include detailed site specific inventories but instead relied upon desktop analysis of activities with the vulnerable areas and where necessary included drive-by inventories
- The inventories collected through this work included various levels of detail (in some studies the general activity was captured while not differentiating between specific activities such as various types of professional offices or farming)
- Most of the inventories were based on NAICS (North American Industry Classification System) codes as it was generally accepted that future risk assessment would be facilitated through provincial linking of the NAICS code to a hazard score
- The work which was initiated through these studies was intended to be a detailed inventory of activities which could be considered a threat within the entire WHPA or IPZ. At the point that the inventories were initiated there was no guidance available on the level of hazard which might constitute a threat nor was there a list of the activities which could be considered a threat.
- Subsequent to the initiation of these studies the CWA requirements, through regulations and rules, were developed. Specifically a list of prescribed threats was released as well as a table indicating the level of risk posed by an activity being undertaken under certain circumstances. This was different than the anticipated list of hazard ratings for a given NAICS code which was needed to assess the risks posed by the land uses identified in the inventories being developed.
- Although the inventories being developed through the initial studies will be useful in the risk assessment defined in this local guidance they were not developed with the needs now established through the regulations and rules.
- There are other challenges with adopting those inventories for use in this work such as the wide variation in the format and structure of the databases as well as the level of detail which was captured through the inventories.
- The rules now require lists of activities that are or would be threats. Inventories of existing activities are not required to develop these lists due to the requirement to identify what would be a threat if it were to be undertaken. Further, it is not necessary to distinguish whether an activity is currently undertaken from those that would be threats if they were to be undertaken, as a policy will need to be in place to manage the risk. Specifically, policies will be required to prevent activities from becoming a significant risk should such an activity be undertaken in the future. This is a significant departure from the methodology initiated based on interim guidance.
- The inventories will be useful in assisting the SPC to develop policies in that those polices may be significantly different if an activity is being undertaken than if it is not. For example it may be more likely to prohibit future activities than ones which are already in existence

- Assessment Reports also need to include a number of maps including significant drinking water threats
- Maps are needed which indicate where activities associated with chemicals, DNAPLs and pathogens pose significant. As the areas for each type of risk are different and overlap it may be necessary to map these areas on different maps.
- Similar maps are required for areas where acitivites associated with chemicals, DNAPLs and pathogens pose moderate risks as well as maps where those activities pose low risks. Ways of combining these maps with the maps of significant should be considered.
- These maps will all rely upon the vulnerability maps which have been created through previous work on these projects

4 Purpose and Objectives

This local guidance is intended to provide direction and guidance to consultants engaged in studies for the conservation authorities. It is recommended that municipalities working on similar projects utilize this local guidance in undertaking their projects, as ultimately their deliverables will be assembled into the Assessment Report with the other projects guided by this local guidance. This local guidance is intended to describe the minimum requirements to be included in the AR. There are also other aspects of the work related to threats and risk assessment which will be needed to inform and implement the Source Protection Plan (SPP).

The objectives of work described in this local guidance are:

1. to identify the number and types of significant risks,
2. to describe the lists and maps required by the Clean Water Act (and its regulations and rules)
3. to satisfy the requirements of the Clean Water Act, related rules and regulations as they pertain to water quality threats and risk assessment,
4. to provide information useful in developing policies to reduce risks to drinking water sources,
5. to provide information which will be beneficial when implementing the SPP

Although all of these objectives should be kept in mind, the focus of this local guidance is currently on satisfying the requirements of the first Assessment Report (numbers 1, 2 and 3 above) related to threats and risk assessment. The remaining objectives will be the focus of the second tier of this local guidance, described in Sections 5.3, 5.4 and 5.7, but currently beyond the scope of this local guidance.

5 Discussion

5.1 Studies

Threats and risk assessment work is being carried out through various technical studies. These studies are being lead by municipalities or CAs within the source protection region.

They were initiated through agreements with MOE. The work was defined within the agreement and later based on draft guidance modules provided as interim guidance. Those agreements still require the delivery of specific deliverables including threats inventories. These studies are currently being updated to meet the technical rules. This local guidance is focused on the minimum requirements related to threats and risk assessment required to meet those rules and focused on receiving those deliverables in time to meet legislated requirements rather than awaiting the completion of the other aspects of the studies (such as the threats inventories) which can be completed later. Much work has been undertaken on updating the other aspect of the technical work to meet those rules.

Table 1 Current projects involving threats and risk assessment

Ground-water		Surface Water	
Projects	**Systems**	**Projects**	**Systems**
Perth	Stratford St Marys West Perth -Mitchell Perth East -Shakespeare (& Milverton)* Perth South - St Pauls, Sebringville*	Essex - Chatham Kent	Wallaceburg Wheatley South Chatham Kent/Chatham
London-Middlesex	City of London - Fanshawe, Hyde Park Thames Centre - Thorndale, Dorchester Kilworth Heights Subdivision, Melrose, Mount Brydges, Birr	West Elgin	West Elgin
Oxford	Woodstock, Innerkip, Ingersoll, Beachville-Loweville, Mount Elgin*, Embro, Lakeside*, Thamesford, Tavistock, Hickson-King*	Southern Lake Huron	LAWSS* Petrolia*
Chatham-Kent	Ridgetown Highgate		

Municipalities identified with an asterisk (*) include vulnerable areas from water systems in neighbouring municipalities
Note: Milverton is outside of the TSR SP Region but included in the technical study

5.2 Threats Inventories

County groundwater studies developed lists of potential threats within WHPA. They relied largely on professional judgment of the individuals undertaking the studies to identify land uses that could pose a risk to drinking water sources. This has resulted in significant variation in the detail and nature of the inventories. Source Protection technical studies improved those inventories where they existed before and initiated inventories where none existed before (surface water sources). These inventories were based on general land use categories or more specific categories as listed under the NAICS (North American Industry Classification System) classifications. Further information on the NAICS codes may be obtained at: http://www.statcan.gc.ca/subjects-sujets/standard-norme/naics-scian/2002/naics-scian-02index-eng.htm

Previous methodologies and guidance suggested that:

- a detailed parcel by parcel inventory was needed of all activities which might pose a threat to drinking water sources
- the activity would be described by a NAICS code

- each activity would need to be assessed to determine the hazard rating and multiplied by the vulnerability of the area where the activity was occurring
- the province would provide hazard scores related to the NAICS
- a database and look-up tables would be provided to facilitate this work

Since the studies were initiated the prescribed list of activities and the table of threats and circumstances under which they are considered threats have been released. The rules require a different approach where:

- a threat is an activity that occurs *or could occur* in an area
- the table of threats includes detailed descriptions of circumstances and identifies the level of risk (significant, moderate or low) depending on the type of vulnerable area and vulnerability score of a part of the vulnerable area in which the activity is being engaged
- the table includes the risk score of the activity based on the vulnerability zone and score in which the activity is being undertaken.
- the rules only require the number of significant threats to be counted in each vulnerable area.

This allows the inventory to be scoped and focus on:

- those areas where a significant risk could occur (with a vulnerability score of 8 or greater for chemical threats, WHPA-A and B, IPZ-1 and 2 for pathogens and WHPA-A, B and C for DNAPLs)
- the activities within those areas which could be significant

Threats inventories being developed and refined may be utilized if they are detailed enough and organized in such a fashion as to allow them to be compared or linked to the table of threats. The detailed circumstances are difficult to relate to the categories of NAICS codes. Although some links have been provided by the province along with the other look-up tables, this requires significant work to make links between the inventory and the table of activities and circumstances. In most cases additional information would be required to determine the appropriate circumstances under which the activity is being undertaken. Further, the list of NAICS codes and activities is not considered to be complete. These threats inventories will be important for the development of policies and in the implementation of the Source Protection Plan however they may not be the most efficient way to develop the required lists or count the number of locations where significant risks are occurring. Even if these lists are not used to determine the significant risks it will be important that they be completed and delivered to the conservation authorities as part of tier 2 of the work described in this local guidance. A more efficient methodology is described in this local guidance for completing the required deliverables in time for the submission of the Assessment Report.

In many cases the areas where a significant risk could occur is relatively small. Further, depending on the vulnerability score in those areas, the types of activities which need to be assessed to determine whether they are significant are limited. This list may include activities which were not captured in the originating inventories. Similarly, many activities

included in those inventories would not pose a significant risk in that location or perhaps even at locations with a lower vulnerability score.

Even if not utilized for this work it will be important that the inventories of threats be refined as they will be useful for other purposes. However, it may not be the most efficient way of satisfying the requirements of the rules and providing the required content for the Assessment Report. Scoped inventories with a focus on the deliverables identified below may be a more efficient way to collect and report on the information. This local guidance is intended to better describe the required outputs, rather than to define the methodology for creating those outputs.

5.3 WHPA-E and F for GUDI Systems *(beyond the scope of this local guidance)*

Drinking water systems which have been determined to be Groundwater Under Direct Influence (GUDI) of surface water have additional vulnerable areas wich must be defined. A WHPA-E must be defined if the surface influence has the potential for "short circuiting" the travel times established though the delineation of WHPA-B, C and D. A WHPA-F is also to be delineated where the system has issues which are not dealt with through WHPA-A, B, C, D and E.

Most of these areas have yet to be delineated and assessed for vulnerability. As a result the work associated with threats and risk assessment in those areas is beyond the scope of this local guidance. The methodologies described in this local guidance will be applied to those areas upon completion of the delineation and vulnerability scoring of those areas.

5.4 Threats contributing to Issues *(beyond the scope of this local guidance)*

The rules require threats contributing to issues to be identified. The rules also allow for that work to be undertaken later if a work plan is included which identifies how and when that work will be completed. This is due to the significant effort and data which may be required to refine and substantiate the "issues contributing area".

In this region issues assessment on municipal water sources is currently underway. Until the issues assessment has been completed, identifying the threats contributing to the issues cannot be undertaken. It is expected that, in most cases, the issues assessment will identify a work plan for investigating the area and threats contributing to the issues, but will not actually be able to identify specific threats contributing to issues.

Threats contributing to issues are therefore not currently a part of this local guidance. In the future, however, it will be necessary to include, in the lists of threats, the threats which are tied to issues. This is important as threats associated with issues are significant and will therefore need to be added to the count of significant threats.

5.5 Conditions *(beyond the scope of this local guidance)*

Conditions are the result of past activities. Technical Rule 126 describes the types of things which can be considered Conditions.

MOE has indicated that a condition cannot be the result of an activity which is still occurring. This is most likely a result of the fact that there are existing regulatory methods for dealing with these situations. However, if a material is found in a concentration and manner that would be considered a condition then it needs to be documented so that the SPC and MOE can consider the situation.

Although inventorying conditions is beyond the scope of this work and will be considered through separate local guidance, the following is provided in case a situation is identified through the work described in this local guidance.

- The situation needs to be considered to determine if it may be considered an imminent risk to the drinking water system. The operating authority, conservation authority and MOE need to be involved considering the situation.
- Where the potential condition is attributed to an existing activity, the activity should be assessed as a threat.
- Where the circumstances associated with the activity do not adequately describe the situation the unique circumstances surrounding this situation need to be considered and an appropriate hazard score is to be developed using the method described in the rules.
- The criteria for defining conditions may be used as a comparison.

As work associated with conditions is beyond the scope of this local guidance, therefore no allowance is required for this work. Should the situation above be identified a work plan will be developed with the consultant to deal with the situation.

5.6 Activities that are not included in the prescribed list

Rule 119 (see Table 4 in Appendix A) allows the SPC to identify activities which are not on the prescribed list and which pose a risk to a drinking water source. The SPC is also able to identify circumstances not in the list with an activity. In order to identify an activity in this manner the committee (or actually the consultant on their behalf) must calculate the hazard related to the activity in the same manner as the hazards associated with the prescribed activities in the table of threats. The Director must agree with the calculations.

The consultant is to identify if there are any activities which the operating authority is concerned about. The consultant will investigate to determine if the activity is included in the prescribed lists. If it is not included in the prescribed lists or if the circumstances under which the activity is being undertaken are different than those described in the table of drinking water threats, such activities will be listed separate from the prescribed activities considered threats.

Further, through their review of activities occurring in the vulnerable areas, the consultant may identify activities being undertaken in the area which they think may pose a risk to the drinking water system, but which they cannot associate with the prescribed threats. The consultant shall consider activities which are similar in nature to those identified in the prescribed list, activities which involve similar chemicals to those listed, and circumstances which are not included in the prescribed list.

One such activity that the SPC has expressed a concern over is transportation corridors such as pipelines. Known major transportation corridors are to be identified and mapped within the vulnerable areas. The chemicals of concern identified in the threats tables are to be reviewed to determine the most hazardous material (highest hazard score) which may be transported along the corridor within the vulnerable area. This chemical is to be used to assess the risk score.

Activities which are identified in this manner will need to be evaluated to determine the hazard score for the activity. Where the methodologies described above are not able to allow the threat to be assessed the consultant is to provide suggestions as to similar activities or circumstances which could be relied upon in determining the hazard associated with the activity of concern. Doing a detailed analysis of the risk associated with these activities is beyond the scope of this local guidance and will need to be identified through a specific work plan should this situation arise.

The consultant shall also document activities which the operating authority is concerned about which are occurring beyond the vulnerable area. This may be useful in delineation of IPZ-3 and GUDI-F (for a GUDI system) where applicable. There is however no similar methodology for the extension of a vulnerable zone to include activities beyond WHPA-D for non-GUDI systems.

5.7 Future threats

Activities which are or "would be" threats are to be included in the required lists. Generally this is addressed by including all activities listed in the prescribed lists even if they are not being engaged in an areas. Activities not currently being undertaken in the vulnerable areas "would be" threats if the activity was to be undertaken in the vulnerable area in the future. This greatly simplifies the process of identifying the activities which are or would be threats as the lists provide that information. Filtering and sorting of the lists will provide for a list which can be utilized for local consultation on the threats and risks. However, this is considerably more challenging when counting the number of locations at which significant risks are occurring.

O. Reg. 287/07 s13(1)6i requires that we identify the number of locations at which a person is engaging in an activity which is a significant threat. It also includes counting locations where the activity "would be" a *significant* drinking water threat. It is very difficult and in many cases impossible to identify the circumstances associated with a future activity, especially based only on land use identified in Official Plans and bylaws. The circumstances are critical in identifying whether an activity would be significant or not. It is therefore apparent that this was not the intent of the rules. Therefore a different

interpretation of "would be" is required in identifying if future activity should be included in the count of significant threats. MOE has indicated that in this case **"would be" should be interpreted as having the infrastructure in place to undertake the activity** which would be a significant drinking water threat.

As an example, if the structure is in place to house or store the quantity which would make the activity a significant risk, but it is not in use or houses a lower quantity, then this location is to be included as "would be" even although at that location the circumstances are not in place (ie there is not sufficient quantity) to make this a significant risk at this time. An empty fuel tank or chemical storage would be an example of this. The level of risk would be established based on the quantity which could be stored rather than based on the amount which is there at the current time. This is obvious for certain activities as the risk should not be calculated based on the half empty storage tanks at the time of assessment, when they will likely be filled at the time of the next delivery. A barn which is currently empty or houses far fewer livestock than it could house would be another example. Similarly it does not make sense to assess the risk based on en empty chicken barn when the barn could be filled up days or weeks later. This does present significant challenges when the intended activity is less obvious. Empty warehouses or other commercial buildings will require considerable judgment to be exercised in assessing the future risks associated with this activity. Reasonable assumptions will be needed. These assumptions must be documented. These assumptions should be conservative but reasonable. These types of situations will need to be dealt with on a case by case basis and will likely need to be considered through the tier 2 threats and risk assessment described below.

It is likely that in the first tier of threats and risk assessment those areas with the infrastructure in place to undertake an activity which would be a drinking water threat will be assumed to be engaged in that activity. It would only be through direct contact with the person engaged in the activity that we would be able to determine whether or not the activity is currently being engaged in. Through the subsequent tiers, an assessment of whether the activity should be classified as a future threat will need to be made, but at this stage it should be counted as a location where the activity is or would be a significant risk.

5.8 Event Based Significant Threats (beyond the scope of this local guidance)

Rule 130 of the Technical Rules: Assessment Report (Dec 2008) identifies a activity threat as significant if modeling demonstrates that a release of a chemical parameter or pathogen from the activity would be transported to the intake and result in the deterioration of the water for use as a source of drinking water. Currently rule 130 restricts this methodology for identifying a significant risk to IPZ-3, however we understand that MOE is considering amending the rules to allow that same event based modeling to identify significant threats in the other intake protection zones. The work to undertake this event and activity specific modeling is beyond the scope of this local guidance.

6 Deliverables

The Clean Water Act, General Regulation (O. Reg. 287/07) and Technical Rules all make reference to deliverables required in the Assessment Report. Appendix A includes a table of those references. The previous guidance referred to a tier 1 and tier 2 risk assessment where tier 2 involved site investigation and discussions with landowners. Threats and Risk Assessment in most studies in the Thames-Sydenham and Region will require a similar 2 tiered approach where the first tier is based on existing inventories, desktop investigations or windshield surveys. Tier 1 of the Threats and Risk Assessment must be completed in time for Assessment Report Consultation - Phase 2 (October 2009). Where time permits more detailed investigation can be undertaken in tier 1, however in most cases the detailed, site specific investigation will not be able to be completed within tier 1.

6.1 Tier 1 Deliverables

The deliverables required are described in the following table. It is important to note that most of the deliverables do not rely upon a threats inventory in any way. The only exception to this is the enumeration of significant threats. Even this enumeration requires a scoped inventory only.

The scoped inventory is focused on the areas where a threat can pose a significant risk- where the vulnerability score is 8 or higher. Significant Risks can also be from threats which contributes to an issue or are identified through event specific modeling, both of which are beyond the scope of this project (although any threats contributing to an issue, that have been identified through other work, can be brought forward to this work and included in the lists).

While the Act, Regulations and rules identify the deliverables, the following table is intended to provide a local interpretation of how those deliverables may be satisfied. These deliverables are to be based on best available information through desktop exercises relying on existing threats inventories and where necessary or more efficient, windshield surveys. Where there is uncertainty, reasonable, but conservative assumptions are to be made. These assumptions may include what activity is being undertaken or specifics on the circumstances associated with the activity. These assumptions and the level of uncertainty also need to be documented.

The following table considers water quality threats only. Water Quantity threats and the vulnerable areas associated with water quantity are being considered through the Water Budget process and are therefore beyond the scope of this local guidance.

The focus of this local guidance is on the WHPAs and IPZs and the projects associated with these areas being undertaken by consultants and municipalities. Similar methodologies will be applied to the water quality threats associated with HVAs and SGRAs, but not as part of the work currently being undertaken through these technical studies.

Table 2 Local Description of Deliverables related to threats

#	Deliverable	Reference	Description
1.	List of Significant Threats	TR 9 (1)(d), OReg 287/07 s13(1)(3)	• List by prescribed activity for each vulnerability score within the vulnerable areas (WHPA, IPZ) in the study • Include the circumstances under which the prescribed activity is considered a significant threat • Include any local circumstances (which were not identified in the above point) under which the prescribed activity is considered a significant threat • Table, text
2.	Map of areas where pathogen activities can be significant	CWA s15 (2) (h)	• In the Assessment Report maps do not need to be separated out for each of significant, moderate, low and pathogen, DNAPL and chemical, but for the purposes of clarity and consultants submission each combination is to be mapped separately. Suggestions as to ways to map these collectively would be appreciated. The SPC will consider more efficient mapping methodologies in the Assessment Report • Clean Water Act Mapping Symbology (April 2009) and data standards to be met • Maps, text (explain in text the interpretation of the map of vulnerability scores and table of circumstances together that give the areas where activities are significant, moderate or low)
3.	Map of areas where DNAPL activities can be significant	CWA s15 (2) (h)	
4.	Map of areas where chemical activities can be significant	CWA s15 (2) (h)	
5.	List of Moderate Threats	OReg 287/07 s13(1)(4)	• List by prescribed activity for each vulnerability score within the vulnerable areas (WHPA, IPZ) in the study • Include the circumstances under which the prescribed activity is considered a moderate threat • Include any local circumstances (which were not identified in the above point) under which the prescribed activity is considered a moderate threat • Table, text
6.	Map of areas where pathogen activities can be moderate	OReg287 s13(1)2(i)	• As per deliverables 2-4 above
7.	Map of areas where DNAPL activities can be moderate	OReg287 s13(1)2(i)	

#	Deliverable	Reference	Description
8.	Map of areas where chemical activities can be moderate	OReg287 s13(1)2(i)	
9.	List of Low Threats	OReg 287/07 s13(1)(5)	• List by prescribed activity for each vulnerability score within the vulnerable areas (WHPA, IPZ) in the study • Include the circumstances under which the prescribed activity is considered a low threat • Include any local circumstances (which were not identified in the above point) under which the prescribed activity is considered a low threat • Table, text
10.	Map of areas where pathogen activities can be low	OReg287 s13(1)2(ii)	• As per deliverables 2-4 above
11.	Map of areas where DNAPL activities can be low	OReg287 s13(1)2(ii)	
12.	Map of areas where chemical activities can be low	OReg287 s13(1)2(ii)	
13.	Local threats (other Activities) that are or would be drinking water threats	CWA s15(2)(g)(i), TR 7(3), 119-125, OReg 287/07 s13(1)(3), 13(1)(4), 13(1)(5)	• To be brought to the attention of the SPC for consideration as a drinking water threat • Consider any concern of the treatment plant operating authority • Consider any threat identified by the public through consultation on Assessment Report (information to be provided by CA following Phase 1 and 2 consultation sessions) • Include a recommendation as to how to determine hazard rating (consider similar activities or activities with similar chemical, pathogen or DNAPL circumstances) • Hazard rating approved by Director must be listed for each local threat • Must be listed separately from the prescribed activities (No. 1,5,9) • List local circumstances for activities that are significant, moderate or low drinking water threats • Table, text

#	Deliverable	Reference	Description
14.	Activities considered linked to issues	TR 115(4)	• This is a cross reference to the work undertaken through Issues Evaluation, the work is to be undertaken through that project, any issues based threats identified through that process can be brought forward to this project to complete the list of threats if they are available
15.	Number of Locations where Significant Threats occur	OReg 287 Sec 13 (1) 6(i) TR 9(1)(e)	• This is to be the total number of locations at which an activity which is a significant threat is being engaged in within the WHPA or IPZ. • For the purposes of this count a location will be defined as a property parcel. • Where multiple occurrences of an activity are identified on the same parcel it is generally only to be counted once (except as noted in the following point). Where this the case the cumulative effect of the occurrences are to be considered (ie the volumes are to be summed) in evaluating the risk associated with that activity at that location • Where multiple tenants are know to occupy the same property parcel and are involved with the same activity they shall each be included in the count. • Roads and other corridors are to be counted as a single location • Summarized as per the 19 prescribed activities under OReg 287/07 s 1.1(1) which are prescribed drinking water threats related to water quality • The details associated with the activities counted are to be recorded as per deliverable 16 below. • Table, text
16.	Details on locations of significant threats	Information for SPC and project team	• Details on the locations where significant threats exist are to be submitted in a database and not to be included in the technical memo (deliverable 18) • Data to be included with this deliverable will be defined in Appendix B. • This information will allow the total to be recalculated when updated information is available as well as providing the staff and the SCP with a better understanding of the total

#	Deliverable	Reference	Description
17.	List of prescribed Activities that are or would be drinking water threats for each vulnerable area	CWA s15(2)(g)(i) TR 7(3), 118, OReg 287/07 s1.1	• As per Technical Rule 118 these may be collectively listed in the assessment report as "*the activities prescribed to be drinking water threats in paragraphs 1 through 18 and paragraph 21 of subsection 1.1(1) of O. Reg. 287/07 (General)"* • The above statement when combined with the lists of activities which are significant, moderate and low should satisfy this requirement, thus no separate deliverable is required as part of the technical studies.
18.	Technical memorandum	Information to SPC	• to inform Assessment Report compilation • description of the method of calculations and the general nature of assumptions shall be included in the technical memorandum • to include specific description of work but may refer to this local guidance for general description

6.2 Tier 2 Deliverables (beyond the scope of this local guidance)

Deliverables completed in tier 1 will likely need to be refined through site specific investigation. Where an activity was identified as a significant risk, contact with the person engaged in the activity will occur through the Assessment Report Consultation (phase 3). This personal contact may result in refinement of assumptions made through the tier 1 Threats and Risk Assessment and may well eliminate activities from being identified as significant or in some cases from being identified as threats. As a result deliverables 15 and 16 above will be refined in tier 2. Although beyond the scope of this local guidance the following will be required in the tier 2 Threats and Risk Assessment:

- Threats inventories initiated through previous tiers of this work will be finalized and delivered to the municipality and SPA.
- These threats inventories are to satisfy the data standards developed by the MOE and/or the SPA
- It is proposed that the survey or census that was developed by the Regional Municipality of Waterloo and is being applied in the Lake Erie Source Protection Region would be used to ascertain the circumstances around the activities which are being undertaken in the vulnerable areas where a significant risk is possible.
- The work associated with this tier of the project is currently beyond the scope of this local guidance. This will be refined when final guidance and database are received from the MOE.

7 Consultation

The Thames-Sydenham and Region Source Protection Committee has adopted a staged consultation plan for the Assessment Report which goes beyond the regulatory requirements.

- Phase 1 focuses local consultation on the vulnerable areas.
- Phase 2 is again a locally focused consultation adding issues and an overview of threats and risk assessment.
- Phase 3 is a regionally focused consultation on the draft proposed Assessment Report.

Output from the technical studies is required for phase 2 consultation. It is, however, expected that in areas where there may be higher numbers of risks or a great deal of uncertainty related to the circumstances associated with the activities, that more work will be undertaken beyond phase 2 consultation and perhaps beyond the submission of the first assessment report in April 2010.

The consultants' participation in consultation is not required. Results from the consultation may however be brought to the attention of the consultants for consideration in finalizing their submissions.

For more details on the consultation phases please refer to the Assessment Report Consultation Plan.

8 Schedule

The Assessment Reports in the Thames-Sydenham and Region are required to be submitted by April 20, 2010. It is generally accepted that the Assessment Reports will not be complete at that time, however, they will be submitted with data gaps identified. Work will continue on filling those gaps while work on the Source Protection Plan is initiated. An addendum will be submitted which addresses those data gaps, where possible. The schedule for the submission of the addendum has not yet been determined. The addendum needs to be submitted in sufficient time to allow for its approval prior to and allow sufficient time for the submission of a complete Source Protection Plan by its legislated due date of August 20, 2012 (5 years from the appointment of the chair of the Thames-Sydenham and Region Source Protection Committee).

The addendum may include, among other things, an update of Threats and Risk Assessment based on a more detailed inventory of existing threats and circumstances (referred to in past provincial guidance and in this local guidance as Tier 2 Risk Assessment). The Assessment Report submitted in April 2010 must include the deliverables identified in section 6.1 above (Table 2). Prior to submission of the Assessment Report the stakeholders in the region must be consulted. This consultation will be undertaken by the Conservation Authorities as part of the consultation identified in the Source Protection Committee's Assessment Report Consultation Plan. As such the consultant will not be required to participate in the consultation as part of the work

described in this local guidance. Where the specific expertise of the consultant is required their involvement will be arranged for separately, outside of the work described in this local guidance.

The phased approach to consultation, as described in Section 7 above, has been adopted by the Source Protection Committee. The deliverables identified in Table 2 must be completed to allow for consultation in Phase 2 of the Assessment Report Consultation as this is the last local consultation of the components of the Assessment Report.

It is therefore necessary to have completed the work contained in this local guidance by October 23, 2009. The following table outlines the schedule for the completion of this work.

Table 3 Schedule

	Task/Milestone	Description	Date Due
1.	Comments on ToR	• This ToR is to be distributed to that consultants engaged in these projects and technical steering committees • Consultant and municipal comment will be considered along with comments received from the SPC	Aug 14, 2009
2.	Final local guidance	• Local guidance will be finalized and redistributed to consultants for proposals	Sept 8, 2009
3.	Proposals Due	• Proposals to be brief letter form proposal requesting extension of existing work plan to include this work • Proposals to include a cost of undertaking the work and a confirmation of schedule	Sept 16 2009
4.	Draft Tier 1 Report	• Technical memorandum including required lists and maps as per deliverables identified in table 2	Oct 5, 2009
5.	Final Tier 1 Report	• Final report considering comments of technical steering committee	Oct 23, 2009
6.	Tier 2 (beyond the scope of this ToR)	• To follow consultation on preliminary Assessment Report • Timing to align with addendum to Assessment Report	To be determined (summer/fall 2010)

Threats and Circumstances Tables

Threats Tables

The tables included and referenced in this appendix are intended to provide information on the types of activities which are or would be significant, moderate or low threats, as well as the circumstances which would result in the activity being a significant, moderate or low threat.

The province developed tables of drinking water threats which are posted on the MOE website (http://www.ene.gov.on.ca/environment/en/resources/STD01_078436.html). These tables include the prescribed activities that can be identified as threats, the vulnerable areas where they can be identified as threats, the circumstances which make them threats and the level of risk that they pose in that area under those circumstances. The MOE tables of circumstances are available at: http://www.ene.gov.on.ca/environment/en/legislation/clean_water_act/STDPROD_081301.html

The Technical Rules require that assessment reports identify the activities which would be threats and the areas where, within the vulnerable areas, they would be considered significant, moderate or low threats. The tables included and referenced in this appendix are intended to help satisfy that requirement.

The tables in this appendix should be read in conjunction with the maps related to Section 7 – Threats and Risk Assessment and the tables included on those maps. These maps, included in Appendix 1 of the Assessment Report, identify the areas where activities are or would be significant, moderate or low threats. The tables on the maps indicate the vulnerability and vulnerable area in which the activities would be significant, moderate or low threats. The tables included in this appendix indicate which activities in each of those vulnerable areas (as identified by the vulnerability score) would be significant, moderate or low.

The tables are numbered based on the appendix that they are contained in (A10), the series (1), the vulnerable area (I2 for IPZ-2, WB for WHPA-B), and the vulnerability score (4.6) (eg. A10-1-I2-4.6 would indicate the activities which would be threats in an IPZ-2 with a vulnerability score of 4.6). The tables are included in the appendix in alpha-numeric order.

To determine the circumstances which would result in activities being significant, moderate or low, one can refer to the province's tables of drinking water threats discussed in the previous paragraph. The province has also developed individual tables which list the activities as either significant, moderate or low for a specific type ofvulnerable area and with a specific vulnerability score. There are 73 tables many of which are up to or over 50 pages. As such they have not been included in this Assessment Report, but are available on the internet. A link to the tables is provided at http://www.sourcewaterprotection.on.ca/threats.

An interactive threats tool has also been developed to search, query and filter the threats tables. This tool is based on the lookup tables which the province utilized to develop the tables of drinking water threats. This tool continues to be refined and updated as the province issues updated versions of the lookup tables. It is provided “as is- with no warranty as to its accuracy or completeness” . The tool allows the user to explore the activities and the circumstances around those activities and determine the potential level of risk that would result in that area. As the work is continually being updated and improved it is important that the user refer to the official version of the tables of drinking water threats to confirm the results from the threats tool. This tool can be accessed from the web page http://www.sourcewaterprotection.on.ca/threats.

Table A10-1-WA-10 Circumstance which would result in a threat by prescribed activity in a WHPA-A with a vulnerability score of 10	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	**Yes**	**Yes**	**Yes**	No	Yes	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	**Yes**	**Yes**	**Yes**	**Yes**	Yes	No
3. The application of agricultural source material to land.	**Yes**	**Yes**	**Yes**	No	No	No
4. The storage of agricultural source material.	**Yes**	**Yes**	**Yes**	No	No	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	**Yes**	**Yes**	**Yes**	**Yes**	No	No
7. The handling and storage of non-agricultural source material.	**Yes**	**Yes**	**Yes**	**Yes**	No	No
8. The application of commercial fertilizer to land.	**Yes**	n/a	**Yes**	n/a	No	n/a
9. The handling and storage of commercial fertilizer.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
10. The application of pesticide to land.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
12. The application of road salt.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
13. The handling and storage of road salt.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
14. The storage of snow.	**Yes**	n/a	**Yes**	n/a	No	n/a
15. The handling and storage of fuel.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	**Yes**	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	**Yes**	**Yes**	**Yes**	No	No	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Table A10-1-WB-6 Circumstance which would result in a threat by prescribed activity in a WHPA-B with a vulnerability score of 6	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	**Yes**	No	Yes	Yes
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	**Yes**	No	Yes	Yes
3. The application of agricultural source material to land.	No	No	No	No	Yes	Yes
4. The storage of agricultural source material.	No	No	No	No	Yes	Yes
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	No	No	No	No	Yes	Yes
7. The handling and storage of non-agricultural source material.	No	No	No	No	Yes	Yes
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	**Yes**	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	**Yes**	n/a
10. The application of pesticide to land.	No	n/a	No	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	**Yes**	n/a
12. The application of road salt.	No	n/a	No	n/a	**Yes**	n/a
13. The handling and storage of road salt.	No	n/a	No	n/a	**Yes**	n/a
14. The storage of snow.	No	n/a	No	n/a	**Yes**	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	**Yes**	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	No	**Yes**	**Yes**

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Table A10-1-WB-8 Circumstance which would result in a threat by prescribed activity in a WHPA-B with a vulnerability score of 8	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	**Yes**	No	**Yes**	**Yes**	Yes	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	**Yes**	No	**Yes**	**Yes**	Yes	Yes
3. The application of agricultural source material to land.	No	No	**Yes**	**Yes**	Yes	No
4. The storage of agricultural source material.	No	No	**Yes**	**Yes**	Yes	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	No	No	**Yes**	**Yes**	Yes	Yes
7. The handling and storage of non-agricultural source material.	No	No	**Yes**	**Yes**	Yes	Yes
8. The application of commercial fertilizer to land.	No	n/a	**Yes**	n/a	**Yes**	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	**Yes**	n/a	**Yes**	n/a
10. The application of pesticide to land.	No	n/a	**Yes**	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	No	n/a	**Yes**	n/a	**Yes**	n/a
12. The application of road salt.	No	n/a	**Yes**	n/a	**Yes**	n/a
13. The handling and storage of road salt.	No	n/a	**Yes**	n/a	**Yes**	n/a
14. The storage of snow.	No	n/a	**Yes**	n/a	**Yes**	n/a
15. The handling and storage of fuel.	No	n/a	**Yes**	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	**Yes**	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	No	n/a	**Yes**	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	**Yes**	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	**Yes**	**Yes**	**Yes**	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the UTRSPA.

Table A10-1-WB-10 Circumstance which would result in a threat by prescribed activity in a WHPA-B with a vulnerability score of 10	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	**Yes**	**Yes**	**Yes**	No	Yes	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	**Yes**	**Yes**	**Yes**	**Yes**	Yes	No
3. The application of agricultural source material to land.	**Yes**	**Yes**	**Yes**	No	No	No
4. The storage of agricultural source material.	**Yes**	**Yes**	**Yes**	No	No	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	**Yes**	**Yes**	**Yes**	**Yes**	No	No
7. The handling and storage of non-agricultural source material.	**Yes**	**Yes**	**Yes**	**Yes**	No	No
8. The application of commercial fertilizer to land.	**Yes**	n/a	**Yes**	n/a	No	n/a
9. The handling and storage of commercial fertilizer.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
10. The application of pesticide to land.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
12. The application of road salt.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
13. The handling and storage of road salt.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
14. The storage of snow.	**Yes**	n/a	**Yes**	n/a	No	n/a
15. The handling and storage of fuel.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	**Yes**	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	**Yes**	n/a	**Yes**	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	**Yes**	**Yes**	**Yes**	No	No	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the UTRSPA.

Table A10-1-WC-2 Circumstance which would result in a threat by prescribed activity in a WHPA-C with a vulnerability score of 2	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	No	No	No	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	No	No	No	No
3. The application of agricultural source material to land.	No	No	No	No	No	No
4. The storage of agricultural source material.	No	No	No	No	No	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	No	No	No	No	No	No
7. The handling and storage of non-agricultural source material.	No	No	No	No	No	No
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	No	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	No	n/a
10. The application of pesticide to land.	No	n/a	No	n/a	No	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	No	n/a
12. The application of road salt.	No	n/a	No	n/a	No	n/a
13. The handling and storage of road salt.	No	n/a	No	n/a	No	n/a
14. The storage of snow.	No	n/a	No	n/a	No	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	No	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	**Yes**	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	No	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	No	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	No	No	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Table A10-1-WC-4 Circumstance which would result in a threat by prescribed activity in a WHPA-C with a vulnerability score of 4	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	No	No	No	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	No	No	No	No
3. The application of agricultural source material to land.	No	No	No	No	No	No
4. The storage of agricultural source material.	No	No	No	No	No	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	No	No	No	No	No	No
7. The handling and storage of non-agricultural source material.	No	No	No	No	No	No
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	No	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	No	n/a
10. The application of pesticide to land.	No	n/a	No	n/a	No	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	No	n/a
12. The application of road salt.	No	n/a	No	n/a	No	n/a
13. The handling and storage of road salt.	No	n/a	No	n/a	No	n/a
14. The storage of snow.	No	n/a	No	n/a	No	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	No	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	**Yes**	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	No	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	No	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	No	No	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Table A10-1-WC-6 Circumstance which would result in a threat by prescribed activity in a WHPA-C with a vulnerability score of 6	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	**Yes**	No	Yes	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	**Yes**	No	Yes	No
3. The application of agricultural source material to land.	No	No	No	No	Yes	No
4. The storage of agricultural source material.	No	No	No	No	Yes	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	No	No	No	No	Yes	No
7. The handling and storage of non-agricultural source material.	No	No	No	No	Yes	No
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	**Yes**	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	**Yes**	n/a
10. The application of pesticide to land.	No	n/a	No	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	**Yes**	n/a
12. The application of road salt.	No	n/a	No	n/a	**Yes**	n/a
13. The handling and storage of road salt.	No	n/a	No	n/a	**Yes**	n/a
14. The storage of snow.	No	n/a	No	n/a	**Yes**	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	**Yes**	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	No	**Yes**	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the UTRSPA.

Table A10-1-WC-8 Circumstance which would result in a threat by prescribed activity in a WHPA-C with a vulnerability score of 8	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	**Yes**	No	**Yes**	No	Yes	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	**Yes**	No	**Yes**	No	Yes	No
3. The application of agricultural source material to land.	No	No	**Yes**	No	Yes	No
4. The storage of agricultural source material.	No	No	**Yes**	No	Yes	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	No	No	**Yes**	No	Yes	No
7. The handling and storage of non-agricultural source material.	No	No	**Yes**	No	Yes	No
8. The application of commercial fertilizer to land.	No	n/a	**Yes**	n/a	**Yes**	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	**Yes**	n/a	**Yes**	n/a
10. The application of pesticide to land.	No	n/a	**Yes**	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	No	n/a	**Yes**	n/a	**Yes**	n/a
12. The application of road salt.	No	n/a	**Yes**	n/a	**Yes**	n/a
13. The handling and storage of road salt.	No	n/a	**Yes**	n/a	**Yes**	n/a
14. The storage of snow.	No	n/a	**Yes**	n/a	**Yes**	n/a
15. The handling and storage of fuel.	No	n/a	**Yes**	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	**Yes**	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	No	n/a	**Yes**	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	**Yes**	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	**Yes**	**Yes**	**Yes**	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the UTRSPA.

Table A10-1-WD-2 Circumstance which would result in a threat by prescribed activity in a WHPA-D with a vulnerability score of 2	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	No	No	No	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	No	No	No	No
3. The application of agricultural source material to land.	No	No	No	No	No	No
4. The storage of agricultural source material.	No	No	No	No	No	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	No	No	No	No	No	No
7. The handling and storage of non-agricultural source material.	No	No	No	No	No	No
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	No	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	No	n/a
10. The application of pesticide to land.	No	n/a	No	n/a	No	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	No	n/a
12. The application of road salt.	No	n/a	No	n/a	No	n/a
13. The handling and storage of road salt.	No	n/a	No	n/a	No	n/a
14. The storage of snow.	No	n/a	No	n/a	No	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	No	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	No	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	No	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	No	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	No	No	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Table A10-1-WD-4 Circumstance which would result in a threat by prescribed activity in a WHPA-D with a vulnerability score of 4	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	No	No	No	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	No	No	No	No
3. The application of agricultural source material to land.	No	No	No	No	No	No
4. The storage of agricultural source material.	No	No	No	No	No	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	No	No	No	No	No	No
7. The handling and storage of non-agricultural source material.	No	No	No	No	No	No
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	No	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	No	n/a
10. The application of pesticide to land.	No	n/a	No	n/a	No	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	No	n/a
12. The application of road salt.	No	n/a	No	n/a	No	n/a
13. The handling and storage of road salt.	No	n/a	No	n/a	No	n/a
14. The storage of snow.	No	n/a	No	n/a	No	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	No	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	No	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	No	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	No	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	No	No	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the UTRSPA.

Table A10-1-WD-6 Circumstance which would result in a threat by prescribed activity in a WHPA-D with a vulnerability score of 6	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	**Yes**	No	Yes	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	**Yes**	No	Yes	No
3. The application of agricultural source material to land.	No	No	No	No	Yes	No
4. The storage of agricultural source material.	No	No	No	No	Yes	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	No	No	No	No	Yes	No
7. The handling and storage of non-agricultural source material.	No	No	No	No	Yes	No
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	**Yes**	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	**Yes**	n/a
10. The application of pesticide to land.	No	n/a	No	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	**Yes**	n/a
12. The application of road salt.	No	n/a	No	n/a	**Yes**	n/a
13. The handling and storage of road salt.	No	n/a	No	n/a	**Yes**	n/a
14. The storage of snow.	No	n/a	No	n/a	**Yes**	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	No	n/a	**Yes**	n/a	**Yes**	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	No	**Yes**	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the UTRSPA.

Table A10-1-HV-6 Circumstance which would result in a threat by prescribed activity in a HVA with a vulnerability score of 6	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	**Yes**	No	Yes	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	**Yes**	No	Yes	No
3. The application of agricultural source material to land.	No	No	No	No	Yes	No
4. The storage of agricultural source material.	No	No	No	No	Yes	No
5. The management of agricultural source material.	n/a	No	n/a	No	n/a	No
6. The application of non-agricultural source material to land.	No	No	No	No	Yes	No
7. The handling and storage of non-agricultural source material.	No	No	No	No	Yes	No
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	**Yes**	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	**Yes**	n/a
10. The application of pesticide to land.	No	n/a	No	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	**Yes**	n/a
12. The application of road salt.	No	n/a	No	n/a	**Yes**	n/a
13. The handling and storage of road salt.	No	n/a	No	n/a	**Yes**	n/a
14. The storage of snow.	No	n/a	No	n/a	**Yes**	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	No	n/a	**Yes**	n/a	**Yes**	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	No	**Yes**	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Table A10-1-SG-2 Circumstance which would result in a threat by prescribed activity in a SGRA with a vulnerability score of 2	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	No	No	No	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	No	No	No	No
3. The application of agricultural source material to land.	No	No	No	No	No	No
4. The storage of agricultural source material.	No	No	No	No	No	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	No	No	No	No	No	No
7. The handling and storage of non-agricultural source material.	No	No	No	No	No	No
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	No	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	No	n/a
10. The application of pesticide to land.	No	n/a	No	n/a	No	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	No	n/a
12. The application of road salt.	No	n/a	No	n/a	No	n/a
13. The handling and storage of road salt.	No	n/a	No	n/a	No	n/a
14. The storage of snow.	No	n/a	No	n/a	No	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	No	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	No	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	No	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	No	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	No	No	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Table A10-1-SG-4 Circumstance which would result in a threat by prescribed activity in a SGRA with a vulnerability score of 4	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	No	No	No	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	No	No	No	No
3. The application of agricultural source material to land.	No	No	No	No	No	No
4. The storage of agricultural source material.	No	No	No	No	No	No
5. The management of agricultural source material.	No	No	No	No	No	No
6. The application of non-agricultural source material to land.	No	No	No	No	No	No
7. The handling and storage of non-agricultural source material.	No	No	No	No	No	No
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	No	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	No	n/a
10. The application of pesticide to land.	No	n/a	No	n/a	No	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	No	n/a
12. The application of road salt.	No	n/a	No	n/a	No	n/a
13. The handling and storage of road salt.	No	n/a	No	n/a	No	n/a
14. The storage of snow.	No	n/a	No	n/a	No	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	No	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	No	n/a	No	n/a	No	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	No	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	No	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	No	No	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Table A10-1-SG-6 Circumstance which would result in a threat by prescribed activity in a SGRA with a vulnerability score of 6	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	**Yes**	No	Yes	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	**Yes**	No	Yes	No
3. The application of agricultural source material to land.	No	No	No	No	Yes	No
4. The storage of agricultural source material.	No	No	No	No	Yes	No
5. The management of agricultural source material.	n/a	No	n/a	No	n/a	No
6. The application of non-agricultural source material to land.	No	No	No	No	Yes	No
7. The handling and storage of non-agricultural source material.	No	No	No	No	Yes	No
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	**Yes**	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	**Yes**	n/a
10. The application of pesticide to land.	No	n/a	No	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	**Yes**	n/a
12. The application of road salt.	No	n/a	No	n/a	**Yes**	n/a
13. The handling and storage of road salt.	No	n/a	No	n/a	**Yes**	n/a
14. The storage of snow.	No	n/a	No	n/a	**Yes**	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	No	n/a	**Yes**	n/a	**Yes**	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	No	**Yes**	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Table A10-1-WE-6.3 Circumstance which would result in a threat by prescribed activity in a WHPA-E with a vulnerability score of 6.3	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	No	**Yes**	Yes	Yes
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	**Yes**	**Yes**	Yes	Yes
3. The application of agricultural source material to land.	No	No	No	**Yes**	Yes	No
4. The storage of agricultural source material.	No	No	No	**Yes**	Yes	Yes
5. The management of agricultural source material.	n/a	n/a	n/a	n/a	n/a	n/a
6. The application of non-agricultural source material to land.	No	No	No	**Yes**	Yes	Yes
7. The handling and storage of non-agricultural source material.	No	No	No	**Yes**	No	Yes
8. The application of commercial fertilizer to land.	No	n/a	No	n/a	**Yes**	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	No	n/a	**Yes**	n/a
10. The application of pesticide to land.	No	n/a	**Yes**	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	No	n/a	No	n/a	**Yes**	n/a
12. The application of road salt.	No	n/a	No	n/a	**Yes**	n/a
13. The handling and storage of road salt.	n/a	n/a	n/a	n/a	n/a	n/a
14. The storage of snow.	No	n/a	No	n/a	**Yes**	n/a
15. The handling and storage of fuel.	No	n/a	No	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	No	n/a	No	n/a	**Yes**	n/a
17. The handling and storage of an organic solvent.	No	n/a	No	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	No	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	No	**Yes**	**Yes**	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Table A10-1-WE-7.0 Circumstance which would result in a threat by prescribed activity in a WHPA-E with a vulnerability score of 7	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	**Yes**	**Yes**	Yes	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No	No	**Yes**	**Yes**	Yes	Yes
3. The application of agricultural source material to land.	No	No	**Yes**	**Yes**	Yes	No
4. The storage of agricultural source material.	No	No	**Yes**	**Yes**	No	Yes
5. The management of agricultural source material.	n/a	n/a	n/a	n/a	n/a	n/a
6. The application of non-agricultural source material to land.	No	No	**Yes**	**Yes**	Yes	Yes
7. The handling and storage of non-agricultural source material.	No	No	**Yes**	**Yes**	Yes	Yes
8. The application of commercial fertilizer to land.	No	n/a	**Yes**	n/a	**Yes**	n/a
9. The handling and storage of commercial fertilizer.	n/a	n/a	n/a	n/a	n/a	n/a
10. The application of pesticide to land.	No	n/a	**Yes**	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	No	n/a	**Yes**	n/a	**Yes**	n/a
12. The application of road salt.	No	n/a	**Yes**	n/a	**Yes**	n/a
13. The handling and storage of road salt.	n/a	n/a	n/a	n/a	n/a	n/a
14. The storage of snow.	No	n/a	**Yes**	n/a	**Yes**	n/a
15. The handling and storage of fuel.	No	n/a	**Yes**	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	No	n/a	**Yes**	n/a	**Yes**	n/a
17. The handling and storage of an organic solvent.	No	n/a	**Yes**	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	**Yes**	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	**Yes**	**Yes**	**Yes**	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Table A10-1-WE-7.2 Circumstance which would result in a threat by prescribed activity in a WHPA-E with a vulnerability score of 7.2	*Threat level dependant on circumstances related to the activity*					
Prescribed Drinking Water Threat (Activity)	**Significant**		**Moderate**		**Low**	
	Chemical	**Pathogen**	**Chemical**	**Pathogen**	**Chemical**	**Pathogen**
1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	No	No	**Yes**	**Yes**	Yes	No
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	No		**Yes**	**Yes**	Yes	Yes
3. The application of agricultural source material to land.	No	No	**Yes**	**Yes**	Yes	No
4. The storage of agricultural source material.	No	No	**Yes**	**Yes**	Yes	Yes
5. The management of agricultural source material.	n/a	No	n/a	No	n/a	Yes
6. The application of non-agricultural source material to land.	No	No	**Yes**	**Yes**	Yes	Yes
7. The handling and storage of non-agricultural source material.	No	No	**Yes**	**Yes**	Yes	Yes
8. The application of commercial fertilizer to land.	No	n/a	**Yes**	n/a	**Yes**	n/a
9. The handling and storage of commercial fertilizer.	No	n/a	**Yes**	n/a	**Yes**	n/a
10. The application of pesticide to land.	No	n/a	**Yes**	n/a	**Yes**	n/a
11. The handling and storage of pesticide.	No	n/a	**Yes**	n/a	**Yes**	n/a
12. The application of road salt.	No	n/a	**Yes**	n/a	**Yes**	n/a
13. The handling and storage of road salt.	n/a	n/a	n/a	n/a	n/a	n/a
14. The storage of snow.	No	n/a	**Yes**	n/a	**Yes**	n/a
15. The handling and storage of fuel.	No	n/a	**Yes**	n/a	**Yes**	n/a
16. The handling and storage of a dense non-aqueous phase liquid.	No	n/a	**Yes**	n/a	**Yes**	n/a
17. The handling and storage of an organic solvent.	No	n/a	**Yes**	n/a	**Yes**	n/a
18. The management of runoff that contains chemicals used in the de-icing of aircraft.	No	n/a	**Yes**	n/a	**Yes**	n/a
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	n/a	n/a	n/a	n/a	n/a	n/a
20. An activity that reduces the recharge of an aquifer.	n/a	n/a	n/a	n/a	n/a	n/a
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	No	No	**Yes**	**Yes**	**Yes**	No

Notes:
- n/a means that the combination of zone and activity is not applicable. In the case of activities 19 and 20 which pertain to water quantity threats, these will only be identified in a WHPA-Q1 or Q2, through a Tier 3 Water Budget. Current information indicates that there are none of these identified in the LTVSPA.

Appendix 11- Glossary of Terms and Acronyms

Glossary of Terms and Acronyms has been replaced by one included with the Source Protection Plan

Appendix 12 – References

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Appendix 13 – Uncertainty Analysis of Vulnerability Assessment

A13-Uncertainty Analysis of Vulnerability Assessment

Based on the Technical Rules, the uncertainty assessment of WHPA is to include:

- an evaluation of the uncertainty associated with the assessment of the vulnerability of groundwater within the area of interest (low, medium, high vulnerability),
- an evaluation of the uncertainty associated with the delineation of the WHPA and
- an assignment of an uncertainty rating (high or low) for each vulnerable area.

The *technical rules* also state that an analysis of the uncertainty, characterized by 'high' or 'low', shall be made with respect to the delineation and assessment of *wellhead protection areas*. The factors to be considered in the analysis include:

- the distribution, variability, quality and relevance of data used;
- the ability of the methods and models used to accurately reflect the flow processes in the hydrological / hydrogeological system;
- the quality assurance and quality control procedures applied;
- the extent and level of calibration of models
- the accuracy of the groundwater vulnerability categories to effectively assess the relative vulnerability of underlying hydrogeological features.

The evaluation of uncertainty is a very subjective process and varied between studies. The key considerations of the evaluation in each study are discussed below by topic area and study. This includes the uncertainty in the delineation of the WHPA, the assessment of the vulnerability in the WHPA and the consideration of transport pathways. For uncertainty in vulnerability scoring for *WHPA-E* associated with *GUDI* wells, the accuracy to which the area vulnerability factor and the source vulnerability factor effectively assesses the relative vulnerability of the hydrological features must also be considered. The uncertainty associated with the delineation of HVA and SGRA are also considered in this appendix and summarized in the appropriate subsection of Section 4.0 of the Assessment Report.

1.1 WHPA Uncertainty

1.1.1. Uncertainty in the Delineation of WHPA-A to D

The uncertainty in the delineation of the Wellhead Protection Areas (WHPA) is evaluated in each study. This is discussed by study in the following sections in many cases by direct quotations from the studies.

1.1.1.1. London, Middlesex Centre & Thames Centre (Birr, Dorchester, London - Fanshawe and Hyde Park back up wells, Melrose and Thorndale) WHPA-A to D

As summarized in Source Protection Study, London, Middlesex Centre & Thames Centre Wellfield Source Protection Study Vulnerability Assessment Report Final Draft Report (October 16, 2009):

> "The delineation of the *wellhead protection areas* comprises a number of assumptions and estimates based on point data such as lithology described in water well records and hydrogeological information provided from technical reports. Each model was developed making the most use of the available data, and therefore the results represent the best estimate that can be made based on that data. Improvements in the models can be made based on any additional information that becomes available in the future. Even with this uncertainty, the wellhead delineation process provides a good indication of the source of the water for the water supply system, which can facilitate a good water resource protection policy.
>
> Overall, significant data gaps are identified if observed. These gaps include information on groundwater recharge values and the heterogeneity in the hydraulic conductivity of the aquifer and aquitard. In addition, better information on the hydraulic levels in the aquifer in the local/regional area would be beneficial, and could be used to improve the

model. Should future pumping rates differ than those used in the model, then a reassessment of the modeled capture zones should be performed.

Groundwater recharge values used in the model greatly control the width of the modelled capture zone. This value is often used to calibrate the model, and is not measured directly. The uncertainty associated with this factor is considered high.

The static water levels recorded in the water well records are notably erratic in nature. Improvement to the model would involve installation of several monitoring wells in key areas and additional hydrogeological studies (including pumping test).

For many of the systems there are no observation wells. When available hydraulic head levels used during model calibration were taken from water levels at different times of the year and over several decades, a more recent and comprehensive survey of hydraulic head levels would provide for a more accurate calibration in all areas. The hydraulic head levels used for calibration, while useful for comparison, could be offset by as much as 2 to 3 m due to seasonal fluctuation or other influences. Nevertheless, it is not expected that the variation would cause significant changes in the interpreted direction of the capture zones. As a result, the uncertainty associated with this factor is considered low.

The heterogeneity of overburden aquifer hydraulic conductivity could only be evaluated at a cursory level. Since hydraulic conductivity and other parameters can vary by as much as two orders of magnitude within the same hydraulic unit, it is likely that significant variation exists within these systems. This heterogeneity could not be completely identified based on the data available for the development of the model. Uncertainty associated with this factor is considered high.

For shallow overburden systems (e.g. Dorchester), the *WHPA* -B, and *WHPA* -C receive a low uncertainty. The rationale for this decision is that the hydrogeology of the overburden aquifer is not complex (shallow relatively homogeneous unconfined aquifer,

with good quality calibration wells). A high uncertainty is given to *WHPA* -D in the overburden aquifer as the uncertainty of the model is higher at large travel times.

The most significant limitations for the confined overburden groundwater flow models are the assumption that the aquifer is continuous over the entire model area. Confined overburden aquifers are known to be discontinuous and coincide with the depositional environment that occurred during interstadial periods in which the aquifers were formed. However, considering the limited extent of the 25-year time of travel area and the correlation of the intermediate aquifer at other wells in an area, the uncertainty associated with this factor is considered low.

For bedrock aquifers the delineation of the *wellhead protection areas* comprise a number of assumptions and estimates based on point data such as lithology described in water well records and hydrogeological information provided from technical reports. The most significant limitations for bedrock groundwater flow model are that there is little information on the geology of the area and few monitoring wells to calibrate the model.

As a result of these factors, there is significant uncertainty associated with the modelled capture zones. Even with this uncertainty, the wellhead delineation process provides a good indication of the source of the water for the water supply system, which can facilitate a good water resource protection policy."

1.1.1.2. Oxford WHPA-A to D

The uncertainty of WHPA delineation is **high** for almost all wellfields of the Oxford systems (Beachville, Embro, Hickson, Ingersoll, Innerkip, Lakeside, Mount Elgin, Tavistock, Thamesford and Woodstock-urban wellfield). The exception is the rural wells of the Woodstock system (Thornton and Tabor overburden wells), which are assigned a **low** uncertainty in delineation. According to the County of Oxford Source Protection Technical Studies Report ‘Groundwater Vulnerability Assessment for the Wellhead Protection Areas in the County of Oxford’ (April 2011), there is uncertainty in the effective porosity used in the capture zone time-of-travel

delineation for the bedrock production wells. The fractured bedrock aquifer flow system was simplified into an equivalent porous media system (a common groundwater modeling approach), resulting in uncertainty in properties of the bedrock, such as hydraulic conductivity. These limitations apply to the systems of Beachville, Embro, Hickson, Ingersoll, Innerkip, Lakeside, Mount Elgin, which are comprised of only bedrock wells, and to the bedrock wells of the Tavistock, Thamesford and Woodstock systems. For the Thamesford overburden wells, uncertainty stems from local variability in hydraulic conductivity values estimated from pump tests in the vicinity of the wells. For the Tavistock overburden well, the capture zone was developed using a low pumping rate, and is relatively long and narrow, leading to a higher uncertainty in the WHPA delineation. There is a lower uncertainty associated with the Woodstock rural overburden supply wells (Thornton, Tabor and the planned well) as they have been studied in detail (outside of the source protection program) and there is considerable data available on the hydrogeology, both locally and regionally.

1.1.1.3. Perth WHPA-A to D

The vulnerability assessment and the WHPA (time of travel) delineation are based on a number of parameters, each of which contributes to the overall uncertainty. For all groundwater systems, there is a high uncertainty associated with hydraulic head levels, groundwater recharge, and the nature of aquifer. Groundwater head levels are taken from the WWIS which are recorded at different times of the year and over several decades. Furthermore, sub-surface properties can only be measured where boreholes exist. The resulting uncertainty is not simply the sum of the uncertainties of all the individual parameters. Some parameters are more influential and have a greater affect on the uncertainty. For example doubling the pump rate influences the shape of WHPA capture zone more than a doubling of conductivity of the aquifer. Fractured bedrock aquifers of Stratford and St. Marys were modeled with higher hydraulic conductivity values. All capture zones in fractured bedrock are therefore considered to have high uncertainty.

Groundwater recharge values are estimated and not measured directly. The nature of the aquifer matrix and its ability to transmit water through the aquifers and the resultant hydraulic

conductivity could not be confidently estimated based on the data available (pump test data). A significant limitation for the groundwater flow models is the assumption that an aquifer is continuous over the entire model area. The geology which controls the aquifer geometry is very rarely laterally continuous or of uniform thickness over broad areas of the landscape. However, the extent of the 25-year time of travel area is limited and, the uncertainty associated with this factor is therefore considered low. Probably, the most significant limitation for a groundwater flow model is the unpredictable/ unknown nature of the regional groundwater flow direction at the site of the municipal well which controls the direction of the WHPA. In general the models have undergone sensitivity analysis and through the various studies, been peer reviewed and at this time, although there is uncertainty, the best available science has been employed and the uncertainty is adequate for source protection purposes.

1.1.2. Uncertainty associated with Vulnerability Assessment (WHPA-A to D)

The groundwater vulnerability assessment was based on the Intrinsic Susceptibility Index (ISI) methodology in Perth and Middlesex. Overall, the uncertainty associated with the groundwater vulnerability map is deemed low, as there appears to be a consistent regional trend in the ISI results. However, uncertainty associated with the vulnerability assessment of the individual system using *ISI* varies between high and low.

From the Perth study, the groundwater vulnerability assessment of Stratford, Shakespeare and St. Pauls WHPA are assigned low uncertainty levels, due to the low vulnerability within the flow model domain. High uncertainty levels are assigned to the groundwater vulnerability assessment of Mitchell (due to the presence of a sand lens), Sebringville (due to the uncertainty in the permeability of the overburden layer), and St. Marys (due to low spatial density of wells and the high spatial variation of the overburden thickness).

From the London-Middlesex study, a low uncertainty is assigned to Fanshawe (City of London back up wellfield), Birr, Thorndale and Dorchester. There is high uncertainty in the groundwater vulnerability assessment of Hyde Park and Melrose due to the presence of few wells in the capture zones.

The groundwater vulnerability within the County of Oxford has been assessed in previous studies using three methodologies (AVI, ISI and SWAT). Excerpts surrounding the discussion from the County of Oxford Source Protection Technical Studies Report 'Groundwater Vulnerability Assessment for the Wellhead Protection Areas in the County of Oxford' (April 2011) are included below. Note that the ISI results from an earlier study (referred to below) were not used; instead the AVI results were used as they were found to provide a more realistic representation of the aquifer examined.

> "The intrinsic groundwater vulnerability within the County of Oxford has been assessed using three methodologies (AVI, ISI, SWAT). The resulting map products were reviewed as part of this groundwater vulnerability assessment, and some minor adjustments were made by a hydrogeologist based on professional judgment. The adjustments included infilling of apparent gaps within the vulnerability mapping of the WHPA, smoothing of contacts, and removal of relatively small anomalies that were not clearly supported by the available hydrogeological information. As with most of the regional scale hydrogeological work in the Province of Ontario, there is a heavy reliance on information from the water well record database maintained by the Ministry of the Environment, and this would typically involve a high level of uncertainty. However, the previous work (Golder 2001, 2003, 2005) included an in-depth review of many of the water well records and the incorporation of other sources of information, such as the surficial (Quaternary) geological mapping, in the vulnerability mapping. In a general sense, the intrinsic vulnerability mapping (SWAT, AVI) procedures used in the groundwater vulnerability assessment have a **low** uncertainty" with the exceptions of Innerkip and Tavistock. At Innerkip, "The AVI mapping appears irregular and difficult to confirm in the vicinity of the WHPA". For Tavistock, "Uncertainty in the bedrock characterization is **high**", and "There are significant gaps and variability in the AVI for the overburden aquifer".

1.2 Uncertainty associated with Transport Pathways (WHPA-A to D)

Some uncertainty is associated with the approach to the mapping of transport pathway information for all well systems. Since information on the presence or absence of *transport pathways* did not involve confirmatory site visits and visual inspection alone would not be

conclusive as to whether a transport pathway exists, the actual presence of the identified *transport pathways* is unknown. Therefore, the mapped extent of the area where these *transport pathways* exist is deemed conservative. Throughout all of the studies, the features of concern would be poorly maintained water wells or oil and gas wells and many of these locations are unknown. Where vulnerability has been adjusted based on an area of increased density of potential transport pathways the location of the individual pathways is less of a concern and therefore the uncertainty associated with adjusting the vulnerability of the area is limited as to whether the potential pathways are poorly constructed or maintained. As this methodology is applied to an area rather than to individual features the number of features which are potentially transport pathways further reduces the uncertainty.

1.3 Overall WHPA-A to D Uncertainty

Based on the discussion above, the uncertainty associated with the vulnerability assessment of the 22 groundwater systems *Wellhead Protection Areas* is to be identified as 'Low' or 'High', as required by the *technical rules*. The overall uncertainty is largely affected by the uncertainty associated with the *wellhead protection area* modelling rather than the aquifer vulnerability assessment for all systems or the adjustments due to transport pathways.

As discussed above, the peer reviewers have had considerable discussion about uncertainty with the consultants who have undertaken the studies for ground water vulnerability assessment. This was also consistent with the uncertainty associated with the Intake Protection Zones in the other Source Protection Areas of the region. Through that discussion it became apparent that there is considerable subjectivity to the assignment of the uncertainty factors. It has been suggested that upon completion of the peer review of all of the reports that an overall assessment and comparison of the uncertainty be undertaken so that relative comparison between studies can be made and priorities for future assessment can be identified. It is important to understand that a high uncertainty associated with any aspects of the work does not suggest that the conclusions are inappropriate for the purposes that the results are being used. This is merely an acknowledgement of the potential for a better understanding with further analysis or data. If it were identified that the uncertainty was too great, additional work

would have been undertaken to reduce the level of uncertainty if data were available to support the additional work. Even with the completion of additional work, it is unlikely that all uncertainty can be eliminated.

1.4 WHPA-E Uncertainty

For the GUDI wells at the Dorchester, Fanshawe and St. Marys wellfields, uncertainty was assigned to the WHPA-E delineation and to the vulnerability scoring as per the Dillon Consulting Ltd. study 'WHPA-E and F Delineation and Vulnerability Assessment –Dorchester, Fanshawe and St. Marys Municipal Water Supplies' (May 2011). For the GUDI wells at the Thamesford and Woodstock (rural) wellfields, uncertainty was assigned to the WHPA-E delineation and to the vulnerability scoring as per the Dillon Consulting Ltd. study 'WHPA-E Delineation and Vulnerability Assessment – Thamesford, Woodstock and Tillsonburg Municipal Water Supplies' (May 2011).

Known and reliable empirical equations were used to determine the 2-year flow estimation and hydraulic calculations for Big Swamp Drain near the Dorchester wells, and for tributaries in the St. Marys and Thamesford study areas. The cross-section characteristics were obtained from the Digital Elevation Model and confirmed during field surveys. The calibrated hydraulic HEC-RAS model used for the WHPA-E instream delineations for St. Marys (extent up the North Thames River) and Thamesford (extent up the Middle Thames River) contained sufficient detail in the vicinity of the well and the study area to provide a high confidence in the delineation. No travel time analysis was needed for the Woodstock (rural) and Fanshawe WHPA-Es. Waterbodies considered in these WHPA-Es (such as creeks and ponds) were buffered with a 120 m zone as prescribed in the Technical Rules. Therefore, the uncertainty level assigned to each of the WHPA-E delineations for Dorchester, Fanshawe, St. Marys, Thamesford and Woodstock (rural) is **low**.

The area vulnerability factors assigned to each of the WHPA-Es delineated is based on known land use data, soil types, permeability, slopes, hydrological and hydraulic conditions of the area.

All these data were available in sufficient detail and have low uncertainty. Therefore, the degree of uncertainty related to each of the area vulnerability factors for Dorchester, Fanshawe, St. Marys, Thamesford and Woodstock (rural) is **low**.

The source vulnerability factor for WHPA-E is based on known well design characteristics (depth of the well, distance to the surface water feature). Sufficient information is available to assign each source vulnerability factor with a high level of confidence. The degree of uncertainty related to the source vulnerability factor for each WHPA-E of the Dorchester, Fanshawe, St. Marys, Thamesford and Woodstock (rural) systems is **low**.

The area and source vulnerability factors are multiplied to obtain the vulnerability score for each WHPA-E delineated. Considering the low uncertainty assigned to these factors, the uncertainty of the vulnerability score assigned to each WHPA-E delineation for Dorchester, Fanshawe, St. Marys, Thamesford and Woodstock (rural) is deemed **low**.

Considering the low uncertainty in both the WHPA-E delineation and vulnerability scoring, the overall uncertainty level assigned to each WHPA-E for Dorchester, Fanshawe, St. Marys, Thamesford and Woodstock (rural) is **low**.

1.5 Highly Vulnerable Aquifers

The *Highly Vulnerable Aquifer* area mapping product is a derivative product based primarily on ISI mapping. The ISI mapping is based on assigning an index based on aquifer, confining materials and water level information identified by drillers as recorded in the Water Well Information System (WWIS). The uncertainty in the *ISI* product is considered high due to a number of factors including:

- Uncertainty associated with the location information and therefore the accuracy of the elevation used in interpreting the description of depth in the *WWIS*
- Uncertainty associated with the material description in the *WWIS*
- Uncertainty associated with water table mapping

- The interpolation process associated with this mapping (and limited data in some areas)

In conclusion, the uncertainty is high in the use of the *WWIS*. The high uncertainty associated with individual data is offset to some degree by the high amount of data included in the *WWIS*. The location and presence of sand and gravel deposits in the Surficial Geology (OGS) mapping are based on a different data set from the *WWIS*. The level of uncertainty is reduced substantially due to the agreement of the two mapping products and the incorporation of professional judgement. The impact of the uncertainty in the low and medium vulnerability areas is minimal from a Source Protection Planning perspective. There is uncertainty related to the Highly Vulnerable Areas (HVA) although the product is acceptable for the purposes of delineating the Highly Vulnerable Areas. This uncertainty is associated with the data sets available for use in this analysis and would exist irrespective of whether the other methods identified in the rules were used to delineate the Highly Vulnerable Areas. Additional work to map the extent and thickness of aquifers in the region would greatly reduce the uncertainty.

1.6 Significant Groundwater Recharge Areas

The uncertainty associated with the delineation of the SGRA is discussed in the Significant Groundwater Recharge Area technical memorandum (UTRCA, May 2010).

> "Groundwater recharge is one of the more elusive quantities to estimate at any level of water budget analysis. Recharge in the present analysis is derived from a continuous GAWSER model for each HRU/Climate zone combination within the UTRSPA. The GAWSER model relies on surficial geology mapping which is presented as a continuous surface, but clearly all areas are not sampled in the creation of the mapping, and some interpolation is used in the creation of these maps. This interpolation carries with it a degree of uncertainty. In any modelling exercise there is an attempt to calibrate the model being used with observed field data with varying degrees of success. In the case of GAWSER modelling, median monthly flows derived from the model are compared with median monthly flows with have been measured, on the long term, at key Environment Canada hydrometric stations. A further discussion of the GAWSER

calibration process is found in the SWS Tier 2 integrated model document (SWS 2010). Published stream flow values at these locations carry with them a certain degree of uncertainty, and this is discussed in detail in the TSR Tier 1 water budget report (TSR, 2010), Section 8.1.1.4.

We should keep in mind that inherent in the stream flow records are the effects of flow augmentation from upstream reservoirs (Wildwood and Pittock), as well as water added from other sources (i.e. Great Lake or groundwater) in the form of pollution control plant effluent. Further more, stream flow records are also affected by discharges from quarry dewatering operations, and also are somewhat reduced by surface water withdrawals, particularly in dry months. These numbers are accounted for in the modelling process as much as is possible, however we need to also realize that these numbers do affect the output and calculation of the recharge rates for the various HRU/climate zone combinations by GAWSER.

As the estimation of SGRAs are based upon the estimate of recharge, this also would have a degree of uncertainty associated with it."

1.7 Summary

The peer reviewers have had considerable discussion with the consultants who have undertaken the studies for both surface water and ground water vulnerability assessment in the Thames-Sydenham and Region. Through that discussion it has become apparent that there is considerable subjectivity to the assignment of the uncertainty factors. It has been suggested that upon completion of the peer review of all of the reports that an overall assessment and comparison of the uncertainty be undertaken so that relative comparison between studies can be made and priorities for future assessment can be identified. It is important to understand that a high uncertainty associated with any aspect of the work does not suggest that the conclusions are inappropriate for the purposes that the results are being used. This is merely an acknowledgement of the potential for a better understanding with further analysis or data. If it

were identified that the uncertainty was too great, additional work would have been undertaken to reduce the level of uncertainty if data were available to support the additional work. Even with the completion of additional work, it is unlikely that all uncertainty can be eliminated. The Source Protection Committee is satisfied that the uncertainty of the vulnerability assessment is low enough for the purposes intended.

Appendix 14 – MOE Communications

UTRSPA Assessment Report Approval

Ministry of the Environment

Source Protection Programs Branch

14th Floor
40 St. Clair Ave. West
Toronto ON M4V 1M2

Ministère de l'Environnement

Direction des programmes de protection des sources

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40, avenue St. Clair Ouest
Toronto (Ontario) M4V 1M2

Ontario

Log: ENV1174IT-2010-242

September 26, 2011

Mr. Robert Bedggood
Thames, Sydenham and Region
Source Protection Committee Chair
Upper Thames River CA
1424 Clarke Road
London, ON N5V 5B9

Mr. Ian Wilcox
General Manager
Upper Thames River SPA
1424 Clarke Road
London, ON N5V 5B9

Dear Mr. Bedggood and Mr. Wilcox:

Thank you for the submission of your amended proposed Assessment Report (AR) for the Upper Thames River Source Protection Area on July 14, 2011. I have completed my review of the amended proposed AR and in accordance with my authority under Section 17(3) (a) of the Clean Water Act (CWA), 2006 I hereby approve your amended proposed AR, as submitted with the additional revisions provided to the ministry on September 15, 2011.

Based on communications between the Upper Thames River Source Protection Authority (SPA) Project Manager, Chris Tasker, and the ministry on July 25, 2011, it is understood that the September 15, 2011 revisions are required to the amended proposed AR to address minor concerns raised during the consultation period that was completed after submission of the AR in July. I understand, based on information provided, that these revisions do not impact the number of Significant Drinking Water Threats (SDWTs) or the ability for persons to determine whether they are engaging in an activity that could be a potential SDWT.

I would like to remind you that the SPA is required to make the approved AR available to the public as soon as reasonably possible on the Internet and in any other manner the SPA considers appropriate. If you have not already done so, please ensure the revised pages submitted to the ministry after the resubmission of the amended proposed AR are included in the approved AR version to be posted on the Internet.

Review of the amended proposed AR also shows that there are several minor changes in the AR that could be made for the purposes of clarity, accuracy and transparency. These items will be provided separately to the Project Manager for the SPA by the Liaison Officer. These changes, in addition to the other changes identified by the SPA for an updated AR, could be made in a future round of planning.

...2

As per the Clean Water Act, 2006 and General Regulation, your Source Protection Plan is due to be submitted to the Minister of the Environment on August 20, 2012, the fifth anniversary of the date that the chairs of the Source Protection Committees (SPCs) were appointed.

In addition, at this time I would like to advise you that all final water quality and quantity AR data must be uploaded as follows:

- Final water quality data is to be uploaded to ARDB@CAMaps within four (4) months of the date on this letter; and
- Final water quantity data is to be uploaded to the Ministry of Natural Resources (MNR) data base within four (4) months of the date on this letter.

Thank you for your work to protect Ontario's sources of drinking water.

Sincerely,

Heather Malcolmson, Acting Director
Source Protection Programs Branch
Ministry of the Environment

cc: Joni Baechler, Chair of Board of Directors, Upper Thames River CA
Chris Tasker, Project Manager, Thames and Sydenham and Region SPA
Keith Willson, Manager, Source Protection Approvals
Katie Fairman, Manager (A), Source Protection Planning
Teresa McLellan, Liaison Officer, Source Protection Implementation
Melanie Ward, Group Leader, Source Protection Programs Branch
Charlie Worte, Conservation Ontario
Mike Garraway, Ministry of Natural Resources