



**Quinte Source Protection Region
Updated Conditions Report**

**Submitted to the Source Protection Committee
as part of the
Updated Assessment Report**

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1 Introduction

As part of the Source Water Protection program Quinte Conservation has undertaken an inventory of drinking water threats within the vulnerable areas of the Quinte Source Protection Region. These areas include the sensitive zones around four municipal wells and seven surface water intakes serving as municipal drinking water supplies to residents of the Quinte Region. Details of these systems and associated drinking water threats are as outlined in the Quinte Region Assessment Report (March 4, 2011). Drinking water threats are identified in regards to the Clean Water Act which defines a threat as:

“an activity or condition that adversely affects or has the potential to adversely affect the quality or quantity of any water that is or may be used as a source of drinking water, and includes an activity or condition that is prescribed by the regulations as a drinking water threat.”

In terms of the MOE Technical Rules (August, 2009) a threat to a drinking water source can be identified in the following ways:

- 1) Through an inventoried activity prescribed by the Clean Water Act as a Prescribed Drinking Water Threat (PDWT);
- 2) Through an activity identified by the Source Water Protection Committee as an activity that may be a threat and (in the opinion of the Director) a hazard assessment confirms that the activity is a threat;
- 3) Through an activity associated with a drinking-water issue; and
- 4) A condition resulting from a past landuse activity.

An earlier version of the Quinte Region Assessment Report (March 4, 2011) contained a listing of drinking water threats which were determined following the first method. No threats were identified by the Source Water Protection Committee through any of the latter three methods. The following has been prepared as part of an updated Assessment Report to consider a review of past landuse activities (potential conditions) at drinking water intakes in the Quinte Region. A summary of the information reviewed and process followed is provided below.

2 Methodology

To identify areas within intake protection zones of drinking water systems past activities were reviewed. These past activities were assessed to identify potential conditions that would be considered drinking water threats as defined by the Technical Rules (MOE, 2009). Such activities require an assessment of environmental condition in order to determine if the site presents an environmental concern to the drinking water intake.

The process that was followed to assess if conditions exist was as follows:

- 1) Review of available information pertaining to the location of potentially contaminated sites,
- 2) Confirm the location of the site within a vulnerable area,
- 3) Apply local knowledge about the location of potentially contaminated sites (current or past activity),
- 4) Review available records to determine if sufficient information was available to provide evidence of contamination,
- 5) Compare the evidence of contamination to the Technical Rule 126 (2009) to determine if the site can be classified as a condition,
- 6) Determine if the site represents a significant drinking water threat in reference to the MOE Technical Rules (2009).

2.1 Identifying Conditions

In reference to Part X1.3 of the Technical Rule 126 a condition may exist on a property where there is contamination resulting from past activities and if it meets one of the following:

- 1) The presence of a non-aqueous phase liquid in groundwater in a highly vulnerable aquifer, significant groundwater recharge area, or wellhead protection area,
- 2) The presence of a single mass of more than 100 litres of one or more dense non-aqueous phase liquids in surface water in a surface water intake protection zone,
- 3) The presence of a contaminant in groundwater in a highly vulnerable aquifer, significant groundwater recharge area, or a wellhead protection area, if the contaminant is listed in Table 2 of the Soil, Ground Water and Sediment Standards and is present at a concentration that exceeds the potable groundwater standard set out for the contaminant in that Table,
- 4) The presence of a contaminant in surface soil in a surface water intake protection zone if, the contaminant is listed in Table 4 of the Soil, Groundwater and Sediment Standards is present at a concentration that exceeds the surface soil standard for industrial/commercial/community property use set out for the contaminant in that Table,
- 5) The presence of a contaminant in sediment, if the contaminant is listed in Table 1 of the Soil, Groundwater and Sediment Standards and is present

at a concentration that exceeds the sediment standard set out for the contaminant in that Table.

In order for a condition to be identified, documented proof of one of the above must be met. Following this the condition is ranked as significant, moderate or low through the determination of a risk score as outlined below.

2.2 Risk Score

Following the identification of a property with a condition the potential threat to drinking water was identified as significant, moderate, or low in accordance with the Technical Rules (2009). This entails determination of a risk score as follows:

$$\text{Risk Score} = A \times B$$

Where:

A = the hazard rating of the condition,

B = the vulnerability score of the vulnerable area (as outlined in the relevant section of the assessment report),

The hazard rating is determined as outlined in the Technical Rules based on either a score of 10 or 6. A score of 10 is assigned where there is evidence of off site contamination or the condition is associated with the property of a drinking water system, or a score of 6 if neither applies. The threat level is then assigned as significant, moderate, or low in accordance with Table 1.

Table 1: Risk Score and Drinking Water Threat Category

Drinking Water Threat Level	Risk Score
Significant	Equal to or greater than 80
Moderate	Equal to or greater than 60 and less than 80
Low	Greater than 40 and less than 60

3 Contaminant Inventory Review

To provide information about the location of historic contaminated sites a review was completed of the contaminant inventory provided in the Quinte Regional Groundwater Study (Dillon, 2004) and the Bay of Quinte Remedial Action Plan Inventory of Contaminated Sites (February, 2004). The Regional Groundwater Study provided a summary of a review of records about potentially contaminated sites such as certificate of approvals, provincial, and municipal records for fuel storage, waste disposal sites and waste generators. The Bay of Quinte study also focused on a review of provincial databases to identify sources of potential contamination within the watershed.

3.1 Contaminant Inventory Results

From the review seven potentially contaminated sites in five of the designated vulnerable areas were identified as listed in Table 2.

Table 2: Potential Conditions Associated with a Municipal Drinking Water System

System	Site #	Zone	Contaminant
Madoc	1	WHPA A	Commercial Property
Tweed	2	WHPA D	Closed Landfill
Wellington	3	IPZ 2	Closed Landfill
Deseronto	4	IPZ 3a	Closed Landfill
Picton	5	IPZ 3a	Waste Transfer Station
Picton	6	IPZ 2	Closed Landfill
Belleville	7	IPZ 1	Industry
Belleville	8	IPZ 1	Closed Landfill

WHPA means Wellhead Protection Area

IPZ means Intake Protection Zone

Following identification of these sites an initial assessment of available information was completed to determine if the site meets Technical Rule 126. Further review was completed of each site to identify if documented evidence of contamination was available to establish that a condition exists. A summary of this review for each of the potential conditions is provided below.

3.2 Site 1 in the Village of Madoc

Local knowledge of landuse in the Madoc area resulted in the identification of a site requiring review. This site was situated next to the Rollins St. well in the Wellhead Protection Zone A. From available information it was indicated that there was potential for contamination of this site from fuel storage as well as vehicle and equipment repair (Ministry of the Environment correspondence,

August 8, 1980). It was also reported that the Ministry provided funding to the municipality to assist in the purchase of the property. Again, no records were available to confirm the presence of contamination. Further review of records did not provide proof of groundwater contamination.

Although contamination of groundwater in the Madoc area by hydrocarbons does exist (Historic municipal correspondence and water supply evaluations provided through internal Ministry of the Environment correspondence) there is no direct linkage to this site. This site does not have sufficient documentation to meet the definition of a concern.

3.3 Site 2 in the Village of Tweed

A closed landfill site within the Village of Tweed Wellhead Protection Area D was investigated and all available records were obtained. The Certificate of Approval for this site, as included in Appendix A, indicated the site was used for the disposal of wood waste from a planing and sawmill located in the Village of Tweed. The records indicated that this activity occurred during the 1970s and entailed the filling of a wetland area with sawdust, slab wood and scrap wood. Such activity can result in the contamination of groundwater by such things as Phenols, Tannins and Lignins, biological oxygen demand, Total Kjeldahl Nitrogen, Organic Nitrogen, Nitrates and Total Phosphorus. From our review of records and discussion with neighbouring residents there was no onsite testing done in this regard. As a result insufficient information exists to identify this property as a condition. It is recommended that groundwater quality testing be undertaken at this site to establish the impact the former landfill may be having on the aquifer.

3.4 Site 3 in the Village of Wellington

A historic landfill site is located within the IPZ2 for the Village of Wellington water supply system. Little history is known about this site other than it was reported to be used for domestic and construction debris and then covered with soil. In 2010 an environmental study was completed by Trow Consulting on behalf of The Corporation of the County of Prince Edward (September, 2010). During this study a total of six monitor wells were installed with samples collected and analysed for petroleum hydrocarbons, volatile organic compounds, polyaromatic hydrocarbons, PCBs and heavy metals. From the information provided it was reported that groundwater at this site flows northerly towards Lane Creek which drains to Lake Ontario within the IPZ2 for the Village of Wellington intake. Samples were collected from the monitor wells and submitted for laboratory analysis for a suite of parameters indicative of typical landfill contamination. The report concluded that landfill leachate exists in the groundwater and that there is potential for offsite impact. The results of analyses from the groundwater monitor wells, as included in Appendix B, were compared with Table 2 of the Soil, Groundwater Water and Sediment Standards for Use Under Part XV.1 of the

Environmental Protection Act Ministry of the Environment July 27, 2009. From this review the parameters as listed in Table 3 were noted as exceeding the standards. As such this site can be considered a condition.

Table 3: Parameters Identified as Meeting Technical Rule 126

Parameter	Units	Table 2 Criteria *	MW-1	MW-2	MW-3	BW-1
Metals						
Mercury	µg/L	0.29	4.4	0.7	1.9	<0.1
Polynuclear Aromatic Hydrocarbons (PAHs)						
Acenaphthylene	µg/L	1	10.7	<0.5	2.3	<0.05
Anthracene	µg/L	2.4	2.5	1.1	5.1	<0.05
Benzo(a)anthracene	µg/L	1	8	3.9	14	<0.05
Dibenzo(a,h)anthracene	µg/L	0.2	1	<1	2	<0.1
Fluoranthene	µg/L	0.41	13	6.2	26	<0.05
Phenanthrene	µg/L	1	8.7	4.9	13	0.07
Pyrene	µg/L	4.1	10	4.9	19	<0.05
Volatile Organic Compounds (VOCs)						
Benzene	µg/L	5	0.2	0.3	0.2	270
Toluene	µg/L	24	<0.2	0.3	0.2	260

*Soil, Ground Water and Sediment Standards for use Under Part XV.1 of the Environmental Protection Act, Ministry of the Environment July 27, 2009.

3.4.1 Risk Score

Based on the identification of this property as a condition the risk score was determined to assess whether this property is a significant, moderate or low condition. The risk score was calculated as follows:

$$\text{Risk Score} = 10 \times 3.5 = 35$$

Where:

- The hazard rating was assigned as 10 given the property is in the IPZ2 associated for the Village of Wellington,
- The vulnerability score of the IPZ2 was assigned as 3.5 as outlined in the Assessment Report (Quinte Conservation, March, 2011).

Given a low risk score of 35 this past landuse is not considered to be either a significant, moderate, or low drinking water threat.

3.5 Site 4 – Town of Napanee (Deseronto System)

A former landfill site is located in the Town of Napanee within the IPZ 3a for the Town of Deseronto drinking water intake. It was reported that this site was

owned and operated by the Town of Napanee from the 1950's to the early 1980's (Genivar, 2010). The site is located on a 2.4 hectare parcel of land (Part Lot 20, Concession 1, Town of Greater Napanee, Lennox & Addington County) along the Napanee River adjacent to the Napanee Water Pollution Control Plant. This site is located within the Town of Deseronto IPZ 3a.

Information about the site was taken from correspondence from Malroz Engineering Incorporated dated April 23, 2010 and Genivar dated November 3, 2010. These reports indicate that groundwater monitoring has been ongoing at the site since 2005. Contaminants of concern have been identified as petroleum hydrocarbons and heavy metals. Seasonal seeps of contaminated groundwater were reported to exist along the down gradient side of the site adjacent to the River.

3.5.1 Assessment as a Condition

To determine if the landfill site can be considered a condition with respect to the Technical Rules (2009) a review of soil chemistry data from 2004 and 2008 was completed. This data, as included in Appendix B, was compared with Table 4 of the Soil, Ground Water and Sediment Standards, potable groundwater standard (MOE, July 27, 2009). From the available data the parameters as listed in Table 4 were noted as exceeding the surface soil standard for Industrial/Commercial/Community Property Use. In addition to the surface soil data a cursory review of groundwater data indicate petroleum hydrocarbons fractions F2 to F4 exceed the Table 2 standard of the Soil, Ground Water and Sediment Standards, potable groundwater (MOE, July 27, 2009). Based on the detection of parameters exceeding the relevant criteria this site is considered to be a condition with the Town of Deseronto IPZ3a.

Table 4: Parameters Identified as Meeting Technical Rule 126

Parameter	Units	Table 4 Criteria *	BH16	BH17
Arsenic	µg/g	18	20	-
Cadmium	µg/g	1.9	13.5	3.6
Copper	µg/g	230	269	-
Lead	µg/g	120	884	644
Zinc	µg/g	340	4730	681
Anthracene	µg/g	0.67	4.12	1.06
Benzo(a)anthracene	µg/g	0.96	23.3	-
Benzo(b)fluoranthene	µg/g	0.96	39.8	1.9
Benzo(a)pyrene	µg/g	0.3	20.6	1.08
Benzo(k)fluorethene	µg/g	0.96	8.23	-
Chrysene	µg/g	9.6	19.7	-
Dibenzo(a,h)anthracene	µg/g	0.1	11	0.77
Fluoranthene	µg/g	9.6	30.6	-
Indeno(1,2,3-cd)pyrene	µg/g	0.76	36.6	1.52
Phenanthrene	µg/g	12	17.4	-
PHC-F4	µg/g	3300	25100	-

*Soil, Ground Water and Sediment Standards for use Under Part XV.1 of the Environmental Protection Act, Ministry of the Environment July 27, 2009.

3.5.2 Risk Score

Based on the identification of the landfill as a condition the risk score was determined to assess whether this property is considered a significant, moderate or low condition. This score was calculated as follows:

$$\text{Risk Score} = 10 \times 7.2 = 72$$

Where:

- The hazard rating was assigned as 10, given the property is in the IPZ3a associated for the Town of Deseronto Intake,
- The vulnerability score of the IPZ3a was assigned as 7.2 as outlined in the Assessment Report (Quinte Conservation, March, 2011).

Given a risk score of 72 this past landuse is considered to be a moderate threat for the Town of Deseronto drinking water.

3.6 Site 5 Town of Picton Waste Transfer Station

A review of records resulted in the identification of two landfill sites in the intake protection zone for the Town of Picton drinking water system. One of these sites (Site5) is referred to as the Town of Picton Waste Transfer Station on Church

Street. The other site (Site 6) is the former Town of Picton Dump located at Delhi Park adjacent to Marsh Creek as located by Map 1. The review of Site 5 is discussed in Section 3.7.

A review of the Certificate of Approval Number 350102 (as included in Appendix A) indicates the Picton Waste Transfer site was licensed as a waste disposal site for the disposal and burning of wood waste only. The current certificate 350104 no longer permits waste disposal, but indicates the site is to be used for a transfer station for municipal waste only. Discussion with representatives of Prince Edward County indicated no recollection that burial of waste occurred. Additionally, it was reported that there has been no testing for contamination at this site. Further discussion with Ministry of the Environment representatives indicated that a recent site inspection was completed and there does not appear to be evidence of land filling. Local knowledge is that it was common practice at this site to burn brush and wood. Regardless of past use there is insufficient information to allow the assessment of the site as a condition in regards to Technical Rule 126 (Ministry of the Environment, 2009). Note that this does not mean that contamination does not exist.

3.7 Site 6: The Town of Picton Landfill

The Town of Picton operated a landfill site from approximately the early 1900s until 1979. This site, as illustrated by Map 1, is located within the Town of Picton IPZ2. The site was developed through the filling of a wetland along the banks of Marsh Creek. Historic maps, as illustrated by Figure 1, show the area of filling. Over the lifespan of the site it is believed that agricultural and canning industry waste were land filled in the early 1900s. Domestic waste was land filled starting in the 1940s and finally construction debris was deposited during reconstruction of the Town's Main St. in the 1970s. The landfill was closed in 1979 and a 0.6 metre thick cap of clean fill was placed over the site followed by redevelopment as a Park in the early 1980s. A copy of the Certificate of Approval is provided in Appendix A.

3.7.1 Environmental Condition

To assess whether the site is considered to be a condition a review was completed of a hydrogeological assessment of the site completed in 1988 (Water & Earth Science & Associates, 1988). Other information was reviewed to provide additional detail regarding potential overall impact including water quality data for the Town of Picton drinking water system, surface water quality of Marsh Creek and sediment quality in Marsh Creek and Picton Bay.

A review of the Hydrogeological Assessment report indicated that the assessment included the installation of monitor wells, surface water sampling sites and seepage meters in Marsh Creek at the locations illustrated by Map 1. A discussion of the results of this assessment is as provided below.

3.7.2 Groundwater

A total of five boreholes were installed at the site with four constructed as monitor wells and the remaining as a gas probe. Some of the wells were constructed as multi level with deep and shallow zones. Samples were collected from the monitor wells in 1988 and analysed for inorganic and organic parameters with the data as summarized in Appendix B.

Measurement of the monitor wells indicated groundwater flow at the site is towards Marsh Creek and Picton Bay with vertical gradients suggesting the site is in an area of groundwater discharge. Under these conditions, contaminants generated at the site may discharge into Marsh Creek. Elevated levels of parameters indicative of leachate (iron, manganese, chloride, calcium and sodium) from a landfill were detected in the monitor wells but overall thought to represent low strength leachate. The low strength of the leachate was thought to be potentially related to shallow depth of the landfill (3 to 6 metres). The rapid flow of groundwater through this area of groundwater discharge may also minimize the amount of time of leaching as well as flush contaminants out of the site. Higher concentrations of inorganic parameters were determined in the shallow groundwater and associated with contamination from the landfill. Measurable levels of volatile compounds were found in one of the monitor wells (P1-2) including hydrocarbons, chloroform, tetrachloroethylene, and trichlorofluoromethane. These contaminants may be derived from petroleum products, solvents, dry cleaning fluids, and Freon used in refrigeration.

3.7.3 Surface Water

It was reported that landfill operations was recommended to maintain a 30 metre separation from Marsh Creek. However this recommendation did not appear to be followed (Water & Earth Science Associates, 1989). Water quality monitoring of the creek by the Ministry of the Environment in 1971 and 1979 found the landfill to be impacting on the creek with some parameters identified at higher levels in 1977 than in 1971.

Map 1

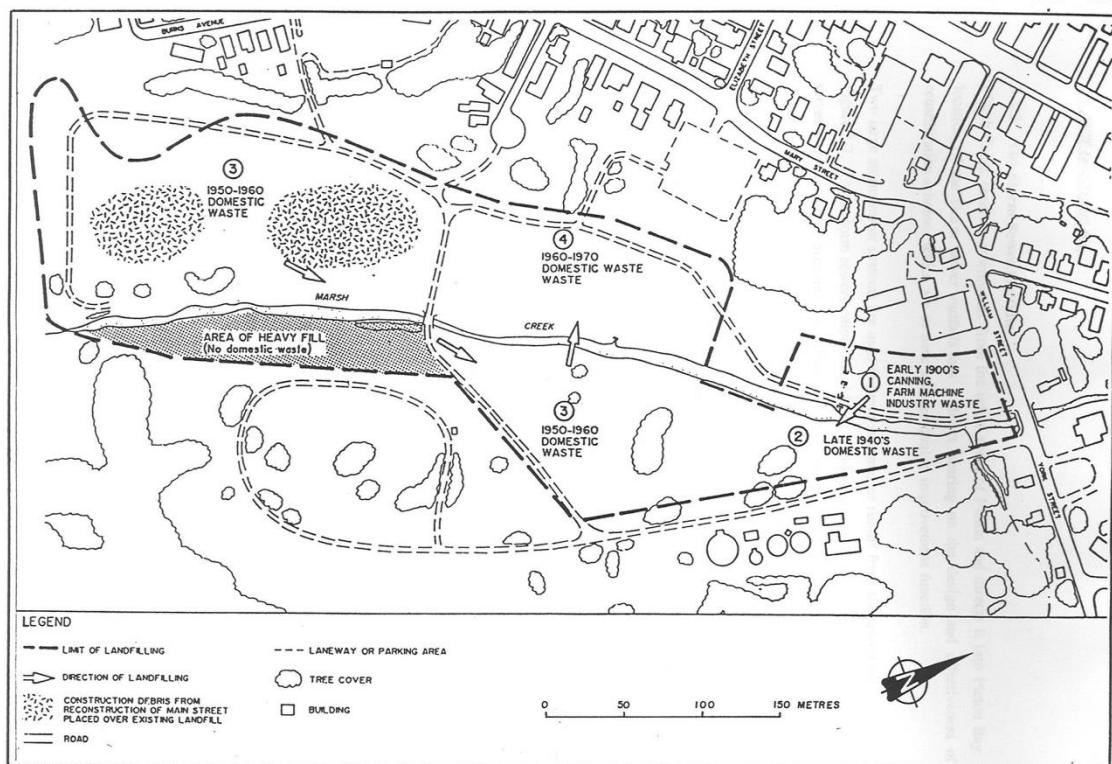
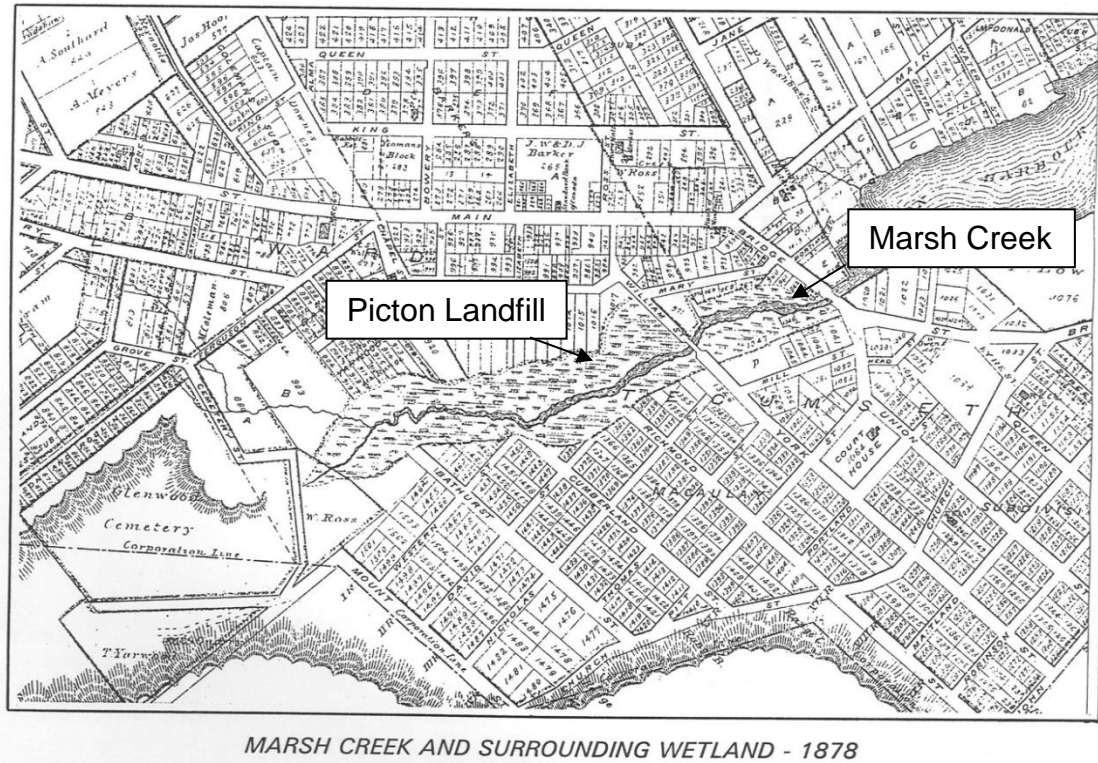


Figure 1: Town of Picton Landfill Site

Monitoring in the creek by Water & Earth Science Associates in 1988 indicated an improvement of quality over sampling completed in 1977. This monitoring included sites up and down stream of the sewage treatment plant discharge to allow assessment of water quality parameters potentially originating from the sewage plant as opposed to the landfill site. As a result parameters were detected that were indicative of leachate from the landfill. This included low levels of both inorganic and volatile organic compounds with levels increasing as the creek traverses through the site. The levels of these contaminants were reported as being below the drinking water standards at that time and it was speculated that the impacts of this leachate would likely be immeasurable in Picton Bay due to biodegradation and dilution. The overall degradation of water quality was speculated as not being severe, however an oily film and scum were reported to exist on the creek during periods of low flow (WESA, 1989).

As part of that study two seepage meters were also established in the Marsh Creek to measure the quality of groundwater discharging to the creek. Analysis of a sample from one of the sites confirmed the discharge of groundwater as the quality was similar to groundwater.

3.7.4 Assessment as a Condition

To determine if the landfill site can be considered a condition with respect to the Technical Rules (2009) a review of the 1988 groundwater data was completed for comparison with Table 2 of the Soil, Ground Water and Sediment Standards, potable groundwater standard (MOE, July 27, 2009). From the available data the parameters as listed in Table 5 were noted as exceeding the potable drinking water standard. The results of analysis are from samples collected at monitor well P1-2 at a depth of 6 metres.

Table 5: Picton Landfill Parameters Identified as Meeting Technical Rule 126

Parameter	Units	Table 2 Criteria *	P1-2
Chloroform	ug/l	2.4	90.7
1,1 Dichlorethylene	ug/l	1.6	2.8
1,1 Dicchloroethane	ug/l	5	7.9
Ethylbenzene	ug/l	2.4	12
Trichlorfluoromethane	ug/l	150	540
1,4 Dichlorobenzene	ug/l	1	1.2

*Soil, Ground Water and Sediment Standards for use Under Part XV.1 of the Environmental Protection Act, Ministry of the Environment July 27, 2009.

Based on the detection of these parameters above the standards the site is considered a condition within the Town of Picton IPZ. These parameters are organic and related to a group of chlorinated hydrocarbons. Sources of such chemicals may be from solvents, refrigerants, plastics, rubber, insecticides and

pesticides. Typical disposal of items containing these chemicals is possible in the landfill site.

3.7.5 Risk Score

Based on the identification of the landfill as a condition the risk score was determined to assess whether this property is considered a significant, moderate or low condition. This score was calculated as follows:

$$\text{Risk Score} = 10 \times 9.0 = 90$$

Where:

- The hazard rating was assigned as 10, given the property is in the IPZ2 associated for the Town of Picton Intake and past evidence suggests there is offsite impact,
- The vulnerability score of the IPZ2 was assigned as 9.0 as outlined in the Assessment Report (Quinte Conservation, March, 2011).

Given a risk score of 90 this past landuse is considered to be a significant drinking water threat.

3.7.6 Sediment Data

Additional information about environmental quality was provided through review of sediment quality data for samples collected from Marsh Creek and Picton Bay. This information was taken from a Summary of Recent Sediment Investigations for the Bay of Quinte, Lake Ontario National Water Research Institute September, 2006. This overview included a summary of eight independent studies completed since 1995 with some of the studies focused on individual areas and others spread through the Bay with sampling intensity based on proximity to urban centres and the tributary mouths of creeks and rivers.

From this compilation, two sampling sites were noted in the general area of the Picton intakes as illustrated by Map 1. One station (labeled as EHD-6) is located near the mouth of Marsh Creek where it discharges to Picton Bay, downstream of the landfill site and the sewage treatment plant outfall. This site was part of an Environment Canada study when samples were collected between July and November of 2003. During this study surface sediment samples were taken to a depth of 1-2 cm and analysed for trace metals, PCBS, as well as PAHs.

The other site (labeled as 2031) was also part of an Environment Canada study and is located near the drinking water intake. Bulk sediment samples were collected and analysed for trace elements including Mercury, Total Phosphorus, Total Kjeldahl Nitrogen, and Total Organic Carbon. Analysis for PCBs and PAHs was not completed.

To assess sediment quality at these locations a review of the data, as included in Appendix C, was completed in respect of Table 1 of the Ministry of the Environment Soil, Groundwater and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act (July 27, 2009). Parameters noted as being elevated above the standards are as listed in Table 6.

Table 6: Sediment Parameters Elevated in Marsh Creek & Picton Bay

Parameter	Units	Table 1 Criteria *	2031	EHD-6
Arsenic	µg/g	6	9.49	<5
Cadmium	µg/g	0.6	1	1.3
Chromium	µg/g	26	49.1	52
Copper	µg/g	16	45.1	215
Lead	µg/g	31	73	89
Mercury	µg/g	0.2	0.167	0.647
Nickel	µg/g	16	46.1	9
Silver	µg/g	0.5	0.25	11.3
Zinc	µg/g	120	179	504
Fluoranthene	µg/g	0.75	n/a	1.11
Phenanthrene	µg/g	0.56	n/a	0.852
PCB	µg/g	0.07	n/a	0.11

*Soil, Ground Water and Sediment Standards for use Under Part XV.1 of the Environmental Protection Act, Ministry of the Environment July 27, 2009.

From the sediment sample at the mouth of Marsh Creek it was found that many of the parameters related to trace metals were elevated. However, many of these parameters are commonly elevated in sediments throughout the Bay of Quinte. A review of relevant studies indicates that effluent from sewage treatment plants can contribute to elevated levels of heavy metals and some may be naturally occurring such as Cadmium and Zinc which may be related to the geology of the limestone bedrock. A study of water quality in the Bay suggested that the major tributaries may contribute significantly to levels of heavy metals in the Bay. Water quality data at Marsh Creek as reported in the Bay of Quinte Rap reports (Beak, 1988) indicate elevated levels of Copper, Zinc, Lead, Nickel, Iron and Phenols at Marsh Creek.

In addition to the heavy metals, organic parameters including fluoranthene, phenanthrene, and PCBs were found to be elevated at the Marsh Creek site. The first two parameters are classed as polyaromatic hydrocarbons and were not reported to be prevalent throughout the sediments in the Bay of Quinte but can be found near urban centres. These parameters are closely associated with coal tar, however there is no record of a coal gasification plant in this vicinity. PCBs were reported to be slightly elevated throughout the Bay but generally not exceeding the standard. Coincidentally, Marsh Creek was one of the few sites where the concentration exceeded the standard. This occurrence may be related

to the discharge of sewage treatment plant effluent upstream. Overall, the detection of the elevated levels of heavy metal and organic parameters may be related to the landfill, yet insufficient evidence exists to pinpoint this as a source due to other potential sources of contamination in the area.

For the station near the drinking water intake (station 2031) trace metal parameters were detected above the standard similar to the general quality of sediments throughout the Bay. The exception was Arsenic which has been recorded at elevated levels near the mouth of the Moira River and is attributed to historical mining and smelting operations at Deloro farther up the Moira River system. The other parameters may be associated with sources as discussed for the site at Marsh Creek given they were also elevated at that location. Note that analysis of organic parameters was not completed at this location.

3.7.7 Review of Picton Drinking Water and PWQMN data

Given the identification of elevated parameters in the groundwater and sediments additional review of other data has been completed to determine if correlation exists between the detection of indicator parameters and the water quality at the PWQMN station on Marsh Creek and the Picton Drinking Water Plant. A detailed review of this information is provided in Appendix D and summarized below.

From this review it was found that the 5 of the 6 groundwater contaminants were tested and detected in the raw water at the Picton drinking water intake. Of the 12 parameters found to be elevated in the sediment ten were detected in the raw water. As regards the Provincial Water Quality Monitoring Station on Marsh Creek none of the groundwater parameters are tested for in the regular monitoring at the Creek, however, 8 of the 12 sediment parameters are. Monitoring of the quality of storm water includes 6 of the contaminants found in the sediments. All six were detected during periods of wet weather suggesting this is a contributing factor.

In reference to this review and detection of elevated parameters it is recommended that the water quality monitoring programs continue.

3.8 Site7: Former Industrial Property in the City of Belleville

Two sites that could be considered conditions were identified within the vulnerable area for the City of Belleville drinking water system. Site 6 is a former industrial property located within the IPZ2. Site 8 is the closed Zwicks Island landfill site located in the IPZ1. A discussion of the findings for Site 7 is presented in Section 3.9.

An industrial property located within the City of Belleville near Bridge and Sidney Streets was identified as being potentially contaminated. Detailed information about this site (Site6) was provided by the City of Belleville and included reports on Phase 1 and 2 Environmental Site Assessments and a work plan for the

Phase 3 cleanup. From these reports it was found that property was previously used by a company manufacturing electrical circuit boards. An assessment of the site was completed through sampling of soil and groundwater from 17 boreholes due to potential for contamination of the site by PAHs and heavy metals. This assessment identified several heavy metal parameters (Barium, Cadmium, Copper, Lead, and Zinc) as being elevated above the standards. A cleanup of the site was accomplished by excavation of contaminated soil and disposal offsite. Correspondence was provided indicating that the contaminated soils were removed from the site. It was reported that the site was cleaned up to meet the requirements of Ontario Regulation 153/04 for a record of site condition as a sensitive site. The environmental studies were peer reviewed on behalf of the City and it was reported that they were satisfactory. A follow up report and Record of Site Condition was not available. However correspondence provided by the City of Belleville indicated that the contaminated soil was removed from the site. Based on this information this site would not be considered a condition.

3.9 Site 8: Zwick's Island Landfill in the City of Belleville

The City of Belleville operated the Zwicks Island Landfill site in the 1950s and 60s for the disposal of mainly municipal waste with reports of the site also receiving some commercial, industrial, and liquid waste. The area was filled through the construction of an earthen dyking system out into the Bay of Quinte with waste deposited behind the dyke. An illustration of the filled area can be viewed from Figure 2 which includes a historic aerial photograph from 1948. After closure of the site in 1971 the landfill was covered and converted to a park.

3.9.1 Environmental Condition

Over the years a number of studies have been completed on the closed landfill site to assess environmental impact. For the purposes of this review information contained in the following two reports was considered.

Zwick's Island Landfill Environmental Investigations Final Report, Ontario Ministry of the Environment, October 1991,

Report on 2008 Environmental Monitoring Program Zwick's Centennial Park, Belleville, Ontario. Golder & Associates, March 2009.



Aerial Photograph 1 (Roll No. A11795-73) Zwick's Island, Belleville, December 3, 1948



Aerial Photograph 2 (Roll No. 92032-10-132) Zwick's Island, Belleville, May 6, 1992

Figure 2: Zwicks Island Landfill Before & After Filling

From review of the 1991 Ministry of the Environment Report it was reported that a network of nine monitor wells and 10 surface water stations was established in April of 1990. These stations were sampled in May and August of 1990 for

parameters indicative of landfill leachate. As a result it was found that groundwater flows radially outward from the site towards the Bay of Quinte. Analysis of samples of groundwater found the site to be impacted by landfill leachate, however the overall strength of the leachate was thought to be low.

This low strength was attributed to how the waste was deposited (filling of the Bay) with significant flushing of contaminants and dilution. Parameters that were detected in the groundwater included Benzene, Toluene, Trichloroethane and some pesticides such as Aldrin. Analysis of surface water samples found discharge of leachate to ditches on the site, however the water quality in the Bay was found to not be significantly poorer than water farther off shore. Regardless it was reported that there is continual loading of relatively low strength landfill leachate to the Bay. Continued monitoring was recommended.

To provide more up to date information about the monitoring of the Zwick's Island site a recent report prepared by Golders & Associates (2009) was reviewed. This study included the sampling of 10 groundwater monitoring wells, as located by Map 2, with analysis for a complete suite of parameters. Groundwater flow was determined as radially outward from the northwest corner of the site generally beneath the perimeter of the berm along the Bay of Quinte. The presence of leachate at the site was confirmed with detection of levels of petroleum hydrocarbons, volatile organic carbons, and other key indicator parameters.

Monitoring of surface water quality included the sampling of 11 stations in the spring and fall as well as three precipitation event samplings. This sampling indicated water quality as generally similar to background with marginally elevated levels of key indicator parameters. Parameters noted as exceeding the Provincial water quality objectives were Total Phosphorus, Iron and Copper. Non point discharge of leachate occurs around the perimeter of the site however, there are three areas of point leachate discharge at the ditch near the Ramada Inn Hotel draining eastward (surface water station SW1), a ditch at the bay at surface water station SW8 and the embayment at the west near stations SW4 and SW9. Leachate is observed to discharge at the shoreline of this embayment subject to the water level in the Bay. Photos of this area of discharge and surface of the discharge are illustrated by Figures 3 & 4. Water quality at these points of discharge were noted to be indicative of leachate with elevated levels of Phenols, Total Phosphorus, Iron, Fluoride, Ammonia, Aluminum, Arsenic, Cadmium, Cobalt, Lead, Vanadium, Zinc, Phenanthrene, and Total Suspended Solids. Acute lethality testing for Rainbow Trout and *Daphnia magna* were completed at these locations from samples collected at these sites in 2008. All of the lethality tests were reported as pass. Nevertheless, continued monitoring was recommended.

Map 2



Figure 3: Seep from Zwicks Island Landfill



Figure 4: Surface of Seep at Zwicks Island Landfill

3.9.2 Assessment as a Condition

To determine if the site represents a condition a review of the available data was compared with the Ministry of the Environment Technical Rule 126. Based on these rules the data from 2 monitor wells located within the IPZ was reviewed and compared with Table 2 of the Soil, Ground Water and Sediment Standards, potable groundwater standard (July 27, 2009). From the available data, as included in Appendix B, the parameters as listed in Table 7 were noted as exceeding the potable drinking water standard.

The results of analysis are from samples collected at monitor well BH4 and BH8 which both extend to approximate depths of 4.6 metres and are located within the limits of the IPZ1. These parameters are organic and related to a group of chlorinated hydrocarbons. Sources of such chemicals may be from solvents, refrigerants, plastics, rubber, insecticides and pesticides. Typical disposal of items containing these chemicals is possible in the landfill site. Based on the detection of these parameters above the standard, the site is considered a condition within the City of Belleville IPZ1.

Table 7: Zwicks Island Parameters Identified as Meeting Technical Rule 126

Parameter	Units	Table 2 Criteria *	BH 4	BH 8
<i>BNAs, PAHs, and Phenols</i>				
Benzo(a)anthracene	µg/L	1		1.9-3.4
Benzo(a)pyrene	µg/L	0.01	0.09-0.24	0.09-2.7
Benzo(b)fluoranthene	µg/L	0.1	0.2	0.2-3.6
Benzo(g,h,i)perylene	µg/L	0.2		0.75-1.3
Benzo(k)fluoranthene	µg/L	0.1	0.2	0.13-1.4
Chrysene	µg/L	0.1	0.27	0.24-3.1
Dibenzo(a,h)anthracene	µg/L	0.2		0.33
Fluoranthene	µg/L	0.41		0.73-6.4
Indeno(1,2,3-cd)pyrene	µg/L	0.2	0.27	0.27-1.4
Pyrene	µg/L	4.1		4.6-4.9
<i>Petroleum Hydrocarbons and PCBs</i>				
Petroleum Hydrocarbons F2 (>C10-C16)	µg/L	150		x
<i>Metals</i>				
Cadmium	mg/L	0.0027	0.005	0.0039-0.005
Cobalt	mg/L	0.0038	0.05	0.05
Lead	mg/L	0.01	0.05	0.05
Molybdenum	mg/L	0.07	0.2	0.2
Silver	mg/L	0.0015	0.005	0.005
<i>Pesticides</i>				

Parameter	Units	Table 2 Criteria *	BH 4	BH 8
Heptachlor Epoxide	µg/L	0.048		0.05
Volatile Organic Compounds				
1,4-Dichlorobenzene	µg/L	1	2.9-13.8	1.5-5.5
Benzene	µg/L	5	6.6-9.7	5
Bromomethane	µg/L	0.89	0.2-10.0	0.2-10.0
Vinyl Chloride	µg/L	0.5	0.2-10.0	0.2-10.0

*Soil, Ground Water and Sediment Standards for use Under Part XV.1 of the Environmental Protection Act, Ministry of the Environment July 27, 2009.

3.9.3 Risk Score

Based on the identification of the landfill as a condition the risk score was determined to assess whether this property is considered a significant, moderate or low condition. This score was calculated as follows:

$$\text{Risk Score} = 10 \times 9.0 = 90$$

Where:

- The hazard rating was assigned as 10 given the property is in the IPZ1 associated with the City of Belleville Intake and offsite impact,
- The vulnerability score of the IPZ1 was assigned as 9.0 as outlined in the Assessment Report (Quinte Conservation, March 4, 2011).

Given a risk score of 90 this past landuse is considered to be a significant drinking water threat.

3.9.4 Sediment Data near Zwicks Island

Information about sediment quality was obtained through a review of a compilation of studies on sediment quality in the Bay of Quinte (Summary of Recent Sediment Investigations for the Bay of Quinte, Lake Ontario National Water Research Institute September, 2006). This overview included a summary of eight independent studies completed since 1995 with some of the studies focused on individual areas and others spread through the Bay with sampling intensity based on proximity to urban centres and the tributary mouths of creeks and rivers draining to the Bay.

From this compilation, the data from five sampling sites as included in Appendix C was reviewed. The location of the sampling sites is as illustrated by Map 2. These sites were part of different studies including one completed in 1997 by a private consulting company and another by Environment Canada in 2000. The 1997 study (sites Sed1, Sed2, & Sed-SW4) was completed through collection of composite samples and analysis for Polyaromatic hydrocarbons and trace

metals. The Environment Canada samples were collected as cores with analysis for trace metals, organics and nutrients.

The parameters found to be elevated are listed in Table 8 and are similar to those found in Picton Bay and Marsh Creek. Exception was that Pyrene was not found in Picton. The sources of the common parameters are likely similar as discussed for Picton and may include natural occurrences, sewage treatment plant effluent, air borne particulate matter as well as non point sources from the many tributaries draining into the Bay of Quinte. The organic parameters were reported to be elevated in the vicinity of urban centres with things like Fluoranthene and Phenanthrene, which are potentially related to coal tar. The detection of Pyrene may also be directly related to coal tar.

Some of the elevated parameters (Cadmium, Lead, Fluoranthene, and Pyrene) coincide with elevated levels of the same constituents found in the groundwater at Zwicks (listed in Table 7) and there is significant potential that this may be the source in part.

Table 8: Sediment Parameters Elevated in the Bay of Quinte near Zwicks Island.

Parameter	Units	Table 1 Criteria*	SED-SW4	SED1	200610602	SED2	2007
Arsenic	µg/g	6	-	-	7.1		2.5
Cadmium	µg/g	0.6	-	0.6	1.5	0.5	1
Chromium	µg/g	26	-	24	61	47	54.2
Copper	µg/g	16	-	30	45	21	48
Lead	µg/g	31	-	<0.4	81	<0.4	74.3
Mercury	µg/g	0.2	-	-	0.81	-	0.45
Nickel	µg/g	16	-	-	24		25.5
Silver	µg/g	0.5	-	-	-	-	0.7
Zinc	µg/g	120	-	150	190	121	208
PCB	µg/g	0.07	-	-	0.18	-	-
Anthracene	µg/g	0.22	0.0002	0.689	-	0.23	-
Fluoranthene	µg/g	0.75	0.00062	1.01	-	0.266	-
Phenanthrene	µg/g	0.56	0.00026	0.645	-	0.216	-
Pyrene	µg/g	0.49	0.00051	0.705	-	0.167	-

* Soil, Ground Water and Sediment Standards for use Under Part XV.1 of the Environmental Protection Act, Ministry of the Environment July 27, 2009.

3.9.5 Review of Belleville Drinking Water Quality Data

Given the identification of elevated parameters in the groundwater and sediments additional review of other data has been completed to determine if correlation exists between the detection of indicator parameters and the treated water

quality at the Belleville Drinking Water Plant. A detailed review of this information is provided in Appendix D with a summary as provided below.

From this review it was found that most of the indicator parameters are monitored in the treated water at the Belleville intake. In total 37 contaminants from either sediment or groundwater data were detected in raw water at the intake. However, six of the indicator parameters are not routinely tested in the raw water (see Appendix D for the list).

4 Conclusions & Recommendations

- 1.0 Based on review of available information nine potential conditions within the vulnerable areas of six drinking water systems were identified. These sites are closed gas stations, closed landfill sites and an industrial property.
- 2.0 Review of available information for sites located in Madoc and Tweed did not provide enough data to allow assessment of the sites as conditions. Nevertheless, the absence of such information is expected considering that such data either does not exist or rarely becomes public. Therefore, it is possible that condition-related drinking water threats do exist; however, no data is available to either confirm or refute this possibility.
- 3.0 Review of recent information for a closed landfill located within the Village of Wellington IPZ2 indicated this site to be classified as a condition. However, determination of the risk score indicated the score was not high enough for this area to be considered a drinking water threat.
- 4.0 A closed municipal landfill site is located within the Town of Napanee along the Napanee River. This property is located down gradient of the drinking water intake for the Town of Napanee but is within the IPZ3a for the Town of Deseronto drinking water system. A review of recent soil and groundwater data indicated heavy metal and petroleum hydrocarbon parameters as exceeding the relevant standards to classify this property as a condition. Calculation of the risk score indicated the site is considered to be a moderate drinking water threat for the Town of Deseronto drinking water.
- 5.0 A waste transfer station located in the Town of Picton IPZ 3a was reported to be formerly used for waste disposal. A review of records indicated the site was licensed to receive wood waste but is currently used as a transfer station only. There is no evidence of actual filling at this location as it was common practice to burn the wood waste. The absence of data on the presence of contamination prevents assessment of the site as a condition in reference to the MOE Technical Rules (2009).
- 6.0 The former Town of Picton Dump was established in the early 1900's and closed in 1979. Hydrogeological assessment of the site was completed in 1988 and review of groundwater quality data for the site indicated that some parameters meet the standard for classification as a condition. The calculated risk score classified this property as a significant drinking water threat. Given the date of the data it is recommended that updated data be obtained to confirm this assessment.
- 7.0 A potential condition was identified within the IPZ2 for the City of Belleville. This site was a property which was formerly used for industrial purposes with soils assessed as being contaminated with heavy metals. Information was

provided by the City to indicate that the contaminated soils were removed from the site and the property is not considered to be a condition.

- 8.0 The Zwicks Island landfill site was identified as a condition in the City of Belleville IPZ1. Review of groundwater data from 2008 confirmed the presence of contamination in the groundwater with many parameters exceeding the relevant standard. The risk score for this site indicted that it is to be classified a significant drinking water threat.
- 9.0 This review was the first attempt at identifying contaminated sites that should be considered as conditions and drinking water threats in the source protection planning process. It is recognized that other conditions and potentially contaminated sites may exist. However in the absence of data it is not permissible to identify such sites as conditions. As such data becomes available it is recommended that the condition process be applied to address potential drinking water threats.

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Appendix A: Certificates of Approval

Appendix B: Groundwater & Soil Quality Data

Appendix C: Sediment Quality Data

Appendix D1: Belleville Water Quality Report
Appendix D2: Picton Water Quality Report