

## 11. GRIMSBY WATER TREATMENT PLANT

The Grimsby Water Treatment Plant (WTP) is located in Grimsby, Ontario and provides treated drinking water to the Towns of Grimsby and Lincoln and the Township of West Lincoln. With a total capacity of 44 million litres per day, the plant services a population of approximately 54,000. The Grimsby WTP receives raw water from Lake Ontario via an intake pipe that is located 1.8 km from the shore and over 7.7 m deep. A map showing the local setting of the Grimsby WTP and its intake is shown in Figure 11.1.

A surface water vulnerable area and water quality threats assessment has been completed for the Grimsby WTP intake. The methodology used for this assessment is described in Chapter 5 and specific results are outlined in Sections 11.1 through 11.7. Data sources used for each task are listed in Appendix B.

### 11.1 Classification of Intake

The Grimsby WTP draws raw water from Lake Ontario. Therefore, the Grimsby WTP intake is classified as **Type A – Great Lake**.

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### 11.2 Delineation of Surface Water Intake Protection Zones

The following sections describe the delineation of the primary (IPZ-1) and secondary (IPZ-2) Intake Protection Zones.

#### 11.2.1 Primary Zone (IPZ-1) Delineation

The IPZ-1 (Figure 11.2) for the Grimsby WTP was delineated in accordance with the TR. The resulting IPZ-1 is a circle centred on the intake crib with a radius of 1,000 m. The IPZ-1 does not touch land.

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#### 11.2.2 Secondary Zone (IPZ-2) Delineation

The IPZ-2 (Figure 11.2) for the Grimsby WTP was delineated in three components: in-water, upland and up-tributary. The development of each of these components is described in further detail below.

##### 11.2.2.1 In-water

The in-water component of IPZ-2 was established using a 2-Dimensional Advanced Circulation Model (ADCIRC) which provided inputs for the refined 3-dimensional (3D) model using the Princeton Ocean Model (POM), 10-year return period inputs and a 2-hour Time Of Travel (TOT) factor (HCCL, 2008a and 2009). Ten-year wind and wave conditions used included:

- Alongshore: 19.2 m/s winds from E, and 3.2m, 7.5s waves from NE;
- Onshore/Offshore: 22.3 m/s winds from W, and 1.6m, 5s waves from NW; and
- Alongshore: 17.6 m/s winds from N, and 1.7 m, 5s waves from N.

The results of the in-water modelling are shown in Figure 11.3. As can be observed from Figure 11.3, with a 2-hour TOT, the in-water portion of IPZ-2 extends about 6,500 m west of the intake, 6,150 m east of the intake and 3,250 m offshore, at its furthest extent. The in-water IPZ-2 extends about 5,720 m along the shore, west of the intake.

TR 65-66

**11.2.2.2 Upland – Transport Pathways**

Where an IPZ-2 touches land, the zone is extended to include a setback distance of 120 m from shore or the Conservation Authority Regulation Limit, whichever is greater. In addition to these setbacks, the upland extent is also affected by transport pathways such as storm sewersheds and tile drains.

As required by the TR, any storm sewershed that could contribute water to the intake within the modelled TOT (2-hours), must be included as part of IPZ-2. Therefore, the upland portion of the IPZ-2 includes the Town of Grimsby and City of Hamilton storm sewer catchment areas. These catchment areas are drained by 14 storm sewer outfalls which discharge into IPZ-2 directly to the lake or indirectly to adjacent watercourses, as illustrated in Figure 11.4. The catchment extents were identified in concert with Town of Grimsby staff from a consideration of land elevation and the storm sewer network. The extent of the networks included was also based on additional information provided by the City of Hamilton and reports from NPCA (Marshall Macklin Monaghan, 1998).

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) tile drained area data (OMAFRA, 2009a) were reviewed and it was determined that no tile drains exist along the extents of watercourses delineated in the up-tributary analysis, or along the shoreline. Therefore tile drained areas were not included in the upland delineation.

TR 65(2)

**11.2.2.3 Up-Tributary**

The following watercourses discharge within Grimsby’s IPZ-2 (Figure 11.3):

Campview Rd. Watercourse	Winona Rd. Watercourse	East St. Watercourse
Creanona Blvd. Watercourse	Fifty Creek Watercourse	Kelson Ave.N.Watercourse
Outlet 1	Outlet 2	Outlet 4a
Outlet 4b	Outlet 5	Outlet 6
Outlet 7		

Cross sections were surveyed for Fifty Creek, Campview Rd. Watercourse, Creanona Blvd. Watercourse, Outlet 2 and Outlet 6 (Chambers and Associates, 2009). From the survey data, an average of the bankfull (1:2 year flow) velocities, i.e. 1.1 m/s, was calculated and assumed for the remaining watercourses in the study area for which data was unavailable. Using velocity and residual TOTs, the up-tributary distances for the watercourses were calculated. Where the calculated up-tributary extent of the watercourses exceeded the actual length of the tributary, the delineations were terminated at the headwaters of the watercourse with a circular cap radius of 120 m. The 120 m

watercourse setback was applied to the upland extent however, where the area of the Conservation Authority Regulation Limit was greater, the IPZ-2 was extended to that limit. Conservation Authority Regulation Limits provided by the Hamilton Conservation Authority were applied for the up-tributary extent of Fifty Creek as it is located west of the Municipal boundary. Where the topography or subwatershed boundaries indicated overland flow away from the watercourse, the 120 m watercourse setback was truncated (refer to Figure 11.4).

The Biggar Lagoons have been decommissioned, remediated, and turned into a wetland. It is assumed that there is water flow from these ponds to adjacent watercourses and ultimately to the lake. The upland extent of the IPZ-2 includes the Biggar Lagoons in their entirety and the 120 m setback has been applied.

TR 72-75

### **11.3 Assignment of Vulnerability Scores**

As described in Section 5.3, a vulnerability score must be determined for each IPZ to represent the susceptibility of the intake to contaminants. The vulnerability score is calculated using the area and source vulnerability factors using the methodology described in Section 5.3.

TR 8(2), 9(1)(c)(iv), 86-96

#### **11.3.1 Area Vulnerability Factor**

The TR prescribe an IPZ-1 area vulnerability factor of 10 for all intake types. Therefore, the IPZ-1 area vulnerability factor for Grimsby is 10. In the case of IPZ-2, the TR require that the area vulnerability factor be not less than 7 and not more than 9 (refer to Table 5.3).

TR 88-89

An area vulnerability factor of 8 was determined for the Grimsby IPZ-2 as summarized in Table 11.1.

<b>Table 11.1: Grimsby WTP IPZ-2 Area Vulnerability Factor</b>		
<b>Factor</b>	<b>Description</b>	<b>Supports an Area Vulnerability Factor of :</b>
Percent Land	<ul style="list-style-type: none"> <li>• 21% of the IPZ-2 is land</li> </ul>	Low
Land Characteristics	<ul style="list-style-type: none"> <li>• Imperfectly drained soils</li> <li>• 41% impervious land cover</li> </ul>	Moderate
Transport Pathways	<ul style="list-style-type: none"> <li>• 13 watercourses</li> <li>• 14 storm sewer outfalls</li> </ul>	High
<b>Overall Area Vulnerability Factor</b>		<b>Moderate (=8)</b>

### 11.3.2 Source Vulnerability Factor

The source vulnerability factor is based on intake properties. The TR require that the source vulnerability factor be between 0.5 to 0.7 for Type A intakes (refer to Table 5.3).

TR 95

A source vulnerability factor of 0.5 was determined for the Grimsby intake as summarized in Table 11.2.

<b>Table 11.2: Grimsby WTP Source Vulnerability Factor</b>		
<b>Factor</b>	<b>Description</b>	<b>Supports a Source Vulnerability Factor of :</b>
Depth of intake	7.7 m depth below surface at low water levels.	Low
Distance of intake from land	Located 1,830 m from shoreline and is outside the wave breaking zone	Low
Historical raw water quality concerns	Excellent historical raw water quality recorded at the intake	Low
<b>Overall Source Vulnerability Factor</b>		<b>Low (=0.5)</b>

### 11.3.3 Overall Vulnerability Scores

The calculated vulnerability score was determined to be 5.0 for IPZ-1 and 4.0 for IPZ-2. These results are summarized in Table 11.3.

<b>Table 11.3: Grimsby WTP Vulnerability Score Summary</b>					
<b>Intake Type</b>	<b>Area Vulnerability Factor (Vf<sub>a</sub>)</b>		<b>Source Vulnerability Factor (Vf<sub>s</sub>)</b>	<b>Vulnerability Score (V)</b>	
	<b>IPZ-1</b>	<b>IPZ-2</b>		<b>IPZ-1</b>	<b>IPZ-2</b>
Type A	10	8	0.5	10 x 0.5 = <b>5.0</b>	8 x 0.5 = <b>4.0</b>

## 11.4 Identification of Threats

Surface water quality threats are defined as activities or conditions that pose a potential risk to source water quality. Threats may be identified by an activity or condition. An activity is a land use; for example the storage, application or discharge of a substance including chemicals and pathogens. A condition is an existing situation as a result of a past activity; for example, contaminated sediment.

The TR require consideration of the following activities and conditions:

- Activities that are prescribed as drinking water threats in O.Reg. 287/07,
- Non-prescribed, locally based activities, and
- Conditions resulting from past land use activities.

Each of the above were evaluated and described in detail in Sections 11.4.1 through 11.4.3, respectively.

**11.4.1 Prescribed Activities**

Section 5.4.1 lists the activities that are prescribed as drinking water threats for a vulnerable area in paragraphs 1 through 18 and paragraph 21 of subsection 1.1(1) of O.Reg. 287/07.

TR 7(3), 118

To determine the number of activities that constitute significant, moderate or low drinking water threats (if they were to occur) within the Grimsby IPZs, the Tables of Drinking Water Threats (TDWT) were truncated by vulnerability score, as described in Section 5.4.1. Table 11.4 provides Appendix reference numbers for the Provincial Tables of Circumstances corresponding with significant, moderate and low threats for each IPZ (both chemical and pathogen).

<b>Table 11.4: Grimsby WTP References for Provincial Tables of Circumstances</b>							
<b>IPZ</b>	<b>Vulnerability Score</b>	<b>Provincial Table Reference - Chemical Threats</b>			<b>Provincial Table Reference - Pathogen Threats</b>		
		<b>Sig.</b>	<b>Mod.</b>	<b>Low</b>	<b>Sig.</b>	<b>Mod.</b>	<b>Low</b>
1	5.0	--	--	Appendix C.30	--	--	Appendix C.29
2	4.0	--	--	--	--	--	--

There are no potential significant threats in Grimsby’s IPZ-1 and IPZ-2 because the vulnerability score is less than 8.

TR 118.1

Figure 11.5 illustrates areas where activities are or would be significant, moderate or low drinking water quality threats. This figure should be viewed in conjunction with the appendices referenced in Table 11.4 to determine specific activities within an IPZ that would be significant, moderate or low drinking water quality threats. For example, if one wants to determine activities that would be low threats within Grimsby’s IPZ-1, one should reference Appendices C.29 and C.30.

TR 8(4), 9(1)(c)(ix), 127-129, 132-137

### 11.4.2 Non-Prescribed Activities

The NPSPC has included additional (locally based) activities other than those already identified as prescribed threats (Section 5.4.2). Transportation threats were enumerated by cross-referencing the intake zone vulnerability scores with Table 1 (Appendix E, MOE letter May, 2011) and then identifying roads, railways and marine transport pathways within the IPZ where there transportation corridors could be threats.

IPZ	Vulnerability Score	Appendix E-Chemical Threats			Appendix E-Pathogen threats		
		Sig.	Moderate	Low	Sig.	Moderate	Low
1	5.0	--	--	Table 1	--	--	Table 1
2	4.0	--	--	--	--	--	--

TR 7(3), 119-122, 125

### 11.4.3 Conditions

The TR state that conditions may exist in a vulnerable area if the presence of a single mass of more than 100 litres of dense non-aqueous phase liquids occurs in the surface water of an IPZ and/or if there is the presence of a contaminant in the surface soil or sediment.

TR 126

Sediment data were available from an Environmental Canada Report (Dove et al., 2003) for Fifty Creek which discharges into the Grimsby IPZ-2. The data in this report were compared with the Table 4 Soil Standards (MOE, 2008b). Based on this analysis, no parameters were present at concentrations exceeding the soil standard and therefore no conditions were identified.

As described in Section 5.4.3, a condition is determined to represent a significant threat if it has a risk score greater than 80, a moderate threat for scores between 60 and 80 and a low threat for scores between 40 and 60. A condition is also considered significant if it is associated with a drinking water quality issue or if there is evidence that it may be causing off-site contamination.

The following contaminated sites registries were also reviewed to assist with further identification of conditions within the WTP vulnerable area:

- Provincial Brownfield Sites Registry (MOE, 2009c);
- Federal Contaminated Sites Inventory (TBCS, 2009);
- MOE IPZ-1 Threats Database for Niagara Region (MOE, 2009d);
- MOE Spills Database for Niagara Region (WHI, 2005);
- Brownfield site GIS layer (NPCA, 2009c); and

- Closed landfill GIS layer (WHI, 2005).

After reviewing the available data sources listed above, no conditions were identified that result from past activities. The collection of additional soil and sediment data is noted as a future consideration in Section 5.9.

TR 7(4), 9(3)(c), 126, 139

### **11.5 Enumeration/Listing of Existing Threats**

The TR require the enumeration of locations at which:

- A person is engaging in an activity that is or would be a significant threat; and
- A condition resulting from a past activity is a significant drinking water threat.

TR 9(1)(e) and (f)

Existing moderate threats have also been enumerated as these may be addressed in the Source Protection Plan. Enumeration of each of these types of threats is described in further detail in Sections 11.5.1 and 11.5.2.

#### **11.5.1 Activities**

As described in Section 5.5, land use information and other data were obtained from various sources and compared with threat circumstances from the TDWT to determine existing threats within each IPZ.

For this analysis, existing threats are defined as activities that could occur because infrastructure is in place. For example if there are two livestock enterprises in operation and a third has an empty barn with no livestock, then three livestock enterprises are counted because the third barn could have livestock brought in the next day.

With the low vulnerability scores of 5.0 and 4.0, no activities representing significant or moderate drinking water threats exist within Grimsby's IPZ-1 or IPZ-2, respectively.

#### **11.5.2 Conditions**

As described in Section 11.4.3, no conditions were identified that result from past activities. Therefore, no conditions represent a significant drinking water threat.

### **11.6 Evaluation of Drinking Water Quality Issues**

To determine if any drinking water issues exist, the methodology described in Section 5.6 was applied for the Grimsby WTP raw water quality data.

#### **1. Collect raw water quality data**

Drinking Water Information System (DWIS) data for the years 2003-2008 and Drinking Water Surveillance Program (DWSP) data for the years 1990-2007 was collected from the MOE for the Grimsby WTP intake.

#### **2. Establish issues benchmarks**

Issues benchmarks established by the NPSPC are listed in Table 5.7.

**3. Identify “parameters of interest”**

As described in Section 5.6, parameters of interest are those that consistently measure above 10% of their regulatory criteria and often above 25%. The following parameters of interest were identified for the Grimsby WTP intake:

- Hardness;
- Turbidity;
- Temperature; and
- Organic nitrogen.

**4. Identify “potential water quality issues”**

Parameters of interest were plotted and analyzed to determine if they were regularly present at their benchmark values and/or trending upwards toward their benchmarks. Based on this analysis, all four preliminary issues were identified as non health related potential water quality issues for the Grimsby WTP vulnerable area. Turbidity and temperature were identified because of several values above their issues benchmark (Table 5.7). Hardness and organic nitrogen were also identified as potential water quality issues because of consistent concentrations above the benchmark.

**5. Identify “issues”**

The potential water quality issues were further evaluated to determine if they are directly related to human health considerations and/or can be attributed to artificial source(s). It was found that none of the potential water quality issues are directly related to human health considerations. Furthermore, hardness, turbidity and temperature have been attributed to naturally occurring processes and characteristics. For these reasons, hardness, turbidity and temperature are not considered drinking water quality issues.

In the case of organic nitrogen, the information available does not clearly indicate an absolute source(s) and therefore further investigation should be undertaken. Information related to the source(s) of organic nitrogen is identified as an item for future consideration in Section 5.9.

In summary, no water quality issues were identified for the Grimsby WTP IPZs. The high quality of raw water received at the Grimsby WTP combined with its diligent operation ensures a safe supply of treated drinking water.

TR 6, 9(1)(c)(xii), 114-115, 131,  
134.1

**11.7 Evaluation of Uncertainty**

The TR require a description of every uncertainty analysis conducted as part of the surface water quality assessment.

TR 9(2)(f), 13-14



Descriptions of the sources of uncertainty considered for each major task are outlined in Table 11.5. As indicated in Table 11.5, the overall level of uncertainty for the Grimsby WTP surface water vulnerability assessment is low.

<b>Table 11.6: Evaluation of Sources of Uncertainty for Grimsby WTP</b>		
Task	Description of Uncertainty	Uncertainty
<b>Section 11.1: Classification of Intake</b>		
Intake classification	The TR prescribe Lake Ontario to be a Great Lake.	Low
<b>Section 11.2: Delineation of IPZs</b>		
IPZ-1 Delineation	Dimensions for the IPZ-1 delineation are prescribed by the TR.	Low
IPZ-2 Delineation	Data acquired for modelling was of sufficient quality to conceptualize the in-water IPZ-2. However the resolution of the model used is limited and the available data were insufficient for a rigorous model calibration and verification therefore as a future consideration more work is required to fully understand physical processes in Western Lake Ontario.	High
<b>Section 11.3: Assignment of Vulnerability Scores</b>		
Vulnerability Scores	Data contributing to the area and source vulnerability factors are from reliable provincial and federal monitoring programs, Niagara Region Water Operations staff, Town of Grimsby staff and City of Hamilton staff.	Low
<b>Section 11.4: Identification of Threats</b>		
<b>Section 11.5: Enumeration/Listing of Existing Threats</b>		
Identification of Land Use Activities	The data used to find specific parcels were provided by government resources and were of a sufficient quality. Multiple resources were used to identify the land use activities present on parcels within the vulnerable areas. The quality & quantity of these resources was sufficient.	Low
<b>Section 11.6: Evaluation of Issues</b>		
Issues Evaluation	The issues evaluation was based upon raw water quality data provided by the MOE. The data spanned 14 years; however, the frequency of sampling for each parameter varied. The methodology was tailored to suit the quality and quantity of available data and was appropriate for the issues evaluation.	Low