

9. NIAGARA FALLS WATER TREATMENT PLANT

The Niagara Falls Water Treatment Plant (WTP) is located in Niagara Falls, Ontario and provides treated drinking water to the City of Niagara Falls and parts of Niagara-on-the-Lake and Port Robinson. With a total capacity of 145 million litres per day, the plant services a population of approximately 78,000 plus 20,000 visitors per day during the peak summer tourist season.

The Niagara Falls WTP intake is 5.5 m deep and located on the west bank of the Welland River, just south of the Niagara River. Although located in the Welland River, the intake actually receives raw water from the Niagara River. This is because the Chippawa/Queenston power canal draws water from the Welland River to fill reservoirs for the Sir Adam Beck hydroelectric power generation station, so that the direction of flow in the Welland River is reversed. This flow reversal causes Niagara River water to flow south into the Welland River and enter the WTP intake. A map showing the local setting of the Niagara Falls WTP and its intake is shown in Figure 9.1.

In the event that the Chippawa/Queenston power canal is shut down for maintenance, the Welland River water would resume its natural flow direction and enter the WTP intake. In 2009, Niagara Region completed a Schedule C Municipal Class Environmental Assessment (EA) for the temporary relocation of the intake in the event of a planned shutdown of the Chippawa/Queenston power canal. The study concluded that a contingency plan would be implemented if and when OPG shuts down the Chippawa/Queenston power canal for maintenance. The plan would consist of a temporary pumping station which would draw raw water from the Niagara River downstream of OPG Tunnel No. 2 and convey it by 900 mm diameter pipe to the existing intake of the Niagara Falls WTP. It is intended that components of this temporary system will be removed when flow reversal in the Chippawa Creek is complete (i.e. when the OPG power canal is placed back into service), a period of time expected to be between 3 and 7 months. A conceptual design has been completed and is valid for a period of 10 years.

A surface water vulnerable area and water quality threats assessment has been completed for the Niagara Falls WTP intake. The methodology used for this assessment is described in Chapter 5 and specific results are outlined in Sections 9.1 through 9.7. Data sources used for each task are listed in Appendix B.

9.1 Classification of Intake

The MOE has classified the Niagara Falls intake as a **Type B – Connecting Channel** intake under Assessment Report Technical Rule 55.1 (I. Smith, 2010c). Although the Niagara Falls intake is located in the channel of the Welland River which is a Type C setting, it actually receives 100% of its flow from the Niagara River. This is because the lower reach of the Welland River is part of the water diversion of Niagara River water used to power the Adam Beck Generating Station, as described above.

TR 55 TR 1(1)

9.2 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.

9.2.1 Primary Zone (IPZ-1) Delineation

The IPZ-1 (Figure 9.2) for the Niagara Falls WTP was delineated in accordance with the TR. It extends 100 m downstream, 1,000 m upstream, and includes 450 m of the Niagara River off the Canadian bank. The north side of the semi-circle of the IPZ-1, in the Niagara River has been truncated because hydrodynamic modelling showed high flows limit lateral movement of water, making it extremely unlikely for water flowing in this location to enter into the Welland River. Where the IPZ-1 touches land, appropriate setbacks were included.

TR 61-64

9.2.2 Secondary Zone (IPZ-2) Delineation

The IPZ-2 (Figure 9.2) for the Niagara Falls 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.

9.2.2.1 In-water

The in-water component of IPZ-2 was established using two conservative analyses to determine the 2-hour Time Of Travel (TOT) to the intake. The two analyses were conducted with the hydraulic flow models HEC-RASTM and ECOMSEDTM. The conservatively modelled flow conditions were of maximum stage combined with 10-year peak flow.

The results of the in-water modelling are shown in Figure 9.3. As can be observed from Figure 9.3, with a 2-hour TOT, the in-water component of IPZ-2 extends about 10 km southward (upstream in the Niagara River) from the intake.

TR 65-66

9.2.2.2 Upland – Transport Pathways

Where the IPZ-2 touches land, the required setback distance of 120 m or the Conservation Authority Regulation Limit was applied. 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 following storm sewer catchment areas:

- A small area north of the Welland River; and
- The eastern portion of the community of Chippawa.

The catchment extents were identified in concert with City of Niagara Falls staff from a consideration of land elevation and the storm sewer network. In total there are four storm sewer outfalls which discharge into the IPZ-1 and IPZ-2, as illustrated in Figure 9.4.

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)

9.2.2.3 Up-Tributary

The following watercourses discharge within Niagara Falls' IPZ-1 or IPZ-2 (Figure 9.4):

- Usshers Creek;
- Bayers Creek; and
- Numerous unnamed small watercourses along the west shore of the Chippawa Channel.

Surveyed cross sectional data were used to calculate an average velocity for each of the watercourses listed above (Chambers and Associates, 2009). 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. Appropriate setback distances of 120 m or the Conservation Authority Regulation Limit were also applied around each watercourse. However, where the topography or subwatershed boundaries indicated that overland flow traveled away from the watercourse, the 120 m watercourse setback was truncated (refer to Figure 9.2).

TR 72-75

9.3 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

9.3.1 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 Niagara Falls 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 Niagara Falls IPZ-2 as summarized in Table 9.1.

Table 9.1: Niagara Falls WTP IPZ-2 Area Vulnerability Factor		
Factor	Description	Supports an Area Vulnerability Factor of :
Percent Land	<ul style="list-style-type: none"> • 49% of the IPZ-2 is land 	Moderate
Land Characteristics	<ul style="list-style-type: none"> • Moderate runoff potential • Approximately 19% impervious surface 	Low
Transport Pathways	<ul style="list-style-type: none"> • 4 storm sewer outfalls • Three named and numerous unnamed watercourses 	Moderate
Overall Area Vulnerability Factor		Moderate (=8)

9.3.2 Source Vulnerability Factor

The source vulnerability factor is based on intake properties. The TR require that the source vulnerability factor be between 0.7 to 0.9 for Type B intakes (refer to Table 5.3).

TR 95

A source vulnerability factor of 0.8 was determined for the Niagara Falls intake as summarized in Table 9.2.

Table 9.2: Niagara Falls WTP Source Vulnerability Factor		
Factor	Description	Supports a Source Vulnerability Factor of :
Depth of intake	5.5 m below water surface	Low
Distance of intake from land	Intake terminates at the west bank of the Welland River	High
Historical raw water quality concerns	Excellent historical raw water quality recorded at the intake	Low
Overall Source Vulnerability Factor		Moderate (=0.8)

9.3.3 Overall Vulnerability Scores

The calculated vulnerability score was determined to be 8.0 for IPZ-1 and 6.4 for IPZ-2. These results are summarized in Table 9.3.

Table 9.3: Niagara Falls WTP Vulnerability Score Summary					
Intake Type	Area Vulnerability Factor (V_{f_a})		Source Vulnerability Factor (V_{f_s})	Vulnerability Score (V)	
	IPZ-1	IPZ-2		IPZ-1	IPZ-2
Type B	10	8	0.8	10 x 0.8 = 8.0	8 x 0.8 = 6.4

9.4 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 9.4.1 through 9.4.3, respectively.

9.4.1 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 Niagara Falls IPZs, the Tables of Drinking Water Threats (TDWT) were truncated by vulnerability score, as described in Section 5.4.1. Table 9.4 provides Appendix reference numbers for the Provincial Tables of Circumstances corresponding with significant, moderate and low threats for each IPZ (both chemical and pathogen).

IPZ	Vulnerability Score	Provincial Table Reference - Chemical Threats			Provincial Table Reference - Pathogen Threats		
		Sig.	Mod.	Low	Sig.	Mod.	Low
1	8.0	Appendix C.3	Appendix C.6	Appendix C.11	Appendix C.17	Appendix C.20	Appendix C.25
2	6.4	--	Appendix C.8	Appendix C.13	--	Appendix C.22	Appendix C.27

There are no potential significant threats in IPZ-2 because of the low vulnerability score.

TR 118.1

Figure 9.5 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 9.4 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 moderate threats within Niagara Falls’ IPZ-1, one should reference Appendices C.6 and C.20.

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

9.4.2 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 IPZs where these transport corridors could be significant or moderate threats (Stantec Consulting Limited, 2010).

Table 9.5: Niagara Falls WTP Reference for Non-Prescribed (Transportation) Activities							
IPZ	Vulnerability Score	Appendix E - Chemical Threats			Appendix E - Pathogen Threats		
		Sig.	Mod.	Low	Sig.	Mod.	Low
1	8.0	--	Table 1		--	Table 1	
2	6.4	--			--		

TR 7(3), 119-122, 125

9.4.3 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

Two Environment Canada reports (Dove et al., 2003a and 2003b) detailed sediment data sampled at tributaries discharging into the Great Lakes, including Usshers Creek and Bayers Creek. Both of these creeks are located within the IPZ-2 and are tributaries that outlet to the Chippawa Channel portion of the Niagara River (Figure 9.1). The sediment

data in these reports were compared to Table 4 Soil Standards (MOE, 2008b). MOE approved the comparison to Soil Standards instead of sediment criteria because the soil standards are based on human health considerations whereas the sediment criteria are based on ecological considerations. (The MOE letter dated June 21, 2010 is provided in Appendix E.) Based on this analysis, one parameter (naphthalene) was present at a concentration exceeding the soil standard and is therefore considered a condition. This condition is assigned a hazard rating of 6. This is because (i) there is no evidence of off-site contamination and (ii) the condition is not located at the intake parcel.

The above listed condition occurs within the IPZ-2 vulnerable area. Therefore, using a hazard rating of 6 and vulnerability score of 6.4, the sediment condition within the Niagara Falls WTP IPZ-2 has a risk score of 38.4, and is not considered a threat.

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 further 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

9.5 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 threat types is described in further detail in Sections 9.5.1 and 9.5.2.

9.5.1 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.

Based on this analysis, no significant threats were found to exist within Niagara Falls IPZ-1 or IPZ-2.

There were nineteen (19) moderate threat activities identified in total as shown below in Table 9.6.

Table 9.6: Enumeration of Locations At Which A Person is Engaging in An Activity That is Or Would Be A Moderate Threat		
Threat Category	TDWT Circumstances	Number - Count
Niagara Falls IPZ-1		
10. Application of pesticide to land	66-76	2
	77-87	1
12. Application of road salt	92, 93	2
15. Handling and storage of fuel	1354	1
Niagara Falls IPZ-2		
3. Application of agricultural source material to land	1944	4
10. Application of pesticide to land	78, 82, 84	5
21. Use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard	1945	4

The number count per TDWT circumstance indicates the number of parcels within the individual IPZ for which this activity or the potential for this activity has been identified. For example, there are two parcels identified within the IPZ-1 for moderate TDWT circumstance 71. In this case, circumstance 71 refers to the application of pesticide to land where the area of land is between 1-10 hectares and the application may results in the presence of MCPA (2-methyl-4-chlorophenoxyacetic acid), e.g. Weed'n'Feed, in surface water. For additional explanations of individual circumstances please refer to the appropriate Provincial Table of Circumstances in Appendix C (refer to Table 9.4).

9.5.2 Conditions

As described in Section 9.4.2, one parameter was identified as a condition resulting from past activities. However, according to the TR, it was not considered a threat. Therefore, no conditions represent a significant drinking water threat.

9.5.3 Non-Prescribed Activities

Moderate pathogen roadway transportation threats were enumerated for the Niagara Falls IPZ-1 corridor threats as shown on Figure 9.6.

Table 9.7 lists the moderate transportation threat type counts per category. This analysis is similar to the TDWTs analysis, as threats were identified (based upon the vulnerability score) and where a transportation corridor (road, rail, marine) exists which could allow these materials to be transported.

Table 9.7 Moderate Niagara Falls IPZ-1 Transportation Threats	
Chemical Threats	
Organic Solvents	3
DNAPLS	4
Fuels	2
Pesticides/Herbicides	9
Other Chemicals	15
Agricultural Source Material	2
Non-Agricultural Source Material – Sewage Biosolids	2
Non-Agricultural Source Material – Pulp and Paper Waste	2
Pathogen Threats	
Agricultural Source Material	1
Non-Agricultural Source Material – Sewage Biosolids	1
Non-Agricultural Source Material – Pulp and Paper Waste	0

9.6 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 Niagara Falls 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 Niagara Falls 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 Niagara Falls WTP intake:

- Colour;
- Temperature;
- Turbidity
- Aluminum;
- Hardness;
- pH; 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 an analysis of the above parameters of interest, only three non health related potential water quality issues were identified for the Niagara Falls WTP vulnerable area. pH was identified based upon an upward trend approaching the drinking water quality issue 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, pH and hardness have been attributed to naturally occurring processes and characteristics. For these reasons, pH and hardness 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 Niagara Falls WTP IPZs. The high quality of raw water received at the Niagara Falls 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
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9.7 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 9.8. As indicated in Table 9.8, the overall level of uncertainty for the Niagara Falls WTP surface water vulnerability assessment is low.

Niagara River (upstream of intake, looking east)



Table 9.8: Evaluation of Sources of Uncertainty for Niagara Falls WTP		
Task	Description of Uncertainty	Uncertainty
Section 9.1: Classification of Intake		
Intake classification	TR prescribe the Niagara River to be a Connecting Channel	Low
Section 9.2: Delineation of IPZs		
IPZ-1 Delineation	Dimensions for the IPZ-1 delineation are prescribed by the TR. Abutted shore setbacks were determined using the topographic surface and area of the Conservation Authority Regulation Limit, both of which were provided by the NPCA and have low uncertainty associated with their accuracy.	Low
IPZ-2 Delineation	Data acquired for modelling was of sufficient quality to conceptualize the in-water IPZ-2. Maps of storm sewer catchments, networks, outfalls, and topography were also considered to be of sufficient quality.	Low
Section 9.3: Assignment of Vulnerability Scores		
Vulnerability Scores	Data contributing to the area and source vulnerability factors are from reliable provincial and federal monitoring programs, Niagara Region Water Operations staff, and City of Niagara Falls staff.	Low
Section 9.5: Enumeration/Listing of Existing Threats		
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 and quantity of these resources was also sufficient.	Low
Section 9.6: Evaluation of Issues		
Issues Evaluation	The issues evaluation was based upon raw water quality data provided by the MOE. The data spanned 17 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