# TABLE OF CONTENTS



# LIST OF MAPS

## LIST OF TABLES

# 16.0 HALDIMAND COUNTY

## 16.1 Dunnville Water Treatment Plant

The Dunnville Water Treatment Plant (WTP) is an existing large municipal residential drinking water system (**Table 16-1**), and as such is a Type I system as defined by the Technical Rules.

**Table 16-1: Drinking Water System Information for the Dunnville Water Treatment Plant**

| DWS Number | DWS Name | Operating Authority | GW or SW | System Classification[1] | Number of Users Served |
|---|---|---|---|---|---|
| 220003555 | Dunnville Water Treatment Plant | Veolia Water Canada | SW | Large Municipal Residential | 5,729 |

[1] as defined by O. Reg. 170/03 (Drinking Water Systems) made under the *Safe Drinking Water Act, 2002.*

The Dunnville WTP is located in the Town of Dunnville, Haldimand County, along the shore of the Grand River. The Dunnville WTP services residential and industrial users in Dunnville and has an estimated serviced population of 5,729. The serviced areas are shown on **Map 16-1**. Raw water from Lake Erie is delivered to the WTP from a pump station located approximately 6.7 km south of the WTP. Technical studies to delineate intake protection zones and assign vulnerability scores are described in detail in the following reports:

- Surface Water Vulnerability Assessment Study Update for the Dunnville and Nanticoke Water Treatment Plants, Stantec Consulting Ltd. (January 2010)
- Haldimand County Source Protection Technical Study Phase 1, Stantec Consulting Ltd. (March 2008)
- Haldimand County Source Protection Technical Study Phase 2 Volume 1: Dunnville Water Treatment Plant, Stantec Consulting Ltd. (March 2008)

In addition to the primary intake located in Lake Erie, the Dunnville WTP is equipped with an emergency raw water intake in the Grand River adjacent to the plant. Technical studies describing the delineation of riverine intake protection zones, assignment of vulnerability scores and threat assessment are contained in the following references:

- Surface Water Vulnerability Assessment for the Dunnville Water Treatment Plant Emergency Intake, Stantec Consulting Ltd. (March 2011)
- Haldimand County Source Protection Planning Study: Dunnville WTP Emergency Intake (August 2014)

The Dunnville WTP has an existing rated capacity of 14.5 MLD, average monthly and annual flow of raw water from the pump station to the WTP in 2009 is summarized in **Table 16-2**. It should be noted that raw water is only supplied to the WTP via the Lake Erie intake, the emergency intake would only be operated under exceptional circumstances.

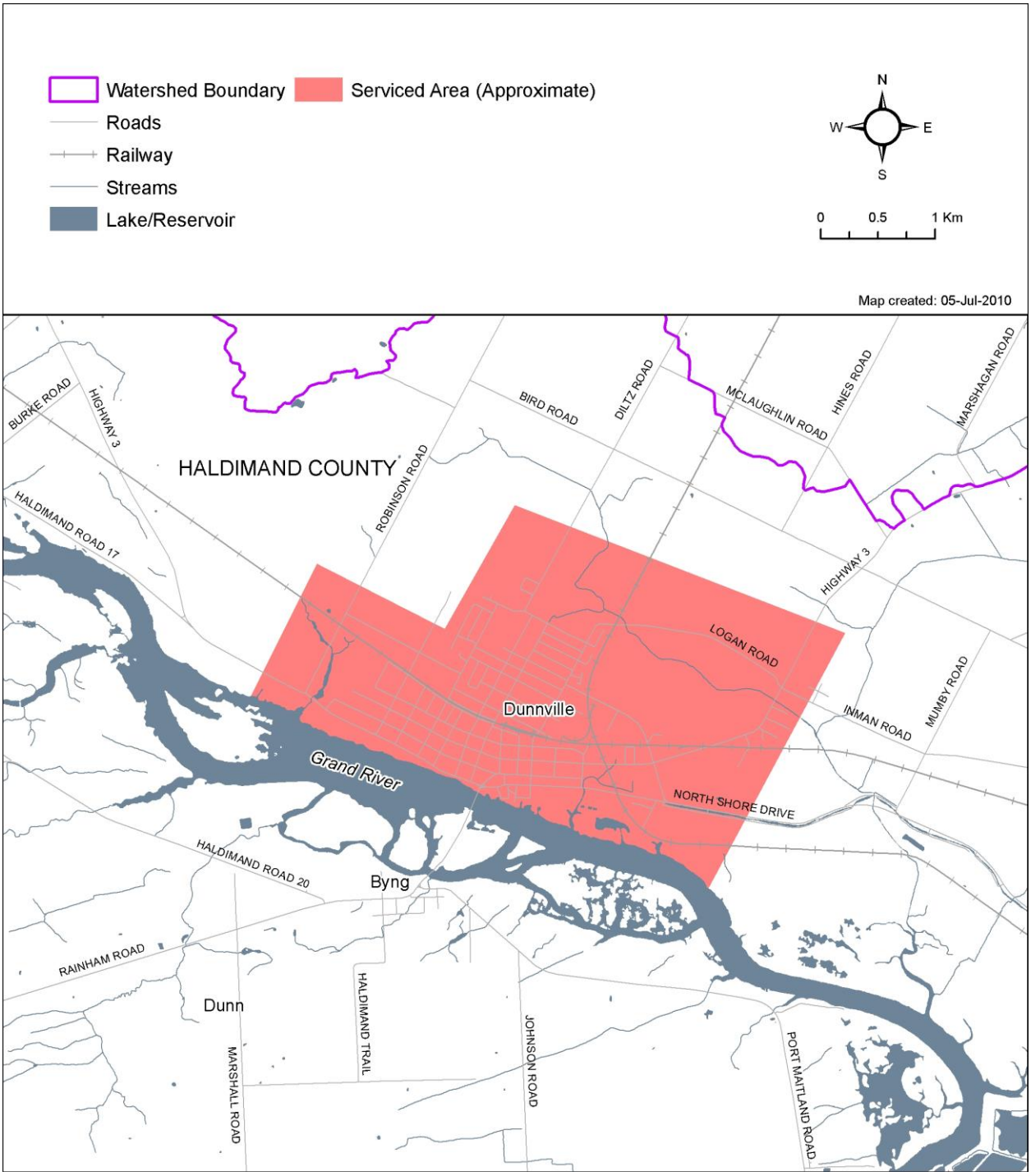
**Table 16-2: Annual and Monthly Average Pumping Rates for the Dunnville WTP (m3/day)**

| Annual Avg. | Jan Avg. | Feb Avg. | Mar Avg. | Apr Avg. | May Avg. | June Avg. | July Avg. | Aug Avg. | Sept Avg. | Oct Avg. | Nov Avg. | Dec Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6,420 | 6,036 | 5,985 | 5,274 | 5,603 | 7,060 | 6,609 | 6,639 | 8,176 | 6,009 | 6,815 | 6,605 | 6,227 |

[1] Source: 2009 data from Haldimand County

The Dunnville WTP has a single, type A (Great Lakes) intake located in Lake Erie in accordance with Technical Rule 55. The intake crib is located approximately 385 m offshore. The top of the crib is about 2.7 m below the Low Water Datum for Lake Erie. The emergency intake is located in the Grand River upstream of the Dunnville dam approximately 15 m from shore in shallow water. The emergency intake is classified as a type D intake in accordance with Technical Rule 55 due to the influence of the Dunnville dam which affects the velocity of the water at the intake.

**Map 16-1: Dunnville Water Treatment Plant Serviced Areas**



### 16.1.1 Lake Erie Intake

***Intake Protection Zone - 1***

Intake protection zones (IPZ) 1 and 2 were delineated for the intake in accordance with Part VI of the Technical Rules set by the Ministry of the Environment (November 2009).

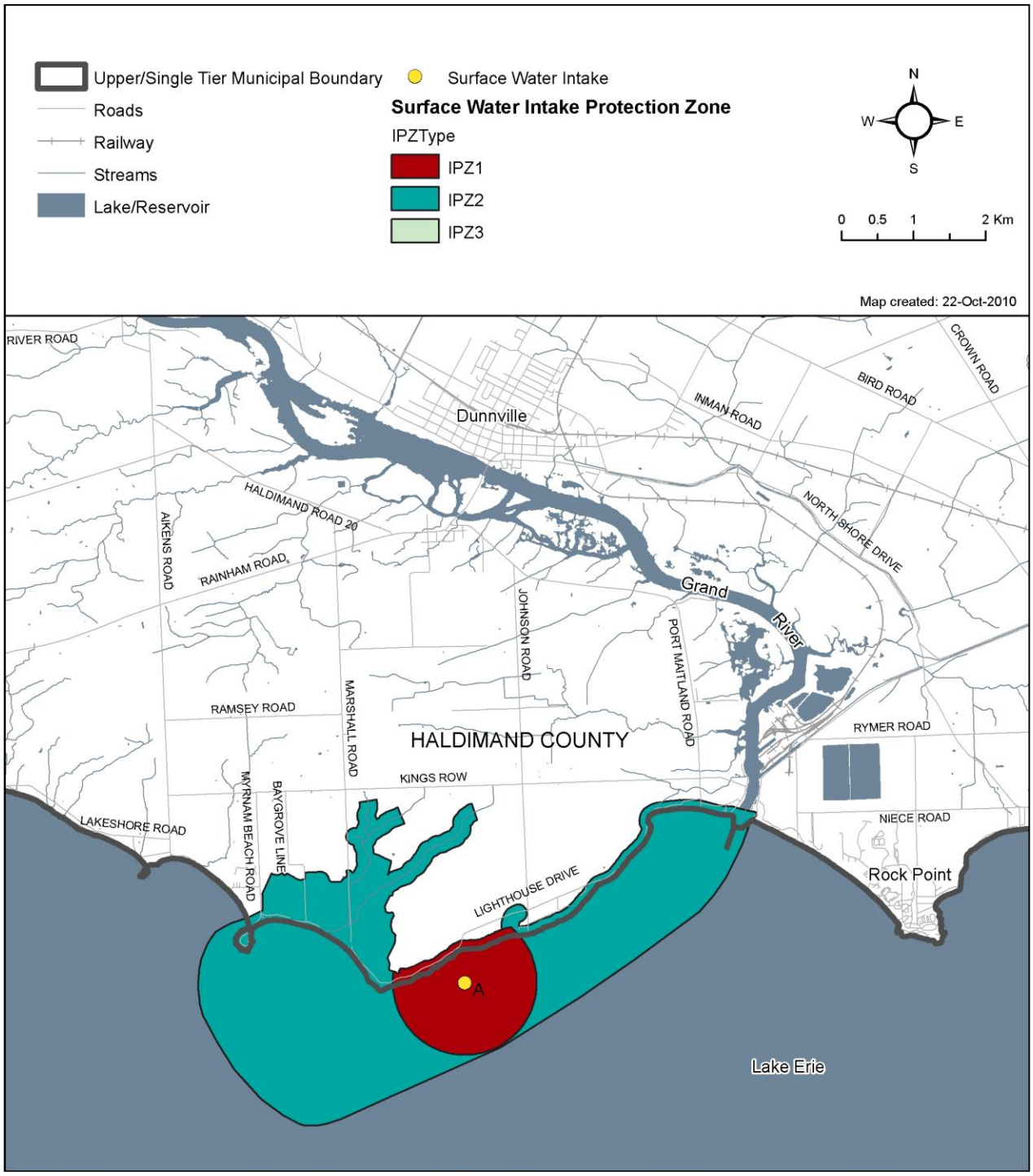
An IPZ-1 represents the most vulnerable and immediate area around an intake and, for a type A intake, is defined as a circle that has a radius of 1,000 m centered at the entry point of raw water supply for the system **(Map 16-2)**. Where the 1,000 m circle intersected land, only the portion of land within the Conservation Authority Regulation Limit or within 120 m, whichever is greater, was included. There were no special or unique conditions that required IPZ-1 to be modified to account for hydrodynamic conditions.

***Intake Protection Zone - 2***

An IPZ-2 was delineated for the Dunnville WTP intake using a time of travel of 2 hours. The 2 hour time of travel was deemed sufficient for operators to respond to an adverse situation based on interviews with water treatment plant operators. The IPZ-2 for the Dunnville WTP was delineated in two parts, in-water and upland. The in-water IPZ-2 was defined using the three-dimensional MIKE3 hydrodynamic model using 10-year return period wind speed from 8 compass directions and 2-year return period flows for the Grand River. The upland extent of the Dunnville IPZ-2 includes portions of the King and Bravin municipal drainage areas as these were determined to be transport pathways. The up-tributary extents were estimated for the King and Bravin municipal drainage areas based on calculated velocities and the residual time of travel to the intake. Channel velocity in the King and Bravin drains was estimated based on Manning's equation assuming bankfull flow conditions. The time of travel from the outlet of these drains was estimated to be approximately 1.5 hours; therefore, the up-tributary extent of IPZ-2 was based on a travel time of 0.5 h in the drain. The alongshore IPZ-2 generally extended upland 120 m, however it was extended to meet the area of the Regulation Limit, where it was greater. This included a Provincially Significant Wetland between Low Point and Grant Point. No municipal storm, sanitary sewers, or tile trained areas were identified in the Dunnville WTP IPZ-2.

A variety of information was synthesized to determine the most suitable approach for determining both the in-water extent, shoreline extent and up-tributary extent of the IPZ-2 and included the data sources listed in **Table 16-3**. This table also identifies the purpose for which the data was used.

## Map 16-2: Dunnville Water Treatment Plant Intake Protection Zone



## Map 16-3: Dunnville Water Treatment Plant Intake Protection Zone Vulnerability

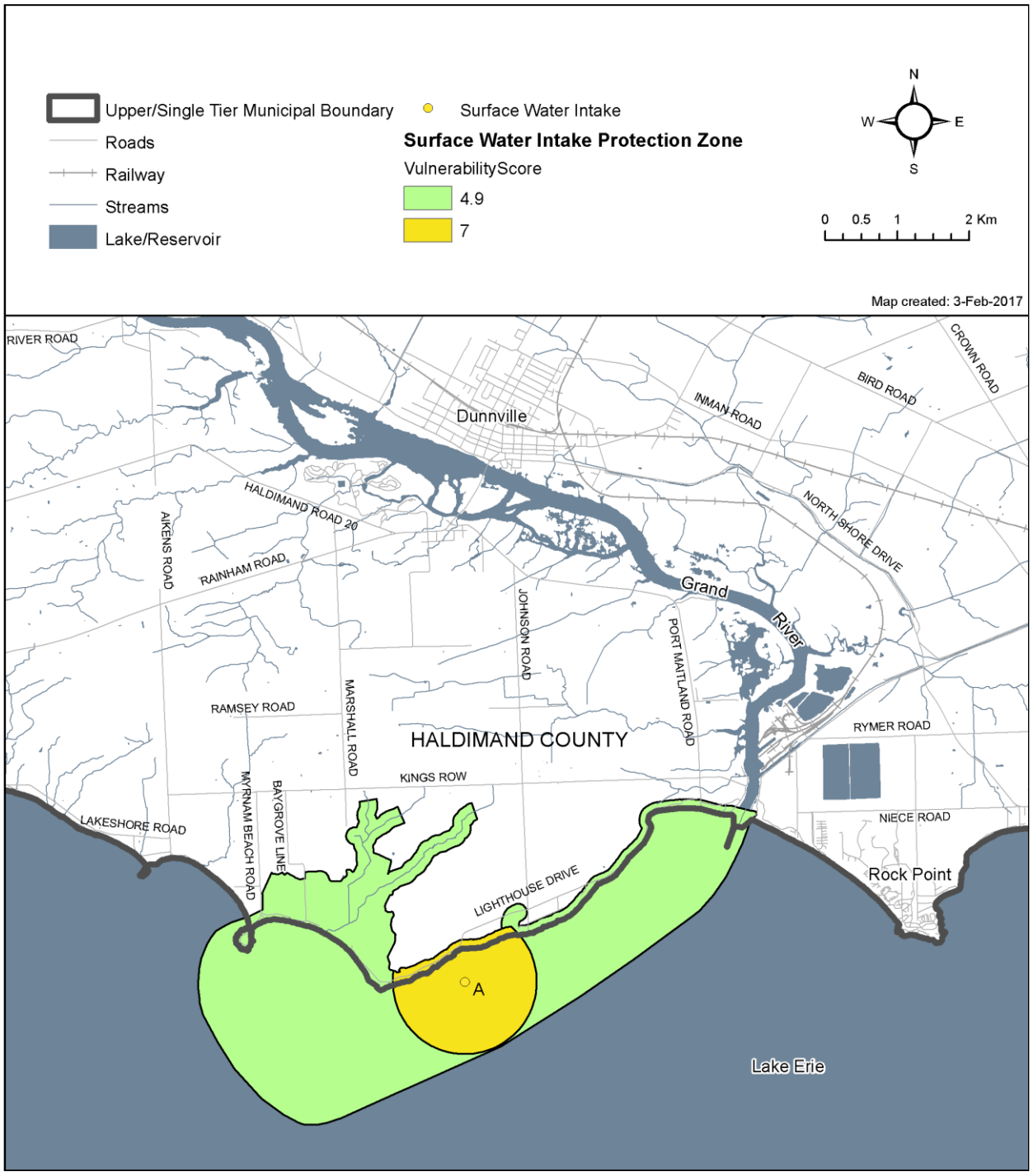


**Table 16-3: Summary of Data Sources Used in the Delineation of the IPZ-2 for the Dunnville Water Treatment Plant**

| Data Type | Source | Purpose |
|---|---|---|
| Lake Erie bathymetry | Raw depth sounding released by US National Oceanic and Atmospheric Administration (NOAA) in 2007 | Development of hydrodynamic model to determine in-water extent of IPZ-2 |
| Location of Lake Erie shoreline GIS dataset | Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF) Ontario Base Map theme | Development of hydrodynamic model to determine in-water extent of IPZ-2 |
| Wind speed and direction | Atmospheric Environment Service station at Long Point, the Marine Environmental Data Service buoy located in Lake Erie off Port Colborne and the Lake Erie Operational Forecast System, which uses the Princeton Ocean Model to forecast winds over the entire lake | Development of hydrodynamic model to determine in-water extent of IPZ-2 |
| Lake current data | Ministry of the Environment data for the period between May and October 2004 | Development of hydrodynamic model to determine in-water extent of IPZ-2 |
| Daily average flow in the Grand River at York | Water Survey of Canada | Development of hydrodynamic model to determine in-water extent of IPZ-2 |
| Water levels for Lake Erie | Canadian Hydrographic Service and NOAA | Development of hydrodynamic model to determine in-water extent of IPZ-2 |
| Digital elevation model v2.0 with 10 m resolution | NDMNRF Land Information Ontario (LIO) dataset | Infer stormsewer catchments and determine land slope for overland flow analysis |
| Stormsewer GIS dataset | Haldimand County | Identify stormsewer systems that may impact IPZ |
| Watercourse mapping using Water Virtual Flow and Water Poly Segment GIS datasets | NDMNRF | Identify watercourses/transport pathways that may impact IPZ |
| Constructed drain and tile drainage GIS dataset | Ontario Ministry of Agriculture, Food and Rural Affairs | Identify transport pathways that may impact IPZ |
| Conservation Area Regulation Limit GIS dataset | Grand River Conservation Authority | Determine land area to be included in IPZ |
| 2006 orthoimagery with 30 cm resolution | Haldimand County | General mapping and identification of surface features |

**Table 16-3: Summary of Data Sources Used in the Delineation of the IPZ-2 for the Dunnville Water Treatment Plant**

| Data Type | Source | Purpose |
|---|---|---|
| Water treatment plant operator interviews | Water treatment plant operator | Identify operational concerns and obtain local knowledge |
| Raw water quality | MOE Drinking Water Surveillance Program, MOE Drinking Water Information System, Ontario Clean Water Agency *E. coli* process data, Haldimand County turbidity process data | Assess vulnerability of intake and identify concerns |
| SOLRIS Land cover and soil permeability GIS dataset | NDMNRF | Assess vulnerability of intake |

The modeling work completed for the delineation of the IPZ-2 was generally a conservative approach and is typical of planning level investigations.

The in-water IPZ-2 was defined using hydrodynamic modeling and extended approximately 3,700 m to the west, 4,500 m to the east, and 2,750 m offshore (at its furthest extent). The IPZ-2 also extended 2,316 m up the Bravin Drain, 2,745 m up King Drain #1 and 2,456 m up King Drain #2. The IPZ-2 is illustrated in **Map 16-7**.

### *Vulnerability Assessment*

Vulnerability analysis of the IPZ-1 and 2 includes consideration for both the area and the source as described in the Technical Rules. The area vulnerability and the source vulnerability are multiplied to generate a vulnerability score for IPZ-1 and IPZ-2.

The area vulnerability factor for an IPZ-1 is prescribed to be 10 in the Technical Rules while the area vulnerability factor for an IPZ-2 can range from 7 to 9.

The area vulnerability for an IPZ-2 takes into account the percentage of the IPZ-2 area that is land, land cover, soil type, soil permeability and transport pathways. The area vulnerability score for the IPZ-2 for the Dunnville WTP was determined to be 7.0 based on the following considerations:

- less than 1/3 of the IPZ-2 consists of land;
- land characteristics describe moderate to low runoff potential; and
- there are a limited number of transport pathways including storm sewers and tile drains.

The source vulnerability factor for a Great Lake intake (type A) can range from 0.5 to 0.7 and takes into consideration intake characteristics, such as the depth of the intake, the distance the intake is offshore and whether there have been any identified water quality concerns at the intake. The source vulnerability was determined to be 0.7 considering that the intake is relatively shallow (i.e. 2.7 m); it extends out less than 500 m from shore; and there have been some water quality concerns identified at the intake.

Based on combining the area and source vulnerability scores, the overall vulnerability score for the Dunnville Water Supply IPZ-1 was 7.0 and IPZ-2 was 4.9 (**Table 16-4**).

**Table 16-4: Vulnerability score summary for the Dunnville Water Treatment Plant**

| Intake Type | Area Vulnerability Factor | | Source Vulnerability Factor | Vulnerability Score | |
|---|---|---|---|---|---|
| Type A | IPZ-1 | IPZ-2 | 0.7 | IPZ-1 | IPZ-2 |
| | 10 | 7 | | 7 | 4.9 |

***Managed Lands within the Dunnville Intake Protection Zones***

Managed lands are lands to which nutrients are applied. Managed lands can be categorized into two groups: agricultural managed land and non-agricultural managed land. Detailed methods on calculating managed lands are described in Chapter 3 of this Assessment Report.

The percentage of managed lands has been calculated for the Dunnville WTP IPZ-1 and 2, as shown on **Map 16-4**.

***Livestock Density within the Dunnville Intake Protection Zones***

The percentage of livestock density has been calculated for Dunnville WTP IPZ-1 and 2, as shown on **Map 16-5**. Detailed methods on calculating livestock density are described in Chapter 3 of this Assessment Report.

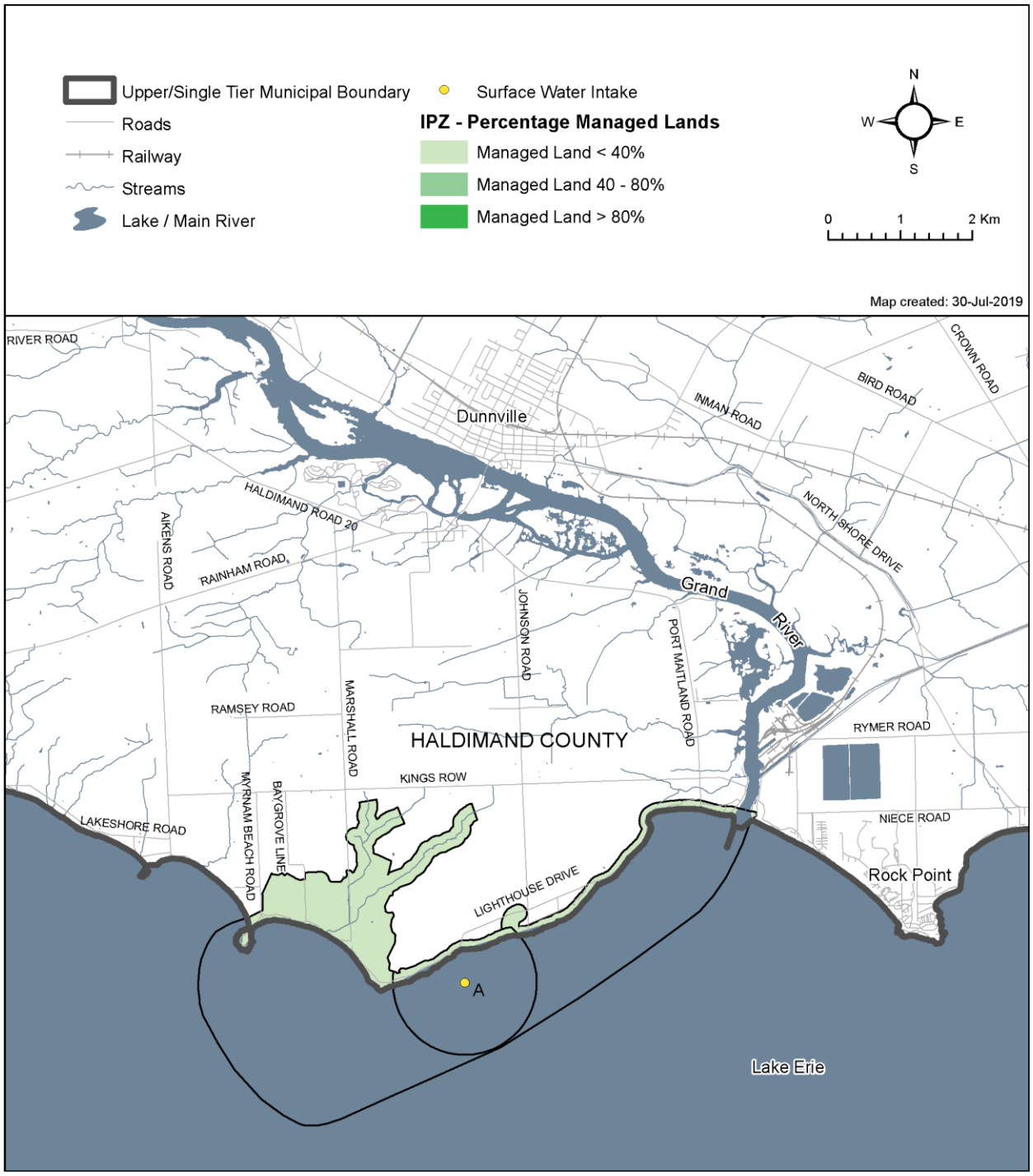
The vulnerability scores for these IPZs are less than the vulnerability score necessary for the related activities to be considered significant threats, according to the Ministry of Environment, Conservation and Parks (MECP's) Table of Drinking Water Threats.

***Percentage of Impervious Surfaces within Intake Protection Zones***

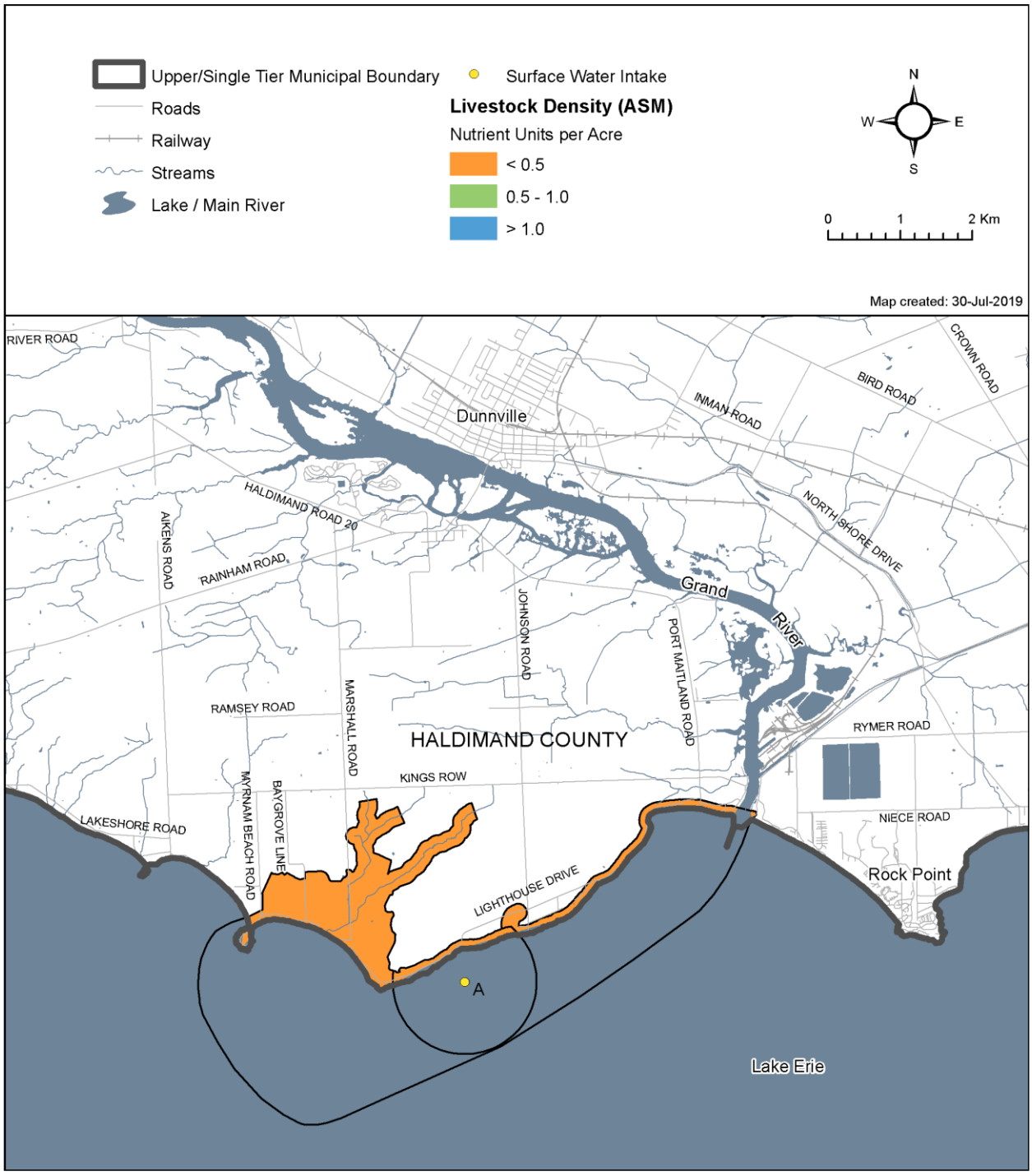
To determine whether the application of road salt poses a threat in the Dunnville area, the percentage of impervious surface where road salt can be applied per square kilometre was calculated as per the Assessment Report: Technical Rules subrule 16(11) and 17.

The percentage of impervious surface area for the Dunnville WTP IPZ-1 and 2 and is shown on **Map 16-6**.

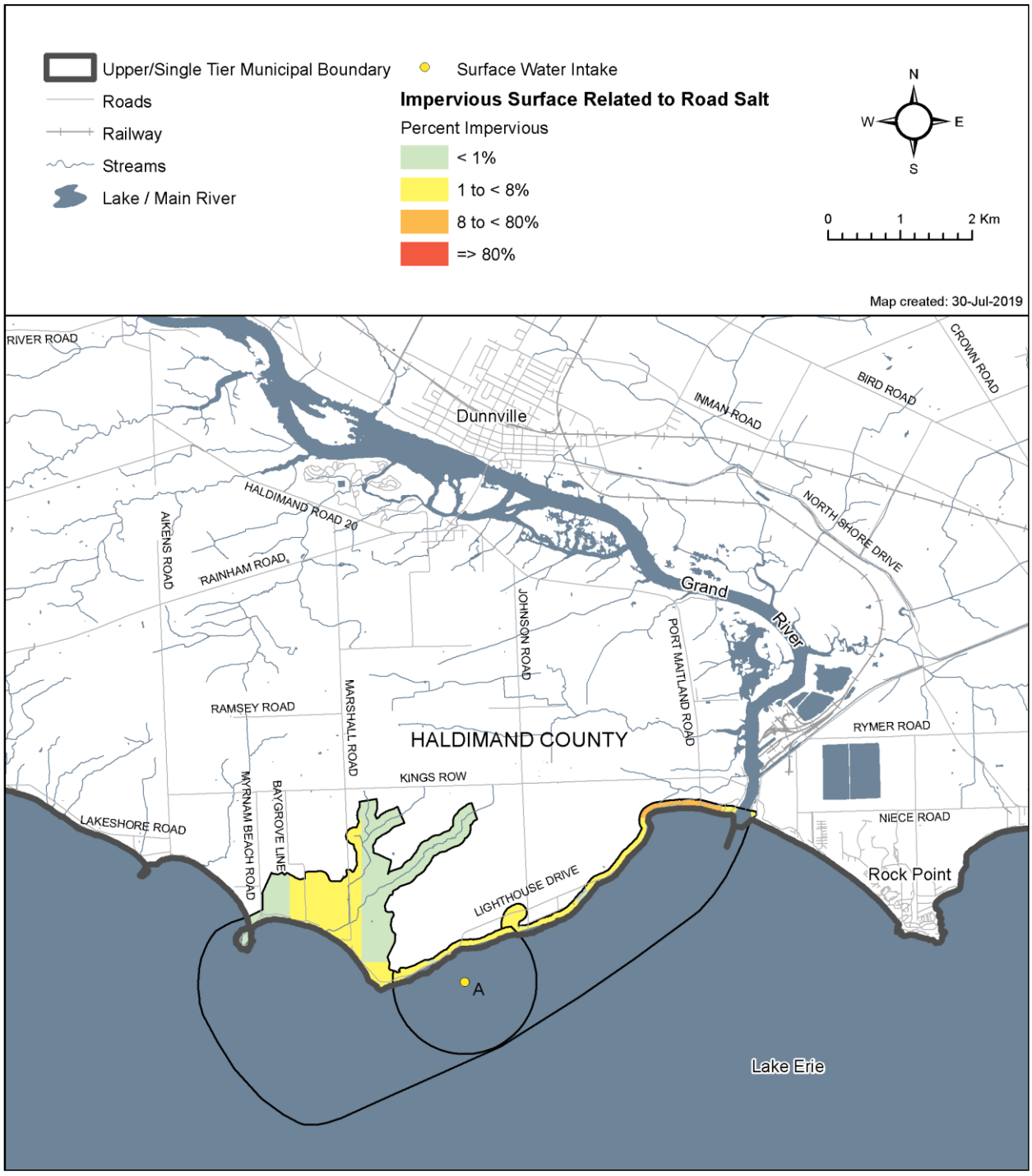
## Map 16-4: Dunnville Water Treatment Plant Percent Managed Lands



## Map 16-5: Dunnville Water Treatment Plant Livestock Density



## Map 16-6: Dunnville Water Treatment Plant Percent of Impervious Surfaces



The vulnerability scores for these IPZs are less than the vulnerability score necessary for the related activities to be considered significant threats, according to the MECP's Table of Drinking Water Threats.

***Limitations of Data and Methods for the Vulnerability Assessment***

There was a high level of confidence in the datasets used to delineate IPZ-1 and the methodology was prescribed by the Technical Rules, therefore a low level of uncertainty was assigned and no limitations were identified. Hydrodynamic modeling was used for the delineation of IPZ-2 and the following limitations were noted:

- The numerical model did not account for wave-induced currents, which are more important in shallow water and may impact the IPZ-2;
- Hydrodynamic modeling provided a general understanding of currents and the resultant in-water IPZ-2 for a range of conditions, however it did not provide a detailed analysis of the physical processes at the site such as upwelling or the dispersion of contaminant plumes through natural diffusion transport processes as a result of density currents;
- A 10-year return period wind speed was used in the matrix runs. The model was run at a constant wind speed until the model reached steady state. This is not realistic as this constant wind speed would not be sustained in reality, so it is not possible to associate a return period duration with the event;
- Cross-section data for the rivers was limited to the information supplied in the hydrographic dataset. Actual river cross-section data should be collected and used in future phases to better define the velocities in the river and the IPZ-2 limits;
- Only gauged tributaries were defined in the model; and
- A conservative approach was taken in the reverse particle tracking. Particles were released at the surface where currents are stronger. Particles were also released near the lakebed for comparison; however the particles released at the surface were used to delineate the IPZ-2s.

*Uncertainty for the Vulnerability Assessment*

Uncertainty was assessed for the delineation of the IPZ's and the vulnerability scoring for the Dunnville WTP intake considering the (1) data that was used in the analysis; (2) modeling; (3) quality assurance and quality control; (4) calibration and validation; and (5) accuracy of the vulnerability factors. Overall, the delineation of the IPZ-1 was considered to have low uncertainty, as this was a relatively straight-forward mapping exercise. Although large, in-lake hydrodymanic modelling is inherently uncertain, the study team felt that the IPZ-2 delineation was sufficient for the purposes of source protection planning and an overall uncertainty for IPZ-2 for the in-lake intakes was considered low. Sufficient data and information was gathered to assign a low level of uncertainty for the vulnerability score for IPZ-1. Vulnerability scoring for IPZ-2 was determined to have low uncertainty. Although there were a limited number of sources of data used in determining the vulnerability score for IPZ-2, there was sufficient information available to determine a vulnerability score in accordance with the Technical Rules.

Despite the inherent limitations and challenges associated with large in-lake modeling, there was sufficient information and analysis completed to ensure that the intent of the Technical Rules to delineate and score vulnerability areas for the Dunnville WTP intake was met. Therefore the vulnerability assessment for the intake, at the time of this report, is classified as having low uncertainty.

The associated overall uncertainty assessment is summarized on **Table** 16-5.

**Table 16-5: Uncertainty Evaluation for the Dunnville WTP Intake**

| Vulnerable Area | Delineation Uncertainty | Vulnerability Uncertainty |
|---|---|---|
| IPZ-1 | Low | Low |
| IPZ-2 | Low | Low |

### 16.1.2 Grand River Emergency Intake

***Intake Protection Zone – 1***

IPZ-1 and -2 for the emergency intake were delineated in accordance with Part IV of the Technical Rules. For a Type D intake, IPZ-1 begins as a full circle about the intake with a 1,000 metre radius. Owing to the presence and hydrodynamic effect of the Dunnville Dam, this circle has been truncated at the dam and two other water control structures to remove areas downstream of these structures. Where the IPZ-1 abuts land, it was delineated upland to the maximum of the GRCA Regulation Limit or 120 metres (**Map 16-7**). The upland portion, however, does not include any area that drains to the Grand River downstream of the Dunnville Dam or Byng Weirs #2 and #3.

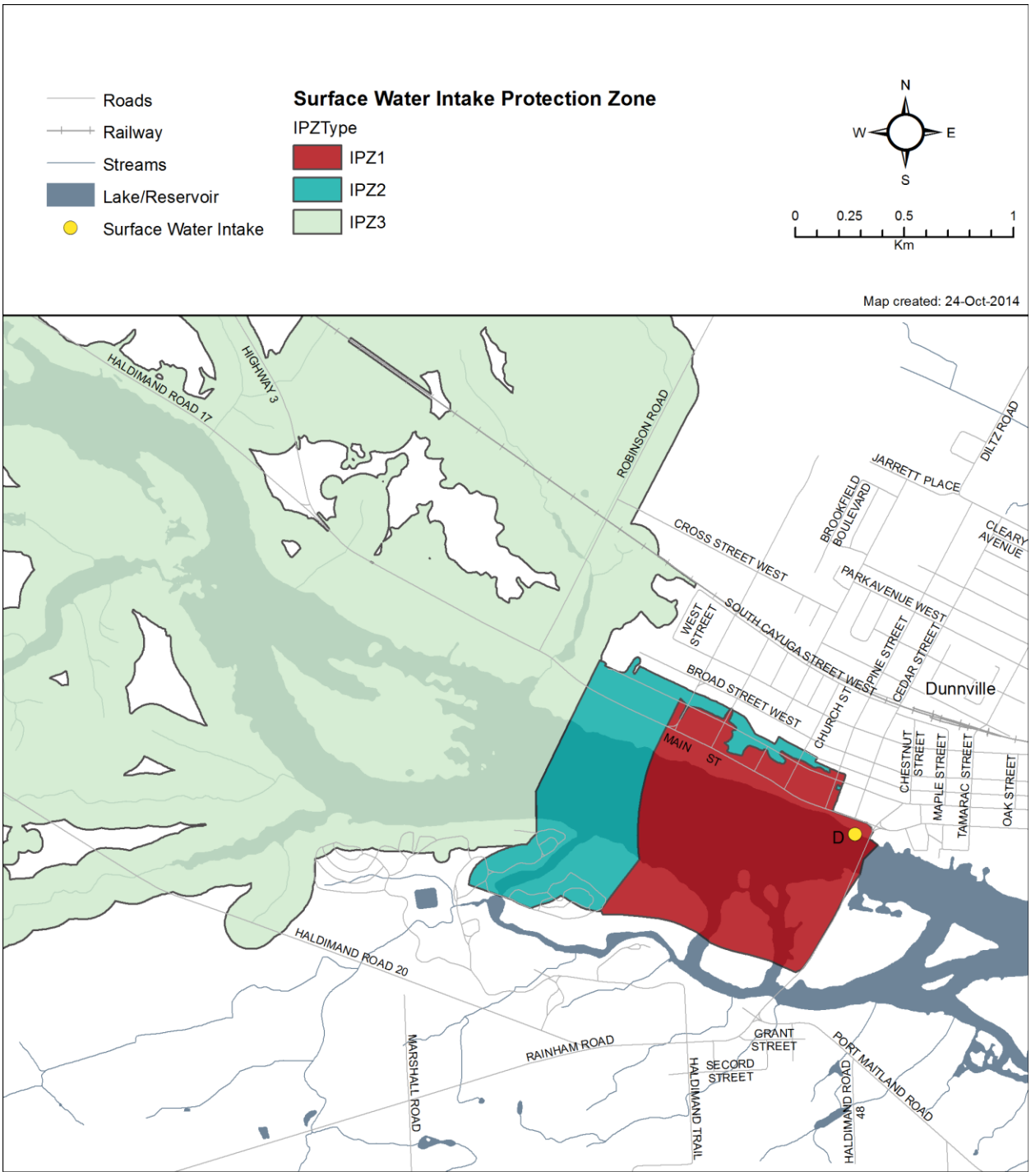
***Intake Protection Zone – 2***

Per Technical Rule 65, IPZ-2 for the emergency intake was derived by delineating the water area and abutting land that could contribute flow to the intake within two hours. A two hour time of travel was used to delineate IPZ-2 as this is the minimum required by the Technical Rules and is considered to be sufficient time for the Dunnville WTP operator to respond to an adverse condition.

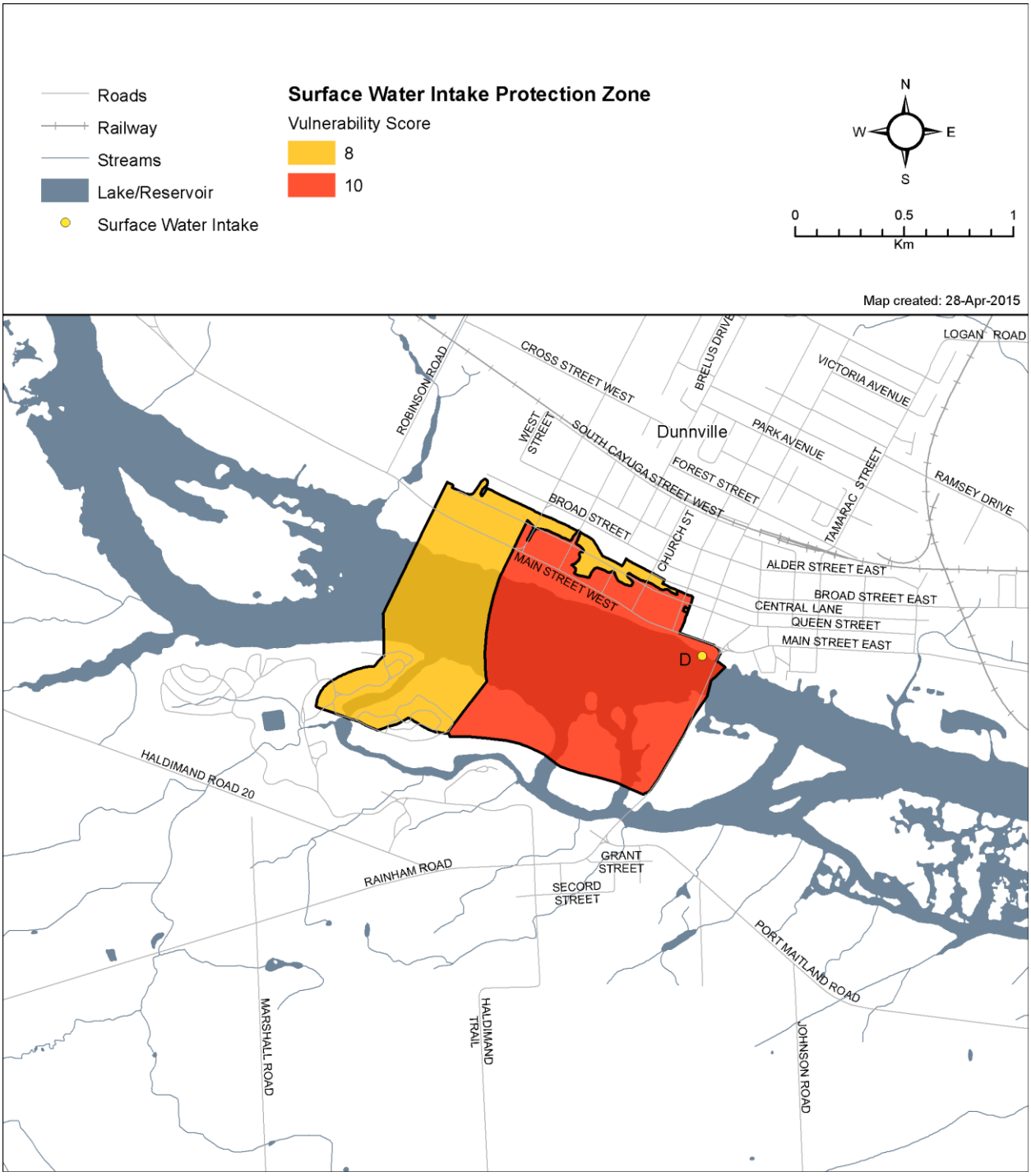
A HEC-2 hydraulic model for the Grand River for McKenzie Creek to Lake Erie was obtained from the GRCA and used to calculate the velocity of flow upstream of the intake under design flow conditions. The design flow was based on the 95$^{th}$ percentile of estimated daily flow at Dunnville, which was conservatively estimated to be 257 m$^3$/s. Under these design conditions, the hydraulic model predicted relatively low velocities in the order of 0.2 m/s, which produced a two-hour upstream distance of 1,467 metres from the intake. The IPZ-2 includes this portion of the Grand River, as well as abutting land up to the maximum of the Regulation Limit and 120 metres while accounting for topography that directs flow away from the source water.

Additional area was also included due to the presence of storm sewers that may act as transport pathways in the event of a spill. Analysis of storm water catchments indicated that there are two storm sewer outlets located near the emergency intake and velocities within these systems was sufficiently high to warrant inclusion of the entire catchment within IPZ-2 (**Map 16-7**).

**Map 16-7: Dunnville Water Treatment Plant Emergency Intake Protection Zone 1 and 2**



## Map 16-8: Dunnville Water Treatment Plant Emergency Intake Protection Zone 1 and 2 Vulnerability

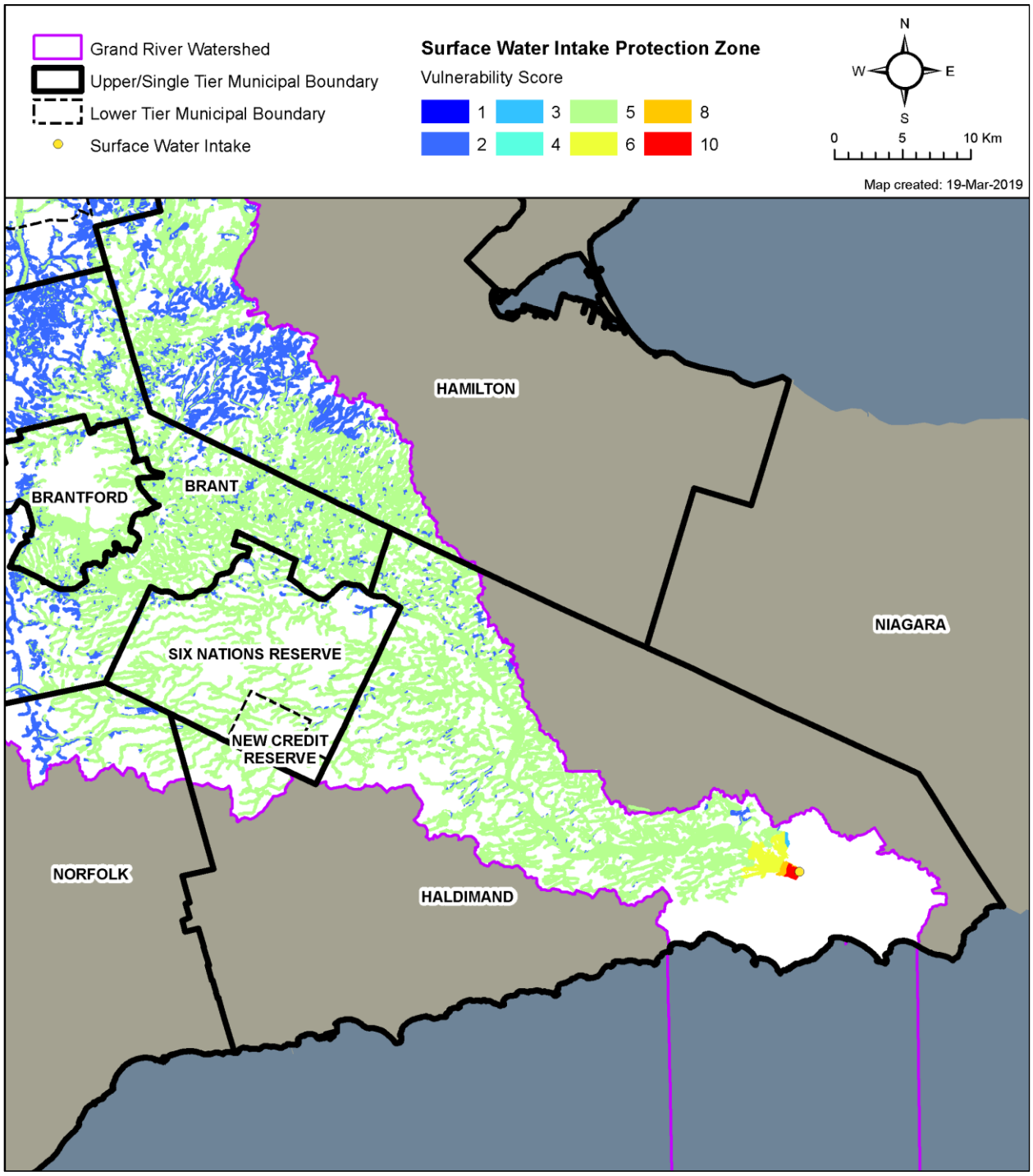


### *Intake Protection Zone – 3*

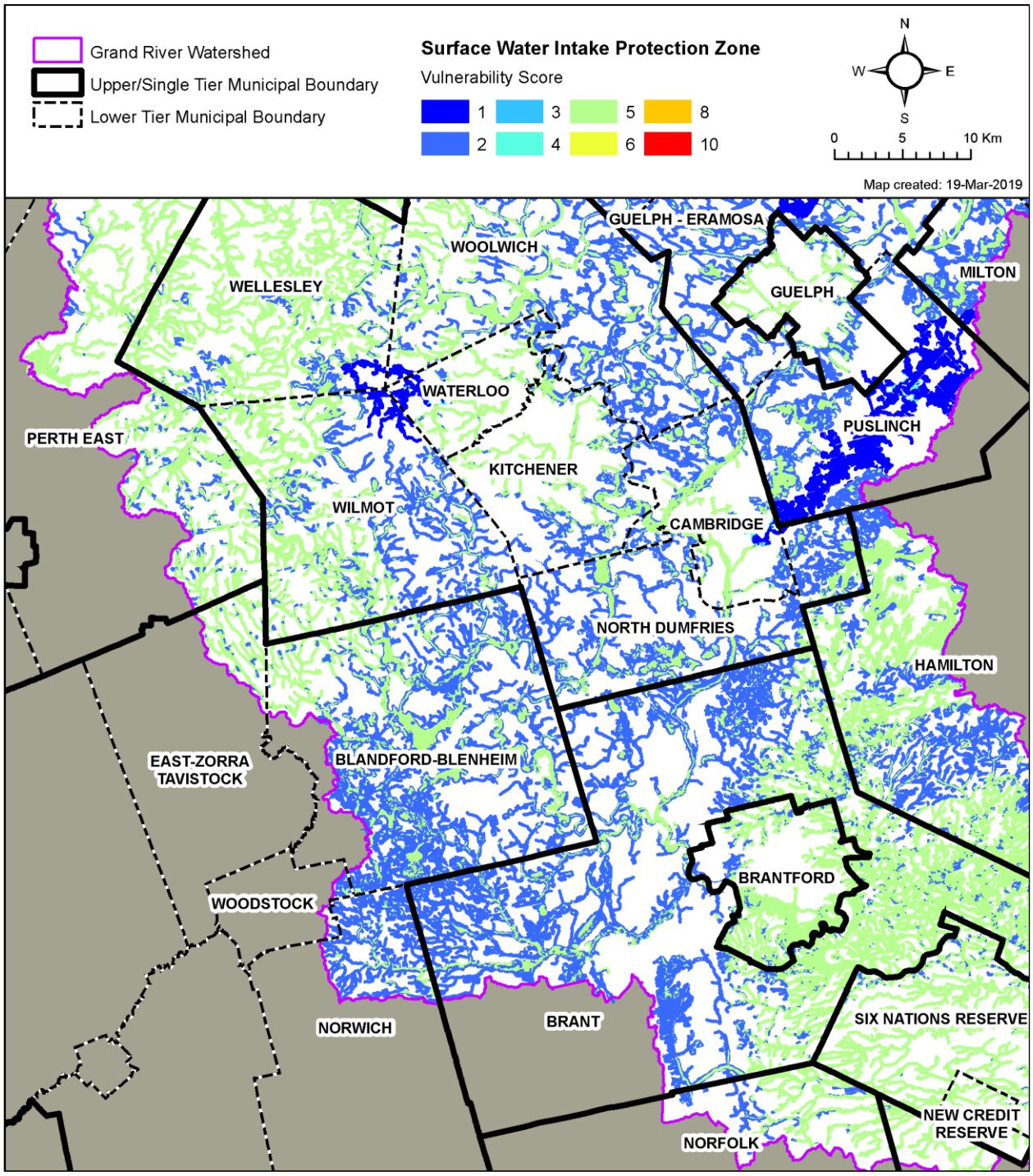
In accordance with Technical Rule 70, IPZ-3 for the emergency intake was delineated to incorporate the area within each surface water body that may contribute water to the intake. Therefore the full extent of the Grand River and its tributaries upstream of the intake was included, in addition to the appropriate 120 metre or Regulation Limit setback. Transport pathways were not included. The delineation is extensive and covers approximately 320,000 hectares of land, ranging from Woodstock in the east, to Hamilton in the west and Melancthon Township in the north, and incorporating parts of the cities of Waterloo, Kitchener, Cambridge, Brantford and Guelph.

For the purposes of delineating IPZ-3 for the emergency intake, the NDMNRF Water Virtual Flow – Seamless Provincial Data Set and Water Poly Segment GIS data layers from the Ontario Land Information Warehouse were used to identify water bodies upstream of IPZ-2 that may contribute water to the intake. IPZ-3 for the Dunnville WTP emergency intake is shown in **Map 16-9, Map 16-10, and Map 16-11.**

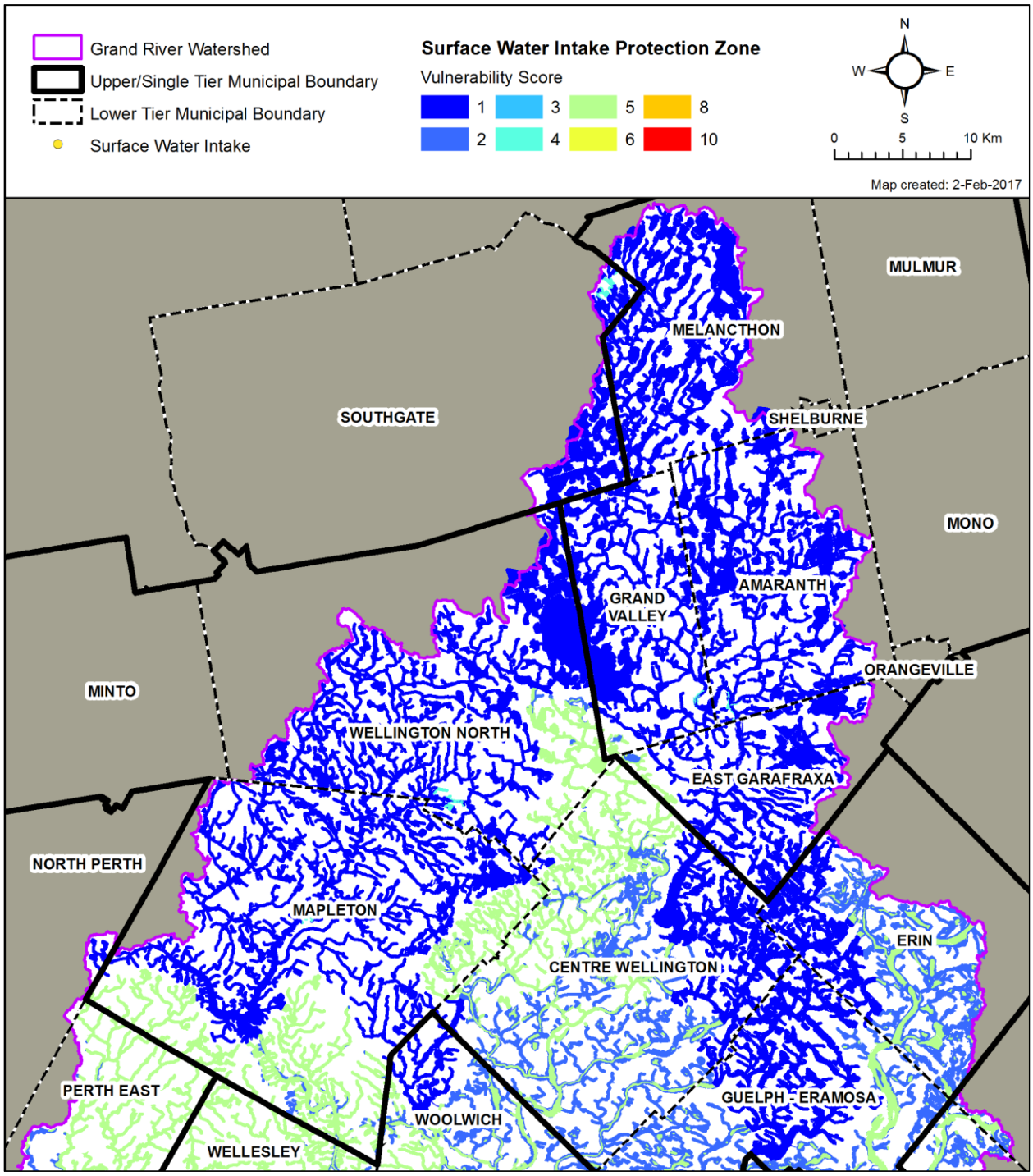
**Map 16-9: Dunnville Water Treatment Plant Emergency Intake Protection Zone 3 (1 of 3)**



## Map 16-10: Dunnville Water Treatment Plant Emergency Intake Protection Zone 3 (2 of 3)



**Map 16-11: Dunnville Water Treatment Plant Emergency Intake Protection Zone 3 (3 of 3)**



***Vulnerability Assessment***

The vulnerability analysis of IPZ-1, IPZ-2 and IPZ-3 included the consideration for both the area and the source as described in the Technical Rules. The area vulnerability and source vulnerability are multiplied to generate the vulnerability score for IPZ-1, IPZ-2 and IPZ-3 for the Dunnville WTP emergency intake.

The source vulnerability factor for a Type D intake can range from 0.8-1.0. The source vulnerability factor takes into account the intake characteristics and the history of water quality concerns at the intake. The emergency intake for Dunnville is located in shallow water within the backwater area associated with the Dunnville Dam, located approximately 100 m upstream of the Dover Road/Rainham Road bridge crossing. The intake extends approximately 15 m into the Grand River, which, at this location, is approximately 160 m across. Although there is no historical chemical or physical water quality monitoring available at the emergency intake location, the quality of the lower Grand River sub-basin is heavily impacted by the cumulative influence of numerous point source discharges and runoff from both urban and rural land uses. Given the nature of the upstream watershed and location of the intake, the overall source vulnerability was deemed to be high and a score of 1.0 was selected.

As prescribed by the Technical Rules, the area vulnerability score for the emergency intake IPZ-1 is assigned a score of 10. The area vulnerability score for IPZ-2 can be assigned a value between 7 and 9 taking into account the percentage of the IPZ-2 area that is land; land cover, soil type, and soil permeability which combine to characterize runoff potential; and transport pathways. The area vulnerability score for the emergency intake IPZ-2 was assigned a value of 8 considering the following factors:

- 61% of IPZ-2 is composed of land, which makes the emergency intake more susceptible to land-based threats

- The land cover is approximately 40% urban, soils are predominantly Group C with low permeability and a shallow slope. Although a shallow slope favours infiltration, the other land characteristics suggest a relatively high potential for runoff that could carry contaminants to the emergency intake

- There are a small number of transport pathways, however they are associated with storm sewers and therefore make the emergency intake more vulnerable to land-based threats within the town of Dunnville.

Generally, the area vulnerability scoring for IPZ-3s was approached consistently across the Lake Erie Source Protection Region. The following criteria, according to Technical Rule 92, were used:

- Percentage of the area composed of land;
- Runoff potential that incorporates land cover, soil type, permeability and slope;
- Transport pathways; and
- Proximity of the area to the intake.

The IPZ-3 for the Dunnville emergency intake is extensive and extends up the Grand, Nith, Speed, and Conestogo Rivers among other smaller tributaries. Consequently, the study team felt that a watershed this size needed to be described first according to the proximity to the intake and then second, according to land use and runoff potential. Therefore, ‘close’, ‘intermediate’ and ‘far’ zones were delineated to best describe the vulnerability in the context of its proximity to the intake. ‘Close’ was defined being within twice the travel distance of IPZ-2. For the Dunnville emergency

intake, IPZ-2 extends approximately 1.5 km from the intake up the Grand River. The 'close' zone was therefore defined as any watercourse within 3 km of IPZ-2 measured along the centreline of the stream. Given the extent of the entire upstream watershed, the study team felt that two-times the IPZ-2 distance best described the 'Close' zone. Proximity, combined with runoff potential and land use (e.g. urban and rural) then determined the overall vulnerability for these areas. 'Moderate' was considered to be anything between the 'close' zone and the major flood control reservoirs (i.e. Guelph Dam, Shand Dam, Conestogo Dam, Woolwich Dam, Laurel Creek Dam and Shades Mill Dam). Any areas upstream of a major reservoir was considered to be 'far', as there is considerable dilution and retention within the reservoirs.

Areas in the 'close' zone were assigned a higher vulnerability score relative to areas in the 'far' zone which were given a lower vulnerability score. The IPZ-3, composed mostly of land, includes both urban and rural areas. Higher vulnerability scores were assigned to urban areas relative to rural areas that were given lower vulnerability scores. Urban areas were identified using the SOLRIS Built-up Areas GIS layer to identify towns and villages larger than 2.5 $km^2$. A value of 2.5 $km^2$ was chosen as this is the size of a small village which would contain approximately 1000 to 1500 homes (e.g. about the size of Ayr, St. George or Arthur). Smaller communities are likely to have less impervious surface as they have less municipal infrastructure (e.g. fewer sidewalks, stormdrains, etc.) and less industrial, commercial and institutional development. For this reason, urban areas smaller than 2.5 $km^2$ are considered to be less vulnerable than larger urban centres.

The runoff potential, as determined through the Tier II water budget (AquaResource Inc. 2009), varies considerably throughout the watershed. Those areas with high runoff (i.e. greater than 250 mm/year) were assigned a higher vulnerability score relative to those areas with low runoff scored a lower vulnerability score. Proximity, land use (e.g. rural /urban) and runoff potential were combined to yield relative vulnerability scores for each zone.

**Table** 16-6 summarizes the source and area vulnerability scores for the emergency intake IPZ.

**Table 16-6: Vulnerability Score Summary for the Dunnville Emergency Intake**

| IPZ | Area Vulnerability Factor | Source Vulnerability Factor | Vulnerability Score |
|---|---|---|---|
| IPZ-1 | 10 | 1.0 | 10 |
| IPZ-2 | 8 | 1.0 | 8 |
| IPZ-3 (urban area, close to intake) | 8 | 1.0 | 8 |
| IPZ-3 (rural area, high runoff potential, close to intake) | 6 | 1.0 | 6 |
| IPZ-3 (rural area, low runoff potential, close to intake) | 3 | 1.0 | 3 |
| IPZ-3 (urban area, intermediate distance) | 5 | 1.0 | 5 |
| IPZ-3 (rural area, high runoff potential, intermediate distance) | 5 | 1.0 | 5 |
| IPZ-3 (rural area, low runoff potential, intermediate distance) | 2 | 1.0 | 2 |
| IPZ-3 (urban area, far) | 4 | 1.0 | 4 |

| | | | |
|---|---|---|---|
| IPZ-3<br>(rural area, high runoff potential, far) | 1 | 1.0 | 1 |
| IPZ-3<br>(rural area, low runoff potential, far) | 1 | 1.0 | 1 |

### *Managed Lands within the Dunnville Emergency Intake Protection Zones*

Managed Lands are lands to which nutrients may be applied. These lands are categorized into two groups: agricultural managed land and non-agricultural managed land. Agricultural managed land includes areas of cropland, fallow, and improved pasture that may receive nutrients. Non-agricultural managed land includes golf courses, sports fields, lawns and other built-up grassed areas that may receive nutrients (primarily commercial fertilizer). The percentage of managed lands within the IPZ for the emergency intake was calculated as described in Section 3 of the Assessment Report and is shown on **Map 16-12, Map 16-13, Map 16-14 and Map 16-15.**

### *Livestock Density within the Dunnville Emergency Intake Protection Zones*

The Technical Rules (Part II, Rule 16) also require the mapping of livestock density. Livestock density is defined as the number of nutrient units over a given area, and is expressed by dividing the nutrient units by the number of acres in the agricultural managed land area or the livestock grazing area depending on the threat being assessed.

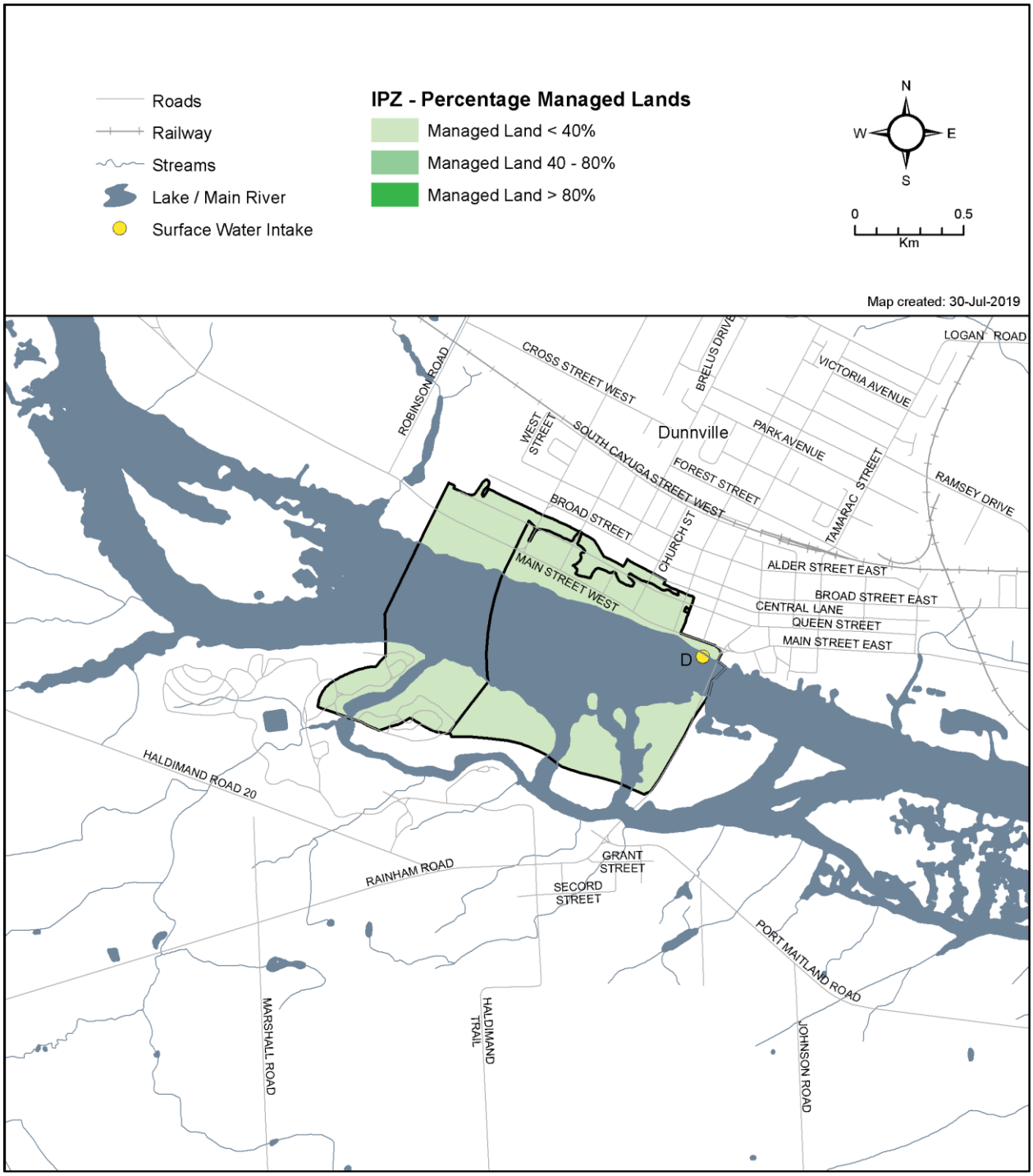
The percentage of livestock density has been calculated for Dunnville emergency intake IPZ, as shown on **Map 16-16, Map 16-17, Map 16-18, and Map 16-19**.

### *Percentage of Impervious Surfaces within the Dunnville Emergency Intake Protection Zones*

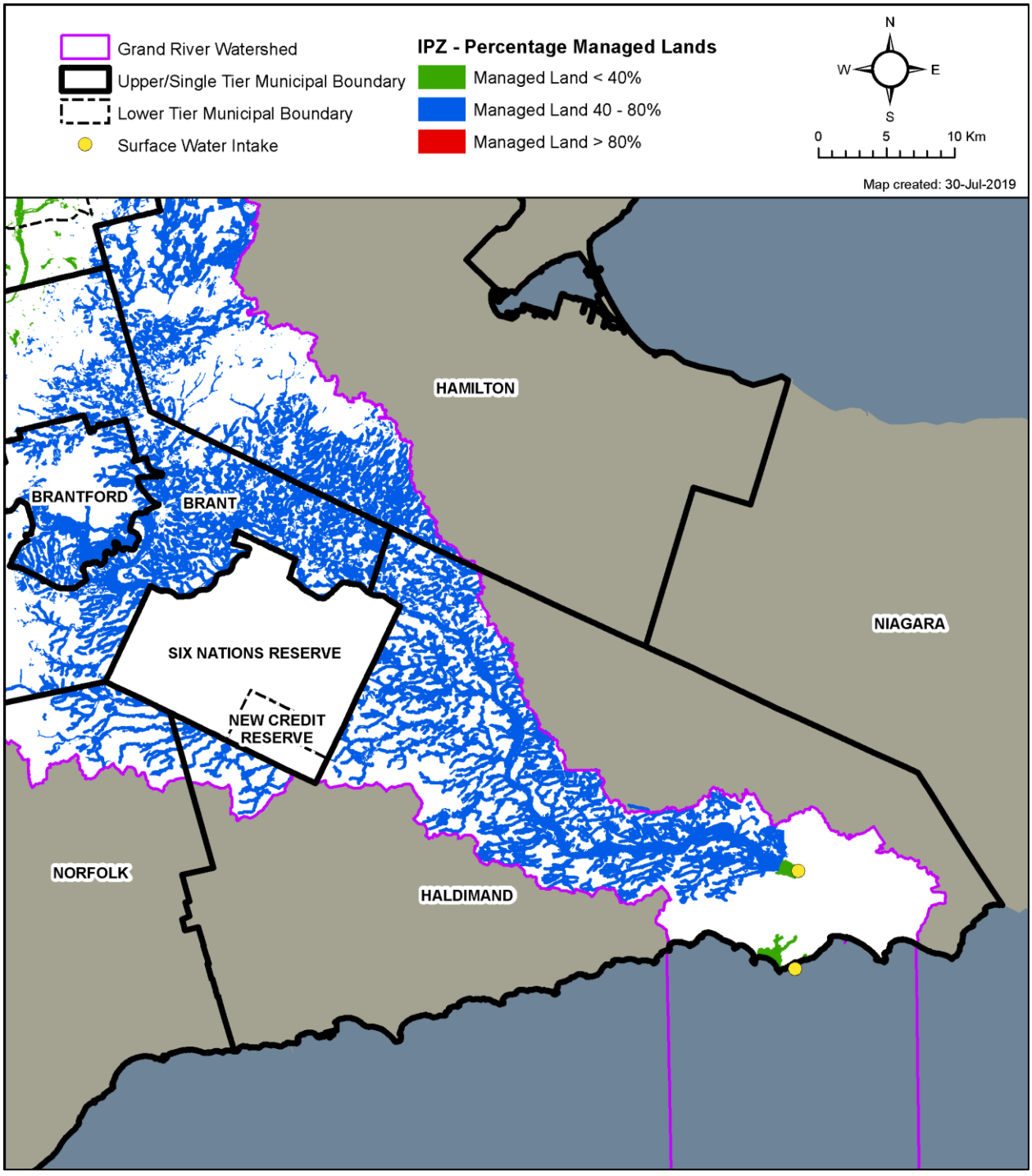
To determine whether the application of road salt poses a threat in the Dunnville area, the percentage of impervious surface where road salt can be applied per the moving window average method as described in Section 3 of the Assessment Report.

The percentage of impervious surface area for the Dunnville emergency intake IPZ is shown on **Map 16-20, Map 16-21, Map 16-22, and Map 16-23**.

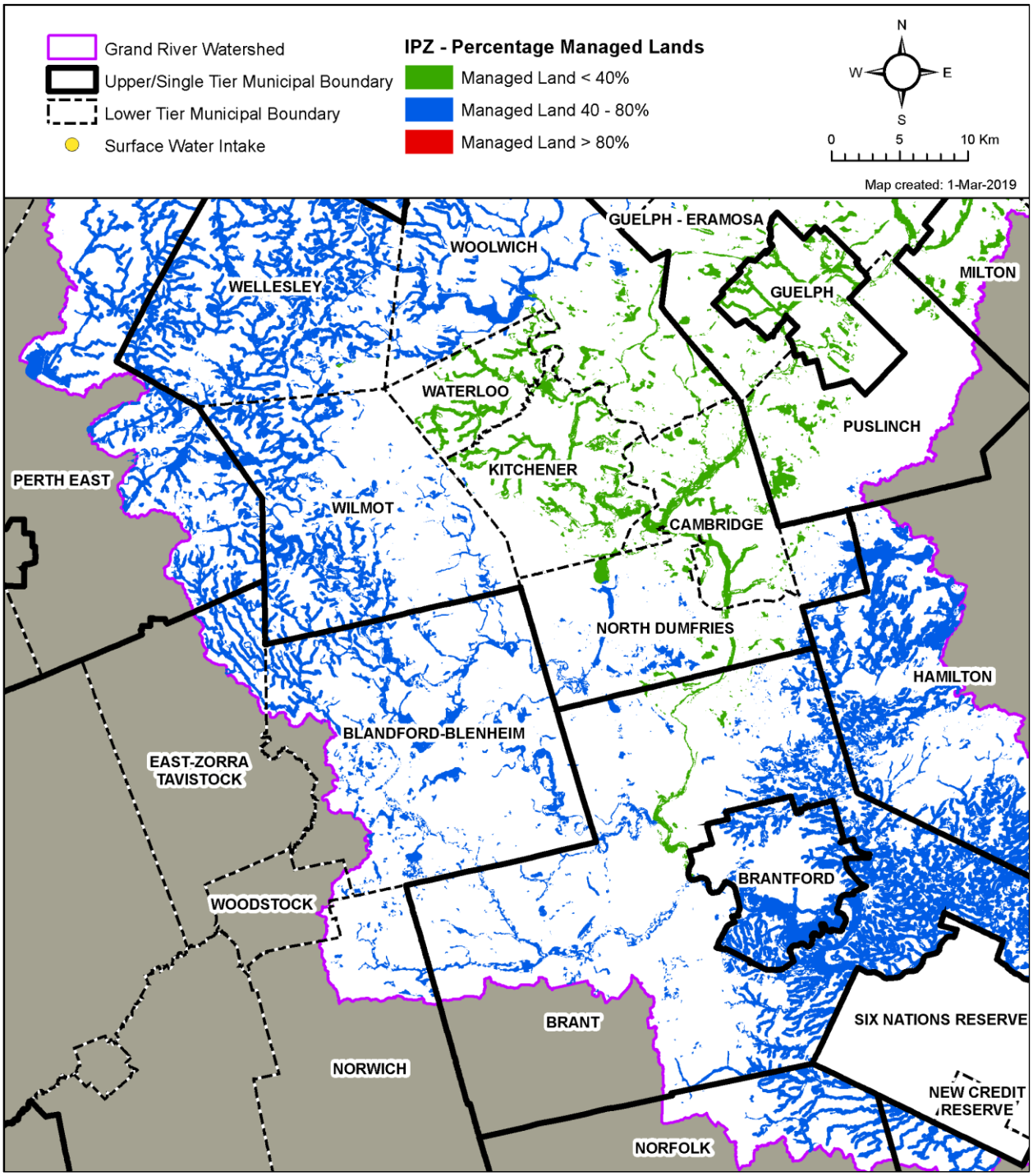
## Map 16-12: Dunnville Emergency Intake IPZ-1 and IPZ-2 Percent Managed Lands



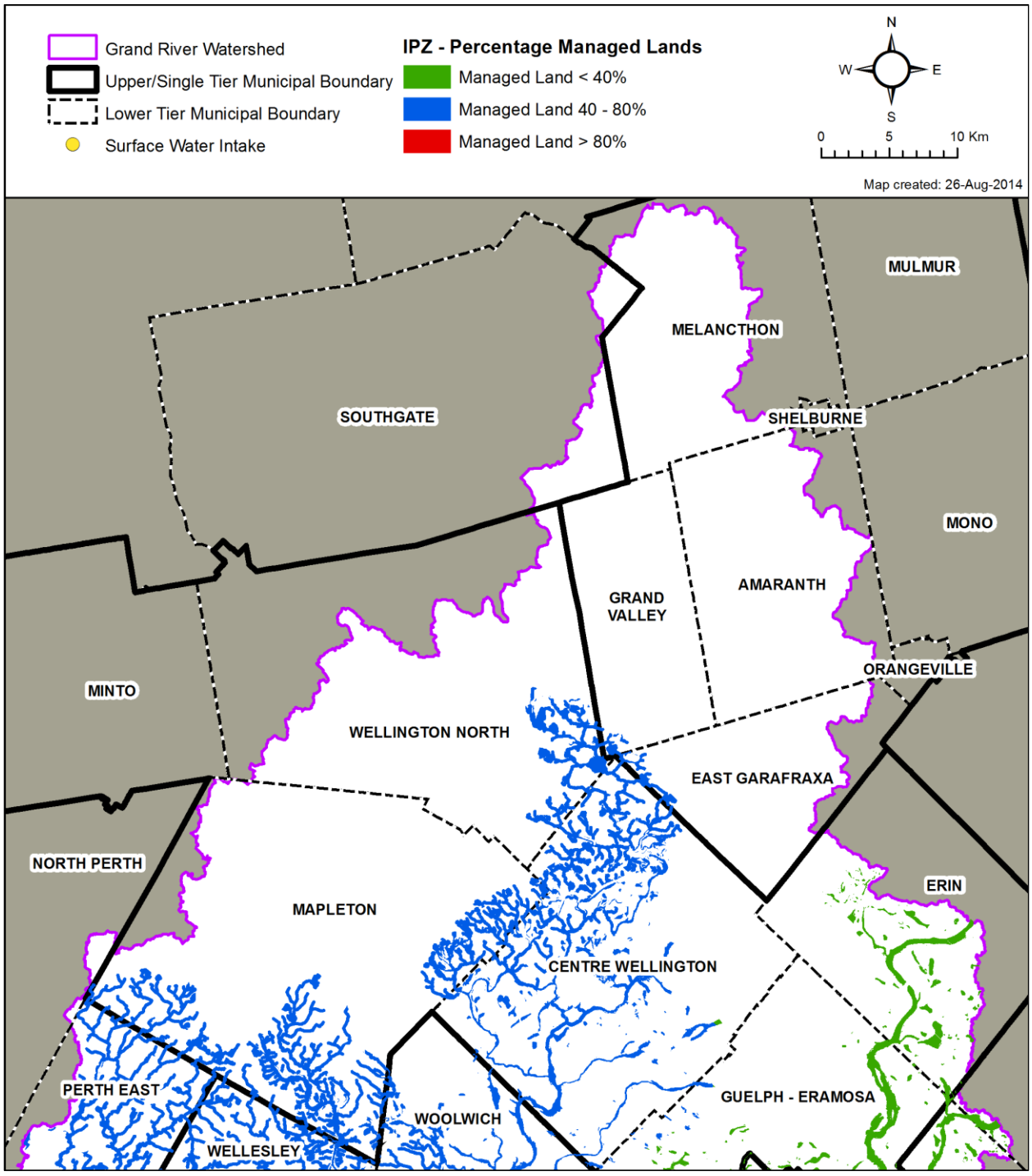
**Map 16-13: Dunnville Water Treatment Plant Emergency Intake IPZ-3 Percent Managed Lands (1 of 3)**



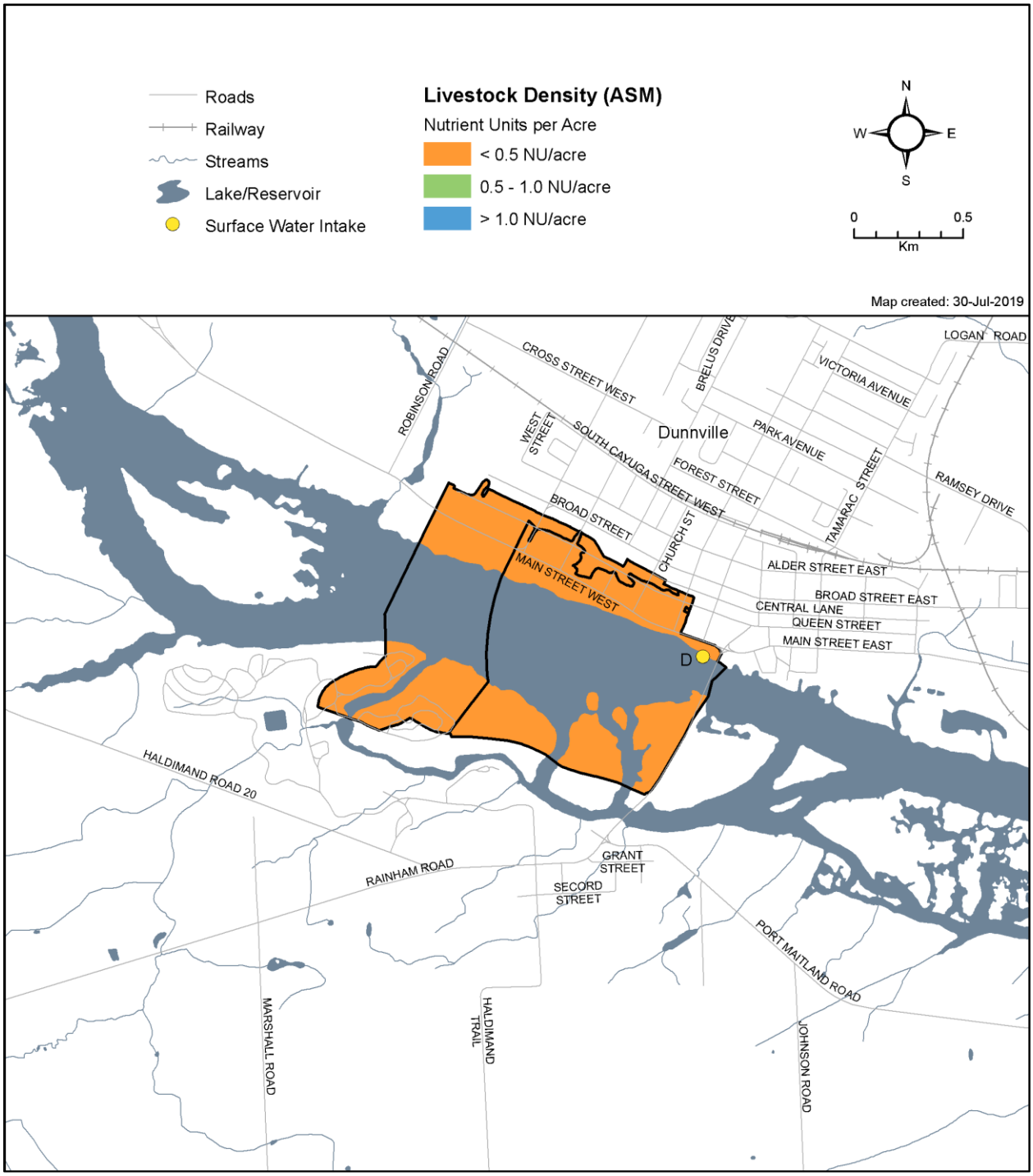
**Map 16-14: Dunnville Water Treatment Plant Emergency Intake IPZ-3 Percent Managed Lands (2 of 3)**



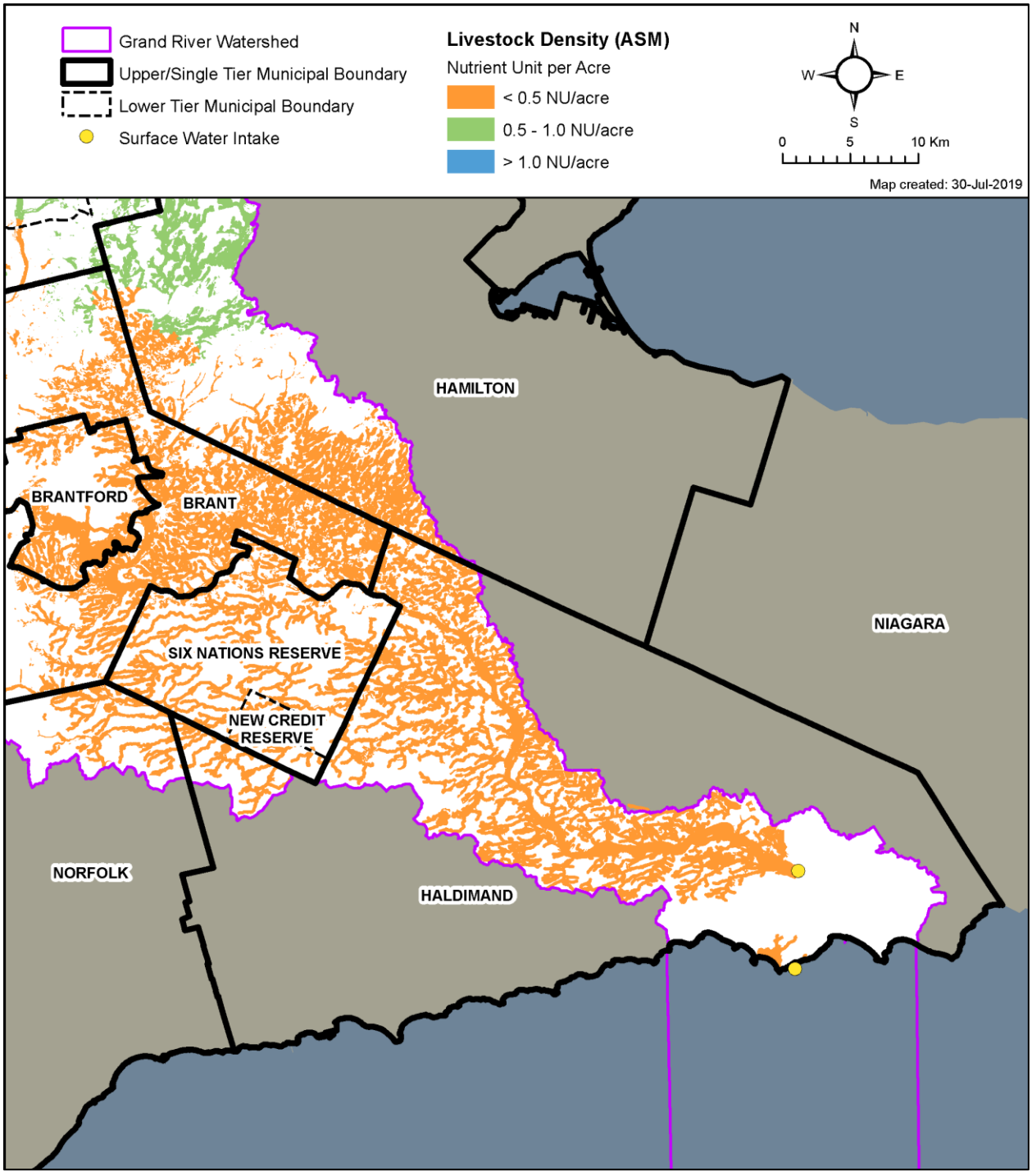
**Map 16-15: Dunnville Water Treatment Plant Emergency Intake IPZ-3 Percent Managed Lands (3 of 3)**



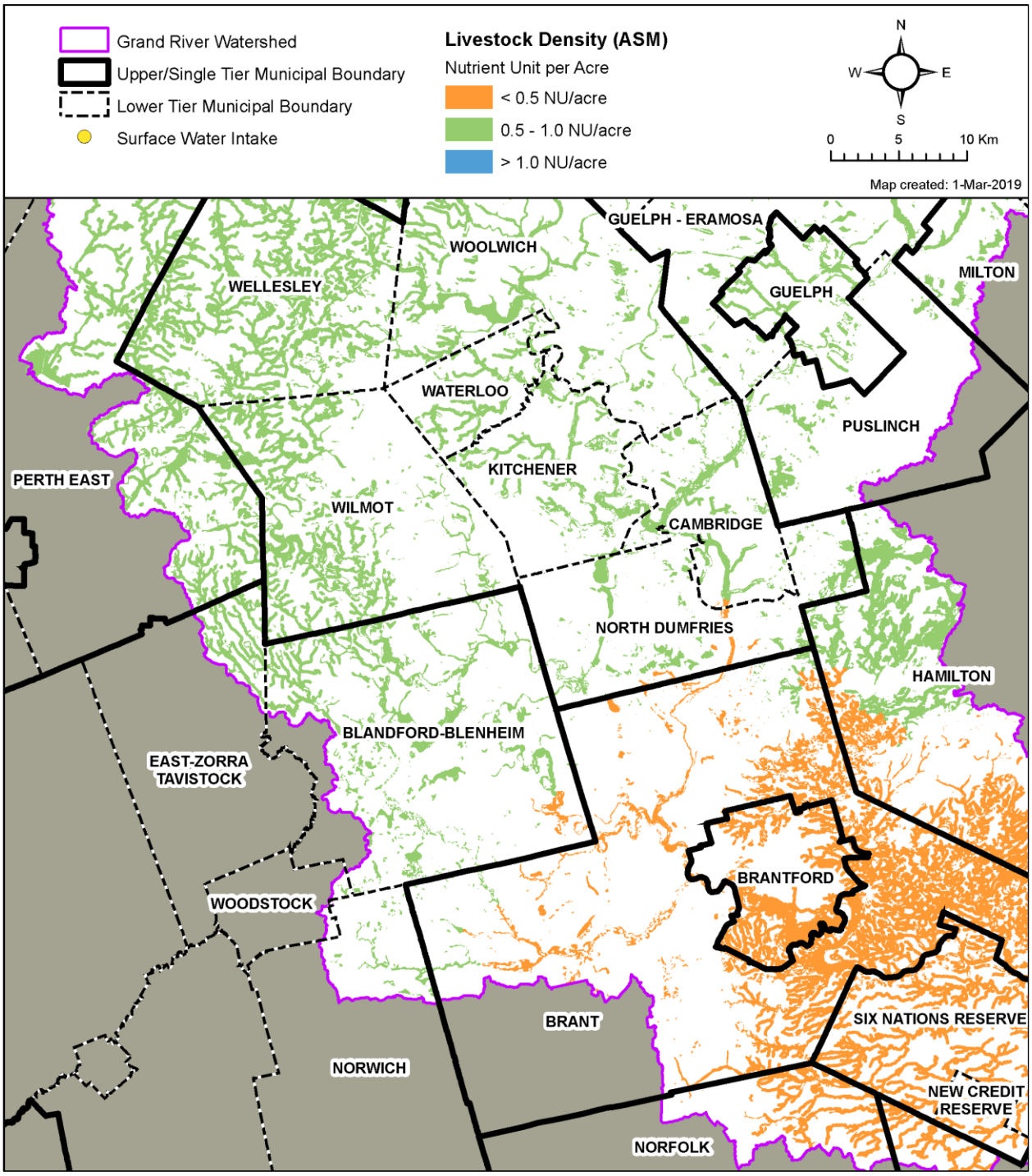
## Map 16-16: Dunnville Emergency Intake IPZ-1 and IPZ-2 Livestock Density



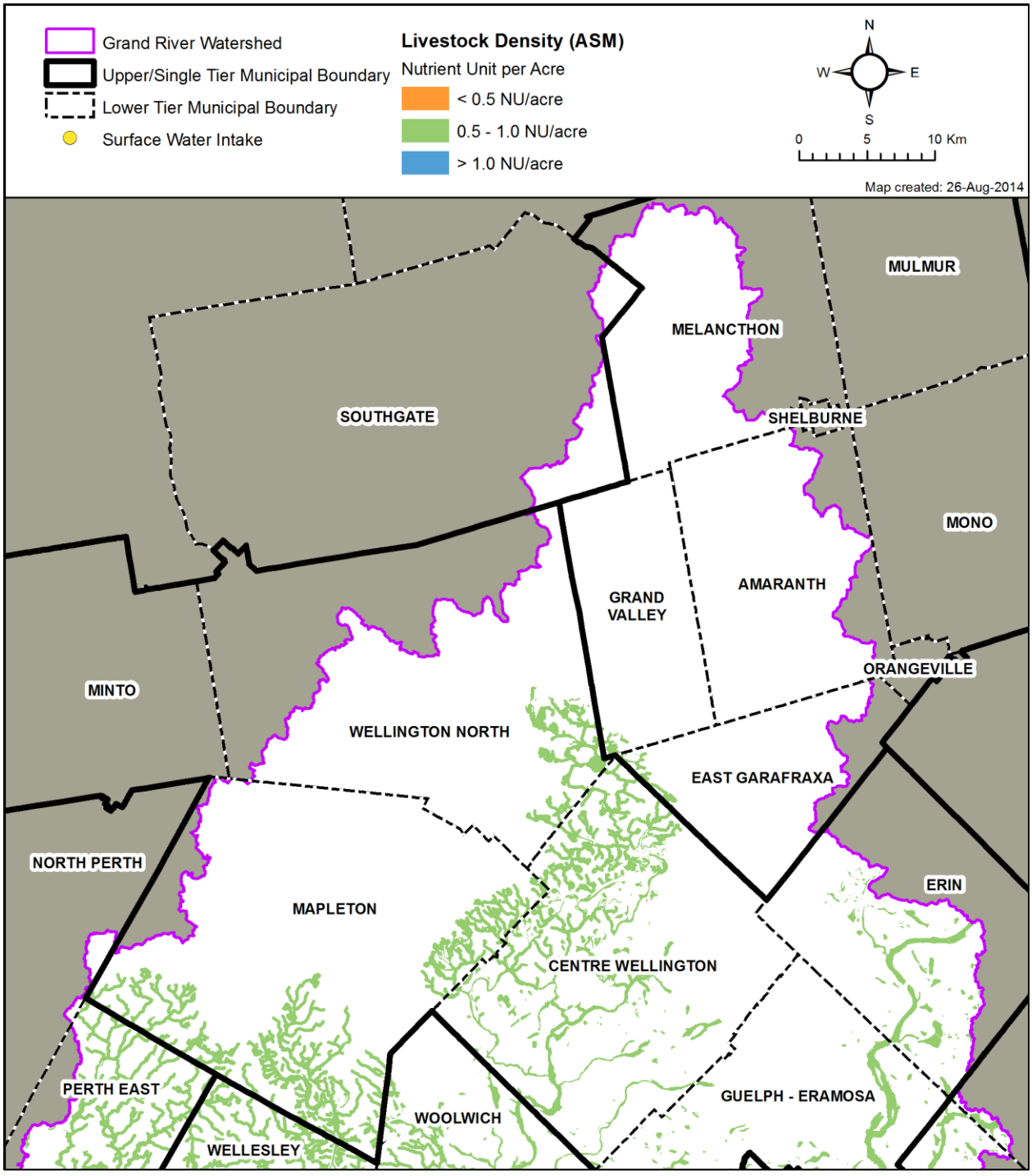
**Map 16-17: Dunnville Water Treatment Plant Emergency Intake IPZ-3 Livestock Density (1 of 3)**



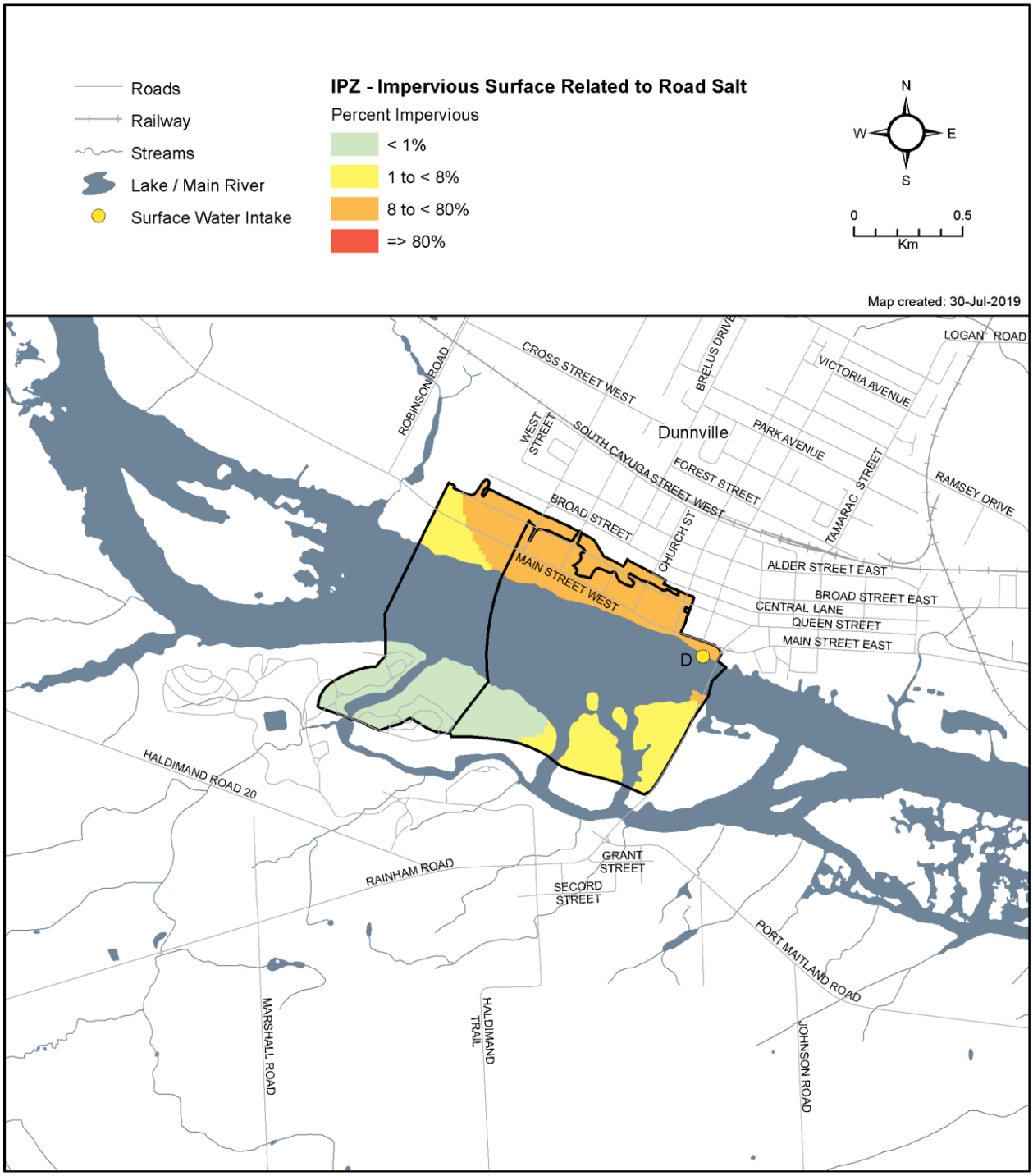
## Map 16-18: Dunnville Water Treatment Plant IPZ-3 Livestock Density (2 of 3)



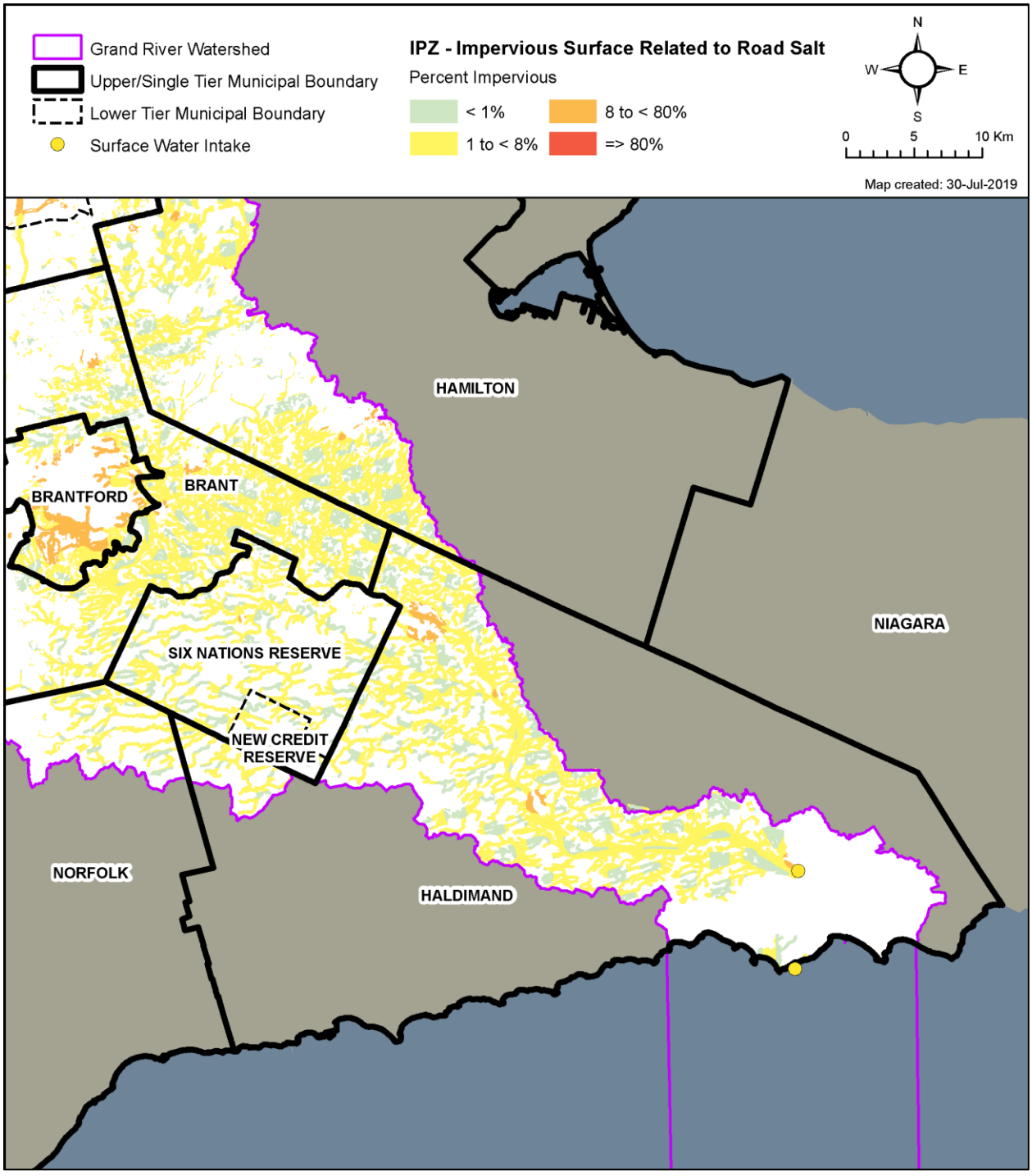
**Map 16-19: Dunnville Water Treatment Plant Emergency Intake IPZ-3 Livestock Density (3 of 3)**



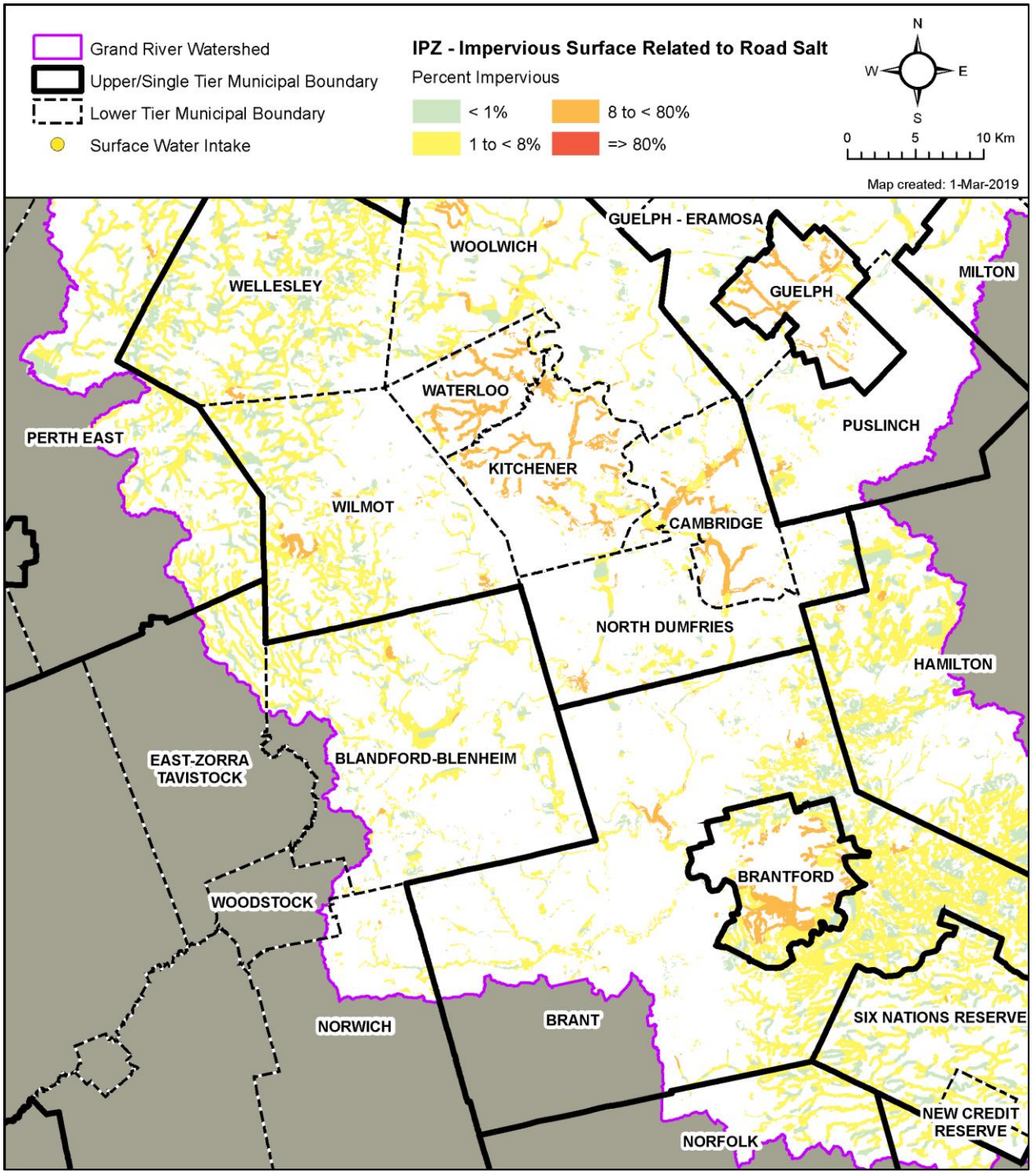
## Map 16-20: Dunnville Emergency Intake IPZ-1 and IPZ- 2 Percent Impervious Surfaces



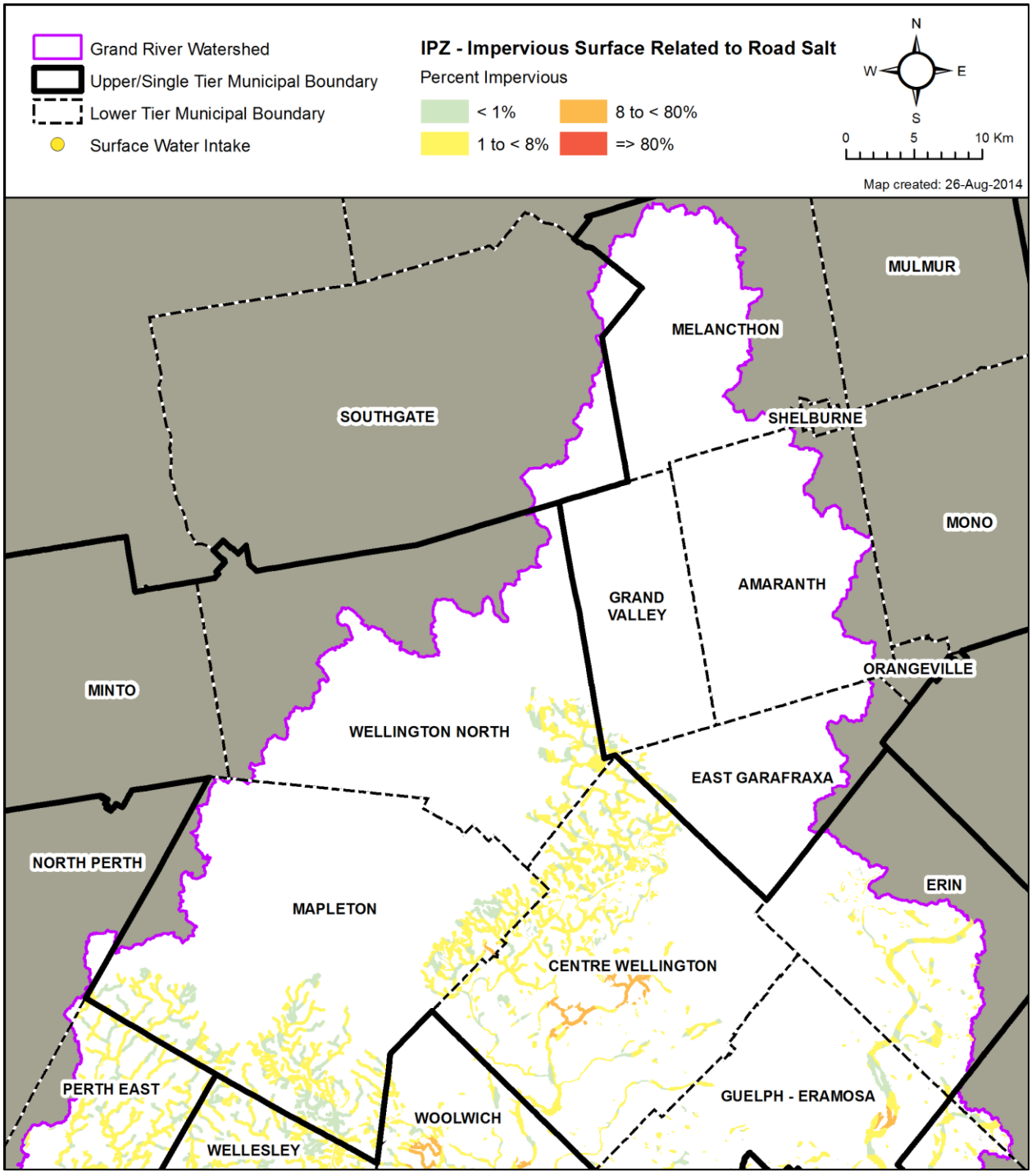
**Map 16-21: Dunnville Water Treatment Plant Emergency Intake IPZ-3 Percent Impervious Surfaces (1 of 3)**



**Map 16-22: Dunnville Water Treatment Plant Emergency Intake IPZ-3 Percent Impervious Surface (2 of 3)**



**Map 16-23: Dunnville Water Treatment Plant Emergency Intake IPZ-3 Percent Impervious Surfaces (3 of 3)**



### *Information Sources for the Emergency Intake Vulnerability Assessment*

**Table 16-7** summarizes the data sources used to delineate IPZs for the Dunnville emergency intake.

**Table 16-7: Summary of Data Sources Used in the Delineation of IPZs for the Dunnville Water Treatment Plant Emergency Intake**

| Data Type | Source | Purpose |
|---|---|---|
| Digital elevation model v2.0 with 10 m resolution | NDMNRF Land Information Ontario (LIO) dataset | Infer stormsewer catchments and determine land slope for overland flow analysis |
| Stormsewer GIS dataset and reports | Haldimand County | Identify stormsewer systems that may impact IPZ |
| Watercourse mapping using Water Virtual Flow and Water Poly Segment GIS datasets | NDMNRF | Identify watercourses/transport pathways that may impact IPZ |
| Conservation Area Regulation Limit GIS dataset | Grand River Conservation Authority | Determine land area to be included in IPZ |
| 2006 orthoimagery with 30 cm resolution | Haldimand County | General mapping and identification of surface features |
| Water treatment plant operator interviews | Water treatment plant operator | Identify operational concerns and obtain local knowledge |
| SOLRIS Land cover and soil permeability GIS dataset | NDMNRF | Assess vulnerability of intake |
| HEC-2 hydraulic model of the lower Grand River | GRCA | Used to determine river velocity needed to delineate IPZ-2 |
| Flow data for Grand River at York and McKenzie Creek | Water Survey of Canada | Used to determine design flow conditions for IPZ-2 delineation |
| River water quality | GRCA reports, E. coli sampling in Grand River at Dunnville emergency intake from OCWA | Assess vulnerability of intake |

### *Limitations of Data and Methods for the Emergency Intake Vulnerability Assessment*

The delineation of IPZ-1 is defined by geometry and modified by municipal, provincial and Conservation Authority datasets. Storm sewersheds were estimated and therefore some uncertainty may exist as to the precise boundary in a limited area along Pine Street and along Main Street east of Pine Street. While representing the best available data, the storm sewer infrastructure information within the Town of Dunnville is known to have some uncertainty associated with it in terms of connections, flow direction, and placement of sewers. In addition, flow was assumed to be sufficiently high to delineate the entire catchment. Therefore there is some uncertainty with regards to the accuracy of the extent of the delineation of IPZ-1.

The delineation of IPZ-2 relies on hydraulic modeling and an estimate of flows based on data from gauges well outside the study area. The HEC-2 hydraulic model used to support IPZ-2 delineation is a source of uncertainty. The HEC-2 model for this area was developed for floodplain mapping

purposes and there have been no dye tracer studies to validate or calibrate channel velocity estimates provided by the model. Flow rates for the Grand River were established using flow data from other creeks, recommended by the GRCA technical staff. This was due to the lack of reliable flow data of sufficient period of record in the immediate vicinity of the emergency intake. Therefore there is some uncertainty with regards to the accuracy of the design flow rate established.

The delineation of the IPZ-3 is based on provincial and Conservation Authority datasets, and the upstream boundary of the IPZ-2. As such, the delineation of IPZ-3 is only as accurate as the GIS datasets that identify watercourses and regulated areas upstream of the intake. While the in-water extent of this zone is well defined, the large upland area has not been verified. It may contain areas which do not contribute overland flow directly to the adjacent waterbody, but where flow may take a more circuitous route due to the built environment or local topography.

The available data used to determine the vulnerability scores were provided by both provincial and municipal sources and by the GRCA. A high level of confidence in the quality of the data was established based on the assumption that adequate quality control programs are in place for the sources. Available datasets for the area factor analysis were relevant. The % area that is land was determined using the WPS datasets available from the Ministry of Northern Development, Mines, Natural Resources and Forestry. The impervious land cover and land cover type was determined using SOLRIS (2009) information. Slope was determined using OBM contours. Storm sewers were analyzed for the transport pathway portion of the area vulnerability analysis. Storm sewer networks were obtained from the Dunnville Master Servicing Plan – Water, Wastewater, Stormwater, and transportation. All the datasets used were relevant to the study area.

***Uncertainty of the Vulnerability Assessment for the Emergency Intake Vulnerability Assessment***

Based on the limitations stated above, uncertainty was assessed for the delineation of each IPZ and the vulnerability scores assigned to each IPZ. Although some limitations were noted with respect to the exact location of storm sewer boundaries, a low level of uncertainty has been assigned to IPZ-1. Delineation of IPZ-2 was given a high level of uncertainty given the questions about the accuracy of velocity estimates from HEC-2 and lack of measured flow data at the emergency intake. A high level of uncertainty was also assigned to the delineation of IPZ-3 based on the limitations described above.

Quality assurance and control measures were applied to each component of the vulnerability factor analysis. Vulnerability factors were reviewed throughout the analysis process and as such the confidence in the data and the calculations used in the vulnerability analysis was high resulting in an uncertainty rating of low.

### 16.1.3 Drinking Water Quality Threat Assessment

The Ontario Clean Water Act, 2006 defines a Drinking Water 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 regulation as a drinking water threat.” A Prescribed Drinking Water Threats table in Chapter 3 lists all possible drinking water threats.

***Identification of Significant, Moderate and Low Drinking Water Quality Threats for the Dunnville Water Treatment Plant Intake***

**Table 16-8** and **Table 16-9** provide a summary of the threat levels possible in the Dunnville Water Supply for Chemical, Dense Non-Aqueous Phase Liquid (DNAPL), and Pathogen. A checkmark indicates that the threat classification level is possible for the indicated threat type under the corresponding vulnerable area / vulnerable score; a blank cell indicates that it is not. The colours shown for each vulnerability score correspond to those shown in the maps.

**Table 16-8: Identification of Drinking Water Quality Threats for the Dunnville Lake Erie Intake**

| Threat Type | Vulnerable Area | Vulnerability Score | Threat Classification Level | | |
|---|---|---|---|---|---|
| | | | Significant 80+ | Moderate 60 to <80 | Low >40 to <60 |
| Chemicals / Handling & Storage of DNAPLs | IPZ-1 | 7 | | ✔ | ✔ |
| | IPZ-2 | 4.9 | | | ✔ |
| Pathogens | IPZ-1 | 7 | | ✔ | ✔ |
| | IPZ-2 | 4.9 | | | ✔ |

**Table 16-9: Identification of Drinking Water Quality Threats for the Dunnville Emergency Intake**

| Threat Type | Vulnerable Area | Vulnerability Score | Threat Classification Level | | |
|---|---|---|---|---|---|
| | | | Significant 80+ | Moderate 60 to <80 | Low >40 to <60 |
| Chemicals | IPZ-1 | 10 | ✔ | ✔ | ✔ |
| | IPZ-2 | 8 | ✔ | ✔ | ✔ |
| | IPZ-3 | 6 | | ✔ | ✔ |
| | IPZ-3 | 5 | | | ✔ |
| | IPZ-3 | 1, 2, 3, 4 | | | |
| Handling / Storage of DNAPLs | IPZ-1 | 10 | ✔ | ✔ | |
| | IPZ-2 | 8 | | ✔ | ✔ |
| | IPZ-3 | 6 | | | ✔ |
| | IPZ-3 | 5 | | | ✔ |
| | IPZ-3 | 1, 2, 3, 4 | | | |
| Pathogens | IPZ-1 | 10 | ✔ | ✔ | ✔ |
| | IPZ-2 | 8 | ✔ | ✔ | ✔ |
| | IPZ-3 | 6 | | ✔ | ✔ |
| | IPZ-3 | 5 | | | ✔ |
| | IPZ-3 | 1, 2, 3, 4 | | | |

According to the Tables of Drinking Water Threats, a vulnerability score of 7 for IPZ-1 and 4.9 for IPZ-2 means that there are no significant threats in IPZ-1 or 2 for the Dunnville WTP Lake Erie Intake. However, it is possible to have significant threats in IPZ-1 and IPZ-2 for the Emergency Intake because these areas were assigned higher vulnerability scores. No locally determined drinking water threats were identified by the Lake Erie Region Source Protection committee.

### 16.1.4 Conditions Evaluation

Conditions are contamination that already exist and are a result of past activities that could affect the quality of drinking water.

#### *Conditions Evaluation for the Dunnville Water Treatment Plant*

An inventory of conditions resulting from past land use activities was completed, including sediment samples collected from the mouth of the Grand River and the low lift well. Based on the sediment samples, the following conditions were identified in Lake Erie IPZ-1 and IPZ-2 for the Dunnville WTP due to the concentrations of these parameters exceeding the sediment standards described in Table 1 of the Soil, Ground Water and Sediment Standards:

- Chromium (Total);
- Copper;
- Nickel; and
- Zinc.

As per Technical Rule 139(2) the hazard rating for these conditions is 10 as the sediment is present on the same property as the intake. Combining the hazard and vulnerability scores makes these conditions moderate threats (risk score of 70) in IPZ-1 and low threats (risk score of 49) in IPZ-2. There were no Conditions resulting from past activities identified in IPZ-1 or 2 that are significant threats.

The Treasury Board database of federal contaminated sites was reviewed, and no significant threats related to Conditions were identified.

No conditions have been identified for the Dunnville WTP Emergency Intake in the Grand River.

#### *Limitations of Data and Methods Used for Conditions Evaluation*

Conditions were identified on the basis of a single sediment sample collected at two separate locations within the vulnerable areas of the Dunnville WTP Lake Erie intake. Five of the sampled parameters had method detection limits (MDLs) that were above the Table 1 sediment standards and therefore, it could not be determined if these parameters exceeded the standard. No data was available regarding surface soil information within the Dunnville WTP vulnerable areas. Collection of additional soil or sediment quality data is not considered a priority since the vulnerability scores for IPZ-1 and 2 are such that Conditions can only be identified as moderate or low threats. MOE datasets related to past spills, Records of Site Condition and potentially contaminated sites were not assessed for Dunnville.

### 16.1.5 Drinking Water Quality Issues Evaluation

The objective of the Issues evaluation is to identify drinking water Issues where the existing or trending concentration of a parameter or pathogen at an intake, well or monitoring well would result in the deterioration of the quality of water for use as a source of drinking water.

#### *Drinking Water Quality Issues Evaluation for the Dunnville Water Treatment Plant Lake Erie Intake*

Historical raw water quality data from the Ministry of the Environment's Drinking Water Information System and Drinking Water Surveillance Program were reviewed to determine whether any parameters exceed established benchmarks based upon the Ontario Drinking Water Quality Standards (ODQWS). ODQWS are instruments to be applied to treated water only; however, they were applied to raw water samples for the purposes of this assessment to determine whether any parameters should be flagged for further review.

The following parameters were consistently observed to exceed ODQWS in raw water at the Lake Erie intake and were therefore identified as parameters of concern:

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

All of these parameters do not directly impact human health and are largely attributed to naturally occurring processes and characteristics. These parameters of concern are not considered drinking water Issues at this time but further assessment of aluminum and organic nitrogen to determine potential anthropogenic sources is recommended. Further monitoring and evaluation of these parameters is needed before they can be identified as an Issue under Technical Rule 114.

At this time, relevant water quality data is not available that may identify drinking water quality issues for the Emergency Intake.

***Limitations of Data and Methods Used for the Drinking Water Quality Issues Evaluation***

In general, the available data were of sufficient quality and quantity to evaluate issues for the Lake Erie intake. Raw water quality data for parameters listed on Schedule 1 were provided for the years 2005 - 2008. The analysis may benefit from improved frequency and consistency of sampling data.

Raw water quality data for parameters listed on Schedules 2, 3, and Table 4 were provided for the years 1990 to 2007. Not all parameters had sampling data for these years. These data were sufficient for a general characterization of the raw water quality; however, more frequent and consistent sampling is required to complete a statistical analysis with associated confidence.

### 16.1.6 Enumeration of Significant Drinking Water Quality Threats

According to the MECP's Table of Drinking Water Threats, a vulnerability score of 7 for IPZ-1 and 4.9 for IPZ-2 means that there are no significant threats in IPZ-1 or 2 for the Dunnville WTP Lake Erie Intake.

Potentially significant threats in IPZ-1 and -2 of the emergency intake were identified based on an analysis of land use activities.

***Data Sources for the Enumeration of Significant Drinking Water Quality Threats for the Emergency Intake***

The following data and information sources were queried to identify significant threats for the Dunnville WTP emergency intake:

- National Pollutant Release Inventory (NPRI);
- Tables of Drinking Water Threats (November 2009);
- MOE Technical Bulletin: DNAPLSs and Organic Solvents;
- MOE Technical Bulletin: Threats Assessment and Issues Evaluation;
- LESPR Drinking Water Threat Discussion Papers;
- O. Reg. 213/01, O.Reg. 217/01, and O.Reg. 525/98;
- Pesticides Act;
- Ontario Inventory of PCB Storage Sites, October 1991 (MOE);
- Haldimand County Zoning By-Law and Official Plan;

- Brant County Zoning By-Law;
- Haldimand County Source Protection Planning Technical Study: Surface Water Vulnerability Assessment for the Dunnville Water Treatment Plant Emergency Intake (Stantec);
- Grand River Source Protection Area Approved Assessment Report (LESPR);
- Percent Impervious Surface GIS dataset (LESPR);
- Assessment Parcel GIS and MPAC data where available;
- Business directory GIS dataset (Haldimand County);
- Stormwater and sanitary GIS dataset (Haldimand County);
- 2010 Southwestern Ontario Orthophotography Project (MNR);
- Google Streetview;
- Dunnville WTP First Engineer's Report (Douglas Vallee Ltd);
- Byng Conservation Area brochure (GRCA);
- Frank A. Marshall Business Park brochure (Haldimand County); and

**Table 16-10** summarizes the significant threats that were identified in the IPZ for the emergency intake. There were no significant drinking water threats enumerated in the IPZ-2 for the emergency intake.

**Table 16-10: Significant Drinking Water Quality Threats for the Emergency Intake IPZ-1**

| PDWT[1] # | Threat Subcategory[2] | Number of Activities | Vulnerable Area |
|---|---|---|---|
| 2 | Sewage System Or Sewage Works – Discharge of Untreated Stormwater From A Stormwater Retention Pond | 2 | IPZ-1 |
| | Sewage System Or Sewage Works – Sanitary Sewers and Related Pipes | 2 | IPZ-1 |
| 9 | The Handling And Storage Of Commercial Fertilizer | 1 | IPZ-1 |
| 11 | The Handling And Storage Of Pesticide | 1 | IPZ-1 |
| 12 | The Application Of Road Salt | 2 | IPZ-1 |
| 14 | The Storage Of Snow | 1 | IPZ-1 |
| 16 | The Handling And Storage Of A Dense Non-Aqueous Phase Liquid | 2 | IPZ-1 |
| 17 | The Handling And Storage Of An Organic Solvent | 1 | IPZ-1 |
| **Total Number of Activities** | | **12** | |
| **Total Number of Properties** | | **6** | |

*1: Prescribed Drinking Water Threat Number refers to the prescribed drinking water threat listed in O.Reg 287/07s.1.1.(1).*

*2: Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.*

*Note: Certain types of activities on residential properties that are incidental in nature and that are significant drinking water threats are not enumerated. These threats include the application of commercial fertilizer on residential properties, the storage of organic solvents (dense non-aqueous phase liquids) on residential properties, and the storage of fuel (e.g., heating fuel tanks) on residential properties in natural gas serviced areas.*

| Table 16-10: Significant Drinking Water Quality Threats for the Emergency Intake IPZ-1 | | | |
|---|---|---|---|
| **PDWT[1] #** | **Threat Subcategory[2]** | **Number of Activities** | **Vulnerable Area** |
| *Note: Storm sewer piping is not considered to be part of a storm water management facility.* | | | |

### *Limitations, Data Gaps and Uncertainty in the Enumeration of Significant Drinking Water Quality Threats for the Emergency Intake*

A variety of sources were consulted to undertake the enumeration of significant threats. Limitations may exist in the completeness or up-to-date nature of these resources, and in the compliance of staff at various businesses and institutions with stated policies and procedures. Direct correspondence was initiated with owners or operators wherever the presence of a significant threat could not be discounted through other sources of information. To date, only one business has not provided a response to a request for more detailed information regarding activities carried out on their property.