DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay Lake Simcoe Source Protection Region

Ontario

DRAFT

Explanatory Document

October, 2011

Lake Simcoe Region Conservation Authority

Nottawasaga Valley Conservation Authority
Celebrating 50 Years 1960-2010

Severn Sound Environmental Association

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1 INTRODUCTION

1.1 HISTORY OF SOURCE WATER PROTECTION IN ONTARIO

Walkerton, Ontario: The catalyst

> "The first barrier to the contamination of drinking water involves protecting the sources of drinking water. I recommend that the Province adopt a watershed-based planning process, led by the Ministry of the Environment and by the Conservation Authorities (where appropriate), and involving local actors. The purpose is to develop a source protection plan for each watershed in the province…"
> *- Justice Dennis O'Connor, The Walkerton Inquiry, 2002*

Until May 2000, there was little to distinguish Walkerton from dozens of small towns in southern Ontario. It is a pretty town, located at the foot of gently rolling hills, along the banks of the Saugeen River. Walkerton traces its history back to 1850, when Joseph Walker, an Irish settler, built a sawmill on the river, starting a settlement that adopted his name. In time, it became the county seat for Bruce County. The name survived an amalgamation in 1999, when Walkerton was joined with two farming communities to form the Municipality of Brockton. Walkerton has kept its small-town look and feel. Many of its 4,800 residents make their living from businesses that serve the surrounding farms.

In May 2000, Walkerton's drinking water system became contaminated with deadly bacteria, primarily Escherichia coli O157:H7.1 (E. coli). Seven people died, and more than 2,300 became ill. The community was devastated. The losses were enormous. There were widespread feelings of frustration, anger, and insecurity. The tragedy triggered alarm about the safety of drinking water across the province.

Immediately, many important questions arose. What actually happened in Walkerton? What were the causes? Who was responsible? How could this have been prevented? Most importantly, how do we make sure this never happens again?

The government of Ontario responded by calling an Inquiry – The Walkerton Commission of Inquiry. The inquiry was divided into two parts. The first, which is referred to as Part 1, relates only to the events in Walkerton, and focuses on the circumstances that caused the outbreak – including, very importantly, the effect, if any, of government policies, procedures, and practices. The second, Part 2, goes beyond the events in Walkerton, and looks into other matters necessary to ensure the safety of Ontario's drinking water. The overarching purpose of both parts of the Inquiry was to make findings and recommendations to ensure the safety of the water supply system in Ontario.

Source water protection is one of the last of the Inquiry's recommendations to be implemented.

2 THE SOUTH GEORGIAN BAY-LAKE SIMCOE SOURCE PROTECTION REGION

The South Georgian Bay-Lake Simcoe Source Protection Region contains four watersheds and spans over 10,000 km^2, from the Oak Ridges Moraine in the south to the Canadian Shield in the north and is comprised of the Black-Severn, Lake Simcoe, Nottawasaga Valley and Severn Sound watersheds. The region contains portions of the Niagara Escarpment, Oak Ridges Moraine, Oro Moraine, Peterborough Drumlin Fields, Simcoe Uplands and Lowlands and the Canadian Shield.

The region include fifty-two municipalities and three First Nations communities with over 200 municipal supply wells, 17 municipal surface water intakes, and more than 50,000 private wells. The region is very complex and diverse in terms of geology, physiology, population, and development pressures, with a many, often conflicting, water uses including drinking water supply, recreation, irrigation, agriculture, commercial and industrial uses, as well as ecosystem needs.

These differences represent a significant challenge for the development of a source water protection plan because of the associated variability of available information upon which to base the technical work, the differing stresses on water resources related to development pressure and population growth, and the differences in the nature, density and locations of threats to the quality and quantity of water resources.

3 PURPOSE AND OBJECTIVES OF THE EXPLANATORY DOCUMENT

The Explanatory Document adheres to Ministry guidelines and requirements as outlined in Ontario Regulation 287/07. This regulation calls for the plan, as well as the background reports and policy research, to be made available to the municipalities, Conservation Authorities, stakeholders, agencies, the public and adjacent Source Protection Areas.

It explains in detail how the policies in the plan were developed and the summary of policy options that were considered. The Explanatory Document is required by legislation and accompanies the Source Protection Plan. It includes a detailed record of the rationale that was used to select the policies in the Source Protection Plan. In short, it documents the 'thinking' behind the Source Protection Plan.

The Explanatory Document will be of interest to the Source Protection Authority, stakeholders, the Minister and members of the general public who may wish to understand the information that the Source Protection Committee used to prepare the plan. By disclosing the underlying rationale that was used to select specific policy approaches, the Explanatory Document supports a transparent decision making process.

The Explanatory Document, like the Assessment Report, is a living document that will be updated whenever new information becomes available.

Together, the Assessment Report, the Explanatory Document and the Source Protection Plan serve as the roadmap for protecting drinking water supply in the South Georgian Bay Lake Simcoe Source Protection Region.

4 RELATIONSHIP TO OTHER SOURCE PROTECTION PLANNING DOCUMENTS

4.1 THE BACKGROUND REPORT

The Background Document offers a detailed overview of the history and importance of source water protection in Ontario. It sets important context by providing an outline of the legislation governing drinking water protection and the approach that was taken to create nineteen (19) Source Protection Regions across Ontario.

In addition to important contextual information, the Background Document traces the process that was followed, from the development of the initial Assessment Reports as well as the research, discussion and consultation that took place prior to the development of the Source Protection Plan.

The Background Document offers the historical context and detailed process methodology associated with source water protection in the South Georgian Bay Lake Simcoe Source Protection Region. This document will be of interest to those who may wish to acquire a better appreciation of source water protection in Ontario generally, and in the SGBLS SPR specifically.

The Background Document should be read in conjunction with the Explanatory Document, the Assessment Reports and the Source Protection Plan. In combination, these documents serve as the water protection roadmap for the SGBLS Source Protection Region.

4.2 THE SOURCE PROTECTION PLAN

The Clean Water Act is a major part of Ontario's commitment to ensure that every Ontarian has access to safe drinking water. Introduced by the Ontario Government in 2006, the Act along with the first five associated regulations came into effect in 2007. The intent of the legislation is to ensure communities are able to protect their municipal drinking water supplies now and in the future from overuse and contamination.

Protecting water at its source is the first step in ensuring that this commitment is achieved. By stopping contaminants from getting into sources of drinking water – lakes, rivers and aquifers – efforts can be made to create a first line of defence in the protection of the environment and human health.

For the first time, communities across Ontario are required to create and carry out a plan to protect the sources of their municipal drinking water supplies. The Clean Water Act requires local communities to consider both existing and potential threats to drinking water and to set out and implement actions necessary to reduce or eliminate significant threats. Communities are also empowered to take action to prevent threats from becoming significant. The Source Protection Plan sets out how the risks to municipal drinking water supplies will be addressed and includes a number of recommendations regarding land use planning polices and risk reduction strategies.

The Source Protection Plan is a document that focuses on preventing the overuse and contamination of drinking water supplies across the SGBLS Source Protection Region. The Plan includes the policies and strategies to protect drinking water by preventing, reducing or eliminating significant threats to water resources.

Together, the Background Document, the Assessment Reports, the Explanatory Document and the Source Protection Plan serve as the roadmap for protecting drinking water supply in the South Georgian Bay Lake Simcoe Source Protection Region.

5 OVERVIEW OF VULNERABLE AREAS AND OVERVIEW OF PRESCRIBED THREATS

The *Clean Water Act, 2006* requires that all sources of drinking water must be assessed for vulnerability. The vulnerability of municipal drinking water is assessed through development of surface water intake protection zones (IPZs) and Wellhead Protection Areas (WHPAs). The vulnerability of private wells (groundwater) is determined through a regional groundwater vulnerability assessment which identifies “Highly Vulnerable Aquifers (HVAs)” and “Significant Groundwater Recharge Areas (SGRAs)”.

Surface water and groundwater can be naturally or anthropogenically vulnerable to a decrease in water quantity or decrease in water quality (contamination). The vulnerability of a groundwater system is an expression of the relative ease through which the aquifer could become contaminated by threat activities occurring on or beneath the ground surface. An aquifer that can easily become contaminated is considered to be vulnerable

5.1 WELLHEAD PROTECTION AREAS (WHPA)

The Wellhead Protection Area (WHPA) is the primary vulnerable area to be delineated to ensure the protection of the municipal water supply wells. Each WHPA is subdivided into four time-of-travel zones that estimate the amount of time it would take a contaminant to reach the municipal well. The following time-of-travel zones are required per Technical Rule 51:

- Zone A: 100 m radius.

- Zone B: 2 year time-of-travel (TOT) capture zone.
- Zone C: 5 year TOT capture zone.
- Zone C1: 10 year TOT capture zone. (for WHPAs delineated before April 2005)
- Zone D: 25 year TOT capture zone.

The Groundwater Vulnerability is assessed to provide an indication, within the WHPA, which current (or future) Activities at the surface present the greatest risk to contaminate the water supply. The Vulnerability Analysis considers the WHPA and the Groundwater Vulnerability, as well as the potential for the Vulnerability to be increased by anthropogenic activities, through Transport Pathways, by developing a “Vulnerability Score” within the WHPA.

The WHPA-A is determined as a fixed radius of 100 m to ensure that all wells receive a minimum standard of protection. WHPAs -B to -D are developed based on the area that contributes groundwater to the municipal wells within a specified time for a specified rate of groundwater withdrawal. The rate of groundwater withdrawal is typically selected to reflect the maximum planned taking (or the permitted taking) to ensure that the delineated WHPA is sufficiently large to reflect the zone of contribution for the wells.

In addition, Technical Rules 47 - 51 (Part V) contain the requirement to delineate a WHPA-E and WHPA-F as required for municipal groundwater supplies that are considered to be Groundwater Under the Direct Influence of surface water (GUDI). The intent of this is to provide protection from surface watercourses that may deliver contaminants to the water supply aquifer faster than would be considered based groundwater alone. The typical extent of the WHPA-E is to cover a minimum time-of-travel distance of 2 hours within the surface water course from the point of infiltration that is considered to be in connection with the water supply aquifer. WHPA-F would consider the remainder of the contributing watercourse path but would only be delineated in the event that a Drinking Water Issue is observed. WHPA-E and WHPA-F typically include an area 120 m inland from the surface water feature, but will also consider other contributing areas, such as stormwater catchments that discharge within the WHPA-E or -F.

Technical Rules stipulate that WHPAs be determined by 1 of 4 methods, or a method that in the opinion of the Director is equivalent to or better than those permitted. The prescribed methods are:

1) A computer based three-dimensional groundwater flow model,

2) Two-dimensional analytical model,

3) Uniform flow method,

4) Calculated fixed radius method;

The majority of WHPAs within the SGBLS Source Protection Region were delineated by using a three dimensional groundwater flow model. However, a number of WHPAs were also delineated using methods 2 to 4 above. Specific details on the model(s) used can be found in the municipal vulnerability and threats chapters (Assessment Report, Chapters 6-17) and their related reports.

While the size and shape is somewhat dependent on the modeling approach used (e.g. fixed radius versus the 3-D model), the characteristics of a WHPA are dictated by the hydrogeological properties of the aquifers and aquitards, and the pumping rates of the supply wells. The greater the pumping rate, the wider the WHPA and conversely, the lower the pumping rate, the narrower the WHPA. Within the SGBLS Source Protection Region many of the WHPAs are long and narrow, and this reflects the low pumping rates of the wells. In terms of the hydrogeological properties, the greater the porosity and hydrologic conductivity (i.e. the easier it is for water to travel through the aquifer) the larger the WHPA – water can travel much further in a set period of time (e.g. 5 years) in porous rock than non-porous rock.

Table 1: Municipal Well Count, by Municipality

Source Protection Area	Upper tier Municipality	Lower Tier Municipality	Well_Count
Black River	KAWARTHA LAKES	KAWARTHA LAKES	2
	SIMCOE	ORILLIA	2
		RAMARA	5
		SEVERN	1
Lake Simcoe	SIMCOE	BARRIE	11
		BRADFORD WEST GWILLIMBURY	5
		INNISFIL	9
		ORO-MEDONTE	10
		RAMARA	5
	KAWARTHA LAKES	KAWARTHA LAKES	3
	DURHAM	UXBRIDGE	3
		BROCK	8
	YORK	AURORA	6
		EAST GWILLIMBURY	9
		KING	7
		NEWMARKET	6
		WHITCHURCH-STOUFFVILLE	2
Nottawasaga Valley	SIMCOE	ADJALA-TOSORONTIO	14
		BARRIE	4
		CLEARVIEW	19
		ESSA	10
		INNISFIL	7
		NEW TECUMSETH	11
		ORO-MEDONTE	3
		SPRINGWATER	22

		WASAGA BEACH	7
	PEEL	CALEDON	1
	DUFFERIN	MELANCTHON	2
		MONO	1
		MULMUR	3
		SHELBURNE	3
Severn Sound	SIMCOE	MIDLAND	14
		ORILLIA	1
		ORO-MEDONTE	9
		PENETANGUISHENE	7
		SEVERN	8
		SPRINGWATER	5
		TINY	46
		Total	**291**

5.2 INTAKE PROTECTION ZONES

The surface water Vulnerability Analysis looks at the likelihood that surface water will become contaminated, especially in the areas around drinking water intake pipes. Given how much more quickly surface water travels than ground water, surface water time-of-travel is generally given in hours, not years. This type of analysis requires that vulnerable areas around intake pipes, Intake Protection Zones (IPZs), be identified, mapped and given Vulnerability Scores.

The Intake Protection Zone (IPZ) is the primary vulnerable area to be delineated to ensure the protection of the municipal surface water supply. For each drinking water system, an IPZ-1, IPZ-2 and IPZ-3 have been delineated.

The Technical Rules classify surface water intakes according to their location, with slightly different rules for delineating the Intake Protection Zone and Vulnerability Score for the four different classifications. The four classifications are:

Type A: Intakes or the planned intake is or would be located in a Great Lake;

Type B: Intake or the planned intake is or would be located in a connecting channel;

Type C: Intake or the planned intake is or would be located in a river and neither the direction nor velocity of the flow of the water at the intake is affected by a water impoundment structure; or

Type D: If the intake is not a Type A, B or C.

Within the Region, all intakes with the exception of Collingwood are considered to be Type-D intakes. Collingwood intake is located in the open waters of Georgian Bay and is therefore considered a Type-A intake. While the two intakes located in Severn Sound (Victoria Harbour and Rope Subdivision) are technically in a Great Lake (Lake Huron) the physical setting of these intakes (shallow and close to shore) is more typical of

intakes classified as Type-D. As a result, these intake types were reclassified as Type-D once approval from the Director was provided.

5.2.1 Intake Protection Zone (IPZ) Delineation

The Intake Protection Zone (IPZ) is the primary vulnerable area to be delineated to ensure the protection of the municipal surface water supply. For each drinking water system, an IPZ-1, IPZ-2 and IPZ-3 have been delineated (with the exception of IPZ-3s for Georgian Bay intakes which are currently in development).

IPZ-1

The IPZ-1 is the area immediately around the intake crib, defined for the Type A and D intakes by a 1 km radius centered on the crib of the intake (Rule 61-1; MOE, 2008a). Where the IPZ-1 abuts land, it includes a setback of not more than 120 m inland along the abutted land. It is measured from the high water mark of the surface water body that encompasses the area where overland flow drains into the surface water body and the area of the Regulated Limit along the abutted land (Rule 61-2a and 61-2b; MOE, 2008a).

The Regulated Limit is delineated with respect to the Provincial Policy Statement and the Conservation Authority (CA) Act Regulation 97/04 (MOE, 2008c). It includes flood plains, streams, valleys, wetlands and shorelines. These areas are of significant risk for loss of life, property damage, infrastructure damage and social disruption. The IPZ-1 was determined using GIS, based on the 1 km radius, regulation limits and the 120m setback from the shoreline.

IPZ-2

The IPZ-2 acts as a secondary protective zone around the IPZ-1, where the IPZ-2 is larger than the IPZ-1. In the event of a spill or acute situation, the treatment facility will have minimal time to respond. Contaminants released in this zone have a high chance of reaching the intake quickly and will have limited time to be diluted prior to reaching the intake (MOE, 2006a).

The IPZ-2 is defined based on the area that may contribute water to the intake where the TOT to the intake is equal to or less than the time that is sufficient to allow the operator of the system to respond to an adverse condition in the quality of the surface water (Rule 65; MOE, 2008a). Where the time that is sufficient to allow the operator to respond to an adverse condition in the quality of the surface water is less than two hours, the TOT to the intake shall be deemed to be two hours (Rule 66; MOE, 2008a). The two hour minimum response time was used for all intakes in the region, as the operator response times to shut-down the intakes were less than 2 hours after receiving notification.

The IPZ-2 is comprised of four areas:

- The area within each surface water body (in this case, the lake which the intake is located in and an extension up tributaries flowing into the IPZ-2);
- Up-tributary where the IPZ-2 is extended up the tributaries to the 2-hour TOT limit;

- A setback inland along the abutted land; and
- An extension to include areas that contribute water to the IPZ-2 through transport pathways (Rules 65 and 72-74; MOE, 2008a).

In-water IPZ-2s were delineated using hydrodynamic models. For intakes located in Lake Couchiching and Lake Simcoe this was completed by Baird and Associates using the MIKE3 Hydrodynamic model and in Georgian Bay this was completed by SNC Lavalin using the GEMSS Hydrodynamic model. Both of these models were originally developed and calibrated for the Assimilative Capacity Studies as described in Baird (2006) and Lavalin (2006). This previous work demonstrated that the models can successfully simulate currents in these locations.

Where tributaries flow into the lake within the IPZ-2, the IPZ-2 is extended up the tributary (Rule 65; MOE, 2008a). The upstream limit of the IPZ-2 was calculated as 2 hours minus the travel time from the intake to tributary mouth multiplied by the tributary velocity. Tributary velocity was based on velocity at bank full stage as per the MOE (2006a) recommendation and it was assumed that bank full flow is equivalent to the 2 year return period event.

Where the IPZ-2 abuts land, it includes a setback of 120 m inland along the abutted land or the Regulation Limit, whichever is greater. It is measured from the high water mark of the surface water body that encompasses the area where overland flow drains into the surface water body and the area of the Regulation Limit along the abutted land (Rule 65-3; MOE, 2008a).

Where an area that is an IPZ-2 includes a setback from a surface water body delineated in accordance with Subrule 65-3 (MOE, 2008a), the area may be extended to include an area that contributes water to the IPZ-2 through a Transport Pathway (Rule 72; MOE, 2008a).

The IPZ-2s were modified to include potential Transport Pathways based on Rules 72 to 74. A complete description of the methodology, analysis and Transport Pathway delineation is provided in Baird, 2009.

IPZ-3

The IPZ-3 is the area within the surface water body through which contaminants released during an extreme event could be transported to the intake. An extreme event is defined in MOE as “a period of heavy precipitation or winds up to a 100 year storm event; a freshet; or a surface water body exceeding its high water mark.” (2008a, p.2). In Lake Simcoe and Lake Couchiching the IPZ-3 was delineated using the MIKE3 Hydrodynamic model. Reverse particle tracking using neutrally buoyant particles, was used to evaluate the distances that currents could transport a contaminant in Lake Simcoe, during an extreme wind event (up to a 100 year return period). This modeling demonstrated that a contaminant could reach an intake from anywhere in Lake Simcoe, during extreme events. The size and irregular shape of the lake, with two large bays (Cook’s Bay and Kempenfelt Bay) means that movement of the contaminant across the lake, behind islands, and in and out of bays is highly dependent on the directionality of the wind. To complicate matters further, there are eight intakes in Lake Simcoe, and

there is substantial overlapping of the IPZ-3s. Based on discussions with LSRCA and MOE, it was agreed that the modeling supports the original direction in MOE (2006a), to extend the IPZ-3 to the watershed limits. Additional site specific contaminant modeling may be undertaken in the next phase, considering specific threats, to determine whether or not a contaminant could reach the intake in sufficient concentration, to compromise the drinking water at the intake (MOE, 2008a; Rule 130).

Type-A Surface Intakes

While Surface Intakes in Severn Sound have been reclassified from a Type-A (Great Lake) to a Type-D (other) intake, for the purpose of delineating IPZ-3s the methods that apply for Type-A intakes were used, termed an event-based approach. Delineating IPZ-3 for Type-A intakes uses a modeling approach to demonstrate whether a contaminant spill, from an existing or proposed activity, would reach the intake during an extreme event and result in the deterioration of water for the use of as a source of drinking water. Where modeling shows that a spill from an activity would lead to deterioration of drinking water, the activity is considered to be within the IPZ-3 and a Significant Drinking Water Threat. IPZ-3 modeling for Collingwood and Severn Sound has been completed and is included in the updated Assessment Report.

Table 2: Intake Protection Zones, by Municipality

Source Protection Area	Upper tier municipality	Lower tier Municipality	Number of Intakes
Black River	MUSKOKA	GEORGIAN BAY	1
	SIMCOE	ORILLIA	1
		RAMARA	1
		SEVERN	3
Lake Simcoe	DURHAM	BROCK	1
	SIMCOE	BARRIE	1
		INNISFIL	1
		RAMARA	2
	YORK	GEORGINA	2
Nottawasaga valley	SIMCOE	COLLINGWOOD	1
Severn Sound	SIMCOE	TAY	2
TOTAL			**16**

5.3 SIGNIFICANT GROUNDWATER RECHARGE AREAS

An area where rain or snow seeps into the ground and flows to an aquifer is called a recharge area. Recharge areas tend to be areas that are characterized by permeable soils, such as sand or gravel which allow the water to seep easily into the ground. A recharge area is considered significant when it helps maintain the water level in an aquifer that supplies a community with drinking water, or supplies groundwater recharge

to a cold water ecosystem that is dependent on this recharge to maintain its ecological function (MOE, 2007).

The Technical Rules indicate that Significant Groundwater Recharge Areas (SGRAs) need to be delineated for each Source Protection Area within the Source Protection Region. The Significant Groundwater Recharge Areas were delineated using the recharge results from the water budget. The Nottawasaga Valley and Severn Sound recharge estimates were completed by the Nottawasaga Valley Conservation authority (2010) as part of South Georgian Bay West Lake Simcoe (SGBWLS) Tier Two Water Budget and Water Quantity Stress Assessment completed by AquaResource and Golder (2010). The aforementioned report is the guiding document and can be referred to for more detail.

The Technical Rules for delineating Significant Groundwater Recharge Areas are as follows:

44. Subject to rule 45, an area is a Significant Groundwater Recharge Area if,

(1) the area annually recharges water to the underlying aquifer at a rate that is greater than the rate of recharge across the whole of the related groundwater recharge area by a factor of 1.15 or more; or

(2) the area annually recharges a volume of water to the underlying aquifer that is 55% or more of the volume determined by subtracting the annual evapotranspiration for the whole of the related groundwater recharge area from the annual precipitation for the whole of the related groundwater recharge area.

45. Despite rule 44, an area shall not be delineated as a Significant Groundwater Recharge Area unless the area has a hydrological connection to a surface water body or aquifer that is a source of drinking water for a drinking water system.

46. The areas described in Rule 44 shall be delineated using the models developed for the purposes of Part III of these rules and with consideration of the topography, surficial geology, and how land cover affects groundwater and surface water.

The SGRAs thresholds for the NVSPA and SSPA have been delineated in accordance with Technical Rule 44(1) with consideration for Technical Rules 45 and 46. The “related groundwater recharge area” identified in Rule 44(1) was taken as the entire study area covered by the calibrated HSP-F model. For this area, average annual groundwater recharge rates were extrapolated from neighbouring areas with similar surficial geology, assuming a forested land cover (AquaResource and Golder, 2010). The average annual recharge for the combined Nottawasaga Valley and Severn Sound Source Protection Areas is 202 mm/year; therefore all recharge areas exceeding 232 mm/year were deemed significant.

According to Technical Rule 45, the areas identified as SGRA must be hydrologically connected to a surface water body or to an aquifer that is a source of drinking water. Due to the high density of water wells within the Study Area, it is assumed that all identified SGRAs are hydraulically connected to a water supply.

The delineated SGRAs correspond to polygons that are greater than 0.1 km2 (10ha) which are considered more representative of mapped surficial geology features. This modification is considered more practical and workable for planning purposes.

Once each SGRA is delineated, vulnerability scores are determined by overlaying the Groundwater Vulnerability Scoring with the SGRAs, as required in the Technical Rules 80 and 81 (MOE, Nov. 2009). Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas are scored differently for vulnerability. The HVAs show only the high classification of the vulnerability analysis (with a score of 6), but SGRAs show all vulnerability classifications (see Table 3).

Table 3: Vulnerability Score Translated into Vulnerability Categories for SGRAs

Vulnerability Score/Category	
6	High
4	Medium
2	Low

Table 4: Significant Groundwater Recharge Area, by Municipality

Upper Tier Municipality	Lower Tier Municipality	Source Protection Area	SGRA Area (Km2)
DUFFERIN	AMARANTH	NV	14.13
	MELANCTHON	NV	28.86
	MONO	NV	169.51
	MULMUR	NV	177.44
	SHELBURNE	NV	0.10
DURHAM	BROCK	LS	81.92
	SCUGOG	LS	19.44
	UXBRIDGE	LS	155.12
GREY	BLUE MOUNTAINS	NV	7.37
	Grey Highlands	NV	11.73
HALIBURTON	ALGONQUIN HIGHLANDS	BR	2.16
	MINDEN HILLS	BR	4.16
KAWARTHA LAKES	KAWARTHA LAKES	BR, LS	124.81
MUSKOKA	BRACEBRIDGE	BR	15.84
	GEORGIAN BAY	BR	0.96
	GRAVENHURST	BR	32.16
	LAKE OF BAYS	BR	7.36
PEEL	CALEDON	LS, NV	12.05
SIMCOE	ADJALA-TOSORONTIO	NV	169.00
	BARRIE	LS, NV	13.61

	BRADFORD WEST GWILLIMBURY	LS, NV	41.95
	CFB BORDEN	NV	60.48
	CLEARVIEW	NV	179.91
	COLLINGWOOD	NV	6.92
	ESSA	NV	102.07
	INNISFIL	LS	42.78
	INNISFIL	NV	26.82
	MIDLAND	SS	14.60
	NEW TECUMSETH	LS, NV	105.95
	ORILLIA	BR, LS, SS	9.98
	ORO-MEDONTE	LS, NV, SS	211.51
	PENETANGUISHENE	SS	9.37
	RAMARA	BR, LS	113.84
	SEVERN	BR, SS	91.85
	SPRINGWATER	LS, NV, SS	177.13
	TAY	SS	48.81
	TINY	SS	203.66
	WASAGA BEACH	NV	17.69
YORK	AURORA	LS	9.03
	EAST GWILLIMBURY	LS	65.59
	GEORGINA	LS	79.93
	KING	LS, NV	49.05
	NEWMARKET	LS	0.90
	WHITCHURCH-STOUFFVILLE	LS	42.07
		Total Area	**2759.61**

5.4 HIGHLY VULNERABLE AQUIFERS (HVA)

An understanding of what it means when an area is designated as a Highly Vulnerable Aquifer or Significant Groundwater Recharge Area under the *Clean Water Act, (2006)* is crucial for protecting the groundwater resources, found within the SGBLS SPR. *Ontario Regulation 287/07* defines a Highly Vulnerable Aquifer (HVA) as an aquifer on which external sources have or are likely to have a significant adverse effect, and includes the land above the aquifer.

In general, a Highly Vulnerable Aquifer will consist of source granular aquifer materials or fractured rock that have a high permeability and are exposed near the ground surface with a relatively shallow water table. The vulnerability of the aquifer will typically be lower where a greater thickness of fine-grained lower permeability soils is observed to cover the aquifer (Genivar, 2010d).

A vulnerability score was determined for the SGBLS SPR in accordance with Technical Rule 79. According to this rule, an area identified as a Highly Vulnerable Aquifer is assigned a “vulnerability score” of 6.

The map of Highly Vulnerable Aquifer Scores expresses the relative degree to which a land use or activity could affect the local aquifers which may serve as drinking water supply aquifers elsewhere in the region. The vulnerability scores that pertain to the delineated Wellhead Protection Areas surrounding municipal supply wells as per Part VII.3 of the Technical Rules are presented in other studies. In areas where an HVA area overlaps a delineated wellhead protection area, the shallower aquifer will be delineated as an HVA. Following the delineation of the Highly Vulnerable Aquifer within each of the four watersheds, these maps were combined to create a continuous and consistent Highly Vulnerable Aquifer map that provided coverage across the entire SGBLS SPR.

Table 5: Highly Vulnerable Aquifer, by Municipality

Source Protection Area	Upper Tier Municipality	Lower Tier Municipality	Area (Km2)
NV	DUFFERIN	AMARANTH	8.42
NV		MELANCTHON	58.27
NV		MONO	77.91
NV		MULMUR	114.03
NV		SHELBURNE	0.07
LS	DURHAM	BROCK	185.80
LS		SCUGOG	21.69
LS		UXBRIDGE	159.45
NV	GREY	BLUE MOUNTAINS	25.97
NV		Grey Highlands	61.88
BR	HALIBURTON	ALGONQUIN HIGHLANDS	54.40
BR		DYSART ET AL	1.66
BR		MINDEN HILLS	239.66
BR, LS	KAWARTHA LAKES	KAWARTHA LAKES	998.37
BR	MUSKOKA	BRACEBRIDGE	171.43
BR, SS		GEORGIAN BAY	149.78
BR		GRAVENHURST	378.20
BR		LAKE OF BAYS	33.92
BR		MUSKOKA LAKES	20.34
LS, NV	PEEL	CALEDON	5.92
NV	SIMCOE	ADJALA-TOSORONTIO	82.52
LS, NV		BARRIE	17.33
LS, NV		BRADFORD WEST GWILLIMBURY	34.10
NV		CFB BORDEN	35.11

NV		CLEARVIEW	288.89
NV		COLLINGWOOD	22.84
NV		ESSA	52.83
LS, NV		INNISFIL	102.32
SS		MIDLAND	8.35
LS, NV		NEW TECUMSETH	38.47
BR, LS, SS		ORILLIA	16.25
LS, SS, NV		ORO-MEDONTE	178.13
SS		PENETANGUISHENE	10.67
BR		RAMARA	236.85
LS		RAMARA	155.55
BR, SS		SEVERN	438.31
LS, NV, SS		SPRINGWATER	229.75
SS		TAY	39.94
SS		TINY	124.96
NV		WASAGA BEACH	37.84
LS	YORK	AURORA	10.41
LS		EAST GWILLIMBURY	69.42
LS		GEORGINA	40.17
LS, NV		KING	76.19
LS		NEWMARKET	12.06
LS		WHITCHURCH-STOUFFVILLE	62.09
Total			**5188.52**

5.5 PRESCRIBED THREATS: OVERVIEW

The Clean Water Act (the Act) requires a list of Activities and Conditions that *are* or *would be* Drinking Water Threats in four types of vulnerable areas (e.g. WHPAs, IPZs, HVAs, and SGRAs). Through Ontario Regulation (O. Reg.) 287/07 (General) and the Technical Rules the province has set out which activities, at a minimum, are considered Drinking Water Threats under specific circumstances. Specifically, section 1.1 of O. Reg. 287/07 lists Activities that are prescribed as Drinking Water Threats and the Tables of Drinking Water Threats in the Rules specify under what circumstances these Activities are categorized as Significant, Moderate or Low Drinking Water Threats. Categorizing Drinking Water Threats is achieved using what is called the *Threats Based Approach*, the *Issues Based Approach,* the *Events Based Approach*, or a combination of these three approaches. Identification of Threats using the Issues Based Approach was described in the previous section (MOE, 2010).

The Event Based Approach was designed to address threats to drinking water in systems drawing water from larger water bodies where the Vulnerability Scores are generally Low. The approach allows for the use of modeling or other methods (referred to as modeling in this bulletin (MOE, 2010)) to identify existing or future activities or

existing Conditions as Significant Drinking Water Threats if the modeling results indicate that there would be a Drinking Water Issue at an intake if chemicals or pathogens were released from the location under an extreme event. It is a two part process, one part allows identification of Threats that could cause an Issue and the second part allows development of an IPZ-3 (MOE, 2010). The Event Based Approach for modeling IPZ-3 was undertaken for drinking water systems in Georgian Bay and Severn Sound.

The remainder will discuss how Threats are categorized using the Threats Based Approach.

There are four specific requirements set out in O. Reg. 287/07 and the Rules for the completion of the Threats Assessment and Issues Evaluation component of the assessment report for each vulnerable area in a Source Protection Area:

- **Listing Drinking Water Threats – Activities:** Requires identification of the Activities that *are* or *would be* Drinking Water Threats for each type of vulnerable area. These Threats are different depending on whether the source of water is groundwater or surface water (Part XI.2 (Rules 118 to 125))
- **Listing Drinking Water Threats – Conditions:** Requires identification of the Conditions that *are* or *would be* Drinking Water Threats for each type of vulnerable area. These Threats are different depending on whether the source of water is groundwater or surface water (Part XI.3 (Rule 126))
- **List Circumstances:** A list of the circumstances under which each activity listed above *makes* or *would make* the Activity a Significant, Moderate, or Low Drinking Water Threat. For Conditions, include the information that confirms there is a Condition and the hazard rating for the Condition
- **Identifying Areas for Significant, Moderate, and Low Drinking Water Threats – Activities**: Show the areas (for example, area scoring 10) within each vulnerable area and the relevant circumstances where an Activity *is* or *would be* a Significant, Moderate or Low Drinking Water Threat. (Part XI.4 (Rules 127 – 137))
- **Identifying Areas for Significant, Moderate, and Low Drinking Water Threats – Conditions**: Show the areas (for example, area scoring 10) within each vulnerable area and the relevant circumstances where an Condition is or would be a Significant, Moderate or Low Drinking Water Threat (Part XI.5 Rules 138 – 143))
- **Enumerating Significant Drinking Water Threats:** Determine the number of locations (for example, parcels of land) at which a person is engaging in an Activity that is a Significant Drinking Water Threat or where there is a Condition that is a Significant Drinking Water Threat

The following sections will discuss the requirements and methods used for each of these components.

5.5.1 Listing Drinking Water Threats – Activities

Technical Rule 118 requires that all Assessment Reports list the Activities prescribed to be Drinking Water Threats in paragraph 1 through 18 and paragraph 21 of subsection 1.1(1) of Regulation 287.07 (General) be collectively listed. These Activities are:

1) The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.
2) The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.
3) The application of agricultural source material to land.
4) The storage of agricultural source material.
5) The management of agricultural source material.
6) The application of non-agricultural source material to land.
7) The handling and storage of non-agricultural source material.
8) The application of commercial fertilizer to land.
9) The handling and storage of commercial fertilizer.
10) The application of pesticide to land.
11) The handling and storage of pesticide.
12) The application of road salt.
13) The handling and storage of road salt.
14) The storage of snow.
15) The handling and storage of fuel.
16) The handling and storage of a dense non-aqueous phase liquid.
17) The handling and storage of an organic solvent.
18) The management of runoff that contains chemicals used in the de-icing of aircraft.
19) An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.
20) An activity that reduces the recharge of an aquifer.
21) The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.

Prescribed Threats 19 and 20 are considered Threats related to water quantity.

Prescribed Threat number 16 refers to Dense Non-Aqueous Phase Liquids, typically referred to as DNAPLs. This is a class of chemicals that are slightly soluble in water and are therefore often observed as a separate “oil-like” phase in the subsurface. DNAPLs can include compounds such as chlorinated solvents used to clean and de-grease machinery and creosol based wood treating oils. What makes DNAPLs so dangerous is the fact that they degrade to other compounds which are even more toxic. The oil-like phase is denser than water and as a result, the presence and migration of the DNAPL liquids is controlled more by gravity and the distribution of permeable and conductive features in the subsurface rather than by the groundwater flow directions. This class of

chemicals has been considered as a special case for the assessment of the threat to groundwater-based drinking sources.

5.5.2 Listing Drinking Water Threats – Conditions

Conditions are defined as an existing contaminations associated with a past Activity that has the potential effect the quality of drinking water. For example, a previous gas station which no longer exists, but has left contamination in the ground from poorly stored fuel or a fuel leak. Technical Rule 126 requires that the list of Drinking Water Threats shall include the following Conditions that exist in a vulnerable area and that result from a past Activity:

1) The presence of a dense non-aqueous phase liquid in groundwater in a Highly Vulnerable Aquifer, Significant Groundwater Recharge Area or Wellhead Protection Area;
2) The presence of a single mass of more than 100 litres of one or more dense non-aqueous phase liquids in surface water in a surface water Intake Protection Zone;
3) The presence of a contaminant in groundwater in a Highly Vulnerable Aquifer, Significant Recharge Area or a Wellhead Protection Area, if the contaminant is listed in Table 2 of the Soil, Ground Water and Sediment Standards and is present at a concentration that exceeds the potable groundwater standard set out for the contaminant in that Table;
4) The presence of a contaminant in surface soil in a surface water Intake Protection Zone if, the contaminant is listed in Table 4 of the Soil, Groundwater and Sediment Standards is present at a concentration that exceeds the surface soil standard for industrial/commercial/community property use set out for the contaminant in that Table ; and
5) The presence of a contaminant in sediment, if the contaminant is listed in Table 1 of the Soil, Ground Water and Sediment Standards and is present at a concentration that exceeds the sediment standard set out for the contaminant in that table.

The method used to determine if a drinking water supply has a related Condition was based on reviewing records provided by the municipality, Conservation Authorities, and the MOE. In addition, historical review of aerial photographs and historical input from published and anecdotal evidence was also often used in areas where potential Conditions could exist. A list of Conditions for each drinking water supply was prepared and includes information regarding the identified water intake, the chemical or pathogen Threat and the uncertainty associated with each identified Condition. In most situations however there was insufficient data or information to determine if the contamination exceeded the standards. In some of these situations the contamination was identified as a potential Condition that requires further investigation.

5.5.3 List Circumstances

Circumstances are site-specific characteristics of Threats that refine the associated level of a prescribed Threat and are used to define whether an Activity is a Significant, Moderate or Low Threat. The Province has prepared tables – Tables of Drinking Water

Threats (MOE, 2008b) – which detail the circumstance for each prescribed Threat and then relates the Vulnerability of the area in which the activity is located to a Threat level of either Significant, Moderate of Low. Two sets of tables are provided, one for chemical Threats and one for pathogen Threats.

Circumstances specify characteristics of a potential Threat such as the type of chemical being used, volume of storage and whether storage is above or below ground. For example, under the *Handling and Storage of Pesticide Threat* category, one set of circumstances relate to pesticides with a mass of less than 25 kilograms, whereas another set of circumstances relate to different pesticides with a mass between 25 and 250 kilograms. Logically, different circumstances have been developed because the risk to drinking water will vary depending on the specific details of the Activity or potential Activity.

6 EVALUATION METHODOLOGY

The development of the South Georgian Bay Lake Simcoe Source Protection Plan requires the SPC to draft policies that have been evaluated and chosen from a range of existing and new policy options. An important task that was undertaken by the PPWG was the development of an evaluation framework. This evaluation framework was used to assess the policy options and to provide the rationale for the recommendations that emerged from the PPWG and were approved by the SPC. The evaluation framework forms the basis for the Explanatory Document.

6.1 GOVERNING FUNDAMENTALS

A number of governing fundamentals were developed at the beginning of the policy development process. Members of the SPC and PPWG began the deliberations by considering the elements of good policy and defined a number of early governing principles against which the policy options were considered. Good policy, it was determined, is consistent, clear, concise, readily interpreted, easily understood and implementable.

PPWG agreed unanimously that the approach to be taken would align with the following governing principles:

6.1.1 Efficiency & Effectiveness

- Will the policy be successful in reducing the risk to source water?
- Is the schedule for implementing the solution workable?

6.1.2 Flexibility

- Does the policy provide opportunities for local circumstances and conditions to be taken into account?
- Does the policy recognize and accommodate different levels of capacity that may exist across the source protection region?

6.1.3 Consistency

- Is the policy consistent with approaches being used by other Source Protection regions and municipalities?
- Is the policy consistent with other threat policies? Does it align?

6.1.4 Fiscal Responsibility

- What are the financial implications for land owners and municipalities?

In addition to the four guiding principles, the PPWG was also concerned about keeping the process aligned with existing legislation, polices and protocols. The following additional guidelines were agreed upon by the PPWG:

6.1.5 Existing Measures

- To the extent possible, existing measures will be considered first in the development of policies.
- In the event that existing measures do not offer adequate protection, every effort will be made to consider whether and how existing measures can be enhanced or fine tuned.
- New measures will be explored where existing mechanisms do not exist or cannot be enhanced to offer a sufficient level of protection.
- Lessons learned from other jurisdictions particularly as they relate to the use of new tools will be taken into account.

6.2 EVALUATION CRITERIA

A critical step in determining any preferred strategy or approach is the development of a reasonable set of criteria to assess the policy options. There are essentially two types of criteria:

- Evaluative Criteria
- Practical Criteria

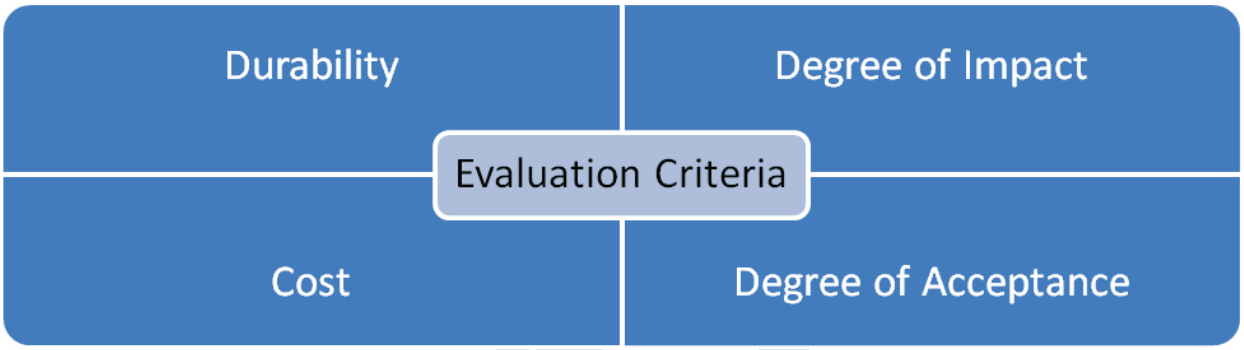
Evaluative Criteria focus on the ultimate outcome of a policy rather than the means of achieving the outcome. For example, efficiency and effectiveness are examples of evaluative criteria. Practical criteria on the other hand, focus more on the feasibility of implementation and can include such components as level of effort, reasonable cost, political constraints or administrative issues.

Ideally, evaluation frameworks include a blend of both evaluative and practical criteria. Against this backdrop, it is important to note that there are a range of decision making criteria against which the policies were assessed. The evaluation criteria that were developed by the PPWG and endorsed by the SPC focused on efficiency, effectiveness, consistency, flexibility, feasibility, fairness and fiscal responsibility. These key criteria – many of which were part of the governing principles developed by the PPWG at the outset of the policy development process – were further categorized into four key areas:

1. Degree of Impact
2. Degree of Acceptance
3. Cost
4. Durability

These four evaluation 'pillars' formed the evaluation framework.

Figure 1: Four Pillars of the Evaluation Framework



6.3 EVALUATION FRAMEWORK

A weighted evaluation framework, incorporating the evaluation criteria was developed. The criteria and assigned weightings are depicted in the following schematic:

6.3.1 Weighted Evaluation Criteria

Table 6: Weighted Evaluation Schematic

Criteria Details	Weighted Values
Degree of Impact:	Sub-Totals
Effectiveness:	
Will this produce the anticipated environmental benefits? No = 0 Yes = 1	
Will it decrease/minimize existing threats? Minimize = 1 Decrease = 2	
Will it eliminate future threats? No = 0 Yes = 1	
Will it have the effect of maintaining or improving water quality? Decrease = 0	

Criteria Details Weighted Values

Maintain = 1
Improve = 2

Is the approach effective?
No = 0
Yes = 1

Does it meet our objectives?
No = 0
Some objectives = 1
All objectives = 2

Does it allow us to achieve our goals?
No = 0
Yes, but only some = 1
Yes, all – 2

Will it make a difference?
No = 0
Yes = 1

What is the breadth of the approach – will it address a big issue that affects the entire watershed?
No impact = 0
Minimal impact = 1
Broad & widespread impact = 2

Will this address an immediate problem/priority? A substantive problem/priority? A minor issue?
Minor Issue = 1
Substantive issue/problem = 2
Immediate priority = 3

Degree of Impact:
Efficiency
Does this avoid duplication & overlap?
No = 0
Yes – 1
Can this be implemented now? Implemented soon?
Soon = 1
Now = 2
Can this approach be implemented easily?
No = 1
Yes = 2

Criteria Details	Weighted Values

Does/will this promote consistency?
No = 0
Yes = 1

Degree of Acceptance:
Community Acceptance:
Can this be easily understood by all?
No, by none = 0
Yes, but only by some = 1
Yes, by all = 2
Does this have community buy in?
No = 0
Yes = 1
Will there be strong opposition from landowners?
Yes = 0
No = 1
Will financial assistance be required?
Yes = 0
No = 1
Does the approach treat all parties equitably?
No = 0
Yes = 1
Political/Legal Acceptance:
Is there political support to implement this approach?
No = 0
Yes = 1
Is this precedent setting? Does it have broader implications beyond the watershed?
Yes = 0
No = 1
Can this be legally implemented?
No = 0
Yes = 1
Institutional/Municipal Acceptance:
Is there existing capacity to implement this approach?
No = 0
Yes = 1
Cost: Time/Resources:
Can the approach be implemented with existing resources? (e.g. existing staffing resources/monetary resources?)
No = 0
Yes = 1
Is the approach financially practical?
No = 0

Criteria Details	Weighted Values
Yes = 1 Is it realistic? No = 0 Yes =1 Are significant new resources required? Yes = 0 No = 1 Does the approach require an ongoing investment of time and money (e.g. enforcement) Yes = 0 No = 1 Is financial assistance required? Yes = 0 No = 1 Are there indirect costs that must be considered? Yes = 0 No – 1 Durability Rationality – Is the approach based on sound science? No = 0 Yes = 1 Flexibility/Adaptability – Is the approach flexible enough to allow for improvements over time? (e.g. improvability) No = 0 Yes = 1 Enforceability – Is ongoing monitoring required? Yes – 0 No – 1 Total:	

For each of the policy options, consideration was given to the four evaluation criteria – Degree of Impact, Degree of Acceptance, Durability and Cost. Ranking was devised and an approach was identified. The evaluation of the policy options factored prominently in the development of a preferred approach. The policy rationale is explained in more detail in the section to follow.

7 PRESCRIBED THREATS: POLICY RATIONALE AND EXPLANATION (BY THREAT NUMBER)

Significant Threats

Ontario Regulation 287/07, Section 1.1 (1), lists 21 activities prescribed to be drinking water threats. Of these, two are water quantity threats and 19 are water quality threats. The Assessment Report outlines the process followed to identify vulnerable areas within

the Source Protection Area where threats to drinking water sources exist or would exist if the activity were occurring.

7.1 WASTE DISPOSAL

According to Ontario Regulation 287/07, Section 1.1 (1) paragraph 2, the activities that are deemed to be a threat to drinking water supplies are the establishment, operation, or maintenance of these waste disposal facilities. There are ten sub-threat activities listed under this threat in the Ministry of the Environment's Tables of Drinking Water Threats (2009). They are:

- Application of untreated septage to land;
- Storage, treatment, and discharge of tailings from mines;
- Land farming of petroleum refining waste;
- Land filling of hazardous waste;
- Land filling of municipal waste;
- Land filling of solid, non-hazardous industrial, or commercial waste;
- Liquid industrial waste injection into a well;
- PCB (Polychlorinated biphenyl) waste storage;
- Storage of hazardous waste at disposal sites; and
- Storage of certain hazardous wastes.

Generally, the Ministry of the Environment issues certificates of approval for waste disposal sites, under the *Environmental Protection Act*. These certificates are required prior to the establishment, extension, or ongoing operation of a waste disposal site. Exemptions are given for domestic waste generation. The regulations for waste disposal sites do not apply to the storage or disposal on a private property, unless the situation becomes a nuisance (Director's decision), or where the activity would fall under the *Ontario Water Resources Act*. Therefore, activities such as dumpsters on privately owned property and salvage yards would not normally be considered under this threat category.

The Ministry of the Environment identifies many chemicals of concern related to the ten sub-threat activities listed above. These chemicals have the potential to be introduced into surface and groundwater as a result of the storage and land disposal of waste and could threaten the safety of drinking water sources in certain situations.

Waste disposal site threats are primarily due to the release of chemicals, with only the application of untreated septage to land listed as a pathogen threat. The chemicals of concern include nutrients, petroleum, hydrocarbons, metals and organic compounds. All of these chemicals could have an impact on the quality of source water and require appropriate treatment at the Water Treatment Plant, if treatment is possible.

Within the South Georgian Bay Lake Simcoe Source Protection Region, there are three sub-threat categories of concern:

- hauled sewage
- mile tailings
- waste disposal sites

The policy approaches and the deliberations that took place at the Planning & Policy Working Group and Source Protection Committee were very specific. The following captures the rationale and the considerations that factored prominently in the discussions.

7.1.1 Policy Rationale for the Establishment, Operation or Maintenance of a Waste Disposal Site Within the Meaning of Part V of the Environmental Protection Act (Threat #1a: Hauled Sewage)

Prescribed Instruments

The use of prescribed instruments, certificates of approval, was the preferred, primary option to address the threats of the establishment, operation, or maintenance of waste disposal sites.

The consensus of the Planning and Policy Working Group and the Source Protection Committee was that the use of prescribed instruments was an effective tool, with clear criteria for implementation. Certificates of approval have been a long-standing requirement for these types of facilities, and the criteria used to assess these certificates are thorough. It was noted that a proposed waste disposal site would also require an extensive environmental assessment under the *Environmental Assessment Act*. The environmental assessment is an important procedure that predicts the environmental effects of proposed initiatives before they are carried out.

In the review of this option, the SPC elected to direct the Ministry of the Environment to amend all existing Certificates of Approval to ensure specific measures are addressed. The Committee felt strongly that conditions should be included that mirrored those in place for Nutrient Management Plans. The issue of consistency factored prominently.

In addition, the SPC elected to direct the Ministry of the Environment to deny an application for a Certificate of Approval for a waste approval site within a vulnerable area where there would be a significant threat to drinking water. Although the Certificate of Approval process was considered to be rigorous, denial of an application was preferred, from a policy perspective, to eliminate the option of allowing these sites to be located within vulnerable areas, i.e., where significant drinking water threats would occur in the future if the activity were undertaken.

There was some discussion concerning the approach to be taken for hauled sewage. The SPC considered a range of approaches from an outright prohibition of future to a provisional prohibition whereby a Certificate of Approval could be approved if it was demonstrated that there would be no impact.

Research

The Committee suggested writing policies that encourage ongoing research around hauled sewage treatment options and the opportunity to create environmentally friendly usable by-products (i.e. compost). Research and the approval for use of emerging

technologies should be supported. A policy to encourage such research and consider new treatment options and by-product development would be a proactive, forward thinking and strategic policy.

7.1.2 Policy Rationale for the Establishment, Operation or Maintenance of a Waste Disposal Site Within the Meaning of Part V of the Environmental Protection Act (Threat #1b: Waste Disposal Sites)

Prescribed Instruments

The use of prescribed instruments, Certificates of Approval, was the preferred, primary option to address waste disposal sites that are a significant threat to municipal drinking water supplies.

The consensus of the Planning and Policy Working Group and the Source Protection Committee was that the use of prescribed instruments was an effective tool, with clear criteria for implementation. Certificates of approval have been a long-standing requirement for these types of facilities, and the criteria used to assess these certificates are thorough. It was noted that a proposed waste disposal site would also require an extensive environmental assessment under the *Environmental Assessment Act*. The environmental assessment is an important procedure that predicts the environmental effects of proposed initiatives before they are carried out.

In the review of this option, the SPC indicated that they would want to ensure that these sites cannot receive hazardous waste in the future. They were of the opinion that the policy should direct the Ministry of the Environment to amend all existing Certificates of Approval to ensure that these restrictions are imposed and further that additional measures including mandatory inspections, system upgrading, regular monitoring and regular reviews be completed to ensure that any potential impacts to drinking water quality are identified early.

In addition, the SPC elected to direct the Ministry of the Environment to deny an application for a Certificate of Approval for any new or expanded systems.

- in WHPA & IPZ1
- in vulnerable areas
- unless it can be demonstrated that there is no adverse impact on drinking water quality

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan restrictions were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to waste disposal sites. However, it was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with waste disposal sites. While these methods can be used to inform individuals and agencies about the importance of pollution prevention, other methods are needed to address both existing and future threats. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the use of incentives, where available, to encourage ongoing stewardship and pollution prevention to address the threat of activities related to waste disposal sites. However, it was felt that incentives on their own would not be sufficient to address the threats associated with waste disposal. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

Research

The Committee suggested writing policies that encourage ongoing research and investigation at the municipal level to identify historical landfills. A policy to encourage such research would be a proactive, comprehensive, forward thinking and strategic policy that would address the issue of historical vestiges that exist on the landscape and the need to properly identify these sites and manage them accordingly.

7.1.3 Policy Rationale for the Establishment, Operation or Maintenance of a Waste Disposal Site Within the Meaning of Part V of the Environmental Protection Act (Threat #1c: Mine Tailings)

The use of prescribed instruments, Certificates of Approval, was the agreed-upon approach to address the storage of mine tailings as a threat to municipal drinking water supplies. It was felt that Certificates of Approval offered a clear, consistent approach for managing existing and future threats associated with the storage of mine tailings.

The Committee determined that strong wording was needed. They were of the opinion that the policy should direct the Ministry of the Environment to amend all existing Certificates of Approval for the storage of mine tailings that are a significant threat to ensure that the storage ceases to be a significant drinking water threat. They were also of the opinion that the policy should direct the Ministry of the Environment to deny an application in any vulnerable area for the storage of mine tailings, where the activity would be a significant drinking water threat. Although the Certificate of Approval process was considered rigorous and although an environmental assessment would be required for any new facilities, denial of future applications was preferred, from a policy perspective, to eliminate the option of allowing these sites to be located within vulnerable areas.

The Committee also determined that the areas affected by this policy direction were fairly limited in area and therefore, easily identified as lands to be considered off-limits for such activities.

7.2 SEWAGE

Sewage is defined by the *Ontario Water Resources Act* as drainage, stormwater, commercial wastes and industrial wastes. The Ministry of the Environment has designated certain sewage systems that pose a significant threat to drinking water sources under specific circumstances in the Table of Drinking Water Threats (2009). Sewage systems that collect, store, transmit, treat or dispose of sewage include:

- combined sewer discharge
- discharge from a stormwater retention pond
- industrial effluent discharges
- sanitary sewers and related pipes
- septic systems
- septic system holding tanks
- sewage treatment plant bypass discharge
- sewage treatment plant effluent discharges
- storage of sewage

The Ministry of the Environment has prescribed the establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage as threats to drinking water sources. This threat is further defined at a significant level, on the basis of the nine activities listed in bullet form above. The rationale for their inclusion is outlined in Table 7.

Table 7: Rationale for Inclusion of the 9 Activities

Threat Activity	Rationale
Combined sewer discharge from a stormwater outlet to surface water	Occasionally, during periods of high rainfall and snow melt (wet weather) water flows may rise above the capacity of a combined sewer system. At these times, some of the flow may be released to water bodies. **This activity is a significant threat only in areas of surface water vulnerability**
Discharge of untreated stormwater from a stormwater retention pond	Included in the Tables of Drinking Water Threats (2009) are the releases with stormwater of pathogens, as well as 18 chemicals and their compounds, to either groundwater or surface water. The chemicals include metals, nutrients, pesticides, ions, and hydrocarbons. The flow chart for Threat 2 in Appendix B tabulates a full list of these chemicals.

Industrial Effluent Discharges	The main consideration for reducing or eliminating drinking water threats related to industrial sewage systems is to make sure that any discharge from these systems does not contain contaminants in a volume and concentration that would threaten the quality of the receiving surface water body or the aquifer. The drinking water threat relates to industrial sewage systems that discharge to surface water; however, the discharge can affect the quality of surface water or groundwater. According to the MOE Tables of Drinking Water Threats (2009), there are 58 chemicals and their compounds, as well as pathogens that could be released to the environment from industrial sewage works that are considered to result in significant threats under certain conditions.
Sanitary Sewers and Related Pipes	Outflow of raw sewage through pipe joints or degraded pipes could threaten a drinking water source. Infiltration through degraded pipes or pipe joints can happen when the water table is high or soils are saturated following rain or snow melt. Inflow of stormwater or infiltration of groundwater into a degrading, collapsed, cracked, or sagging pipe is a concern as it increases the volume carried. Sanitary sewer systems are designed based on estimates of the amount of sanitary waste to be generated and conveyed in the system. If excess stormwater enters the system, there is the potential for overflows of untreated or partially treated wastewater at pumping stations and/or wastewater treatment plants.
Septic Systems	Only the discharge of pathogens from small septic systems has been identified as potentially adversely affecting drinking water sources. The threat only exists for groundwater sources. Large systems (those with a design flow greater than 10,000 litres per day) are subject to approval by the Ministry of the Environment under the *Ontario Water Resources Act.* Any system, no matter its size, which cannot be located on a single property, is subject to approval by the Ministry of the Environment. Schools, campgrounds, more than one household, and larger businesses are examples of facilities that may require a large system. Pathogens, as well as five chemicals, have been identified as pollutants that could be released from large septic systems and affect drinking water sources. The chemicals are found in household cleaners and products, in food, and in human waste.
Septic System Holding Tanks	Although holding tanks do not release pollutants to the environment for the most part, it is essential to monitor them for potential leaks. Tanks must be pumped out and inspected regularly, and registered haulers should perform both functions.

Sewage Treatment Plants Bypass Discharge to Surface Water	Bypasses from a treatment plant are typically the result of infiltration/inflow and high volumes, equipment failure, power failure, or plant shutdowns for maintenance. Bypasses can be of untreated or partially treated wastewater with untreated discharges being of greater concern, depending on the volumes released.
Sewage Treatment Plant Effluent Discharges	Stormwater may enter collection pipes and add to the volume to be treated. Effluent contains a range of contaminants, and thus the impact on the environment to which it is discharged also varies. Effluent is discharged to water bodies that have sufficient assimilative capacity to receive the effluent without adverse impacts on aquatic life or humans. Although treatment occurs, conventional systems do not remove all contaminants from the effluent. The Ministry of the Environment has identified a variety of chemicals and pathogens as chemicals of concern when released in treated effluent (*see* Appendix B). The Ministry of the Environment sets criteria for the quality of the components of effluent. However, control of the sources of wastewater entering the system alleviates some of the treatment issues. To that regard, municipalities have sewer use by-laws in place that set criteria for contaminants in waste streams discharging to sanitary sewer pipes.
Storage of Sewage	Sewage storage tanks may leak or spills may occur, thereby potentially contaminating groundwater or surface water. In this case, the impact on the environment is based on the quality and the volume of the material released. The circumstances defined as significant threats pertaining to sewage systems are outlined on the flow charts for Threat 2 in Appendix B. The MOE Tables of Drinking Water Threats (2009) identify a number of chemicals and pathogens that could make their way into the groundwater and surface water under certain conditions related to the above systems. A full list of these chemicals is tabulated and included with the Threat 2 flow chart in Appendix B.

In the South Georgian Bay Lake Simcoe Source Protection Region, there are four sub-threat categories that are of particular interest:

- Discharge of Untreated Stormwater from a Stormwater Retention Pond
- Biosolids
- Septics
- Industrial Effluent

7.2.1 Policy Rationale for the Establishment, Operation or Maintenance of a System that Collects, Stores, Transmits or Disposes of Sewage (Threat #2a – Stormwater Management)

Prescribed Instruments

The use of prescribed instruments, Certificates of Approval, was the preferred, primary option to address untreated stormwater that poses a threat to municipal drinking water supplies.

The consensus of the Planning and Policy Working Group and the Source Protection Committee was that the use of prescribed instruments was an effective tool, with clear criteria for implementation. Certificates of approval have been a long-standing requirement for these types of facilities, and the criteria used to assess these certificates are thorough.

In the review of this option, the SPC was of the opinion that the policy should direct the Ministry of the Environment to amend all existing Certificates of Approval to ensure that specific conditions are included that outline design, operation and performance specifics as well as requirements for regular and ongoing maintenance with period removal of accumulated sediment, lining of the pond (where warranted) and the possible need for an oil/water separator. Particularly in settlement areas, oil may be entering the pond and require removal. The Ministry could also impose requirements for the removal of accumulated sediment from the retention ponds on a regular basis. This would be beneficial to ensure the pond has the capacity to operate effectively for sediment removal. In addition, it would be advisable to remove sediment because contaminants may have adsorbed to it and this could improve the quality of the discharge water.

In addition, it was felt that additional measures including mandatory inspections, system upgrading, regular monitoring and regular reviews be completed to ensure that any potential impacts to drinking water quality are identified early.

In addition, the SPC elected to direct the Ministry of the Environment to deny an application for a Certificate of Approval for any new systems where the discharge of untreated stormwater from a stormwater retention pond would be a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that direct stormwater management ponds outside of the vulnerable areas where there would be a significant drinking water threat.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to stormwater management facilities. In particular, it was felt that the municipality responsible for water should undertaken an education and outreach program targeted at residential, industrial and commercial landowners that explains the importance of source water protection and provides information about contaminants found in stormwater. The Committee supported the notion of advancing the yellow fish road program and the value of considering signage at stormwater management facilities. Finally, the Committee noted that there are many water efficiency and water conservation initiatives that are ongoing across the Region, not the least of which is the Region of York's Long Term Water Conservation Strategy. Efforts such as these promote an increased awareness and understanding and the Committee agreed to support education and outreach programs that enhance understanding.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with waste disposal sites. While these methods can be used to inform individuals and agencies about the importance of pollution prevention and the importance of conservation and stewardship, other methods are needed to address both existing and future threats. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the use of incentives, where available, to encourage ongoing stewardship and pollution prevention to address the threat of activities related to stormwater management. It was felt that incentives on their own would not be sufficient to address the threats associated with the discharge of untreated stormwater from a stormwater retention pond. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

Research

The Committee suggested writing policies that encourage research and investigation into alternative methods for stormwater management. A policy to encourage such research would be a proactive, comprehensive, forward thinking and strategic.

7.2.2 Policy Rationale for the Establishment, Operation or Maintenance of a System that Collects, Stores, Transmits or Disposes of Sewage (Threat #2b – Wastewater Treatment Plants / Sewer Systems)

Prescribed Instruments

The use of prescribed instruments, Certificates of Approval, was the preferred, primary option to address sewage treatment plant biosolids that pose a threat to municipal drinking water supplies.

The consensus of the Planning and Policy Working Group and the Source Protection Committee was that the use of prescribed instruments was an effective tool, with clear criteria for implementation. Certificates of approval have been a long-standing requirement for these types of facilities, and the criteria used to assess these certificates are thorough.

In the review of this option, the SPC was of the opinion that the policy should direct the Ministry of the Environment to amend all existing Certificates of Approval to include conditions that may address mandatory inspections, system upgrading, regular monitoring and regular reviews be completed to ensure that any potential impacts to drinking water quality are identified early.

In addition, the SPC elected to direct the Ministry of the Environment to deny an application for a Certificate of Approval for any new sewage treatment plants in vulnerable areas where there would be a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans to prohibit new sewage treatment plants and any associated outlets from being located in areas where there would be a significant drinking water threat.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to sewage treatment plant biosolids. In particular, it was felt that the municipality responsible for water should undertake with the CA/SPA, an education and outreach program targeted at residential, industrial and commercial landowners that explains the importance of source water protection and appropriate sewer use.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with sewage treatment plant biosolids. While these methods can be used to inform individuals and agencies about the importance of pollution prevention and the importance of conservation and stewardship, other methods are needed to address both existing and future threats. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

7.2.3 Policy Rationale for the Establishment, Operation or Maintenance of a System that Collects, Stores, Transmits or Disposes of Sewage (Threat #2c – Onsite Sewage Systems)

Prescribed Instruments

The use of prescribed instruments, Certificates of Approval, was the preferred, primary option to address septic systems that pose a threat to municipal drinking water supplies.

The consensus of the Planning and Policy Working Group and the Source Protection Committee was that the use of prescribed instruments was an effective tool, with clear criteria for implementation. Certificates of approval have been a long-standing requirement for these types of facilities, and the criteria used to assess these certificates are thorough.

In the review of this option, the SPC was of the opinion that the policy should direct the Ministry of the Environment to amend all existing Certificates of Approval to ensure that no large septic systems are permitted to expand where the system is a significant threat.

In addition, the SPC was of the opinion that the Ministry of the Environment should be directed to deny any applications for Certificates of Approval for new or expanded systems in WHPA-A or where there would be a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that prohibit new on-site sewage systems where they would be a significant drinking water threat.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to septic systems. In particular, it was felt that the municipality responsible for water should undertake an education and outreach program with the CA/SPA targeted at landowners in the WHPA-A and WHPA-B about proper care and maintenance of septic systems.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with waste disposal sites. While these methods can be used to inform individuals and agencies about the importance of proper system maintenance and care, other methods are needed to address both existing and future threats. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the use of incentives, where available, to encourage ongoing stewardship and pollution prevention to address the threat of activities related to septic systems. It was felt that incentives on their own would not be sufficient to address the threats associated with septic systems and while incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

7.2.4 Policy Rationale for the Establishment, Operation or Maintenance of a System that Collects, Stores, Transmits or Disposes of Sewage (Threat #2d – Industrial Effluent)

Prescribed Instruments

The use of prescribed instruments, Certificates of Approval, was the preferred, primary option to address industrial effluent that poses a threat to municipal drinking water supplies.

The consensus of the Planning and Policy Working Group and the Source Protection Committee was that the use of prescribed instruments was an effective tool, with clear criteria for implementation. Certificates of approval have been a long-standing requirement for these types of facilities, and the criteria used to assess these certificates are thorough.

In the review of this option, the SPC was of the opinion that the policy should direct the Ministry of the Environment to amend all existing Certificates of Approval to ensure that specific additional conditions are included that identify the need for such things as mandatory inspections, system upgrading, regular monitoring and regular reviews to ensure that any potential impacts to drinking water quality are identified early.

In addition, the SPC determined that policies were needed to direct the Ministry of the Environment to deny any applications for a Certificate of Approval for future facilities where they would be a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that prohibit new industrial effluent ponds in WHPA-A.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to the discharge of industrial effluent. In particular, it was felt that the municipality responsible for water should undertake an education and outreach program in collaboration with the CA/SPA that is targeted at landowners and addresses the importance of pollution prevention by explaining the need for proper industrial effluent management.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with industrial effluent. While these methods can be used to inform individuals and agencies about the importance of pollution prevention and the importance of conservation and stewardship, other methods are needed to address both existing and future threats. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the use of incentives, where available, to encourage ongoing stewardship and pollution prevention to address the threat of activities related to industrial effluent. It was felt that incentives on their own would not be sufficient to address the threats associated with the discharge of untreated stormwater from a stormwater retention pond. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

7.3 POLICY RATIONALE FOR THE APPLICATION OF AGRICULTURAL SOURCE MATERIAL (ASM) TO LAND (THREAT #3)

7.4 POLICY RATIONALE FOR THE STORAGE OF AGRICULTURAL SOURCE MATERIAL (ASM) (THREAT #4)

7.5 POLICY RATIONALE FOR THE MANAGEMENT OF AGRICULTURAL SOURCE MATERIAL (ASM) (THREAT #5)

Agricultural source material is waste from farms that can be applied to land as a source of nutrients. Regulated compost and manure offer two examples of agricultural source material.

According to Ontario Regulation 267/03—General under the *Nutrient Management Act*, agricultural source materials include the following treated or untreated materials if they are capable of being applied to land as nutrients.

- Manure produced by farm animals, including bedding materials;
- Runoff from farm-animal yards and manure storages;

- Wash waters from agricultural operations that have not been mixed with human body waste (e.g., from the milking centre);
- Organic materials produced by intermediate operations that process the above materials (e.g., mushroom compost);
- Anaerobic digestion output, if, the anaerobic digestion materials were treated in a mixed anaerobic digestion facility;
- at least 50 percent, by volume, of the total amount of anaerobic digestion materials were on-farm anaerobic digestion materials; and
- the anaerobic digestion materials did not contain sewage biosolids or human body waste;
- Regulated compost, which is a mixture of dead animals and substrate.

The activities prescribed in regulation under the *Clean Water Act* as threats to drinking water supplies are the storage or the application to land of any of the materials listed above. These materials typically contain chemicals and pathogens that could alter the quality of source water. The management of agricultural source material relates only to aquaculture operations and the release of pathogens to surface water.

Nitrogen, total phosphorus, and pathogens are contaminants that could make their way into groundwater as a result of the application of agricultural source material to land and the storage of agricultural source material. These nutrients and pathogens could threaten the safety of drinking water sources in certain situations due to infiltration, runoff, or spills.

The primary source of nitrogen, total phosphorus, and pathogens in agricultural source materials is from animal waste and by-products. Agricultural source material is generated on livestock farms but can be used to enhance soil quality wherever needed. Permanent nutrient storage facilities are generally, but not always, located near barns and outdoor confinement areas. Temporary field nutrient storage facilities may be located on fields where the agricultural source material will be applied.

Nitrogen is a concern for both surface and ground drinking water sources. When water with high nitrate concentrations is consumed by babies less than six months of age, their digestive systems aren't able to cope and high levels of methemoglobin are formed in the blood. Oxygen is not distributed to the body's cells and Methemoglobinemia, or Blue Baby Syndrome, results.

Total phosphorus associated with agricultural source material can only be a drinking water threat in intake protection zones (IPZs) and in wellhead protection areas (WHPAs) where the groundwater is under the direct influence of surface water (areas designated WHPA-E). The addition of excess nutrients, such as phosphorus, to surface water can cause increased plant growth and the depletion of oxygen. These changes alter the water quality and the aquatic ecosystem.

Pathogens are microscopic organisms capable of producing infections or infectious disease in humans. The bacterium, Escherichia coli (E. coli) is an example of a pathogen typically monitored in water.

The activities related to ASM that are considered significant threats (and therefore part of the policy development process) are outlined in the flow charts for Threats 3 and 4 (*see* Appendix B). Note that the management of agricultural source material (Threat 5) is classified as a moderate or low threat and therefore was not considered in the policy development process for significant threats.

Part IV Prohibition

It was agreed that Part IV Prohibition was considered among the most effective approaches to address Agricultural Source Materials (ASMs) in vulnerable areas. The Planning & Policy Working Group and the Source Protection Committee were in agreement that land use that involve the handling and storage of ASMs that would be a significant drinking water threat are prohibited under Part IV of the Clean Water Act.

Part IV Risk Management Plans

It was agreed that among the best means of addressing the threats associated with ASM for any farm is a nutrient management strategy or plan. For farms that are not required to have a nutrient management strategy or plan, the policy approach proposed by the Policy & Planning Working Group and the Source Protection Committee is to require a risk management plan for the application and storage of agricultural source materials in vulnerable areas where these activities are or would be a significant drinking water threat. This risk management plan would be based on the same principles as the nutrient management plan and scoped to address these specific threats. It would allow existing cropping within the WHPA-A to continue subject to a range of best management practices including:

- no ASM spreading
- soil tests to determine fertilizer requirements every 3 years at minimum
- 2-3 crop rotation
- fertilizer and pesticide use at prescribed rates and applied by a certified professional only
- no mixing or loading of fertilizer/pesticide in WHPA-A
- standard operating procedure for cropping (TBD).

The Source Protection Committee was of the opinion that it is important that the requirements of a risk management plan be disclosed in the policy included in the Source Protection Plan to be used by a risk management official. This way, the farmer and the official are both aware of the requirements of the Plan.

Part IV Restricted Land Use

In keeping with the Risk Management Plans required by policy in the Source Protection Plan, pre-screening of planning applications related to agricultural land uses and of building permit applications for the proposed construction of ASM storage facilities must also be required, to ensure compliance. Pre-screening of applications would be necessary in areas where these activities would pose a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that identify those lands subject to restricted land use provisions and shall require the submission of a disclosure report as part of the complete application requirements within a vulnerable area where there is or would be a significant drinking water threat and include provisions that prohibit land uses that involve the handling and storage of ASM that would be a significant drinking water threat.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to agricultural source material. In particular, it was felt that there was tremendous merit in calling on the Ontario Soil and Crop Improvement Association (OSCIA) in collaboration with the CA/SPA to deliver an education and outreach program targeted at agricultural landowners within vulnerable areas that promote Best Management Practices to safeguard water supplies.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with agricultural source material. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the use of incentives, where available, to encourage ongoing stewardship and pollution prevention to address the threat of activities related to agricultural source material. It was felt that incentives on their own would not be sufficient to address the threats associated with agricultural source material. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

7.6 POLICY RATIONALE FOR THE APPLICATION OF NON-AGRICULTURAL SOURCE MATERIAL (NASM) TO LAND (THREAT # 6)

7.7 POLICY RATIONALE FOR THE HANDLING AND STORAGE OF NON-AGRICULTURAL SOURCE MATERIAL (NASM) (THREAT #7)

Non-agricultural source materials fall into one of three categories:

- unprocessed plant material, such as yard waste
- processed plant material
- animal-originated material, pulp and paper mill biosolids, and other unlisted material.

According to O. Reg. 267/03 – General under the *Nutrient Management Act*, non-agricultural source materials (NASMs) include the following materials. These are intended to be applied to land as nutrients:

- Pulp and paper biosolids;
- Sewage biosolids;
- Anaerobic digestion output, where less than 50 percent of the total material is on-farm anaerobic digestion materials; and
- Any other material that is not from an agricultural source and that is capable of being applied to land as a nutrient.

For more than 30 years, NASM has been applied to Ontario farmland to add valuable nutrients to soil and crops. A beneficial value of the NASM to the growing of crops must be demonstrated. NASM provides organic matter that can help maintain soil productivity and reduce soil erosion. It also could have value as a fertilizer or soil pH adjuster. The application of NASM to farm land is a cost-effective option for improving soil quality and fertilizing crops. NASM is also applied to non-agricultural properties.

NASM comes in two states—solid and liquid, and is placed in one of three categories:

- unprocessed plant material, such as unprocessed leaf and yard waste, or unprocessed fruits and vegetables;
- processed plant material, such as organic food processing waste that contains no meat or fish, or bakery wash water; or
- animal originated material, pulp and paper mill biosolids, sewage biosolids, or unlisted material.

The Ministry of the Environment has prescribed in Ontario Regulation 287/07 the application of NASM to land and the handling and storage of NASM as threats to drinking water sources. The level of risk to a drinking water source from NASM-related threats depends on the cumulative impact from nutrient and pathogen sources. This impact is determined through the relationship between the percentage of managed land in an area and the livestock density in that same area. The greater the percentage of managed land in a vulnerable area, the higher the cumulate amount of nutrients that may be over applied to that area.

NASM that will be applied to fields on a farm can be stored in a permanent nutrient storage facility (usually a steel or concrete tank) or on a temporary field nutrient storage site. There are restrictions made under the *Nutrient Management Act* about what types of NASM can be stored on a farm, for how long, and how it can be applied. For example, liquid NASM must be applied to the land by midnight on the day it is received. The restrictions based on legislation are discussed below.

The Ministry of the Environment identifies nitrogen, total phosphorus, and pathogens as contaminants that could make their way into surface or groundwater as a result of the application of NASM to land, and the handling and storage of NASM. These nutrients and pathogens could threaten the safety of drinking water sources in certain situations due to runoff or spills.

The sources of nitrogen and total phosphorus in the NASM are dependent on the material. Sewage biosolids could have nutrients from human waste and household products, such as soap.

Nitrogen is a concern for both surface and ground drinking water sources. When water with high nitrate concentrations is consumed by babies less than six months of age, their digestive systems aren't able to cope with high levels of methemoglobin that are formed in the blood. As a result, oxygen is not distributed to the body's cells, and Methemoglobinemia, or Blue Baby Syndrome, results.

Excessive phosphorus in surface water results in eutrophication. Eutrophication involves abundant plant growth and decay and causes reductions in water quality.

Pathogen sources where significant threats are possible are meat plants or sewage works. Additional sources of NASM where threats could be low are:

- seafood processing operations;
- dairy producers;
- dairy product manufacturing operations;
- animal food manufacturing operations (from animal sources); and
- pulp and paper mills.

Prescribed Instruments

The use of prescribed instruments, Certificates of Approval, was a preferred, primary option to address septic systems that pose a threat to municipal drinking water supplies.

The consensus of the Planning and Policy Working Group and the Source Protection Committee was that the use of prescribed instruments was an effective tool, with clear criteria for implementation.

In the review of this option, the SPC was of the opinion that the policy should direct the Ministry of the Environment to amend all existing Certificates of Approval/NASM Plans to incorporate conditions to ensure that the storage or application of NASM cease to be a significant drinking water threat. Such conditions could include baseline testing of soils to determine soil limiting factors and ongoing testing to ensure concentrations are not building in the soil.

In addition, the SPC was of the opinion that the Ministry of the Environment should be directed to deny any applications for Certificates of Approval for new NASM plans in vulnerable areas that would be a significant drinking water threat**.**

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that identify those lands subject to restricted land use provisions and shall require the submission of a disclosure report as part of the complete application requirements within a vulnerable area where there is or would be a significant drinking water threat and include provisions that prohibit land uses that involve the handling and storage of NASM that would be a significant drinking water threat.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to stormwater management facilities. In particular, it was felt that there was tremendous merit in calling on the Ontario Soil and Crop Improvement Association (OSCIA) in collaboration with the CA/SPA to deliver an education and outreach program targeted at agricultural landowners within vulnerable areas as well as NASM haulers/appliers to promote Best Management Practices to safeguard water supplies.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with agricultural source material. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the use of incentives, where available, to encourage the purchase of easements within WHPA-A and the maintenance of ongoing stewardship funding and support to address the threat of activities related to non-agricultural source material. It was felt that incentives on their own would not be sufficient to address the threats associated with agricultural source. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

7.8 POLICY RATIONALE FOR THE APPLICATION OF COMMERCIAL FERTILIZER TO LAND (THREAT #8)

7.9 POLICY RATIONALE FOR THE HANDLING AND STORAGE OF COMMERCIAL FERTILIZER (THREAT #9)

Commercial fertilizer is a synthetic material containing one or more plant nutrients. It is either designated for such use or claims to have value in promoting plant growth.

Plants need sufficient nutrients for proper growth. They retrieve these nutrients from soil organic matter, soil minerals, organic fertilizers such as manure, and nitrogen from the air. If the soil still does not contain adequate nutrient levels, commercial fertilizers may be added.

The majority of commercial fertilizers contain nitrogen, phosphorus, and potassium. Nitrogen is important for leaf development; phosphorus promotes good root development and plant growth, especially during plant establishment; and potassium contributes to the general vigour of a plant, including drought tolerance and winter hardiness. Commercial fertilizers also include supplements such as lime and gypsum.

The Ministry of the Environment has identified nitrogen and total phosphorus as chemicals that could affect drinking water sources under certain circumstances related to commercial fertilizers. These nutrients could threaten the safety of drinking water in certain situations due to runoff, leaching, or spills. The application of commercial fertilizer to land is associated with a range of land uses including agricultural, active recreational, institutional, industrial, commercial, and residential.

When assigning risk to drinking water sources from associated land application activities, the Ministry of the Environment considered the cumulative impacts from all sources of nutrients. The combination of percent managed lands and livestock density was used as a surrogate of nutrients present as a result of generation, storage, and land application within the area. This surrogate was used to determine the potential impact of a single property on water quality through the release of nutrients. The level of risk to drinking water sources from the land application of commercial fertilizers depends on the intensity of managed lands and quantity of nutrient units along with the proximity of the activity to a municipal well. A conservative assumption was made for this assessment that a higher nutrient unit density and a larger area of managed lands results in a greater concentration of nutrients and an increased potential for nutrient contamination of source waters.

The primary advantage of using packaged commercial fertilizer over manure is that nutrients are immediately available to the plants and the exact amounts of a given element can be applied. With manure, estimates are made of the quantity of nitrogen and phosphorus it contains. For environmental and economic reasons, it is important to optimize the amount of fertilizer applied.

When more nutrients are applied to land than the crops or vegetation require, the nutrients run off into surface water bodies or infiltrate into the soil and affect the groundwater. Excessive amounts of nitrogen and phosphorus may cause algae blooms in surface waters. Algae can produce toxins that are harmful to humans, and they can

decrease the quality of the water, imparting a foul taste and odour to drinking water. Phosphorus typically binds to soil as it infiltrates through, or precipitates out of, infiltrating water and does not impact groundwater quality significantly.

Nitrogen is the nutrient taken up in the largest amount by crops. Increased nitrate concentrations in groundwater results from excess infiltration of nitrogen. Elevated concentrations of nitrate in drinking water may lead to methemoglobinemia (Blue Baby Syndrome) in infants, the formation of carcinogenic nitrosamines in the human stomach, and hypertension (U.S. Department of Agriculture, 2006).

Commercial fertilizer can be stored in a variety of locations, inside or outside, for retail sale or in relation to its application to land. Although storage for these purposes can occur year-round, the greatest volume of fertilizer is stored in the spring before the growing season begins and application occurs.

Part IV Prohibition

It was agreed that Part IV Prohibition was considered among the most effective approaches to address the handling and storage of commercial fertilizer that would be a significant threat. The Planning & Policy Working Group and the Source Protection Committee were in agreement that land use that involve the handling and storage of commercial fertilizer that would be a significant drinking water threat are prohibited under Part IV of the Clean Water Act.

Part IV Risk Management Plans

It was agreed that among the best means of addressing the threats associated with the handling and storage of commercial fertilizer is a Risk Management Plan. For farms that are not required to have a nutrient management strategy or plan, the policy approach proposed by the Policy & Planning Working Group and the Source Protection Committee is to require a risk management plan for the application and storage of commercial fertilizer in vulnerable areas where these activities are or would be a significant drinking water threat. This risk management plan would be based on the same principles as the nutrient management plan and scoped to address these specific threats. It would allow existing cropping (application) within the WHPA-A to continue subject to a range of best management practices including:

- no ASM spreading
- soil tests to determine fertilizer requirements every 3 years at minimum
- 2-3 crop rotation
- fertilizer and pesticide use at prescribed rates and applied by a certified professional only
- no mixing or loading of fertilizer/pesticide in WHPA-A
- standard operating procedure for cropping (TBD)

Where there are existing storage facilities, there was agreement that additional conditions should be imposed on existing facilities so that the following are required:

- double walled tanks or secondary containment
- collision protection (bollards) around the storage
- removal from WHPA-A at earliest opportunity.

Part IV Restricted Land Use

In keeping with the Risk Management Plans required by policy in the Source Protection Plan, pre-screening of planning applications related to agricultural land uses and pre-screening of building permit applications for the proposed construction of NASM storage facilities must also be required, to ensure compliance. Pre-screening of applications would be necessary in areas where these activities would pose a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that identify those lands subject to restricted land use provisions and shall require the submission of a disclosure report as part of the complete application requirements within a vulnerable area where there is or would be a significant drinking water threat and include provisions that prohibit land uses that involve the handling and storage of NASM that would be a significant drinking water threat.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to NASMs. In particular, it was felt that there was tremendous merit in calling on the Ontario Soil and Crop Improvement Association (OSCIA) in collaboration with the CA/SPA to deliver an education and outreach program targeted at residential and institutional landowners within vulnerable areas that promote Best Management Practices to safeguard water supplies.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with agricultural source material. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

7.10 POLICY RATIONALE FOR THE APPLICATION OF PESTICIDES TO LAND (THREAT #10)

7.11 POLICY RATIONALE FOR THE HANDLING AND STORAGE OF PESTICIDES (THREAT #11)

Pesticides are used to treat, repel, or control insects, weeds, and other hindrances to healthy plant growth. Pesticides that are of concern to drinking water source protection include those that are used to control weeds, fungi or nematodes.

The *Pesticides Act, 1990*, defines pesticide as

> *any organism, substance or thing that is manufactured, represented, sold or used as a means of directly or indirectly controlling, preventing, destroying, mitigating, attracting or repelling any pest or altering the growth, development or characteristics of any plant life that is not a pest and includes any organism, substance or thing registered under the Pest Control Products Act (Canada).*

Generally, pesticides are classed as:

- herbicides (weeds);
- insecticides (insects);
- fungicides (fungi);
- rodenticides (rodents);
- pediculicides (head lice);
- algaecides (algae);
- avicides (birds);
- bactericides (bacteria);
- miticides (mites);
- molluscicides (slugs and snails);
- nematicides (nematodes);
- virucides (viruses); and
- biocides (living organisms).

Each of the above is formulated to control its targeted organism.

All of the pesticides considered through the drinking water source protection initiative are chemicals used to control weeds (herbicides) or fungi (fungicides), or used as a soil fumigant to control fungi, nematodes, and weeds.

Pesticides have benefits and drawbacks. The target organisms can destroy property, spread or carry disease, or cause a nuisance. This leads to public health or environmental concerns and possible impacts on the economy.

The Stockholm Convention on Persistent Organic Pollutants, an international environmental treaty first signed in 2001 and effective from May 2004, identified nine pesticides as the most dangerous persistent organic pollutants out of the 12 chemicals listed (Stockholm Convention, 2011). Eight of these pesticides were identified for elimination, and one was identified for restriction of its production and use. In May 2009, the Convention added five additional pesticides to the list for elimination. In April 2011, another pesticide was added to the list of persistent organic pollutants, bringing the total number of pesticides now listed for elimination or restricted production and use to 15.

Some pesticides are available for domestic use, while a much larger number are available for agricultural, commercial, or industrial uses. Each of these available pesticides is regulated and approved for use in Canada.

Eleven chemicals that are ingredients in pesticides are listed in the Ontario Ministry of the Environment (MOE) Tables of Drinking Water Threats (2009). These chemicals could make their way into groundwater as a result of the application of pesticides to land, or through spills or leaks resulting from the improper handling and storage of pesticides. The chemicals are:

- Atrazine
- Dicamba
- 2,4-Dichlorophenoxy Acetic Acid (2,4-D)
- 1,3-Dichloropropene
- Glyphosate
- Mecoprop
- Metalaxyl
- Metolachlor or s-Metolachlor
- MCPA (2-methyl-4-chlorophenoxyacetic acid)
- MCPB (4-(4-chloro-2-methylphenoxy) butanoic acid).

Glyphosate is a chemical of concern only at a moderate or low threat level. All of these substances are active ingredients in herbicides, with the exception of 1,3-dichloropropene, which is used as a soil fumigant or nematicide, and metalaxyl, which is a fungicide.

The Ministry of the Environment has prescribed the application of pesticide to land, and the handling and storage of pesticide, as threats to drinking water sources. The circumstances related to these activities when drinking water threats are a significant risk are summarized on flow charts for Threats 10 and 11 (*see* Appendix B).

Manufacturing, processing, and wholesale activities are generally permitted on lands that are zoned for industrial uses in order to provide separation between industrial establishments and incompatible land uses. Storage of pesticides for retail sale or for use in extermination could exist on many properties since this activity is generally

associated with agricultural, recreational, institutional, commercial, industrial, and public works (for use along roads and utility corridors) land uses.

Part IV Prohibition

It was agreed that Part IV Prohibition was considered among the most effective approaches to address the application and storage of pesticides in vulnerable areas. The Planning & Policy Working Group and the Source Protection Committee were in agreement that land uses that involve the handling and storage of pesticides that would be a significant drinking water threat are prohibited under Part IV of the Clean Water Act.

Part IV Risk Management Plans

It was agreed that among the best means of addressing the threats associated with the application and storage of pesticides is a Risk Management Plan. This risk management plan would be based on the same principles as the nutrient management plan and scoped to address these specific threats. It would allow existing cropping within the WHPA-A to continue subject to a range of best management practices including:

- no ASM spreading
- soil tests to determine fertilizer requirements every 3 years at minimum
- 2-3 crop rotation
- fertilizer and pesticide use at prescribed rates and applied by a certified professional only
- no mixing or loading of fertilizer/pesticide in WHPA-A
- standard operating procedure for cropping (TBD).

Where there are existing storage facilities, there was agreement that additional conditions should be imposed on existing facilities so that the following are required:

- double walled tanks or secondary containment
- collision protection (bollards) around the storage
- removal from WHPA-A at earliest opportunity.

The Source Protection Committee was of the opinion that it is important that the requirements of a risk management plan be disclosed in the policy included in the Source Protection Plan to be used by a risk management official. This way, the farmer and the official are both aware of the requirements of the Plan.

Part IV Restricted Land Use

In keeping with the Risk Management Plans required by policy in the Source Protection Plan, pre-screening of planning applications related to agricultural land uses and of building permit applications for the proposed storage of pesticides must also be required, to ensure compliance. Pre-screening of applications would be necessary in areas where these activities would pose a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that identify those lands subject to restricted land use provisions and shall require the submission of a disclosure report as part of the complete application requirements within a vulnerable area where there is or would be a significant drinking water threat and include provisions that prohibit land uses that involve the handling and storage of pesticides that would be a significant drinking water threat.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to the use of pesticides. In particular, it was felt that there was tremendous merit in calling on the Ontario Soil and Crop Improvement Association (OSCIA) in collaboration with the CA/SPA to deliver an education and outreach program targeted at agricultural landowners within vulnerable areas that promote Best Management Practices relevant to pesticide storage and handling to safeguard water supplies.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with pesticide handling and storage. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the use of incentives, where available, to consider additional conveniences that could assist in achieving the objectives of the Plan. Some additional conveniences could include the creational of additional hazardous waste drop off/pick up arrangements and increasing the frequency and location of ‘toxic taxi’s.’ It was felt that incentives on their own, would not be sufficient to address the threats associated with agricultural source. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

7.12 POLICY RATIONALE FOR THE APPLICATION OF ROAD SALT (THREAT #12)

7.13 POLICY RATIONALE FOR THE HANDLING AND STORAGE OF ROAD SALT (THREAT #13)

Road salt is defined as any inorganic, chloride salt product used to maintain human safety on roads and pedestrian areas. The majority of road salt is used as a de-icer or an ice prevention agent, although there is some limited use of salt for dust suppression. The most commonly used products are sodium chloride and calcium chloride because they are effective, inexpensive, readily available, and easy to use.

The Ministry of the Environment identifies chloride and sodium as chemicals of concern. These chemicals could threaten the safety of drinking water sources in certain situations. When large amounts of road salts are released to the environment, they can have an adverse effect on freshwater ecosystems, soil, vegetation, and wildlife.

Chloride ions move with water through the environment without undergoing chemical reactions or being lost in other ways. Therefore, all of what is added to the environment will reach surface water bodies eventually.

At typical concentrations in drinking water sources, sodium and chloride are not risks to human health. If concentrations of sodium exceed 20 milligrams per litre in a water supply, the Medical Officer of Health is notified by the individual completing the study. Both chemicals can render a water source unusable at high concentrations because the water becomes salty and has an unpleasant taste.

The levels of sodium and chloride found in drinking water sources are monitored so local physicians can use this information when advising patients on sodium-restricted diets. Sodium and chloride are difficult to remove from water, and treatment can become quite expensive.

The Ministry of the Environment has prescribed the application of road salt, and the handling and storage of road salt as activities that are threats to drinking water supplies. The federal, provincial, and municipal road authorities are the greatest users of road salt.

Winter road salt application works by breaking the bond formed between the pavement and the ice/compacted snow. As snow accumulates on the road and compacts due to traffic, it forms a bond with the pavement, making it difficult to remove with snowploughs. The salt reacts with moisture to create a layer of salty water, called brine, between the snow or ice layer and the road. This brine layer has a freezing point below zero degrees Celsius, and breaks the bond, thereby permitting the snow and ice to be ploughed from the road.

A widely used technique for keeping the salt on the road and increasing the speed of the melt action is “pre-wetting.” Pre-wetting involves spraying liquid salt brine onto the solid salt as it is spread. This has two benefits. The first is that it makes the salt sticky, increasing its adhesion to the road. The second benefit is that the salt is already wet,

and therefore, it starts to form the brine that is needed to break the ice-road bond more quickly.

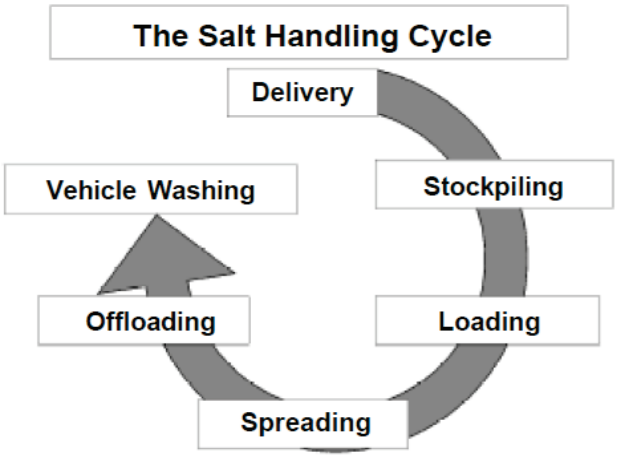
Liquid salts are applied either as an additive to conventional rock salt (pre-wetting as discussed above) or applied on their own in advance of snow accumulation (direct liquid application). The pre-wetting chemicals include near-saturation solutions of calcium chloride brine, with corrosion inhibiting additives, and magnesium chloride brine, with corrosion inhibiting additives. The direct liquid application is used extensively on all provincial highways.

A study by Environment Canada and Health Canada (2001) showed that regional-scale, groundwater chloride concentrations—greater than the aesthetic objective of 250 milligrams per litre—will likely result where the road network is dense and where road salt is applied at annual loadings above 20 tonnes sodium chloride per two-lane-kilometres.

Local impacts from road salt are typically caused by inappropriate handling and storage facilities and practices. Handling practices where impacts to the environment are possible are the loading and unloading of trucks, storm water runoff from the site, and the release of water used to wash equipment (*see* Figure 5). Salt storage should be out of direct contact with precipitation and runoff to reduce dissolution. Salt storage domes dot the landscape, but the loading of trucks typically occurs outside. In these situations, the area around the salt dome should be paved with asphalt. Good housekeeping practices (sweeping up spilled salt) are needed to prevent local contamination of soil and water resources.

The best practice for storage and handling of road salt is to store and handle it under cover. A permanent, roofed facility keeps the salt dry, easy to work with, prevents loss through dissolution and runoff, and eliminates the possibility of contaminating watercourses and water supplies. Even if salt is stored indoors, it will absorb moisture when humidity reaches 75 percent. That moisture will evaporate when the humidity falls, and this does not affect the salt’s effectiveness as a de-icer. The Ministry of Transport is in the process of changing their facilities to indoor storage sites.

Figure 2: The Salt Handling Cycle *



* Transport Association of Canada, 2003

The risk level for handling and storage of road salt depends on the coverage of the salt pile, the quantity of salt stored, and the potential release of sodium and chloride into the environment.

The following identifies where significant threats for road salt would occur if the activities were engaged in, in the future:

- WHPA–A or B with a vulnerability score of 10
  - Application of road salt: a significant threat exists when the percentage of total impervious surface area is greater than or equal to 80 percent. The chemicals of concern are chloride and sodium.
  - Handling and storage of road salt: a significant threat exists when the storage facility exposes salt to precipitation, runoff, or snow melt, and the quantity stored is greater than 5,000 tonnes. The chemicals of concern are chloride and sodium.
- WHPA–E with a vulnerability score of 9
  - Application of road salt: a significant threat exists when the percentage of total impervious surface area is greater than or equal to 80 percent. The chemicals of concern are chloride and sodium.
- Handling and storage of road salt: a significant threat exists when the storage facility exposes salt to precipitation, runoff, or snow melt, and the quantity stored is greater than 5,000 tonnes. The chemicals of concern are chloride and sodium.

Part IV Prohibition

It was agreed that Part IV Prohibition was considered among the most effective approaches to address activities related to the handling, storage and application of road salt that are threats to municipal drinking water supplies.

The Planning & Policy Working Group and the Source Protection Committee were in agreement that land uses that involve the storage of road salt in vulnerable areas that would be a significant drinking water threat would be prohibited under Part IV of the Clean Water Act.

Part IV Risk Management Plans

It was agreed that among the best means of addressing the threats associated with handling, storage and application of road salt is a Risk Management Plan. There was agreement that policies should be developed to direct the Risk Management Official to negotiate a Risk Management Plan with landowners who are storing and applying road salt where there is or would be a significant drinking water threat. These Risk Management Plans would be based on the same principles as a Salt Management Plan.

Part IV Restricted Land Use

In keeping with the Risk Management Plans required by policy in the Source Protection Plan, pre-screening of planning applications related to the handling, storage and application of road salt and the pre-screening of building permit applications for the proposed construction of salt storage facilities must also be required, to ensure compliance. Pre-screening of applications would be necessary in areas where these activities would pose a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Policy & Planning Working Group and the Source Protection Committee explored the question of whether a retail operation could store enough salt in one location to become a significant threat. As the storage threshold is 5,000 tonnes, it was felt that the threat relates in large measure to large-scale municipal and provincial salt storage facilities.

It was recommended that Official Plans be amended to prohibit salt storage facilities within vulnerable areas that would be a significant drinking water threat.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to the handling, application and storage of road salt. It was agreed that a policy should be included in the Plan to direct municipalities in collaboration with the CA/SPA to undertake an education and outreach program targeted at landowners and private contractors within vulnerable areas that address the importance of source protection planning and the impact of road salt on drinking water. The key message, it was felt, should focus on the efficient use of road salts or the use of alternatives.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with agricultural source material. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the use of incentives, where available, to encourage risk reduction and to promote the upgrade by smaller municipalities to newer salt application technologies. It was also felt that policies were needed to require municipalities to consider incentives that can be offered to promote safe salt management including the implementation and use of advanced salting equipment.

It was felt that incentives on their own would not be sufficient to address the threats associated with the handling, storage and application of road salt. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

Research

The Committee suggested writing policies to encourage the Province, the Ontario Good Roads Association and the Association of Municipalities of Ontario to continue to undertake research that focuses on the cost effective alternative to the use of road salt. A policy to encourage such research and consider new application and products would be a proactive, forward thinking and strategic policy.

7.14 POLICY RATIONALE FOR THE STORAGE OF SNOW (THREAT #14)

During the winter months, snow can accumulate along the side of roads and in parking lots. Large snow banks can affect driver and pedestrian safety and reduce available parking. In these instances, it is often necessary to remove the snow by either melting it on site or by transporting it to designated disposal sites. Municipal and commercial snow-removal operators use designated areas to store snow removed from roads and parking lots during the winter season. The snow is either melted or stockpiled and then permitted to melt.

Snow ploughed from roads and parking lots can be contaminated with road salt, oil, grease and heavy metals from vehicles, litter, and airborne pollutants. It must therefore be stored and disposed of in an appropriate manner. Storing large quantities of snow in one location concentrates the contaminants in melt water, which results in a greater impact on the surrounding environment.

Storing snow can pose a significant drinking water threat, depending on the geographic location of the storage area and whether the snow is stored above or below grade. (Snow storage below grade would occur in a pit or quarry.) In general, the greater the snow storage area, and therefore the possible volume of snow stored, the greater the risk to drinking water sources. The circumstances that cause a significant threat are outlined in the flow chart for Threat 14 in Appendix B.

If the storage area is large, a significant release of chemicals to groundwater or surface water can occur.

The four storage area sizes considered in the threat assessment were as follows:

- hectares (ha) to 0.5 ha;
- 0.5 ha to 1 ha;
- 1 ha to 5 ha; and
- greater than 5 ha.

The MOE Tables of Drinking Water Threats (2009) list chemicals that could be released from snow storage areas and affect surface and groundwater. The eight listed below are associated with conditions that present a significant drinking water threat:

- Chloride
- Sodium
- Nitrogen
- Petroleum hydrocarbon fractions F1 to F4
- Cyanide (CN^-)
- Copper and copper compounds
- Lead and lead compounds
- Zinc and zinc compounds.

The main source of sodium, chloride, and cyanide in snow is road salt. The other contaminants are generally from vehicle fluids, exhaust, brake linings, and tire and engine wear.

Part IV Prohibition

It was agreed that Part IV Prohibition was considered among the most effective approaches to address activities related to the storage of snow in areas that would be a significant drinking water threat (WHPA-A and portions of WHPA-B).

The Planning & Policy Working Group and the Source Protection Committee were in agreement that land uses that involve the storage of snow in vulnerable areas that would be a significant drinking water threat would be prohibited under Part IV of the Clean Water Act.

Part IV Risk Management Plans

It was agreed that among the best means of addressing the threats associated with snow storage is a Risk Management Plan. There was agreement that policies should be developed to direct the Risk Management Official to negotiate a Risk Management Plan with landowners who are storing snow, where there is or would be a significant drinking water threat. These Risk Management Plans would be based on the same principles as a Salt Management Plan.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. It was recommended that Official Plans be amended to prohibit snow storage and melting facilities within vulnerable areas that would be a significant drinking water threat. It was further recommended that policies be included in Official Plans to require the submission of a Disclosure Report as part of a complete application.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to the handling, application and storage of road salt. It was agreed that a policy should be included in the Plan to direct municipalities in collaboration with the CA/SPA to undertake an education and outreach program targeted at landowners and private contractors within vulnerable areas that address the importance of source protection planning and the impact of road salt on drinking water. The key message, it was felt, should focus on the efficient use of road salts or the use of alternatives.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with agricultural source material. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the use of incentives, where available, to encourage risk reduction and to promote the upgrade by smaller municipalities to newer salt application technologies. It was also felt that policies were needed to require municipalities to consider incentives that can be offered to promote safe salt management including the implementation and use of advanced salting equipment.

It was felt that incentives on their own would not be sufficient to address the threats associated with the handling, storage and application of road salt. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

7.15 POLICY RATIONALE FOR THE HANDLING AND STORAGE OF FUEL (THREAT #15)

The *Canadian Environmental Protection Act, 1999*, defines fuel as any form of matter that is combusted or oxidized for the generation of energy.

The fuels considered in the threats assessment are used in appliances and equipment, such as furnaces and generators, and to power motor vehicles. They include, for example, gasoline, diesel fuel/home heating oil and kerosene.

It is expected that fuel is always stored in a tank. The handling of fuel is in relation to its storage through piping and dispensing equipment.

The Clean Water Act, 2006, specifies the handling and storage of liquid fuels (at facilities regulated under Ontario Regulations 213/01 – Fuel Oil, and 217/01 – Liquid Fuels, made under the *Technical Standards and Safety Act*), and the storage of fuel at manufacturing or refining facilities as drinking water threats (*see* Tables of Drinking Water Threats, 2009).

Fuels are used extensively to provide energy to heat our homes and work places, fuel our vehicles, and power machinery. However, due to their wide-spread use, there is also widespread release of fuels to the environment. Therefore, the handling and storage of fuel can be a significant threat to drinking water sources. About 60 percent of Canada's contaminated sites involve petroleum hydrocarbon contamination (CCME, 2001). Without adequate cleanup or management, these contaminants can impair water sources.

Petroleum hydrocarbons are mixtures of organic compounds that occur in geological substances such as oil, bitumen, and coal. The compounds are composed of carbon and hydrogen, with minor amounts of nitrogen, sulphur, and oxygen. The Canadian Council of Ministers of the Environment grouped the compounds into four fractions — F1, F2, F3 and F4 — to standardize monitoring and reporting. The compounds in each fraction act alike in soil and water.

Petroleum hydrocarbon fractions are grouped by the equivalent number of carbon atoms in the straight-chain molecules of the compounds.

- F1: 6 to 10 Carbon atoms
- F2: more than 10 to 16 Carbon atoms
- F3: more than 16 to 34 Carbon atoms
- F4: 35 and more Carbon atoms.

Most petroleum hydrocarbon constituents are toxic to some degree (CCME, 2001). Those that have lighter molecular weights dissolve more readily, are mobile, and can flow with groundwater or surface water for great distances. Those with heavier molecular weights are persistent in the environment, dissolving and degrading very slowly.

The Provincial Tables of Circumstances (2009) identify chemicals that could make their way into groundwater as a result of a leak or spill from the handling and/or storage of fuel. These chemicals include:

- BTEX; and
- Petroleum hydrocarbon fractions F1, F2, F3, and F4.

BTEX is an acronym that stands for benzene, toluene, ethylbenzene, and xylenes. These are volatile compounds with ringed structures that are found in gasoline and other petroleum hydrocarbon mixtures. These compounds are the most soluble compounds released from petroleum hydrocarbons, and therefore, spread more quickly

with groundwater and surface water flows. Benzene is a known carcinogen, while toluene, ethylbenzene, and xylenes are less toxic.

The classification of the handling and storage of fuel as a significant drinking water threat is dependent on:

- the location of the activity,
- the quantity of fuel stored or handled, and
- whether the activity occurs above grade, partially below grade, or fully below grade.

The circumstances for this threat are set out in detail on the flow chart for Threat 15 (*see* Appendix B).

The threat subcategories considered in the threat assessment are as follows:

- Handling of Fuel
  - Handling at a below-grade facility as defined in Section 1 of Ontario Regulation 213/01 or 217/01 under the *Technical Standards and Safety Act*.
- Storage of Fuel
  - Facility defined in Section 1 of Ontario Regulation 213/01 or 217/01 under the *Technical Standards and Safety Act*.
- Bulk plant as defined in Ontario Regulation 217/01 or a facility that manufactures or refines fuel.

Part IV Prohibition

It was agreed that Part IV Prohibition was considered among the most effective approaches to address the handling and storage of fuel in excess of 2500 L that would be a significant drinking water threat. The Planning & Policy Working Group and the Source Protection Committee were in agreement that land uses that involve the handling and storage of fuels that would be a significant drinking water threat are prohibited under Part IV of the Clean Water Act.

Part IV Risk Management Plans

It was agreed that among the best means of addressing the threats associated with the handling and storage of fuels is a Risk Management Plan. The policy approach proposed by the Policy & Planning Working Group and the Source Protection Committee is to require a risk management plan for the handling and storage of fuels in vulnerable areas where these activities are or would be a significant drinking water threat. The risk management plan should take into account and consider the following:

- leaks/spills associated with above ground storage are easier to detect visually and on an odour basis;
- the importance of secondary containment
- the need for monitoring and spills detection; and

- the need to consider collision protection (e.g. bollards).

Part IV Restricted Land Use

In keeping with the Risk Management Plans required by policy in the Source Protection Plan, the Plan includes policies that designate all Industrial, Commercial and Institutional (ICI) land uses within the areas where the handling and storage of fuel in excess of 2500 L would be a significant drinking water threat as a restricted land use. Pre-screening of applications would be necessary in areas where these activities would pose a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that identify those lands subject to restricted land use provisions. A disclosure report is to be required as part of a complete application within a vulnerable areas where there is or would be a significant drinking water threat. Finally, land uses that involve the handling and storage of fuel in excess of 2500 L that would be a significant drinking water threat are prohibited.

Incentives

There was support for the use of incentives, where available, to encourage ongoing stewardship and pollution prevention to address the threat of activities related to fuel storage and handling. It was felt that incentives on their own would not be sufficient to address the threats associated with the handling and storage of fuels. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

7.16 POLICY RATIONALE FOR THE HANDLING AND STORAGE OF A DENSE NON-AQUEOUS PHASE LIQUID (THREAT #16)

Chemicals that do not dissolve easily in water are called non-aqueous phase liquids (NAPLs). Some of these chemicals are lighter than water (i.e., they have a lower density), and some are heavier than water. The lighter chemicals, such as gasoline, are called light non-aqueous phase liquids (LNAPLs). These float on the surface of water. Liquids that are denser than water are called dense non-aqueous phase liquids (DNAPLs).

DNAPLs are a group of organic substances that, because of their density, sink vertically below the water table flowing by gravity. The extent to which the liquid will sink depends on the geologic conditions. Once in bedrock, the fracture network and bedding planes will control the liquid's distribution. The liquids will dissolve sparingly into the passing groundwater, creating a contaminant plume. The slow dissolution of the substance suggests that the pure chemical can be present below ground for decades or centuries before being depleted. It is because of these characteristics that DNAPLs have been considered independently under the *Clean Water Act*.

The most common DNAPLs are chlorinated solvents. DNAPLs have been used in vast quantities for decades in industrial and commercial applications such as dry cleaning, cleaning/degreasing solvents, electronics, aerosols, plastics, pesticides, pharmaceuticals, wood preservation, asphalt operations, varnishes and the repair of motor vehicles and equipment. These chemicals can also be found in small quantities in common household products (for example, adhesives and cleaners).

DNAPLs can also be discharged as spent solvents or wastes that contain noticeable fractions of other organic chemicals. Co-contaminants may represent a wide range of organic and inorganic chemicals that are miscible with the DNAPL and therefore migrate through the subsurface with them.

The Ministry of the Environment Tables of Drinking Water Threats (2009) identify five DNAPLs that could make their way into groundwater as a result of the handling and storage of these chemicals and pose a significant threat to a drinking water source in certain situations. These substances are:

- 1,4-Dioxane;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Tetrachloroethylene (also known as perchloroethylene, PCE);
- Trichloroethylene (TCE) or a DNAPL that degrades to TCE; and
- Vinyl chloride (VC) or a DNAPL that degrades to vinyl chloride.

1,4-Dioxane

1,4-dioxane is manufactured in and imported into Canada. It is an industrial chemical and a residual left over from the manufacturing process of some consumer products. It is used primarily as a solvent in the manufacture of pharmaceuticals, veterinary drugs, natural health products, for research and development, and as a laboratory reagent. 1,4-dioxane is also an impurity in substances used in the manufacturing of items such as personal care products, detergents, pesticides, and food packaging.

Environment Canada and Health Canada recently completed a screening assessment of 1,4-dioxane under Section 74 of the *Canadian Environmental Protection Act, 1999*, to assess potential harm to the general population, not including workplace exposure (Environment Canada and Health Canada, March 2010). Canadians are expected to be exposed to this chemical through air, drinking water, food, and use of consumer products containing the substance.

1,4-dioxane is not expected to bioaccumulate, and not degrade in water, soil, or sediment. It was concluded, based on the evidence reviewed, that 1,4-dioxane is not entering the environment in a quantity or concentration or under conditions that may pose a danger to human life or health. It also is not expected to have an immediate or long-term harmful effect on the environment on which life depends or its biological diversity.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 persistent chemicals that are released into the environment from natural and man-made sources. They are one of the most widespread organic pollutants. Forest fires are the primary natural source. They are formed during the incomplete burning of carbon containing materials like coal, wood, oil and gas, or other organic substances like tobacco or charbroiled meat. Asphalt, creosote, mothballs and coal tar shampoos also contain PAHs. They also accumulate in soils adjacent to railways. The major sources of PAHs in the aquatic and soil environments include creosote-treated products, spills of petroleum products, metallurgical and coking plants, and atmospheric deposition. Industrial and wastewater treatment plant effluents discharged to water may also contain PAHs. In the environment, PAHs adsorb onto particulate matter and are transported with flowing water or air.

In 1994, Environment Canada and Health Canada published the Priority Substances List Assessment Report for polycyclic aromatic hydrocarbons. Due to limited data, they focused their assessment of the effects on human health to five PAHs with exposure to humans only from air. They concluded that based on the data reviewed, the five PAHs may constitute a danger in Canada to human life or health.

PAHs at high concentrations in coal tar are what contaminate Randle Reef in Hamilton Harbour. Remediation of the site involves encasement of the sediments to reduce exposure to the aquatic environment.

Tetrachloroethylene

Tetrachloroethylene is a manufactured chemical also known as perchloroethylene, PCE, and tetrachloroethene. The manufacture of tetrachloroethylene in Canada stopped in 1992 and since that time it has been imported for use (Environment Canada and Health Canada, 1993). Tetrachloroethylene has been the principal solvent used in the dry cleaning industry since the 1940s. With the current focus on protecting the environment, products that are less toxic are being introduced to replace tetrachloroethylene. These products include glycol ethers, hydrocarbon solvents, liquid silicone, liquid CO_2, and biodegradable soaps used for wet cleaning (Wikipedia, 2011).

Tetrachloroethylene is also used for the cleaning and degreasing of metals. It is also used in smaller quantities in the manufacture of textiles, paint removers, printing inks, adhesives, specialized cleaning fluids, and is used as an aerosol and dye carrier (Environment Canada and Health Canada, 1993). Tetrachloroethylene is present in small quantities in household products such as automobile cleaners, suede protectors, paint removers and strippers, water repellents, silicone lubricants, and adhesives.

Tetrachloroethylene enters the environment through air emissions, discharges from wastewater systems, leachate from landfills, and spills to land and water. It has been found in both surface waters and groundwaters, and based on an assessment of existing data, Environment Canada and Health Canada concluded that tetrachloroethylene contamination of groundwater in Canada could be significant.

Trichloroethylene

Trichloroethylene (TCE) is also a manufactured chemical, and since 1985, it has been imported into Canada for use. Its primary use is as a solvent to remove grease from fabricated metal parts in the automotive and metal industries (Environment Canada and Health Canada, 1993). It is also used in the production of additives and copolymers, in dry cleaning, the manufacture of textiles, the cleaning of electronic components, and in laboratory reagent/solvent applications. Household products that may contain trichloroethylene are paint removers/strippers, adhesives, spot removers, and rug-cleaning fluids.

Sources of trichloroethylene released to the environment include discharges from dry cleaning facilities, wastewater treatment plants, septic tanks, storage tanks, industries, leachate from landfills, and incinerators. Trichloroethylene is also a degradation product of tetrachloroethylene and can be formed where the latter has been released. Trichloroethylene has been found in groundwater and many surface waters as a result of the inappropriate disposal of the chemical and spills.

Trichloroethylene is classified as probably carcinogenic to humans.

Vinyl Chloride

Vinyl chloride is a synthetic chemical with no known natural sources. It is also a degradation product of trichloroethylene. At room temperature, vinyl chloride is a gas, therefore, if it is released to surface water, it will disperse in air. Vinyl chloride is primarily used in Canada to make polyvinyl chloride (PVC). PVC is used to make a variety of plastic products, including pipes, wire and cable coatings, latex, and packaging materials. Vinyl chloride is also used as a raw material in the glass, rubber, paper, and automotive industries.

Health Canada (1992) indicates that sufficient evidence exists to classify vinyl chloride as a human and animal carcinogen.

The activities associated with DNAPLs, prescribed by the Ministry of the Environment to be threats to drinking water sources, are the handling and storage of the five DNAPLs discussed above. The circumstances related to these activities are outlined in the flow charts for Threat 16 *see* Appendix B.

As noted above, DNAPLs are chemical compounds that are denser than water and do not dissolve readily in water. These chemicals will sink downward through the water column and the soil or rock until their flow is impeded. These liquids flow with gravity and are difficult to track underground. Since it is so difficult to clean up water sources affected by DNAPLs, and due to their persistence in the environment, their storage and handling pose a threat to the drinking water sources at greater distances from the well than other chemical threats.

Not only are DNAPLs extremely difficult to locate in the subsurface, but also small amounts of DNAPLs can contaminate large volumes of water. It is widely considered that restoration of DNAPL sites to drinking water standards or maximum contaminant levels is unattainable. A key challenge is the difficulty in adequately characterizing the volume and extent of DNAPL releases to the environment, in particular finding and delineating DNAPL source zones. Remediation can take place via extraction or in situ processes. The prospect of an incomplete removal of the source and leaving residual DNAPL behind is a real possibility.

Chlorinated solvents such as trichloroethylene are among the most prevalent contaminants identified in groundwater supplies and at contaminated sites (Ministry of the Environment, 2011). DNAPLs are used widely in many industrial sectors and some are manufactured in Canada in large quantities. Because of this continued use, the potential exists for future contamination through spills and leaks from bulk storage.

The Technical Experts Committee (2004) identified DNAPLs as posing greater risk to source water than other chemicals and recommended that the storage of commercial quantities of DNAPLs be considered a very high risk within the five-year time of travel to a well. This assessment was based on the likely inability to remediate the aquifer and the time needed to replace the well.

Part IV Prohibition

It was agreed that Part IV Prohibition was considered among the most effective approaches to address the handling and storage of DNAPLs that would be a significant drinking water threat. The Planning & Policy Working Group and the Source Protection Committee were in agreement that land uses that involve the handling and storage of DNAPLs that would be a significant drinking water threat are prohibited under Part IV of the Clean Water Act.

Part IV Risk Management Plans

It was agreed that among the best means of addressing the threats associated with the handling and storage of DNAPLs is a Risk Management Plan. The policy approach proposed by the Policy & Planning Working Group and the Source Protection Committee is to require a Risk Management Plan that mirrors the requirements specified by the TSSA and/or industry Best Management Practices (e.g. Responsible Care) for the handling and storage of DNAPLs in vulnerable areas where these activities are or would be a significant drinking water threat. With this measure in place, there was confidence that new land uses would be screened by a Risk Management Official and require to meet a set of criteria within vulnerable areas where the handling and storage of DNAPLs would be a significant drinking water threat.

Part IV Restricted Land Use

In keeping with the Risk Management Plans required by policy in the Source Protection Plan, the Plan must include policies that designate all Industrial, Commercial and Institutional (ICI) land uses within the areas where the handling and storage of DNAPLs would be a significant drinking water threat as a restricted land use. Pre-screening of

applications would be necessary in areas where these activities would pose a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that identify those lands subject to restricted land use provisions. A disclosure report is to be required as part of a complete application within a vulnerable areas where there is or would be a significant drinking water threat. Finally, ICI land uses that involve the handling and storage of DNAPLs that would be a significant drinking water threat are prohibited.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to the handing and storage of DNAPLs. Policies have been included in the Plan that call on the municipality in collaboration with the CA/SPA to undertake an education and outreach program targeted at residential, industrial and commercial landowners that addresses the importance of pollution prevention by explaining the importance of source protection planning and the need for proper waste disposal and proper DNAPL handling and storage. A policy promoting the use of alternatives to DNAPL products has also been included and is based on the need to increase awareness and understanding across the Region.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with fuel storage and handling. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the use of incentives, where available, to encourage ongoing stewardship and pollution prevention to address the threat of activities related to the handling and storage of DNAPLs. Policies have been developed in the Plan that speak about the importance of considering ways in which additional conveniences can be created either through additional hazardous waste drop off and/or pick up arrangements and increasing the frequency and location of toxic taxi’s.

It was felt that incentives on their own, would not be sufficient to address the threats associated with the handling and storage of fuels. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that

incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

7.17 POLICY RATIONALE FOR THE HANDLING AND STORAGE OF AN ORGANIC SOLVENT (THREAT #17)

A solvent is a substance capable of dissolving another substance to form a solution. Solvents are typically liquid but can be gases or solids. Organic solvents are those solvents that contain carbon as their base. The *Clean Water Act, 2006,* identifies four organic solvents as having the potential to be released to the environment through improper handling and storage. Under certain circumstances, these activities would pose a threat to a municipal drinking water source. These organic solvents are:

- Carbon tetrachloride;
- Chloroform;
- Dichloromethane; and
- Pentachlorophenol.

Carbon tetrachloride

The Montreal Protocol on Substances That Deplete the Ozone Layer, an international treaty, came into force in 1989 in order to phase out the production of ozone depleting substances. Carbon tetrachloride was identified as a class 1 ozone depleting substance and prohibited (with exceptions) from being made, used, sold, or discharged to the environment in Ontario (*see* Ontario Regulation 463/10). Carbon tetrachloride production and use was phased out in Canada in 1996. Between 1996 and 1998, all incidences of storage of this substance had to be reported to the province, and as of July 1, 1998, the storage of carbon tetrachloride was banned. This man-made product is considered a hazardous waste and is classified as a possible human carcinogen. However, it may be imported to Canada for limited use in chemical production and is primarily found in air because of direct releases (Health Canada, 2009).

In 2009, Health Canada completed a review of the health risks associated with carbon tetrachloride in drinking water in order to revise the current drinking water guideline set in 1986. Their report indicates that, because of the high volatility of carbon tetrachloride, it is unlikely to pose a concern from surface water sources. Inhalation and dermal absorption during bathing and showering may be important exposure routes; however, spills or leaks to ground will volatilize quickly and likely won't bind to soil.

Chloroform

In 2001, chloroform was assessed under the *Canadian Environmental Protection Act,* Priority Substances List. Chloroform is a suspected carcinogen to humans based on studies on animals. However, chloroform is not considered to be toxic as defined in Section 64 of the Act. Showering was determined to be the greatest contributor to the total daily intake of chloroform from drinking water.

Chloroform is a naturally occurring chemical, but most of what is found in the environment is manufactured. Historically, chloroform was used as an anaesthetic and, more recently, as a solvent and to make coolants. The primary sources of chloroform releases are pulp and paper mills, pharmaceutical manufacturing plants, and chemical manufacturing plants. Chloroform also forms during the water chlorination process when organic matter is present. Thus, concentrations are higher in treated surface water than in treated groundwater due to the presence of more organic matter in the former. In addition, concentrations are higher in chlorinated effluent discharged to water bodies from wastewater treatment plants. Chloroform evaporates quickly from lakes, streams, and soil, but can leach into groundwater and remain for years.

Dichloromethane (also known as Methylene Chloride)

The Priority Substances List Assessment Report, prepared for dichloromethane in 1993, approximates that 13.2 kilotonnes of dichloromethane are used each year for paint removal and foam production, and in aerosols. The substance is also used in film processing, as a solvent for degreasing, and as an extraction solvent for spices, hops, and coffee. It is not manufactured in Canada, but it is imported.

Most releases of this man-made chemical are into the air; however, it has been found in surface waters and groundwater. The Priority Substances List Assessment Report links the detection of dichloromethane in groundwater to landfills or waste-disposal sites. The primary source of human exposure to dichloromethane is through indoor air. It is classed as probably carcinogenic to humans, which means there could be some adverse health effect at any level of exposure.

Pentachlorophenol

Pentachlorophenol (PCP or Penta) is a manufactured chemical that is persistent in the environment. It is inherently toxic to humans and other species, and a probable human carcinogen (Environment Canada, 2011). It has not been manufactured in Canada since the early 1980s but has been used widely for almost 50 years, primarily as a fungicide and insecticide for long-term industrial wood protection (Wood Preservation Canada, 2011). It is used to preserve utility poles, railroad ties, foundation pilings, timbers in highway construction, construction timbers and poles, bridge timbers and ties, and fence posts. An assessment by Environment Canada and Health Canada found no additional uses or releases of pentachlorophenol than those listed above.

Health Canada's Pest Management Regulatory Agency, under the *Pest Control Products Act,* and the United States Environmental Protection Agency are re-evaluating the registration for use of pentachlorophenol and other wood preservatives (Health Canada, August 2010). These agencies assess the risks to the public and to those workers who use the chemical and any end products containing the chemical. They have suggested that, under the proposed conditions of use, pentachlorophenol is acceptable for continued registration. The report notes that pentachlorophenol and the other wood preservatives are critical to the wood preservation industry. However, a final decision on their re-evaluation has yet to be made and could include new registration requirements.

As expected, the primary source of pentachlorophenol release to the environment is from wood preservation facilities. Leaching of the chemical from treated wood used in the environment also occurs, although minimally. It is unlikely that the use of treated wood in aquatic environments will have a significant affect on aquatic life (Sinnott, 2000). However, it is recommended that treated wood not be used in direct contact with drinking water systems, but is acceptable for incidental contact, such as docks and bridges.

Pentachlorophenol is also the most significant source for dioxin release to the environment and contains furans (Health Canada, 2007). Dioxins and furans are toxic impurities formed during the manufacturing process.

As mentioned above, the handling and storage of an organic solvent has been prescribed as a threat to drinking water sources. There are a number of circumstances listed in the Ministry of the Environment Tables of Drinking Water Threats (2009) under which these activities are a significant risk.

The circumstances focus on where the organic solvent is stored, the volume stored, and the chemical released. Handling circumstances are not specified. Storage can be:

- below grade;
- a portion below grade; or
- at or above grade.

For the risk of storage to be significant, the volume stored at a site must be greater than 25 litres. Storage volumes are classed as:

> 25 to 250 litres;

> 250 litres to 2,500 litres; or

>2500 litres.

Part IV Prohibition

It was agreed that Part IV Prohibition was considered among the most effective approaches to address the storage of organic solvents. The Planning & Policy Working Group and the Source Protection Committee were in agreement that land uses that involve the storage of organic solvents that would be a significant drinking water threat are prohibited under Part IV of the Clean Water Act.

Part IV Risk Management Plans

It was agreed that among the best means of addressing the threats associated with the storage of organic solvents is a Risk Management Plan. The policy approach proposed by the Policy & Planning Working Group and the Source Protection Committee is to require a Risk Management Plan that mirrors the requirements specified by the TSSA and/or industry Best Management Practices (e.g. Responsible Care) for the storage of organic solvents in vulnerable areas where these activities are or would be a significant drinking water threat. With this measure in place, there was confidence that new land uses would be screened by a Risk Management Official and require to meet a set of

criteria within vulnerable areas where the storage of organic solvents would be a significant drinking water threat.

Part IV Restricted Land Use

In keeping with the Risk Management Plans required by policy in the Source Protection Plan, the Plan includes policies that designate all Industrial, Commercial and Institutional (ICI) land uses within the areas where the storage of organic solvents L would be a significant drinking water threat as a restricted land use. Pre-screening of applications would be necessary in areas where these activities would pose a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that identify those lands subject to restricted land use provisions. A disclosure report is to be required as part of a complete application within a vulnerable areas where there is or would be a significant drinking water threat. Finally, land uses that involve the storage of organic solvents that would be a significant drinking water threat are prohibited.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to the storage of organic solvents. Policies have been included in the Plan that call on the municipality in collaboration with the CA/SPA to undertake an education and outreach program targeted at residential, industrial and commercial landowners that addresses the importance of pollution prevention by explaining the importance of source protection planning and the need for proper waste disposal and proper fuel handling.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with fuel storage and handling. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the use of incentives, where available, to encourage ongoing stewardship and pollution prevention to address the threat of activities related to the storage of organic solvents. It was felt that incentives on their own, would not be sufficient to address the threats associated with the storage of organic solvents. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and

future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

Research

There was considerable discussion by the Policy & Planning Working Group around the importance of research. In this regard, a policy has been included that calls on the Ministry of the Environment to establish a research program to ensure that the Liquid Fuels Handling Act requirements for bulk storage and handling of liquid fuels are also adequate for solvent products and waste material currently used in the Province. The proposed research is to evaluate whether a risk-based system would meet the requirements stipulated in the O'Connor Inquiry regarding an 'imperceptible level of risk.' The Province based on the findings of this research is encouraged to develop appropriate legislative policies to ensure acceptable handling and storage practices for liquid chemicals and liquid industrial wastes are established. It was felt that having a standard approach, implemented by the province, is needed.

7.18 POLICY RATIONALE FOR THE MANAGEMENT OF RUN-OFF THAT CONTAINS CHEMICALS USED IN THE DE-ICING OF AIRCRAFT (THREAT #18)

Canadian Aviation Regulations forbid aircraft that have frost, ice, or snow on any of their critical structures to attempt take-off. The frost, ice, or snow increases the roughness and movement of the lift, controls surfaces of an aircraft, and disrupts air flow over them. Ice also can add significant weight to the aircraft. The interference in air flow results in severe lift loss, increased drag, and impaired manoeuvrability of the aircraft. If ice forms on the wing or fuselage during takeoff, or when the aircraft is climbing to higher altitudes, it can dislodge and damage engines and other aircraft components. Accordingly, in appropriate conditions, aircraft may be sprayed with de-icing and/or anti-icing fluids prior to take-off.

De-icing and anti-icing fluids are primarily ethylene glycol, diethylene glycol, or propylene glycol. These fluids contain additives in varying quantities, including corrosion inhibitors, flame retardants, wetting agents, and thickeners. The additives protect the aircraft surfaces and allow the fluid to cling to the aircraft to prolong the time during which ice or snow is prevented from adhering to the aircraft surfaces. The chemical formulations of de-icing fluids are considered trade secrets, and therefore, exact compositions are not known (United States Environmental Protection Agency, 2002).

The Ministry of the Environment identifies 1,4-dioxane and ethylene glycol as chemicals that could make their way into surface and groundwater without proper management of the runoff from aircraft de-icing areas. These chemicals could threaten the safety of drinking water sources in certain situations.

Ethylene glycol is a colourless, odourless liquid that completely mixes with water, biodegrades, and therefore, does not persist in the environment. Propylene glycol is less toxic than ethylene glycol and has not been listed as a chemical of concern under

the *Clean Water Act, 2006*. However, ethylene glycol is the chemical of choice for de-icing and anti-icing fluids because of its superior characteristics and the necessity for lower quantities.

1,4-dioxane was previously added to anti-icing fluids as a wetting and dispersing agent. Manufacturers have removed it from their formulations, but it remains as an impurity in some de-icing fluids at trace concentrations. It is highly mobile in groundwater and has not been shown to readily biodegrade in the environment. Environment Canada and Health Canada (March 2010) have completed a screening assessment of 1,4-dioxane and determined that, at the assessed levels of exposure, it is not harmful to the health of the general population, and the chemical is not entering the environment in a quantity or under conditions that constitute a danger to the environment.

De-icing fluids applied to aircraft drain on to the apron surface and, if not managed, will drain off the apron and seep into the surrounding ground or enter nearby watercourses. Once in the watercourse, glycols may decrease the oxygen concentration in the water. This, in turn, would suffocate fish and plant life. The additives in the fluids also increase the toxicity to the aquatic environment.

The activity prescribed as a threat to drinking water sources is the management of the runoff that contains the de-icing fluid chemicals. No or ineffective management could result in an impact to drinking water sources. Management of runoff could include:

- the use of alternative de-icing products that are less toxic, such as propylene glycol;
- the use of mechanical de-icing technologies with less reliance on fluids; and
- the collection and disposal or reuse of fluids.

The classification of this activity as a significant, moderate, or low drinking water threat is dependent on the geographic location of the airport, as well as the classification of the airport as remote, small, regional, or national. The assumption made is that the number of flights and the size of the planes being de-iced increase with the size of the airport, and so does the amount of runoff that could be released to the environment.

7.19 POLICY RATIONALE FOR AN ACTIVITY THAT TAKES WATER FROM AN AQUIFER OR A SURFACE WATER BODY WITHOUT RETURNING THE WATER TAKEN TO THE SAME AQUIFER OR SURFACE WATER BODY (THREAT #19)

7.20 POLICY RATIONALE FOR AN ACTIVITY THAT REDUCES THE RECHARGE OF AN AQUIFER (THREAT #20)

In the SGBLS region, all of the water quantity threats identified and to be identified are all specific to groundwater settings. Both the taking of water from a municipal aquifer (without returning the water to that unit) and the reduction of recharge to a municipal aquifer result in a depletion of available supply that could impair the long-term viability of a water system.

Unlike water quality threats, where the threat level is the product of vulnerability score (or the location) and hazard score (of the activity), water quantity threats are a function of exposure and tolerance. Exposure refers to the likelihood that the drinking water system could require more water under average monthly pumping conditions than is available in the local area under modeled scenarios of drought. Tolerance refers to the predicted ability of the water system to meet peak demands under modeled scenarios of drought.

The one exemption to the water quantity threats assessment is the taking of municipal potable water from deep aquifer systems without replacing this water in the same aquifer complex. Many municipalities take from deep aquifer systems since the water supply is not vulnerable to water quality threats and most if not all typically discharge their treated sewage (i.e. used potable water) to surface water systems. If the water demand from the municipality exceeds the capacity of the deep aquifer system to supply the desired rate, then the aquifer's supply if not sustainable in the longer term and the aquifer is considered to be "mined" of the resource by the collective takings posing a water quantity threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for water quantity threats would be considered in the context of the Official Plan policies. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that identify those lands subject to restricted land use provisions under Section 59 of the Clean Water Act. A disclosure report is also required as part of a complete application within a vulnerable area where there is or would be a significant drinking water threat. Official plan and /or zoning by-law provisions are required to prohibit impervious cover in the WHPA-Q1 and WHPA-Q2 unless it can be demonstrated that pre-development recharge can be maintained.

7.21 POLICY RATIONALE FOR THE USE OF LAND AS LIVESTOCK GRAZING OR PASTURING LAND, AN OUTDOOR CONFINEMENT AREA OF A FARM-ANIMAL YARD (THREAT #21)

Some farm animals, such as cows, horses, and sheep, are allowed to roam on open spaces that have been fenced to restrict their movements. These open spaces are typically covered in grass or herbaceous plants, which are eaten as food by the animals. These spaces are called grazing and pasturing land. During the grazing season, there is typically a concentration of up to two or three animals per acre on these lands.

Outdoor confinement areas are enclosures for livestock, deer, elk, and game animals, with a very high animal concentration. These areas typically contain more than 15 animals per acre, and often they are used for extended periods of time. Ontario

Regulation 267/03, made pursuant to the *Nutrient Management Act, 2002,* defines an outdoor confinement area as an enclosure with the following characteristics:

1. It has no roof, except as described in characteristic #3;
2. It is composed of fence, pens, corrals, or similar structures;
3. It may contain a shelter to protect the animals from the wind or another shelter with a roof of an area of less than 20 square metres;
4. It has permanent or portable feeding or watering equipment;
5. The animals are fed or watered at the enclosure;
6. The animals may or may not have access to other buildings or structures for shelter, feeding, or watering; and
7. Grazing and foraging provide less than 50 percent of dry matter intake.

Farm-animal yards are fenced, outdoor livestock areas associated with a barn or other outbuilding that is lined with concrete or paved with impervious material, other than land meeting the definition of an outdoor confinement area. Food and water are not provided in farm-animal yards. They are generally used as outdoor exercise areas or holding areas when barns are being cleaned.

Farm animal is defined in the *Nutrient Management Act, 2002,* as:

- livestock, including poultry and ratites (flightless birds)
- fur-bearing animals,
- bees,
- cultured fish,
- deer and elk,
- game animals and birds, or
- any additional animals, birds, or fish prescribed by the regulations.

Threat 21 is divided into two sub-threats for classification as chemical threats, and grouped together for pathogen threats. The chemical threats are determined using different methods. The chemical threats are:

- the use of land as livestock grazing or pasturing land, and
- the use of land as an outdoor confinement area or a farm-animal yard.

The circumstances that result in a significant level of risk for this threat are outlined in a flow chart included in Appendix B.

In general, the threat related to land used for livestock relates to the generation of agricultural source material (ASM) and the possible improper management or handling of runoff from these areas. This runoff can have elevated concentrations of nutrients and pathogens and could affect both groundwater and surface water sources. Only the nutrient units generated by farm animals that can be pastured, or that occupy confined areas or yards, were considered in this threat assessment. In general, pasturing or confining farm animals creates a significant chemical drinking water threat only when the generation of nutrient units is over the threshold listed in the reference tables.

Significant pathogen threats exist when these activities occur in a vulnerable area where significant threats are possible.

Nitrogen, total phosphorus, and pathogens are identified as contaminants of concern in runoff from lands used by livestock. If the runoff is not managed appropriately, it could enter watercourses or infiltrate into the ground and affect water resources. Nitrogen is a concern for both surface and ground drinking water sources. When water with high nitrate concentrations is given to babies less than six months of age, their digestive systems aren't able to cope, and high levels of methemoglobin are formed in the blood. Oxygen is not distributed to the body's cells and Methemoglobinemia, or Blue Baby Syndrome, results. Total phosphorous is only considered for surface water impacts. Excessive inputs may result in eutrophication of the water and can cause toxic algae blooms that could affect human health and alter the taste and odour of drinking water.

The nutrients and pathogens that are found in animal manure could threaten the safety of drinking water sources in certain situations. Generally speaking, keeping greater numbers of livestock in a space increases the risk of contamination and the requirements for more active management. As such, the ranking of this drinking water threat in the Tables of Drinking Water Threats (2009) increases proportional to the number of nutrient units generated in a given area.

Part IV Prohibition

It was agreed that Part IV Prohibition was considered among the most effective approaches to address threats associated with livestock grazing and pasturing in vulnerable areas. The Planning & Policy Working Group and the Source Protection Committee were in agreement that land uses that involve livestock grazing and pasturing within WHPA-A should be prohibited under Part IV of the Clean Water Act.

Part IV Risk Management Plans

It was agreed that among the best means of addressing the threats associated with ASM for livestock grazing and outdoor storage is a Risk Management Plan. For farms that are not required to have a nutrient management strategy or plan, the policy approach proposed by the Policy & Planning Working Group and the Source Protection Committee is to require a risk management that would be based on the same principles as the Nutrient Management Plan and scoped to address these specific threats.

The Source Protection Committee was of the opinion that it is important that the requirements of a risk management plan be disclosed in the policy included in the Source Protection Plan to be used by a risk management official. This way, the farmer and the official are both aware of the requirements of the Plan.

Part IV Restricted Land Use

In keeping with the Risk Management Plans required by policy in the Source Protection Plan, pre-screening of planning applications related to livestock grazing and pasturing and of building permit applications for the proposed construction of livestock grazing or pasturing must also be required, to ensure compliance. Pre-screening of applications would be necessary in areas where these activities would pose a significant drinking water threat.

Land Use Planning

Given the policy direction, it was determined that complementary Official Plan policies were needed. The Official Plan is a Council approved, public document that sets the strategic and long term policies for the municipality. Any Official Plan Amendment application for this activity would be considered in the context of the Official Plan policies, based on the protection of drinking water and wellhead protection areas, as well as the details contained in the Source Protection Plan. Although not the primary tool to address this activity, it was felt to be an important supporting policy. Policies are to be included in Official Plans that prohibit livestock grazing and pasturing in WHPA-A.

Education and Outreach

There was support for education and outreach approaches to address the threat of activities related to livestock grazing and pasturing. In particular, it was felt that the municipality in collaboration with the CA/SPA should deliver an education and outreach program targeted at livestock grazing and pasturing operators within vulnerable areas that promote the development of Environmental Farm Plans and Best Management Practices to safeguard water supplies.

It was felt that education and outreach, in and of itself, would not be sufficient to address the threats associated with agricultural source material. The SPC elected to include education and outreach as part of a broad, multi-barrier approach to addressing both existing and future threats.

Incentives

There was support for the continued use of incentives in the form of funding associated with the development of Environmental Farm Plans. It was felt that incentives on their own would not be sufficient to address the threats associated with agricultural source material. While incentives can create additional interest and potential uptake, other methods are needed to address both existing and future threats. The SPC elected to include incentives as part of a broad, multi-barrier approach to addressing both existing and future threats. It was felt that incentives could advance the degree of acceptance and interest and could offer additional opportunity to advance the objectives of the Plan.

8 STRATEGIC ACTION POLICIES

The Regulation requires that any policy that does not fall under one of the categories listed below must be identified in the plan as a "strategic action policy":

- a significant threat policy
- a Great Lakes policy
- any type of monitoring policy that is to be carried out by a specified public body
- a low or moderate threat policy that affects decisions made under the Planning Act or Condominium Act, 1998
- a low or moderate threat policy that affects prescribed instruments (see description of this tool below)

Strategic action policies do not have legal implementation requirements; therefore cannot legally be enforced. However, strategic action policies are still an important part of a source protection plan, and their implementation can be monitored publicly through required progress reports.

8.1 CLIMATE DATA

Over the past twenty years, there has been a great deal of concern around the world over climate change, its causes and potential impacts on humanity. One of the potential impacts of climate change will be related to water supply. It is therefore important to look at climate change in the context of Source Water Protection.

Climate change refers to changes over time in the climate of the planet, or of geographic regions therein. It describes changes in the average state of the atmosphere or the average weather over various long and short-term time scales. Changes in climate may arise from natural processes, such as the internal processes of the earth, external processes, such as variation in levels of energy received from the sun, or from anthropogenic processes. In recent years, discussion of climate change has mainly referred to the changes in modern climate, including global warming. It is now accepted that human activities have played a significant role in these recent changes.

The general theory of climate change is based on the increasing volume of greenhouse gases present in the atmosphere. For thousands of years, there has been a natural balance of greenhouse gases in the atmosphere. Carbon dioxide and other greenhouse gases are naturally produced in some processes, and consumed in others. However, since the industrial era, data suggest that this balance has been disrupted. Worldwide human activities such as the burning of fossil fuels, deforestation, and agriculture have added huge quantities of greenhouse gases to the atmosphere which natural processes are unable to consume, thus upsetting the equilibrium (IPCC, 2007). The three greenhouse gases of primary concern are carbon dioxide, methane, and nitrous oxide, due to their chemical properties and their association with anthropogenic activities. Global atmospheric concentrations of these three gases have been increasing since the industrial revolution in the 1750s and now far exceed pre-industrial values. The global increase in carbon dioxide concentration is due primarily to fossil fuel use and land use

change, while those of methane and nitrous oxide are primarily due to agriculture (IPCC, 2007).

Climate change can change both the quality and quantity of current and future drinking water sources. Warmer temperatures can raise the temperature of surface water sources creating ideal habitats for bacterial growth. Warmer temperatures also indicate that more evaporation and evapotranspiration will be occurring, particularly after a storm event. The increased evaporation rates mean that less water is available to infiltrate the ground, to recharge the groundwater system. An increased frequency in storm events inherently leads to an increase in runoff, potentially introducing harmful pollutants to watercourses. Other potential impacts of climate change will be introduced throughout the section. Understanding how climate change has the potential to affect our water sources, is imperative to protecting the resource for future generations.

8.1.1 Anticipated Climate Projections for the South Georgian Bay-Lake Simcoe Source Protection Region

To anticipate future impacts across the Source Protection Region, including those on safe drinking water, climate models are used to simulate potential future climate scenarios. Climate models are a numerical representation of the climate system based on physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties (IPCC, 2007a).

There are a number of climate change models around the world that are producing simulations of possible future climate scenarios. While many are used individually, research has shown that by running multiple or an ‘ensemble’ of models together, the results are by and large better when projecting seasonal and annual precipitation and temperature. While an ensemble can increase the validity of the projections, there is still a very high level of uncertainty associated with them. For the most part this uncertainty is due to small-scale processes and feedbacks between the different parts of the earth that are not yet fully understood. An example of this is the impact and role of clouds. It is known that clouds play a large part in climate change, yet it is unknown what ensuing cloud responses will be from climate change (IPCC, 2007a). There is also an uncertainty associated with the amount of greenhouse gases (GHG) that will be released into the atmosphere in future years; therefore, climate models are run a number of times for different scenarios to give the best representation of possible outcomes.

In November 2009, the Expert Panel on Climate Change Adaptation released a report titled “Adapting to Climate Change in Ontario: Towards the Design and Implementation of a Strategy and Action Plan” (EPCCA, 2009) to the Minister of the Environment. In addition to providing over 50 recommendations to the Minister, a summary of climate change projections completed by Environment Canada (CCCSN, 2009) were provided. These model projections have been made for 63 grid areas across the province, with one of these grids roughly corresponding to the South Georgian Bay-Lake Simcoe (SGBLS) Source Protection Region.

The model results presented in the report (EPCCA, 2009) are the most current projections for 2050 (compared to 1961-1990 actual climate data) and are based on 24 models that were combined to provide a better estimation of climate conditions.
Potential Climate Change Impacts Related to Source Water Protection

The collection of climate data can help to better understand impacts of climate change on source protection areas and changes over time. This information also provides the scientific information and knowledge on which to base future climate change adaption initiatives. As suggested by the Expert Panel on Climate Change "reliable monitoring provides accurate baseline data on existing climate for risk assessment as well as validating projections against reality to inform adaptive management actions."

8.1.2 Climate Change Data Collection Considerations

The report prepared by the Ministry of the Environment and Conservation Ontario (2010) included an assessment of monitoring requirements for detection of climate change impacts on water resources, and indicators for identifying impacts of climate change on water resources. The report indicates that "*The impact of climatic change on surface [and ground] water could only be detected when long- term monitoring data are available. Hydrological and water quality modeling could be used to assess the long-term impact on water resources using expected changes in average climatic conditions. Although a comprehensive understanding of the hydrological cycle and biogeochemical processes affecting water quality is important, it would be challenging to measure all the required water parameters at all times. Therefore the aim of monitoring programs should be to determine baseline conditions, locate and understand critical areas and to provide reliable information to support modeling efforts*".

The following are some general examples of potential climate condition data that the source protection committees may identify in climate data collection policies. Included in this listing are examples of existing datasets or programs which source protection committees may wish to consider during policy development. Where possible, Source Protection Committees are encouraged to consider existing information/programs to support Source Protection Plan development and implementation.

- Precipitation (rain and snow fall)
    - Existing datasets: Conservation Authority time series meteorological data, snow surveys
- Stream flow, runoff, base flow
    - Existing datasets: Conservation Authority stream gauge network, Environment Canada stream gauge network, spot base flow measurements
- Evapotranspiration/evaporation/ Solar radiation
    - Existing programs: none currently available
- Groundwater levels (groundwater recharge and discharge)

- Existing programs: Provincial Groundwater Monitoring program (MOE-CA), existing municipality monitoring programs

Through the "Monitoring Climate Change Review Project" (2010), the Ministry of the Environment and Conservation Ontario identified surface and groundwater monitoring parameters required for detection and adaptation to climate change. The assessment of monitoring requirements included proposed parameters, distribution, and frequency. The following table has been extracted from the Phase 1 final report.

Table 8: Climate Change Hydrologic Impacts and Proposed Monitoring Parameters (after Chiotti 2008; Colombo, 2007)

ONTARIO - GREAT LAKES BASIN: MONITORING REQUIREMENTS (HYDROLOGIC PARAMETERS) FOR POTENTIAL CLIMATE CHANGE IMPACTS		
Hydrologic Component	**Expected Changes in the 21st Century**	**Proposed Monitoring Requirements (parameters, distribution, frequency, etc.)**
	SOUTH SUBREGION- SW ONT., EAST TO QUEBEC, INCL. THE GREAT LAKES	
Runoff	Decreased annual runoff, but increased winter runoff;	daily stream flows, total annual runoff, seasonal variation
	Earlier and lower spring freshet	daily stream lows, water temperature, seasonal variation
	Lower summer and fall flows	daily stream flows, base flow, duration of low flows
	Longer duration low flow periods	daily stream flows, base flow, duration of low flows
	Increased frequency of high flows due to extreme precipitation events	daily stream flows, continuous monitoring during extreme pptn events, nearby pptn monitoring as trigger
Lake Levels	Lower net basin supplies and declining levels due to increased evaporation and timing of precipitation	stream flow (runoff and base flow contributions) inputs to lakes, lake evaporation, lake temperature, seasonal pptn
	Increased frequency of low water levels	tributary inflows and lake levels , temp.-seasonal variations

ONTARIO - GREAT LAKES BASIN: MONITORING REQUIREMENTS (HYDROLOGIC PARAMETERS) FOR POTENTIAL CLIMATE CHANGE IMPACTS		
Hydrologic Component	**Expected Changes in the 21st Century**	**Proposed Monitoring Requirements (parameters, distribution, frequency, etc.)**
Groundwater recharge	Decreased groundwater recharge with shallow aquifers being especially sensitive. NOTE: TRCA Rouge River study determined INCREASE in groundwater recharge.	daily observation well water levels in shallow aquifers, unconfined and confined (longer term) aquifers, linked to daily pptn, runoff and base flow, soil moisture at key locations
Groundwater Discharge	Changes in amount and timing of base flow to streams, lakes and wetlands	daily stream flows, base flows; water levels in discharge areas e.g. wetlands; linked to pptn and gw levels in shallow aquifers
Ice Cover	Ice cover season reduced or eliminated completely	daily stream water temperatures; ice thickness
Snow cover	Reduced snow cover (depth, areas and duration)	weekly snow cover, remote sensing in representative areas
Water Temperature	Increased water temperatures in surface water bodies	daily stream water temperatures at key stations
Soil Moisture	Soil moisture may increase by as much as 80% during winter but decrease by as much as 30% in summer and fall	weekly soil moisture at key locations linked to daily pptn and gw levels in shallow aquifers, seasonal variation and variability
Water Quality	Changes in water quality due to low flow, increased temperature, different runoff timing. Indications of increased nutrient loading.	weekly stream water chemistry (temp, DO, pH, turbidity, nutrients; or as dictated by stream flow variation and extreme runoff events, drought. Monthly or seasonal gw. quality
Precipitation	Increased flooding between January and May due to rain on snow events. Decreased risk of spring flooding. Increased risk of summer flooding due to more frequent and intense rainfall.	daily pptn. incl. snowfall; seasonal variability, air temp., extreme events; linked to daily stream flow (base flow and runoff)
	From Climate Change Projections for Ontario: Summer: 10% less rainfall; in Kent, Essex, Lambton there will be 10 to 20% less precipitation from April to September. Winter: 10% less cold	daily pptn. Incl. snowfall; seasonal variability, air temp., extreme events; linked to daily stream flow (base flow and runoff); identify sensitive areas

ONTARIO - GREAT LAKES BASIN: MONITORING REQUIREMENTS (HYDROLOGIC PARAMETERS) FOR POTENTIAL CLIMATE CHANGE IMPACTS		
Hydrologic Component	**Expected Changes in the 21st Century**	**Proposed Monitoring Requirements (parameters, distribution, frequency, etc.)**
	season precipitation;	
Temperature	From Climate Change Projections for Ontario: Summer: 2 to 3 deg warmer - up to 5 to 6 deg - equivalent to Virginia. Winter: 1 to 2 deg warmer, except in eastern Ontario where temp remains the same.	daily temperature variations, seasonal variation at key locations esp. sensitive and vulnerable areas
Surface and Groundwater Withdrawals	Climate change vulnerability indicator: Level of Development.	weekly surface and groundwater withdrawals, esp. in sensitive or vulnerable areas, linked to stream flow and gw. levels in shallow aquifers
Aquatic Ecosystems	Changes in water temperature, water quality, water levels	covers all aspects of the aquatic sw and gw ecosystem as impacted by temperature and pptn

8.2 DISPOSAL OF IMPORTED FILL

Imported fill refers to a variety of materials that are not native to a property, which are typically used to alter the elevation of the ground surface. Fill can be comprised of sediments, soils, rocks and broken asphalt.

Depending on the land use of the property from which the fill is removed, the quality of that fill may not be suitable for disposal on another property. Accordingly, all fill should be tested to demonstrate that it is free of contamination prior to transportation. If contaminated fill is used or disposed of on a property, rain and surface runoff percolating through the material could dissolve the contaminants and carry them to watercourses or seep into the groundwater system. Furthermore, if sediment with adsorbed contaminants enters a watercourse, the water quality could be impaired. Whether the fill is contaminated or not, it should not be placed in locations where it has the potential to enter a watercourse of leach into an aquifer.

How does imported fill affect the South Georgian Bay- Lake Simcoe Source Protection Region?

The South Georgian Bay Lake Simcoe Source Protection Region is close to the Greater Toronto Area, where cleanup and development of brownfields is occurring. The proximity of rural lands provides an opportunity for the disposal of imported fill. In July,

2008, Conservation Halton initiated an inter-agency program to screen dump trucks and their drivers carrying excavation waste into the watershed. The Ministry of the Environment sampled the materials carried by the trucks, and testing showed that some material was contaminated at a hazardous level. They also found that not all drivers carried the proper paper work or could verify that the material was clean. As similar activities could be occurring in the Source Protection Area, there are reasons for concern.

The Lake Simcoe Region Conservation Authority recently changed their permitting

requirements to ensure that proposed fill works placement material meet the definition of “inert fill” as defined by the Ministry of the Environment for the proposed land use.

What legislation, guidelines, or protocols already exist?

Environmental Protection Act, 2002

The *Environmental Protection Act*, enforced by the Ministry of the Environment, prohibits the discharge of contaminants into the natural environment that are likely to cause an adverse effect. Construction materials, demolition materials and inert fill are classed as wastes under the Act.

Discussion on Policy Options

The municipalities, conservation authorities and environmental association indicated that their ability to control fill importation may not be sufficient to prevent non-inert material from being used where only inert material was permitted. Not all municipalities have policies that apply to site alteration and fill disposal, and where they exist, site alteration by-laws may be too limited to provide protection to drinking water supplies. Ontario Regulation 172/06, Nottawasaga Valley Conservation Authority and Ontario Regulation 179/06, Lake Simcoe Region Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses, overrides the municipal site alteration by-laws within NVCA and LSRCA jurisdiction. The conservation authorities regulate a minimum of 120 metres from wetlands, and less from watercourses in their jurisdiction. There are concerns that the more restrictive municipal by-laws could not be enforced within their jurisdiction. The regulation allows for scrutiny of applications to asses potential affects to the function of the water body or wetland including affects due to pollution.

Close monitoring of fill quality and placement is necessary to protect the water sources within the South Georgian Bay-Lake Simcoe Source Protection Region. The municipalities and conservation authorities should require appropriate testing of fill and submission of the laboratory analysis reports with development application. The Lake Simcoe Region Conservation Authority has already implemented this measure as part of their permitting process. A condition should be added in source water protection policy to give the authority to the municipality and conservation authority to request verification samples of fill quality at the expense of the applicant if there remains doubt as to the origin or quality of the material being imported. The conservation authority and municipality should ensure fill is tested and documented appropriately and verification of fill quality is made. Typically it is the lack of appropriately skilled man-power and a

proper procedure to follow that limits the agencies from carrying out verification studies. The Ministry of the Environment has indicated that they are writing guidelines to assist municipalities with setting up a fill importation protocol. When the guidelines are released, the fill importation policy developed under the *Clean Water Act* could point to that guidance.

8.3 SPILL PREVENTION, CONTINGENCY AND EMERGENCY RESPONSE PLANS

Spills of potentially toxic substances can occur from facilities through damage to storage containers or power outages or failure of level indicators, pumps or valves. Spills can also occur during transport of toxic substances on roadways, railways and waterways. The spilled material can be introduced into water courses or onto ground and enter the groundwater, potentially influencing water supplies.

Spills management is accomplished by implementing plans based on the principles: prevention, mitigation, preparedness, response, and recovery. Coordination of these activities involves all levels of government as well as private landowners.

Federal

The transportation of dangerous goods on roads, rail or marine routes in Canada is regulated under the Transportation of Dangerous Goods Act Regulations. Transport Canada develops safety standards and regulations based on risks, provides oversight and gives expert advice (through the Canadian Transport Emergency Centre — CANUTEC) on dangerous goods accidents to promote public safety in the transportation of dangerous goods by all modes of transport in Canada. There is a requirement to identify dangerous goods through the use of a 4-digit identification number on a placard, mounted on the vehicle. Shipping documents describing the dangerous goods being transported are also required. In the event of an emergency involving dangerous goods, the operator should call CANUTEC (613-996-6666 or *666 on a cellular phone) to report on the accident. Accident reports must also report on a “spill” (an immediate or continuous discharge from containment) or a “leak” (a small, sporadic discharge from containment).

A Regional Environmental Emergencies Team (REET) is a multi-agency, multi-disciplinary group specializing in environmental emergencies. A REET is designed to provide consolidated and coordinated environmental advice, information and assistance in the event of an environmental emergency. REET members represent several federal, provincial and municipal government departments, aboriginal communities, private sector agencies, and local individuals. Environment Canada and the Ontario Ministry of the Environment Co-Chair the REET program in the Province of Ontario.

To assist in emergency planning and preparation the Province of Ontario has been divided into 18 REET Planning Areas. For each of these 18 Areas a REET has been developed consisting of local and regional representatives. Each REET is designed to function in two clearly distinctive and separate modes of operation: planning and response.

The Source Protection Plan could require involvement of SPA staff (municipal staff are already involved) on an ongoing basis to integrate the SPP requirements and policies with those of federal, provincial, municipal and private organizations.

Provincial

Part X of the Ontario Environmental Protection Act requires all pollutants spilled into the natural environment be reported at once to the Ministry's Spills Action Centre (SAC) by:

- the person who causes or permits a spill
- the person who has control of the pollutant immediately before the discharge
- a member of a public agency who may have reason to believe the spill has not already been reported to the ministry.

Spills can be reported by calling a province-wide toll-free number at 1-800-268-6060. This line is answered by environmental officers 24 hours a day, seven days a week, who then determine what, if any, response should be taken by the ministry. SAC also supports the reporting process for other agencies including Environment Canada (Ontario Regional Office) and Ontario's Technical Standards and Safety Authority (TSSA).

By Order in Council under the Emergency Management and Civil Protection Act, the Minister has responsibility for spill and drinking water emergencies. To this end, the Ministry has developed an Emergency Management Program that includes an Emergency Response Plan, a Continuity of Operations Plan and an Emergency Operations Centre.

The Ministry of the Environment has worked with Emergency Management Ontario, the Ontario Water Works Association (OWWA) and a team of stakeholders from the water industry and municipal/provincial/federal governments to provide examples of emergency response plans and resources for municipal water providers.

These plans and resources provide the water industry with examples of different emergency response approaches including procedures for training and periodic testing of response plans. A range of materials is included that may be tailored to systems of different sizes and organizational structures. While these example plans are consistent with the requirements of the Emergency Management element of the Drinking Water Quality Management Standard, in some cases they exceed the minimum requirements.

The Drinking Water Systems Regulation (O. Reg. 170/03) regulates municipal and private water systems that provide water to year-round residential developments and designated facilities that serve vulnerable populations such as children and the elderly. Designated facilities include children's camps, child and youth care facilities, health care and social care facilities, a school or private school, a university, college or institution with authority to grant degrees.

Municipal

The operation of the municipal water supply system (under Safe Drinking Water Act, 2002 - O. Reg. 170/03) requires the municipality to develop a Risk Assessment

Outcomes analysis to protect the water supply in the event of various contingencies. Some of these contingencies involve response to contamination of the raw water source or an accident causing a spill. The emergency procedure is outlined as part of the Drinking Water Quality Management Standard and generally involves receiving a report from first responders at the scene of the spill or the contamination occurrence and then responding to the contamination to protect the finished water supply.

The procedures for municipal surface water drinking water systems are more immediate as time frames require a more rapid response to contingencies. The procedures for the protection of groundwater supplies from contingencies are more general and dependent on clean-up of the contingency and monitoring to ensure that the water supplies are safe from contamination. The same notification procedures with emergency response personnel are required.

Under the SPP, the presence of an activity that is or could be a significant threat to a municipal water supply may require a Risk Management Plan that will include contingency procedures.

An individual municipality can develop their own emergency response system and/or may also enter into cooperative assistance agreements with neighbouring municipalities for response to spills by area HazMat Teams and training of staff.

Official Plan policies and bylaws also control land uses, especially in relation to sensitive land uses nearby. This can include the provision of contingency planning.

Industrial and Commercial Landowners

The management of potential spills in industries within the Source Protection Region depends on the requirements of the supplier of the material (in the case of fuel), provincial or federal requirements (in case of pesticides) and on the due diligence of the company.

The agricultural sector has the option of attending Environmental Farm Plan workshops where specific aspects of managing potential spills are considered for farming operations.

The marina sector has the voluntary Clean Marine rating system for marina operation which includes contingency planning for spills.

8.4 TRANSPORT PATHWAYS

The vulnerability of an aquifer may be increased by any land use activity or feature that disturbs the surface above the aquifer, or which artificially enhances flow to that aquifer. Constructed or man-made preferential pathways (transport pathways) to aquifers such as large and small diameter wells and excavations can have a significant impact locally on the vulnerability of an aquifer. The Technical Rules 39-40, state that a Transport Pathway can increase Intrinsic Vulnerability from a Low to a Medium or High Vulnerability and from a Medium to High Vulnerability. When determining whether the vulnerability of an area has increased, the following factors shall be considered (Technical Rule 41).

Hydrogeological conditions;

- The type and design of any transport pathways;
- The cumulative impact of any transport pathways; and
- The extent of any assumptions used in the assessment of the vulnerability of the groundwater.

Examples of features that may provide a Transport Pathway that could result in an increase in Vulnerability of a water supply source include:

- Existing wells or boreholes
- Unused or abandoned wells
- Pits and quarries
- Mines

In the Source Protection Region domestic wells that intersect with the municipal supply wells were the most commonly identified Transport Pathway. Criteria used to determine if a domestic well should be considered a Transport Pathway included:

- Whether the well intersects with the municipal well
- Density of wells
- Age of wells (as a proxy for integrity of the annular seal)
- Height of the well casing above ground surface

For municipal surface water supplies, natural or anthropogenic transport pathways may contribute to the Intake Protection Zone 2 (IPZ-2) where discharges on abutting lands are included in the two-hour time of travel to the water intake.

Consideration could be given to on-going well surveys that would evaluate the condition of private wells within WHPAs and identify the potential transport pathways that are currently unknown.

8.5 WATER CONSERVATION

Water conservation refers to reducing the amount of water used on an individual basis. A reduction in the quantity of water used benefits all users in the watershed, including ecological users. The goals of water conservation are to ensure enough water is available for future generations and to conserve aquatic habitat. A corresponding goal is to conserve energy, i.e., less water treated and delivered means less energy consumed.

Substantial benefits are also realized when less water is treated and fewer chemicals are used to treat the water. The life of the infrastructure is extended without the need for upgrades, repairs, or replacement, and there is no need to find additional water supplies to satisfy increased demand. More efficient water use also reduces demand.

Efficient use of water is using the minimal amount of water feasible to accomplish a function, task, or process. In addition, modification to a process or the equipment used could improve efficiencies.

For the most part, education, outreach, and awareness improve water conservation. Therefore, promoting water conservation and the use of water efficient technologies to large and small water users will raise awareness and could change water-use practices.

For homeowners, a change in behaviour and the use of more efficient equipment is effective in reducing water use. For businesses, it may take a change in equipment, or improved system design or process to realize water savings.

Under the Technical Rules: Assessment Report (2009), water quantity threats can only occur where it has been determined that a local area around a municipal well is stressed. The identification of threats occurs following the completion of a Tier 3 water budget. Tier 3 water budgets and Local Area Risk Assessments are currently underway in the City of Barrie (Hewitt's Creek and Lovers Creek subwatersheds), the Regional Municipality of York and the Town of Bradford (East Holland, West Holland and Maskinonge subwatersheds) and in the Village of Woodville in the City of Kawartha Lakes. Because they are not yet complete, in this version of the Source Protection Plan, no policies will be included for water quantity threats. However, water quantity concerns can be addressed through strategic action policies.

In York Region, the Water for Tomorrow program has provided residents with information, workshops, water efficient landscape visits and other incentives since 1998. The program has received numerous community recognition awards and estimates saving an average of 22.4 million litres of water each day.

Durham Region's Water Efficiency Program, known as Water Efficient Durham, was launched in 1996 to implement the Regional Water Use Efficiency Strategy adopted by Regional Council. In the spring of 1998 the Region launched its "Household Guide to Water Efficiency". In June 2006 the Third Edition was published, packed with the most up to date methods of saving water all around your home. There are over 64 pages of water saving insights. The guide also features full colour photos to help with plumbing repairs as well as a water efficient garden planner. There are sections on general water use, as well as opportunities for indoor and outdoor water efficiency, a landscape plan, and a section on understanding your water bill. In a compliment to Durham Region and a testament to the quality of the Guide, Canada Mortgage and Housing Corporation (CHMC) produced a national version of the guide in 2000.

Other communities in our region have launched water efficiency programs. Most communities also adopt watering restrictions particularly in summer when the demand on water services increases as a result of watering of lawns and gardens.

What legislation, guidelines, or protocols already exist?

Water Opportunities Act, 2010

The Water Opportunities Act, 2010 is provincial legislation intended to assist municipalities with the development of innovative, cost-effective solutions to water challenges, to optimize existing systems, and improve water conservation.

The province will set water efficiency standards for consumer products, set goals for water use, and raise awareness of water use through information on water bills. Along with the Act, the province will pilot new technologies and practices, and educate the public on wise water use. Once the appropriate regulations are in effect, municipalities that provide water services will be required to prepare and submit a Municipal Water Sustainability Plan.

Under the requirements of the regulations, the plan may be required to contain:

- an assessment management plan for the physical infrastructure of the municipal system;
- a financial plan;
- a water conservation plan;
- an assessment of risks that may interfere with the future delivery of the municipal service, including the risks posed by climate change and a plan to deal with those risks; and
- strategies for maintaining and improving the municipal service in order to satisfy future demand, consider efficient use of water, reduce negative impacts on Ontario's water resources, and increase cooperation with other municipal service providers.

The regulations may also require public agencies to prepare water conservation plans that summarize annual water use for prescribed operations. Additional requirements may include a description and forecast of the expected results from proposed conservation measures, a summary of progress made, and achievements relating to set targets.

Low Water Response Program

The Ministry of Natural Resources has implemented the Low Water Response program in cooperation with Conservation Authorities. This program uses precipitation and stream flows as triggers to suggest that water use should be reduced. There are three levels of low water conditions that require conservation; voluntary conservation; conservation and restrictions on non-essential use; or conservation, restriction, and enforcement of non-essential uses. Municipal water bans are implemented at the Level II stage and are very effective to reduce water usage. The data gap in this program is that only the municipal and permitted water takings are monitored, and therefore, measures to reduce use taken by domestic or agricultural users are unknown.

9 QUESTIONS, COMMENTS AND ADDITIONAL INFORMATION

Conservation Ontario has produced a series of frequently asked questions and answers aimed at simplifying the Source Water Protection Program they are as follows:

What is Source Water Protection?

Source water protection is simply protecting water resources such as lakes, rivers and groundwater, from contamination or overuse. Water is critical to all aspect of our lives. Protecting the sources of our water is important to ensure that there is enough safe water for all our uses- now and in the future.

What are some water sources?

Our water comes from two major sources: surface water and groundwater. Surface water includes lakes, rivers, streams and wetlands. Groundwater includes underground aquifers. Groundwater and surface water are interconnected, flowing from one to the other.

Why is it important to protect sources of drinking water?

We need to protect the sources of our water in order to safeguard the public health of our residents and ensure there is enough water for all. Over two million residents in Ontario get their water directly from surface or groundwater sources and do not have treatment systems. Treating water for drinking is very costly. As a result, conventional water treatment methods cannot always remove many hazardous chemicals.

Don’t we have an unlimited supply of fresh water in Canada?

We do not have an infinite supply of water on our planet. Most of the water we use is recycled through the natural water cycle. It falls to earth as precipitation, is absorbed by plants and soil and then evaporates back into the atmosphere where the cycle begins again. Some of the water we use in thousands of years old. Our supply of groundwater can be depleted if water is taken out of the ground more quickly than it can become naturally recharged.

What is the best way to protect source water?

We protect sources of water by managing the human and natural influences on them. We need to prevent contaminating or overusing our water resources. Water flows within watersheds; therefore it is best to manage our water resources on a watershed basis. As water flows across the watershed, it crosses forest, farmlands, town and cities. Along the way it is affected by different activities. The fewer negative impacts on our sources of water throughout the watershed the better the chance that the water coming out of our taps will be healthy. Protecting our sources of drinking water is absolutely essential to our health.

How do we make sure our drinking water is safe now?

A number of actions are taken to prevent our water from becoming contaminated ensuring that it is safe and clean from source to tap. These include protecting sources of water by monitoring and managing our lakes, rivers, and streams, using up to date

water treatment systems, ensuring that the pipes, watermains and storage towers are in good repair, water testing and training water managers.

How are our sources of water threatened?

Both the quality of our water and the amount available can be threatened by different activities. Some of the threats to our water include:

- Natural contaminants
- Irresponsible land use activities which contaminate our water or take too much out.
- Urban development can make it difficult for water to filter into the ground in order to replenish groundwater sources. When this happens, water just flows across the surface of land rather than percolating down to aquifers.
- Air pollution from vehicles, coal plants, industries and other sources fall directly on surface waters or enter water sources through surface runoff.
- As a result of climate change, there is also concern that the warming of the Earth's atmosphere will reduce the amount of water available in lakes, rivers and streams due to reduced precipitation and increased evaporation.

How can we best protect sources of water?

Lakes, rivers, streams and other sources of water are best protected with proper planning involving a variety of water users. A source water protection plan is a management strategy designed to minimize the impact that human and natural activities have on the quality and supply of our water resources. Source protection plans include physical information about our watersheds, identify sensitive areas where water resource supply and/or quality is threatened, provide scientific data about the quality and supply of current water resources, and include up to date mapping, computer projections about future water resources and recommendation to manage the impacts of harmful activities.

Does source water protection take place today?

Working closely with the province, municipalities, landowners and other local groups, Conservation Authorities already plan and deliver watershed management programs and services for many watersheds in Ontario. This work needs to expand. Conservation Authorities collect data, carry out studies, map our resources and monitor the state of our watersheds daily. Conservation Authorities believe in the importance of involving the people living in watersheds in making decisions about the best way to ensure there are healthy and sustainable resources now and in the future.

How does the Clean Water Act fit into source water protection?

The *Clean Water Act, 2006*, is part of the Ontario government's commitment to ensure the sustainability of clean, safe drinking water for all Ontarians and to implement the Walkerton Inquiry recommendations. Protection water at the source is the first step to a multi-barrier approach and an important part of ensuring the health of people, ecosystems and economies. Provincial laws, such as the *Safe Drinking Water Act* and the *Ontario Water Resources Act*, are in place to regulate other key elements of the

multi-barrier approach including effective water treatment, adequate testing, rigorous monitoring, operator training, permits to take water and to regulate industrial pollution. The *Clean Water Act, 2006*, which was passed into law in October 2006, completes the multi-barrier approach to ensuring safe drinking water from ‘source to tap’. The *Clean Water Act, 2006*, applies primarily to municipal supplies of drinking water. Maintaining safe and secure private drinking water systems, such as private wells, is the responsibility of homeowners, institutions and businesses who own their own water systems. These are regulated separately under the *Safe Drinking Water Act*, the *Ontario Water Resources Act,* and *Health Protection and Promotion Act.*

10 LIST OF ACRONYMS

AO	Aesthetic Objective
ANSI	Areas of Natural and Scientific Interest
AR	Assessment Report
ASM	Agricultural Source Material
AVI	Aquifer Vulnerability Index
BMPs	Best Management Practices
CA	Conservation Authority
CWA	Clean Water Act, 2006
DNAPLS	Dense Non –Aqueous Phase Liquids
DWSP	Drinking Water Source Protection
EO	Education and Outreach
ET	Existing Threats
FT	Future Threats
GUDI	Groundwater Under the Direct Influence of Surface Water
HR	Have Regard For
HVA	Highly Vulnerable Aquifer
IB	Implementing Body
ICA	Issues Contributing Area
In	Incentives
IPZ	Intake Protection Zone
LID	Low Impact Development
LE	Legal Effect
LSRCA	Lake Simcoe Region Conservation Authority
LUP	Land Use Planning
MC	Must Conform
MNR	Ministry of Natural Resources
MOE	Ministry of the Environment
Mon	Monitoring Policy
MOE LUT	Ministry of the Environment Look Up Table
MPAC	Municipal Property Assessment Corporation
MW	Municipal Well
NASM	Non-Agricultural Source Material
NMA	Nutrient Management Act
NMP	Nutrient Management Plan
NMS	Nutrient Management Strategy
NVCA	Nottawasaga Valley Conservation Authority
ODWS	Ontario Drinking Water Standards
Oth	Other
PCB	Polychlorinated Biphenyls
PI	Prescribed Instruments
Pro	Prohibition
PTTW	Permit To Take Water

Re	Research
RMO	Risk Management Official
RMP	Risk Management Plan
SGBLS	South Georgian Bay-Lake Simcoe
SGRA	Significant Groundwater Recharge Area
SSEA	Severn Sound Environmental Association
SPA	Source Protection Area
SPC	Source Protection Committee
SPR	Source Protection Region
SA	Strategic Action(s)
STP	Sewage Treatment Plant
SWP	Source Water Protection
TCE	Trichloroethylene
TR	Technical Rules
ToR	Terms of Reference
TOT	Time of Travel
TSSA	Technical Standards and Safety Authority
WHPA	Wellhead Protection Area
WTP	Water Treatment Plant

11 GLOSSARY OF TERMS

Abandoned Well

A well that is deserted because it is dry, contains unpotable water, discontinued before completion, not being properly maintained, constructed poorly, or determined that natural gas may pose a hazard.

Activity

One or a series of related processes, natural or anthropogenic that occur within a geographical area and may be related to a particular land use.

Aggregate Risks

Multiple risks in a municipal water supply protection area that are considered together relative to the overall risk to drinking water sources

Ambient water

Natural concentration of water quality constituents prior to mixing of either point or non-point source load of contaminants

Aquifer

An underground saturated permeable geological formation that is capable of transmitting water in sufficient quantities under ordinary hydraulic gradients to serve as a source of groundwater supply.

Aquifer Vulnerability Index (AVI)

A numerical indicator of an aquifer's intrinsic or inherent vulnerability susceptibility, to contamination expressed as a function of the thickness and permeability of overlying layers.

Bankfull stage

Stage at which a stream first overflows its natural banks

Bog

Bogs are peat-covered areas or peat-filled depressions with a high water table and a surface carpet of mosses, chiefly Sphagnum. The water table is at or near the surface in the spring, and slightly below during the remainder of the year. The mosses often form raised hummocks, separated by low, wet interstices. The bog surface is often raised, or, if flat or level with the surrounding wetlands, it is virtually isolated from mineral soil waters. Hence, the surface bog waters and peat are strongly acid and upper peat layers are extremely deficient in mineral nutrients.

Broader Landscape

The watershed or Source Water Protection Study area. Applies to regional rather than local aquifer vulnerability assessments usually using an indices method of vulnerability assessment.

Chemical

A substance used in conjunction with, or associated with, a land use activity or a particular entity, and with the potential to adversely affect water quality.

Conceptual Water Budget

A written description of the overall flow system dynamics for each watershed in the Source Protection Area taking into consideration surface water and groundwater features, land cover (e.g. proportion of urban vs. rural uses), human-made structures (e.g. dams, channel diversions, water crossings), and water takings.

Confined Aquifers

An aquifer that is bounded above and perhaps below by layers of geological material that do not transmit water readily.

Consumptive Water Demand

The net amount of water that is taken from a source, and not returned locally to the same source in a reasonable time.

Contaminant

Chemicals and pathogens.

Contaminant of Concern

A chemical or pathogen that is or may be discharged from a drinking water threat.

Cumulative (water quality) Effects

The consequence of multiple threats sources, in space and time, which affect the quality of drinking water sources.

Cumulative (water quantity) Effects

The consequence of multiple threats sources, in space and time, which affect the quantity of drinking water sources.

Data Gaps

The lack of raw information for a specific geological area and/or specific type of information.

Decommissioned Wells

Capped, plugged and sealed in compliance with regulatory requirements by the Ministry of the Environment

Designated System

A drinking water system that is included in a terms of reference, pursuant to resolution passed by a municipal council under subsection 8(3) of the Clean Water Act, 2005.

Developed / Developable

Reference to the useable portion of a parcel of land that meets the regulatory zoning provisions, particularly those pertaining to defining the area of occupation for buildings, structures, facilities and infrastructure.

Drinking Water Concern

A purported drinking water issue that has not been substantiated by monitoring, or other verification methods; will be identified through consultations with the public, stakeholder groups, and technical experts (e.g. water treatment plant operators).

Drinking Water Issue

A substantiated (through scientific means) condition relating to the quality of water that interferes or is anticipated to soon interfere with the use of a drinking water source by a municipal residential system or designated system.

Drinking Water Threat

An existing activity, possible future activity or existing condition that results from a past activity, (a) 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, or (b) that results in or has the potential to result in the raw water supply of an existing or planned drinking-water system failing to meet any standards prescribed by the regulations respecting the quality or quantity of water, and includes an activity or condition that is prescribed by the regulations as a drinking water threat.

Entity

One or a series of related objects, natural or anthropogenic that may be related to a specific process. Examples: Storage Tank, Bird Colony, Abandoned Well, Mine Tailing, Natural Radiation Source.

Event

Occurrence of an incident (isolated or frequent) with the potential to promote the introduction of a threat into the environment. An event can be intentional as in he case of licensed discharge or accidental as in the case of a spill.

Existing Drinking Water Source

The aquifer or surface water body from which municipal residential systems or other designated systems currently obtain their drinking water. This includes the aquifer or surface water body from which back-up wells or intakes for municipal residential systems or other designated systems obtain their drinking water when their current source is unavailable or in the event of an emergency.

Exposure

The extent to which a contaminant or pathogen reaches a water resource. Exposure, like a drinking water threat, can be quantified based on the intensity, frequency, duration and scale. The degree of exposure will differ from that of a drinking water threat

dependent on the nature of the pathway or barrier between the source (threat) and the target (receptor) and is largely dependent on the vulnerability of the resource.

Fen

Fens are peatlands characterized by surface layers of poorly to moderately decomposed peat, often with well-decomposed peat near the base. The waters and peat in fens are less acid than in bogs, and often are relatively nutrient rich and minerotrophic since they receive water through groundwater discharge from adjacent uplands. Fens usually develop in situations of restricted drainage where oxygen saturation is relatively low and mineral supply is restricted. Usually very low internal drainage occurs through seepage down very low gradient slopes, although sheet surface flow may occur during spring melt or periods of heavy precipitation or if a major local or regional aquifer discharges into the wetland. Some fen wetlands develop directly on limestone rock where minerotrophic waters are emerging through constant groundwater discharge.

Freshet

The sudden overflowing of a river caused by heavy rain or melting snow.

Future Municipal Water Supply Areas

An area corresponding to a wellhead protection area or a surface water intake protection zone, or an aquifer or surface water area identified for potential future municipal water supply.

Goals

High level achievements to aim for with respect to source protection (e.g. to protect drinking water sources). Provides an opportunity to add value statements. Not measurable through numeric means.

Great Lakes

The five (large) lakes located in Canada and United States: Lake Ontario, Lake Superior, Lake Huron, Lake Erie, and Lake Michigan.

Great Lakes Connecting Channels

The large rivers that connect the Great Lakes (e.g. St. Clair River, St. Lawrence River, Ottawa River)

Groundwater

Subsurface water that occurs beneath the water table in soils and geological formations that are fully saturated.

Groundwater Recharge Area

The area where an aquifer is replenished from (a) natural processes, such as the infiltration of rainfall and snowmelt and the seepage of surface water from lakes, streams and wetlands, (b) from human interventions, such as the use of storm water management systems, and (c) whose recharge rate exceeds a threshold specified in the regulations. The Director's rules will specify the acceptable

methodologies to determine groundwater recharge rates i.e. what qualifies as significant.

Hazard

In the context of this guidance, a hazard is equivalent to a contaminant and pathogen threat.

Hazard Rating

The numeric value which represents the relative potential for a contaminant of concern to impact drinking water sources at concentrations significant enough to cause human illness. This numeric value is determined for each contaminant of concern in the Threats Inventory and Issues Evaluation of the Assessment Report.

Highly Vulnerable Aquifer (HVA)

An aquifer that can be easily changed or affected by contamination from both human activities and natural processes as a result of (a) its intrinsic susceptibility, as a function of the thickness and permeability of overlaying layers, or (b) by preferential pathways to the aquifer. The Director's rules will permit the use of various methods, such as the Intrinsic Susceptibility Index (ISI), to determine those aquifers that are highly vulnerable. Ontario's ISI defines a highly vulnerable aquifer as having a value of less than 30. An ISI is a numerical indicator that helps to indicate where contamination of groundwater is more or less likely to occur as a result of surface contamination due to natural hydrogeological features. The ISI is the most commonly used method of index mapping and was the prescribed method set out in the provincial 2001/2002 Groundwater Studies.

Hydrogeology

Hydrogeology is the study of the movement and interactions of groundwater in geological materials.

Imminent Threat to Health

A contaminant of concern that can affect human health in a short period of time.

Impact

Often considered the consequence or effect, the impact should be measurable and based on an agreed set of parameters. In the case of source water protection, the parameters may be an acceptable list of standards which identify maximum raw water levels of contaminants and pathogens of concern. In the case of water quantity, the levels may relate to a minimum annual flow, piezometric head or lake level.

Inland Lake

An inland body of standing water, usually fresh water, larger than a pool or pond or a body of water filling a depression in the earth's surface.

Inland Rivers

A creek, stream, brook and any similar watercourse inland from the Great Lakes that is not a connecting channel between two Great Lakes

Intake Protection Zone (IPZ)

The contiguous area of land and water immediately surrounding a surface water intake, which includes:

- the distance from the intake;
- a minimum travel time of the water associated with the intake of a municipal residential system or other designated system, based on the minimum response time for the water treatment plant operator to respond to adverse conditions or an emergency;
- the remaining watershed area upstream of the minimum travel time area (also referred to as the Total Water Contributing Area) – applicable to inland water courses and inland lakes only. (See also “Surface Water Intake Protection Zone”)

Intrinsic Vulnerability

The potential for the movement of a contaminant(s) through the subsurface based on the properties of natural geological materials.

Knowledge Gaps

Lack of referenced materials or expertise to assess certain characteristics of the specific watershed that can be adequately described without tabular or spatial data.

Land Use

A particular use of space at or near the earth’s surface with associated activities, substances and events related to a particular land use designation.

Liaising

Business act to refine logistics around gathering data and information.

Local Area

Specific area around a wellhead or surface water intake as determined through analysis. This area must encompass a drinking water system and surrounding potential quantity threats.

Marsh

Marshes are wet areas periodically inundated with standing or slowly moving water, and/or permanently inundated areas characterized by robust emergents, and to a lesser extent, anchored floating plants and submergents. Surface water levels may fluctuate seasonally, with declining levels exposing drawdown zones of matted vegetation or mud flats.

Model

An assembly of concepts in the form of mathematical equations or statistical terms that portrays a behaviour of an object, process or natural phenomenon

Model Calibration

The process for generating information over the life cycle of the project that helps to determine whether a model and its analytical results are of a quality sufficient to serve as the basis of a decision

Model Evaluation

A comparison of model results with numerical data independently derived from experiments or observations of the environment

Model Validation

A test of a model with known input and output information that is used to adjust or estimate factors for which data are not available

Model Verification

The examination (normally performed by the model developers) of the numerical technique in the computer code to ascertain that it truly represents the conceptual model and that there are no inherent numerical problems with obtaining a solution

Municipal Residential System

All municipal drinking-water systems that serve or are planned to serve a major residential development (i.e. six or more private residencies).

Naturally Occurring Processes

Processes that occur in nature and that are not the result of human activity. For example, erosion along a stream that provides a source of drinking water of the leaching of naturally occurring metals found in bedrock into groundwater.

Parcel Level

A parcel is a conveyable property, in accordance with the provisions of the Land Titles Act. The parcel is the smallest geographic scale at which risk assessment and risk management are conducted.

Pathogen

A disease causing organism.

Peak Demand Tolerance

A measure of ability for a water supply system to reduce short-term water demands.

Percentage (%) Water Demand

The ratio of estimated consumptive water demand to difference between groundwater or surface water source supply and water reserve.

Planned Drinking Water Source

The drinking water source (i.e. aquifer or surface water body) from which planned municipal residential systems or other planned designated systems are projected to obtain their drinking water from in the future and for which specific wellhead protection areas and surface water intake protection zones have been identified. The planned

drinking water sources are described in the Municipal Long Term Water Supply Strategy component of the Assessment Report.

Preferential Pathways

Any structure of land alteration or condition resulting from a naturally occurring process or human activity which would increase the probability of a contaminant reaching a drinking water source.

Raw Water

Water that is in a drinking-water system or in plumbing that has not been treated in accordance with, (a) the prescribed standards and requirements that apply to the system, or (b) such additional treatment requirements that are imposed by the license or approval for the system.

Raw Water Supply

Water outside a drinking-water system that is a source of water for the system.

Receptor

The exposed target in danger of incurring a potential impact. An example would be any aquifer or surface water body used for drinking water consumption.

Recharge

Recharge is the process by which water moves from the ground surface, through the unsaturated zone, to arrive at the water table.

Regulated Areas

Those areas for which Conservation Authorities delineate and restrict land uses by making regulations under subsection 28(1) of the Conservation Authority Act. This subsection applies to water courses, streams, lakes, valleys, flood plains, and wetlands in Ontario.

Reliability Influence Area

A geographic area within which water users could have a possible influence on the reliability of a municipal water supply. For surface water intakes, the Reliability Influence Area would be defined as the total contributing drainage area to the intake. For groundwater, the area would be defined by subtracting the simulated groundwater levels under pumping conditions from those without pumping to estimate the drawdown of the municipal pumping system.

Reserve Amounts

Minimum flows in streams that are required for the maintenance of the ecology of the ecosystem.

Response Factor

Typical factors affecting the response include dilution, rate of discharge, absorption, and degradation of the contaminant or pathogen in question. Because of the nature of the water resource, certain contaminants and pathogens may not have an impact great

enough to warrant concern or responsive action. The level of impact may not effectively degrade the water resource and therefore would not require a mitigative action.

Riparian Area

The area that lies as a transition zone between upland areas such as fields, etc. and streams, wetlands, lakes, rivers, etc. The zone is intermittently inundated and usually supports wet meadow, marshy or swampy vegetation.

Risk

The likelihood of a drinking water threat (a) rendering an existing or planned drinking water source impaired, unusable or unsustainable, or (b) compromising the effectiveness of a drinking water treatment process, resulting in the potential for adverse human health effects.

Security of well or intake infrastructure

An evaluation of structures/measures that are in place or are needed to protect a municipal groundwater supply well or surface water intake from potential contamination from external sources.

Semi-Quantitative

Describes an approach or methodology that uses measurable or ranked data, derived from both quantitative and qualitative assessments, to produce numerical values to articulate results.

Sensitivity Analysis

Sensitivity analysis evaluates the effect of changes in input values or assumptions on a model's results.

Sensitivity Area

That portion of a defined vulnerable area that has been assigned a vulnerability score.

Severity

The degree to which an impact is measured compared to an idealized value of some parameter of concern. In the case of water quality, the severity may relate to degree of measurable exceedance of some contaminant or pathogen. In the case of water quantity deviation from some measurable parameter (e.g. minimum annual flow, piezometric head or lake level) must also be established.

Significant Hydrologic Features

(a) A permanent and intermittent stream, (b) wetlands, (c) kettle lakes and their surface catchment areas, (d) seepage areas and springs, and (e) aquifers and recharge areas that have been identified as significant.

Site-level

The most refined scale at which technical assessment of hydrological and hydrogeological conditions can be conducted. These assessments may contribute to water budgets, vulnerability assessments, and issues evaluation.

Sub-Watershed

An area that is drained by an individual tributary into the main watercourse of a watershed.

Surface to Aquifer Advection Time (SAAT)

The average time required by a water “particle” to travel from a point at the surface to the aquifer of concern. The SAAT is approximated by using the vertical component of the advective velocity integrated over the vertical distance and the average porosity.

Surface to Well Advection Time (SWAT)

The average time required by a water “particle” to travel from a point at the ground surface to the well, including both vertical and horizontal movement.

Surface Water

Water that is present on the earth’s surface and may occur as rivers, lakes, wetlands, ponds, etc.

Surface Water Intake Protection Zone (IPZ)

The contiguous area of land and water immediately surrounding a surface water intake, which includes:

- the distance from the intake;
- a minimum travel time of the water associated with the intake of a municipal residential system or other designated system, based on the minimum response time for the water treatment plant operator to respond to adverse conditions or an emergency;
- the remaining watershed area upstream of the minimum travel time area (also referred to as the Total Water Contributing Area) – applicable to inland water courses and inland lakes only

Swamp

Wooded wetlands with 25% cover or more of trees or tall shrubs. Standing to gently flowing waters occur seasonally or persist for long periods on the surface. Many swamps are characteristically flooded in spring, with dry relict pools apparent later in the season.

Targets

In this context, detailed goals that are often expressed as numeric goals. (e.g. to reduce contaminant X in this aquifer by 10% by 2009).

Threat Assessment - Tier 1

Preliminary examination of a drinking water threat based on readily accessible information.

Threat Assessment - Tier 2

Advanced examination of a drinking water threat through accessing more detailed information, interviews and perhaps when warranted, additional monitoring, modeling or studies.

Tier 1, 2, and 3 Water Budgets

Numerical analysis at the watershed/subwatershed (Tier1 and 2) or local area (Tier 3) level considering existing and anticipated amounts or water use within the watershed, as well as quantitative flow between the groundwater and surface water systems.

Time of Travel (TOT)

An estimate of the time required for a particle of water to move in the saturated zone from a specific point in an aquifer into the well intake.

Tolerance of a Water Supply System

A measure of the ability to sustain required pumping levels even during exposure events.

Uncertainty Analysis

Uncertainty analysis investigates the effects of lack of knowledge and other potential sources of error.

Uncertainty Score

Uncertainty addresses known gaps in data/information about, or deficiencies in methods of assessment for, threats and/or vulnerability. It reflects the degree of confidence in the semi-quantitative data used to calculate risk.

Unconfined Aquifer

An aquifer whose upper boundary is the water table.

Valuation of the Supply

An evaluation of the importance of a particular municipal well or intake to the whole municipal drinking water supply. For example, where there are multiple supplies, value may be smaller, versus a single supply where value may be greater.

Vulnerable Area

An area referring to a groundwater recharge area, a highly vulnerable aquifer, and a surface water intake protection zone or wellhead protection area.

Water Intake Reliability

The probability that a wellhead or surface water intake can meet demand.

Water Reserve

A proportion of surface water flow that must be sustained to support anthropogenic or ecological requirements.

Water Source

An aquifer or surface water body being used to supply drinking water.

Water Source Supply

The total amount of water flowing through a surface water or groundwater system.

Water Supply System

The group of surface water intakes and/or groundwater wells that pump water to supply a municipal water distribution system.

Water Quantity Exposure

The extent to which a threat or group of threats affects the availability of water at an intake or wellhead.

Water Quantity Receptor

A competing water demand or requirement in danger of incurring a potential impact. This includes other anthropogenic or ecological water uses within the watershed, particularly those that are required to be maintained by provincial or federal law (e.g. permitted wastewater assimilation flows, other Permits To Take Water, or fish habitat protected by Department of Fisheries and Oceans legislation).

Water Quantity Risk

The likelihood that the threats to water quantity may render an existing or planned drinking water source impaired, unusable or unsustainable.

Water Quantity Targets / Water Reserve Targets

These are detailed physical goals that are often expressed as numeric goals (e.g. to maintain streamflow above X).

Watershed

An area that is drained by a river and its tributaries.

Wellhead Protection Area

The surface and subsurface area surrounding a water well or well field that supplies a municipal residential system or other designated system through which contaminants are reasonably likely to move so as to eventually reach the water well or well.

Wetlands

Land such as a swamp, marsh, bog or fen (not including land that is being used for agricultural purposes and no longer exhibits wetland characteristics) that, (a) is seasonally or permanently covered by shallow water or has the water table close to or at the surface, (b) has hydric soils and vegetation dominated by hydrophytic or water-tolerant plants, and (c) has been further identified, by the Ministry of Natural Resources or by any other person, according to evaluation procedures established by the Ministry of Natural Resources, as amended from time to time.