Municipality of the County of Annapolis

Margaretsville Source Water Protection Plan

Approved by Council, September 15, 2015

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A Source Water Protection Plan is a general strategy and outline of the management practices to be implemented by community stakeholders, with the objective of maintaining a source of high quality drinking water. This report is the Margaretsville Source Water Protection Management Plan designed to protect the source water drinking supply for the community of Margaretsville, Annapolis County, Nova Scotia, as required by Nova Scotia Environment (NSE).

The Margaretsville water supply is currently obtained from two excavated spring-fed crock wells called the East Well and the Southwest Well. These two production wells (shown on Figure 2) are located on a County owned 5.4-hectare parcel of land off the Ben Phinney Road. There are another two drilled wells, called PW-1 and PW-2, available to supply water for treatment but have not been used in recent years. The other drilled well on the property, located slightly to the northeast of the East Well, is not hooked into the production system and is intended to be used as a monitoring well. The 5.4-hectare property was designated as the Margaretsville Protected Water Area in 1967, under the then Nova Scotia Water Act.

The Margaretsville Source Water Protection Area is a fifty hectare area (as shown on Figure 4) based upon an evaluation of surface topography and groundwater hydrology. Because the water supply is derived from wells, it involves a groundwater source. The drilled well and each of the crock wells have their own unique zones of contribution, where the water that ultimately discharges from the wells originates. A well's zone of contribution is where the water it produces falls as precipitation percolates into the ground, and enters the aquifer. The limits of these zones of contribution were calculated based upon the best available regional, local, and site-specific data. They were transferred to the base map of Figure 4 and the most vulnerable zones identified. Recognizing that surface water runoff, originating between the zones of contribution and the local topographic divide could carry potential contaminants into the contribution zones, the entire catchment basin upstream of the reservoir has been included in the Margaretsville Source Water Protection Area.

To delineate higher and lower-priority areas within the Source Water Protection Area and to reflect the fact that certain contaminants can travel further than others, this report includes a conceptual model of the travel of groundwater to the Margaretsville water supply. The supporting documentation is supplied in Appendix A and the results are shown in Figure 4. However, since this model was based on certain assumptions and generalized information, this report discusses the need for additional field work to better characterize the hydrogeology (and possibly identify additional well locations) within the Source Water Protection Area.

As shown on Figure 3, the Margaretsville water supply is located in an area where there are various threats or potential threats to water quality, due to a variety of land uses. These include the potential for contamination from commercial fuel spills on Ben Phinney Road, heating oil or chemical storage tank leaks, forest or structural fires, impacts from road salting, the use of fertilizers and manure, and infiltration of herbicides/pesticides and other chemicals. For ongoing management of these risks, the severity of the risk of contamination from the various sources, and the likelihood they have of impacting the water supply was evaluated and ranked by appropriateness and effectiveness for managing each risk (see Table 4.1). The management options selected for each potential contaminant were incorporated into seven initiatives, which are listed in Table 5.1 and are summarized as follows:

i. Review and modify current contingency / emergency response planning to better mitigate incidents involving commercial fuel spills, heating oil or chemical storage leaks, forest or structural fires, and the detection of increased concentrations of chloride (from road salting) and of herbicides / pesticides or other chemicals.
ii. Request a repeal of the existing Margaretsville Protected Water Area Designation and request a new Provincial Water Area designation via the Environment Act that coincides with the Margaretsville Source Water Protection Area outlined in this Plan so that the Water Utility may oversee regulated activities that may impair water quality within the Margaretsville source water supply area. The technical bases for this are discussed more fully in Section 5.3.
iii. Establish municipal planning documents to regulate land uses within the Source Water Protection Area that have the potential to impact the Margaretsville water supply in terms of the severity of the risk and vulnerability.
iv. Initiate collaboration among the Water Utility, Nova Scotia Power, and the provincial road de-icing program, to facilitate the implementation of Best Management Practices (BMPs) to reduce risks of source water contamination.
v. Develop an Education and Stewardship Program for the landowners, residents, and other users (including fuel providers), of the Source Water Protection Area, informing them of their roles and responsibilities in protecting the water supply.
vi. Identify priorities and funding sources for the acquisition of land within the Source Water Protection Area, if other approaches to the management of threats to water quality are insufficient.
vii. Initiate a water quality-monitoring plan to document the health of the waters, identify any changes, determine if the plan is effectively protecting water quality, and identify any improvements that might be necessary.

1.0 Introduction

Margaretsville is a small residential and fishing community overlooking the Bay of Fundy in District 2 of the Municipality of the County of Annapolis, Nova Scotia. The community water treatment and supply system is located on a 5.4-hectare property along Ben Phinney Road (see Figures 1 & 2). The Margaretsville water supply is currently obtained from two excavated spring-fed crock wells called the East Well and the Southwest Well. There are another two drilled wells on the property, called PW-1 and PW-2 that are available to supply water for treatment but have not been used in recent years. The other drilled well on the property, located slightly to the northeast of the East Well, is not hooked into the production system and is intended to be used as a monitoring well. Population varies seasonally due to a significant population of summer residents, with an average of number is 120 customers, which are largely residential.

The 5.4-hectare property was designated as the Margaretsville Protected Water Area in 1967, under the then Nova Scotia Water Act. Since accepting responsibility for the water utility in 1973, the Municipality of the County of Annapolis (hereinafter "the County") has made a variety of improvements and modifications to the water supply and storage system. These have included actions to accommodate changes in water supply demand, maximize the production that can be obtained from the fractured bedrock aquifer, and protect the water supply from potential contamination. The utility currently holds an Approval to Operate the Margaretsville water supply system through 2018, issued by Nova Scotia Environment (NSE), conditional upon the completion of a Source Water Protection Plan. This Margaretsville Source Water Protection Plan is the fulfilment of this condition of the Approval.

1.1 Delineation of the Area for Protection

The effectiveness of any Source Water Protection Plan depends upon a careful definition of the Source Water Protection Area boundary. Knowledge of the boundary delineation will facilitate: (1) the determination of land uses and industrial, commercial, and recreational activities; as well as (2) current and future residential and municipal population and development that may impact water-quality and source-water demands. Because they are so important for understanding the delineation of the Source Water Protection Area, information on the history of the system's wells will precede the discussion of the delineation. The Margaretsville water supply system has five wells: two currently inactive drilled wells, PW-1 & PW-2, both 91.4 metres deep; two spring-feed production dug crock wells, the East Well and the Southwest Well, which are approximately 5 metres deep. The fifth well, also a drilled well is located

slightly to the northeast of the East Well, which was never connected into the production system, will be sealed in accordance with NSE requirements. As indicated in Table 5.1, the fifth well will remain in commission as a monitoring well and be grout sealed in accordance with the Well Construction Regulations made pursuant to Sections 66 and 110 of the Nova Scotia Environment Act. The four historically significant principal wells are:

1. PW1, which was drilled in 1966 to a depth of 91.4 metres and cased to a depth of 5.5 metres. The well has a 155 mm-diameter steel casing. It is also known as the Trescott well, after Peter C. Trescott. According to Hennigar (2004b), it may have been drilled by the Nova Scotia Department of Mines, for a study (Trescott 1968) that he was performing. When last tested, in 1996, it had a static water level of 36.8 metres below the ground surface and had a potential safe pumping rate of 130 m^3/day (Hennigar 2004b). According to information received from the County in August 2013, the well was sealed to keep infiltration from entering and has not been used in years, although it still has a pump and can be used, if the springs or reservoir become unusable. The water pumped is considered to be potentially "groundwater under the direct influence" (GUDI) of surface water (Hennigar 2004b).

2. PW2, which was drilled in 1993 to a depth of 91.4 metres and cased to a depth of 5.2 metres. The well has a 155 mm-diameter steel casing. According to the NSE license to withdraw water (Authorization No. 93-WH-009), the well was drilled by D.J.'s Well Drilling (License No. 422). The Authorization (which has an expiry date of December 31, 2014) also indicates that the well is approved to withdraw up to 11.9 million litres annually, at a maximum rate of 33 m^3/d. This appears to be the only well in the system that has an approved withdrawal. When tested in 1993, it had a static water level of 33.5 metres below the ground surface and had a potential safe pumping rate of 33 m^3/day (Hennigar 2004a). According to information received from the County in August 2013, the well has not been sealed and contains a pump, and is "tied to the original well," that is, to PW1. This probably means that it shares a collector line with PW1. According to the County's 2004 Assessment for Public Drinking Supply Wells, the two wells are hydraulically connected through common fractures, and cannot be pumped simultaneously. According to Hennigar (2004a), PW1 and PW2 are only 3 metres apart. The data received from the County also indicates that both wells "have not been used in years." However, PW2 still has a pump and presumably can be used, if the springs or reservoir become unusable. The water pumped is considered to be potentially GUDI (Hennigar 2004a). Because PW1 is sealed and this well is not, we have assumed that PW2 is the "drilled well" cited under the Equipment section of the current Approval to Operate.

3. Southwest Well, which is a dug well that intercepts a spring located at the south side of the reservoir. According to data received from the County in August 2013, it is finished as a crock well, with a depth of approximately 5 metres and a depth to water of about 2.2 metres below the top of casing. Water diverted from the well is blended with water

withdrawn from the East Well "to supply water going to the sand filters." According to the most recent (probably 2013) NSE Approval to Operate, the water pumped from this well is GUDI. Since PW1 and PW2 are "both out of production," it can be assumed that virtually all of the water supplied to Margaretsville passes through this well or the East Well. It is assumed that there are no other springs supplying the reservoir, or baseflow below its surface, supplementing the overflows from the dug wells.

4. East Well, which is a dug well that intercepts a spring located at the east end of the reservoir. According to data received from the County in August 2013, it is finished as a crock well, with an unknown depth. The depth to water is approximately 2 metres below the top of casing. Water diverted from the well is blended with water withdrawn from the Southwest Well before it arrives at the sand filters. According to the current Approval to Operate, the water pumped from this well is GUDI.

By way of a February 24, 1967 order made by the Nova Scotia Water Authority, pursuant to Section 16 of the Water Act, an area of approximately 5.4 hectares, roughly corresponding to the county-owned property (as shown on Figure 2), which includes the surface water reservoir, the treatment and storage facility, and two privately-owned parcels located between the county-owned property and Ben Phinney Road, was designated as the Margaretsville Protected Water Area. May 9, 2007, a reiteration of this designation was filed in the Royal Gazette Part II Regulations, noting that Subsection 106(5B) of the Environment Act deemed that designation to have been filed under subsection 24(1) of the Regulations Act before April 1, 1978.

In accordance with the *Drinking Water Strategy for Nova Scotia* and recognizing that surface water runoff could potentially introduce contamination, the Source Water Protection Committee has delineated a 50.0-hectare topographically-defined catchment that would drain to the water supply reservoir, if the intervening soils were totally saturated. The catchment area is superimposed on a map (Figure 3) showing the parcel boundaries and the Protected Water Area Designation. It should be noted that when the boundary of the current Protected Water Area Designation is plotted using the Province's official surveyed description, the metes and bounds do not align very well with the GIS parcel boundary for the Water Utility property provided by the County.

The inferred boundaries of the catchment area are based solely upon topography. The drainage catchment of the surface-water reservoir is the area enclosed within the topographic divide up-slope of the reservoir. Although tracing a line through a topographic divide is normally a reasonably accurate way to delineate a protection area for a watershed drained by internal streams, Margaretville's system is supplied by wells and the use of topographic divides is not sufficient to represent the groundwater hydrology. In addition, for groundwater sources, the NSE Guidelines require estimates of the lateral extents of each well's zone of contribution

and potential contaminant-entry zones with 0- to 2-year, 2- to 5-year, and 5- to 25-year times of travel (TOT) to the wellhead. The NSE Guidelines refer to these TOT zones as Zone 1, Zone 2, and Zone 3, respectively. The establishment of different TOT zones reflects the fact that different types of contaminants in groundwater will persist for different lengths of time, pose different health risks, and travel different distances before being absorbed, degraded, or otherwise mitigated. Naturally, the zones that are closer to the well require a higher level of protection. Nevertheless, the catchment area is still important for the Margaretville system because surface runoff, from the land surface and the drainage ditches along Ben Phinney Road, flows in the direction of the wells and passes through their zones of contribution before reaching the by-pass channel that protects the reservoir. Runoff is capable of transporting dissolved and suspended contaminants over relatively large distances in very short times.

In order to determine the dimensions of the TOT zones, the aquifer geometry and hydraulic properties, the portion of the aquifer penetrated by the wells, the ambient hydraulic gradient, and the diversion rates of the wells and mutual interference between them must be known. Information pertinent to regional and site hydrogeology, the approach to modeling the flow of groundwater and associated assumptions, the software used for the calculation of flow lines, and how the results were processed to obtain the TOT zones, are fully related in Appendix A. The calculated zones of contribution and TOT zone boundaries for the individual wells extend beyond the combined boundaries of the currently designated (1967) Protected Water Area and the catchment area, in a few areas near the wells. Including the locations unique to the TOT zones, the Source Water Protection Area would then increase to 50.0 hectares. The limits of the zone of contribution and the TOT zones shown in Figure 4 are based upon estimated parameter values that are considered conservative and reasonable, but some uncertainty remains in the magnitudes of the hydraulic-gradient or hydraulic-conductivity components, and the gradient direction. The uncertainty could result in the TOT zones not being optimally sized and oriented, leaving the system less protected in some parts of the Source Water Protection Area than intended and more protected than necessary in others. This uncertainty can only be addressed by undertaking a field study to measure the hydraulic parameters in the vicinity of the wells. While further study of the area is listed as an initiative in the Plan, it is a costly endeavour, especially considering the cost/benefit ratio of further study relatively to the small customer base the treated water is sold to. While there is some reservation to outright implementing this further study initiative, the concept is not discounted outright but rather this plan discusses the need for additional field work to better characterize the hydrogeology (and possibly identify additional well locations) and as such is elaborated on in Section 5.2. It does however require saying that it does not appear likely that the estimated parameter values are so far from correct that using the recommended TOT zones would not be effective. Despite the

uncertainty, the TOT zones derived from estimated parameter values would significantly increase the level of protection provided by the current 1967 Protected Water Area Designation boundaries. Nor does it appear likely that using them would incur significantly greater risk, relative to delineations that might be derived from more elaborate testing. In defense of further study, certain advantages would derive from knowing more about the aquifer. This knowledge would improve the level of confidence in the interpretation of the data that will be obtained from the monitoring plan and with any future modifications of the Source Water Protection Plan or area delineation. It would provide a basis for optimizing the operation of the wells for enhanced protection and yield. Finally, it would better inform the selection of locations for additional wells to improve the firm capacity of the system and lessen the dependence upon the more vulnerable crock wells.

1.2 Existing Conditions in the Source Water Area

As shown on Figure 3, the Source Water Protection Area primarily includes undeveloped forested land, agricultural fields, power supply infrastructure, and a transportation corridor (Ben Phinney Road), along which a few residences are located. Winter snow and ice control of the Ben Phinney Road is by plowing and road-salting. Dwellings in the area use on-site septic systems; have heating oil storage tanks and can potentially store other petroleum based products. There is room for additional residences to be built in the future. It can be seen that, within the 0- to 2-year TOT zone, there is a roadway, power distribution lines, agricultural fields, forested areas, and a few residences within the 2-to 5-year TOT zone, there are all of these, plus a companion-animal advocacy and boarding facility. Commercial fuel vehicles enter and leave the area to make deliveries to residential heating oil tanks, as well as using Ben Phinney Road as a delivery route to other areas. Nova Scotia Power Inc. (NSPI) maintains power transmission infrastructure in the area, but the exact configuration and management practices specific to this area have yet to be determined. The transmission lines may include chemically treated utility poles and older transformers containing polychlorinated biphenyls (PCBs). Utility poles are treated mainly with pentachlorophenol (PCP) and less frequently chromated copper arsenate (CCA). NSPI may also utilize herbicides to control vegetation from interfering with power infrastructure. Existing agricultural fields in the area are currently used for hay, but historically other crops have been present, and are planned for the future. The herbicides MCPA and Roundup and fertilizers/nitrates are known to be used periodically on these fields, although future usage may increase or expand to other substances. Fuel and chemical storage is usual in agricultural areas. The potential exists for currently forested land to be cleared for agricultural use. Animals currently indicated to be kept in the area include several horses and a companion animal advocacy and boarding facility, which is believed to house primarily cats. A hobby farm with unspecified animals is reported to exist, and historic

animal holdings are reported to have included a pig farm. The presence of these animals may lead to heavier nitrate and pathogen loadings to soils than would be found in a residential area, which could potentially be transported to the reservoir or to the 0- to 2-year TOT zone in runoff, following a storm event. Management practices for animal waste within the area remain undetermined. The potential also exists for animal holdings within the area to increase. Formerly, roadside ditches discharged to the water supply reservoir via a ditch that crossed an agricultural field, collecting agricultural runoff as well. In 1984, concerns over contamination from road salting and pesticides led to the installation of a settling pond and open channel diversion, which routes runoff directly to the stream flowing out of the south side of the reservoir. However, should a precipitation event result in the amount of incoming runoff to overwhelm the settling pond diversion channel by-pass outlet (a settling pond surface rise of 0.2 feet above the normal outflow weir) runoff may still be routed to the reservoir through a settling pond auxiliary overflow outlet that discharges to the reservoir.

By 2004, the supply was drawing from a drilled well (PW1, also known as the Trescott well) in addition to the water supply reservoir. Treatment included slow sand filtration and disinfection with mixed oxidants, and water storage consisted of a 1023 m^3Gunite storage tank. A second drilled well (PW2, also known as MA-93-01) was used as a back-up supply for the first well, despite its lower yield. PW2 was the only well listed on the license to withdraw water (Authorization No. 3161). Between 2004 and 2012, PW1 appears to have developed an infiltration problem and the primary water supply shifted to the second drilled well and a shallow dug well (probably the East Well) intercepting a spring that feeds the supply reservoir. Withdrawals directly from the reservoir were only supplementary for the water supply in the summer months. The occurrence of a summer drought, which drained the reservoir, led to the completion of a second dug well, intercepting a spring on the south side of the reservoir. The two existing dug wells are referred to as the East Well and the Southwest Well. The water treatment plant is located just northwest of the catchment area, but is included in the Protected Water Area Designation area. Storage of chemicals and/or fuel may exist on the site in proximity to the water supply. The approximate locations of water supply infrastructure are shown on Figure 2. Additionally, as indicated in Table 5.1, the PW-2 will be grout sealed with bentonite in accordance with the Well Construction Regulations made pursuant to Sections 66 and 110 of the Nova Scotia Environment Act.

Margaretsville currently has a complete program of water treatment, testing, and monitoring, which is in full compliance with provincial and federal regulations, to provide a finished product that meets or exceeds the *Guidelines for Canadian Drinking Water Quality,* published by Health Canada. Water quality analyses performed on raw water in 2003, 2004, 2008, and 2010

indicate non-detects for pathogens, herbicides, pesticides, and most household chemicals. The contaminants listed in Table 1.1 were detected at acceptable levels, with occasional exceedances of the Guidelines for Canadian Drinking Water Quality. These are shown in boldface type. These exceedances were reported by AGAT Laboratories in the samples collected on June 23, 2008 from the drilled water well, which may be PW-2, and therefore part of the water supply system. This appears to be the only date where individual wells were separately sampled. The reservoir was also sampled on this date. None of the contaminants display an increasing trend in the provided composite data.

Table 1.1 Margaretsville Raw Water Quality

Contaminant	Detected Range (mg/L)	Guideline for Canadian Drinking Water Quality (mg/L)
Bicarbonate Alkalinity	33 to 56	NA
Calcium	9.5 to 19.7	NA
Chloride	11 to 39	(250)
Magnesium	4.1 to 7	NA
Nitrogen	ND to 7.7	10
Ortho-Phosphate	ND to 0.02	NA
Potassium	0.3 to 0.6	NA
Silica	2.7 to 15.9	250
Sodium	9.6 to 20.7	(200)
Sulphate	5 to 9	(500)
Total Dissolved Solids	75 to 156	(500)
Total Organic Carbon	ND to 4.4	5 (Lab)
Turbidity	0.1 to **1.2** NTU	1 (Lab) NTU
Aluminium	0.01 to 0.08	(0.1)
Boron	0.006 to 0.07	5
Copper	ND to 0.005	(1)
Iron	ND to **0.809**	(0.3)
Lead	ND to **0.012**	0.01
Manganese	ND to **0.269**	(0.05)
Strontium	0.022 to 0.045	5
Titanium	ND to 0.002	NA
Uranium	ND to 0.0001	0.02
Vanadium	0.002 to 0.003	NA
Zinc	ND to 0.01	(5)

*ND = Non-detect, values printed in **bold typeface** = exceeds the Guideline, () = guidelines which are not health based, i.e. aesthetic objectives or operational guidance values, NA = standard not available, values followed by "(Lab)" = used by laboratory in reporting, but is not included in current GCDWQ.

1.3 The Need for Management

Provision of an adequate and safe water supply to consumers is the top priority for the Province of Nova Scotia and the Municipality of the County of Annapolis. This is achieved through a Multiple-Barrier Approach – that is a series of steps, which together, provide a multi-layer protection system to ensure that safe water is delivered to the consumer. In Nova Scotia, the barriers defined in the Drinking Water Strategy are as follows:

- Keeping it Clean - ensure the water source is protected from contamination
- Making it Safe - provide the required treatment
- Proving it Safe - continuous testing and monitoring

The Source Water Protection Plan is a general strategy and outline of management practices that form a program designed for use by community stakeholders. The program is developed and administered by the stakeholders, with the objective of providing high quality drinking water by maintaining a clean and adequate water supply source.

1.4 Process of Management Plan Preparation

In 2002, the province of Nova Scotia released *A Drinking Water Strategy for Nova Scotia*, which outlines a multiple-barrier approach to clean, safe drinking water. Subsequently, Nova Scotia Environment developed a 5-step process to planning and establishment of safe drinking water for all Nova Scotians. The scope of work for implementation of the 5-step strategy is as follows:

Step 1 Form a Source Water Protection Advisory Committee
Step 2 Delineate the Source Water Protection Area Boundary
Step 3 Identify Potential Contaminants and Assess Risks
Step 4 Develop and Adopt a Source Water Protection Plan
Step 5 Monitor and Evaluate the Plan

In accordance with the requirements of the Approval to Operate, the Municipality of the County of Annapolis has undertaken to follow these guidelines and adopt a Municipal Source Water Protection Plan for the Margaretsville water supply. The remainder of this report describes the actions taken and presents the results found and initiatives to be undertaken. The term “Source Water Protection Area” used in this report refers to the 50.0 hectare proposed delineation shown in Figure 4, which was delineated by the Margaretsville Source Water Protection Committee in accordance with the established provincial guidelines.

1.5 Source Water Protection Advisory Committee

The Margaretsville Source Water Protection Advisory Committee, hereinafter also referred to as the Committee, is tasked with developing a source water protection plan and providing the Municipality of the County of Annapolis with direction on land use issues, water quality, levels and flows within the catchment area. The Mandate of the committee includes addressing issues such as:

- Identification of stakeholders;
- Water quantity and quality concerns;
- Actual and potential sources of contamination;
- Management strategies; and
- The effectiveness of the Source Water Protection Plan.

The Terms of Reference, which define the Source Water Protection Committee's composition, roles and responsibilities of committee members, operations and reporting hierarchy, and, committee members' length of term, are provided in Appendix B.

1.6 Deliverables and Time Frames

The Margaretsville Source Water Protection Advisory Committee will oversee the preparation and review of the following deliverables:

- Protection area boundary description and map;
- Identification of contaminants and associated risks;
- Source water management plan;
- Set time frames for the completion of initiatives;
- Implementation of Monitoring program; and
- Continuous evaluation of the effectiveness of the Margaretsville Source Water Protection Plan by the committee, which is to meet at a minimum on an annual basis or on a more frequent as-needed basis.

2.0 Water Quality Issues

Identification of potential sources of contamination and their associated risks is critical to the success of any source water protection plan. Point and non-point sources of potential contamination were identified by the committee. Point sources, as defined by Nova Scotia Environment, are sources of pollution which can be monitored and regulated; conversely, non-point sources are diffuse in nature and difficult to locate. Examples of point sources are fuel tanks, landfills and salt storage depots. Non-point source examples include land application materials, such as fertilizers (chemical and organic), road salting, and pesticide application.

2.1 Activities Within the Source Water Supply Area

Land use within the Margaretsville Source Water Protection Area is primarily limited to forested areas and agriculture, as shown on Figure 3. A few residential buildings and their associated outbuildings are within the Source Water Protection Area. Currently, only a few landowners, residents, and users inhabit or impact the area, although there is potential for the land to be subdivided and further developed in the future. The number of individuals who directly impact the Source Water Protection Area is a much smaller group than the end users of the drinking water supply, which includes approximately 120 customers per year. Land use information for the Margaretsville Source Water Protection Area is divided into three categories:

1. Land Ownership

The total land involved in the Margaretsville Source Water Protection Area is 50.0 hectares. Ninety percent of the land is privately owned and the remaining 10% is comprised of County owned land and Provincial land in the form of the Ben Phinney Road parcel (see Figure 1).

2. Number of Buildings/Structures

There are seven occupied residences in the Source Water Protection Area, all located along the Ben Phinney Road. An additional four residences are located adjacent to the defined Source Water Protection Area. Several of the residences have barns which are used for either livestock or storage, and some also have sheds which are used for storage. There is also a companion-animal advocacy and boarding facility, and the buildings associated with the water supply and treatment facility for Margaretsville's potable water system. All eleven residences within and immediately adjacent to the watershed area are supplied by individual water wells.

3. Percentage of Land Use

The land use in the Margaretsville Source Water Protection Area is a combination of transportation corridors, wooded forest, cleared agricultural land for forage and or crop production, agricultural pasture land, residential areas, wetlands, and surface water areas. Based on land use mapping polygons provided by the Municipality and a review of the land use conducted at the July 2013 Committee meeting, the approximate breakdown, by area within the source water protection area is:

- 34% wooded forest
- 34% agricultural land, without animals
- 5% agricultural or residential land, with agricultural animals
- 8% residential
- 5% companion-animal advocacy and boarding
- 7% roads and driveways
- 1% surface water
- 6% potable water supply and treatment facility

2.2 Potential Sources of Contamination

Potential sources of contamination within the Margaretsville Source Water Protection Area were identified by reviewing land use practices, agricultural operations, recreational uses and residential practices. Both point sources: (contaminants that are released from a specific, known location) and non-point sources (diffuse in nature, difficult to locate and hard to identify the source) were identified.

A public meeting was held on October 10, 2013 to consult with the land owners and community water end users for the identification of potential contaminant sources. In addition, an online survey form was created and publicized through various Annapolis County forums throughout the month of October 2013. No additional potential sources of contamination were identified by the public.

2.3 Pathways of Contamination and Prioritization Based on Risk

The Committee considered the likelihood of a release for each of the identified contaminant sources, as well as the severity of the consequences should such a release occur, in order to determine a general level of concern, as shown in Table 2.1.

Table 2.1 Potential Sources of Contamination

Potential Contaminant	Description	Probability [1]	Severity[1]	Rank
Point Sources				
Ben Phinney Road (including residences)	Road salt	2	2	Medium
	Commercial fuel spills	1	4	Medium
	Residential fuel spills	3	2	High
	Residential petroleum products	1	1	Low
	Septic systems	1	2	Low
NSPI infrastructure	PCB's	1	2	Low
	Utility pole treatment	2	2	Medium
	Herbicides	1	2	Low
Water Treatment Plant	Chemical storage	1	2	Low
Non-Point Sources				
Transportation corridors	Road salt	2	2	Medium
	Fuel/oil spills	1	4	Medium
Herbicides/Pesticides	Agriculture, NSPI, Public Works	4	3	High
Fertilizers/manure	Agriculture/hay/livestock	1	1	Low
Septic systems	Residential (pathogens)	1	2	Low
Fuel storage	Heating oil tanks	3	2	High
	Agriculture – diesel storage	2	3	High
Storm water collection (culverts, ditches)	Sedimentation	2	2	Medium
Forest and structural fires	Sedimentation	1	3	Low
	Fire suppressants	1	3	Low

[1]Note: The Committee assigned lower numbers to indicate a lower probability or severity.

After the potential contaminant sources were identified and the general level of concern assigned, the Committee undertook to identify the source activities and pathways that specific contaminants have in common. They then consolidated them in order to facilitate management and ranked them in order to optimize the allocation of resources. The rationale that the Committee used to rank each potential contaminant source is provided in the following paragraphs. The results of the contaminant risk ranking process and rationale are summarized in Table 2.2.

Road salt

NSTIR uses plowing and salt to manage snow and ice conditions on Ben Phinney Road. Salt poses a threat to drinking water by increasing sodium and / or chloride concentrations. Salt applied to Ben Phinney Road would either runoff into ditches collecting meltwater, or infiltrate into groundwater. Runoff collected by road ditches is routed via an interceptor ditch to a settling pond and then to a channel designed to by-pass the water supply reservoir. Salt infiltrating through the soil and reaching groundwater would be diluted upon reaching the water supply wells or reservoir. Therefore, groundwater contamination from salt is primarily a concern in the 0-2 year time of travel zone. The committee ranked the probability of road salt entering the water supply as relatively low (2), the severity of this risk as relatively low (2), and an overall risk of Medium.

Commercial fuel spills

Commercial fuel trucks pass through the source water protection area on a regular basis, both to fill domestic heating oil tanks within and adjacent to the source water protection area, and to reach residences in the general area of Ben Phinney Road. If a commercial fuel spill occurred along Ben Phinney Road, any contaminants that are not cleaned up would ultimately either runoff into ditches, or infiltrate into the ground, potentially impacting the aquifer. Petroleum contaminants pose significant health concerns, would be difficult to remove from water source area once introduced, and commercial trucks could introduce a large volume of petroleum contaminants at one time in the rare event of a spill. The committee ranked the probability of commercial fuel spills as low (1), but with high severity (4), and an overall risk of Medium.

Heating oil tanks

The seven residences on Ben Phinney Road within the source water protection area, as well as the four homes adjacent to the source water protection area, are assumed to have domestic heating oil tanks. Heating oil tanks commonly experience leaks due to a variety of reasons, including an aging or corroding tank and piping, overfills, or improper installation and maintenance. The volume of a residential leak is likely to be much smaller than a commercial

fuel spill, but this type of contamination could go undetected, allowing infiltration to groundwater and migration to the water supply. Consequently, they are often considered, collectively, to be a non-point source, due to difficulties in detection. However, with increasing environmental awareness, leaking tanks are more often reported, and then considered point sources. The severity of this risk would vary depending on the proximity of the heating oil tank to the water supply. Petroleum contamination introduced into the subsurface within the 5-25 year time of travel zone would be likely to degrade before reaching the water supply wells or reservoir, and therefore is primarily of concern in the 0-2 and 2-5 year time of travel zones. The committee ranked the probability of contamination from domestic heating oil tank as moderate (3), the severity as relatively low (2), and the overall risk as High.

Chemical storage

The water treatment facility stores approximately 100 kg of sodium hypochlorite for water treatment. Based on their physical location, introduction of these contaminants into the subsurface is primarily of concern in the 0-2 year time of travel zone. The probability of contamination from these stores was ranked as low (1) and the severity moderately low (2) with an overall Low risk. Residential petroleum storage (aside from heating oil tanks) is expected to be rare and to consist of very small volumes. Just as in the case of contamination from residential heating oil tanks, the introduction of these degradable petroleum contaminants into the subsurface is primarily of concern in the 0-2 and 2-5 year time of travel zones. The probability and severity of contamination from residential petroleum storage were both ranked as low (1) with an overall Low risk.

Septic systems

The residences in the Margaretsville source water protection area use on-site septic systems. Typical contaminants in household wastewater include nutrients (nitrogen and phosphorus) and pathogens (viruses and bacteria). Pathogens may survive in improperly maintained systems and may be transported through groundwater to the reservoir, with varying risk depending on the proximity of the septic system. Excess nutrient loading could potentially lead to an algal bloom in the reservoir. However, well-designed and installed septic systems are not usually problematic; the treatment facility is well-equipped to address pathogens, and the low population density means that the quantities of nutrients which might be introduced would be unlikely to produce a bloom. Pathogens are unlikely to survive in the subsurface for lengthy periods of time, and therefore are only a concern in the 0-2 year time of travel zone. Introduction of nutrients to the subsurface is primarily of concern in the 0-2 and 2-5 year time of travel zones. The committee ranked the probability of septic system contamination as low (1), the severity as relatively low (2), and the overall risk as Low.

Storm Water Collection (Culverts, Ditches)

Runoff collected by ditches along Ben Phinney Road is routed to a settling pond and then to a ditch designed to by-pass the water supply reservoir. In the event of a very large storm, runoff may be routed to the reservoir through an auxiliary overflow if the by-pass outlet is overwhelmed. This could lead to an increase in sediment load to the water supply reservoir. It should also be noted that the reservoir banks themselves could be susceptible to erosion in the event of a heavy rainfall. Increased nutrient loadings from agricultural runoff could lead to an algal bloom which would result in biomass accumulation and sedimentation in the reservoir. The committee ranked the probability of sediment as relatively low (2), the severity as relatively low (2), and the overall risk as Medium.

Fertilizers/manure

The use of fertilizers and manure on agricultural fields, and the production of waste by agricultural animals or large numbers of domestic animals, could lead to increased nutrient loadings to soils within the source water protection area. If nutrients reached the water supply reservoir through groundwater infiltration or surface runoff, an algal bloom could result. Algae growth, especially seasonal blooms, can potentially affect water quality and possibly the operation of the facility. The low density of animal holdings and infrequency of fertilizer/manure application to fields in the source water protection area means that the quantities of nutrients, which might be introduced, would be unlikely to produce a bloom. The introduction of nutrients to groundwater is primarily of concern in the 0-2 and 2-5 year time of travel zones, as these contaminants would be likely to degrade in the subsurface over longer periods of time. The committee ranked the probability of contamination from fertilizers/manure as low (1), the severity as low (1), and the overall risk as Low.

NSPI infrastructure

NSPI pole-top transformers may be located within the source water protection area, and some of these may be PCB-containing, depending upon their ages. More recently-installed transformers use mineral oil, but NSPI considers transformer manufactured prior to 1983 to be potentially contaminated with PCBs. Frequent inspection and maintenance may be necessary to prevent leaks. NSPI treats utility poles with pentachlorophenol (PCP) and chromated copper arsenate (CCA), but requires a minimum set-back of 15 and 5 metres, respectively, from the high-water mark of any freshwater resource. NSPI typically uses herbicides to control vegetation along the utility pole line, but has a policy of not using these within a watershed area.

According to NSPI, there is a two-year inspection cycle.Maintenance has the potential to cause a spill, and NSPI trains and equips their service crews for immediate response, in the event of a spill. Cleanup is carried out to meet Atlantic RBCA Tier 1 guidelines, in the case of more serious spills that "trigger reporting" under the Nova Scotia Emergency Spill Regulations. The possible introduction of PCBs, pole treatments, and herbicides into the subsurface is of greatest concern closest to the water supply reservoir and wells (0-2 and 2-5 year time of travel zones), but since certain of these chemicals are persistent (*i.e.* not degradable), they are of concern throughout the 5-25 year time of travel zone as well. The committee assigned an overall risk of low for PCB and herbicide and medium for utility pole treatments, owing to the relatively small concentrations that are allowable.

Herbicides/Pesticides

The herbicides MCPA and Roundup are known to be used periodically on agricultural fields within the source water protection area, and other herbicides/pesticides may be used for agricultural or domestic purposes. The municipal works department has indicated that they do not use herbicides to control vegetation growth along roads. As mentioned in the NSPI section above, herbicide application is not employed in watershed areas. The possible introduction of herbicides and pesticides into the subsurface is of greatest concern closest to the water supply reservoir and wells (0-2 and 2-5 year time of travel zones). Persistent herbicides and pesticides are also of concern throughout the entire 5-25 year time of travel zone. If herbicides or pesticides reached the water supply through groundwater infiltration or surface runoff, they are not easily removed by water treatment and could pose significant health risks. The committee ranked the probability of contamination from herbicides and pesticides as 4, the severity as 3, and the overall risk as High.

Forest and structural fires

A forest or structural fire and subsequent fire-fighting activities within the source water protection area would cause increased erosion and sedimentation which could impact the water supply. In addition, if water-soluble fire-suppressant chemicalsare used, they could reach the water supply through groundwater infiltration or surface runoff and pose health risks. The possible introduction of these chemicals is of greatest concern closest to the water supply reservoir and wells (0-2 and 2-5 year time of travel zones), but also of concern throughout the 5-25 year time of travel zone as wellsince these chemicals tend to be persistent and not degrade. The committee ranked the probability of contamination from forest fires as 1, the severity as 3, and the overall risk as Low.

Table 2.2 Rationale for Ranking

Item	Potential Contaminant	Rationale	Rank
1	Heating oil tanks	• Detection of leaks can be difficult • Risk varies depending on proximity to source water and size of tank	High
2	Road salt	• Increased salinity and hardness	Medium
3	Commercial fuel spills	• Trucks re-fuelling domestic tanks • Proximity of a spill to source water • Volume of a spill	Medium
4	Septic systems	• Detection of leaks can be difficult • Risk varies depending on proximity to source water • Water treatment system can handle	Low
5	Storm water collection (culverts, ditches)	• Sedimentation • Interceptor ditch	Low
6	Chemical storage	• 100 kg of sodium hypochlorite stored for water treatment • Residential petroleum products	Low
7	Fertilizers/manure	• Agriculture/hay/livestock	Low
8	NSPI infrastructure	• PCB's • Utility pole treatment • Herbicides	Medium
9	Herbicides/Pesticides	• Agriculture • NSPI • Public Works	High
10	Forest and structural fires	• Sedimentation • Fire suppressant chemicals	Low

3.0 Goal and Objectives

The overall goal of this Source Water Protection Plan is to manage land uses within the defined source water protection area to assure the continued supply of water of good quality to the Margaretsville water supply system.

3.1. Objectives

While the previous section states the overall goal of the Margaretsville Source Water Protection Plan: that the goal can be achieved through the accomplishment of specific objectives:

1. Establish multiple lines of protection, which will take the form of different initiatives for different types of contaminants. In order to reduce contaminant influx in a cost-effective manner, these initiatives will address vulnerable areas identified in earlier steps. They variously include: physical isolation from ongoing potential contaminant sources, changes in practice, the adoption of Municipal planning documents, a new expanded area Protected Water Area Designation and regulations, educating the public about responsible behaviour within the boundaries of a drinking-water supply watershed, and developing effective contingency plans to mitigate an incident, if one does occur.

2. Provide a plan that is flexible and can be adapted or augmented, if there are changes in contaminants (or activities that have the potential to introduce contaminants) changes in terms of land uses and land activities. It is important to incorporate ongoing public and key stakeholder input into the management plan, so as to design a well-integrated plan that builds upon existing programs and resources.

3. Provide a management plan that allows the potential sources of contamination to be easily and cost-effectively monitored. The degree of monitoring and management depend on the locations of the potential contaminant sources and their proximity to the water source.

The development of a management plan for protecting a source water area includes the development of a variety of management tools that work together to effectively mitigate risks within a protected area. Step 4 in the NSEGuide to Source Water Protection Planning focuses on the development and implementation of the management plan within the Source Water Protection Area.

3.2 Risk Management Practices

As stated in Step 4 of the NSE 2009 guidelines, almost every activity on the land has the potential to affect the quality of water in a community. Management planning brings together the people within the source water protection area to address those activities. By working together a source water protection plan can be designed to provide a coordinated effort that builds upon the strengths of existing programs and resources, and addresses the water quality concerns in an integrated, cost-effective manner. The following is a list of source-water protection management options:

a) **Acquisition of Land** - Typically the most expensive option, but also the most effective, as it provides direct control over the land usage and development.
b) **Best Management Practices (BMPs)** - Methodologies used by residents and industry to define practical and effective means of protecting source water areas.
c) **By-Laws** - By-laws are enacted under Municipal Planning Strategies and allow the Municipality to restrict land usage and activities in sensitive areas.
d) **Contingency Planning** - Not all risks to a protected water area can be mitigated. Contingency Planning defines emergency response protocols, in case of a dangerous contamination occurrence within the source water protection area.
e) **Designation** - Regulations enacted under the *Nova Scotia Environment Act*, Section 106. The Source Water Protection Area can be formally designated as Protected Water Area under this legislation. Regulations can be drafted that would enable the Water Utility to define allowable activities within the protected area.
f) **Education and Stewardship** – educating people and communities on the importance of source water protection creates a sense of ownership and shared responsibility of the water resource and the need for its protection.

The Source Water Protection Advisory Committee is to advise Municipal Council on these various management options in a Source Water Protection Plan, considering the effectiveness, cost, maintenance, useful life, adverse effects, and public acceptability of each option. After the adoption of the plan by Council, the next step for the Committee is to administer the development of education programs and best management practices for residents, stakeholders and other users within the source water protection area. The Committee then prepares an annual report of the effectiveness of the Source Water Protection Plan, noting the stages of completeness of the Initiatives herein contained.

4.0 Management Recommendations

For each potential contaminant within the Margaretsville Source Water Procreation Area, the management options presented in the NSE guidelines were evaluated for effectiveness, cost, maintenance, useful life, adverse effects, and public acceptability. Table 4.1 provides a visual summary of the expected effectiveness of the available management options on the identified potential contaminants. The management options were ranked by assigning a "1" to the option that was deemed to be the most effective. Options judged to be progressively less likely to be effective are numbered with sequentially higher numbers.

Table 4.1 Management Options and Effectiveness

Potential Contaminant	Acquisition of Land	BMP's	By-laws	Contingency Plan	Designation	Education & Stewardship
Heating oil tanks		2	4	3		1
Road salt		1		2		
Commercial fuel spills		2		1		
Septic systems		2				1
Sediment		2	1			3
Chemical storage		2		3		1
Fertilizers/manure	4	2	3		5	1
NSPI infrastructure		1		2		
Herbicides/Pesticides	3	2		5	4	1
Fires (forest, structure)		1		3		2

Although certain management options are judged to be more effective than others for specific contaminant source activities, the Committee recognizes that the most effective initiatives would make use of two or more management options in a coordinated fashion. Rationale for the assigned priorities is presented in the sections that follow.

4.1 Acquisition of Land

The acquisition of land is the most expensive management option for potential contaminants, but it is a highly effective way to gain direct control of land use and practices within the watershed. In small watersheds, such as the Margaretsville Source Water Protection Area, the cost of acquiring a small acreage of land may be reasonable and therefore a viable management option. However, this course of action may be unnecessary, if the risks of contamination can be adequately managed in other ways. In addition, land acquisition is contingent upon the landowners' willingness to sell their properties. Therefore, for Margaretsville, the acquisition of land was ranked as a low priority management approach for the risk of contamination from fertilizers/manure and for herbicides and pesticides, which will be primarily addressed by promoting education and stewardship and best management practices. However the purchase of available, undeveloped land to the south and the closest to the water storage and treatment facilities is an option that will be explored.

4.2 Best Management Practices

Best Management Practices (BMPs) for potential contaminants in source water protection areas are established and well-defined, and are a good way to initiate change in individual land holder and business operational practices. Additionally, BMPs are often cost effective solutions resulting from minor changes in day-to-day decision making. In some cases, government grants may be available to help attain these practices. Therefore, all of the identified potential contaminants in the Margaretsville Source Water Protection Area will be addressed by implementation of BMPs, as either the most effective management option (road salt, NSPI infrastructure, fires), or the second most effective option (heating oil tanks, commercial fuel spills, septic systems, sediment, chemical storage, fertilizers/manure, herbicides/pesticides). It should be noted that for some sources of contamination, BMPs can only be effective if they are accepted and implemented by the community. For government, changes in policy may be all that are required to implement BMPs. For industry, commercial and residential adoption of BMPs, education is needed and in some cases, changes in by-laws or other regulations or enforcement of existing laws may be required. Table 4.2 lists BMPs commonly applied to the potential contaminant source activities of concern in the Source Water Protection Area.

Table 4.2 Best Management Practices

POTENTIAL CONTAMINANT	BEST MANAGEMENT PRACTICES
Heating Oil Tanks	• Follow recommendations contained in the NSE Homeowners Guide to Heating Oil Tank Systems. • Tanks must meet national construction standards at a minimum. Used or "refurbished" tanks have inherent risks and should not be installed. Innovative home oil tanks tend to exceed minimum standards and have a longer life cycle before needing replacement. Also consider secondary containment systems and release barriers. • Oil tanks should be installed by a trained and experienced installer and in accordance with installation and fire codes. • Oil tanks should be regularly inspected for rust, damage, and corrosion by a heating service professional. • Ensure that tanks can be visually inspected from all sides and are maintained free of contact with vegetation or debris. Ensure that oil tanks are properly supported to prevent shifting, settling or falling over. Do not locate directly under house eaves or against a building wall. • Provide oil tanks with adequate protection in areas exposed to vehicles.
Road Salt	• Use appropriate salt application equipment, including zero-velocity spreaders if possible. Salt and sand should be pre-wetted prior to application. • Maintain appropriate application rates, especially in vulnerable areas. Reduce application volumes by pre-treating roads prior to storms and using other strategic application methods. • Salt storage should be located outside of source water protection areas and away from wells and aquifers where feasible. Ensure storage locations are designed to avoid any runoff or material loss on site. Store salt indoors on impermeable pads, and load and unload trucks/spreaders indoors. • Consider the use of alternative de-icing chemicals in sensitive areas and/or when source water sodium or chloride concentrations are elevated. • Monitor and keep proper records on de-icing practices to determine optimal usage.
Commercial Fuel Spills	• Follow recommendations contained in the NSE Pollution Prevention Workbook for Business in Nova Scotia. • Place road signage to indicate protected water source area. • Spill kits are required on commercial fuel supply vehicles. • Reduced speed of commercial vehicles in source water protection area. • Immediately clean up any spills with proper equipment.

Table 4.2 Best Management Practices (cont'd.)

POTENTIAL CONTAMINANT	BEST MANAGEMENT PRACTICES
Septic Systems	• Follow recommendations contained in the NSE Booklet - Before you Construct an On-site Sewage System: Facts a Homeowner Should Know. • Ensure septic system is designed and installed by a qualified professional with the appropriate training and experience. • Inspect septic systems regularly, maintain records, and complete maintenance and pumping properly and in a timely manner. • Don't overload the system with water or operate the system outside of its design limits. Keep roof drains, basement sump pump drains, and other rainwater or surface water drainage systems away from the drain field. • Never dispose of any unwanted pesticide, oil, or other hazardous chemicals by flushing them down the drain or toilet. • Notify authorities and quickly and resolve causes of sewage backup or wet spots / sewage appearing on the ground, with the assistance of a septic professional. • Don't plant trees, shrubs or other large plants near the septic system or drive or park vehicles on any part of the septic system.
Sediment	• Review erosion and sedimentation control plans for all construction within proximity to watercourse. • During construction activity, implement sedimentation controls such as check dams, filter barriers, surface stabilization, sediment ponds and proper grading. • Limit the length and steepness of the designed slopes to reduce runoff volumes and velocity. • Avoid clearing/cutting large portions of land, if possible. If clearing land is required, expose the smallest practical area of land for the shortest possible time. • Where possible, keep exposed soil covered with temporary or permanent vegetation to minimize surface runoff.
Chemical Storage	• Ensure that water treatment chemicals, such as chlorine, are stored securely. • When transporting herbicides/pesticides, fertilizers, or other chemicals, keep them secured to prevent any spillage. • Don't recycle empty pesticide or oil containers or reuse them for anything else. • Store manure or fertilizers as far from water bodies or streams as possible and secure storage piles to eliminate the potential for erosion.

Table 4.2 Best Management Practices (cont'd.)

POTENTIAL CONTAMINANT	BEST MANAGEMENT PRACTICES
Fertilizers and Manure	• Follow recommendations contained in the NS Agriculture Manure Management Guidelines and the Environmental Regulations Handbook for Nova Scotia Agriculture. • Avoid applying fertilizers or manure on frozen or snow-covered ground, excessively wet soils, exposed bedrock, or excessively sloped land. • Maintain adequate separation distances and buffer zones between agricultural land and water bodies and streams.
NSPI Infrastructure	• Avoid using treated wooden poles if possible. • Replace outdated PCB-containing transformers with environmentally preferred alternatives. • Avoid disturbing any wetland or tributary stream during installation of any utility pole or other infrastructure.
Herbicides and Pesticides	• Make use of vegetated buffers to reduce herbicides/pesticides runoff. • Avoid herbicide/pesticide drift by applying during low/no wind conditions, keeping booms low and using nozzles that produce large droplet sizes. For agriculture practices, use hooded and recirculating spray booms to reduce drift. • Make use of natural, biological, or organic forms of pest and weed control where applicable. • Rotate crops to reduce pest cycle.
Fires (forest, structure)	• Follow NS Forest Fire Protection Regulations in Section 40 of the Forests Act. • Reduce the risk of forest fires by planning burning activity to take into account weather, time of year, and fuel conditions. • Follow the provincial Department of Natural Resources Wildfire Risk Burning Season Restriction Program (March 15 to October 15 for all outdoor fire activities. • Avoid smoking in and around dry brush during fire season. • Power saws operated during fire season are to be equipped with both an exhaust muffler and a spark arresting device in functional condition. • Following a fire, provide temporary or permanent cover on the site as soon as possible to control erosion. • All Class I or Class II equipment requires a fire extinguisher and a round- point shovel. Class II machines also require a back tank pump unit.

4.3 Municipal By-Laws

By-laws provide the Municipality with another barrier for protecting source water, by regulating or prohibiting land uses within the watershed or near surface water bodies or municipal wellheads. Due to the absent of water supply protection themed planning documents, a substantive initiative of this Source Water Protection Plan is the implementation of a specific municipal planning strategy and land use by-law designed to encompass the Margaretsville Source Water Protection Area (as shown in Figure 4) and protect the Margaretsville water supply. Such a by-law could then restrict land uses and their associated activities relating to the risk of contamination introduced to the water supply through surface runoff, as well as tiers of restrictions regarding land uses which could introduce contamination to groundwater. These tiers of restrictions are based on the time of groundwater travel to the water supply reservoir and wells. For example, the consequences of contamination introduced to the subsurface within the 0-2 year time of travel (Zone 1) within the Source Water Protection Area, would be most serious, and activities relating to all of the potential contaminants should be regulated in this zone. Within the 2-5 year time of travel (Zone 2), most contaminants would still be a concern, but pathogens would not be expected to survive in the subsurface long enough to reach the water supply. Within the 5-25 year time of travel (Zone 3), persistent contamination, such as PCBs and herbicides and pesticides, would be of most concern, but degradable chemicals, such as certain petroleum compounds, might warrant less regulation.

4.4 Contingency Planning

Contingency planning is necessary where the risk of unintentional contamination exists, and this risk cannot be removed entirely from the Source Water Protection Area through the use of other management options. For example, in the event of a spill of a hazardous substance within the watershed, the Municipality must be prepared to react quickly to assure the efficient removal of the hazardous substance from the area, before it can cause serious harm. A well-developed contingency plan is especially crucial in the case of the Margaretsville Source Water Protection Area for a number of reasons. No alternate source water supply is readily available if the surface water supply were to become unsafe for consumption. The source water area is geographically small, meaning that a moderate sized event could easily affect the protection area in its entirety. The water system is currently drawing from crock wells installed near the ground surface at spring locations, and therefore any surface contamination would quickly infiltrate the system. Therefore, contingency planning was ranked as the most effective management option for commercial fuel spills and fires, the second most effective option for road salt contamination and NSPI infrastructure, the third ranked option for heating oil tanks, chemical storage, and fires, and the fifth (least effective) option for herbicides / pesticides.

4.5 Designation

The Designation of a source water supply area as a Protected Water Area under the *Nova Scotia Environment Act, Section 106*, enables a Water Utility to define allowable activities within the watershed, unlike a municipal land use by-law which generally focuses on the use made of land, buildings and structures. Designation can also help when reviewing by-laws for areas with increased sensitivity. The existing designation for the Margaretsville Protected Water Area only includes the county-owned property on which the reservoir, treatment facility, and wells are located, and does not extend to include the watershed catchment area or the groundwater TOT zones. A substantive initiative of this Source Water Protection Plan is the requesting of a repeal of the existing Margaretsville Protected Water Area Designation and the requesting of a new Provincial Water Area Designation that coincides with the Margaretsville Source Water Protection Area outlined in Figure 4, the technical bases for which is set out in Section 5.3. Designation was ranked as the fourth and fifth effective management option for the risks of contamination from herbicides/pesticides and fertilizers/manure, respectively.

4.6 Education and Stewardship

Residents, land owners, and those working or engaging in recreational activities in the Source Water Protection Area must made aware of their responsibility to manage potential contaminants and protect the water for users. Education is especially crucial in the case of Margaretsville, where the practices of a small number of persons have the potential to affect the water supply for a much larger group of end users. A successful education and stewardship program will create a sense of ownership by those who are in the best position to implement good practices and reduce risks. The program will allow the Municipality to send a clear message about the importance of protecting source waters, the necessary actions to achieve this goal, and help residents, land owners, and county personnel assume responsibility for taking those actions. Education efforts should include information about the regulations applicable to the various zones within the Protected Water Area, and information about best management practices which should be utilized to reduce risks of introducing contamination to the water supply. Education and stewardship was ranked as the most effective management option for many of the potential contaminants, including heating oil tanks, septic systems, chemical storage, fertilizers/manure, and herbicides/pesticides. Education and stewardship was also ranked as an effective management option for the prevention of fires and the need for the development of sedimentation and erosion controls (after BMPs).

5.0 Implementation Plan

In order to bring about the desired level of source water protection, several initiatives were reviewed; each of which addresses one or more of the prioritised risks previously described in the previous section. These initiatives, including the individual actions they entail, estimated costs, and suggested implementation dates, are listed in Table 5.1. It should be noted though that the most significant cost is associated with the need for further hydrological / hydrogeological investigation. As further elaborated upon in Appendix A, for the purposes of this Plan, the limits of the zone of contribution and the TOT zones (see Figure 4) are based upon estimated parameter values that are considered conservative and reasonable. It is also reasonable to say that it does not appear likely that the estimated parameter values are so far from correct that using these recommended TOT zones would not be effective. Nor does it appear likely that using them would incur significantly greater risk, relative to delineations that might be derived from more elaborate testing. In defense of further study, certain advantages would derive from knowing more about the aquifer. This knowledge would improve the level of confidence in the interpretation of the data obtained from the monitoring plan and with permit rationalization of any future modifications of the Source Water Protection Plan or its area delineation. It would also provide a basis for optimizing the operation of the wells for enhanced protection and yield. Finally, it would better inform the selection of locations for additional wells to improve the firm capacity of the system and lessen the dependence upon the more vulnerable crock wells. While further study of the area is listed as an initiative in the Plan, it is a costly endeavour, especially considering the cost/benefit ratio of further study relatively to the small customer base the treated water is sold to. While there is some reservation to outright implementing this further study initiative, the concept is not discounted outright but rather this plan discusses the need for additional field work and as such is elaborated on in Section 5.2. A more detailed explanation of each recommended initiative and the action entailed follows after the table.

Table 5.1 Initiatives

INITIATIVE (The initiatives are not presented in order of priority.)	TIMELINE	ESTIMATED COST	RESPONSIBLE PARTY
1. Contingency / Emergency Response Planning			**$6,000**
(1) Review & update incident-response procedures for spills/releases/fires.	Year 2	$1,000	ACWU/Cons.
(2) Identify fuel providers; advise them of the SWPA; pertinent BMPs to reduce likelihood/ impact of spills, and penalties for non-compliance.	Year 1/ bi-annual	See Initiative 6.	ACWU/Cons.
(3) Identify likely fire responders and advise them of the presence of the SWPP, agree upon fire-fighting protocols.	Year 2	$500	ACWU/Cons.
(4) Review security needs for the pond and well area.	Year 1	$2,500, TBC	ACWU/Cons.
(5) Review & update current contingency plans if water quality reduced.	Year 2	$500	ACWU/Cons.
(6) Establish action threshold for chloride in water supply to trigger use of alternative de-icers.	Year 2	$1,500	ACWU/Cons.
(7) Include spill-reporting procedures in education materials.	Year 2	See # 6.	Committee/Cons.
2. Hydrologic/Hydrogeologic Study of Source Water Area (Conditional)			**$127,700**
(1) Establish monitoring network for reservoir and dug wells to measure inflow and outflow.	Year 1	$9,500	Committee/Cons.
(2) Consider the option of developing a hydrological model to predict impacts of drought or increased demand.	Years 2-4	$10,200	Committee/Cons.
(3) Install observation/monitoring wells and complete aquifer testing dependent on findings of Item 2.	Year 5+	$78,000	Committee/Cons.
(4) Numerically model surface and groundwater and derive a more accurate protection area dependent on findings of Item 2.	Year 5+	$30,000	Committee/Cons.
3. Provincial Re-Designation of the Margaretsville Protected Water Area			**$15,800**
(1) Apply to repeal existing PWA Designation & initiate new PWAD process.	Year 1	$1,000	Committee/Cons.
(2) Define boundaries of PWA for submission in acceptable format.	Year 2	$5,000	Committee/Cons.
(3) Develop designation regulations & consult with stakeholders and public	Year 2	$5,000	Committee/Cons.
(4) Submit re-designation application to NSE and undertake the required public process.	Year 3	$4,000	Committee/Cons.
(5) Notify public & register designation.	Year 4	$300	Committee/Cons.
(6) Post signs at the new boundaries of protected water area.	Year 4	$500	Council
4. Establish Municipal By-laws for Protection of Margaretsville Water Supply			**$8,600**
(1) Council authorize development of new Margaretsville source water protection planning documents. Begin public consultation. Propose restrictions based on risk level and proximity to water supply.	Year 1	$5,000	Committee/Cons.
(2) Submit draft to PAC and hold Public Meetings in area. Municipal Council hold Statutory Public Hearing & advertise same	Year 2	$2,000	Committee/Cons.
(3) Submit proposed planning documents to Province for review.	Year 2	$600	Committee/Cons.
(4) Advertise adoption of planning documents. Establish continual administration of land use by-law process (issuance of permits)	Year 3	$1000	Council/Cons.
(5) Distribute new by-laws and zoning maps online and in educational	Year 4/when	See Initiative	Council/Cons.

materials for residents, property owners and other stakeholder.	available	6	
5. Municipal Utility Permitting and BMPs for Transportation & Power Infrastructure			**$31,700 +**
(1) Determine permitting status of production wells / apply for permits to divert water from the crock wells.	Year 1	$17,000	ACWU/Cons.
(2) Install gates at entrances to prevent unauthorized vehicular access. Secure Southwest well cover. Grout seal PV2 and Monitoring well.	Year 2	$5000	ACWU
(3) Complete periodic inspections of property to identify risks promptly.	Ongoing	ACWU staff	ACWU
(4) Request NSPI inspection of transformers/poles/lines and pesticide/herbicide practices in protected area.	Year 1	$600	NSPI/Committee/ Cons.
(5) Establish relationship with NSPI to collaboratively manage risks from NSPI infrastructure.	Year 2	$500/ year	NSPI/Committee/ Cons.
(6) Evaluate existing wells as backup supply, including possible modifications to increase yield / decommissioning.	Year 2	$7,500	ACWU/Cons.
(7) Request that province establish special road salt management practices on Ben Phinney Road.	Year 2	$600/year	Council/Cons.
(8) Establish reduced speed zones on Ben Phinney Road near water supply.	Year 2	$500	Province/ Council/Cons.
6. Education and Stewardship			**$9,500**
(1) Identify available grants/other resources for implementing BMPs, such as for tank upgrades, etc.	Year 1	$1,000	Committee/Cons.
(2) Develop educational materials including water protection responsibilities, regulations, and BMPs.	Year 1/ongoing	$5,000	Committee/Cons.
(3) Distribute educational materials to all residents, property owners, and users.	Year 2	$500	Committee/Cons.
(4) Educate fuel providers about applicable restrictions / BMPs for water protection area.	Year 1/ongoing	$2,000	Committee/Cons.
(5) Determine best media channels for distributing Source Water Protection educational materials.	Year 2	$1,000	Committee/Cons.
7. Acquisition of Land			**$1,500 +**
(1) Identify/rank vulnerability of properties near the water supply to potential contamination.	Year 1	$500	Committee/Cons.
(2) Inform property owners of responsibilities in managing risks and consequences of mismanagement.	Year 1/ongoing	$500	Committee/Cons.
(3) Determine financial resources available for acquisition of land.	Year 1/ongoing	$500	Committee/Cons.
(4) If lands become available, are poorly managed, and/or funds are available, proceed to acquire land.	Ongoing	Varies with property	Committee/Cons.

ACWU = Annapolis County Water Utility, Cons. = Consultant

Table 5.1.1 Initiatives Sorted By Year

INITIATIVE	TIMELINE	ESTIMATED COST	RESPONSIBLE PARTY
(1) Complete periodic inspections of property to identify risks promptly.	Ongoing	ACWU staff	ACWU
(2) If lands become available, are poorly managed, and/or funds are available, proceed to acquire land.	Ongoing	Varies with property	Committee/Cons.
(3) Review security needs for the pond and well area.	Year 1	$2,500, TBC	ACWU/Cons.
(4) Establish monitoring network for reservoir and dug wells to measure inflow and outflow.	Year 1	$9,500	Committee/Cons.
(5) Apply to repeal existing PWA Designation & initiate new PWAD process.	Year 1	$1,000	Committee/Cons.
(6) Council authorize development of new Margaretsville source water protection planning documents. Begin public consultation. Propose restrictions based on risk level and proximity to water supply.	Year 1	$5,000	Committee/Cons.
(7) Determine permitting status of production wells / apply for permits to divert water from the crock wells.	Year 1	$17,000	ACWU/Cons.
(8) Request NSPI inspection of transformers/poles/lines and pesticide/herbicide practices in protected area.	Year 1	$600	NSPI/Committee/ Cons.
(9) Identify available grants/other resources for implementing BMPs, such as for tank upgrades, etc.	Year 1	$1,000	Committee/Cons.
(10) Identify/rank vulnerability of properties near the water supply to potential contamination.	Year 1	$500	Committee/Cons.
(11) Develop educational materials including water protection responsibilities, regulations, and BMPs.	Year 1/ongoing	$5,000	Committee/Cons.
(12) Educate fuel providers about applicable restrictions / BMPs for water protection area.	Year 1/ongoing	$2,000	Committee/Cons.
(13) Inform property owners of responsibilities in managing risks and consequences of mismanagement.	Year 1/ongoing	$500	Committee/Cons.
(14) Determine financial resources available for acquisition of land.	Year 1/ongoing	$500	Committee/Cons.
(15) Identify fuel providers; advise them of the SWPA; pertinent BMPs to reduce likelihood/ impact of spills, and penalties for non-compliance.	Year 1/ bi-annual	See Initiative 6.	ACWU/Cons.
Total Year 1		**$45,100 +**	
(1) Review & update incident-response procedures for spills/releases/fires.	Year 2	$1,000	ACWU/Cons.
(2) Identify likely fire responders and advise them of the presence of the SWPP, agree upon fire-fighting protocols.	Year 2	$500	ACWU/Cons.
(3) Review & update current contingency plans if water quality reduced.	Year 2	$500	ACWU/Cons.
(4) Establish action threshold for chloride in water supply to trigger use of alternative de-icers.	Year 2	$1,500	ACWU/Cons.
(5) Include spill-reporting procedures in education materials.	Year 2	See # 6.	Committee/Cons.

(6) Define boundaries of PWA for submission in acceptable format.	Year 2	$5,000	Committee/Cons.
(7) Develop designation regulations & consult with stakeholders and public	Year 2	$5,000	Committee/Cons.
(8) Submit draft to PAC and hold Public Meetings in area. Municipal Council hold Statutory Public Hearing & advertise same	Year 2	$2,000	Committee/Cons.
(9) Submit proposed planning documents to Province for review.	Year 2	$600	Committee/Cons.
(10) Establish relationship with NSPI to collaboratively manage risks from NSPI infrastructure.	Year 2	$500/ year	NSPI/Committee/ Cons.
(11) Evaluate existing wells as backup supply, including possible modifications to increase yield / decommissioning.	Year 2	$7,500	ACWU/Cons.
(12) Request that province establish special road salt management practices on Ben Phinney Road.	Year 2	$600/year	Council/Cons.
(13) Establish reduced speed zones on Ben Phinney Road near water supply.	Year 2	$500	Province/ Council/Cons.
(14) Distribute educational materials to all residents, property owners, and users.	Year 2	$500	Committee/Cons.
(15) Determine best media channels for distributing Source Water Protection educational materials.	Year 2	$1,000	Committee/Cons.
(16) Install gates at entrances to prevent unauthorized vehicular access. Secure Southwest well cover. Grout seal PV2 and Monitoring well.	Year 2	$5,000	ACWU
(17) Consider the option of developing a hydrological model to predict impacts of drought or increased demand.	Years 2-4	$10,200	Committee/Cons.
Total Year 2		**$41,900**	
(1) Submit re-designation application to NSE and undertake the required public process.	Year 3	$4,000	Committee/Cons.
(2) Advertise adoption of planning documents. Establish continual administration of land use by-law process (issuance of permits)	Year 3	$1,000	Council/Cons.
Total Year 3		**$5,000**	
(1) Notify public & register designation.	Year 4	$300	Committee/Cons.
(2) Post signs at the new boundaries of protected water area.	Year 4	$500	Council
(3) Distribute new by-laws and zoning maps online and in educational materials for residents, property owners and other stakeholder.	Year 4/when available	See Initiative 6	Council/Cons.
Total Year 4		**$800**	
(1) Install observation/monitoring wells and complete aquifer testing dependent on findings of Item 2.	Year 5+	$78,000	Committee/Cons.
(2) Numerically model surface and groundwater and derive a more accurate protection area dependent on findings of Item 2.	Year 5+	$30,000	Committee/Cons.
Total Year 5		**$108,000**	

5.1 Contingency / Emergency Response Planning

This initiative is employed to mitigate risks associated with incidents, which cannot be prevented or were not successfully prevented through other initiatives and is comprised of the following actions:

(1) Review current municipal incident-response procedures, and, making use of the BMPs in Table 4.2 and other sources, draft additional procedures for source water protection during and following commercial fuel spills, chemical storage or heating oil leaks, forest or structural fires, or releases of herbicides/pesticides or NSPI chemicals. Consultant reviews plans and provides recommendations to utility. Anticipated cost is $1,000.

(2) Contact commercial oil providers operating within the Source Water Protection Area. Determine if vehicles are equipped with spill kits and if training is completed in spill prevention and mitigation. Provide the Municipality's spill response plan and contact information. Costs are included as part of Initiative 6 - Education & Stewardship.

(3) Contact municipalities/provinces likely to respond to a forest or structural fire. Inform them of the boundaries of the Source Water Protection Area, and that certain fire suppressant chemicals would compromise the potable water source for Margaretsville, and therefore alternative methods are preferred. Anticipated cost is $500.

(4) Review security needs for the pond and well area. Anticipated cost is $1,000 for security consultant.

(5) Review current municipal contingency planning, making certain that adequate provisions are in place for ensuring the supply of potable water in the case of a temporary reduction of raw water quality. Consultant will teleconference with Annapolis County Water Utility. Anticipated cost is $500.

(6) Statistically analyze raw-water chloride concentration trends to establish a baseline for normal seasonal variation, and set a conservatively low action threshold. Prepare to implement non-chloride alternative de-icers in the protection area if chloride levels exceed this threshold. Reviews historical meteorological data and analytical results and makes recommendations. Anticipated cost is $1,500.

(7) Include instructions for immediately reporting overfills, spills, apparent loss of product, or observation of sheen or floating product on standing water, in education/stewardship materials related to heating oil tanks and the use of herbicides/pesticides. Costs are included as part of Initiative 6 (Education & Stewardship).

5.2 Hydrologic/Hydrogeologic Study of the Source Water Area

This initiative is to methodically determine the extent of the contributing source water area for the Margaretsville water supply, and to better approximate the appropriate zones of exclusion for certain activities based on travel times to the water supply diversion points.

(1) Consultant establishes individual flow meters, weirs, and measured stream sections to obtain information on the inflows and outflows of the reservoir and dug wells. Obtain flow measurement over a variety of weather conditions. Use the measurements to develop a rating chart so that pressure-transducer dataloggers can be used to monitor changes in hydrology in response to precipitation events and seasonal variations in evapotranspiration and demand. Costs include obtaining data logging equipment ($3,200), setting up the equipment in the field ($1,000), and setting up the database ($1,000), travel for non-local consultant staff ($1,500), training of local consultant staff ($1,200), and completion of quarterly data retrieval and equipment maintenance ($1,600). Total cost of $9,500.

(2) Consultant collects sufficient data to establish a hydrologic database that contains the system's responses to changes in demand during years of normal precipitation and drought. When sufficient data is available, develop a conceptual hydrological model that can be used to make predictions about the behaviour of the system in response to droughts of specific periods and changes in demand. Field work expense is approximately $1600 per year for 3 years. Hydrologic analysis estimated cost $6,000 for consultant. Total cost of $10,200.

(3) Consultant review of hydrogeologic work and water resources evaluation that have been performed at the site and region. Prepare a plan for a series of aquifer parameter tests, including down-hole acoustic logs, packer testing, and pumping tests. Hire a drilling contractor and install observation wells at specified locations. These wells should be cased for production in accordance with NSE requirement, in case they are found to intersect productive fractures. Review of available information will cost approximately $4,000. Preparation of a Request for Proposals will cost approximately $5,000. Hiring the contractor for the installation of wells (including casing) and to conduct testing is anticipated to cost $60,000. Consultant oversight and documentation of the well installation and testing is $9,000. Total cost of $78,000.

(4) Consultant reviews collected and compiled data to develop a numerical model of the aquifer and surface water hydrology of the source water protection area. The model will then be used to up-date the delineation of the source water protection and limits of the TOT zones and related management practices. Anticipated cost is $30,000.

5.3 Provincial Designation of the Water Protection Area

This initiative is to implement further protection / management options for the Margaretsville water supply area that the Municipal Planning Strategy and Land Use By-law (see Imitative 5.4) cannot regulate. This includes an application for repeal of the existing designation. Municipal Council is to make the formal repeal and designation applications.

(1) Notify stakeholders, including land owners, commercial fuel suppliers, logging companies, NSE, NSPI, NSTIR, environmental organizations, and other persons doing business in the Margaretsville Source Water Protection Area that a modification of the current Protected Water Area is being proposed. Anticipated cost is $1,000.

(2) Request the Source Water Protection Area shown in Figure 4 as the designation area for the Margaretsville Protected Water Area. Anticipated cost is $5,000 for land survey.

(3) Draft proposed regulations for the Margaretsville Protected Water Area based on the BMPs presented in Table 4.2, the persistence of various types of contamination in the subsurface and the specific risks identified in the SWPP. Include restrictions to reduce the risk of contamination from surface runoff, as well as tiers of restrictions within the zones corresponding to 0-2, 2-5, and 5-25 year times of groundwater travel to the water supply. Extend the right of the province or municipality to obtain the most critical land, if necessary. Where possible, risks should be addressed in by-law restrictions applying to land use, before being proposed as regulations in association with the provincial designation. Once this re-designation is formal, it will be the duty of the Water Utility to enforce it. Anticipated cost of $5,000 for consultant to complete a draft, consider committee input, and make revisions.

(4) Send the revised delineation, proposed regulations, and summary of the public consultation to NSE for review and comment. Cooperate with NSE requests related to advancing the proposed changes toward designation. Anticipated cost is of $4000 for the consultant to complete these tasks.

(5) After the designation formally takes effect, have it recorded in the Registry of Deeds and published in local newspapers. The anticipated cost is $300 for the newspaper/record fees and consultant's time for the submittal.

(6) Post signs to clearly identify the boundary of the Protected Water Area and indicate that regulations are in effect for the designated drinking water supply. Anticipated cost of $1900 for signs, with installation coordinated by council/MCA.

5.4 Establish By-Laws for the Protection of theWater Supply

This initiative is proposed to restrict activities which could cause erosion, spills or leaks from heating oil tanks, and contamination from the use of fertilizers/manure. The committee recommends the following actions:

(1) Determine appropriate restrictions for activities within the Margaretsville Source Water Protection Area, based on the BMPs presented in Table 4.2. Include restrictions for the use of persistent chemicals within the SWPA, degradable chemicals within the 2-5 year TOT zone, and pathogens within the 0-2 year TOT zone shown in Figure 4. Also, include restrictions to reduce the risk of sediment and contaminants from surface runoff, including agricultural and construction activities.Create draft zoning maps based on the current TOT zones provided in Figure 4. Anticipated cost is $2,000 for consultant to assist.

(2) Formalize restrictions as proposed new By-laws for the protection of the Margaretsville Water Supply. Risks which cannot be addressed in municipal by-law restrictions should be addressed in regulations in association with the proposed provincial re-designation of the Margaretsville Protected Water Area. Anticipated cost is $3,000 for consultant.

(3) Submit draft to the Municipal Council, and complete the formal process required to establish the By-laws for the protection of the Margaretsville Water Supply. Revise and complete amendments as needed and obtain approval for the By-laws. Anticipated cost is $3,000 for consultant to complete these tasks.

(4) Post new by-laws for the protection of the Margaretsville Water Supply,and zoning maps online, and include in educational materials for residents / landowners.Costs are included as part of Initiative 6 – Education & Stewardship.

(5) In the future, update TOT zoning maps based on the numerical model for the Source Water Protection Area and republish. Anticipated consultant cost is $600.

5.5 Municipal Utility Permitting and BMPs for Transportation / Power Infrastructure

This initiative is to obtain collaborative efforts by the utility, province, and power utility to implement BMPs to protect the water system. These include the following actions:

(1) Determine status of water withdrawal permit of the East and Southwest Well production wells (complete permitting process if needed). Estimated cost to install two shallow observation wells and prepare the crock wells for testing is $7,000. Consultant oversight and preparation of application cost is anticipated at $10,000. The total cost $17,000.

(2) Implement BMPs relating to security on the Margaretsville water supply property. Restrict access to the production wells, well site control zones, chlorination building, any chemicals stored on-site, water storage tank, and any other vulnerable water supply components by installing locks or fences. To be completed by Annapolis County.

(3) Conduct periodic inspections of Margaretsville water supply property in order to promptly identify risks to the water supply. Inspect settling pond and ditch on either side of culvert, and remove sediment as needed to ensure runoff is diverted around the wells and pond. To be completed by Annapolis County.

(4) Formally request an inspection of the NSPI infrastructure located within the Source Water Protection Area, to determine if any pole-top transformers containing PCBs are present, if lines present are distribution or transmission. Incorporate the obtained information for managing the risk of NSPI infrastructure contamination into the contingency plan initiative. Anticipated cost is $600 for consultant to complete with committee.

(5) Establish a relationship with NSPI and request information regarding existing general management practices. Request the implementation of specific BMPs for infrastructure within the protection area and special considerations within TOT zones. The use of electrical transformers that contain PCBs is strongly discouraged. Seek input and collaboration for contingency plan for managing the risk of NSPI infrastructure contamination. Maintain ongoing relationship for risk management of inventory in the Source Water Protection Area. Anticipated annual consultant cost is $500

(6) Assess the future usefulness of drilled wells on the Margaretsville water supply property. Water utility will provide any available records/information. Hiring of contractor to access wells, prepare wells and perform step-drawdown testing is anticipated to cost $3,000. Consultant testing oversight and the evaluation to determine if well modifications can be made to improve yield or should be sealed to protect the aquifer from surface infiltration is anticipated to cost $4,500. Total cost to complete $7,500.

(7) Request that the province implement BMPs according to Table 4.2 as the standard procedure in regards to salt application rates, storage, record-keeping, spreading and pre-wetting on roads within the protection area. Ensure alternate material is available for de-icing, if baseline chloride levels in the raw water supply exceed the action level, as per the contingency plan. Maintain ongoing relationship with appropriate provincial representative in order to collaboratively manage risks. The anticipated cost is $600 per year for consultant to complete (in conjunction with Municipal Council).

(8) Request that the province establish reduced speed zones within the 0- to 2-year and 2- to 5-year TOT zones. The anticipated consultant cost is $500 to prepare Council request

5.6 Education and Stewardship

This initiative is to develop and distribute educational programs for the residents, land owners, and operators in the Source Water Protection Area regarding the importance and their role in protecting source waters, the BMPs and regulations so adopted. These include:

(1) Identify any grants or government resources that may be available for teaching or encouraging BMPs, such as grants for upgrading residential heating oil tanks or installing corrosion protection systems. Anticipated consultant cost is $1,000.

(2) Compile/develop educational materials for raising awareness and teaching (a) BMPs for reducing the risks of contamination and conserving water (b) describing and relating enforcement timelines for any new regulations and by-laws changes; and (c) encouraging the stewardship role of residents, land owners, and others that make use of the resources within the Source Water Protection Area. Anticipated consultant cost is $5,000.

(3) Present, teach, post, broadcast, mail, and otherwise deliver educational materials to all property owners, residents, and other entities that do business within the Source Water Protection Area. Anticipated initial cost is of $500 for consultant to complete.

(4) Identify and contact commercial fuel vendors who service residents of the Source Water Protection Area. Inform them of the location of the water supply protected area, and of the regulations and by-laws intended to reduce the possibility of commercial fuel spills. Recommend pertinent BMPs from Table 4.2. Repeat this outreach regularly. Anticipated initial cost is $2,000 for consultant to complete in conjunction with committee.

(5) Determine the types of media that would be most effective for disseminating information about each potential contamination source to each target audience. These might include seminars, broadcasted messages, social media, signs, telemarketing, flyers, dramatizations, presenting educational films, materials sent via mail, etc. The anticipated cost is $1,000 for consultant to complete in conjunction with committee.

5.7 Acquisition of Land

This initiative is to acquire the most critical lands within the Margaretsville Source Water Protection Area, if other management options are insufficient. These include:

(1) Identify the most vulnerable source water properties within the 0- to 2-year TOT zone. Rank the identified land by level of vulnerability. The anticipated cost for a consultant to complete this task in conjunction with the committee is $500.

(2) Establish relationships with the owners of the most vulnerable land in the protection area. Review the distributed education materials and new Protected Water Area designation regulations with them, and strongly encourage them to reduce or eliminate the use of herbicides / pesticides and fertilizers / manure on their properties. If appropriate, offer financial incentives to compensate for any resultant crop losses. Review the possible acquisition of the land by the Municipality. Anticipated initial cost is $500 for consultant to complete in conjunction with committee.

(3) Determine financial resources available for the acquisition of land, including yearly allotted amounts or one-time allotments. If possible, modify existing budgets to include allotments for land purchases. Anticipated initial cost is $500 for consultant to complete in conjunction with committee.

(4) Maintain relationships with the owners of the identified vulnerable land. If other management options are insufficient, financial resources become available, or the land is posted for sale / has changes in ownership, begin the process of acquiring these lands. Costs will be based on price of property.

6.0 Monitoring & Evaluating Program

6.1 Purpose

A key evaluation component is to monitor for water quality contaminants entering the source water supply. A formalized review process is also established, the purpose of which is to evaluate the performance of the plan and ensure that it is updated regularly. Once the monitoring program proposed herein is approved by NSE, compliance with it will become part of the operating approval and annual operating report required under the approval.

6.2 Monitoring Parameters and Locations

Raw or untreated water samples, taken as part of the utility's regular testing program, may be considered a composite of the water being produced by the source water protection area. Sources of contamination at one point in the area can affect the concentrations of contaminant down-gradient of that point, but unless the source is very close to the well or spring, the concentration is likely to be reduced by adsorption, degradation, or dispersion due to variability in the direction of groundwater flow, before reaching the water supply. Sampling parameters, listed in Table 6.1, were selected based on the identified potential contaminants, and include both direct and indirect indicators of contamination. The utility's existing raw water sampling program includes some of these parameters, including those required by the Guidelines for Monitoring Public Drinking Water Supplies (GMPDWS).

Table 6.1. Source Water Monitoring Program Sampling Parameters and Locations

PARAMETER	LOCATION		
	PW-2 and Southwest / East Crock Wells	Water Supply Reservoir†	Raw water before treatment
Turbidity	Quarterly	Quarterly	Daily*
Conductivity	Quarterly	Quarterly	Annual**
pH	Quarterly	Quarterly	Daily*
Total Coliform and *E. coli*	Annual	Annual	Annual
Pathogens/Viruses	Annual	Annual	Annual
Nitrate	Annual	Annual	Annual**
Ortho-Phosphate	Annual	Annual	Annual
Sodium	Annual	Annual	Annual
Chloride	Annual	Annual	Annual
Total Dissolved Solids	Annual	Annual	Annual**
Pesticides/Herbicides	Annual	Annual	Annual
Polychlorinated Biphenyls (PCBs)	Annual	Annual	Annual
Lead	Annual	Annual	Annual**
Volatile Organic Compounds (VOCs)	Annual	Annual	Annual
Total Petroleum Hydrocarbons	Annual	Annual	Annual
Total Organic Carbon	Annual	Annual	Annual**

*requirement of the utility's approval to operate
**requirement of the Guidelines for Monitoring Public Drinking Water Supplies (GMPDWS)
† the sampling interval shown is for the second and following years. Several sampling events are recommended for the first year, targeting a wide range of hydrological conditions.

6.3 Sampling Procedures

The water sampling will be conducted using established protocols. Sampling is to be conducted by qualified water utility personnel, and sampling equipment should be cleaned, maintained, and calibrated according to the established protocols. For groundwater sampling points (the two crock wells and the drilled wells) the well should be purged to remove stagnant water (typically 3 to 5 well volumes). In the case of surface water, samples should be collected from the same sample location for each sampling event. At the discretion of the Director of the Water Utility, additional samples may be collected periodically to assure quality. Samples are to be processed by a laboratory at detection limits that do not exceed the maximum acceptable concentrations (MAC) or interim maximum acceptable concentration (IMAC) for substances listed in the most recent version of the Guidelines for Canadian Drinking Water Quality. The QA/QC sample results should be evaluated, and if QA/QC objectives have not been met, additional sampling should be performed.

6.4 Monitoring Schedule

It is important to characterize the existing water quality parameters as thoroughly as possible during the initial stages of the monitoring program, before any changes occur in the source water protection area. As related in Section 1.2, water-quality data for the individual wells and reservoir are each represented by a single sampling event. Consequently, no baseline exists for the parameters of concern in the individual wells and reservoir. For the purpose of generating the needed database, in the first three years of the monitoring program, periodic monitoring (quarterly at a minimum) of the various water supply intakes, including the crock wells, drilled well (PW-2), and water supply reservoir will be undertaken. This will allow the creation of a baseline for each contaminant in each water supply intake. The baseline will represent the normal local range of variation for each contaminant of concern. According to the SWPP Guidelines for Developing a Monitoring Program to Evaluate the Effectiveness of a Source Water Protection Plan, surface water sampling should be conducted at various times of the year "during periods of varying hydrological conditions (e.g. periods of low flow, after large rainfall events, during spring melt, etc.)." This may be necessary in order to obtain an adequate baseline for both the water supply reservoir and the wells, which are classified as GUDI wells (Groundwater Under Direct Influence of surface water). Baseline data established over years one and two can be charted to help predict conditions that may "spike" certain water quality parameters. Once the operating conditions are known, the Utility can better manage the water treatment in anticipation of these quality challenges.

In addition to the sampling program, the utility should conduct regular inspections of the Source Water Protection Area, in the form of a walk through or drive-by, to identify any obvious changes in the protection area and early warning signs for potential water quality problems. Changes in the protection area may warrant increased sampling frequency for certain parameters such as an increase in the number of agricultural animals, or other changes in land-use within the source water protection area.

6.5 Contingency Monitoring

During monitoring, if one or more of the identified contaminants are detected at elevated concentrations in the raw water supply, additional sampling should be completed in the source water protection area to identify the contaminant source. A measured increase in the concentration of a given contaminant may or may not have a known cause in the source water protection area. It may have resulted from a known incident, in which case, enough may be known to predict how its concentration in the raw water will vary over time, how long it will take to attenuate or whether it can be contained or remediated, and to plan additional

sampling to confirm these predictions. Alternatively, the source could be an unknown (or unreported) spill or a non-point discharge. If that is the case, a hydrogeologic investigation may be needed in order to determine the size of the discharge, the pathway it is following to the water supply, and how best to mitigate it. If there is an observed increase in the concentration of a monitored contaminant, the source water protection plan will be examined to determine whether it is working as planned, and, if not, how it might be corrected.

In theory, abundant precipitation would tend to dilute the concentrations of contaminants applied to the ground surface. A sustained drought may cause the water table to fall and the hydraulic gradient to decrease. The result would be a temporary change in the direction of groundwater flow, or an increase in the area of the zone of contribution. This would require more frequent sampling during and for some time following a drought, unless it has been offset by water use restrictions during the drought. For these reasons, it is important for the water utility to monitor trends in precipitation. Monitoring can include the installation of a rain gauge at the water treatment plant to keep track of monthly precipitation and can be cross referenced with the information recorded by the Greenwood meteorological station.

6.6 Monitoring Records and Reporting

The water utility will maintain records of ongoing monitoring, analyze results, document trends and changes in water quality, and report findings annually to the Source Water Protection Advisory Committee and Nova Scotia Environment.

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