KELLY LAKE

Source Water Protection Plan

CBRM Water Utility
2013

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF MAPS

LIST OF TABLES

1.0 INTRODUCTION

Nova Scotia's Drinking Water Strategy (Nova Scotia Environment and Labour 2002) outlines a multi-barrier approach to deliver safe, clean drinking water to all Nova Scotians. The barriers are:

- Keeping clean water clean: select the highest quality sources of water and protect these sources to prevent contamination.
- Making the water safe to drink: treat water to remove natural and manmade impurities.
- Proving the water is safe to drink: consistently monitor water quality and take swift, corrective action when deficiencies are identified.

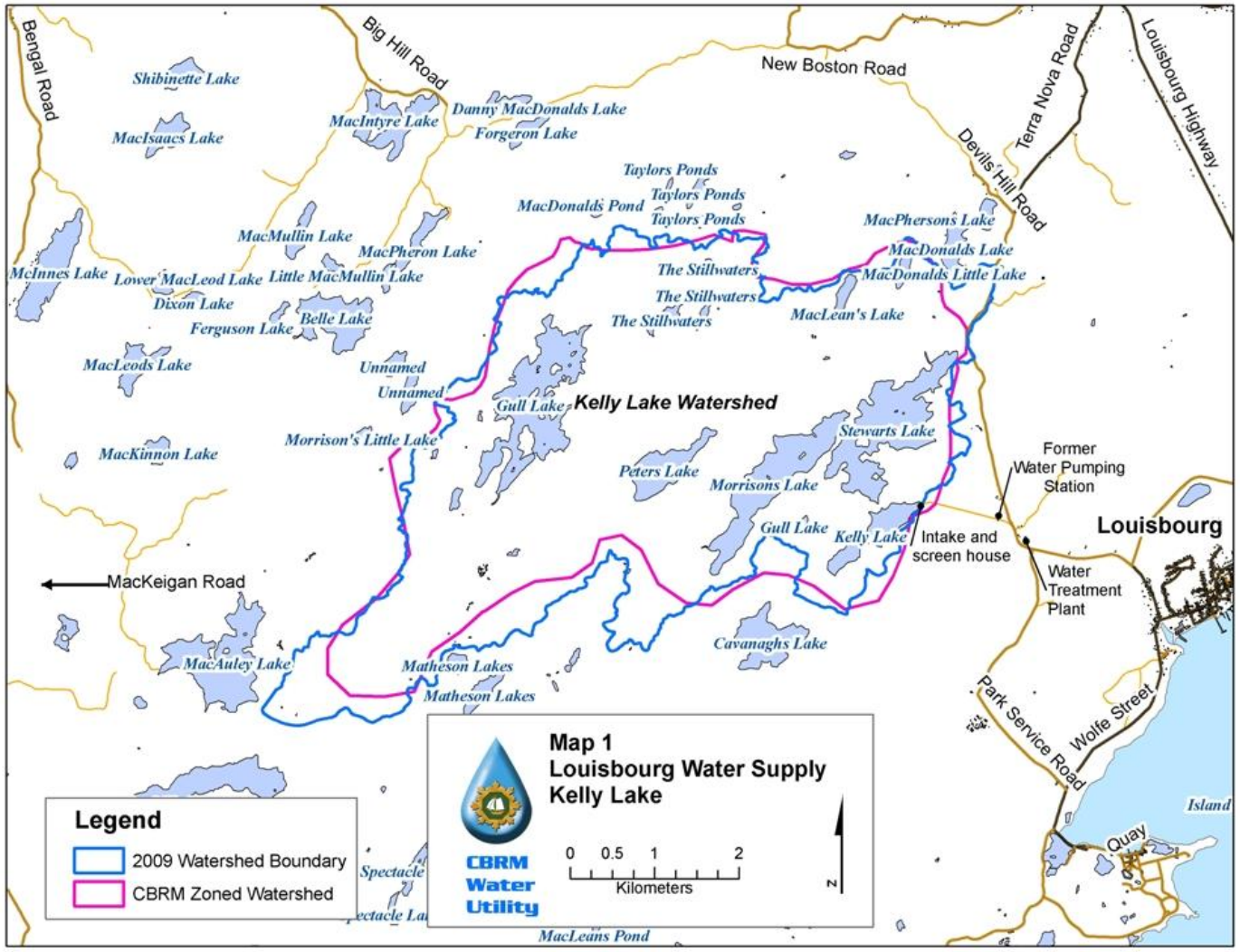
To address the first barrier, keep clean water clean, all municipal units must develop a source water protection (SWP) plan. A SWP plan is a document outlining the drinking water supply area. The plan identifies potential risks to the drinking water quality and quantity, and identifies strategies to reduce those risks.

This SWP plan was completed using a background report prepared by ADI Limited (2006) *Louisbourg Water Supply Source Water Protection Planning for the Kelly Lake Watershed* and the knowledge and expertise of the Source Water Protection Committee (described in more detail in Section 2.2).

1.1 Overview of the Drinking Water Supply Area

Kelly Lake, the drinking water source for the community of Louisbourg, lies northwest of the community (see Figure 1). The Kelly Lake watershed includes Stewarts Lake, Gull Lakes, Morrisons Lake, Peters Lake, MacLeans Lake, MacDonalds Little Lake, and all the lands, ponds, streams, and stillwaters which drain into Kelly Lake (see Map 1).

Figure 1. Kelly Lake intake, access road and Louisbourg. G. Langille photograph 2008.



Map 1. Louisbourg water supply, the Kelly Lake watershed area

The Kelly Lake watershed is in the Atlantic Coastal Hydrological Region, a thick sequence of glacial tills overlying igneous-metamorphic bedrock (Baechler et al., in preparation; ADI Limited, 2006). Water flow is controlled by five Hydrostratigraphic Units (HUs):

- igneous/metamorphic (bedrock) HU, base layer
- clayey silt till HU, overlies bedrock
- sandy till HU, overlies bedrock
- soil HU, surface layer of altered till
- organic HU, in numerous localized depressions, one quarter of watershed area

Surface runoff from rainfall or snow melt mainly interflows within the soil and organic Hydrostratigraphic Units. Some of the runoff penetrates to the next layer, the upper sandy till, but it cannot penetrate the clayey silt till. Three conditions influence the flow of local groundwater:

- high water surplus (excess of precipitation over evaporation and transpiration)
- low permeability of bedrock and till
- mostly flat terrain, few steep hills

These three conditions mean local groundwater flow fields dominate within the till, but may be missing from the low permeability bedrock. In the Kelly Lake watershed area, groundwater flow mimics surface water flow from higher elevations to lower.

According to ADI Limited (2006), no limnological studies have been done on the lakes within the Kelly Lake watershed. Kerekes (1981) investigated lakes within Louisbourg National Historic Park including a cursory look at Kelly Lake, which was noted only as having no islands. Kelly Lake's maximum length is 1.31 km, width is 0.40 km and shore length is 3.22 km. Current mapping indicates Kelly Lake has an area of 28 hectares while Stewarts Lake covers 97 hectares. Ian Spooner (2009) of Acadia University recorded bathymetry for Stewart and Kelly Lakes in June 2009 (see Figures 2 and 3).

1.2 Drinking Water System

The Town of Louisbourg was amalgamated with the City of Sydney, the County of Cape Breton, and five other towns in 1995 to form the Cape Breton Regional Municipality (CBRM). Since amalgamation, CBRM Water Utility has operated the Louisbourg treatment plant.

In 1985 C.A. Campbell Consultants Limited produced the *Louisbourg Water Supply Study* which reported that the first system of piped water for the Town was built in 1900 by the Louisbourg Light & Power Company Ltd. Water was drawn from Gerard Brook on the Terra Nova Road to supply water to the coal company's wharf and ships at the dock. By 1922, the system included 100 domestic customers and, between 1938 and 1952, distribution expanded to supply 150 customers.

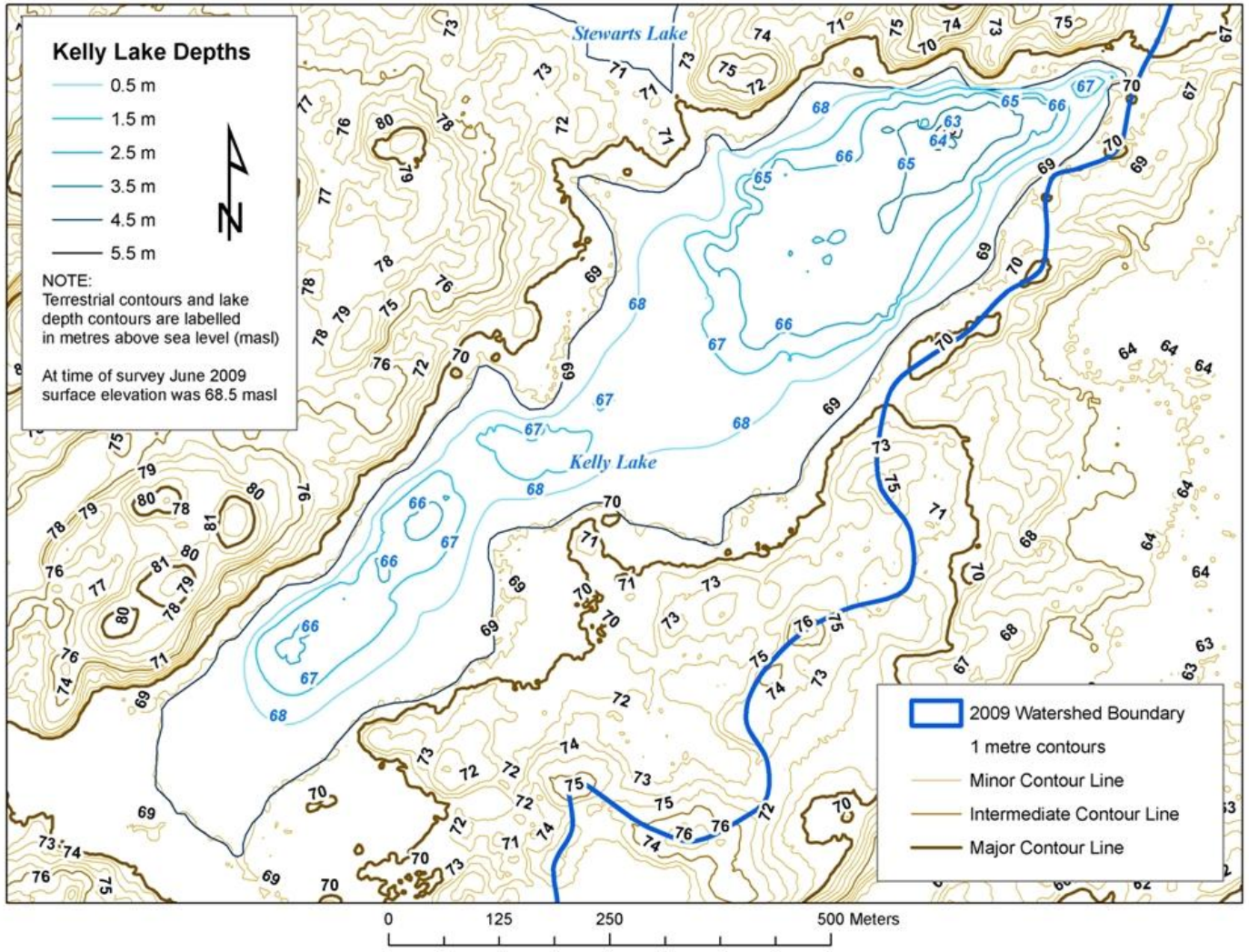


Figure 2. Kelly Lake bathymetry

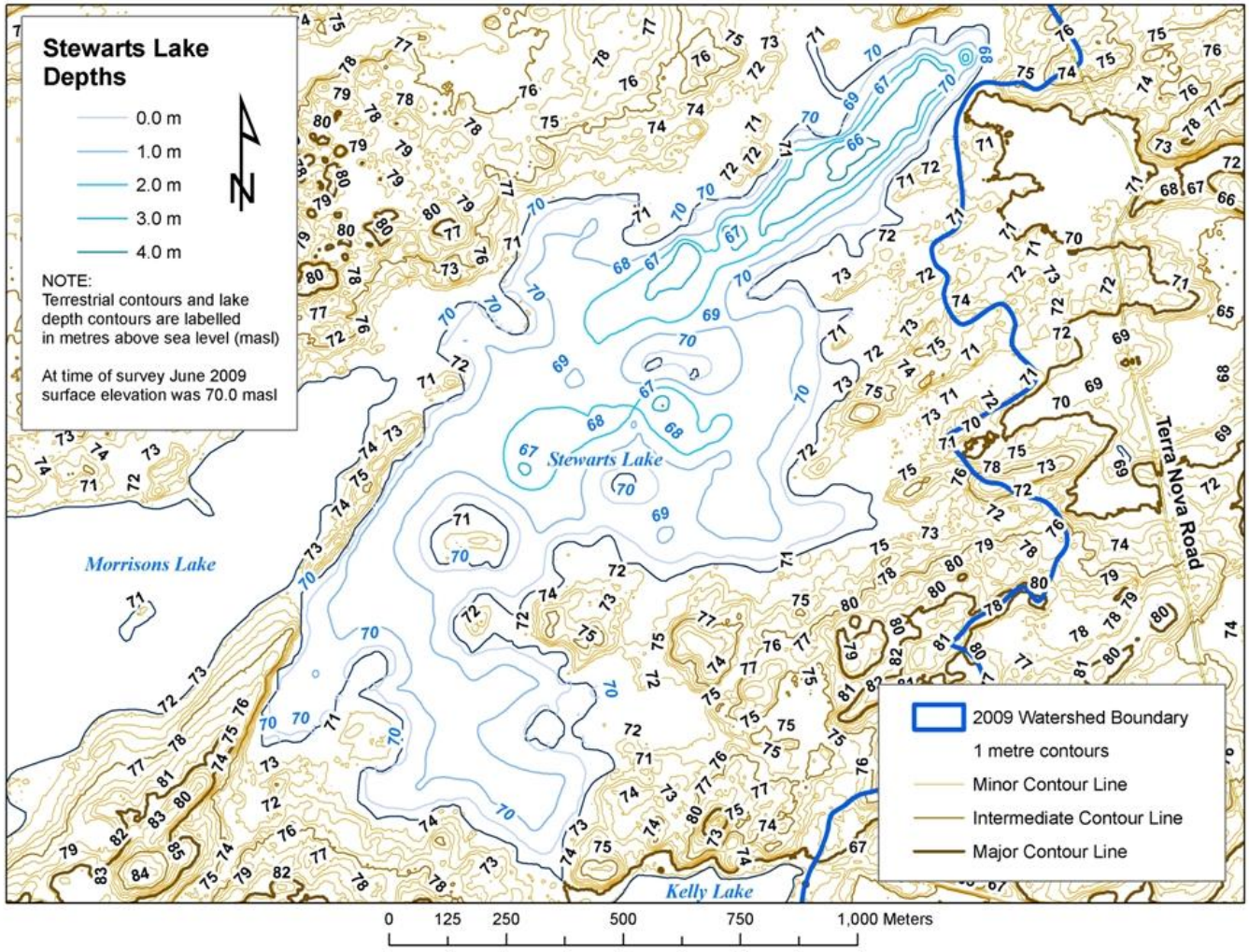


Figure 3. Stewart Lake bathymetry

In the early 1950s, an intake was constructed at Kelly Lake. At 69 metres above sea level, Kelly was the lowest of the five major lakes in the watershed. A chlorination facility was built on the access road to the intake and new water mains were laid. Although Gerard Brook is fed from Kelly Lake, the water source was now acknowledged to encompass the large catchment area of almost 2600 hectares as described in section 1.1 above.

By 1985, the Fortress of Louisbourg had joined the system with a large storage tank on the Park Service Road. With the Fortress and additional water mains in Town, there were 450 users. Currently, in 2013, there are approximately 510 user accounts, four of which are unmetered. The water system is estimated to support 1420 people, not accounting for seasonal increases due to the Fortress and the hospitality industry which supports it.

As shown in Figure 1 and Map 1, the Louisbourg water supply intake is approximately a kilometre from Terra Nova Road and five kilometres northwest of the community. The 600 millimetre diameter intake pipe and screen are about 10 metres offshore in Kelly Lake in 0.9 to 1.5 metres of water, depending on the season. Raw water is transferred through a below grade, concrete, screened, wet well within a recently rebuilt concrete block structure. Raw water from the wet well flows through the former chlorination and pump house (now a backup system) to the Terra Nova Road treatment plant.

Water is withdrawn from Kelly Lake under Nova Scotia Environment (NSE) permit number 2007-055933, which expires on April 1, 2018. According to the original terms and conditions of approval, the average rate of withdrawal should be 1.6 million litres per day (Lpd) with a maximum rate of withdrawal of 2.2 million Lpd. CBRM now pays for a withdrawal of 3.5 million Lpd to cover maximum withdrawal to cover fish plant activity. Average withdrawal for both process and treated in 2011 was less than 1.5 million litres per day, but the maximum total for July, 2011 was 3.1 million Lpd.

The Louisbourg water treatment plant, constructed in 2007 at a cost of 7.4 million dollars, went on line April 17, 2008, and operates under approval number 2008-061256. The plant uses dissolved air flotation (DAF) units to remove colour and organics. Two 300 millimetre water lines leave the treatment plant; one of fully treated residential water runs to the elevated one million litre capacity storage tank on the Park Service Road. Water is also stored in a half million liter capacity underground clear well at the water treatment plant. Four kilometres of water line provide chlorinated and pH adjusted process water to the fish plants. There is no storage of process water.

Louisbourg water treatment plant has a capacity of three million litres per day (Lpd) of fully treated water. Water for the Fortress and the community of Louisbourg is stored in the tank on the Park Service Road near the Fortress administration building. The Fortress used 14.4 million litres in total in 2012, averaging over 130,000 Lpd in summer, but only 3800 Lpd in winter. In 2008, three fish plants—Louisbourg Seafoods, A&L Seafoods, and SNE Sea Products—consumed an average of 800,000 litres per day of process water, half of the permitted average water withdrawal of 1.6 million Lpd. In 2012, SNE Sea Products did not operate and total annual consumption of process water for the other two plants was about 95 million litres or one third of the 2008 amount.

CBRM's utility manager and the water operations manager are responsible for safety of the various water supplies throughout the municipality. A treatment supervisor works with a team of ten certified treatment and distribution system specialists in daily operations of the various physical plants and distribution systems. They are supported by a water quality analyst, a water quality tester, a water systems engineer, meter reading and repair staff, two operations supervisors, and a watershed coordinator. Operators at the Louisbourg water treatment plant are also responsible for the Sydney plant.

1.3 Water Quality and Quantity

Kerekes (1981) assessed nine lakes within the National Historic Park and made some general observations for lakes in the area. They are generally shallow, with a mean depth of 0.8 metres, ranging from 0.22 to 1.44 metres. There was no thermal stratification, probably due to mixing by wind action, and it is likely that lakes undergo rapid changes in temperature due to the large surface area. Again, given the shallow depth, dissolved oxygen (DO) is normally near or above 100 per cent saturation. In winter, when ice cover stops mixing and isolates water from the atmosphere, there could be oxygen depletion and changes in chemistry. Water in the lakes is generally dilute, with low buffering capacity and a sodium-chloride typing, being sensitive to acid rainfall. The pH ranges from 5.5 to 7.5. The lakes are oligotrophic, defined as nutrient poor and oxygen rich and containing relatively little plant life.

ADI Limited (2006) reviewed available chemical analytical results of Kelly Lake source water for the period September 1999 to February 2005. The water was highly coloured (29 to 101 true colour units (TCU)), slightly acidic (pH 5.7 to 6.9), low in cloudiness or turbidity (1.1 to 1.6 Nephelometric Turbidity Units (NTU)), slightly elevated in organic concentration as indicated by total organic carbon (4.3 to 9.1 mg/L) and with relatively low concentrations of iron and manganese. Appendix E presents the baseline chemical quality of raw and treated water from the Louisbourg water system obtained spring and fall for 2011. Values for 2011 correspond to those from the 2006 report. A detailed *2011 Annual Report Louisbourg Water Treatment Plant* (CBRM Water Utility, 2011) was prepared by the CBRM Water Utility and submitted to NS Environment on April 1, 2012. These reports are submitted annually.

The Louisbourg plant removes colour from the Kelly Lake water. There can be large fluctuations in pH, turbidity, and colour following heavy rain events, as acids and organic material from wetlands pour into Kelly Lake. Initially, this was problematic for the plant operators, but procedures have been developed to deal with these variations.

ADI Limited and Hydro-Com (2007), in *Safe Yields - Pottle Lake, MacAskills and Kelly Lake Water Supplies* defined safe yield as the amount of water that can be taken from a source of supply over a period of years without depleting that source beyond its ability to be naturally refilled. In the early 1950s, a safe yield for the Kelly Lake system was estimated to be 36.4 million litres/day (Lpd) for human use only. Safe yield now includes consideration of environmental flows needed to maintain fish habitat and other aquatic resources within watershed ecosystems.

The probability of the combined required flow for the Kelly Lake basin being exceeded during the summer is 64 per cent. This means that the required flow cannot be supplied by the natural flow of the basin approximately 36 per cent of the time. During the time of exceedance, water will come from lake storage. According to records examined by ADI Limited and Hydro-Com Technologies (2007), the most severe historic multi-year dry period was 1944 through 1947. They concluded that during the years with the most severe sustained drought on record the maximum drawdown is well within the range of natural water level fluctuations and the extraction of water to satisfy municipal demand is not expected to pose significant environmental consequences. Armour

ADI Limited and Hydro-Com Technologies (2007) concluded that although the natural stream flow cannot meet the municipal water demand from the three water supply basins examined, the associated lakes and reservoirs have sufficient storage to satisfy all but the most extreme situations. Several sources of uncertainty in the safe yield analysis were identified, encouraging the utility to use the report as a basis for, but not a substitute for, ongoing sound water supply management practices.

Using Spooner's preliminary findings, a high lake elevation of 68.5 metres, and an assumed intake elevation of 67 metres, Kelly Lake would provide 232,250 m^3 of storage. Using an elevation of 69.5 metres for the bottom of the brook flowing from Stewart Lake and a high water level of 70 metres, Stewart Lake provides 365,000 m^3 of storage. This equates to a total of about 600 million litres of water in storage at a period of fairly high water, which makes the 1950s estimate of 36.4 million Lpd seem optimistic. However, with an average withdrawal of 1805 m^3/day in 2008, this volume represents almost a year's supply of municipal water. Using the estimate of 11,000 m^3/day required for environmental flows provided by ADI Limited and Hydro-Com Technologies (2007), there would be about two months of storage available for all ecosystem requirements.

ADI Limited and Hydro-Com Technologies (2007) concluded that the surface areas of the five major lakes in Kelly Lake basin (see Map 1) total approximately 14 percent of the watershed area. The consultants calculated a maximum watershed area of 27 square kilometres. They noted that if the channel between Kelly Lake and Stewart Lake goes dry or is filled with ice the drainage area is reduced to only about 1.5 square kilometres. Figure 4 shows the channel between Stewart Lake and Kelly Lake at a period of very high water in December 2007. The beaver dam shown in Figure 5 has drastically reduced the flow through the channel the following October, but there was still a good level of water available at the intake in Kelly Lake.

Delineation of the Kelly Lake watershed area is complicated by the possible blockage of connectivity between Kelly and Stewart Lakes and by dual outflows from Stewart Lake (see Figure 6 for a view of Six Mile Brook, the upper outlet). Intricate relief, based on a thick sequence of glacial tills overlying igneous metamorphic bedrock, results in complex drainage patterns. Global Mapper software was used to produce a 1 metre contour layer from a "bare ground" raster image developed from 2009 LIDAR data. The contour layer was exported to ArcMap GIS and an accurate boundary for the Kelly Lake watershed area (see Map 1) was created by manually following topographic high points in the GIS.

Figure 4. Outlet from Stewart Lake into Kelly Lake, mid December 2007.

Figure 5. Beaver dam restricting the outlet shown in Figure 4, early October 2008.

2.0 SOURCE WATER PROTECTION PROCESS

Nova Scotia Environment and Labour Water and Wastewater Branch (2004) prepared a handbook for municipalities, *Developing a Municipal Source Water Protection Plan: A Guide for Water Utilities and Municipalities.* ADI Limited used this document as a template for their background report on the Kelly Lake watershed. CBRM Water Utility has used the five-step process to guide the structure of this report.

2.1 A Five-Step Process

STEP ONE **Establish Advisory Committee**	• The committee should reflect the jurisdictional make-up of the water supply area. It is important to include municipal councillors, water utility engineers, planners, landowners, and residents from the area. • In addition, the committee may also include stakeholders from sectors such as agriculture, forestry, and other commercial operations, as well as special interest groups with an interest in the water supply area.
STEP TWO **Delineate Boundary**	• Use maps and land-use information to delineate the boundary of the watershed area or groundwater capture zone. • Mark the water supply boundary on a 1:50,000 scale (or less) map. • Solicit public input during this step if necessary to provide information about the watershed.
STEP THREE **Assess Risks**	• Conduct a comprehensive assessment of all land-use activities within the water supply area. • Determine what activities impact or impair water quality. • Identify potential future sources of contamination. • Assess the risk that each activity or source of contamination will have on the source water. • Solicit public input at this step if needed.
STEP FOUR **Management Plan**	• Compile all information and set goals and objectives. • Evaluate options. • Develop management strategies to reduce negative impacts to water quality. • Management options may include the following: (A)cquisition of land (B)ylaws - municipal planning for land-use (B)est Management Practices (C)ontingency planning for emergency situations (D)esignation (E)ducation • Consult the public
STEP FIVE **Monitor & Evaluate**	• Develop a monitoring program and schedule. • Continue to evaluate the effectiveness of the management plan. • Develop a mechanism for the committee to respond to impairment or changes in water quality. • Modify the plan if necessary.

Table 1. Developing a Source Water Protection Plan summary chart

From Nova Scotia Environment and Labour Water and Wastewater Branch (2004, pages 8 and 9), *Developing a Municipal Source Water Protection Plan: A Guide for Water Utilities and Municipalities.*

2.2 Source Water Protection Planning Committee

The CBRM Water Utility feels the most important members of an advisory committee are the residents and landowners within the watershed. Using a geographic information system, the watershed coordinator generated a map of landowners within the existing water supply zone as defined by CBRM Planning Department in 2004. This Public Water Supply Zone, (see Map 1) was intended to correspond with the natural watershed and was based on the best mapping available at the time. On March 5, 2008, letters were sent out to eight property owners; five in CBRM and three non-residents. The letter explained the requirement by NS Environment to develop a source water protection plan for the Kelly Lake watershed. Addressees were invited to attend a meeting on April 10, 2008, or to contact the watershed coordinator.

Other stakeholders were also invited and the meeting on April 10 was attended by three local landowners, two representatives from NewPage (the forestry company leasing the crown Land within the watershed), the local municipal councillor, the watershed coordinator, the NS Environment watershed planner, an inspector specialist from the Sydney office of NS Environment, and a forester and geologist from NS Department of Natural Resources (NSDNR). Later meetings were attended by other landowners, a representative from the Fortress of Louisbourg, and an officer with NS Fisheries. Two representatives of regional ATV clubs also attended, but felt there was very little opportunity for ATV travelling in the watershed and they saw no reason to be involved in the committee.

By the third meeting, in September 2008, the committee had developed and accepted a Terms of Reference document, which is included in Appendix B. Membership was divided between voting and non-voting member as follows:

Voting Members
Private landowner representatives – 3 members
Port Hawkesbury Paper representative – 1 member
Parks Canada Agency – 1 member
Councillor, CBRM – 1 member
NS Department of Natural Resources – 1 member
CBRM Water Utility – 1 member

Resource Members (non-voting)
NS Department of Environment
NS Department of Natural Resources
NS Department of Fisheries

At the annual review meeting in February 2013 the NS DNR member noted that the former New Page Port Hawkesbury was now owned by Port Hawkesbury Paper (PHP). The Cape Breton Island planner with PHP has agreed to sit on the Kelly Lake committee.

The Kelly Lake committee finalized the source water protection plan in September 2009 and a public meeting was held in Louisbourg in late October 2009 to present the plan to the community. Feedback from residents was positive and the plan was presented to the CBRM Water Utility Committee on January 13, 2010 for their information.

3.0 DELINEATION OF SOURCE AREAS

A source water area is the watershed or wellhead contribution zone that provides all the water used to supply drinking water from the source. The source water area for the community of Louisbourg is the watershed containing the surface water supply Kelly Lake. ADI Limited (2006) assumes the shallow groundwater and surface watersheds are similar. However, the divides for the deeper groundwater flow within the bedrock may not coincide with the surface watersheds. ADI Limited concluded there is presently insufficient technical data to subdivide the watershed into higher priority zones such as riparian zones or groundwater recharge zones. Therefore, to be conservative, ADI Limited recommended the entire surface water watershed be designated for source water protection.

A watershed is *the area drained by, or contributing to a stream, lake, or other body of water. It is the area that topographically appears to contribute all the water that passes through a given cross-section of a stream.* From the Step 2 brochure, Nova Scotia Environment and Labour, Environmental and Natural Areas Management (no date a).

Map 1 displays two versions of a watershed boundary for the Kelly Lake area. The CBRM zoned watershed was prepared some years ago by CBRM and was used for the definition of the area zoned by CBRM Planning Department in 2004 as a Public Water Supply (PWS) Zone. A third version (not shown) was prepared by ADI Limited for the 2006 report, using 1:10,000 mapping with a 5 metre contour interval. ADI Limited (2006, page 10) concede that "due to the coarseness of the contour interval, intricate localized topographic relief and presence of wetlands over the depressions, the exact location for localized portions of the divide are arbitrary." The ADI and zoning versions roughly correspond with each other and were used by the Kelly Lake Source Water Protection Planning Committee (SWPPC) to discuss activities and risks within the watershed. A more precise digital elevation model (DEM) became available for the Kelly Lake area in 2009 based on LIDAR mapping. One metre contours were prepared from the DEM and these contours were the basis for the 2009 watershed boundary displayed in Map 1.

Kelly Lake is at the lowest elevation of the five lakes in the system and receives surface flow from most of the watershed, making it the optimum location for the intake structure. Gerard Brook, which drains Kelly Lake, is one of two outlets from the watershed (visible in Figure 1). The other is Six Mile Brook, draining from the east end of Stewart Lake, located to the north of Kelly Lake (Figure 6). ADI Limited (2006) sees the dual outflow as a unique feature and the key to delineating the watershed as the configuration of the channel between Kelly Lake and Stewart Lake. If shallow and higher than the outflow to Six Mile Brook, the drainage area during times of low flow may only be from the

immediate Kelly Lake watershed, not the entire Kelly Lake system. This may also occur if the channel becomes iced over and sufficiently thick enough to reach the bed.

The DEM elevations indicated that the outflow to Six Mile Brook may be marginally higher than the outlet to Kelly Lake. There were unmaintained beaver dams at each outlet in 2009 which complicate the drainage patterns as well. Precise GPS readings were obtained in early September 2009 for the bottom of the channels of Six Mile Brook and the brook leading into Kelly Lake, where they leave Stewarts Lake. Both channels have an elevation of approximately 69.6 metres. The low points of both unmaintained beaver dams are also similar, about 70 metres above sea level. Currently, the beaver dams are helping to maintain about an extra half metre depth of water in Stewarts Lake.

Figure 6. Six Mile Brook looking north from Terra Nova Road

4.0 RISK IDENTIFICATION

Step Three of the source water protection planning process should produce:

- *a complete listing of all identified existing and potential issues that pose a risk to drinking water quality*
- *a list of existing and potential issues prioritized in the order in which they are to be addressed in the management plan*

NSEL (no date b, page 3) provides a flowchart to guide risk assessment.

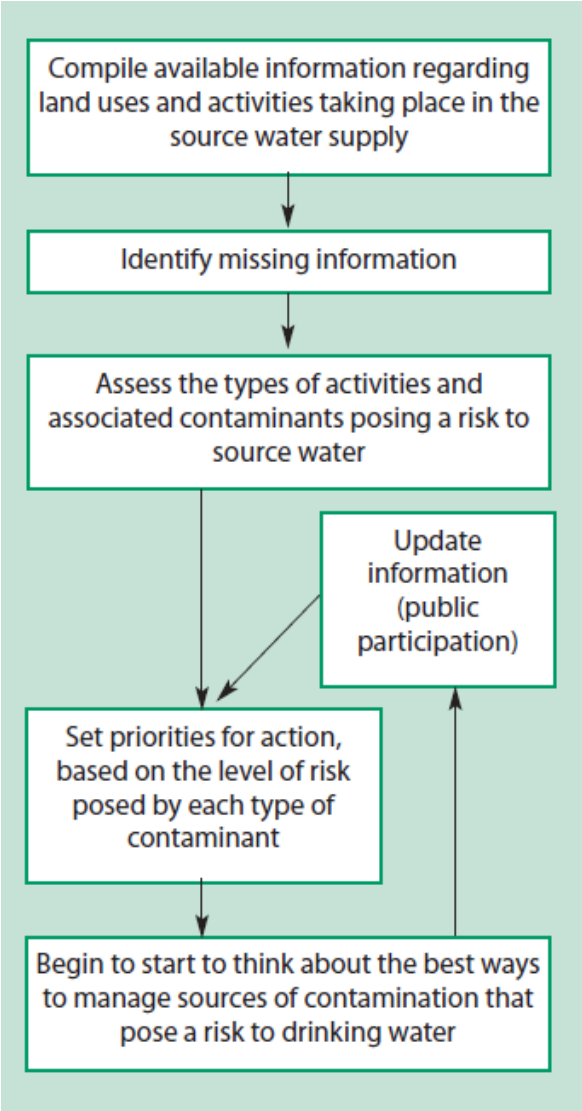


Figure 7. Risk assessment flowchart for source water protection from NS Environment.

NSEL (no date b, page 5) offers a list of land uses and their relative risk to source water.

Assessing Risk To Source Water

Land Uses and their Relative Risk to Source Water

Least risk

1. Land surrounding reservoir/well, owned by water utility/municipality
2. Permanent open space dedicated to passive recreation
3. Woodlands and managed forests

1. Field crops: pasture, hay, grains, vegetables
2. Low-density residential: lots greater than 2 acres
3. Churches, municipal buildings

1. Institutional uses
2. Medium-density residential: 0.5 to 1.0 acre lot sizes
3. Commercial uses with limited hazardous material storage or underground chemical or fuel storage

1. Agricultural production: dairy, livestock, nurseries, orchards,
2. Golf courses, quarries
3. High-density housing: lots smaller than 0.5 acre

1. Retail commercial: gasoline, farm equipment, automotive, dry cleaners, photo labs, machine shops, furniture strippers
2. Industrial: all forms of manufacturing and processing
3. Underground chemical and fuel storage
4. Waste disposal: pits, dumps, ponds, lagoons, landfills

Greatest risk

Table 2. List of land uses with relative risk to source water from NS Environment.

4.1 Natural Sources

There are natural sources of "contamination" in the environment which may impact surface water systems such as:

- natural mineralization
- pathogens (bacteria from wildlife, decaying vegetation, or blue-green algae)
- organic acids, low pH, elevated metals (iron and manganese) and colour from wetland drainage.

4.1.1 Mineralization

ADI Limited (2006, page 12) lists two metamorphic rock types in the source water area containing minerals:

1. Volcano-Sedimentary Massive Sulphide Environments: *The Forchu Group exhibits mineralization associated with intrusions of granitic plutons, related dyke rocks and lava flows, exemplified by polymetallic sulphide mineralization at Deep Cove, Eagle Head and Kennington Brook, just south of the Louisbourg Watershed.*

2. Meta Sediment Hosted Bodies: *These are exemplified by copper, molybdenum, bismuth and gold at Deep Cove-Gabarus, just south of the Watershed.*

4.1.2 Stream/Lake Sediments

Various metals can be adsorbed onto the surface of fine grained sediments in stream and lake beds. These metals can then be refluxed up into the water column in dissolved form.

ADI Limited (2006) reviewed the Geochemical Atlas of Nova Scotia (Lombard, 1990). The atlas listed elevated metal concentrations in stream sediments in the general area of the Louisbourg watershed for manganese, cobalt, copper, lead, zinc, silver, iron, arsenic, mercury, molybdenum, gold, tin, titanium, and antimony. Lake sediments, compared to the rest of the Atlantic Coastal Hydrological Region, were elevated in manganese, cobalt, cadmium, vanadium, arsenic, silver, antimony, tungsten, copper, zinc, iron, and mercury.

ADI Limited (2006) stressed that although there may be elevated metals on stream and lake sediments, concentrations are not necessarily above environmental quality standards. Also, they may not be available in dissolved form for intake by organisms.

4.1.3 Wildlife

Beaver can host Giardia, a common cause of water borne disease in humans. Figure 5 shows a beaver dam blocking the flow between Stewart Lake and Kelly Lake in October 2008. A trapper visits all CBRM water supply watersheds twice a year to remove beaver. The trapper took two beaver from Stewarts Lake in the winter of 2012 and reported no beaver on Kelly Lake. The dams on the streams flowing from Stewarts Lake have not been maintained for several years.

4.1.4 Wetlands

Map 2 displays wetlands in the Kelly Lake watershed area. GIS analysis concludes that wetlands constitute 692 hectares of the total 2598 hectares in the 2009 watershed boundary. In other words, 27 percent of the watershed is wetland. Water from wetlands contains organic acids that can lower stream pH and buffering capacity, create coloured water systems, and elevate iron and manganese levels. The 2011 chemical analysis of Kelly Lake raw water in Appendix E confirms that pH, colour, iron, and manganese levels exceed the aesthetic standards of the Canadian Drinking Water Quality Guidelines (2006).

4.1.5 Blue-Green Algae toxins

In late September 2011, contractors inspecting the intake at Kelly Lake noticed an accumulation of algae. Samples were collected and sent for identification and analysis for microcystin, a toxin found in blue-green algae. Some samples were identified as cyanobacteria or blue-green algae. Samples of raw and treated water were found to contain microcystin, but at levels well below the guideline of 1.5 micrograms per litre (µg/l) microcystin LR. The watershed coordinator now checks for algae blooms in late summer and early fall.

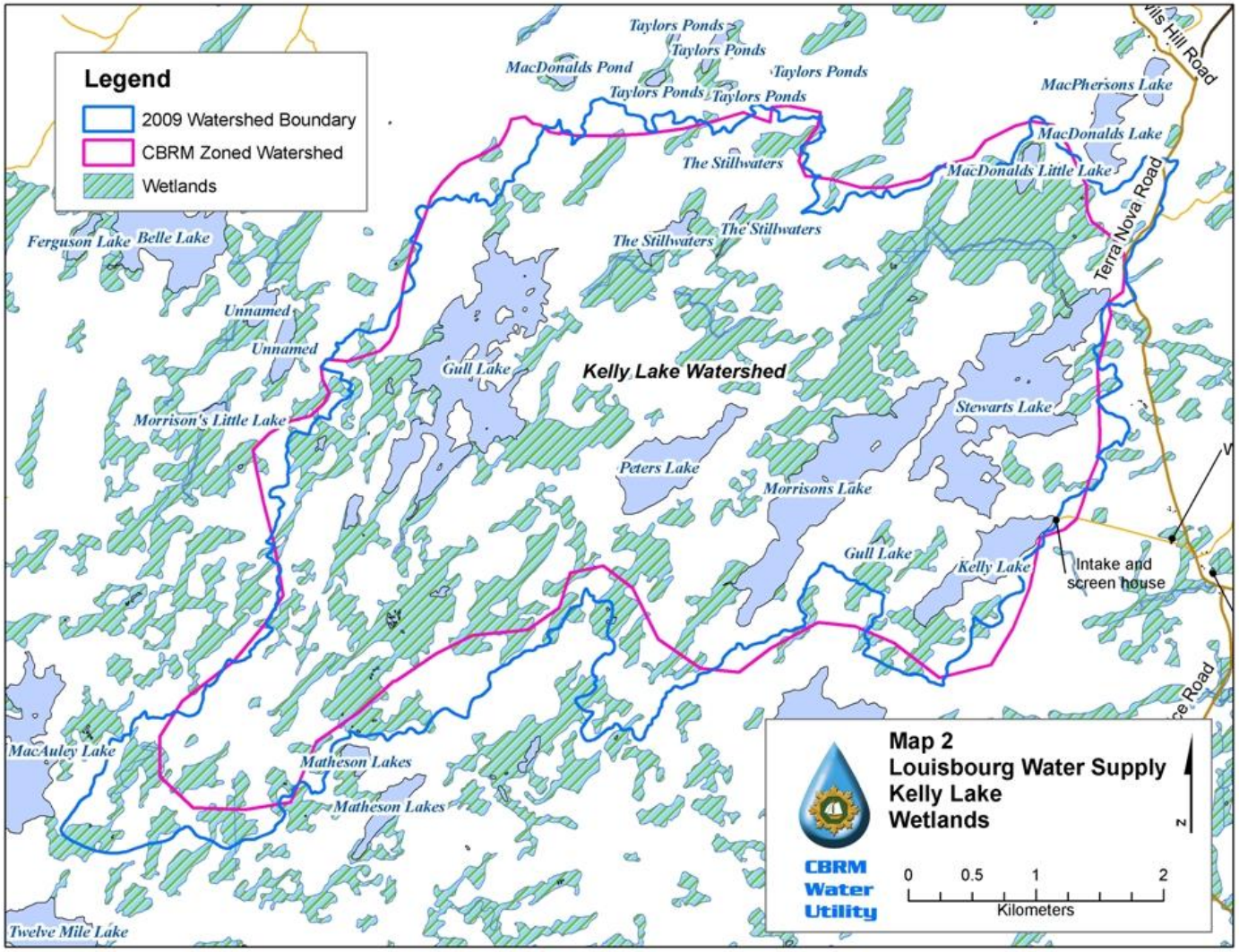
4.2 Human Activities

The Kelly Lake watershed is an area of largely stunted forest lands with an abundance of wet areas (see Map 2). There are no residential, commercial, or industrial land uses within the watershed.

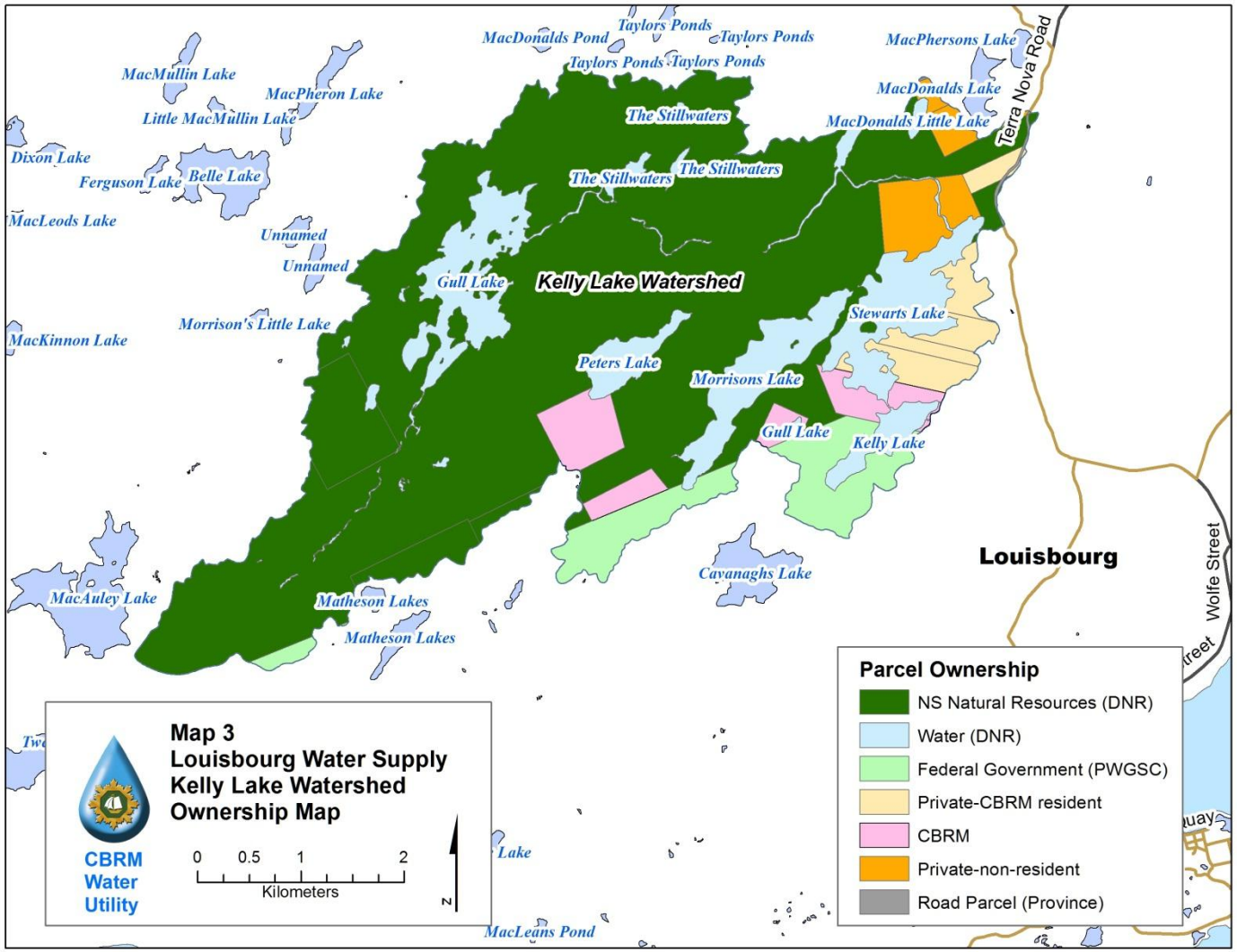
Map 3 shows property ownership within the watershed. Table 3 displays the number of hectares and the percentage of the watershed owned by each category. The table includes the area of the lakes in the watershed.

Kelly Lake watershed ownership		
	Hectares	**%**
NS Natural Resources (DNR)	1805	69%
Lakes (Provincial Crown - DNR)	379	15%
Federal Government (PWGSC)	151	6%
Private - CBRM resident	104	4%
CBRM	82	3%
Private - non-resident	76	3%
Road Parcel	2	0%
	2599	100%

Table 3. Land (and water) ownership, within the Kelly Lake watershed (see Map 3).



Map 2. Provincially mapped wetlands in Kelly Lake watershed area



Map 3. Land (and water) ownership, within the Kelly Lake watershed

4.2.1 Recreational Land Use

Some members of the Kelly Lake source water protection committee have travelled the backlands and stillwaters of the watershed and agree that there are not many ATV trails. There might be some access from Devil's Hill Road to the northeast, New Boston and Big Hill Roads to the north, and MacKeigan Road to the west. Gull Lake could be accessible by trails from MacPherson Lake (refer to Map 1 for road locations). Representatives of local ATV groups attended a meeting of the watershed committee and agreed that, due to the large areas of wetlands, lakes, and streams, the area is not compatible with extensive ATV use.

4.2.2 Sand and Gravel Pits

There are no known sand or gravel pits or rock quarries within Kelly Lake Watershed.

4.2.3 Forestry Activities

There has been minimal forestry activity within the watershed. Forestry activities have been confined mainly to pulpwood and firewood cutting on private lands near the Terra Nova Road. Most of the watershed is provincial crown land formerly under lease to Port Hawkesbury Paper (PHP). Representatives of PHP have offered to attend Kelly Lake watershed committee. The DNR forester has stated that the landscape is not conducive to commercial forestry operations. Nova Scotia Environment evaluated the provincial Crown land around the Kelly Lake watershed as a possible protected area under the 12 per cent protected areas target. However, the site class was well represented and not required. As the protected areas program moves forward, there is a possibility that the Kelly Lake watershed may eventually become protected.

4.2.4 Residential/Mining/Commercial/Industrial Activities

There are no dwellings located within the watershed boundaries. The Nova Scotia Mineral Rights database at http://www.gov.ns.ca/NATR/MEB/links/modblinks.asp as of February 2013, listed no mineral claims within the Kelly Lake watershed. As stated above, there are no commercial or industrial activities within the area.

4.2.5 Disposal Sites and Illegal Dumping

There are no permitted or abandoned waste disposal sites within the watershed. Kelly Lake watershed committee members and the watershed coordinator have found household garbage and old appliances dumped off the Terra Nova Road near Stewart Lake. Littering has diminished since signs (see Figure 10, Appendix G) now identify Stewart Lake as a public water supply.

4.2.6 Transportation and Recreational Boating Access

The 2009 draft watershed boundary includes slightly more than one kilometre of the Terra Nova Road, which passes within 150 metres of Stewart Lake. At the closest point, there is a trail over crown land being used as a boat launching area (see Figure 8). Committee members see very

little boating activity on Stewart Lake and have found the few anglers and boaters in the Kelly Lake system to be respectful of the environment.

Paul Whalen, responsible for the Louisbourg area for Nova Scotia Transportation and Infrastructure Renewal (NSTIR), does not sit on the Kelly Lake source water protection committee, but is available as a resource. Mr. Whalen reports that no salt is used for ice control on the Terra Nova Road and brush removal is done by mechanical means, not herbicides. NSTIR constructed a new bridge on the Terra Nova Road in 2011 at Six Mile Brook and the Gerard Brook Bridge was replaced in 2010. Both bridges are outside the watershed boundary.

Figure 8. Trail over crown land used as boat launching area to Stewart Lake

4.2.7 Summary

Considering the continuum of risks presented in Table 2, the human risks in the watershed supplying water to Kelly Lake are very low. There is no industrial, commercial, or residential activity in the watershed. Approximately 70 percent of the watershed is provincial crown land for which harvesting rights were under lease to Port Hawkesbury Paper but by the company's own admission, the likelihood of forestry activity being pursued is low. Only seven percent of the watershed is held privately and it is being used for recreational purposes and minimal forestry activity. Recreational use is minimal and illegal dumping, while present, remains relatively low.

Using the example provided by Nova Scotia Environment (see Appendix D) the committee prepared a risk assessment matrix which is included in Table 4.

Current Contamination Issue	Activity\Cause	Scale of Problem*	Priority Rank**
natural toxins	**blue-green algae**	**3**	**1**
pathogens from wildlife	**beaver activity**	**3**	**2**
elevated colour, pH, iron and manganese	**wetland drainage**	**3**	**3**
hydrocarbons, other contaminants	**illegal dumping**	**3**	**3**
hydrocarbons, invasive species	**boating**	**4**	**3**
hydrocarbons, siltation, and other contaminants	**trucking, road maintenance**	**4**	**4**
hydrocarbons, siltation, and water storage	**forestry**	**4**	**4**
hydrocarbons and siltation	**pit and quarry activity**	**5**	**5**
hydrocarbons, siltation, pathogens, and water storage	**PROPERTY DEVELOPMENT**	**5**	**5**
heavy metals and minerals	**refluxing of bottom sediments**	**5**	**5**
hydrocarbons and siltation	**ATV use**	**5**	**5**
hydrocarbons, siltation, and other contaminants	**MINERAL EXPLORATION**	**5**	**5**

* Scale 1 = Severe 3 = Moderate 5 = Minimal ** Rank 1 = High 3 = Moderate 5 = Low

Future concerns in bold, all caps: example **PROPERTY DEVELOPMENT**

Table 4. Risk assessment matrix prepared by SWPP committee.

5.0 SOURCE WATER PROTECTION STRATEGIES

ADI Limited (2006) identified fifteen strategies to manage risks associated with source water supplies. These are an expansion of a list of five ABCs provided by NS Environment: Acquisition, By-laws, Best Management Practices, Contingency Planning, Designation, and Education (see Table 1). This section examines ten such strategies.

5.1 Land Use and Planning

The Cape Breton Regional Municipality, through their Planning Department, developed a regional municipal planning strategy and land use by-law in August 2004. This regional plan created a Public Water Supply (PWS) Zone which was applied to the various water supply source water areas throughout the municipality, including Kelly Lake. Zone restrictions are listed below.

Section 1 PWS Uses Permitted

Development Permits shall only be issued in the PWS Zone for one or more of the following uses in compliance with any relevant section of the General Provisions Part, and any specific section of this Part devoted to the use.

- ***agricultural – only the following***
- *crop farming*
- *animal grazing*
- *existing agricultural buildings housing or impounding animals highlighted on the Land Use By-law Map*

- ***conservation and water utility related uses – (all)***

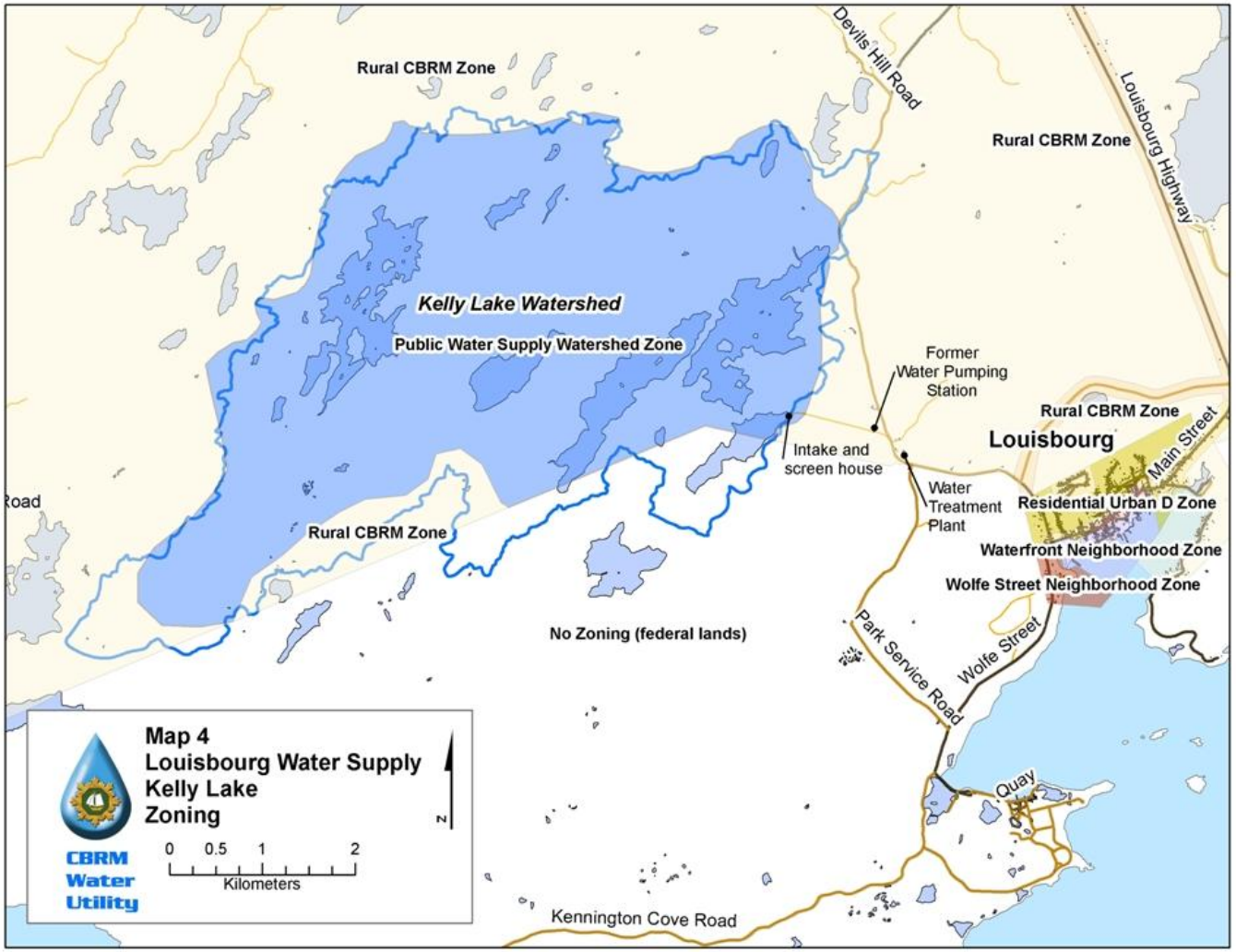
- ***forestry uses – only the following***
- *harvesting*
- *silviculture*

- ***residential – only the following***
- *existing residential dwellings*
- *mobile/mini/rectangular dwellings in compliance with Section 2*
- *single detached dwellings in compliance with Section 2*

Section 2 Lot Development Requirements for dwellings

- *Minimum lot size = 5 acres*
- *Minimum public street/road frontage = 300 feet*
- *The lot on which the dwelling is to be constructed shall only front along a public street/road that existed on the date this Land Use By-law came into effect.*

CBRM (2007b, page 98)



Map 4. Land use zoning in Kelly Lake watershed area

5.2 Best Management Practices (BMPs)

The Vision Statement for the CBRM Water Utility requires us:

To be a Utility that earns the confidence of its customers, embraces modern technology and management practices to provide the best quality service and value to its customers, and applies conscientious stewardship of water resources for today and the future.

Although the CBRM water utility has no written BMPs we are working with the source water protection committee to develop and encourage these practices.

In 2005, the Nova Scotia Department of Natural Resources and at that time Nova Scotia Environment and Labour collaborated in the preparation of two manuals of best practice, *Best Management Practices/Forest Planning in Municipal Drinking Water Supply Areas Nova Scotia* and *Mineral Exploration and Development in Municipal Water Supply Areas*. The Water and Wastewater Branch of the NS Department of Environment (2005), working separately, prepared *General Provisions for Pesticide Use in Nova Scotia.* In the same year, the Nova Scotia Department of Agriculture and Fisheries released *A Guide to Recommended Agricultural Practices Within Municipal Drinking Water Supply Areas in Nova Scotia*.

With the exception of the document relating to agricultural practices (agricultural land use seems unlikely in the Kelly Lake watershed), these reports were reviewed by the watershed coordinator and by committee members with knowledge in the particular sector. Pertinent practices are listed in the following subsections.

5.2.1. Forest Management Best Management Practices

The document *Best Management Practices/Forest Planning in Municipal Drinking Water Supply Areas Nova Scotia*, page 1, distinguishes between Best Management Practices (BMPs) and sustainable forest management. BMPs are designed to protect watercourses and woodlands, while maintaining water quality and wildlife habitat. Sustainable long-term forestry management planning is thought by some to better assure that water quality and quantity will be maintained or enhanced over the long term, by retaining or establishing healthy forest cover and placing limits on the overall amount of human-caused forest disturbance within specified time frames. Simpson's (2008) *Restoring the Acadian Forest: A Guide to Forest Stewardship for Woodlot Owners in the Maritimes* encourages forestry for the long term.

The Best Management Practices approach is included in Appendix A of the Nova Scotia Department of Natural Resources and Nova Scotia Environment and Labour (2005a) document. Appendix A, *Summary of Existing Regulations and Practices that Contribute to Maintaining Water Quality*, encourages due diligence and includes reasonable practices to mitigate or protect against foreseeable potentially damaging actions or activities. Appendix B is entitled *Potential Analysis, Planning, Implementation, Inspection, Monitoring and Continual Improvement Process.*

Appendix C of *Best Management Practices/Forest Planning in Municipal Drinking Water Supply Areas Nova Scotia* outlines examples of enhanced practices that might be adopted following an analysis and planning exercise. Contractors on municipal land and landowners working on their own properties are encouraged to follow these enhanced practices, which have been included as Appendix F of this source water protection plan. The CBRM Water Utility could provide assistance with trail planning and locating vegetable-based oil and spill kits. Staff from Nova Scotia Environment can advise on stream crossings and wetlands delineation.

Halifax Water has a major lumber company working in some of its watershed areas and has developed a document to guide forestry operations. The paper is available at:

http://www.halifax.ca/hrwc/documents/2010ApprovedBMPs.pdf

5.2.2. Mineral Exploration and Development Best Management Practices

The provincial document *Mineral Exploration and Development in Municipal Water Supply Areas* includes MWSA (Municipal Water Supply Area) Provisions from the Mineral Resources Act (Nova Scotia Department of Natural Resources and Nova Scotia Environment and Labour, 2005b). NSDNR requires those interested in obtaining an Exploration Licence in municipal water supply watershed lands to take special precautions outlined in the Mineral Resources Act.

If a proponent is conducting regional exploration with no ground disturbance or explosives use, they must first notify the Registrar of Mineral and Petroleum Titles, DNR, providing the dates that the exploration will begin and end. Detailed ground exploration with ground disturbances such as drilling, blasting, road construction, and watercourse alteration requires all necessary approvals from Nova Scotia Environment. Landowners, occupants, or tenants may also establish requirements pursuant to a surface rights permit.

Although there are apparently no current mineral claims within the Kelly Lake watershed, CBRM should consider developing a set of practices to guide mineral exploration in water supply watersheds. Nova Scotia Department of Natural Resources and Nova Scotia Environment and Labour (2005b) advise that exploration and mining activities proposed in municipal drinking water supply areas are subject to any strategies included in a SWPP for the watershed area. These management strategies could include regulations under designation of a protected water area or best management practices. Proponents planning to conduct mining-related activities in a watershed area must contact the NS Environment and the local water utility operator to determine how SWPP management strategies may affect them.

The pamphlet *Mineral Exploration and Development in Municipal Water Supply Areas* does not list any best management practices. The paper explains the application process and identifies the various departments or stakeholders that must be contacted before mineral exploration or development can occur within a municipal water supply. In spite

of provincial oversight, the CBRM Municipal Planning Strategy (CBRM 2007a, p. 6.18) recommended prohibiting the issuing of extraction permits within these watersheds. To date, CBRM Council has not demanded amendment of the provincial regulations.

5.3 Emergency Response Plan

ADI Limited (2006) acknowledged the CBRM Water Utility had no emergency response plan for instances of chemical or hydrocarbon spillage in a watershed. Currently, a plan would involve a network of local companies for response and remediation. NS Environment would have to provide advice on remediation. Although there is no emergency backup water supply source in place for the Town of Louisbourg, ADI Limited conceded that, given the size of the Kelly Lake watershed and the lack of roads and small probability of air crashes, the potential for a polluting incident would be relatively low. However, ADI Limited did suggest that first response materials might be made available in a central location and a written response plan would have merit. ADI Limited (2006, page 19) believe an emergency response plan could

focus on typical spill scenarios, available equipment and materials in the local area, a chain of command procedure for implementation and a follow up scenario to "close the loop" following remedial activities.

A basic draft contingency plan is included in Appendix C of this report.

5.4 Land Acquisition

The CBRM Water Utility has a policy of acquiring lands in drinking water supply areas when they become available. Given the low risks in the watershed, land acquisition is not a priority for the Kelly Lake watershed. However, ADI Limited (2006) noted that the portions of long narrow strips of privately held land remote from the Terra Nova Road might be the easiest to acquire. Owners of these lands fronting on Stewarts Lake may want to keep their lands for selective hardwood cutting, but they have been approached to determine if they would want to sell land on the lake to CBRM.

ADI Limited (2006) also referred to a couple of parcels located in the south central and western part of the watershed that do not have road access. The owners were listed in the provincial database as having unknown addresses. In February 2009, the CBRM tax department put these properties on a tax sale and purchased them (see Map 3).

5.5 Road Maintenance

The Terra Nova Road is maintained by Nova Scotia Transportation and Infrastructure Renewal. TIR staff report that the department uses sand only to provide traction on ice and snow in the winter months and mechanical means rather than herbicide to control roadside vegetation.

The CBRM Water Utility maintains a locked gate at the entrance to the former pump house and intake structure. Access is available to CBRM staff and operators of a cell tower adjacent to the former pump house. Winter snow clearing, which uses no salt or other de-icing compounds, is done under contract to a local plow operator. Roadside maintenance is by mechanical means only.

5.6 Adaptation for Climate Change

Consultants have predicted that Cape Breton will probably be warmer in the future with more extreme rainfall events. Precipitation will most likely not increase so we will experience longer dry periods with increased frequencies of low flows. Warmer temperatures may also exacerbate the problem by increasing the rate of evaporation in lakes, reducing the water levels. The incidence of Cyanobacteria may also increase.

To monitor effects of climate change consultants have recommended that the water level of Kelly Lake be measured on a regular basis. Stream flow gauges should also be installed to measure inflow into Kelly Lake and, if necessary, environmental flows downstream of the point of water withdrawal. According to ADI Limited and Hydro-Com Technologies (2007) stream flow gauges could be supplemented with environmental sensors to monitor parameters such as air and water temperature. They also suggested CBRM consider installing appropriate field equipment to estimate evaporation rates. CBRM is considering the installation of a water level recorder.

5.7 Public Education and Stewardship

The *Municipal Planning Strategy of the Cape Breton Regional Municipality* (CBRM 2007a, page 9.7) discusses public education:

The majority of people will respect the need to protect the watershed of a source of public drinking water. However, people need to know if and when they are within a watershed. The responsibility of the Regional Municipality is to notify and educate. Notification in the form of signage will be placed directly within the watersheds. Property owners could regularly receive literature (e.g. along with their tax bill) that they own land within a public water supply watershed and what conservation methods are recommended.

The CBRM Water Utility encourages inclusive rather than restrictive use of water supply watersheds. We would like to allow continued use of the watershed by fishermen, hikers, cross country skiers, and other self-propelled users. It is hoped that these users would provide a certain level of inspection and security.

Landowners on the Kelly Lake Source Water Protection committee concur that fishing and hiking in the watershed are not a problem, but illegal dumping along the Terra Nova Road will always need monitoring. The Utility stresses education of the community to encourage cooperative use of the watersheds without requirements for enforcement of regulations. These themes will be the foundation of public education and outreach work by the Kelly Lake SWP planning committee.

CBRM staff feels use of the media is key in creating awareness among watershed users and residents of the importance of clean source water. CBRM and the Atlantic Coastal Action Plan (ACAP) Cape Breton have developed media messages and newsletters. Goals and objectives of the 2012-13 education program, listed below will be met through activities such as school programs and attendance at community festivals and fairs.

Goals:

- To increase the general awareness of the CBRM water sources.
- To encourage stewardship by residents to protect these valuable water sources.
- To highlight potential watershed concerns and provide residents with a reasonable option to recognize, report or change such issues.

Objectives:

- The Water Education Tool Kit will be promoted to grade 5 and 6 teachers within the CBRM.
- The Water Education Tool Kit will be expanded to include grades 1 and 2 with appropriately designed and themed lessons.
- With the new lessons, the Water Education Tool Kit will be re-launched.
- The Water Cycle school presentation will be given as appropriate and as requested within CBRM school and community programs.
- The French “cycle d’eau” presentation will also be given to expand the reach of the water conservation messages.

Activities:

- ACAP CB will work with the CBVRSB to promote the grades 5-6 Tool Kit. Five presentations to principals or teachers will be given by March 31, 2013.
- Two new lessons will be researched and developed by September 2012. The lessons will be tested at a teacher focus group by December 31, 2012. The lessons will incorporate suggestions and finalize design.
- The Tool Kit will be assembled with 6 lessons and re-launched by March 31, 2013.
- A Tool Kit review will be completed by survey, with incentives, from teachers who received the lessons by March 31, 2013.
- ACAP CB will conduct 12 school and group presentations within the 2012-13 contract year.
- ACAP CB will conduct 2 school presentations in French within the 2012-13 contract year.

5.7.1 Web Site

Source Water Protection is now part of the CBRM web site:

http://www.cbrm.ns.ca/source-water-protection.html

The watershed coordinator posts meeting notices, maps, and other items related to source water protection. Links are provided to approved minutes of source water protection committee meetings posted by the Clerk's office.

5.7.2 Signs

Part of the media campaign is to inform the public where the water supplies are located. Signs have been made and are being distributed throughout the watershed areas. The so-called "Violation" sign (see Figure 9, Appendix G) has been placed near water supplies on CBRM land. There is one at the entrance of the road to the lake intake and screen house on Kelly Lake. Other "Keep it Clean" signs (see Figure 10, Appendix G) are placed in the watershed on private lands where the landowner has requested it or on crown land with the permission of provincial Natural Resources staff.

5.8 Cooperation with Other Levels of Government

Nova Scotia Department of Natural Resources and the Fortress of Louisbourg (Parks Canada Agency) are the main government players in the Kelly Lake Watershed area. A forester or a geologist from DNR has attended the Kelly Lake Source Water Protection Committee meetings and DNR is a voting member of the committee. Parks Canada Agency is also a voting member of the committee.

Fortress of Louisbourg cultural resource management staff have invited the Kelly Lake SWPPC to provide input to the Fortress management plan. The management plan (Minister of Public Works and Government Services Canada, 2001) acknowledges part of the Kelly Lake watershed is within the Fortress boundaries and the shoreline of the lake forms the site boundary in this area. As CBRM supplies water to the Fortress, Parks Canada continues to preserve their own water supply by protecting the watershed area within its boundaries.

5.9 Information Management

The CBRM planning department and the current watershed coordinator have significant GIS capability which is a valuable planning tool for watershed protection. CBRM water supply system data is managed using programmable logic controls (PLC) and automatic communication to servers tied into a supervisory control and data acquisition (SCADA) system. Information for the Louisbourg system is transferred to the main server located at the Sydney water treatment plant. The treatment plant brought full SCADA capability to this water supply system. CBRM conducted a regional communications upgrade for the water utility and all information now reports to a central server.

Although the digital database is continually upgraded as change occurs, the current efforts of the CBRM are focussed on systems to document and track drinking water quality. Expansion of the system will be required to accommodate suggested monitoring programs.

The current watershed coordinator was a former GIS technologist with the CBRM planning department and has been able to build GIS files for all the watershed areas. It will be crucial to ensure that any future monitoring data is supplied in digital formats that can be related to the georeferenced GIS files. It is also important that the water utility retain an employee with GIS skills, particularly in ArcMap, as the CBRM engineering and public works department relies totally on CAD software which does not provide the analytical tools required for watershed management.

5.10 Demand Side Management

As noted in Section 1, with the Fortress, the Louisbourg water system now serves approximately 1400 people through 510 user accounts. Water meters were introduced early on in Louisbourg, possibly in the 1950s. Customer demand was probably not much affected because of the low water rates at the time. The utility, however, has been proactive in water conservation and has greatly reduced the response time to fix leaks.

CBRM water rates approved by the Nova Scotia Utility and Review Board effective between 01 August 2011 and 31 March 2013 are based on meter size and consumption. A total of 471 of the accounts are for a 5/8" meter, while the remainder is distributed between 3/4" and 6". Table 5 displays the current and 2013 rates for a 5/8” meter.

	April 2012	April 2013
Base charge 5/8” meter	$48.95 per quarter	$51.52 per quarter
0 to 2500 m^3	$1.18 per m^3	$1.23 per m^3
Over 2500 m^3	$0.72 per m^3	$0.75 per m^3

Table 5. 2012 and 2013 water rates: fully treated water.

In spite of the increased rates shown in Table 5 CBRM Water Utility staff has seen no noticeable reduction in residential water use. More meters have been distributed throughout the Fortress to help them locate leaks in their system. Fish plants have drastically reduced operations in Louisbourg. As they still use partially treated industrial water, they pay a current rate of 45 cents per cubic metre and have little incentive to conserve water.

6.0 MONITORING AND IMPLEMENTATION PLANS

Source water protection monitoring is a formalized process that reviews the performance of the source water protection plan. This typically involves monitoring the quality of source waters to evaluate changes in the state or health of the water supply area. The plan may not be meeting its objectives if water quality is deteriorating in the water supply or the identified management options (such as BMPs) are not being followed. A municipality or utility should be able to link deterioration in water quality to one or more of the risks identified in a source water protection plan.

This complements, but is different from, the raw water monitoring completed by a utility or municipality to meet regulatory requirements (i.e. regulatory compliance monitoring). Raw water quality monitoring may occur on a much more frequent basis depending on the source of supply, risk of contamination, type of treatment, and similar factors.

As well, source water protection plans need to be regularly reviewed to ensure they record any changes in land uses or activities or any changes to the water supply infrastructure (e.g. construction of a new well). Utilities should also note any impacts of new legislation. The monitoring and evaluation program for the SWPP will help assure the Kelly Lake Source Water Protection Planning Committee that the plan remains current with changing conditions and priorities in the water supply area.

6.1 Regulatory Compliance Monitoring

Under the requirements of the Environment Act, the Activities Designation Regulations and the Water and Wastewater Facilities and Public Drinking Water Supplies Regulations, the CBRM Water Utility samples raw water before it enters the treatment process. Raw water is tested for microbiological (bacteria, protozoa and viruses), physical (turbidity and pH), and chemical quality.

6.2 Water Supply Area Monitoring

The CBRM Water Utility has tested raw water from Kelly Lake for microcystin on the one occasion when blue-green algae were noted near the intake. The watershed coordinator monitors the intake area in late summer to look for the presence of blue-green algae. Compliance monitoring from the clear well is sufficient to reveal any other quality issues. There are no residential water supplies in the watershed or these could be tested.

In addition to monitoring the water supply area through water quality and quantity sampling, CBRM also undertakes visual monitoring of water supply areas. The watershed coordinator regularly drives or walks through the watersheds to identify potential water quality problems, such as all-terrain vehicles (ATVs) in watercourses. Surveys and discussions with local landowners can reveal if they are following Best Management Practices. This helps determine if additional education efforts are required, identifies problems that are not being adequately addressed, or may identify activities that are in violation of the bylaws or regulations that have been put in place to protect water quality.

6.3 Source Water Protection Plan Review and Update

The Kelly Lake SWPP Committee regularly reviews and updates the source water protection plan. These update sessions include:

- review of monitoring results for information on the effectiveness of management options;
- identification of any changed risks in the area (e.g. new businesses in area or increased recreational use) and corresponding update to the plan;
- identification of changes to the water system infrastructure (e.g. new monitoring equipment) and corresponding update to the plan.

6.4 Further Research

There is a lack of detailed hydrological and hydrogeological studies for the Kelly Lake watershed area and thus ADI recommended long-term monitoring programs. The best approach would be to undertake affordable, practical programs each year to obtain information pertinent to answering specific operation or protection issues as they arise.

ADI Limited suggested some priority questions:

- *How much water resides in storage within the lakes? How does it fluctuate seasonally/annually? How much is accessible at the extraction point?*
- *What are the seasonal, storm, and snowmelt fluctuations in the water chemistry and quality?*
- *What are the fresh water biological characteristics of the lakes and streams within the watershed that should be protected and/or managed for recreational use?*
- *Do Gerard and Six Mile Brooks below the extraction point provide salmonid habitat? If so, how should flows be managed to maintain and improve habitat?*
- *What is the character of stream and lake sediment geochemistry within the watershed? Can metals, nutrients and other parameters be easily refluxed into the water column? If so under what conditions?*
- *What is the impact of climate change on quantity and quality of flows?*

CBRM Water Utility has discussed possible research projects in the Kelly Lake watershed with limnology researchers at Acadia University and the Applied Geomatics Research Group (AGRG) at the Centre of Geographic Sciences (COGS). The bathymetric surveys of Kelly Lake and Stewarts Lake by Ian Spooner of Acadia, providing preliminary stage-storage curves, are an important first step toward future research. There may also be students at Cape Breton University interested in Cyanobacteria research.

Following discussion of the draft source water protection plan and guided by the list of land uses with relative risk to source water (see Appendix D), the committee prioritized concerns for the Kelly Lake watershed. These were presented in Table 4. An implementation schedule has been developed and is presented below in Table 6.

6.5 Implementation Schedule

	2013				2014	
Management Strategy	**Jan - Mar**	**Apr - Jun**	**Jul - Sep**	**Oct - Dec**	**Jan -Mar**	**Apr - Jun**
Outreach and Education						
Develop and distribute SWP Plan Newsletter (June 2013)						
Work with ACAP CB to create community awareness (schools)						
Maintain watershed protection signage at access roads						
Put source water protection materials on the CBRM web site						
Approach private landowners to determine willingness to sell						
CBRM Policy and Procedure						
Update contingency/ EMO plans for spills\accidents						
Develop CBRM policy on mineral exploration in watershed						
Continue to fund beaver removal						
Obtain water samples for cyanobacteria (if algae are present)						
Work with CBRM Planning Department on zoning requirements						
Research, Mapping and Monitoring						
Monitor stream flow in Gerard's Brook and from Stewarts Lake						
Research lake bottom sediment and aquatic life						
Improve mapping of surface and ground watershed boundaries						
Research groundwater\surface water interaction						
Install sensors for air and water temperature						
Obtain bathymetry and develop stage-storage curves (done 2010)						
Support Provincial\Federal Initiatives						
Sustainable forestry methods education (NSDNR)						
NSEN Water Caucus						
Determine if Gerard and Six Mile Brook support salmonids (DFO)						
Evaluate impact of provincial wetland strategy on watershed						
Review and update SWP Plan						

Table 6. Implementation schedule for Kelly Lake management options

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APPENDIX A SWPP COMMITTEE

Kelly Lake Source Water Protection Planning Committee

2012-2013 Kelly Lake Source Water Protection Planning Committee

Citizen member – Alex Webber
Citizen member – John DeVries
Citizen member – Olive DeVries
Citizen member – Sonny MacPherson (deceased 2012)
Port Hawkesbury Paper representative – Dennis Boulet
CBRM Councillor – Kevin Saccary
CBRM Watershed Protection – Britt Roscoe
NSEL Watershed Planner – Cheryl Benjamin
NSEL Inspector Specialist – Michael Florien
DNR Forester – Brian MacSween
Fortress of Louisbourg – David Skinner
NS Fisheries and Aquaculture – Eugene Samson

Other contacts

Department of Transportation and Infrastructure Renewal – Paul Whalen
ACAP Cape Breton Education Manager – Kelly Krawchuk
NS Environment Protected Areas Coordinator – David Williams

APPENDIX B COMMITTEE TERMS OF REFERENCE

Terms of Reference
Kelly Lake Source Water Protection Planning Committee

TERMS OF REFERENCE
Kelly Lake Watershed Advisory Committee

1.0 PURPOSE

The purpose of the Kelly Lake Watershed Advisory Committee is to protect the Kelly Lake Watershed by:

(a) Advising the CBRM Water Utility on the management of Kelly Lake watershed in order to ensure an adequate supply of safe drinking water from the watershed;

(b) Collecting and reviewing information from stakeholders and other resources, and using that information to work with stakeholders to protect Louisbourg's water supply;

(c) Providing a forum for landowners, residents, and users of the watershed to contribute and receive information and discuss all matters related to the management of the watershed;

(d) Preparing, and helping to implement through activities such as education, a water supply watershed management strategy for the Kelly Lake watershed.

2.0 SCOPE

The water supply watershed of Kelly Lake which includes Stewarts Lake, Gull Lake, Morrisons Lake, Peters Lake, MacDonalds Little Lake, and all those lands, ponds, and stillwaters which drain into Kelly Lake.

3.0 MEMBERSHIP

Voting Members

Private Landowner Representatives – 3 members
Port Hawkesbury Paper representative – 1 member
Parks Canada Agency – 1 member
Councillor, CBRM – 1 member
Department of Natural Resources – 1 member
CBRM Water Utility – 1 member

Resource Members (non-voting)

NS Department of Environment
NS Department of Fisheries

4.0 OPERATION OF COMMITTEE

(a) The committee chair and vice-chair will be elected every two years by the committee.

(b) CBRM will provide secretarial services.

(c) The committee will endeavour to conduct business by consensus which requires:

- much discussion involving all sides or points of view
- agreement by all concerned on a specific issue
- encouragement of participation and involvement by everyone

(d) Five committee members will constitute a meeting quorum.

(e) A General Meeting may be called every two years at the discretion of the committee.

APPENDIX C CONTINGENCY PLAN

CONTINGENCY PLAN

A contingency plan is a set of predetermined actions and communications to be initiated in the event that a water utility cannot provide adequate water supply due to contamination or a loss in available quantity. The area around Kelly Lake is reasonably remote, however, in an effort to be vigilant, the contingency plan identifies key personnel, other resource people including agencies such as EMO and the Department of Environment and Labour. The Contingency Plan for Kelly Lake watershed is currently being completed by the CBRM Water Utility.

Source Water Contamination and Operational Issues:

Potential contamination of the watershed could occur from various situations and land uses. Loss of water quantity is a result of the lack of normal precipitation - mainly during the summer months. Specific land use activities/hazards that have been identified for potential contamination and immediate response may include:

- Bacterial contamination
- Petroleum spill from any mechanized vehicle or machinery
- Increased siltation from significant climatic events
- Illegal dumping
- Forest fires

Additionally, other problems can occur that would require immediate response. They include:

- Power outage
- Break in chlorine line
- Vandalism

Being prepared with a list of options is important to ensure a fast and efficient response to emergencies. Making an inventory of existing and required equipment allows the utility to document what options exist in an emergency. The following are important considerations to be prepared for an emergency:

Bacterial Contamination:

- What was the source?
- Kept abreast of Boil Order Procedures and communications plan.

Chemical/oil spill:

- EMO, fan out list (existing)
- Develop an inventory of all materials and/or chemicals that travel through the watershed on a regular basis
- Confirm contacts for emergency excavators and booms (existing)

Siltation:

- Monitor changes in siltation after significant events.

Garbage:

- Prepare an inventory of sites where illegal dumping has occurred.
- Monitor sites for dumping.
- Prepare to remove garbage immediately.

Forest Fires:

- Continue to work with DNR to develop Contingency actions regarding forest fires.
- What are alternative sources of water?

Power Outage:

- Standby power generation (existing).

Break in chlorine line:

- Duplex Chlorine System (existing).

Vandalism:

- Inventory possible impacts from vandalism.

Action Plan

1. Shut water system down

CBRM Water Utility is to immediately block all water lines to the public.

Ray Boudreau, Water Operations Supervisor: (902) 842-4202 or (902) 578-4609

2. EMO Notification and Environmental Emergencies

John Dilney, EMO Co-ordinator: (902) 563-2352

Environmental Emergencies: 1-866-424-5620

The EMO Co-ordinator has a list of all people, agencies, and groups that must be called and their telephone or pager numbers, for any type of emergency.

Anyone responsible for a spill or release of dangerous goods or hazardous wastes, or anyone witnessing such an incident is responsible for reporting such to the proper agencies. All calls should be directed first towards the Public Works Operator at (902) 563-5255 or 911.

The EMO Co-ordinator and Committee will be responsible for ensuring the proper agencies, groups and people are notified in an emergency. They will authorize the commitment of any resources that may be required, act as focal points for information exchange, and be responsible for communication with government personnel.

Callers should be prepared to report:

- The substance, if known, and the amount
- Location of the spill
- Time of the spill
- Source of the spill

Other agencies and people that must be contacted through the EMO Director:

- Department of Environment 1-800-705-2388
- Cape Breton HazMat Team, George Muise (902) 563-6396
- Coast Guard Environmental Emergencies 1-800-565-1633
- Department of Fisheries and Oceans (902) 564-2400
- Canadian Transport Emergency Centre (CANUTEC) Emergency Information Line (613) 996-6666

3. Communicate information to the public

- Alert on TV/Radio
- Public Works (902) 563-5255

4. Provide options for alternative water supply to residents

- Employ boil order
- Employ alternate water sources (determine what would that be for Louisbourg)

List of Emergency Contact Numbers:

EMO 24 Hr. Contact Number: (902) 424-5620
John Dilney Co-ordinator (902) 563-2352

Environmental Emergencies: 1-866-424-5620

Sydney Water Treatment Plant:	1-902-563-5509
Pager/Cell for Manager:	1-902-565-7323
Emergency Back-up:	1-902-563-5255
Cape Breton HazMat Team	1-902-563-6396
Coast Guard Environmental Emergencies:	1-800-565-1633
CANUTEC Emergency Information Line:	(613) 996-6666

APPENDIX D RISK ASSESSMENT MATRIX

Contamination Issue	Activity/Cause	Scale of Problem*	Priority Rank**
Nutrients	• Agriculture	3	2
Fuel Leaks	• Domestic oil tanks	4	1
Sedimentation	• Construction • Agriculture • Forestry	1 2 4	1 2 3
Pesticides	• Agriculture	4	2
Bacteria	• Domestic septic systems • Manure • Municipal effluent	2 3 3	1 2 3
Salt	• Road de-icing	3	4

** 1 = Severe, 3 = Moderate, 5 = Minimal ** 1 = High, 3 = Moderate, 5 = Low*

List of activities with relative risk to source water from NS Environment

APPENDIX E KELLY LAKE WATER CHEMISTRY

2011 Water Results

Table 7: BASELINE CHEMICAL QUALITY

Parameter	Health-based Guideline (mg/L)	AO [or OG] (mg/L)	RAW WATER - Louisbourg Water Treatment Plant 1399 Terra Nova Rd		TREATED WATER- Louisbourg Water Treatment Plant 1399 Terra Nova Rd	
			March 16th (mg/L)	September 21st (mg/L)	March 16th (mg/L)	September 21st (mg/L)
Alkalinity (Total as $CaCO_3$)	--	--	<5	<5	<5	12
Total Aluminum	--	0.1	0.13	0.13	0.025	0.020
Nitrogen (Ammonia Nitrogen)	--	--	<0.05	<0.05	<0.05	<0.05
Total Antimony	0.006	--	<0.0004	<0.0004	<0.0004	0.00056
Total Arsenic	0.010	--	<0.0006	<0.0006	<0.0006	<0.0006
Total Barium	1	--	0.0055	0.0039	0.0053	0.0038
Total Boron	5	--	<0.1	<0.1	<0.1	<0.1
Total Cadmium	0.005	--	0.000026	<0.000017	<0.000017	<0.000017
Total Calcium	--	--	1.9	1.7	1.9	1.8
Dissolved Chloride	--	≤250	13	7	28	30
Total Chromium	0.05	--	<0.001	<0.001	0.0023	0.0084
Colour (TCU)	--	≤15 TCU	47	67	<5	9
Conductivity (µS/cm)	--	--	58	37	120	120
Total Copper	--	≤1.0	0.002	0.0046	0.022	0.009
Dissolved Fluoride	1.5	--	<0.1	<0.1	<0.1	<0.1
Hardness as $CaCO_3$	--	--	9	7	7	9
Total Iron	--	≤0.3	0.23	0.40	<0.1	<0.1
Total Lead	0.01	--	<0.001	<0.001	<0.001	<0.001
Total Magnesium	--	--	0.99	0.66	1.00	0.67
Total Manganese	--	≤0.05	0.075	0.031	0.042	0.0079
Nitrate	10	--	<0.06	<0.05	<0.05	<0.06
pH	--	6.5 - 8.5	6.3	6.4	7.2	7.6
Total Potassium	--	--	<0.6	<0.6	<0.6	<0.6
Total Selenium	0.01	--	<0.001	0.0036	<0.0010	0.0039
Total Sodium	--	≤200	6.9	4.7	19	19
Dissolved Sulphate	--	≤500	3	<2	5	5
Calculated Total Dissolved Solids	--	≤500	28	17	57	64
Total Organic Carbon	--	--	5.7	8.3	2	2
Turbidity (NTU)	1.0	--	0.3	0.6	<0.1	0.3
Total Uranium	0.02	--	<0.00015	<0.00015	<0.00015	<0.00015
Total Zinc	--	≤5	0.023	<0.005	0.013	0.0062
Other Parameters Sampled						
Total Beryllium	--	--	<0.0005	<0.0005	<0.0005	<0.0005
Total Bismuth	--	--	<0.002	<0.002	<0.002	<0.002
Total Cobalt	--	--	<0.001	<0.001	<0.001	<0.001
Total Lithium	--	--	<0.001	<0.001	<0.001	<0.001
Total Molybdenum	--	--	<0.004	<0.004	<0.004	<0.004
Total Nickel	--	--	<0.003	<0.003	<0.003	0.0047
Nitrite (N)	--	--	<0.06	<0.01	<0.06	<0.01
Nitrite + Nitrate	--	--	<0.06	<0.05	<0.06	<0.05
Orthophosphate	--	--	<0.3	<0.01	<0.01	<0.3
Total Phosphorus	--	--	<0.1	<0.1	<0.1	<0.1

2011 Water Results continued

Table7: BASELINE CHEMICAL QUALITY (CONTINUED)

Parameter	Health-based Guideline (mg/L)	AO [or OG] (mg/L)	RAW WATER - Louisbourg Water Treatment Plant 1399 Terra Nova Rd		TREATED WATER- Louisbourg Water Treatment Plant 1399 Terra Nova Rd	
			March 10th (mg/L)	September 15th (mg/L)	March 10th (mg/L)	September 15th (mg/L)
Total Silver	--	--	<0.0001	<0.0001	<0.0001	<0.0001
Total Strontium	--	--	0.011	0.0089	0.011	0.0097
Total Thallium	--	--	<0.0008	<0.0008	<0.0008	<0.0008
Total Tin	--	--	<0.02	<0.02	<0.02	<0.02
Total Titanium	--	--	<0.003	<0.003	<0.003	<0.003
Silica	--	--	2.9	1.9	1.4	2.4
Total Vanadium	--	--	<0.002	<0.002	<0.002	<0.002
Calculated Parameters						
Anion Sum (me/L)	--	--	0.41	0.2	0.93	1.14
Bicarbonate Alkalinity as $CaCO_3$	--	--	<1	<1	<1	12
Carbonate Alkalinity as $CaCO_3$	--	--	<1	<1	<1	<1
Cation Sum (me/L)	--	--	0.48	0.36	0.98	0.99
Ion Balance (% Difference)	--	--	7.87	28.6	2.62	7.04
Langelier Index (@ 20C)	--	--	NC	NC	NC	-2.76
Langelier Index (@ 4C)	--	--	NC	NC	NC	-3.01
Saturation pH (@ 20C)	--	--	NC	NC	NC	9.96
Saturation pH (@ 4C)	--	--	NC	NC	NC	10.2
Dissolved Organic Carbon	--	--	--	7.2	--	2.1

Has any of the parameter exceeded Guidelines: No

If Yes provide date of occurrence and date when Department was notified:

Action taken:

Certified Lab:

Maxxam Analytics
90 Esplanade
Sydney, Nova Scotia
B1P 1A1
Tel: (902) 567-1255
Fax: (902) 539-6504

APPENDIX F ENHANCED FORESTRY PRACTICES

Appendix C Enhanced Practices that May Be Adopted from *Best Management Practices/Forest Planning in Municipal Drinking Water Supply Areas Nova Scotia* Nova Scotia Department of Natural Resources and Nova Scotia Environment and Labour, 2005.

The following are examples of further enhanced practices frequently recommended within municipal water supply areas.

Roads

• Follow the long term and short term road plans approved by the Watershed or Wellfield Advisory Committee. Note: Reduce the overall road network, minimize stream crossings and the length and number of skid trails.

• Roads should be located wherever possible on grades less than 10%.

• There should be minimal road width and curve radius to reduce road erosion.

• Establish grass cover on slopes and ditches adjacent to roadways.

Stream Crossings/Bridges/Culverts

• Water turnouts should be used on all roads where they approach streams to divert storm runoff from roads onto the forest floor.

• Roads should be gravelled where they approach streams with clean gravel.

• Road crossings should be placed at the narrowest section of the stream where stable approaches are available. The approaches and structure should be at right angles to the stream. This reduces sedimentation occurrence.

• Streams should be assessed for bridge or culvert installation and properly sized for peak flows. Failure to do so may result in frequent washouts and sedimentation.

• Open bottom culverts should be used when possible and properly set for fish passage. There is less washout with open bottom culverts. Open bottom culverts can usually be installed with less disturbance to the stream bottom.

• Bridge and culvert placement should create as little disturbance as possible.

Harvest Operations

• Pre-treatment conditions should be recorded.

• Follow operating plan prescriptions.

• Ribbon off stream buffers, special management zones, environmentally sensitive areas and any culturally significant areas.

• Meet or exceed regulations.

• Consider options to save or secure natural regeneration in harvesting applications.

• Operate machines in a manner to minimize impacts to soil, regeneration and understory.

• Time operations in sensitive areas to summer when ground is dry or in winter when ground is frozen or protected by snow cover.

• Keep machinery out of watercourses. Temporary bridges must be removed when the operation is completed.

• Keep debris out of waterways, recreational trails, roads, neighbouring immature stands, boundary lines and ribboned non cut areas.

• All garbage must be removed from the site and all hazardous substances properly disposed of outside the watershed.

• Forest debris should be left on the forest floor after harvesting.

• Portable toilet facilities should be used.

Equipment Maintenance/Oil Spills

Power saws should be used according to the following practices:
• Use vegetable-based oil to lubricate chains.
• Store fuel in approved containers and labelled clearly.
• Remove fuel containers from the site when work shift is over.
• Fuel power saws over a spill pad and keep all fuels on the spill pad.
• Use fire retardant pouches with each saw.

Use of machinery should follow these precautions:
• Vegetable-based oil should be used to lubricate chains.
• Machines should be kept clean and leak-free.
• Machines should be equipped with industry approved fire extinguishers.
• Machines should carry a spill kit.

• Fuel tanks for machinery should be clean, leak-free, have a locking device, a no-drip nozzle, used with a spill kit, and should be stored on mineral soil as far away as possible from watercourses (at least 100 metres or 330 feet).

• No fuel or oil should be stored within the boundaries of the watershed or stored in approved areas.

• Refuelling should take place on spill pads outside of all buffer zones.

• All fuel leaks over five litres should be reported to the Water Utility and Nova Scotia Environment within one hour.

• Fire extinguishers should be available during all harvesting operations and should also meet required specifications.

• All trucks with loaders should have remote engine shut down.

• All trucks with loaders should have a hydraulic tank float switch.

Special Management Zones

• Zones may be enhanced beyond the regulations at specified locations, in cooperation with landowners, particularly the main water supply bodies and those close to the point of intake. Examples include enhanced machine exclusion zones, greater amounts of living trees to be retained in harvesting operations, no cut zones and limits on size of openings within a special management zone that can be created.

Harvesting

• Limits on clearcut size, distribution of cuts and amount of harvest area within specified time frames are sometimes negotiated with landowners.

Fire Fighting Equipment

• Persons in charge of an operation or activity conducted in the woods or within 305 metres (1,000 feet) of the woods during the fire season are required by regulation under the Forest Act to provide and maintain fire fighting equipment. Further details may be obtained from the Department of Natural Resources.

APPENDIX G WATERSHED SIGNS

Figure 9. Violations Sign

Figure 10. Keep it Clean Sign