






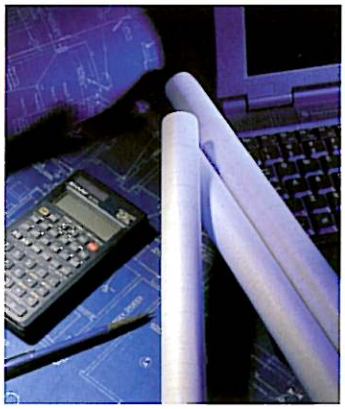

Cape Breton Regional Municipality
New Waterford Water Supply
Source Water Protection Planning for the Waterford and Kilkenny Lakes Watershed

ADI Limited

File: (24) 4012-081.2
Date: March 2007

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EXECUTIVE SUMMARY

ADI Limited (ADI) was retained by the Cape Breton Regional Municipality (CBRM) to assist with Source Water Protection Planning (SWPP) for the Waterford and Kilkenny Lakes water supply Watersheds; a Provincial requirement to operate the New Waterford and area utility. This report identifies the current status of key aspects of SWPP, including: delineating the source area, identifying and managing risks, as well as developing a suitable monitoring plan and Citizen Advisory Committee.

The SWPP plan should be regarded as a work in progress, constantly evolving to meet new issues. The contents provide a practical basis for CBRM managers and a Source Water Protection Advisory Committee to focus future efforts in protecting the supply.

The three guiding principles for SWPP and implementation include:

1. a geographical focus on the Watershed from a human and ecological use perspective;
2. a collaborative partnership based on those most affected to shape key decisions; and
3. a basis of sound science and data.

The CBRM and its predecessors have made significant progress over the last number of years on protection of the Town of New Waterford's water supply. However, its location in proximity to historical coal mining facilities, easy access by the public to the lakes and watershed for recreational and forestry purposes and indiscriminate waste dumping makes it particularly important to be vigilant with future protection initiatives.

The water supply consists of two separate watersheds associated with Waterford and Kilkenny Lakes, joined by a transmission line. The Watersheds are approximately 75% owned by the CBRM. There are several potential sources of man-made contaminants within the Watersheds, paramount of which is potential acidic drainage from the Scotchtown Summit Waste Stone Dump adjacent Waterford Lake.

The assessment has suggested some improvements. There is a deficiency in scientific information on the occurrence, quantity and quality of water, as well as the associated aquatic biological system within the Watershed upon which to base management decisions. More intensive investigations are recommended to determine the full impact of the Summit Stone Waste Dump on Waterford Lake.

An emergency back-up groundwater supply was developed by the Cape Breton Development Corporation (CBDC) in the mid 1990's to replace Kilkenny Lake, if deemed necessary. The wells are in place, but pumping, treatment and transmission facilities are not. Full development of this system should be given consideration due to potential impacts of climate change and effectiveness in enforcing the watershed protection guidelines.

Consideration should be given to improving the existing level-of-effort in emergency response and watershed security, as well as water supply specific public education programming.

A Forestry Management Plan should be developed to map, monitor and maintain the health of the forest so that gradually with time it can create a forest capable of supporting selective forest operations while simultaneously maximizing water resources management.

Finally, given the widespread public use of the watershed lands, there is a need to develop a SWPP Advisory Committee comprising knowledgeable, responsible individuals who are willing to act in a collaborative manner.

1.0 INTRODUCTION

1.1 Location

The Town of New Waterford within the Cape Breton Regional Municipality (CBRM), is located approximately 20 kilometres to the northeast of the City of Sydney on the east coast of Cape Breton Island (Figure 1-1). The community is nestled between Bridgeport Basin to the east, the Atlantic Ocean to the north and Sydney Harbour to the west. This community of approximately 6,900 people is located within the Eastern Zone of the CBRM.

The Town of New Waterford prospered in its earlier years as a coal mining community. It is one of eight municipal units in the Industrial Cape Breton area that were amalgamated forming the CBRM in 1995. The last coal mine closed in 2001.

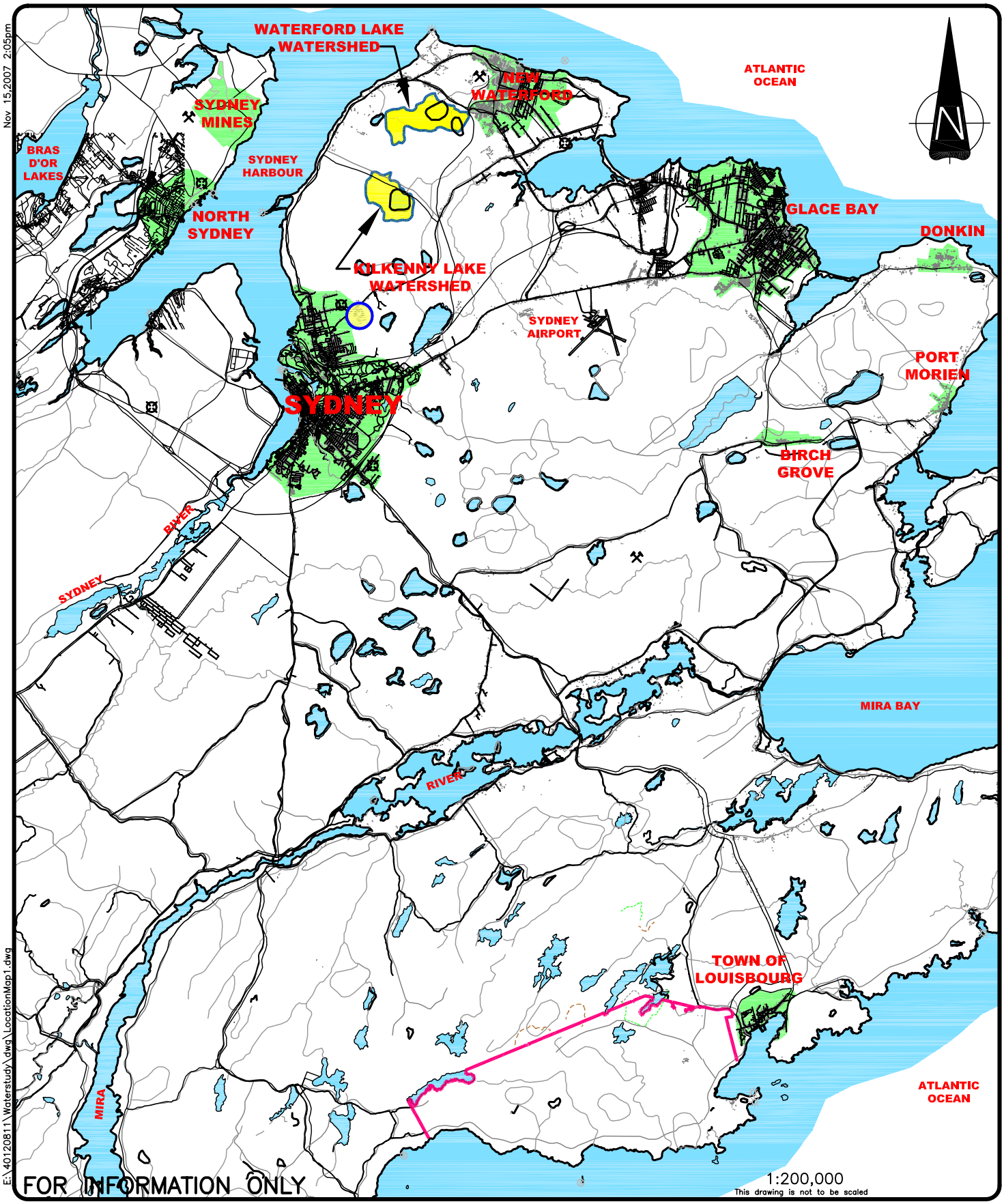
1.2 Goals of This Report

This report has been prepared for the CBRM by ADI Limited (ADI) to meet the requirements of Nova Scotia Environment and Labour's (NSEL) Source Water Protection Planning (SWPP). This is now a condition of approval for all water works in the Province. Given historical work (Section 1.3) and ongoing studies (Section 1.4), SWPP for the New Waterford water supply should be considered in its formative stages and thus, a "work in progress".

1.3 Background

The background on a piped water supply for the Town of New Waterford is elaborated by C. A. Campbell Consultants Limited (C.A. Campbell) in 1972, as well as CBCL Limited (CBCL) in 2004. These accounts note that the first system of piped water for the Town was built in 1912 as part of the New Water Lake Power Plant. At the time, Seaboard Power Corporation sold water to Dominion Utilities Ltd., which inturn sold water to the consumers in New Waterford and adjacent areas. The source of water at that time was Waterford Lake near town. But, with the operating coal mines, the demand exceeded the capacity of the Lake.

In or about 1950, the power plant located at the existing Waterford Lake Intake and treatment plant site was decommissioned and the basement of the power plant converted to a potable water pumping station. Shortly after, an overland pipeline was constructed from Kilkenny Lake Brook to Waterford Lake. This temporary measure was intended to take advantage of



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Proj. SOURCE WATER PROTECTION PLANNING COMMUNITY OF NEW WATERFORD

Dwg. GENERAL LOCATION PLAN WATERFORD & KILKENNY LAKE WATERSHEDS

Drawn By: NB	Proj. No. 4012-081.2	
Dwg. Standards Chk. By:	Dwg. No. FIGURE 1-1	
Designed By: MB/FB	Dwg. Design Chk. By: MB	Rev. 0

the waters from both Kehoe and Kilkenny Lakes. This measure increased the catchment area of 188.6 hectares for Waterford Lake to 461 hectares, but had no effect on the estimated storage capacity of 63.6 million litres, or the safe yield of the system of 4.4 million litres per day (MLPD).

C. A. Campbell (1972) recommended that Kilkenny Lake be connected to Waterford Lake via an underground transmission line and estimated a safe yield of 8 MLPD would result, or a yield approximately 3.5% greater than the expected average daily demand. The pipeline was constructed in 1977 to 1978 and the overland pipeline from the brook abandoned. The system in place today is essentially the same.

In 1987, C.A. Campbell completed another investigation to study concerns that Kilkenny Lake was being drawn down more than expected to augment the resources of Waterford Lake. Using a reevaluated safe yield calculation from 1981, which estimated 9 MLPD from the combined lake system, they concluded, based upon a maximum yearly usage occurring in 1985, that the system was capable of 29% more capacity and that additional storage was not necessary.

In 1992, the Waterford Lake dam was upgraded to correct some leakage problems, resulting in a slight increase on storage capacity.

In the early 1980's, concern was expressed for potential contamination of Kilkenny Lake by CBDC's Victoria Junction Tailings Basin in the adjacent watershed to the south. In 1996, CBDC tested and developed a backup groundwater supply within the Waterford Lake Watershed to replace Kilkenny Lake if such a situation occurred (ADI Nolan Davis, 1996). It was determined that the required demand of 4.1×10^6 LPD could be withdrawn from a two to three well wellfield positioned on Town of New Waterford Water Commission lands south of Waterford Lake. To date, it has not been necessary to make it operational.

The Waterford Lake system will continue to be the source for the Town's potable water. It combines two distinct Watersheds, which for the purpose of this protection planning is referred to herein as the Waterford and Kilkenny Lakes Watersheds.

The existing NSEL approval allows for an average daily withdrawal rate of 6.8 MLPD. There is no maximum withdrawal rate cited.

This SWPP is but one of several efforts the CBRM has underway to provide a safe and reliable public water supply for the Town of New Waterford.

1.4 On-Going Activities

The CBRM is currently in the design/site preparation phase of a new water treatment plant for the Town of New Waterford and adjacent areas, including New Victoria, Scotchtown and Lingan. It is anticipated that construction of the new plant will commence during the summer of 2006 and become operational in mid 2007. The new system will allow the Municipality to meet The Treatment Standard for Municipal Surface Water Supplies. The plant will provide fully treated water to area residents.

The CBRM is working on a number of fronts to ensure the long-term integrity of its public water supplies. These efforts are articulated in the Municipal Planning Strategy for the Cape Breton Regional Municipality (2004). These include planning for long-term supply of safe and dependable water supplies, public and private land owner education, acquisition of lands within water supply watersheds, development of protection plans, designation of watershed lands, refinement of zoning regulations within watersheds, wastewater management district planning for existing homes and/or subdivisions within watersheds and cooperation and liaison with other levels of government. Other activities include expansion of their digital database, striving toward 100% water metering for all customers and working in an effort to transfer CBDC lands in the water supply watersheds to the CBRM.

1.5 Report Outline

Building upon the background outlined above, the main body of the report initially summarizes the characteristics of the existing water system supplying the Town of New Waterford (Section 2.0). The remaining sections follow NSEL's five steps to Source Water Protection Planning, namely:

Section 3.0 Delineate Source Areas
Section 4.0 Identify Potential Risks
Section 5.0 Develop SWP Strategies to Manage Risks
Section 6.0 Develop a Monitoring Plan
Section 7.0 Develop SWP Advisory Committee

The text for each section summarizes salient points. Support documentation can be provided upon request.

2.0 EXISTING SYSTEM

The CBRM currently operates the New Waterford water supply at Waterford Lake under approval from NSEL effective 13 November 2003 (Approval No. 2003-032762, Authorization #1251). The approval expired on 01 September 2005. A specific condition of that approval is: *"The proponent shall as part of the System Assessment Report for the New Waterford Water Treatment and Distribution System (Approval #2003-032756) include a review of the safe yield for the Kilkenny & Waterford Lake source".*

CBCL submitted the assessment document in March 2004, however, the safe yield review was not included. It is believed that renewal of the water withdrawal approval is based upon this review being completed. As of this writing, the CBRM has not completed the review of safe yield for the watershed.

The intake for the surface water supply for the Town of New Waterford is located at the northeastern end of Waterford Lake at UTM (NAD 82) coordinates 5123459.6 N, 4606156.6 E (CBCL, 2004). The 450 mm diameter intake pipe extends approximately 30 metres into a screened box structure and connects with a screening chamber, or wet well at the shore. The intake is in approximately 1.5 to 2.1 metres of water (fluctuates seasonally).

Raw water is transferred through a below grade concrete, screened wet well by gravity and is pumped via an upstream pumping station with wet well, where flouride is injected for dental purposes and polyphosphate added to keep iron and manganese in solution. Chlorine gas is metered into the transmission main leaving the pumphouse as a disinfectant; caustic soda is added to adjust pH levels.

Staff advise that the pipeline connection between Kilkenny and Waterford Lakes is open on average between 6 and 8 months of the year.

The partially treated water is transferred to customers in the district via a system of water mains and laterals.

2.1 Demand

The CBRM staff advise that the current average daily withdrawal from the lake source is in the range of 6.82 MLPD, with about 0.91 MLPD being utilized by Nova Scotia Power Incorporated's (NSPI) Lingan Generating Station. This rate puts the Municipality slightly above the approved rate of 6.8 MLPD.

2.2 Raw Water Quality

Review of available raw water chemical analytical results dating back to 1981 for Waterford Lake indicates, on average, that turbidity and iron do not meet the Guidelines for Canadian Drinking Water Quality (GCDWQ). Many other parameters at one time or another, also did not meet the standards. As for Kilkenny Lake, the water is commonly outside the Guidelines for Canadian Drinking Water Quality (GCDWQ) for many of the parameters indicated (CBCL, 2004).

The source water (taken as Waterford Lake water) is characterized as soft, slightly coloured (< 3 to 21 TCU), aggressive (pH 6.5 to 8.1 units) and low in turbidity (0.4 to 3.3 NTU). It exhibits relatively low total organic carbon (1.1 to 3.0 mg/L) and metals (iron plus manganese of 0.01 to 0.16 mg/L). Additional details are provided in Section 3.1.6.

Biological results for March 2003 show a low count of total coliform bacteria at 8 MPN/100 ml of sample and no faecal coliform. Trihalomethane (THM) levels have typically been within the 100 ug/L GCDWQ limit. There have not been any samples analysed for Giardia and Cryptosporidium to ADI's knowledge. Insect larvae have also been reported to be a problem in Waterford Lake. They tend to be more of a nuisance issue, but the potential exists to carry other pathogenic organisms (CBCL, 2004).

3.0 DELINEATION OF SOURCE AREAS

Section 3.1 summarizes the present state of knowledge concerning physical characteristics of the hydrological cycle (flow of groundwater and streams) within which the extraction is taking place. This forms the technical base upon which the delineation of the Source Water Protection areas (Section 3.2) is based.

3.1 Conceptual Model for Ground and Surface Water Flow Fields

Detailed groundwater and limnological studies have been undertaken within the Kilkenny Lake Watershed by the CBDC, as part of the commitment to track any potential contamination from their Victoria Junction Tailings Basin in the adjacent watershed to the south. Detailed groundwater supply investigations have been undertaken within and adjacent the Waterford Lake Watershed by NSEL, as well as CBDC.

The conceptual model developed below identifies the occurrence, quantity and quality of groundwater, streams, lakes and precipitation, as well as the pathways for movement. It is based upon the information referenced above and relevant experience elsewhere in the Sydney Coalfield.

3.1.1 Water Balance (Availability)

Climatologically, the area experiences a humid continental climate. Based upon Environment Canada's "Sydney" station, the 30 year Normal (1971 - 2000) total annual precipitation is 1501 mm; with a mean annual air temperature of 5.6°C.

The 30 year Normal water balance (Figure 3-1) indicates a minor annual water deficit (38 mm, 3% of total precipitation) occurring primarily in July and August. Actual evapotranspiration losses are around 500 mm (33%). There is a large water surplus of 1003 mm (67%) available for runoff and infiltration, which peaks in the spring (April and May), with a secondary peak in the fall (November and December).

3.1.2 Hydrological Setting (Waterscape)

Once the water surplus reaches ground surface, its movement is controlled by the Hydrological Setting in which it is found.

The Town of New Waterford water supply is positioned within the Lowland Region (Figure 3-2) Sedimentary Plain District (Baechler et al, in preparation). In general, it is dominated by a thin glacial till overlying massive sandstone sedimentary bedrock. Three Hydrostratigraphic Units (HUs) control water flow within this setting, including (Figure 3-3) the Lower Morien (bedrock) HU, overlain by a Till HU; the near surface portion of which has been altered to a Soil HU. Only one major wetland is present, positioned adjacent to and west of Waterford Lake.

Hydrogeological investigations by Baechler (1986) and ADI Nolan Davis (1996) over the ridge forming the southern watershed boundary of Waterford Lake indicated safe yields of 900 to 1600 Lpm and transmissivities of 164 to 518 m^2/d, agreeing with the conceptual model.

FIG.3-1: SYDNEY WATER BALANCE DIAGRAM

1971-2000 NORMALS

AFTER BAECHLER et al (In Preparation)

Calculated by Env. Can using Thornthwaite method assuming water holding capcaitey 100mm, lower zone 60 mm and heat index 27.39

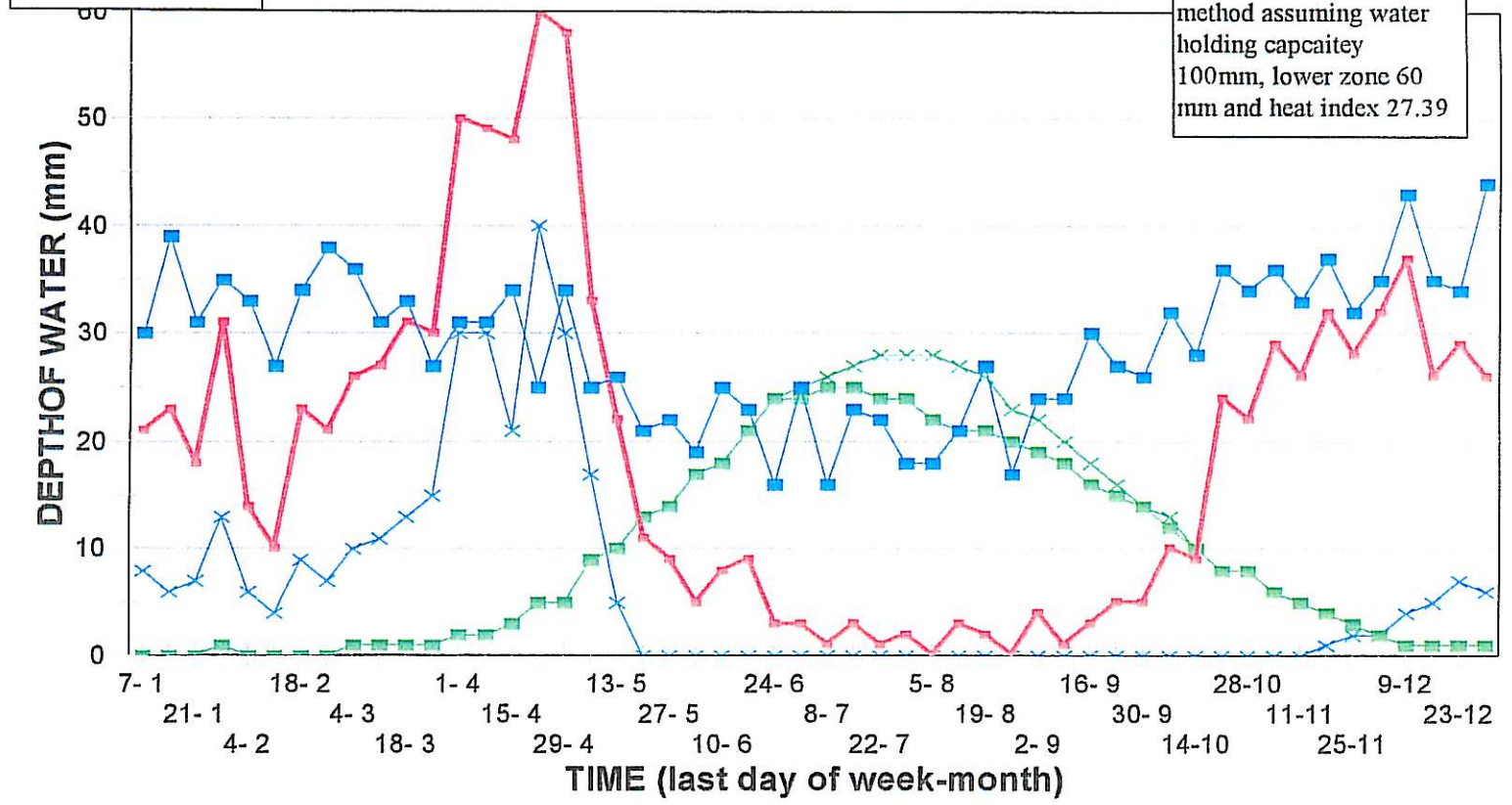

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FIGURE 3-2A

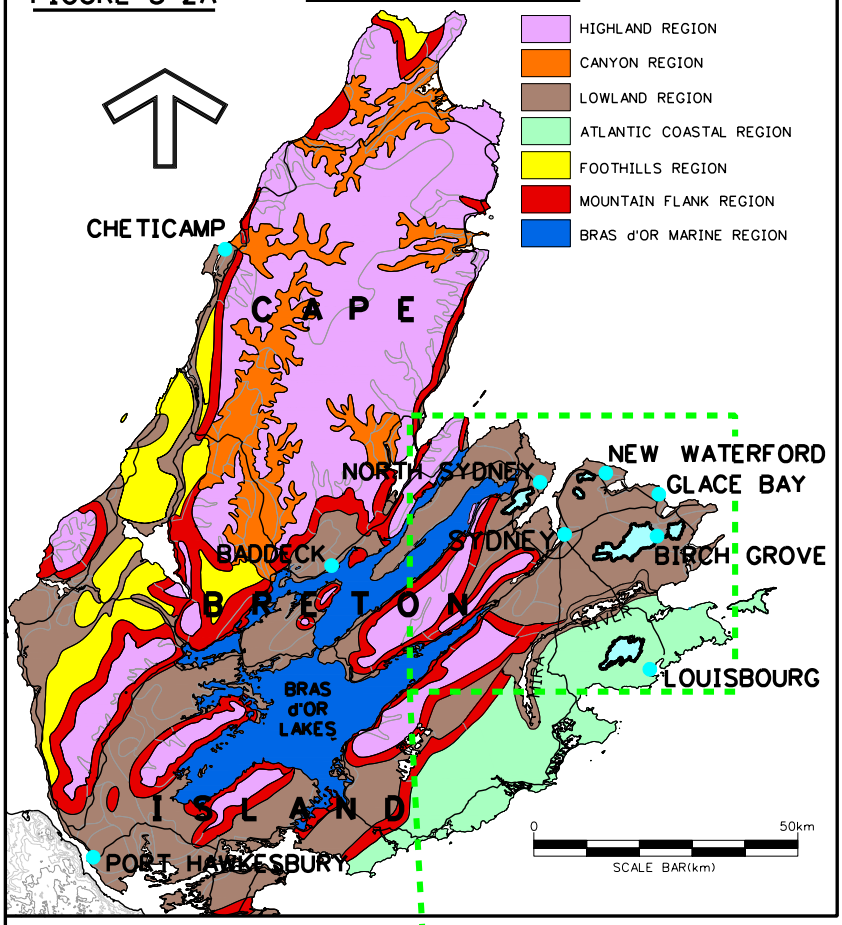
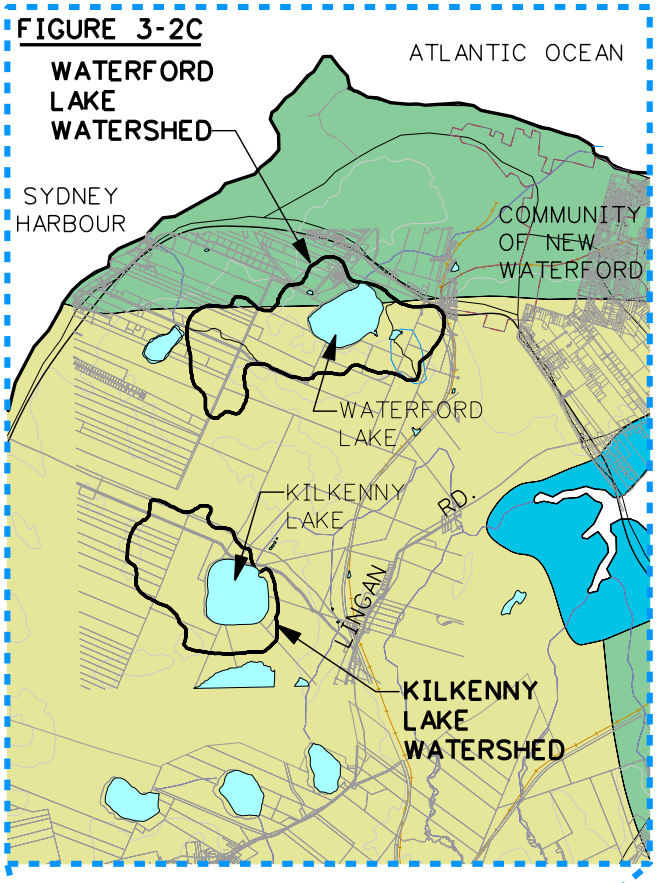


FIGURE 3-2C



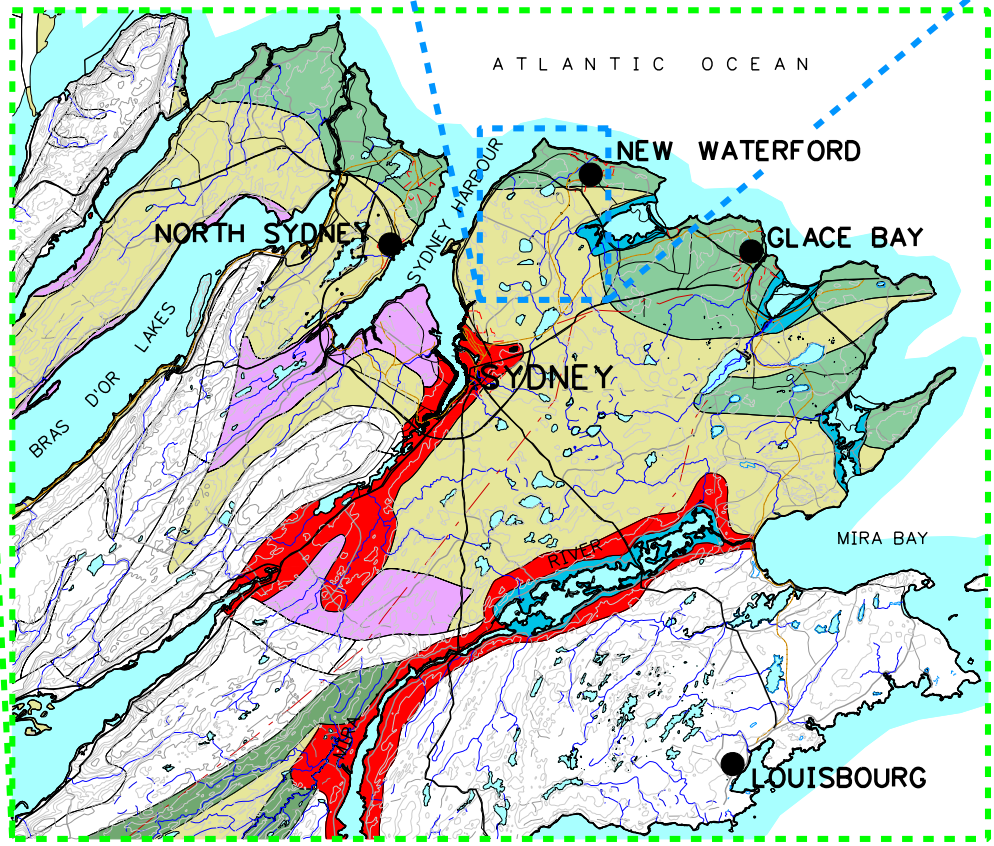


FIGURE 3-2B

LOWLAND HYDROLOGICAL REGION

- ALLUVIAL VALLEY DISTRICT
- WINDSOR LOWLAND DISTRICT
- SEDIMENTARY PLAIN DISTRICT
- HOMOCLINAL FLANK DISTRICT
- ESTUARINE DISTRICT
- KARST DISTRICT

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Proj.
SOURCE WATER PROTECTION PLANNING
COMMUNITY OF BIRCH GROVE

Dwg.
HYDROLOGICAL SETTING
FOR WATERFORD & KILKENNY LAKES
(After Baechler et al, in preparation)

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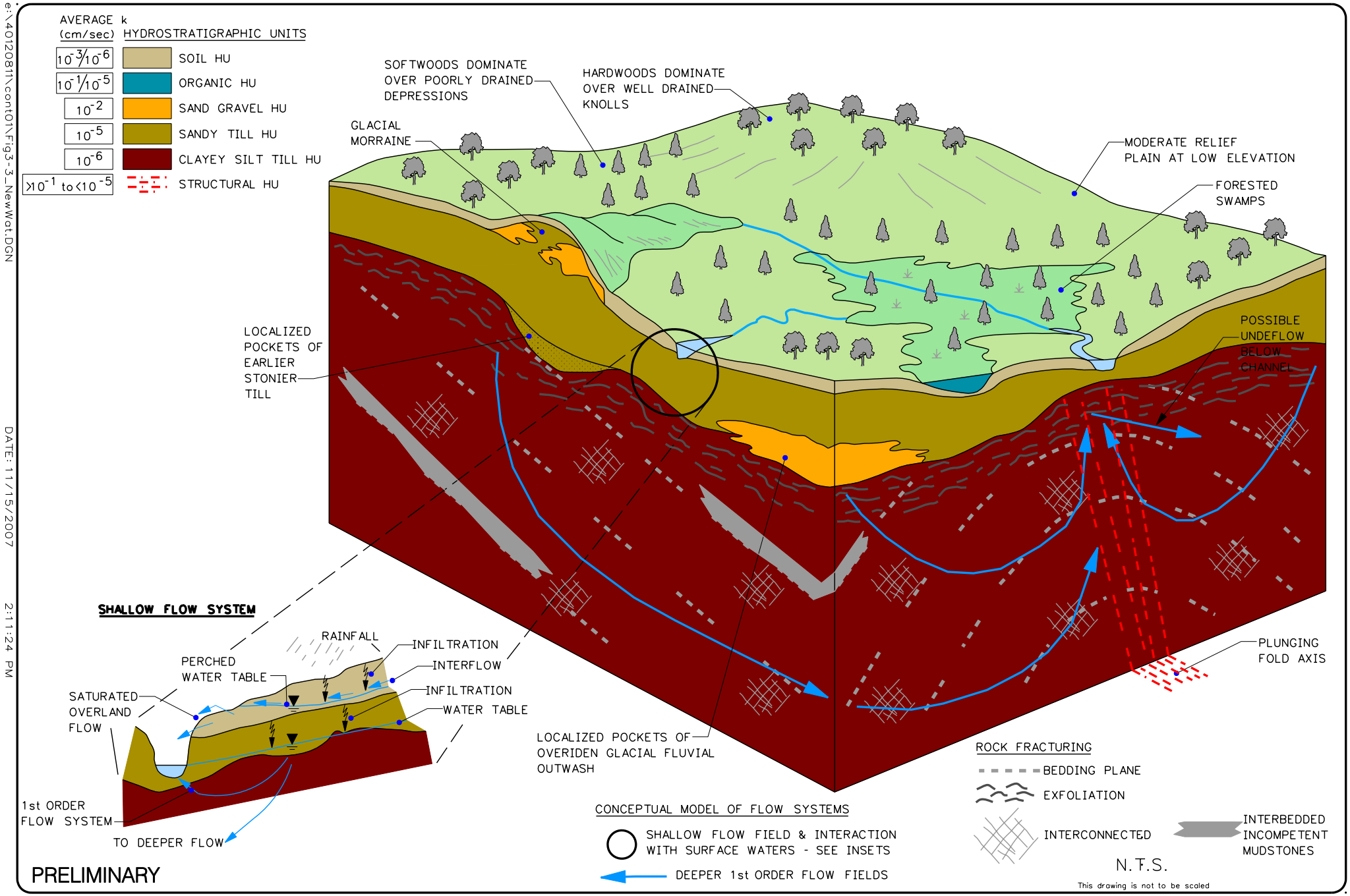

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Proj.
SOURCE WATER PROTECTION PLANNING
TOWN OF NEW WATERFORD

Dwg.
LOWLAND REGION SEDIMENTARY PLAIN DISTRICT CONCEPTUAL HYDROLOGIC MODEL

Drawn By: NEB	Proj. No. 4012-081.4	
Dwg Standards Chk. By:	Dwg. No. **FIGURE 3-3**	
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3.1.3 Runoff (Pathways)

The spatial arrangement and 2 order-of-magnitude range in permeability between these units create a flow field where surface runoff is initially controlled by interflow within the Soil and Organic HUs perched over the Till HU. A portion of this runoff infiltrates through the lower permeable Till HU and recharges the Lower Morien (bedrock) HU, roughly estimated at a long-term annual average of 380 mm, or 25% of total annual precipitation and 38% of the water surplus.

Given the high water surplus, relatively low permeability of the major HUs (bedrock and till) and low topographic relief "Local" first order, groundwater flow fields are expected to dominate. Here, topographic highs form groundwater recharge areas and discharge into the adjacent topographic low. As a result, ground and surface water watersheds should be generally similar.

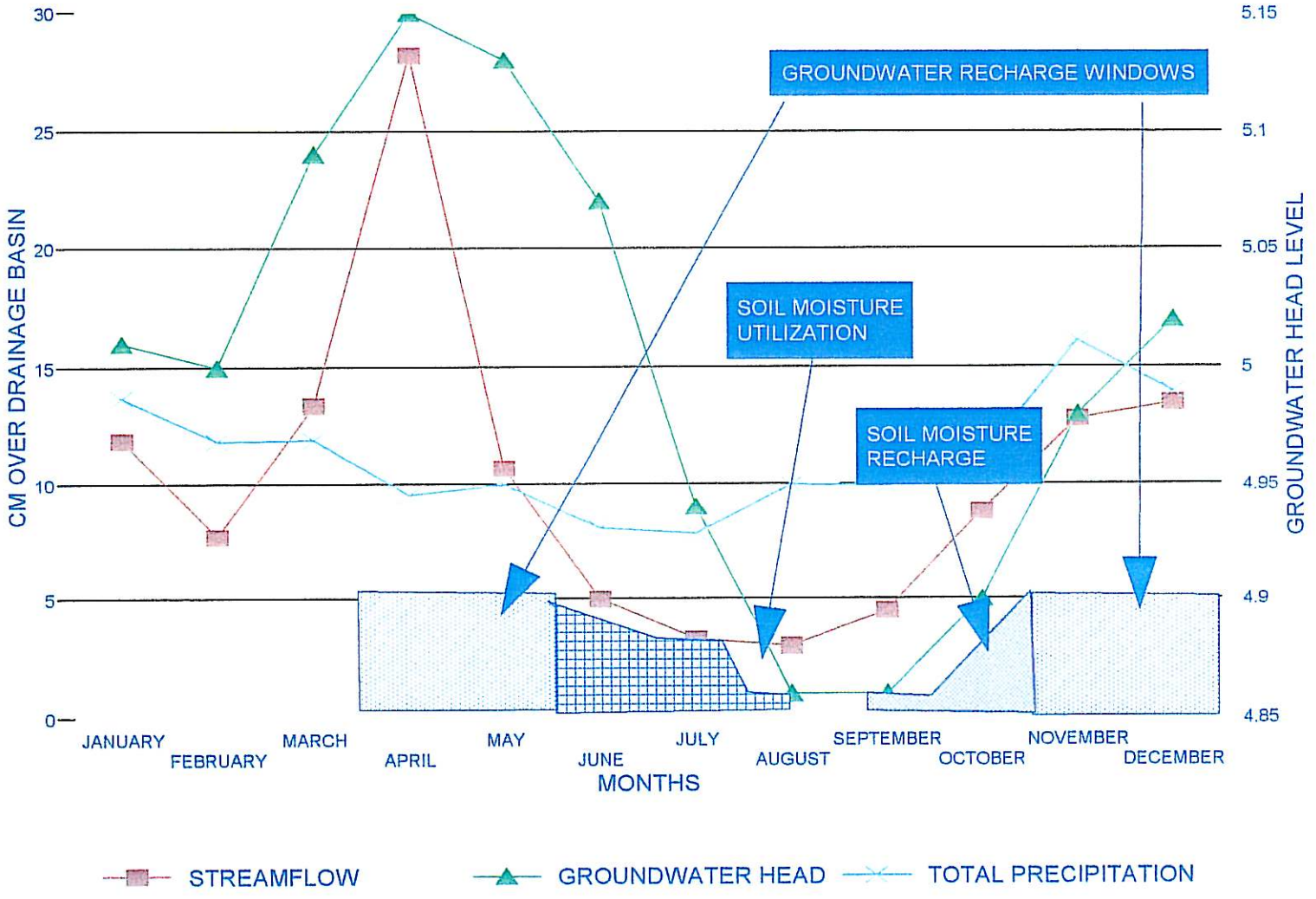
The seasonal response of streamflow and groundwater level within the Lower Morien (bedrock) HU is driven by the water balance (Figure 3-4). Peaks typically arise over nine months in two distinct wet seasons. Warming trends in March and April release the snowpack and frost cover, creating the "Spring Recharge Window", with peak groundwater head levels and streamflows. Summer recession begins in the May/June period, declining to minimums in September. The fall rains received from October to December, inclusive, create the "Fall Recharge Window". Winter conditions of snowfall and frost usually create a minor recession in groundwater levels and streamflow in February. However, the extent is dependent upon the degree of moderating conditions creating snowmelt and rain on snow runoff.

Higher than normal permeabilities can be encountered within the shallow bedrock. These are due to subhorizontal fracturing created as exfoliation planes from glacial unloading. These zones may provide sufficiently large enough hydraulic conductivity (K) compared to the overlying Till HU to create a regional drain effect; thereby altering the First Order flow fields and/or reducing the baseflow component to streams and lakes.

3.1.4 Lakes

Numerous glacial lakes are present over the Sydney Coalfield, derived primarily of glacial origin. Two main lakes are present within the New Waterford water supply watershed. NSEL mapping notes Kilkenny Lake is slightly larger, at 55 hectares, than Waterford Lake (44 hectares).

FIG 3-4: WATER BALANCE DIAGRAM
STREAMFLOW AND GROUNDWATER



A detailed limnological study was undertaken of Kilkenny Lake by C.A. Campbell (1983); nothing is available on Waterford Lake. Field work was undertaken between December 1981 and February 1983 to cover under ice, spring bloom, summer stagnation and fall overturn conditions. This provided a detailed set of baseline data for future comparison.

The lake was found to be a slightly acid, oligotrophic system, with moderate buffering capacity and waters of exceptional clarity; uniformly high quality throughout the year. Since the lake is relatively shallow (5.9 metres) it does not become thermally stratified. Lake volume is replaced about two times per year. The principal source controlling water chemistry was from precipitation, with very little influence from inflowing groundwaters. Substantial reserves of heavy metals were found to be present in lake bottom sediments. As long as the lake waters remain only slightly acidic, no water quality problems were anticipated.

3.1.5 Groundwater-Lake Interaction

Groundwater-lake interaction is expected to be governed by: a) interflow and storm saturated overland flow within the Soil HU; b) the water table in the Till-shallow bedrock; and c) flowing artesian conditions from the "Local" groundwater flow field. Given the higher permeability within the shallow bedrock, there maybe a component of groundwater underflow down-valley under the Till, which does not discharge into the lake.

The unique feature of these lake systems is the absence of defined stream drainage channels into the lakes at 1:10,000 scale mapping. This suggests interflow through the Soil HU and discharge of groundwater from the "Local" groundwater flow field within the bedrock Lower Morien HU will control runoff into the lakes. The latter is supported by anecdotal information on Kilkenny Lake during periods of low water levels where springs were noted in the base of the lake.

However, the limnological investigation of Kilkenny Lake (C.A. Campbell et al, 1983) noted only a minor groundwater component; with inflow limited to within about 200 metres from the lake shore. The presence of a layer of fine sediment overlying bedrock under the lake was expected to form a low permeable layer forcing any deeper groundwater to pass under the lake.

3.1.6 Water Chemistry

Two chemical analyses were available of the raw surface waters at the intake from Waterford Lake on 19 June 2003 and 26 January 2004. Approximately 30 measured, calculated, inorganic, physical and metal parameters were analyzed for, except on the latter when over 50 inorganics and 21 PAH compounds were analyzed. No associated lake levels were available.

The analyses indicated a fairly consistent fresh (TDS 44 to 48 mg/L), soft to moderately hard, corrosive to encrusting, moderately coloured (22 to 26 TCU), lightly turbid (1.1 to 5.2 NTU) water. The typing is quite variable ranging from a Na-HCO_3 to Na/Ca-SO_4/Cl, which is not what would be expected. It exhibited anomalously elevated alkaline pH (6.4 to 10.2), with normal alkalinity (4 to 21 mg/L). Nutrients were present as low concentrations of nitrogen (NO_2 and NO_3) of <0.06 to 0.12 mg/L and low total organic carbon (2.5 to 3.0 mg/L). "Heavy" metals were present predominately as manganese (0.031 to 0.124 mg/L); iron was non-detectable. Other metals that were sporadically detectable at low concentrations included aluminum, barium, copper and zinc.

A summary of the chemical signature for the Lower Morien HU underlying the Watershed is provided by Baechler, et al (in preparation). Generally, the groundwater is characterized as a fresh (TDS average 129 mg/L), soft to hard, primarily corrosive, predominately calcium-bicarbonate type water. The pH is generally slightly alkaline (6.3 to 8.1) and alkalinity averages 82 mg/L. Nutrients are at non-detectable to low concentrations, primarily comprised of total organic carbon (averaging 2 mg/L). Iron (averaging 0.8 mg/L) and manganese (averaging 0.5 mg/L) are usually at relatively low concentrations, but localized elevated zones have been documented.

3.2 Source Water Protection Areas

The delineation of the SWPP area was based on the hydrological System draining water to the extraction point, defined as the "Watershed". Given the conceptual model, the "Local" groundwater and surface watershed divides are assumed to be similar.

At this level of assessment, the depth of the fresh water resource within the groundwater watershed is controlled by fracture density in the Lower Morien HU. This is taken at present to be limited to a 200 metre depth boundary.

There is presently insufficient technical data to sub-divide the Watershed into higher priority zones requiring localized SWPP such as riparian zones, groundwater recharge zones, etc. Therefore, to be conservative, the entire Watershed is regarded as the area designated for SWPP.

While the "Airshed" concept, which controls the quantity and quality of precipitation entering the "Watershed" is important, it is beyond the scope of CBRM to control. The concept, while valid, is not incorporated directly into defining the SWPP area.

Similarly, the "Bioshed" component, which controls the distribution of wildlife and aquatic life using the "Watershed", is important in controlling the ecological aspects of water resource planning. The concept, while valid, is not accommodated directly into defining the SWPP area, due to lack of relevant information.

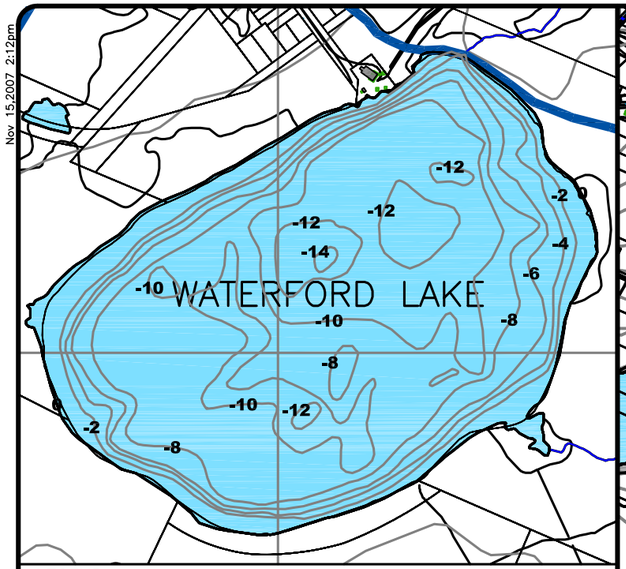
Given the conceptual model of water movement, the watershed draining into the two lakes has been delineated in Figure 3-5. It is based upon 1:10,000 scale mapping with a 5 metre contour interval, courtesy of Cape Breton Regional Metro Planning Department. Due to the coarseness of the contour interval, presence of wetlands and hydrogeology associated with the Tailings Basin and remediation of the Scotchtown Stone dump site, localized portions of the divide are arbitrary.

Kilkenny and Waterford Lake Watersheds are identified as located within IFJ-9B and IFJ-SD39, respectively, on Nova Scotia Watershed Areas Map 11K/1. The SD designation for Waterford Lake denotes shoreline direct drainage to salt water. The approximated land area draining to the lakes is listed at 137 and 189 hectares, respectively. The NSEL watershed delineation system identifies the Waterford Lake system as part of shore drainage 1FJ-SD39. The Kilkenny Lake drainage basin is within 1FJ-9B, locally referred to as Kilkenny Lake Brook, a tributary to Northwest Brook.

Watershed delineation is complicated by two factors. Within the Waterford Lake system, the exact location of the divide within the wetland adjacent to and both east and west of the Lake is unknown. For the Kilkenny Lake system, the position of the groundwater watershed may not be similar to the surface water watershed to the south, due to complexities created by CBDC's tailings basin operations. Both of these problem areas become of critical importance in defining the risks posed by potential contaminant sources.

At this stage, the Waterford and Kilkenny Lakes Watersheds areas range from 233 to 275 hectares and 223 to 317 hectares, respectively (including the lakes).

Nov 15,2007 2:12pm



LEGEND:

-12 LAKE BOTTOM CONTOURS(ft.)
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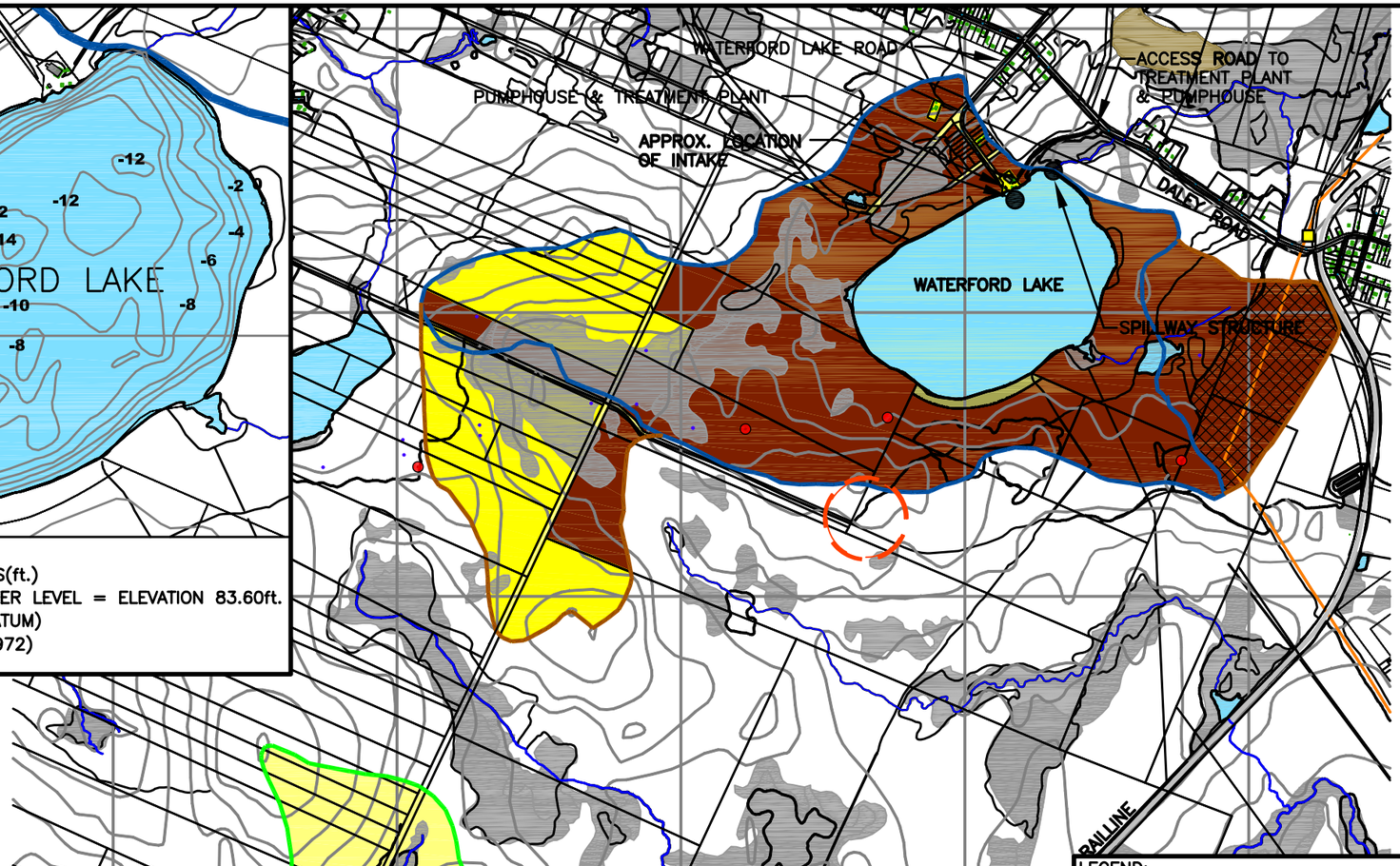
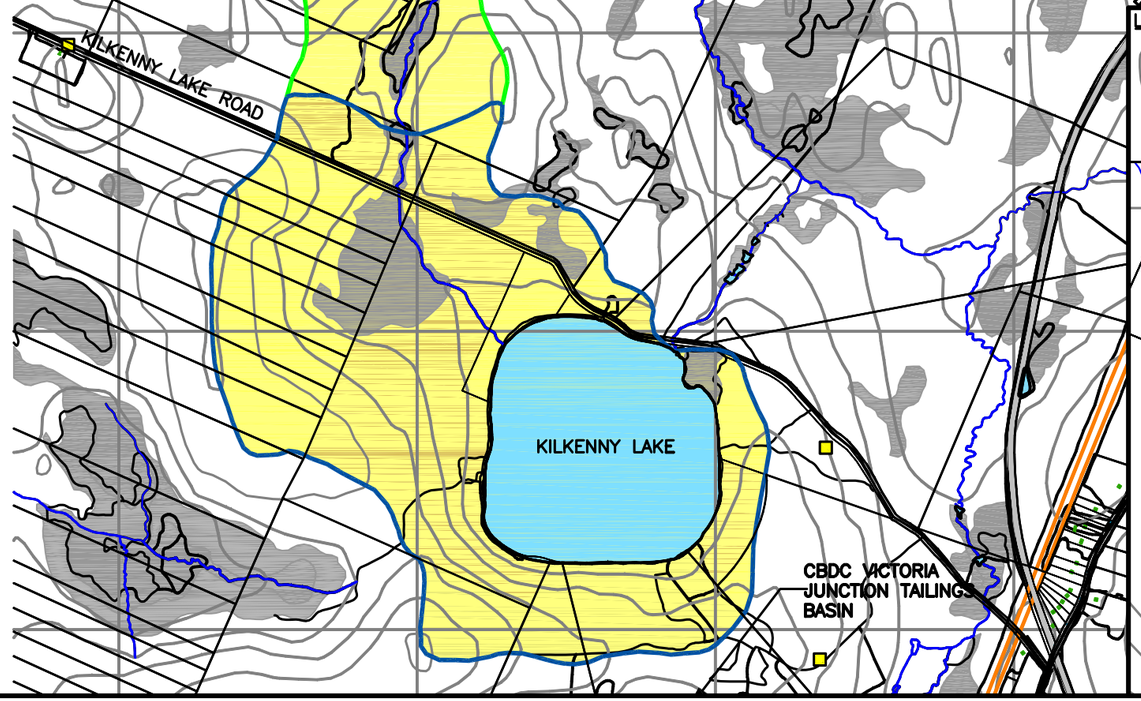
(DOMINION COAL CO. DATUM)
(after C.A. Campbell, 1972)





LEGEND:

-12 LAKE BOTTOM CONTOURS(ft.) IN 1972
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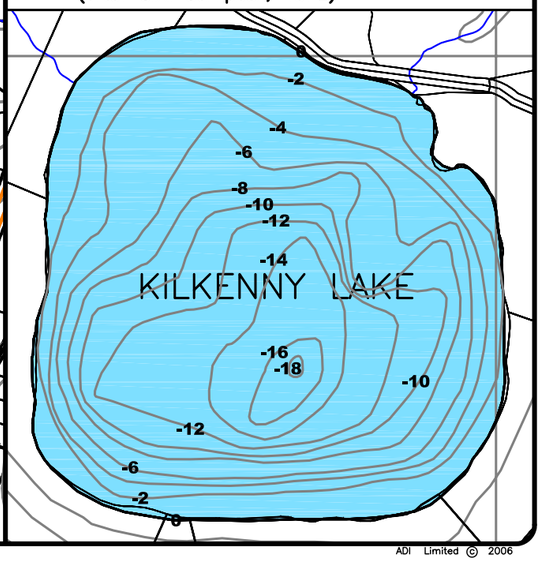
(GEODETIC DATUM)
(after C.A. Campbell, 1972)



No.	Issue	Date
1	ISSUED FOR REVIEW	29-JAN-07

LEGEND: (Data courtesy of CBRM Planning Dept.)

- LAKES/RESERVOIR
- APPROX. LOCATION OF WETLANDS
- RIVERS/BROOKS/STREAMS
- APPROX. GROUND SURFACE CONTOURS(m)
- PROPERTY BOUNDARIES
- WATERSHED BOUNDARIES AS DEFINED BY ADI
- POTENTIAL ADDITION TO WATERSHED BOUNDARY AS DEFINED BY ADI
- POTENTIAL SUBTRACTION TO WATERSHED BOUNDARY AS DEFINED BY ADI
- LAND USE STRUCTURE (HOMES/BUILDINGS)
- GENERAL LAND USE(Other than Agricultural)
- AGRICULTURAL LAND USE
- LOCATION OF ILLEGAL DUMP SITES
- LOCATION OF ABANDONED MINE SHAFTS

No.	Revision	Ckd. By	Date

LAND OWNERSHIP WITHIN WATERSHED

- CBRM LANDS
- PROVINCIAL CROWN LANDS
- FEDERAL CROWN LANDS
- PRIVATE LANDS
- CBDC LANDS
- LOCATION OF BACKUP GROUNDWATER WELL FIELD
- SCOTCHTOWN SUMMIT COAL STONE TIP WITHIN WATERSHED

PRELIMINARY

Const. North

Drawn By: NB
Dwg. Standards Ckd. By:
Designed By: MB
Dwg. Design Ckd. By:
Date Printed 07.Nov.15

ADI Limited
Sydney, NS, Canada
Engineering, Consulting, Procurement and Project Management

Project Title
SOURCE WATER PROTECTION PLANNING TOWN NEW WATERFORD

Dwg. Title
WATERFORD/ KILKENNY LAKES WATERSHEDS DELINEATION

Project No. 4012-081.2

Dwg. No. FIGURE 3-5 | Rev. No. 0

Scale 1:20,000
This drawing is not to be scaled

Offices located in:
Charlottetown, Moncton, Saint John, Truro, Halifax, Sydney
Port Hawkesbury, St.John's, Fredericton and Salem, NH

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Until such time as field work can verify the position of the divide, development of yields should use the smaller area to be conservative. On the other hand, a similar conservative approach to resource management should accept the larger area.

4.0 RISK IDENTIFICATION

Review of aerial photography, available mapping, existing information on the Watershed and supply has identified a number of potential risks as summarized below.

4.1 Risk Index

The risk to the water supply from anthropogenic (man-made) sources at ground surface is a function of the Hydrologic Setting (Section 3.1). The subsequent qualitative risk to the bedrock aquifer and subsequently streams and lakes through groundwater-stream interaction is defined by the Drastic Index (Aller at al, 1987). This does not account for shallow groundwater flow in the near surface interflow zone.

The Drastic Setting best suited for this Watershed is 7Ad (glacial till over sandstone), resulting in a Drastic Index of 109 for general pollutants, with a pesticide index of 129. The higher the Drastic Index, the qualitatively greater the groundwater pollution potential. Drastic Indices range from 65 to 223. Overall, the numbers suggest a qualitatively moderate risk (greatest risk would exceed 160).

4.2 Natural Sources

Any surface water has the potential to exhibit elevated concentrations of selected parameters, which may be considered a “contaminant” due to such factors as:

- natural mineralization.
- pathogens (e.g., bacteria from decaying vegetation, animal carcasses, faeces).
- organic acids, low pH, elevated metals (iron and manganese) and colour from wetland drainage.

4.2.1 Mineralization

The sedimentary rock types, primarily the South Bar Formation of the Cumberland Geological Group, underlying the Watershed does not provide a geological environment for the focus of mineral exploration and/or mining for coal.

4.2.2 Stream/Lake Sediments

Fine-grained sediments in the bed of streams and lakes can provide a natural "sink" for various metals and pathogens through adsorption onto the surface of sediment particles. These can form a source of "contaminants" if they are refluxed into the water column in dissolved form under specific physical and/or chemical conditions (i.e., low pH snow melt, lake turnover, etc.).

A review of the Geochemical Atlas of Nova Scotia (Lombard, 1990) provided a summary of stream sediment geochemistry; no information is available on glacial till geochemistry. In comparison with the rest of the Province, elevated metal concentrations were noted in the general area of the Waterford and Kilkenny Lakes Watersheds within stream sediments for manganese, cobalt, zinc, arsenic, iron, barium, cadmium, tin, titanium, chromium and nickel.

It should be noted, however, that this data set just indicates what is elevated amongst a larger background to delineate target areas for mineral exploration. The concentrations are not necessarily above environmental quality standards and do not denote whether the metals are bio available or environmentally available (i.e., ease in which they could be refluxed into the water column in dissolved form).

4.2.3 Biologicals

Any surface water source has potential for contamination from natural sources. These include the decaying of vegetation resulting in an increase in nutrient and organic loadings, the decay of animal carcases and faeces adding biological organisms such as faecal coliform bacteria and Giardia. Any surface water source has potential for contamination from natural sources. These include the decaying of vegetation resulting in an increase in nutrient and organic loadings, the decay of animal carcasses and faeces adding biological organisms such as coliform and faecal coliform bacteria and the influence on water pH from bogs and wetlands which are typically in the range of 5.0 units.

Staff of the CBRM have advised of the presence of beaver in the Watershed and their attempts to control the population. They employ a trapper to inspect the Watershed semi-annually. The trapper has a "nuisance licence" and is allowed to trap them as necessary. Beavers are known to be a source of Giardia in surface water sources and are, therefore, worthy of the attention.

4.2.4 Wetlands

Wetlands are a source of inorganic acids that can lower stream pH, lower buffering capacity of the water, create coloured water systems and provide a source for elevated iron and manganese. Mapping by NS Department of Natural Resources noted wetlands comprised 22.1 hectares within the Kilkenny Lake Watershed and 50.1 hectares within the Waterford Lake Watershed.

In summary, given these natural sources of potential contaminants, emphasis on monitoring of the raw water source becomes a very important aspect of long-term planning and protection.

4.3 Man-Made Activities

The combined Watershed is comprised primarily of undeveloped and mixed-forest lands with a number of wet areas and some small lakes. There is a small area of residential development within the Waterford Lake Watershed on Waterford Lake Road and close to the north side of the lake. Otherwise, the combined Watershed does not have any residential, commercial or industrial land use within its boundaries.

The CBRM estimates the combined Watershed to be 197 hectares, of which they own 76.5%, or 150.6 hectares. The Government of Canada owns 1 hectare or 0.5 % and the Province of Nova Scotia 0.16 hectares, or 0.1%. The remaining 22.9% is privately owned. Land ownership is provided on Figure 3-5 in Section 3.2.

4.3.1 Recreational Land Use

Several ATV trails exist throughout both of the Watersheds, which provide access into the lakes where local residents are using them for fishing and swimming. There is a major gravel secondary road, which extends through the Kilkenny Lake Watershed from Lingan Road on the east to Victoria Road on west. This road provides access by off road vehicles such as four

wheel drives, motorbikes and ATVs, access for hunting, trail biking and a number of illicit activities (outlined below).

All of these uses have potential to degrade the Watershed and impact the quality of the source water supply by increased erosion, unsanitary use of the lakes, contaminating debris and hydrocarbon spillage.

Previous reporting by C.A. Campbell et al (1972 and 1983) noted the Kilkenny Lake Watershed was the center for informal recreational activity. This included forestry, hunting, swimming boating, angling, with numerous woods roads throughout. Two farms were abandoned and are in a state of gradual regrowth. Within the Waterford Lake Watershed, swimming and boating on the lake were noted with access into the Watershed supported by the road to the abandoned Corbett Farm. Concern was also raised about active use of the lake by seagulls, after feeding at the local landfill immediately to the north; which is now closed down.

4.4 Waste Disposal

Illicit disposal of waste materials such as appliances, domestic garbage, construction and demolition debris, fuel oil tanks, stolen and burnt cars, etc., has been a long-standing problem in these Watersheds. Despite attempts by the CBRM, and the County of Cape Breton before them, to limit access to the Watershed, these potentially polluting activities persist to present day.

Members of the New Waterford Fish and Game Association keep a vigilant eye on waste disposal practices in the Watershed and notify the CBRM when anything is discovered. The CBRM responds immediately by removing the debris. Due to the size and remoteness of the combined Watershed areas, it is very difficult to control this activity.

4.5 Scotchtown Summit Coal Mine Waste Dump

The CBDC Summit Coal Mine Waste Dump is located immediately east of Waterford Lake. This site generates acidic drainage, which historically seeped into Waterford Lake. C.A. Campbell (1972) noted that in 1949 seepage from the stone waste dump entered Waterford Lake and seriously polluted the supply, destroying much of the lake's fish population. Since the initial incident similar less pronounced incidents occurred, i.e., early in 1983 (C.A. Campbell et al., 1983).

Some years ago, the road separating the dump (referred to as Corbetts Road) from the Waterford Lake Watershed was raised in elevation. This resulted in elimination of surface flow (under at least non-rainfall events) from the dump getting into the Watershed. Although the dump site has been capped, it remains a potential source of contamination to this Watershed. There is small pond of very low pH water (Corbetts Pond) adjacent the east side of Corbetts Road. On mapping, the pond appears to be within the Watershed area, however, due to the raising of Corbetts Road, the pond drains in a northerly direction into Irish Brook in route to Colliery Lands Park and the Atlantic Ocean.

Since the waste dump is known to be acid generating, CBDC recently undertook a number of environmental investigations on this property (AMEC, 2004) and Porter Dillon (March 29, 2006 and March 30, 2006).

AMEC assessed Areas of Potential Environmental Concern (APECs) and then delineated the extent of contamination. One of the three transport pathways for acid rock drainage associated with the Summit Waste Dump was into Waterford Lake. Exceedances of guidelines were noted in the western surface water pond and the one monitoring well on the western perimeter of the waste dump. Exceedances were noted in aluminum, cadmium, copper, iron and zinc. Within the shallow overburden monitoring well exceedences were noted in aluminum, cadmium, copper, iron, and lead. In summary they concluded:

> *"In general, the fact that exceedences discussed above were reported suggest that there has been some impact to groundwater between the waste rock pile and Waterford Lake. Furthermore, the concentrations of these metals are higher than that reported for groundwater below the waste rock pile in silty sand soils, suggesting there is lateral flow outwards from the toe of the waste rock pile and supported by upward piezometric head beneath the waste rock pile. However, based on the reported concentrations, considering the distance from the waste rock pile to Waterford Lake, the dilution action of groundwater discharging into Waterford Lake would likely result in no adverse metals impacts to the lake."*

However, it should be pointed out that the assessment was constrained by:

1. only one monitoring well along the entire western perimeter of the waste pile;
2. the well was only representative of shallow overburden groundwaters not bedrock groundwaters;
3. the absence of wells situated downgradient of the pressure-focussed-recharge created by the western pond; and

4. identification of parameters for risk analysis was based upon CCME Canadian Environmental Quality (updated 2002) for groundwaters and surface waters using Freshwater Aquatic Life (FAL) guidelines, not drinking water guidelines.

Subsequent investigation by Dillon under high water runoff in October 2005 (40.2 mm rainfall event) noted that the West Pond overflowed Corbetts Road releasing waters elevated in aluminum, iron, cadmium and zinc to Waterford Lake. Again using the FAL guidelines in their risk assessment, they noted the overflowing waters were elevated in aluminum, iron, cadmium and zinc. They further noted that samples collected in near shore protected, embayments (i.e., along the south shore that receives runoff from the Summit Site) of Waterford Lake in 2005 indicated elevated levels of aluminum, cadmium, copper, iron and zinc.

Therefore, acidic drainage from the Scotchtown Summit waste rock site is considered to be posing a potential risk to drinking water quality within Waterford Lake, requiring further investigation.

4.6 Victoria Junction Tailings Basin

The CBDC Victoria Junction Tailings Basin is located adjacent to and south of the Kilkenny Lake Watershed. The basin was used between 1982 and the closure of the CBDC coal mines for disposal of tailings from the coal preparation plant at Victoria Junction. The tailings were historically acid generating and monitoring programs showed a hydraulic groundwater connection between the basin and Kilkenny Lake. The basin was decommissioned and closed out employing a subaqueous approach about 8 years ago. Monitoring has shown that concentrations of indicator parameters (chlorides and sulphates) have gone down. It is believed that a plan developed by the Kilkenny Lake Monitoring Committee, referred to as "Alarm Chemical Concentration Program", is still in effect, but dormant, due to the positive results recorded since site closure.

4.7 Septic Systems

There are three homes within the Watershed along Waterford Lake Road, which have on-site septic systems. These systems are a potential source of contamination in the Watershed and given their proximity to Waterford Lake and the source water intake, may directly impact the water supply.

There is one other home at the bottom of Waterford Lake Road, which is reported to have a pipe in place that transfers sewage to a concrete holding tank located to the west side of the access road into the treatment plant. Staff advise that the tank discharges to the ditch along the road, but that discharge is normally clear and odourless. This set up should be considered a potential contaminant source to the water supply.

There is also an on-site sewage disposal system serving the water treatment plant in proximity to Waterford Lake. This is another potential source of contamination, however, with construction of the new water treatment plant to start this year, ADI is advised that the on-site system and the holding tank noted above will be eliminated. The plan is to install a small lift station in the area of the plant and pump the sewage out to the Daley Road sewer.

The CBRM has recognized the potential for contamination of public water supplies from malfunctioning septic systems and has made policy, as part of the Municipal Planning Strategy, which states the following:

> *It shall be policy of Council to adopt a By-law that identifies any public water supply watershed with at least one dwelling within it serviced by an on-site sewage disposal system as a wastewater management district pursuant to the Municipal Government Act. Using these tools, the CBRM will implement a monitoring and maintenance program that will include:*
>
> - *inspections of all on-site sewage disposal systems within the wastewater management districts;*
> - *a cost sharing replacement program with the landowner if it is determined the system is malfunctioning or antiquated; and*
> - *regular septic tank clean outs (ie. pumpings) to remove solids in accordance with accepted practices scheduled by the Regional Municipality and paid for by the owner as an additional taxed service amortized over the period of time between clean outs.*

4.8 Forestry Activities

There is very little forestry activity in the Watershed, with the exception of some illegal cutting of hardwood.

5.0 SOURCE WATER PROTECTION STRATEGIES

A total of 14 strategies have been developed to manage the risks outlined above, including:

- Land Use Planning
- Emergency Response
- Land Acquisition
- Forestry Management
- Inspection/Enforcement
- Building/Maintaining a Database
- Ecosystem Approach
- Public Education
- Counter Terrorism
- Road Maintenance
- Planning for Impact of Climate Change
- Personnel and Training
- Demand Side Management
- Best Management Practices

An account of the CBRM's progress in each area is outlined below.

5.1 Land Use and Planning

The CBRM has chosen to take a pragmatic approach to zoning of watershed lands within the Municipality. The objective of the CBRM in this regard is the preservation of water quality. The adopted approach, as articulated in the Municipal Planning Strategy (2004), allows for *"primary industries of forestry and agriculture should be regulated rather than prohibited and, on readily accessible land, rural residential development is condoned, but on relatively large lots in comparison to the standards of the Department of Environment and only along public streets/roads that already exist"*.

The entire Watershed area is zoned Public Water Supply Watershed Zone (PWS) under the CBRM Land Use By-law. A review of CBRM Restricted and Limited Land Use Map (2004a) indicates there is no such designated use within the Kilkenny and Waterford Lakes Watersheds. Review of CBRM mapping on Coal Resource Blocks Ownership (2006) and Location of Mineral Claims and Watersheds in the Sydney Coalfield (2004b) indicates that the Watershed does not have any coal resource blocks or mineral claims within its boundaries. There are, however, two abandoned mine shafts located to the southwest of Waterford Lake within the Watershed boundaries.

Furthermore, the CBRM plan to regulate human activity within watersheds by designating public water supplies as protected areas pursuant to the Nova Scotia Environment Act.

This approach is felt to share the responsibility with land owners in a fair and equitable manner, while still maintaining an overall goal of maintaining safe drinking water.

For the Kilkenny and Waterford Lakes Watersheds, the CBRM owns over three quarters of the lands, however, land use in the privately owned areas is difficult to control despite the two Watersheds being designated as Public Water Supply Watershed Zone (PWS). Due to the wide scale use of the Watersheds for activities with potential for contamination of the water supply, the CBRM must remain vigilant to stay the course on implementation and enforcement of its Municipal Planning Strategy and related By-laws.

A review of the CBRM's Restricted and Limited Use Land Map (2004) indicates that aside from the Kilkenny and Waterford Lakes Watersheds being designated as water supply, there are no other restricted or limited uses. Land use in this category covers typical government defined applications such as national parks, protected places, bird sanctuaries, etc.

5.2 Best Management Practices

The CBRM's position with respect to use of Best Management Practices (BMP) is best summed up in the Vision Statement for the Water Utility:

> *"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."*

The CBRM's proposed use of a By-law applicable to on-site sewage systems within watersheds may be considered somewhat of an example BMP approach to water supply protection. Management will be brought about through development and implementation of a By-law, which recognizes the potential for contamination of public water supplies from malfunctioning septic systems and has made policy as part of the Municipal Planning Strategy, as outlined in Section 4.5.

There is a total of four on-site sewage systems within the boundaries of the Watershed located in proximity to Waterford Lake. The CBRM is illustrating adherence to this BMP

by removing its on-site system serving the water treatment plant, as well as the holding tank system from the closest home at the bottom of Waterford Lake Road.

Implementation of the above noted policy will be key in ensuring these potential sources of contamination are investigated and managed for long-term protection of the Watershed.

There are additional opportunities through adoption of existing BMPs of regulatory agencies that may be applicable to the Watersheds. In the case of the Waterford and Kilkenny Lakes Watersheds, there is only minor land ownership by the Province, however, a large portion is forested. This portion should be managed to ensure any activity in this regard is sustainable in terms of source water protection. DNR would represent an important component of an advisory committee, as would their documents, Best Management Practices/Forest Planning in Municipal Drinking Water Supply Areas Nova Scotia and General Provisions for Pesticide Use in Nova Scotia (September, 2005). Application of the tenets of these documents can be considered BMPs. The latter document summarizes general terms and conditions for application of pesticides "*for all lands, in or near municipal drinking water supplies and within designated drinking water supplies."* The document outlines setback limits for ground and aerial applications of Bacillus thuringiensis (Bt) within Protected Water Areas (PWA) from point of intake, point of intake to 1.5 km upstream and beyond 1.5 km upstream. In addition, for designated municipal drinking water supplies, there are provisions *"...to prohibit, restrict or require an additional setback if a Water Works Operator deems so necessary due to possible effects of the pesticide or pesticide mixture on the water supply."* As well, *"A buffer zone or setback may be established to protect any well serving as part of a Designated PWA. The buffer zones will be established on a case by case basis and will be outlined in the source water protection plan for the water supply."*

5.3 Emergency Response Plan

There is no current Emergency Response Plan within the CBRM that specifically addresses source water protection. For incidences of chemical or hydrocarbon spillage within the Watersheds, the CBRM would rely on the network of companies in the geographic area trained in response and remediation of related impacts. They would also report any incidences to NSEL to obtain their input and advice on any remedial work implementation.

It appears that given the ease of access throughout the Waterford and Kilkenny Lakes Watersheds the potential for a polluting incident would be moderately high. Consideration for first response materials to be available in a central location and a written response plan would have merit for this water supply. The 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.

Nolan Davis (now ADI Limited) carried out an investigation in 1996 on behalf of CBDC to identify a groundwater water supply should the Tailings Basin have a detrimental impact on the surface water supply. Two large diameter boreholes were drilled at the time in the vicinity of Waterford Lake. The program concluded that the required demand of 4.1×10^6 Lpd can be withdrawn from a two to three well wellfield. The groundwater was potable except for manganese (0.48 to 0.50 mg/L), which exceeded the average 0.1 mg/L in Waterford Lake. The cost of developing the wellfield and associated infrastructure to pump, treat and discharge the water into Waterford Lake was estimated (Class C) to range between 1.52 and 1.72 million dollars. Staff advise that these boreholes are still visible within the watershed, but to their knowledge, nothing has been done with the wells since installation. Although these wells were drilled at the time as a potential alternative to the lake system, it is believed that nothing further has been done with them since that time to develop and test the viability for this purpose.

The Town of New Waterford does not have a back up water supply.

5.4 Counter Terrorism Plan

The CBRM does not have a formal counter terrorism plan in place for the Kilkenny and Waterford Lakes Watersheds, but given the results of September 11, 2001 attacks, are aware that water supply Watersheds are attractive targets for terrorists.

The CBRM recently held a one day seminar on watershed security for all water utility managers and operators to emphasize the vulnerability of a watershed and the need to be vigilant to protect it from security breeches. This has currently been the extent of attention to watershed security. In relation to other important areas of source water protection planning, counter terrorism planning is considered low priority within the CBRM at this time.

5.5 Land Acquisition

The CBRM's primary focus of watershed protection is land acquisition based upon a hierarchy of development potential. In the case of the Waterford and Kilkenny Lakes Watersheds, the portion of government versus privately owned lands is relatively small. This makes land acquisition particularly challenging given the number of land owners. For this

particular Watershed, the CBRM sees land acquisition as a priority and plan to implement policy as outlined in the strategy as a means to provide further protection of the Watershed.

The CBRM policy within its Municipal Planning Strategy *"....shall endeavour to lobby the Province of Nova Scotia to designate all Provincially owned lands within watersheds of the Regional Municipality as protected areas pursuant to the Department of Natural Resources' land use plan".* This is not a priority with this Watershed given the relatively small amount of provincially owned lands.

5.6 Road Maintenance

There are no public access roads within the boundaries of the Kilkenny and Waterford Lakes Watersheds, with the exception of the lower portion of Waterford Lake Road. This is an unlisted gravel roadway maintained by the Municipality. Sand only is used for ice control and occasional roadside clearing is done by mechanical means. Daley Road, in proximity to the eastern boundary of the Waterford Lake Watershed, is maintained by the Nova Scotia Department of Transportation and Public Works (DOT). Salt is used for deicing during winter months and all roadside maintenance is done by mechanical means.

The paved portion of Kilkenny Lake Road to the northwest of the Kilkenny Lake Watershed is also maintained by DOT as described above for Daley Road. The gravel portion, which transects the Watershed, is not maintained by any single party, in fact not maintained at all. The CBRM has attempted to keep the gravel roadway at the foot of Mary Joe Lane off Lingan Road (common with Kilkenny Lake Road) through the Watershed gated off. However, staff advise that literally within days the locks are cut and access is regained by all forms of off-road vehicles. This access has resulted in use of Watershed lands for a number of activities, as outlined in Section 4.0, that are potentially harmful to the Watershed.

A locked gate is maintained by the CBRM at the entrance to the pumphouse/treatment building and intake structure. This access is authorized for CBRM staff use and for NSPI, which maintains a weather station on the site. The CBRM staff advise, however, that there is constant access to the site by area residents from pathways through the adjacent wooded areas. Debris such as appliances and garbage present during the site visit in April 2006 is evidence of this illicit use. The roadway itself is maintained by the CBRM under contract to a local plow operator for winter clearing. There is no salt or other deicing compounds used on the road. Sand is occasionally applied, if necessary.

5.7 Forestry Management Plan

Staff of the CBRM advise that there is currently no Forestry Management Plan in place for protection of source water supplies within its municipal boundaries. However, they are aware of the need to manage the resource in the context of source water protection. For this particular source water supply Watershed, the number of property owners within its boundaries makes forestry management a challenge. The CBRM is committed to working with the DNR on alternatives for management in this Watershed.

As noted in Section 5.2, a recently drafted pamphlet (29 September 2005) received through staff of DNR entitled, *"Best Management Practices/Forest Planning in Municipal Drinking Water Supply Areas Nova Scotia*", outlines applicable legislation regarding forestry operations within municipal water supply areas, along with BMP and long-term planning for source water protection. It is contingent upon the CBRM to become familiar with these practices and to open dialogue with DNR and NSEL on their application to watersheds. Although only a very small portion of the Waterford and Kilkenny Lakes Watersheds is owned by the Province, it will become increasingly important to manage the forest in a sustainable manner for long-term protection of the source water supply.

5.8 Adaptation for Climate Change

Climate change is ongoing in the Sydney area since commencement of record keeping in 1895 at Environment Canada's "Sydney" station (Figure 3-1). Moving decadal means analysis indicates an overall trend of increasing precipitation and reduced air temperature commencing in the mid to late 1950's and continuing through to the late 1980's. Since that time, there has been a falling trend in precipitation of approximately 100 mm and rising air temperature.

Streamflow, as monitored on McAskill Brook, indicates that mean annual streamflow is already responding quickly and directly with the decline in precipitation over the last 15 years (Baechler, 2003). This decline in streamflow may become critical in the ability of the resource to meet demand in the future. Monitoring of groundwater head levels within the Lower Morien HU elsewhere in the coalfield suggests the "Local" flow system is not responding as yet to declines in precipitation (Baechler, 2003).

The key to managing for climate change is, therefore, not to wonder if it will happen, but to recognize it already is happening and has so throughout the 110 year period of record keeping in the local area. The key, therefore, is to develop a management strategy that is

constantly adapting to climate change. This requires adequate monitoring to determine first signs of change in the system to allow for the maximum time to adapt.

5.9 Public Education Program

The CBRM feels their responsibility is to notify and educate. This will be done with signage directly in the Watershed and literature to homeowners attached with their tax bills. Providing literature to the Regional School Board that promotes knowledge of public water supplies is also a focus of the CBRM. At the present time, the CBRM does not have a distinct program aimed specifically at public education.

The CBRM has attempted to maintain signage in the Kilkenny and Waterford Lakes Watersheds as to their water supply status, with requests for no recreational use. However, these have largely gone unheeded with obvious use of the watershed lands and the fact the signs are constantly vandalized. A sign posted at the gate at the foot of Mary Joe Lane reads, *"CBRM Public Drinking Water Supply - Please Protect It - No Swimming, or Dumping of Garbage or Debris."* The sign speaks to the problems being encountered in the Watershed.

On occasion, the CBRM will retain consultants, such as Atlantic Coastal Action Program (ACAP), to draft watershed protection or conservation measures for general public distribution through circulation with water and/or tax billings. This form of public education reaches a large number of people, but perhaps to be more poignant, consideration should be given to making these messages water supply specific.

The CBRM plans a proactive role to foster cooperation amongst the three levels of government to encourage diligence in their areas of mandate with the objective of protecting the watershed as a source of public drinking water. They will do this by:

- advising them of the extent of watersheds;
- advising them of the development within these watersheds; and
- working with them to ensure their best management practices are adhered.

This approach forms a significant part of the approach as outlined in the Municipal Planning Strategy.

The CBRM maintains a section on the municipality's web site providing information to the general public on the assets of the Water Utility, operations, water facts, monitoring water

consumption, water rates and water conservation initiatives. This forum could also be used to provide watershed protection information.

5.10 Inspection/Enforcement

Staff visit the raw water intake facilities and pumphouse on a daily basis to record water quality information and inspection for security violations. Staff also check the status of Corbetts Pond on a weekly basis to ensure it is not discharging to the lake.

Swimming in the two lakes has become such a concern that CBRM in the last number of years has hired security to police the Watershed area in an attempt to control this use. Members of the Cape Breton Regional Police Force also inspect the areas on a periodic basis during the summer months. The CBRM has identified a job for inspection and enforcement for the purposes of watershed protection within the CBRM, but have not as of this writing filled such a position.

Other groups, such as the New Waterford Fish and Game Association have local members who frequent the Watershed area. They have played an inspection role of sorts by informing the CBRM of potentially polluting activities.

As noted earlier, the Watershed is inspected semi-annually by a trapper to control the beaver population. The trapper has a nuisance licence from the DNR, which allows trapping for this sole purpose.

The CBRM is considering the merits of wireless technology, web based programs and possible use of cameras as a means to remotely monitor security of its watersheds.

At present, it is the CBRM's position that they would like to allow continued use of the Watershed by interest groups, such as fishermen, hikers, cross country skiers, etc., as opposed to total exclusion. This approach would hopefully result in a passive means of inspection and security by those who use the watershed, as well as drink the water.

5.11 Personnel and Training

The CBRM has a well-established management structure for the Water Utility, commencing with a Utility Manager and a directly reporting Operations Manager. These individuals are essentially responsible for safety of the various water supplies throughout the Municipality.

They are supported by a number of trained treatment and distribution system specialists holding certification in their respective areas.

In the case of the Town of New Waterford water supply, the responsibilities for day-to-day operation of the physical plant and distribution system are shared between individuals responsible for it and the Glace Bay Water Treatment system, whereas there is a dedicated individual to monitoring and maintenance if the distribution system.

The CBRM is an advocate of training and has allocated an annual budget for this purpose within the Water Utility. Recent training for all Utility managers and operators on watershed security is a good example of ongoing training initiatives.

As noted in the previous section, the CBRM has identified a job for inspection and enforcement for the purposes of watershed protection within the CBRM. This position had not been filled at the time of this writing primarily for financial reasons.

5.12 Development of Hydrological/Biological Models

The SWPP strategy outlined in this report is based largely on the understanding of the occurrence, quantity, quality and susceptibility of the ground and surface waters within the Watershed. Unfortunately, no detailed hydrological and/or hydrogeological studies have been undertaken. Therefore, the model outlined in Section 3.1 is conceptual, using experience gained elsewhere. In addition, there has been no research or ongoing monitoring of fresh water aquatic life in the system to base ecological management schemes on.

It is critical to "monitor what you manage". It will, therefore, be important to begin allocating funds to undertake focussed investigations and establish long-term monitoring programs (integrated data collection and monitoring - IDCAM). To make the most efficient use of funds, the monitoring should be to undertake affordable, practical programs each year over the long-term to obtain information pertinent to answering specific operation/protection issues as they arise. In summary, it is difficult to protect what you don't understand.

The CBRM has recently implemented a review of the Safe Yield for the Pottle Lake Watershed. This will utilize the most updated data from Environment Canada's hydrometric and atmospheric monitoring network to develop a model of the physical hydrology of the Watershed. This should have applicability in refining the safe yield for these Watersheds.

Additional priority questions requiring answering include:

- How much water resides in storage within the lake? 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? What chemicals are present on the lake bottom sediments?
- Do Irish and Kilkenny Lake Brooks provide fish habitat? If so, How should flows be managed to maintain and improve it?

5.13 Building and Maintaining a Database

The CBRM has developed a digital database of all of its surface water supply watersheds, which includes not only watershed boundaries, but land ownership, infrastructure, land use and zoning, restricted and limited land use, utilities, etc. This database can be queried to produce drawings, such as included in this report, to support technical submissions such as annual reports to NSEL and for public presentation purposes. This database, perhaps even more importantly, is a useful planning tool for the CBRM to role out programs and policies with respect to watershed protection and initiatives as outlined in the Municipal Planning Strategy.

At the current time, data generated from day-to-day operations at the New Waterford Water Treatment Plant (e.g., flow data, monitoring results, etc.) is recorded manually and the daily results entered into spreadsheet format and saved on disc. Tank level information is saved directly to a computer in the CBRM New Waterford offices. The new treatment plant will bring full SCADA capability to this water supply system. The CBRM is working towards a regional communications upgrade for the water utility with all information reporting to a central sever. It is anticipated that this system will be in place in approximately one year.

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 and investigative programs (Section 5.12).

5.14 Demand Side Management

The CBRM does not have any programs in place at present for the New Waterford system directly aimed at Demand Side Management (controlling demand). However, in light of the anticipated financial and human efforts required to meet existing standards, it is likely to

become as important as Supply Side Management (finding new water sources) in managing this water supply. However, several ongoing efforts are having a profound impact on the demand side. For instance, since the program was rolled out over the last couple of years with a goal to install metres for all water customers, demand is reported to have dropped significantly.

Another effort underway is sectionalized master metering on the main distribution lines. This effort assists in leak detection and through repair, greatly reduces the amount of water required on the demand side. As well, the CBRM has greatly reduced the response, or "run time" to fix leaks. This has also had a positive impact on the average amount of treated water distributed (in this case lost).

One other program currently underway in the Town of New Waterford is the addition of chemicals to the system to inhibit the growth of algae in the mains. This has resulted in a reduction in the need to flush the lines and a commensurate reduction in the amount of treated water lost though this practice.

The CBRM provides information on water conservation on the Municipality's web site under the Water Utility section. Information is currently posted on proposed watering days to conserve and share water amongst the user community developed in conjunction with the ACAP, tips for a water wise garden and use of rain barrels. The CBRM's public education program involving circulars inserted with water and tax bills has likely played a roll in the progress made on the demand side.

Demand Side Management could have the benefit of reducing the demand on the system, thereby generating additional revenues to undertake needed monitoring and investigations as so required.

At a withdrawal rate of 6.82 MLPD, and an estimated population of 6,900, the per capita use for the Town of New Waterford is 988 L/person/day, which is comparatively very high. If one removes the 0.91 MLPD consumed by NSPI's Lingan Generating Station, the per capita use drops to 857 L/person/day, still comparatively high. For instance, the average Canadian residential water demands in 1996-1997 were 72 to 76 litres/person/day. The Atlas of Canada reported in 1999 that average per capita water demand in Nova Scotia ranged from 160 to 320 L/person/day.

The CBRM records for April 2006 show 3584 customers within the Town of New Waterford are metered and receive partially treated water. The CBRM water rates approved by the

Nova Scotia Utility and Review Board effective between 01 August 2005 and 31 July 2008 are based on meter size and consumption. The majority, or 3526 accounts in New Waterford are for a 5/8" meter, while the remainder are distributed between 3/4" and 6". As an example, the base charge for a 5/8" meter is $30.70 per month as of 01 April 2006. In addition, the customer pays $0.54 per m^3 for the first 500 m^3, $0.51 per m^3 for the next 2,000 m^3 and $0.30 per m^3 over 2500 m^3. These costs will increase once fully treated water is brought on stream in 2007.

5.15 Soft Path Management Approach

A relatively new concept in ILWRM is evolving across Canada, referred to as Soft Path. This is a practical approach grounded in ecological science and a belief that human decisions should be made with due regard for essential ecological process, bio-diversity and sustainable uses. It acknowledges the importance of human needs, while at the same time confronting the reality that the capacity of our world to meet these needs in perpetuity has limits and depends on the functions of ecosystems. It recognizes we are in a state of constant change and any management plan must be flexible. It also accommodates the role of "civil society" in decision making and possibly monitoring/inspection.

Soft Path differs fundamentally from conventional supply-focussed water planning (Brandes et al, 2005) in that it strives for efficiency in water use by fundamentally challenging todays pattern of fresh water consumption through:

1. Treat Water As a Service Rather Than an End in Itself: Focus not so much on "how" to do the same with less water, but also "why" use water to do this in the first place? i.e., Why use drinking water quality water to flush away our wastes? Why use potable water to water lawns, gardens and sidewalks? Can these services be achieved in some other way?

2. Ensuring Ecological Sustainability: The Soft Path recognizes ecosystems as legitimate users of fresh water and as the foundation of much of our economy. Environmental constraints are built in from the start to limit the amount of water withdrawn from natural sources.

3. Conserving Quality as well as Quantity: Soft Path policies are designed to match quality of water supplied to the quality required by the end-use. The key is to cascade water systems, ensuring that wastewater from one use becomes the input for another.

4. Looking Ahead by Looking Backwards: Traditional planning starts from the present and projects forward to the future (forecasting). Soft Path planning does the reverse. It defines a sustainable desirable future (20 to 50 years out), at least as water sources and uses are concerned. It then works backward (backcasting) to define policies and programs that will connect the future to the present.

The refinements of Safe Yield calculations, which will account for limiting withdrawals to recognize the water that must remain downstream of the extraction point for fresh water aquatic life, is an example of incorporating the Soft Path Approach.

The development of a SWPP Advisory Committee also exemplifies this approach.

6.0 MONITORING PLAN

Staff of the CBRM advise that the only ongoing monitoring of the raw source water occurs at Waterford Lake and is for pH, which they advise rarely strays below 6. Measurements are taken three to four times per week. Full suite chemical analysis (inorganic, organic, metals) was historically taken annually, but are now taken semi-annually.

Requirements for monitoring of raw water will change significantly when the new water treatment plant is brought on line in 2007. CBCL (2004) outlined a program of recommended monitoring of the raw source water, which meets the requirements of the NSEL Guidelines for Monitoring Public Drinking Water Supplies (2005). They suggest: pH monitored twice daily at the inlet and turbidity daily; colour, iron, manganese and dissolved organic carbon weekly; aluminum monthly; all GCDWQ parameters with a maximum acceptable concentration (MAC), or interim acceptable concentration (IMAC) semi-annually; and Giardia and Cryptosporidium as requested by NSEL.

Good quality raw water data will assist the CBRM with documentation of seasonal and long-term trends in water quality and allow for modifications as necessary for treatment purposes. These data will also assist with identification and prediction of the effects of climate change.

Distribution side (e.g., treated water side) monitoring comprises monitoring for pH, residual chlorine and flouride on a twice daily basis at the injection point in the treatment plant and twice weekly at seven locations throughout the distribution system (Horyls Sausage, Needs Convenience Store, Maplehill Manor, Home Hardware, Lingan Generating Station, Tim Hortons and the New Victoria Seniors Complex) for pH, turbidity, residual chlorine and

bacteria. Bacteria is not sampled at the Tim Horton's location. Full suite chemical analysis is also carried out semi-annually on the treated water side.

CBCL (2004) also outlined a program for distribution side monitoring that will conform with NSEL Guidelines for Monitoring of Drinking Water Supplies. The program consists of: daily monitoring for turbidity, free chlorine (twice daily) and pH; twice weekly monitoring for turbidity, free chlorine and Total Coliform and E. Coli at entrance into the distribution system; weekly monitoring of manganese at entrance to the distribution system and colour at distribution sampling points; quarterly monitoring for corrosion index, aluminum, THM's and lead; semi-annual monitoring for all GCDWQ parameters with a MAC or IMAC; and Giardia and Cryptosporidium as requested by NSEL.

As per the NSEL Guidelines for Monitoring of Drinking Water Supplies, the owner is required to collect a minimum of one sample per 1,000 persons per month for bacteria. For a population of about 6,900, the CBRM is required to take a minimum of seven samples per month. It is currently exceeding this requirement with 12 samples per month.

Bacteriological results are provided to NSEL directly via e-mail on an as received basis as agreed with the Department, as well as on a monthly basis. Quarterly summary reports noting any major changes, exceedances, or operational difficulties, etc., are also prepared for NSEL. Any positive coliform counts are reported directly to the NSEL duty officer by the lab. A repeat sample is initiated in the case of a total coliform count with a boil order issued following two consecutive positive results. The boil order is initiated immediately upon identification of faecal coliform bacteria.

Environment Canada's weather station at the Sydney Airport is the closest station to New Waterford. It provides a host of real time weather data, including temperature and precipitation.

Daily water monitoring is conducted using portable water kits, with results recorded in a log book. Data for chlorine injection into the distribution system is sent directly to the Sydney Water Treatment Plant via the SCADA system for storage.

Additional monitoring programs as discussed in Section 5.12 will be above and beyond the existing ones noted above.

7.0 SOURCE WATER PROTECTION ADVISORY COMMITTEE

Formation of a Source Water Protection Advisory Committee is the first step identified by NSEL in their Guide for Water Utilities and Municipalities for Developing a Municipal Source Water Protection Plan. The CBRM is aware of the importance of a stakeholder committee to help mold the foundation of a good SWPP. The information outlined herein has been compiled to provide a summary of where the CBRM is at this time with respect to the source water side of the New Waterford system. The CBRM has every intention of using this information as a basis to commence discussions on a plan when a committee is formed.

It is CBRM's current thinking that the Municipality would have three to four advisory committees serving the East, West and Central Divisions. New Waterford would be included as one of possibly two in the East Division.

Staff of DNR have expressed a willingness to participate on an advisory committee to develop management plans that will allow for watershed protection while at the same time, continued use for other beneficial activities. DNR would be an asset to any advisory committee for this watershed given the percentage of forest cover. Incorporation of such agencies as DNR will provide an opportunity to apply BMPs focussing on their typical areas of mandate.

It is the CBRM's intention to utilize the information from this planning stage as the basis of developing a SWPP in conjunction with an Advisory Committee. It is suggested that the Advisory Committee have an advisory mandate, but not be involved in, nor responsible for, day-to-day operation of the water utility.

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