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TECHNICAL REPORT

CONTRADICTION AND CONFLICT IN WATER MANAGEMENT: ATLANTIC CANADA

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Executive Summary

This report documents the various methods in which agricultural producers responded or adapted to the severe drought conditions of 2001 and 2002 that were experienced in Nova Scotia, New Brunswick and Prince Edward Island. The agricultural programs that were sponsored by the federal and provincial governments to deal with the drought are documented. The successes and failures of these programs are also discussed within this report.

Stakeholder consultations with agricultural producers, interviews with selected agricultural experts in various fields, and interviews with provincial and federal government officials in the three provinces were done to gain more insight into how well the adaptation process was taking place in the different agricultural regions. Each of the three provinces had distinct issues, challenges and pressing needs. There was a consensus among stakeholders and provincial staff that drought was a major issue in Prince Edward Island, as precipitation patterns were considered to have become more erratic in the last 10 to 15 years. A significant decrease in both yields and crop quality occurred. This was a major issue of concern for processing operations such as French fry processors that require products such as potatoes of a consistent size and quality. The lack of a provincial drought response/contingency plan, access to groundwater for agriculture, and barriers to expand the use of irrigation systems were factors identified that needed to be addressed.

In New Brunswick, drought was not as serious a problem as in Nova Scotia and Prince Edward Island in 2001 or 2002. In contrast, poor soil drainage and soil erosion were the major limitations to achieving optimal crop production in this province. Therefore drainage and soil water management were the most pressing areas that needed attention. However, it was noted that drought is a relevant issue for agricultural producers that grow high value crops. New Brunswick does experience periods of moisture deficiency, and producers have to rely on irrigation to supplement precipitation during these critical growing periods.

Nova Scotia was also severely affected by the drought in 2001 and 2002. Farmers commented on their lack of preparedness for drought despite having experienced several dry summers during the late 1990s. General access to water was not the problem. Instead, having adequate water at the right time was the real issue. Difficulty in accessing water for irrigation was especially pronounced in the Annapolis Valley. This is a concern since the Annapolis Valley is the main agricultural region in the province. Drainage was also a major obstacle that farmers faced in their operations.

Overall, agricultural programs indicated that both federal and provincial governments must strive to improving water resource management and soil water management in each of the provinces. However, programs should be tailored to the local needs of each province as agricultural products, water sources used, environmental conditions and challenges varied.

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1.0 Background

The history of agriculture reflects a series of adaptations to a wide range of factors from both within and without agricultural systems. For example, environmental conditions related to soil, water, terrain, and climate provide constraints and opportunities for agricultural production. As well, technological developments lead to modifications in the structure and processes of farming operations. Similarly, market factors related to input costs and prices paid have a dramatic impact on what commodities are produced and where production takes place. Public polices, legislation, and programs are also major components influencing the nature and dynamic of the farming operations in Ontario. None of these factors remain constant and their effects are interdependent. Their changes over time represent stimuli that affect the success of farming activities and that prompt adjustments to altered circumstances (Wall and Smit, 2005).

The nation wide droughts of 2001 and 2002 had severe impacts on agriculture with many farmers, food producers and water resource managers experiencing severe losses and problems. Periods of drought can have significant environmental and social consequences which include but are not limited to wildfire and disease. Lower flows in streams and rivers can increase the risk of fish dying, algal blooms and wetlands drying up, and loss of habitats for wildlife birds. Drought destroys crops or stunts the crop's growth, causing lower yields and poor crop quality. Not only did agricultural users feel the impacts of the 2001 and 2002 droughts, but so did other non-agricultural users such as transportation, recreation, and tourism. A nationwide project called "Canadian Agricultural Adaptations to 21st century droughts: Preparing for climate change" was undertaken to examine the impacts of droughts that happened in Alberta, Saskatchewan, Ontario, New Brunswick, Nova Scotia and Prince Edward Island. Even though the 2001 and 2002 droughts occurred nationwide, the severity of the droughts was more pronounced in these provinces.

Recent droughts in North America and elsewhere resulted in water restrictions and interruptions, increase in the domestic price of water and treatment costs, crop and livestock losses, more frequent and severe forest fires, and impacts on agriculture,

recreation, and water-dependent ecosystems (Woo, 1992; Gabriel and Kreutzwiser 1993; Subak, 2000). These impacts suggest that many economic sectors and regions are not well adapted to existing climatic variability let alone the future that an altered climatic regime might bring. At the same time while local water managers struggle to balance supplies and demand for water resources, a second set of changes and uncertainties loom. In many jurisdictions across North America and elsewhere, on-going political and institutional restructuring has resulted in the responsibility and cost of many forms of governance shifting from the state to local people and agencies (Weiland, 1998).

Within both the academic field and professional practice of water management, there is growing interest in the capacity of people, communities, and institutions to effectively manage water resources, both now and into the future. Such concerns relate not only to inherent challenges presented by this critical and inherently variable environmental resource, but also to the belief that climate may be changing – and along with it, the availability of water. Among the most worrisome possibilities for many water managers is potential increase in variability of climate and, hence, in the frequency and severity of severe weather events, including drought (Etkin, 1998; Intergovernmental Panel on Climate Change [IPCC] 2001).

1.1 Report Organization

This report is divided into three sections. Chapter Two explores drought issues, irrigation and various programs as they relate to agriculture and water management in Prince Edward Island. This is followed by Chapter Three which specifically deals with drought, drainage and irrigation issues in New Brunswick and various government programs. Chapter Four explores various drought related issues in Nova Scotia by looking at the use of irrigation equipment, water management strategies, and drainage issues, federal and provincial government programs for farmers in the province and the role of various water clubs in provincial water management.

1.2 Methodology

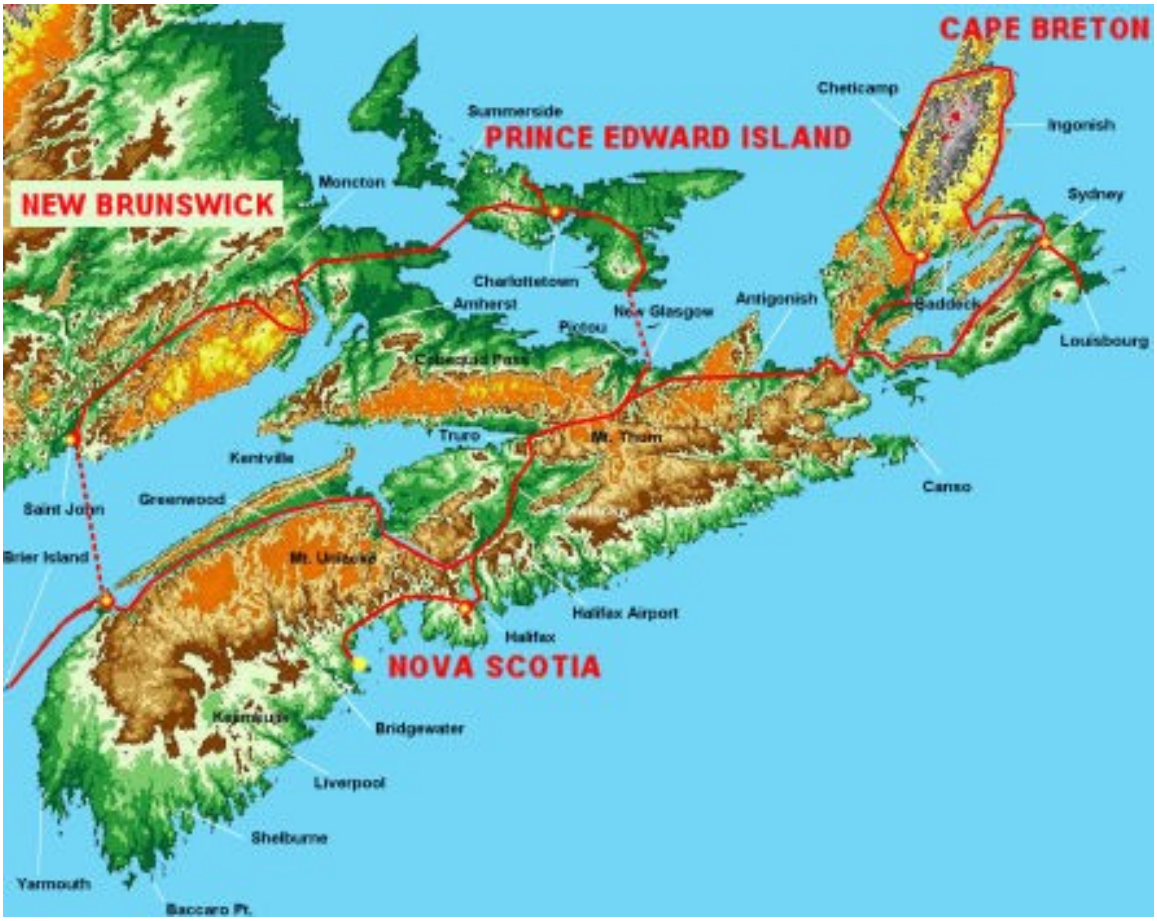
One project component involved undertaking stakeholder consultations in order to understand how agricultural producers responded and, or adapted to, the severe drought conditions in 2001 and 2002. Public consultations with government officials in Nova Scotia, New Brunswick and Prince Edward Island were conducted in December 2006 in order to learn about how adaptation options were used to deal with drought conditions. In all, one focus group interview session was held in Prince Edward Island, one session took place in New Brunswick with people participating in person and via conference call. There was also one phone interview with key officials. In Nova Scotia, four interviews were held with key officials from the Nova Scotia Department of the Environment and Labour, and Nova Scotia Department of Agriculture.

1.3 Study Area

The study area included three of the four Atlantic Provinces: Nova Scotia, New Brunswick, and Prince Edward Island (PEI), but not the province of Newfoundland and Labrador. The agricultural industry throughout this region has experienced profound changes over the past 20 years. The industry has modernized and intensified trends which, in turn, have placed pressure on both the soils and the water that is necessary to sustain productivity. The types of farming practiced, the land ownership patterns, and the water-related issues confronting producers in Atlantic Canada differ both by area and by province. For example, farmers in Prince Edward Island rely to a large extent on ground water and have challenges accessing a secure supply for irrigation. There are also issues related to water quality problems caused by salinisation. The PEI Provincial Department of Environment has put a moratorium on the drilling of high-capacity wells for irrigation purposes until the drought impacts were more closely studied. In Nova Scotia's Annapolis Valley, agriculture is striving to operate efficiently during recent consecutive dry summers. Farm operations are also facing pressure from their proximity to expanding urban communities. In New Brunswick, agriculture has to compete for water with other users and has had to come to terms with depleting aquifers and more efficient means of protecting and conserving watersheds. There are inevitably problems that are common across all of Atlantic Canada, but some issues and factors weigh more heavily

on one area than another. Therefore, this study strives to explore the issues and the factors contributing to water-related problems in each province and examines government programs that were implemented to assist the agricultural sector.

1.3.1 Map of Study Areas



Source: http://www.3oldmen.com/images/nova_scotia_map.jpg, 2007.

2.0 Prince Edward Island

2.1 Literature Review

The 2001 census on agriculture counted 1,845 farms in Prince Edward Island, slightly down 17% from 2,217 in 1996, with numbers declining in all three counties; Kings, Queens and Prince Counties. In 2000, it was estimated that farmers reported 261,593 hectares (646,137 acres) in farmland, a 1.4% decline. The total cultivated cropland rose 3.0% to 175,563 hectares (433,641 acres). And the average farm size increased from 120 hectares (296 acres) in 1996 to 142 hectares (350 acres) in 2001 (Statistics Canada, 2002).

Prince Edward Island's gross farm receipts were $396 million in 2000, while operating expenses was $338 million. Five years earlier, at 1995 prices, receipts totaled $349 million and expenses $289 million. A total of 866 farms reported gross receipts of less than $50,000 in 2000, a 27.8% decline. These represented 46.9% of the farms and 3.4% of gross farm receipts reported for 2000. In addition, a total of 433 farms reported gross receipts of $250,000 or more, up 14.9%. These accounted for 24% of farms and 80% of gross farm receipts. The number of farms with gross receipts greater than $250,000 increased 11.3% in Kings County, 19.1% in Queens County, and 1.1% in Prince Country respectively. The number of farms in all other sales brackets declined in all three Counties. This indicates that farm size, in terms of gross receipts, is rising on the Island (Statistics Canada, 2000).

In 2001, cattle farms accounted for 26% of all Prince Edward Island farms, while potato farms were 19%, and dairy farm, 17%. These figures represent the major commodity produce on the operation, but it should be emphasized that many farms consist of more than one enterprise. A total of 468 farms reported growing potatoes in 2001, down 28.2% from five years previously. Island farmers planted 43,275 hectares (106,889 acres) of potatoes in 2001, down 21.2% from 1996. Since 1981, however, total potato acreage in Prince Edward Island has increased by 67.3%. Most of the increase in potato production can be attributed to increases in the processing capabilities on the island, primarily by Cavendish Farms and McCain Foods. In 2001, potatoes accounted for one-

quarter of the Island's total cropland. Approximately 55% of the Island's total potato acreage is located in Prince County (Statistics Canada, 2002).

Other crops have also increased in acreage from 1996 to 2001. These include carrots and rutabagas, which increased moderately by 5% and 14% respectively. Cole crops, most notably cauliflower and broccoli, increased by over 300% in the same time period. These increases are due mainly to the increased demand from processors. In addition, the reported acreage of lowbush blueberries increased in that 5 year period from 2,175 hectares (5,372 acres) to 3,149 hectares (7,778 acres), an increase of almost 45% (Prince Edward Island Department of Agriculture and Forestry, 2000).

It has been observed by growers who currently have the capability to irrigate their crops that in Prince Edward Island irrigation is not required every year for most crops. Due to an increase in the unpredictability of weather patterns, wider variations in rainfall and the trend to warmer growing seasons (Bootsma et. al., 2001), irrigation is becoming more important to minimize crop losses caused by the lack of moisture at critical times during crop growth. Cavendish Farms, for instance, has reported an average increase in total yield of over 11 tonnes/hectares (100cwt/acre) in the Russet Burbank crop due to irrigation in 2001, a very dry year. In 2002, they found almost 11 tonnes/hectares (100 cwt/acre) increase in total crop yield of Russet Burbanks and almost 9 tonnes/hectare (80 cwt/acre) in the Shepody variety (Coffin, 2002). In order to meet its Customers needs, Cavendish Farms has set a goal of having 4,860 hectares (12,000 acres), or 30% of their contracted crop, under irrigation. At the present time approximately 1,200 hectares (3,000 acres) are irrigated. In another study, Sanderson and Howatt (2002, unpublished) noted a 50% increase in marketable broccoli yield in 2002, due to irrigation. Growing season rainfall in 2002 was recorded at only 10% below normal average, but it was not the total quantity received that was a factor so much as the timing of the rainfall that was received. Where it occurred, supplemental irrigation was able to ensure that crops had sufficient water at critical periods in their development, which is of particular importance for the Island's vegetable, blueberry and potato industries.

As documented in "Some Physical Facts About PEI", Prince Edward Island has some unique physical characteristics that have a direct impact on the water supply (CBCL Limited, 2003). Most of the Island has fine, sandy loam soils, plenty of rain, and a gently sloping terrain. Beneath the soil is a thick, fractured formation of sandstone bedrock, which stores a vast reservoir of readily available groundwater close to the surface. Because of the fractured nature of the bedrock, a relatively high proportion of the rainfall received seeps down to "recharge" the groundwater supply. Groundwater is the principal source of drinking water in Prince Edward Island (CBCL Limited, 2003).

In Prince Edward Island, the boundaries of the groundwater flow systems are virtually the same as those of the watersheds on the surface. The provincial government document "Groundwater – Our Invisible Resource", states that approximately one third of the annual rainfall finds its way underground to recharge the aquifers. The greatest amount, approximately 60-70%, of recharge occurs in the spring when water from melting snow and precipitation soaks into the ground and when there is limited loss of water through evaporation or transpiration. Thus, the water table tends to be highest across Prince Edward Island in the spring. Recharge rates are much lower in the summer when higher temperatures and vigorous plant growth result in more evaporation and transpiration of water. Thus, from spring through to fall, the water table gradually falls. In the fall, when growth slows and evaporation decreases, it is common to have a second, smaller, recharge event, which can last until the ground freezes or precipitation falls as snow. The water table levels then gradually decline until spring (CBCL Limited, 2003).

The degree of rise and fall of the water table varies from year to year and from one area of the Province to another, depending on weather conditions and topography. However, the greatest fluctuations generally occur in the higher regions of a watershed where the water table can fluctuate by five metres or more on an annual basis. In the lower areas of a watershed, which are closer to sea level, the level of the water table may change by a metre or less in the course of a year (CBCL Limited, 2003), there is always an abundance of groundwater in PEI. On average, only about two per cent of the total recharge to our groundwater system is ever used, with the unused amount contributing to stream

discharge. In the few areas with heavy industrial or municipal water demands, withdrawals may be as high as 50 per cent of recharge. As a general rule, this is the maximum level of withdrawal that is approved under the GWEP allocation procedure, so that enough groundwater is left to discharge into streams and maintain a healthy level of flow.

2.2 Consultation Results

2.2.1 Drought as an Issue

In most ways where water is used in agriculture, it is not sustainable. Animals require water for drinking, and plants require water for growth. Hence, the agriculture sector is highly dependent on a good quality, reliable water supply, and is extremely vulnerable to shortages – whether resulting from climate variability, competition with other sectors, or degradation in water quality that makes the supply unsuitable for agricultural production (Harker et al., 2004). In our consultations with government officials in Prince Edward Island, there was a general agreement that drought was a serious issue. Drought affected processors and other growers, affecting their yields and their bottom line. Throughout the interview, it was gathered that drought is probably more serious due to limitations in the use of irrigation systems. In addition, the precipitation patterns seem to be more erratic during the last 10 or 15 years. Some areas in the province received major rainfall for 2001. Drought causes a reduction in yield and the quality is also affected. For example, the proper size of potatoes that French fry processors needed for their processing operations was not available. In 2001, French fry processors had to buy 3000 million pounds of potatoes from Alberta and North Dakota which cost them millions of dollars in extra costs. Even all weather predictions and forecasts cannot tell us if drought could be a more frequent occurrence. There is also no way to determine if there will be an increasing uncertainty over future water distributions and that is driving people crazy (Group communication, 2006).

2.2.2 Access to Water

Our study found that in Prince Edward Island access to water was a major concern or issue in the province particularly among farmers and the easiest method of obtaining water is through water bypass. In other words, producers found it a challenge to obtain water. Factors included financial costs, permission to dig wells or ponds, and distance of water source from the field. Another option that was identified was whether water could be shared with several producers, or the use of other options to maintain adequate soil moisture (i.e. crop rotation). Another problem identified by producers was the utility of digging a holding pond from a low capacity well since this was not an efficient way to provide an adequate supply for agricultural uses.

2.2.3 Drought Response Plan

The term "drought" can have many different definitions: meteorological, hydrological and agricultural. Prince Edward Island droughts tend to consist of dry spells with a subsequent reduction in streamflow, groundwater, reservoir levels and runoff, which result in water allocation problems (Durley et al., 2003). Drought contingency planning represents the preparedness and mitigation measures taken by government, industry, citizens and others prior to a drought (Wilhite, 1996). Drought planning is a dynamic process that takes into consideration socioeconomic, agricultural, technological and political trends, however, in Prince Edward Island there is no drought contingency planning at the local level. The reason given was lack of interest and political will from the PEI government to implement a drought contingency plan in spite of numerous proposals presented to the government for implementation. Furthermore, like any other jurisdiction in Canada, in addition to drought occurrence and its associated impacts in Prince Edward Island, federal and provincial government fragmentation and policy overlap complicated local-scale water quantity management. Responsibility for water resources in Prince Edward Island is shared among numerous provincial government departments (Environment, Agriculture and others).

2.2.4 Agricultural Irrigation Policy

Irrigation development is a capital-intensive process, which must compete with other uses for capital resources at the provincial level. In order to make a decision in favour of

irrigation development, policy-makers must know if irrigation development is good only for irrigators or is in the best interests of society as a whole (i.e. non-farm rural residents). In response to a series of drought events, the Prince Edward Island Departments of Agriculture, Fisheries and Forestry and the Department of Environmental Resources developed an Agricultural Irrigation policy in 1995 (PEIDAFF & PEIDER, 1995). This policy served as a water allocation mechanism for resolving access to the Island's water resources (groundwater and surface water) in order to minimize potential water access conflicts and negative impacts while also setting annual withdrawal fees for each Water Withdrawal Permit. Considering the high rate of recharge for island aquifers and because water extraction for irrigation purposes is of a short term nature, it was concluded that water use for irrigation purpose would have a negligible impact on groundwater reserves. The Policy states "the use of groundwater reserves as a source of water supply for agricultural irrigation purposes is considered to be a viable and sustainable option in terms of water availability and environmental impacts." This has been verified in studies carried in the province (Somers and Mutch, 1999). A major concern associated with irrigation from groundwater reserves is the potential impact of groundwater extraction on discharge available for streams. Irrigation from streams is less preferable under the Agricultural Irrigation Policy, and requires a Watercourse Alteration Permit and a Water Withdrawal Permit. The construction storage ponds adjacent to streams has been encouraged to reduce the withdrawal rate of water from the stream, but the indirect effects of these ponds on maintenance flow of the streams are being re-evaluated (CBCL Limited, 2003).

According to the participants at the consultation session, in their own words "the 1995 agricultural irrigation policy is currently obsolete because at the time groundwater was identified as the primary source of irrigation water for the province. The current view point of this government that groundwater is now the last source for irrigation." There was inadequate discharge of groundwater in the province and there was an increase in gravitation in groundwater after the 2001 drought year. The PEI government looked at the whole procedure and resources to address the issue. Given the seriousness of the 2001 drought and the extent of the crop losses affecting the potato industry, the French

fry processing industry responded by increasing the irrigated potato acreage to safeguard their contractual markets. In spite of this, it was revealed that the current administration is politically opposed to the whole concept of opening up the groundwater resource for irrigation purposes. This is due in part to popular opinion from the public that they do not want to use a lot of groundwater for irrigation

2.2.5 Watercourse Alteration Permit and Water Withdrawal Permit

In Prince Edward Island, water is allocated under the authority of the *Environmental Protection Act* (Revised Statutes of Prince Edward Island 1988, Chapter E-9) and the Water Well Regulations made under the Act. Additional guidance is provided by the *Agricultural Irrigation Policy 1995*. The Department of Environment, Energy and Forestry is responsible for the Act and the Regulation.

Under the Act, the Ministry has exclusive control over the allocation and use of water. This includes surface water and groundwater. Regulations may be created under the Act relating to the withdrawal and use of water. Given the fact that Prince Edward Island is almost 100 per cent groundwater dependent, it is not surprising that detailed groundwater regulations have been developed. Groundwater exploration and extraction permits are required. Persons who wish to withdraw groundwater at a rate of 4 litres per second or more, or for use by a water supply system, require a groundwater extraction permit. Under *the Environmental Provincial Act*, a watercourse alteration permit from the Department of Environment, Energy and Forestry is required for withdrawing water from surface water bodies at a rate in excess of 50 imperial gallons per minute, or when total daily withdrawal exceeds 10,000 imperial gallons.

Records of pump tests must be kept. Under the Agricultural Irrigation Policy 1995, streams must be equipped with flow measurement gauges and monitored to ensure that actual streamflow does not drop below maintenance flow levels in watersheds where the permitted withdrawal rate approaches 50% of the amount of water that is predicted to be available in excess of maintenance flow.

2.2.6 Moratorium on High-Capacity Wells

Over the past 20 years the agricultural industry in Atlantic Canada has modernized in response to both technological changes and market demands. The industry has also strived to keep pace with changing regulatory requirements that imposed new and often increasingly rigorous standards on how a specific operator manages his enterprise. This is particularly true with regard to the use and management of water both for purposes of irrigation and for livestock. In most years, for the majority of producers, irrigation is not cost effective (CBCL Limited, 2003). Rather it is needed for short periods of time either 1) to ensure that a crop, such as broccoli, is ready for market, 2) as frost protection for specific crops such as strawberries or, 3) in some areas of Atlantic Canada, is needed for the potato crop to meet processor demands, higher yields and improved quality. Apparently, many farmers in the Atlantic Provinces have incurred real hardship as a result of water shortages at certain periods over the years. Some of these hardships could have been dealt with through more effective management of the water on an annual basis.

In Prince Edward Island, while many people agreed that there is an abundant groundwater resource that, if well managed, could meet both the needs of agriculture and other user needs on the Island, there is public and, therefore, political hesitation to allow for expansion into this resource. As a result, the principal constraints or impediments to accessing sufficient water, or managing the available water resources efficiently, can be summarized as attributed to the following: the provincial moratorium on the drilling of high capacity wells for irrigation; public concern regarding the use of groundwater for irrigation systems; lack of access to expertise with respect to both the technicalities of irrigation systems and best management practices and conservation; and the lack of financial assistance for irrigation water sourcing. Finally, the moratorium was very successful from the government perspective. It was successful because the idea was not to build high capacity wells; only about 28 high capacity irrigation wells existed before the moratorium came into effect. The moratorium was put in place in the fall of 2001, yet as of December 2006, farmers are still looking for other alternative ways to irrigate their crops.

Given the involvement of many island producers in crops, such as blueberry and cole crops, where a relatively short dry period at a critical point in the growth cycle can mean significantly reduced yields or the loss of an entire crop, reliable irrigation is increasingly critical to many. Irrigation is also necessary to those involved in the production of potatoes to ensure the size and quality of product required by the major producers. Irrigation is therefore an important tool for the effective use of water in key agricultural sectors in Prince Edward Island.

2.2.7 Programs

The drought situation experienced in many parts of Canada over the past years has heightened awareness of the importance of reliable water supplies for domestic, industrial and agricultural purposes. Nowhere is this more critical than in the agricultural sector, where water shortages directly limit yields and result in economic hardships. Thus, across North America, water is increasingly recognized as the precious resource that it is. Governments at all levels are turning their attention to the preservation and enhancement of the quality and quantity of ground and surface water.

2.2.8 National Water Supply Expansion Program (NWSEP)

The National Water Supply Expansion Program (NWSEP) is a four year $60 million initiative by Agriculture and Agri-Food Canada (AAFC). It aims to improve the capacity of agricultural producers to deal with drought and other agriculturally-related water constraints through the development and expansion of water supply systems on a cost-shared basis. An initial $10 million was made available in 2002/2003 and was targeted mainly to help relieve the water supply situation on the drought-affected Prairies. The remaining $50 million of the NWSEP were made available nationally over three years to fund additional infrastructure and strategic water supply studies to address long-term solutions to agricultural water supply problems.

In order to determine the most appropriate use of the funds, AAFC, through the Prairie Farm Rehabilitation Administration (PFRA), initiated a series of scoping studies across

Canada. These were intended to identify the scope of agricultural water needs; to determine the nature and extent of water supply constraints on agriculture; and to identify priorities for agricultural supply expansion across Canada.

In Prince Edward Island, Tier I, II and III are administered under the National Water Supply Expansion Program (NWSEP). Tier I consists of individual irrigation projects that currently has about 45-50 projects approved for the past three years. As for the impact of Tier I, one participant noted "In my view it is very successful". For Tier II, participants noted it was a disappointment because there was less desire and willingness for people to work together as a collaborative group to develop infrastructure.

2.2.9 Sustainable Resource Conservation Program (SRCP)

This program has been under three different names - since 1999 about 12 million have been given out. The program is cost-shared by the federal and provincial governments. In the first five years, PEI provided the funding for the program. However, for the past three years, the federal government has been responsible for the funding. In the first three years, the program was first called AgEnv Conservation Program then renamed as Sustainable Resource Conservation Program. Now it is called the Canada – PEI Agricultural Stewardship Program. The Sustainable Agriculture Resources Section of the PEI government offers technical advice to farmers and landowners on soil conservation, integrated pest management, nutrient management, manure management and site-specific weather forecasting. This section is responsible for the Sustainable Resource Conservation Program (SRCP) which provides financial and technical assistance in specific program areas: soil conservation (strip cropping, terracing, grassed waterways); manure waste management; livestock fencing and alternate watering systems; planting hedgerows; fuel and pesticide storage; milkhouse waste management; deadstock composting; nutrient management planning; and Integrated Pest Management for potatoes (www.gov.pe.ca, 2007).

The PEI agricultural ministry has placed an increased emphasis on nutrient management planning due to increasing nitrate levels in groundwater and nutrient enrichment problems in watercourses. A nutrient management component was offered as part of the Sustainable Resource Conservation Program. Fifty-six applicants completed nutrient management balance sheets under the program which involved approximately 11,000 acres of agricultural land. Nutrient management workshops were held in both Charlottetown and Summerside throughout December with 75 producers attending. An Atlantic Task Group was established as part of the increased demand for nutrient management planning in the region. As a result, the first Atlantic-based nutrient management training course was offered in March 2003 at the Nova Scotia Agricultural College in Truro, Nova Scotia. The course serves as the foundation for Nutrient Management certification in the region.

Figure 1. Sustainable Resource Conservation Program

Sustainable Resource Conservation Program		
Completed Projects	**Number of Projects**	**Dollars Spent**
Manure Storage	23	$551,133
Soil Conservation	39	$195,127
Hedgerows	6	$5,923
Fencing and Watering	93	$434,807
Fuel Storage	31	$72,822
Pesticide Storage	2	$20,275
Milkhouse Waste	7	$13,043
Deadstock Composting	-	-
Integrated Pest Management Protocol for Potatoes	30	$71,400
Nutrient Management Plans	56	$53,105
Totals	287	$1,417,635

Source: www.gov.pe.ca, 2007

The Agricultural Crop Rotation Act (ACRA) was proclaimed in the spring of 2002. Soil conservation staff promoted and provided technical support to ensure that producers were aware of ACRA legislation requirements. Staff has conducted numerous training events to educate department extension staff so that they could assist land owners in developing

management plans. Preliminary conservation plans were developed for hundreds of properties for which land owners wished to meet the requirements of the legislation by matching their management to the topography on their fields. Land owners constructed erosion control structures and/or established strip cropping on 3500 acres in 2002.

With respect to Integrated Pest Management, a comprehensive Integrated Pest Management (IPM) manual for potato production was developed and will be available to growers for the 2003 growing season. Under the Sustainable Resources Conservation Program (SRCP) a new incentive offered potato producers an opportunity to obtain an advanced Integrated Pest Management designation. Thirty producers met the requirements of the protocol and received funding. The Pesticide Reduction Pilot Program (PRPP) was continued in 2002 and financial incentives were offered to 16 farms to demonstrate options for reducing the use of pesticides in commercial agriculture. The Pest Management Regulatory Agency (PMRA) has agreed to work with Prince Edward Island and New Brunswick on a commodity-based risk reduction strategy for potatoes to reduce the risk of future fish kills. The first step is to develop a crop profile for the region. The department restricted the use of Azinphos Methyl in August of 2002 because of its implication in a number of fish kills over the previous five years.

The farm weather forecast was offered to 75 producers and interested government and agribusinesses again in 2002. Five weather stations were used to provide a specific forecast in three hour increments. Subscribers to the service also received updates on the blight severity index. The weather monitoring network was also used in Integrated Pest Management projects. Department representatives continued to work with other government representatives, industry associations and other non-government organizations to provide technical and financial support for farms with the specific objective of eliminating livestock access to watercourses by 2003.

PEI Sustainable Agriculture staff continued to provide technical advice on irrigation for crop production. They also continued to provide technical advice to support industry

initiatives such as Environmental Farm Planning and have made a key contribution to the Soil Quality Monitoring project. Staff continues to respond to public concerns about farming practices and animal welfare.

2.2.10 Best Management Practices

One way blueberry growers can respond to environmental pressures in a proactive manner is to adopt *Best Management Practices*. Best Management Practices are recommendations and guidelines to help growers make sound environmental decisions in their farming operations. They are a combination of management, cultural, and structural practices that are considered to be effective and economical in controlling problems without disturbing the quality of the environment. They provide opportunities for growers to evaluate their own operations and choose the best management practices that are most appropriate for their own situation. It is important to keep in mind that many of the production and management activities that blueberry growers practice influence not just themselves but their neighbours and community. Anything that can be achieved to prevent environmental pressures will make their own operations and the blueberry industry more sustainable.

It is important that growers identify problem areas within their operations and select and implement the appropriate changes. Examples of Best Management Practices that should be considered where appropriate include:

- scout fields and spray only when and where necessary
- match appropriate herbicide rates with soil type
- do not apply herbicides within 50 m of water source
- do not mix or load near water, bring the water to the sprayer
- do not apply herbicides to rock formations and exposed ledges as they may provide a direct channel to groundwater
- avoid spraying if heavy rainfall or high winds are forecasted

- use an anti-backflow device when filling sprayers from a water source to prevent contamination from backflow
- make sure your sprayer or spreader is calibrated properly and accurately
- leave an untreated vegetation strip near any water sources to act as a filter
- read and follow all instructions as stated on the labels

These are a few examples of Best Management Practices to consider within your own blueberry operation. It is critical for growers to re-evaluate their operation and look for ways to reduce and improve upon any environmental pressures. (www.gov.pe.ca, 2007)

2.2.11 Provincial Summary of Agricultural Water Use

Sources of water • Groundwater dependency is almost 100% (Martin et al., 2000) • The thick, fractured sandstone bedrock formation is thought to store a vast amount of readily available groundwater close to the surface. Almost all rural water use, and approximately 90% of the total water used in the Province, is derived from sandstone bedrock aquifers (Martin et al. 2000). Coarse sand and gravel deposits (left by glaciers) are the other sources of groundwater (Martin et al., 2000). Monitoring, since the 1960s, through a network of observation wells does not show significant drops in groundwater levels from pumping, or concerns relating to competition (CBCL Limited, 2003). • On average, approximately 2% of total recharge is ever used; the maximum permitted groundwater withdrawal is as high as 50% of recharge (CBCL Limited, 2003) • Sea water intrusion is a concern in some coastal aquifers (Martin et al., 2000).
Demands for Water • No comprehensive estimates for the amount of water used in the agriculture sector identified. • In the 2001 Census of Agriculture, 38 farms reported using irrigation on 739 hectares of land. The majority of the irrigation (655 ha) occurs in Prince County (western PEI) (Statistics Canada, 2000).
Data Availability, Gaps and Needs • Groundwater Expansion Permits are required for groundwater withdrawals in excess of 3.8 litres/second. Irrigators taking water from streams require a Watercourse Alteration Permit and a Water Withdrawal Permit (CBCL Limited, 2003). • The province's water allocation system attempts to protect in streamflow needs through careful consideration of requests for permits from surface sources (Sketchell et al., 2000).
Issues and Concerns • Irrigation is essential for blueberry and cole crops such as broccoli and cauliflower; dry periods mean reduced yields or failure of entire crop (CBCL Limited, 2003). • The provincial government is concerned about the impacts of groundwater withdrawals for irrigation on baseflow of adjacent streams because streamflow is, to a significant extent, dependent on groundwater for baseflow (CBCL Limited, 2003). Thus, currently there is a moratorium on well development for irrigation • There is public concern about the use of groundwater aquifers for agriculture, and this is constraining expansion (CBCL, Limited, 2003) • Competition among agricultural, municipal and industrial users is a concern in some parts of the province (CBCL Limited, 2003). • Despite the fact that the groundwater resource is thought to be substantial, public concern abut the impacts of irrigation development and possible water shortages are causing policy makers to

restrict rapid development of agricultural irrigation (CBCL Limited, 2003).
Potential for Demand Management • No specific information was found
Technologies and Approaches to Mitigating Problems • The sustainable Resource Conservation Program assists producers in making their farm operations more productive and sustainable, while … achieving compliance with existing or new environmental regulations; reducing the risks of water contamination from agricultural practices is a goal (CBCL Limited, 2003) • Despite the relative abundance and high reliability of the groundwater aquifers, the provincial government aims to develop a broad management plan for groundwater resource (CBCL Limited, 2003).

2.2.12 Conclusions and Recommendations

The use of irrigation systems in PEI is still at a minimum. Only 3-4% of all producers use irrigation, and irrigation is only needed to supplement normal precipitation. The investment in irrigation systems can be viewed at from a risk management perspective – that is, the irrigation is there when it is needed; or alternatively as an economically wise investment that is promised to increase profit margins. Farmers in the province are struggling to attain a balance between the standards that they need to meet to gratify the processor versus the investment they can afford while still making a profit.

There was a general consensus that there was little or no publicly funded research with respect to optimal irrigation use in the province. The research that is taking place on the Island is processor driven, which can be potentially biased toward more irrigation, because irrigating has been seen to increase the size of the potato grown which, in turn, provides the desired market product. This argument was argued against by the fact that it is hard to obtain public funds for irrigation research when it is in such limited use. What is need is collaborative research in the form of partnerships with various stakeholders that have interest in irrigation.

Thus, based on our findings from the consultation we recommend the following:

- The government should strive to encourage research and development in irrigation in the province as irrigation is an essential component of agriculture industries in the region.

- Producers should be provided with basic education on irrigation
- Technical assistance should be made available to producers under certain conditions.
- The government should collaborate with other interest groups to provide extension services to farmers.
- A new agricultural policy should be put in place since the 1995 policy is now obsolete.
- A comprehensive contingent drought plan should be put in place by replicating what is happening in other provinces to reflect local environments and needs of the producers.
- Access to water for farmers should be given a priority by lifting the moratorium in place since evidence shows that PEI has abundant groundwater resources.
- Instead of placing restrictions on water permits, the government should be looking for other alternative ways for sustainable management of water resources in the province because regulations and enforcement would not help the current situation.

On the research side of the recommendations, we recommend that:

- At the very start of a proposal for this type of research, potential partnerships should be established with other stakeholders in the province of interest. Alternatively, a liaison person should be appointed in a region of interest particularly with this type of project that covers many jurisdictions.
- It would be of a great help to work with other departments in the province of interest in order to avoid conflicts like the one we encountered during our trip to Atlantic Canada.
- Institutional barriers regarding policies and procedures should be minimized at the outset of any project in order to avoid discontinuity of the project at a certain point when the project should be in full force.

3.0 New Brunswick

3.1 Introduction

The ability of the agricultural industry to remain competitive on regional and international markets is highly dependent on its land and water resource management strategy and the high quality of its products (MacLean et al., 1995). The relatively small amount of arable land coupled with a short growing season and relatively variable distribution of rainfall in the region brings producers to consider supplemental irrigation where feasible in their cropping management options. Since the early 1990s, efforts have been conducted in the Atlantic region to study potato crop response to irrigation scheduling, crop varieties and water availability.

In 1991 the New Brunswick Department of Agriculture initiated a feasibility study to evaluate water sourcing challenges more thoroughly and the implications of introducing supplemental irrigation in potato production in New Brunswick. The results of a study (Jacques Whitford Environment Ltd, 1993) combined with interest from the industry, brought a number of initiatives such as irrigation research, on-farm demonstration trials and awareness activities. After experiencing several drought events of extended soil moisture deficit periods in some agricultural regions, combined with the rise of conflicts over access to water supplies, some action became essential. In 1996, the Departments of Environment and the Department of Agriculture and Rural Development initiated a joint consultation to implement a proposed soil and water management strategy involving industry stakeholders (NBDARD & NBDE, 1996).

This proposed strategy involved the implementation of two pilot studies done at the watershed level involving potential irrigators and industry representatives. The strategy involved the promotion and encouragement of established on-farm water sourcing or common reservoirs for irrigation purposes. Due to a lack of resources, year-to-year climate variability and preliminary results of the potato irrigation trials, the industry started to shift its immediate actions toward adopting other more cost effective on-farm soil-water management practices. As a result, the proposed strategy did not develop into a long term policy framework. To date, the water allocation and permitting process for

irrigation has not yet been resolved among the various departmental agencies and industry stakeholders.

3.2 Literature Review

Irrigation trials were first undertaken in the Province in 1993 by the New Brunswick Department of Agriculture, Research and Development Branch, to assess potential benefits associated with supplemental irrigation (Eastern Canada Soil and Water Conservation Centre, 1999). This work concluded that the increase in yield resulting from irrigation was not sufficient to justify further investment. Producers with irrigation equipment had been cautious in its use over several years due to an increased probability of late blight, which can be aggravated by increased moisture. It was further noted that water sourcing for irrigation could be difficult given the limited precipitation that occurs during the growing season. The construction of reservoirs was identified as the most practical means of ensuring water supply (CBCL Limited, 2003).

In 1993, the Agricultural Advisory Committee on the Environment (AACE) was established under the Green Plan to advise the government on environmental issues associated with agriculture. AACE consists of representatives of the two New Brunswick Federation of Agriculture, the Soil and Crops Association, the Women's Institute, different commodity representatives, the Conservation Council, the Department of Environment, the Department of Agriculture and the Eastern Canada Soil and Water Conservation Centre. In 1995, specific issues associated with irrigation, including water supply, water quality, rights and permits, common water sourcing and accessibility, and education, became a focus of the group (Eastern Canada Soil and Water Conservation Centre, 1995a). The Ministry of Agriculture at that time requested input to develop a policy on irrigation. It was, however, suggested that irrigation was only one of a number of tools that might be applied to address concerns of moisture deficit. The maintenance of the organic content in the soil by means of crop rotation, the application of compost/manure, terracing, and residue management were all identified as alternative management tools (CBCL Limited, 2003).

McCain Foods (Canada) carried out extensive studies and commercial irrigation trials in the Grand Falls areas (Agricultural Region 1) between 1992 and 1998. The results varied widely from one year to another due to the variability in rainfall. During the driest year, an increase in yield of as much as 11 tonnes/hectare (100cwt/acre) was obtained for the two potato varieties investigated (Russet Burbank and Shepody). Over the six years of testing, irrigation increased the total yield of Shepody by 5.6 tonnes/hectare (50cwt/acre) and the total yield of Russet Burbank by 5.3 tonnes/hectare (47 cwt/acre). A return of $740/hectare ($300/acre) was determined to be necessary to break even on the capital and operating costs of the irrigation equipment. The costs of developing an adequate water source was considered to be an additional capital investment and was not included in the economic analysis. The study concluded that irrigation offers, at best, only limited benefits in the area for the varieties tested (Eastern Canada Soil and Water Conservation Centre, 1999).

A potato seed farm in the Grand Falls areas started supplemental irrigation in 1979. Due to less snowfall and irregular rainfall, the irrigation system has been in operation every year over the past six years. Increased yields have been noted for several varieties including Russets, Superior, Goldrush and Chieftan. An improvement in species quality was also reported (Eastern Canada Soil and Water Conservation Centre, 1999).

With respect to groundwater quality, it has been shown that the presence of nitrates in wells in the potato belt appears to be closely related to farming (10 to 20 per cent of the wells had concentrations that exceeded drinking water quality guidelines), and more specifically with respect to surface water runoff from agricultural operations. Health concerns were identified as the primary issue associated with agricultural chemicals (AACE, 1996).

A feasibility study (JWEL, 1993) of supplemental irrigation in potato production was conducted in the early 1990s for existing and potential potato farming lands in the Edmundston, Grand Falls, Florenvevile and Woodstock areas of the Province (Agricultural Region 1). The study revealed that soil moisture levels varied significantly

over the study area. Soil moisture levels in the Woodstock area - the southern portion of the study areas, were shown to warrant the introduction of supplemental irrigation. Four possible water sources were considered: direct withdrawal from existing surface water sources; groundwater; gravity-fed storage ponds; and pump storage ponds respectively.

On a total basin basis, the study concluded that there were sufficient quantities of surface water available to support the large scale introduction of supplemental irrigation in these areas. However, for a number of the sub-basins, representing approximately 29 percent of the total basin area, it was not physically feasible to support supplemental irrigation by surface water flows alone, due to insufficient quantities of surface water available within the smaller sub-basins. It was noted that this conclusion was based on a minimum aquatic habitat protection flow that is equal to the seven day low flow. It was also noted that this assessment did not consider the cumulative withdrawal of water from a watercourse. After the first water withdrawal is made, surface water availability should be re-evaluated for the areas that are downstream of the first point of withdrawal. It was further observed that other water use conflicts might exist during periods of low flow, and it was recommended that further study be carried out to assess this prospective.

The feasibility of using groundwater for supplemental irrigation was related to the area irrigated by groundwater to the area of influence on a per well basis (JWEL, 1993). The depth to groundwater in the study area was reported to range from 7 to 50 metres, and water quality was expected to be suitable for irrigation purposes. Pumping rates in excess of 7.6 L/s (100 Igpm) were identified for the sand and gravel aquifers located along the river valleys, and yields in the order of 75 L/s (1,000 Igpm) were reported to be obtained. On the other hand, yield from most bedrock wells were considered to be less than 0.8Ls (10 Igpm). It was concluded that adequate water to meet irrigation requirements might be obtained from the sand and gravel deposits associated with the river valleys. This, however, represented a very limited portion of the total study area.

3.2.1 Consultation Results

3.2.2 Drought as an Issue

In New Brunswick, there was a consensus among the participants in our focus group discussion that drought was not a major concern or issue. As it was further noted, drought was not a severe problem particularly for the 2001 and 2002 respectively. However, one participant pointed out that "we always have a series of droughts every other year…most people have high value crops and they need to have irrigation in the period when moisture is deficient. So I will say drought is an issue with people that grow high value crops."

Others have suggested that New Brunswick experienced drought periods on a yearly basis. Because of this, most people that grow high value crops have irrigation systems. For example, in 2001 a lot of normal water sources dried up and farmers were spending so much of their time irrigating. In New Brunswick, some producers in drought years react to droughts by taking up new crops, but as one participant said, to be able to have access to programs you cannot make quick decisions if you are going to go through the process making sure all the environmental issues are met. In some cases, farmers will bypass all the environmental or the government programs to address drought situations and that the programs are limited sometimes to the assistance they can provide. In New Brunswick, high value crops include horticultural crops like strawberries, apples, red berries, and corn. The crops that were most affected in the southeast of the province when there is a shortage of water due to the type of soil (sandy soil) were the horticultural crops, vegetables, fruits, and tomatoes.

3.2.3 Drainage as a Pressing Issue

Soil wetness caused by imperfect or poor soil drainage remains a major limitation to optimal crop production. This was clearly evidence in New Brunswick as the participants in our focus group admitted that drainage was the most pressing water problem in the province. Thus, the causes of soil wetness limitations to crop production usually can be attributed to numerous factors. In some soil situations, permeability of the soil profile is limited to such an extent that closely spaced subsurface drainage systems still appear

ineffective. It has been observed that the drainage of some fine-textured soils where permeability was so impaired that excess soil water movement was largely impeded from timely movement to a subsurface drain. Other soil wetness conditions are caused by topographical conditions where additional water accumulated in low areas and timely removal of the excess water is more difficult. In some cases, many crop species are also less tolerant of wet soil conditions so where these crops are preferred, drainage improvements may be needed.

Although, the majority of participants agreed that drainage was the major water problem in the province, others have said that soil erosion and the control of water runoff is one of the major issues affecting them because soil and water erosion account for 9% of soil loss per year. Another issue that came up in our focus group was the issue of water quality in the southern part of the province. Water quality concerns relating to agricultural practices exist across Canada. For example, in a 1992 survey of groundwater quality in rural Ontario, 34% of wells tested exceeded the maximum acceptable number of coliform bacteria and approximately 7% sere contaminated with both nitrate and bacteria (Fairchild, et al, 2000). The tragedy in Walkerton is still fresh in our memory and highlighted the link between livestock production practices and drinking water safety even though the farm was being operated properly (O'Connor, 2002).

Importantly, across New Brunswick, contamination of groundwater and surface water resources by agricultural practices, constrains the availability of water supplies. Similarly, a 2001 study of surface water quality in Nova Scotia's Annapolis Valley found evidence of impaired water quality in all rivers (CBLC, 2003). As Harker, et al. (2000) noted, not only is contamination of water by agricultural activities a problem for other sectors, but also poor water quality is a constraint on agriculture. To illustrate, in British Columbia, there is growing pressure to maintain water quality, especially in areas of livestock watering. UMA Engineering Ltd found that the lack of an adequate supply of good water quality for agricultural water users is an important concern in Alberta (UMA Engineering Ltd, 2003). Furthermore, in addition to livestock watering, good quality water is needed in irrigation to protect the quality of crops receiving the water.

3.2.4 Water Monitoring

Before the 2001 drought, there was little real-time monitoring of water supply in New Brunswick. There were hydrometric stations, operated by Environment Canada, that are located on a number of watercourses throughout the province for measurement of streamflow. This information is typically used to establish acceptable withdrawal rates as part of the operating permit approval. Over the last several years, the Department has also required that certificates be obtained for new residential wells. In order to withdraw water from a watercourse, or to construct a commercial or industrial well, an operating permit is required from the New Brunswick Department of Environment and Local Government. This operating permit stipulates the quantity of water that can be extracted. Since late 2001, the New Brunswick Department of Environment has instituted a web-based water quantity monitoring web site. The purpose of this website was not to provide data related to agricultural drought. Instead, streamflows were being monitored to identify periods of low flows affecting freshwater fish and other aquatic resources. Unfortunately, only annual totals were available for 2001 and 2002. However, since 2003, monthly water quantity data are available from the website.

With regards to water quality, the New Brunswick Department of Environment and Local Government is monitoring water quality at two locations within the potato belt in Region 1 to measure nitrate levels in groundwater that have exceeded the drinking water quality guidelines. A number of municipalities also monitor water quality on a regular basis to assess water quality for domestic purposes. The operation levels of the wells are normally noted and provide an indication of local groundwater level functions.

3.2.5 Government Assistance for Irrigation Development

At present, there are many long-term programs or provincial initiatives in New Brunswick to assist farmers in addressing water deficit issues. AAFC had developed a portion of the NWSEP to address some of the information and irrigation feasibility questions in the province. The amount of water that can be withdrawn at any location is limited by temporally varying hydrologic, climatic, and anthropogenic constraints. Therefore, extensive withdrawal of water for irrigation may not be sustainable from an

environmental and economic standpoint. Water resources are only renewable within the time frame imposed by the hydroclimatic conditions affecting the watershed or aquifer. Water resource planning involves preparing for the decision regarding the allocation of water resources and addressing the conditions or arrangements under which water resources may be developed (Mitchell, 1989). Historically, water resource planning in Canada as carried out by government has not been a high priority, principally because the government has advocated development according to the "doctrine of usefulness," whereby abundant water resources were used to fuel the growth of the nation (Burton, 1972).

In the last forty years, however, water resource planning has evolved considerably. First, there has been an increase in government involvement in water resource planning (Environment Canada, 1987; Mitchell and Shrubsole, 1994). Second, there has been a shift in societal attitudes towards the environment which encourages stewardship of water and the natural resources base (Hartig and Vallentyne, 1989), and recently the new wave of National Water Supply Expansion Program (NWSEP) initiated by the federal government to support infrastructure development. In spite of that, ensuring adequate supplies of water for the economic sector and for the maintenance of environmental quality is a provincial responsibility in Canada.

In New Brunswick, the National Water Supply Expansion Program (NWSEP) only started in 2006. The funding is fully accessible to all producers, but there are some concerns in order to fully access the grant, you have to have matching funds. As such, the program is a matching fund, which requires you to have infrastructure that would deliver the water and water supply to the field in order to participate in the program. However, if producers have no funds, they could claim crop insurance to finance their projects. In addition, farmers have access to water conservation planning and the provincial government provides technical support through the Department of Agriculture. This is also done through a third party in New Brunswick and the coordinator helps to coordinate technical assistance through the Department of Agriculture and Aquaculture

on a first-come first-serve basis. Some farmers could hire consultants to help them do this depending on their financial circumstances.

Irrigation development is a capital-intensive process, which must compete with other uses for capital resources at the provincial level. In order to make a decision in favour of irrigation development, policy-makers must know if irrigation development is good only for the irrigators or is in the best interest of society as a whole (Kulshreshtha, and Grant, 2003). Farmers in the potato belt have invested substantially in irrigation since the early 1990s and the governments have supported them financially (see the table below). It is important to stress at this point that the irrigation program in New Brunswick has been successful in areas where irrigation is beneficial.

In terms of technical support for producers, there was a general agreement that the provincial government is providing technical support to address many concerns for a number of years particularly by the Department of agriculture and aquaculture. Such supports are summarized below:

- Assists in infrastructure planning and development, drainage and irrigation
- Provides assistance to producers in developing their watercourse alteration
- Cost estimates and budgeting
- Assists in preparing application for water permits
- Provides funding for drainage up to $5,000
- Provides continuous education on benefits of irrigation
- Provides extension
- Provides workshops on crop rotation, organic matter levels, use of compost
- Provides consultation

Use of Irrigation in Canada by Province, 1999 to 2000

Province	Number of Farms Reporting			Area Irrigated (Hectares)		
	1990	1996	2000	1990	1996	2000
British Columbia	6.327	7,761	6,861	94,864	115,374	111.181
Alberta	4,185	4,914	4,098	458,139	516,600	499,240

Saskatchewan	1,224	1,617	1,030	73,733	97,378	68,490
Manitoba	338	449	361	13,196	22,190	28,145
Ontario	3,285	4,288	3,002	52,534	66,090	49,271
Quebec	1,525	1,883	1,307	21,848	33,611	22,578
New Brunswick*	132	193	156	1,060	1,422	1,144
Nova Scotia*	180	280	300	2,170	2,239	3,491
Prince Edward Island*	17	35	38	380	1,086	739
Newfoundland& Labrador	34	50	51	102	142	188
Canada	17,247	21,448	17,204	718,034	856,132	784,467

Source: Data from Statistics Canada, Census of Agriculture raw data tables for 1991-01

Note:* denotes studied areas.

As shown in the above table, many producers purchased irrigation systems under the agreement in the early 1990s in the potato belt area. About 10 to 12 producers out of 300 made substantial investments, but many of them are no longer using them. This could account for the drop in the use of irrigation in the province in 2000.

3.2.6 Obstacles to funding

There are growing public concerns that large quantities of water withdrawals during drought periods may be detrimental to surface and groundwater quality and to water availability for other users. However, it must be recognized at this point that proper use of crop irrigation management and careful irrigation planning are essential elements to secure adequate water storage, quality water and minimize environmental risks. Irrigation of agricultural lands may result in return flows which have deteriorated with respect to water quality because of dissolved and suspended constituents. These constituents may include sediments, nutrients, pesticides, pathogens, and other potential pollutants that could impact human health and the environment if left unchecked and uncontrolled (Hornsby, 1990).

In order to fully have access to water, there are some barriers that producers have to overcome. In New Brunswick, getting water permits is a huge barrier to the point that some farmers just gave up. To illustrate, the New Brunswick Department of Environment and Local Government requires that any proposed work that would alter a watercourse requires approval under the New Brunswick *Clean Water Act.* Any new well that involves the extraction of more than fifty cubic metres per day also requires approval from the Department under the *Clean Water Act.* With respect to withdrawal from a watercourse, an approval is required from the Department of Fisheries and Oceans under the Fisheries act should it be determined that an alteration of fish habitat could occur as result of the installation of a structure or other assessments would be required under the *Canada Environmental Assessment Act* (CEAA). It is important to note that institutional arrangements for water management and planning are fragmented in Canada. There are no comprehensive guidelines for dealing with water management in every province.

Another issue that came up in our consultation is that of funding. Farmers think that getting 1% from the government is not sufficient and do not meet their funding needs. In addition, there is a need for environmental compliance. Farmers must complete requirements for an Environmental Farm Plan (EFP). Otherwise farmers are not eligible for environmental programs. According to the interview participants, this is a problem because in order to be eligible for assistance, producers need EFP approval. The application process is another barrier as they have to wait for approval from the department concerned. Lastly they identified "bureaucratic barriers" which relates to government fiscal years. This type of barrier would not allow for future planning and long-term commitments beyond the current fiscal year. As one participant notes " when someone comes to talk to us today about a project for next year, we cannot talk about next year; we cannot plan for next April. We cannot plan for the future; we cannot make a long-term commitment."

3.2.7 Provincial Summary of Agricultural Water Use

Sources of Water

- Surface water sources and rainfall provide most of the water used for irrigation. Groundwater is also used by some producers (CBCL, Limited, 2003).
- Groundwater is derived primarily from sandstone aquifers (Martin et al. 2000).

Demands for Water

- No comprehensive estimates for the amount of water used in the agricultural sector were identified.
- In the 2001 Census of Agriculture, 156 farms reported using irrigation on 1,144 hectares of land distributed across the province (Statistics Canada, 2004).

Data Availability, Gaps and Needs

- Knowledge regarding irrigation and agricultural production is derived from the Census of Agriculture. No estimates of actual volumes of water used were identified.
- Knowledge of quantity and quality of surface water and groundwater resources is generally poor. Little monitoring of actual quantities of water used occur. Studies that have been completed focus on source water protection for specific communities (CBCL Limited, 2003).

Issues and Concerns

- CBCL Limited (2003) reported that there is a lack of technical support for effective water management, including advice on environmental regulations and processes for obtaining approvals to use water.
- The cost of constructing irrigation infrastructure, and problems associated with the current water use permitting process, were identified as the primary factors limiting further irrigation development (CBCL Limited 2003).
- Respondents in CBCL Limited's (2003) study identified the absence of effective provincial water management strategies as an important constraint to agricultural water supply development.
- Across the province, contamination of groundwater and surface water resources (by agricultural practices, among other) was seen as affecting the availability of water supplies (CBCL Limited 2003).
- In central and western NB, drought and competition from other water users are a key issue (CBCL Limited 2003).
- Groundwater quality in the potato belt area has declined as a result of the presence of nitrates in runoff from agricultural operations. CBCL Limited (2003) reported that 10-20% of wells have nitrate concentrations that exceed drinking water quality guidelines
- Increased competition within agriculture, and from other water using sectors, is occurring (CBCL Limited, 2003).

Potential for Demand Management

- Wells that extract water at the rate of 50 m^2/ day or more require approval from the provincial government. Surface water withdrawals also require permits (CBCL Limited, 2003).

Technologies and Approaches to Mitigating Problems

- According to the NB Department of Agriculture and Fisheries, drip irrigation is used by some farmers (fewer than 25% in most parts of the province) (CBCL Limited, 2003).
- Construction of reservoirs was identified by CBCL Limited (2003) as a practical means of assuring a water supply.
- Education regarding permit requirement and procedures, on-farm water management practices, and agricultural practices that conserve soil moisture was seen as an important priority (CBLC Limited 2003).
- Improved knowledge of groundwater and surface water sources, through hydrological studies, can address some concerns relating to the lack of knowledge of supplies available to agricultural and other users (CBCL Limited 2003).

3.2.8 Conclusions and Recommendations

- There should be a need for the continuity of every federal and provincial program for producers, particularly the NWSEP and other related programs in order to establish farmer's confidence in the programs. By doing so, the producers will gradually buy in.
- The establishment of trust is crucial for any program that will be successful, because there is mistrust among farmers regarding new projects or programs as they are not too sure how long the program will continue.
- Every federal program should be tailored towards local needs and it should be based on a specific region.
- There should be a need for regional adaptability and a template for every program.
- It is important to stress that NWSEP is designed from a western concept; therefore effort should be made to make it reflect the local context when it is being introduced to a region.
- Funding for education to meet needs associated with soil-water management practices, including pilot projects and information packages. This approach might be used for information sessions on permitting, funding research on new technologies and techniques, providing guidance on well and storage pond maintenance, or demonstrations for best management practices.
- There should funding to employ specialists to provide advice for farm-specific water supply management and expansion plans;
- Funding for the capital costs of on-farm water supply expansion, and where feasible, on a group or shared basis;
- Funding for monitoring initiatives, including pump tests, the routine testing of wells and streams, streamflow monitoring and developing a centralized database of both historical and recent records; and
- Funding for watershed studies.

On the issue of irrigation planning in the context of wise water management, we offer the following recommendations:

- Use natural regions (river basins) for analysis and planning.
- Operate through multi-sectoral, multi-jurisdictional organizations
- Pursue maximum efficiency in water use for irrigation and ensure that water use efficiency is also a priority in other sectors
- Use water resources planning to avoid conflicts between irrigation and other uses, and adopt an integrated soil water management approach in management
- Consider the future climate and monitor the situation carefully. Meanwhile, with respect to short-term use, determine flows in a conventional manner.
- Invest in drainage in the province since this is one of the major obstacles farmers face in their farming operations.

On the research side of the recommendations, we recommend that:

- At the very start of a proposal for this type of research, potential partnerships should be established with other stakeholders in the province of interest. Alternatively, a liaison person should be appointed in a region of interest, particularly with this type of project that covers many jurisdictions.
- It would be of great help to work with other departments in the province of interest in order to avoid conflicts like the one we encountered during our trip to Atlantic Canada.
- Institutional barriers regarding policies and procedures should be minimized at the outset of any project in order to avoid discontinuity of the project at a certain point when the project should be in full force.

4.0 Nova Scotia

4.1. Introduction

The objective of this section is to present and analyze our findings from the stakeholders' consultations held in Nova Scotia in December 2006 in order to learn about adaptation process experienced in the province.

4.1.1 Literature Review

According to the most current national census of Agriculture, there are over 4,200 census farms in Nova Scotia (Statistics Canada, 2002a). The top field crops are alfalfa, corn, and barley. The agricultural regions with the greatest land coverage of these crops are the Annapolis Valley, Cumberland, Colchester, Pictou and Antigonish Counties, which also correspond to the areas with the highest count of dairy and beef cows (Statistics Canada, 2002, a&b). Blueberries, apples, strawberries, carrots, beans (green and wax), and peas are the top five fruit and field-grown vegetable crops (Statistics Canada, 2002b). The regions with the greatest land coverage of these crops are the Annapolis Valley, Cumberland and Colchester Counties, and Cape Breton (Statistics Canada, 2002a).

The results of the Agricultural Census (2001) indicate that the agricultural landscape in Nova Scotia has changed in many ways since the 1996 Census. One significant difference is that the number of irrigated hectares in the Province has increased by 56%. This reflects changes that have occurred in a number of areas. For instance, there has been a slight increase in the hectares of land being used for irrigation-sensitive horticulture, most notably a 24% increase in the highbush blueberry crop area. Though the number of dairy and beef cows in the Province has decreased by 22% and 13%, respectively. The hectares being cropped for corn, a more drought-resistant feed crop, have increased by 15% over the same period (Statistics Canada, 2002b). These changes might be indicative both of the agricultural water stress that Nova Scotia has experienced in recent years, and of other factors such as changes in commodity prices.

Since 1997, the Province has witnessed four record breaking dry growing seasons, three of which were in succession. The agricultural sector was not ready for the severity of the resulting water shortages. It became apparent that there was a lack of knowledge of the water resources available to, and required by, agriculture. In addition, there was no plan in place for the effective management of water for the industry.

In the 1997 growing season, the Annapolis Valley experienced its driest growing season in 30 years. As a result, the Grower's Water Group, under Horticulture Nova Scotia,

commissioned a study entitled "Water Resource Needs of the Agricultural Industry of the Annapolis Valley." In their findings, producers revealed that their irrigation needs exceeded the available water supply by an average of 63% (AGRA Earth and Environment Limited, 2000). It was also reported that many farmers did not know the volume of water they were using, did not have the required permits, and that the Nova Scotia Department of Environment and Labour did not have complete records of those that did. Two recommendations came of this study: 1) that the agricultural sector more accurately estimate their water demands; and, 2) that the Nova Scotia Department of Environment and Labour improve their management and enforcement of the water permitting process.

The above study also found that there are many opportunities for the development of surface and groundwater sources in the Annapolis Valley. These conclusions were based on recent river assessments, as well as historical investigations of the groundwater resources (Trescott, 1968, 1969). Due to the landscape of the area, the options tend to be watershed-specific. It also appears that the options must be evaluated on an operation-by-operation basis due to the mix of agricultural practices. The principal recommendation was that more data would be required with respect to both water usage and the extent of supplies before effective watershed planning could be successfully developed. It was further recommended that a watershed stewardship board be formed to ensure that water resources in the area are developed holistically and with respect to the interests of all stakeholders (AGRA Earth and Environmental Limited, 2000).

Following this study, a number of watershed studies designed to address the key recommendations were undertaken; one of these was the Canard River Irrigation Water Enhancement Study. The Canard River Watershed is 52 km^2 in area and encompasses a wide range of land use including suburban development, agriculture, and forestry. At the time of the study, the watershed included 1,200 hectares (2,900 acres) of cropland and 300 hectares (800 acres) of orchard (38-62%). As the quantity of water available to current irrigators in the growing season is not sufficient to meet their needs, future development of the potential agricultural area may be constrained (CBCL Limited, 2003).

Many of the recommendations that came out of the studies include the estimation of agricultural water demand; these included impoundment of the river, the construction of reservoirs, and further development of the groundwater resource. The quality of the water in the Canard River, however, was identified as a primary constraint to the success of any of the identified options (CBCL Limited, 2003; Harris, 2001). It was also recommended that year round river flow monitoring of the major rivers in the watershed as a critical component for future studies, improved efficiencies of irrigation methods, and reviewing regulations and practices with regard to contaminant loading in the Canard River (CBCL Limited, 2003).

Early in the series of drought years that occurred during the late 1990s, the Nova Scotia Federation of Agriculture and Horticulture Nova Scotia recognized the need to develop a planned approach to water resource management, especially in the Annapolis Valley. Again, many studies were commissioned with aid from AAFC to assess the potential for water supply expansion to meet agricultural and watershed needs. The Habitant, Pereaux and Cornwallis watersheds studies were completed in the spring of 2003 (CBCL Limited, 2003).

Water shortages in the 2001 growing season were more severe than any experience during the preceding years. In Cape Breton, August rainfall was only 30% of the 50-year average for that month. The average yield loss of irrigable crops in this region was between 20% and 70% (Bras D'Or Producers Co-Op, 2001). The Annapolis Valley dominated by horticulture and livestock farming lost 50-100% of the area's unirrigated crops. Grain and forage crops were also drastically reduced. In many cases second-cut hay was damage by armyworm, and livestock was fed on first crop and silage (CBCL Limited, 2003). The Pictou an Antigonish Counties experienced similar problems with reduced second-cut hay. In this area, where the beef industry is well pronounced, herds were greatly reduced and the average weight per animal fell. It was estimated that pasture replacement and extra feed in this area cost farmers an additional $30,000 for each herd of 60 cows (Agriculture Services Branch, 2001). The Cumberland-Colchester region, whose dominant agricultural industries are dairy and blueberry farming, had no second

and third-cut hay crops in some areas to draw upon, and water for livestock watering was hauled from other sources. The additional cost of mitigating the effects of the water shortage was estimated to be $100 a head. The blueberry industry in the same year experienced a 75% decrease in yield (Agricultural Services Branch, 2001).

The suggestions of the Nova Scotia Department of Agriculture and Fisheries study of the 2001 drought include both short-term and long-term recommendations for mitigating the effects of water shortages in Nova Scotia. The short-term options were primarily funding programs; recommendations included grants for individual farm improvements and cost-sharing programs for infrastructure development, as well as expanding insurance to cover more types of crops and low interest loans for difficult crop years. One of the primary recommendations for a long-term solution was that the Province should develop a water management strategy for agriculture. This would involve collaborating with industry, through such structures as the Growers Water Group, to ensure that the water resource challenges facing agriculture are considered in provincial water management strategies, and addressing specific agricultural water management needs in association with the recently created Water Task Force Group. Other recommendations suggested that the Province negotiate a safety net program nationally that is more specific to Nova Scotia's needs, invest in climate change research and its implication for agriculture, and develop and fund a water conservation grant program to aid producers in implementing measures to conserve and protect water supplies (Agricultural Services Branch, 2001).

Agricultural regions outside of the Annapolis Valley also experienced water shortages in the late 1990s. In the Minas Basin, the watershed of the Bay of Fundy, agricultural activities include dairy and forage crops. In a series of Minas Basin community workshops organized by the Bay of Fundy Ecosystem Partnership, agricultural practices and water quality were among the priority issues identified by attendees. Agriculture in the area is important and employs more people than the forestry and fishery industries combined. Availability of an adequate amount of water for irrigation and livestock is perceived to be an ongoing problem, which climate change may further exacerbate. Water quality is also becoming an increasing concern to agricultural, residential and

industrial water users in the area. The issue is of particular concern to the small, but expanding number of organic farmers in the region who need good quality water for their crops. Some of the solutions offered by the group were water quality education and awareness, development and enforcement of best management techniques, development of watershed stewardship plans, and partnerships with landowners to create wetlands, riparian buffers, and demonstration projects (Bay of Fundy Ecosystem Partnership, 2002).

The potential for water supply expansion in the Minas Basin area has not been studied for the recent years, but several reports from 1970 to 1981 indicate the potential for groundwater development in the area. Test drilling in the northern part of the area indicated that properly constructed wells in the surficial and deep aquifers would yield sufficient water to provide for the future needs of all sectors in the area. The groundwater is considered to be of good quality, though it may require treatment for iron and manganese, and as of the late 1970s there were no activities identified that may have had an adverse effect on these water supplies (Vaughan and Somers, 1980). A 1972 study of the local groundwater resources in the Truro area (Region 3) indicated an adequate supply for the foreseeable future, but little subsequent research has been done (Henniger, 1972). In the Shubenacadie-Stewiacke River Basin, the potential for groundwater development is restricted due to the presence of the Windsor Group formation, which yields very low quality water (Bailey, 1981).

Cape Breton is the second largest producer of horticultural crops in Nova Scotia. However, there is very little historic documentation as to drought effects in this area. The Bras D'Or Producer's Co-op, in partnership with the Department of Agriculture and Fisheries, documented the effects of four successive water shortage years and made recommendations on how to prevent future water shortages. The research team, for instance, found that many irrigation ponds were undersized for the field area that they had to cover, and most had no means of recharge other than precipitation. Twenty to twenty-five percent of the fields under production had no means of irrigation. After several consecutive years of reduced yield due to persistent water shortages, many growers could

not afford to invest in new irrigation infrastructure, and could not therefore stay viable in this competitive industry (CBCL Limited, 2003).

Though the examination of the impacts of the 2001 drought indicated that Pictou and Antigonish Counties were profoundly affected by water shortages, no documentation of the efforts to mitigate or prevent future occurrences could be found. Within the St. George's Bay Ecosystem Project Report, a partnership between St. Xavier University, the Federal Department of Fisheries and Oceans and the Gulf Nova Scotia Bonafide Fishermen's Organization, there is an examination of the threats to water supply in the St. George's Bay South Watershed area. This is a region of very good agricultural soil known as "Queen and Woodburn soils" and of intensive and extensive agriculture. The "Nova Scotia Ground Water Survey" conducted in 1972 and 1973 contains records of water quality and quantity for the area. Gibb and McMullin (1980) examined the potential to expand ground and surface water supply in Pictou County; and Young (1971) published a surface water quality report for the same region. However, it was observed that the landfill and urban runoff threaten the quality of water in the West River, which supplies water for the town of Antigonish, but quantity is not an anticipated concern (CBCL Limited, 2003). In Antigonish County, where the primary agricultural practice is dairy farming, water supply issues are expected to centre on the contamination of groundwater from agricultural practices, rather than drought and competing uses for supply, particularly in the South River watershed (Davis et al., 2000).

Much attention since 1997 has revolved around the issue of water quantity, but given a year of sufficient rainfall, attention has turned back to the issue of water quality. The 2000-2001 annual report of the Nova Scotia Agricultural Services Branch shows that water quality was given higher priority than water supply than in previous years in terms of both activity and research. The Resource Stewardship Division, for instance, worked with many municipalities to develop agricultural land use activity standards that would reduce the risk of farming activities adversely impacting drinking water supplies. Wastewater treatment and water management were priority research initiatives in 2000-2001 (Agricultural Services Branch, 2001). The Nova Scotia Department of

Environment and Labour has also released the Nova Scotia Drinking Water Strategy, which focuses on source protection and long term planning for sustainability. Specific components include reference to inventory and the characterization of water sources as well as of pollution. In the strategy, there was no clear indication of a plan of action to achieve the identified goals (CBCL Limited, 2003).

The document of water quality centers primarily on concerns in the Annapolis Valley. A 1994 study of 237 wells in Kings County found that nitrate-N and coliform levels exceeded Canadian drinking water limits in 13% and 9% of the wells, respectively. Historical records show that these results represent no significant change since 1974. Well type and depth both appeared to play significant roles in determining which wells met guidelines. Although 93% of the well owners surveyed reported that they knew the type of well that they had, only 24% actually knew the depth. Similarly, there is a general lack of knowledge among well owners about water supply, in terms of both quantity and quality (CBCL Limited, 2003). Recommendations to improve these situations were not acted upon as the same findings were made in the "Water Resources Needs of the Agricultural Industry of the Annapolis Valley" study that was completed years later (AGRA Earth and Environmental Limited, 2000).

A study of the quality of water in the Eastern Annapolis Valley, which was conducted in the 2001 growing season, found that all rivers in the study area exhibited evidence of impaired water quality. The water analyzed was taken during the growing season; it did not include samples from the spring runoff. While the Pereaux, Habitant and Canard Rivers all experienced increased drawdown for agricultural irrigation during the dry summers, each exceeded the fecal coliform level permissible for the irrigation of produce for human consumption at least 50% of the time. Recommendations from this study included more monitoring and the enforcement of best management practices (Brylinsky and Pindham, 2001). It is noticeable that the broad-based, large-scale water management plans that work elsewhere are not suited to the scale and nature of Nova Scotia's agricultural industry; the approach must be adapted to the particular circumstances within each agricultural region (Webster, 1999).

4.2 Consultations Results.

4.2.1 Drought in the Province

Droughts in Eastern Canada are usually shorter, affect smaller areas, and are less frequent and severe. Nevertheless, they still have costly and disruptive impacts (Wheaton, 2000; Phillips, 1990). Nova Scotia has suffered its share of severe drought conditions and difficulties in accessing irrigation water supplies, mostly during the late 1990s in the Annapolis Valley. The majority of participants in our consultations agreed that drought is an issue, particularly in the Annapolis Valley. The Valley is an important agricultural region. It is underlain by Triassic Wolfville sandstones and conglomerates and stretches for approximately 100 km between the Annapolis and Minas Basins. The Wolfville Aquifer lies below most of the lowlands of the valley and provides a stable supply of groundwater throughout the region (Trescott, 1968; Palermo, 1993; Timmer, de Loë, and Kreutzwiser, 2007).

Important issues that were identified repeatedly in our interviews in Nova Scotia were the lack of drought preparedness. This makes it more difficult for farmers to access their water supplies. They should try to make a plan of action of how to better prepare for drought. Another issue that was consistently identified was the issue of not having enough water at the right time. In most cases, there is a shortage of water in the growing season (summer) when crops need it the most. There is generally enough water available during the rest of the year.

Over the years, as one interviewee puts it, “we had hydrological drought in this province and we had growing season’s drought. Growing season’s drought occurred in 1997 for six years.” In an interview of a subject, it was observed that in order for the province to attract federal funding, it had to have a drought. Thus, agricultural funding in the province of Nova Scotia is contingent on drought. Without declaring a drought, there is no funding to support programs for farmers. As a result of the 1997 drought, money was made available to farmers to purchase irrigation equipment, hence the trend towards an increase in the use of irrigation.

4.2.2 Water Quality

Water quality concerns relating to agricultural practices exist across Canada. Many provinces set quality objectives for water used for particular purposes, such as drinking, recreation, fish and wildlife, irrigation, livestock watering and industrial uses. In most cases objectives are designed to meet the requirements of the International Joint Commission (Pearse, Bertrand, and MaClaren, 1985). Since the contamination of the water supply of the Town of Walkerton in Ontario in 2000, the issue of water quality has been given priority in many jurisdictions across Canada. In this project, we found that in Nova Scotia, water quality is a concern for every stakeholder interviewed, though some of them admitted that water quality management is a provincial standard.

4.2.3 Water Management

Another issue that came out of this consultation is that of water management in terms of getting water off the land with controlled drainage, and at the same time having enough water when there is a drought period. Nova Scotia's *Environment Act* is the main mechanism for managing water resources in the province. Under this Act, the Nova Scotia Department of Environment and Labour is designated as the lead agency for water management and regulation. As such, the Department has the authority to restrict activities that will affect water quality, designate watersheds and recharge areas as protected water areas, regulate water and wastewater utilities, create monitoring standards, regulate on-site sewage disposal systems, and ensure that water is managed appropriately and used efficiently.

Municipalities can request that the Department designate their drinking water source areas (both surface and groundwater) as protected water areas under the *Water Act*. Currently 24 of the province's 82 municipal water supplies are designated as protected water areas. Public water utilities attached to the municipalities have the responsibility of managing these areas.

The *Municipal Government Act* is also pertinent to source water management. This Act gives authority to municipalities to plan land use within municipal boundaries. It is through restrictions on land uses and activities that water protection measures can be implemented at the municipal level.

In September 2000 the Department of Environment and Labour launched the Clean Water Watch website, providing public information on water-related issues and the best practices for water management. At the same time, the provincial government released "Guidelines for Monitoring Public Drinking Water Supplies" and the Water and Wastewater Facility Regulations. These documents set out requirements for water monitoring, as well as for compliance with the Guidelines for Canadian Drinking Water Quality. In 2002, the Department released "A Drinking Water Strategy for Nova Scotia," which underscores the need for a multi-barrier approach that includes source water protection.

As stated earlier, Nova Scotia has suffered its share of severe drought conditions and difficulties in accessing irrigation water supplies. In the Annapolis Valley in 1999, a study was initiated to address access concerns raised by a Valley Water Group representing agricultural producers and interested stakeholders. The study was carried out to evaluate the 'Water Resource Needs of the Agricultural Industry in the Annapolis Valley" (Hennigar, 2000). The study assessed the water allocation problems and recommended short and long term strategies for securing water supplies to meet agricultural demands. In some key agricultural watershed areas such as the Canard River, the overall average annual water utilization throughout the study area was estimated at 30% of the mean monthly supply. However, the water utilization during the growing season was approximately 53% on average. This provides a prime example for the need of a cooperative and coordinated approach at the watershed scale. One of the study's interesting suggestions was to set up Water Resources Management Stewardship Boards with representation from major stakeholders in the Valley who have an interest in water supply and availability.

The management of water resources on a watershed basis is being promoted under the proposed "Water Resource Management Strategy" by the Nova Scotia Department of Environment. As a result the Valley Water Group who first requested the study created a new Valley Watershed Stewardship Association to bring local participation in water issues. The intention was that this ground may be recognized as a community-based grass roots organization composed of individuals with a diverse focus in water priorities on a watershed basis.

4.2.4 Water Permit Process and Procedure

Under the Environment Act, the Activities Designation Regulations (Division 1) require a water withdrawal approval ("Water Approval") if groundwater withdrawal exceeds 23,000 litres per day. In order to obtain a withdrawal approval, a completed application form and supporting documentation must be submitted to Nova Scotia Environment and Labour (NSEL). Section 6 of the application form specifies that supporting documentation must include a Qualified Persons Assessment Report. For groundwater withdrawal approvals, the Qualified Persons Assessment Report consists of a hydrological study (NSEL, 2004).

The hydrogeological study must be completed to the satisfaction of NSEL and must clearly evaluate the potential effects of the proposed withdrawal on existing groundwater users and the environment. The report must be prepared by, or under the direction of, a qualified hydrogeologist. In Nova Scotia, groundwater approvals are one of the primary mechanisms used by NSEL to ensure that groundwater resource development is sustainable (NSEL, 2004).

4.2.5 The Guiding Principles for Groundwater Withdrawals

The following are guiding principles used in allocating groundwater withdrawals:

- Withdrawals from the aquifer must be sustainable overtime without causing unacceptable environmental, economic or social consequences.

- New groundwater withdrawals should not cause any significant adverse effects to existing groundwater users or the environment. Note that existing users are not required to modify operations of their water withdrawals that interfere with water levels in newly installed wells.
- Groundwater allocations are based on a "first-come, first-served basis" with priority given to drinking water applications. Priority is also given to existing withdrawal approvals over new applications. For new approval applications that are being processed, those received at the earliest date will be given priority over those received at a later date.
- Groundwater allocations are based on the application's current water needs, rather than potential future needs. The application must demonstrate the need for the volume of water requested. The application cannot typically reserve water for future uses beyond the expiry date of approval, up to 10 years of the Approval Procedure Regulations.

The results of our interviews show that a majority of producers were aware of the requirements for a water permit and cannot provide an estimate of the amount of water being used not as claimed by CBCL Limited Consulting Engineers in their 2003 final report. On the contrary, according to our interviewees, many irrigators are knowledgeable about the water permitting process. The exception would be those who do not have the permits yet, and they do not realize they need one. It was also suggested that there are many programs in place to educate farmers about the permit approval requirements such as the Environmental Farm Plan (EFP), which is more or less done on a voluntary basis. However, the Department of Environment and Labour is moving towards mandatory, regulation and enforcement throughout the province. In addition, other industries such as primary producers are moving towards the same level of compliance for provincial funding.

During the drought of 2001, the Department of the Environment and Labour conducted an amnesty survey with farmers to find out who was withdrawing water and how much they are withdrawing from the aquifers. The survey was a way of educating farmers about

their water use. Letters were sent out to farmers so that they can have the information they need regarding water permits in the province, particularly those farmers that needed to irrigate. On the enforcement side, there are about 15 to 16 inspectors that enforce regulations and there is a compliance department that is responsible for the enforcement of the regulations.

4.2.6 The Pilot Project

The "Pilot Project" that was launched in Annapolis Valley was based on the Ontario model with slight modifications to reflect local context in the region. The pilot project came into existence as a result of a guide developed for surface water return applications which was meant for municipal water supplies and industrial water supplies. However, many farmers were not too happy about the guidelines. As a result, the Nova Scotia Department of Agriculture and Nova Scotia Federation of Agriculture formed a working group to deal with issues and concerns raised by farmers. Before this was put in place in 2001 during the drought year, the number of application for approvals increased dramatically in the province. At this time, the province felt that they did not get a good deal from the farmers and other water users and decided to put a moratorium on the approvals until a better program was put in place. Nevertheless, the province decided to process the approvals without much information and approvals were only good for two years in the hope that within two years they would put a better program in place.

The province did not issue any applications for approval until 2006. As a result of the moratorium in place, many of the applications were unprocessed for almost four years. Under the new program, the province has processed about 50 approvals since the pilot project started in the summer of 2006. A majority of application for approvals were renewals and easy to process. These new approvals were given out for three years with the idea that this is just a pilot project run only in the Annapolis Valley and the idea was to extend it to other parts of the province if the project was successful.

4.2.7 Category of Permit

There are three types of approval permits in Nova Scotia based on the degree of their risk:

Category 1

- In category one they have 35 permits renewed
- No application fee for a farmer
- Cost $266.25
- Process time less than 2 months
- Also include off-line ponds
- No study required

Category 2

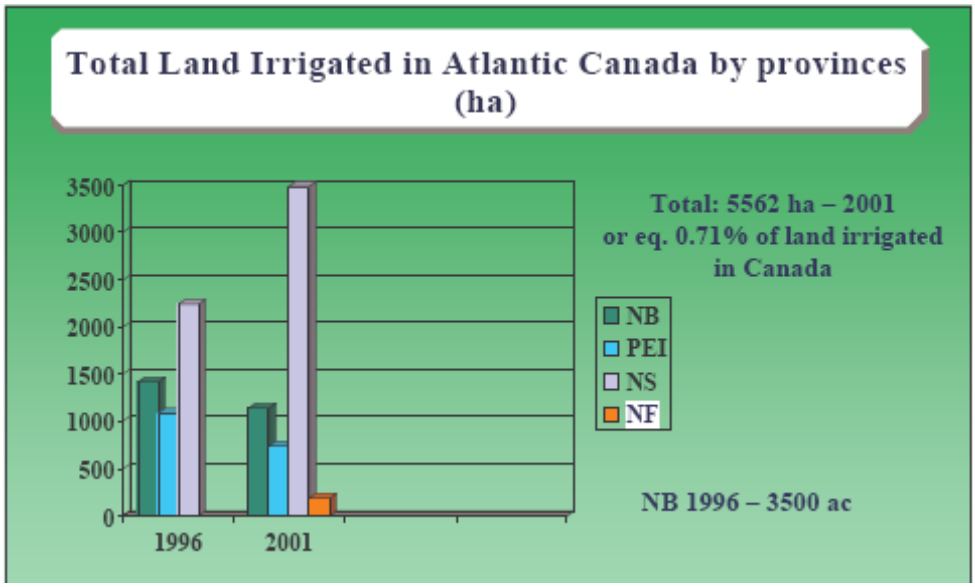
- There are about 10 – 12 applicants
- Need to calculate 75% median flows (DFO)
- 3rd order or higher category stream
- Require hydrological/hydrogeological study/report cost between $1,000 - $, 3000

Category 3

- Not done yet, need about $10,000 for the study of surface and groundwater.

4.2.8 The use of Irrigation in the Province

Before 1997, at the beginning of the series of dry growing seasons, most irrigators had less than 25% of their land set up for irrigation. Since then, many irrigators have between 50% and 75% of their holdings under irrigation. In Cape Breton, less than 10% of the agricultural land is set up for irrigation (see chart below). The reasons given by our respondents include availability of funding as money was made available to farmers to purchase irrigation equipment, pressure from consumers for robust and high quality produce, pressure from international competition, and farmers switching to high value crops that required them to irrigate.



Source: Statistics Canada 2002

4.2.9 Current Programs and Initiatives

The following sections elaborate on existing programs and initiatives in the province.

i) AWARD 2000

This program is targeted toward the identification of solutions to short and long term water and soil moisture management concerns. It is meant to address both water quality and quantity through the cooperation of the agricultural industry, the Nova Scotia Department of Agriculture and Fisheries, and the Nova Scotia Department of Environment and Labour. The objects of AWARD 2000 include:

- Identify and utilize alternative or non-conventional sources of water;
- Encourage multi-purpose water uses (between agricultural and non-agricultural users), and
- Support co-operation in agricultural water management (among agricultural users).

Award 2000 is a component of the Canada/Nova Scotia Technology Development 2000 Program. It is aimed at in-field testing, design and demonstrations at an applied level,

and is not designed to fund capital projects related to water management on individual farms. Up to 50 percent assistance is available for eligible project costs to a maximum of $30,000 per project per year for individual projects, or $40,000 per project per year for community-based or multi-user projects. Past AWARD 2000 projects include the release of three Farm Fact Sheets on Soil Water Management, several assessments of watershed water quality and evaluations of groundwater resources in the Annapolis Valley. This program started in March 2000, the current of status of the program is unknown, but it was pointed out that program was completed in 2003.

ii) TECH 2000

This program is designed to support the development and adaptation of new and leading agricultural technologies and knowledge that will enhance the competitive position of the Nova Scotia Agri-Food industry. Assistance on eligible costs may be up to 75 percent of total project costs to a maximum of $20,000 per year per project. This program has the potential to be used for innovative ways of increasing production in drought conditions. We are not certain what happened to this program as our respondents could not provide use with solid answers as regard to its status.

iii) Farm Investment Fund

This fund provides public financial support for projects that enhance economic viability and farm and food safety that promote environmental stewardship. It provides assistance of up to 50 percent of eligible project costs to a maximum of $10,000 per year or $20,000 over two years.

iv) Environmental Farm Plan (EFP) Program

This is a voluntary program to help farmers identify and assess environmental risk on their property. Arguably, it not completely voluntarily because it is tied to provincial and federal funding. In most cases, before a farmer can qualify for funding he/she has to comply or submit to the Environmental Farm Plan (EFP). As one respondent puts it “we have the Environmental Farm Plan and the Nutrient Management Plan so if someone

comes to your farm, they do an assessment on your environmental practices and nutrient management and water quality issues and if you have neither one of those things you are able to access funding."

This type of process was called incentive building because many farmers are totally for water conservation since they share their water supplies and water conservation supports the viability of agriculture. It allows farmers to incorporate environmental considerations into their everyday business decisions, rather than addressing environmental issues in a reactive sense. Farmers work with the EFP Coordinator to develop a confidential environmental farm plan for their operation and it is a service that is rendered by the Nova Scotia Federation of Agriculture with funding from Agri-Food Canada through Nova Scotia Agri-Futures and the Nova Scotia Department of Agriculture and Fisheries. The uniqueness of this program in Nova Scotia is that planners are available to assist farmers in the preparation of the Environmental Farm Plan by visiting farmers on their farm and make recommendations about what needs to be changed. According to information gathered in our interviews "it is more of a different process than other programs or projects where the farmers have to do it themselves. Thus, Environmental Farm Plan team members are out there meeting with farmers and they are providing a lot of information to the farmers about program licensing requirements, water quality, storage of pesticide and gas. The planners are sources of information to farmers in the province."

v) Factsheets

The province has embarked on producing numerous educational factsheets through partnerships with the Department of Agriculture and Fisheries, Federation of Agriculture, Horticulture Nova Scotia, and the Nova Scotia Agriculture College. These are available free of charge to producers; topics include water, waste, and soil management, environmental compliance, and new technologies for production extensions in water shortage conditions. To date, the Department of Agriculture and Fisheries, in partnership with the Nova Scotia College, have released several factsheets.

vi) Water Management Group

In October of 2002, a series of producers-based Water Management Groups were started in the Province to identify and address on-farm water issues. This pilot project, initiated by the Nova Scotia Federation of Agriculture, was funded by the province. Three groups (known as Water Clubs) have been established; these are located in the Annapolis Valley, Stewiacke, and Cape Breton agricultural regions, which represent the main agricultural regions in the province. The intent is that producers from all agricultural sectors will meet with a facilitator to develop a set of priority issues, which will then be reviewed by an advisory committee comprising representatives of government, the Federation of Agriculture and AAFC. A set of action items will be developed to address the identified concerns; this was how PFRA was set up in the province.

The pilot project involvement gives water to farmers that were irrigating in those regions and by putting siting gauge on holes to know how much water they are getting. At present, they are trying to restart the water club again because the water clubs are going to be essential to the whole process. As a result of the water clubs, the application process has become very successful and the best way to manage water is to put it in the hands of farmers on the watershed basis where the water source is. The idea behind this is that farmers will manage the water while government officials oversee the whole operation.

According to our respondents, the projects did not succeed very well because they were started prematurely. They were started in 2001 and the water funding program did not kick in until 2004 so there was about three years in funding delays. There was frustration on the part of the farmers, not only on their ability to gather information that was not there. Unfortunately, because of the delays in funding, farmers began to show a lack of interest for the whole project.

vii) The National Water Supply Expansion Program (NWSEP)

The federal government maintains a number of programs to help alleviate the short and long term effects of droughts. The Agricultural Policy Framework had $60,000 allocated

to the National Water Supply Expansion Program (NWSEP) to help improve capacity to deal with drought related situations through expanded water supply and water management measures beginning in 2002 and continuing over three years (Government of Canada, 2002a).

The objective of the Canada-Nova Scotia Water Supply Expansion Program is to ensure the agricultural sector/community has access to secure, good quality water resources to meet its existing and growing needs through a water management program that stresses efficient and effective use of available rural water supplies. Eligible participants include individuals and/or incorporated groups of farmers; agricultural and conservation groups; agri-businesses and rural enterprises; educational institutions and provincial government departments, agencies and crown corporations.

The Canada-Nova Scotia Water supply Expansion Program will support three types of projects:

Tier One – On-farm water infrastructure project: individual on-farm infrastructure such as water meters, ponds, off-stream water collection, and storage structures that supply a secure water source. Tier one applications were available through the Farm Investment Fund that begun in the 2005-2006 program year. In Nova Scotia, Tier one has been very successful as there was very high uptake by the industry and they are in their second year. In the first year, there were about 180 projects funded and close to 300 projects in the second year. The application process and procedure are very simple as producers only need to fill out one application for the farm investment fund. The Tier one and the Best Management Practices (BMP) are within the same rank. This helps the industry to get help from the province and the federals in one program. Tier two and three projects are managed by Agriculture and Agri-Food Canada. There is a disappointment with the Tier two and three components. There was a lack of interest by farmers in applying. For Tier three projects, they only had about 20 participants. Conversely, the collaborative Tier Two projects have been very popular in the Prairie Provinces for many years. It is important to stress that there are external factors involved that affect the uptake of the same funding program among provinces.

4.2.10 Provincial Summary of Agricultural Water Use

Sources of Water

- Most producers rely on surface water from ponds, streams and rivers (CBCL Limited, 2003).
- Surface and sandstone bedrock aquifers are important in the Annapolis Valley (CBCL Limited, 2003; Martin et al., 2000).
- Since 1997, quality and quantity concerns exist regarding surface sources during the growing season (CBCL Limited, 2003).
- Sustainable rates of pumping of aquifers in the Annapolis Valley are known (CBCL Limited, 2003).

Demands for Water

- No comprehensive estimates for the amount of water used in the agriculture sector were identified.
- In the 2001 Census of Agriculture; irrigation was reported on some 300 farms that irrigated 3,491 ha in 2000. Most of the irrigated area is in the Annapolis Valley, in the Census Division of King's County (Statistics Canada, 2004).
- Numbers of irrigated hectares has increased by 56% since 1996 (CBCL Limited, 2003)
- Livestock is also important, but the number of beef and dairy cows has declined by 13% and 22% respectively since 1996 (Statistics Canada, 2002b).
- CBCL Limited (2003) reported that before the dry summer of 1997, 25% of producers with irrigation equipment had prepared land to irrigate, while after 1997 between 50% and 70% actually irrigated.
- In the Annapolis Valley, demands for irrigation water were found to exceed available supplies by 63% (CBCL Limited, 2003).

Data Availability, Gaps and need

- Surface and subsurface water resources and water usage by sector still need to be determined in Nova Scotia (CBCL Limited, 2003).
- The province's water allocation system does not provide a sound basis for collection of data on water use. Due to provincial government restructuring, many permit records have been lost, and the database is out of date (CBCL Limited, 2003).
- In a study conducted in the Annapolis Valley, farmers commonly did not have required permits, or could not provide estimates of water use (CBCL Limited, 2003).
- Watershed studies have been competed in the Annapolis Valley, but otherwise the province's water resources have not been assessed for 20 years (CBCL Limited, 2003)
- Despite their importance, the yields and capabilities for sustained pumping of aquifers in the Annapolis Valley (both surface and bedrock) have not been determined satisfactorily (CBCL Limited, 2003).
- Attempts are been made to update the groundwater well log database (CBCL Limited, 2003).

Issues and Concerns

- CBCL Limited (2003) reported that due to water shortages in 2001, the average yield of irrigable crops in Cape Breton was between 20-70 percent of normal. The blueberry crop alone yielded a 75 percent decrease in 2001 compared to normal.
- In the Cumberland-Colchester region, water had to be hauled for livestock (a considerable expense for producers) (CBCL Limited, 2003).
- Competition for water in the Annapolis Valley is a concern (agriculture and expanding communities) (CBCL Limited, 2003).
- Demand for water is increasing in the Annapolis Valley and Cape Breton due to increases in horticultural crops. Hence, these may be prone to water shortages (CBCL Limited, 2003).
- During dry summers, livestock producers have had to haul water for watering livestock and

washing barns and equipment. Feed crop supplies have also been affected by dry conditions (CBCL Limited, 2003).
- Lack of adequate irrigation infrastructure and water storage facilities limit further growth of agriculture on Cape Breton (CBCL Limited, 2003).
- A study of surface water quality in the Eastern Annapolis Valley, during 2001, showed evidence of impaired water quality in all rivers (CBCL Limited, 2003).
- Dairy farmers in central Nova Scotia are concerned about the costs associated with complying with pending regulations requiring potable water for cleaning milkhouse equipment (CBCL Limited, 2003).
- Ineffective management of water resources was identified as a more significant concern by CBCL Limited (2003) than the overall lack of water supply.

Potential for Demand Management

- No specific measures were identified
- However, demand management and water conservation require adequate databases and monitoring of water use.

Technologies and Approaches to Mitigating Problems

- The Nova Scotia Department of Environment and Labour is digitally mapping provincial watershed boundaries, a project expected to be completed in 2005 (CBCL Limited, 2003).
- The province of Nova Scotia has released a strategy for drinking water protection and management (Nova Scotia Department of Environment and Labour, 2002).
- At a workshop conducted by CBCL Limited (2003), the following were identified as worthwhile solutions: funding for extension and educational services to farmers to improve understanding of water supply, distribution, use and management practices; establishment of a comprehensive water resource database; funding for on-farm water storage; and water quality protection measures.

4.2.11 Conclusion and Recommendations

- The government at both levels should invest in source protection planning
- Constantly monitor the progress of the plan to make sure things are working well
- There should be investment in education and training for producers in the province, particularly the irrigators
- More extension staff and inspectors should be hired in the province to provide extension services to producers while the inspectors will help enforce the regulations.
- Departmental fragmentation should be streamlined, particularly those that handle application for approvals
- The departments of Environment and Labour, and Agriculture should work in partnership with each other by sharing their experiences and expertise to solve complex problems.

On the issue of irrigation planning in the context of wise water management, we offer the following recommendations:

- Use natural regions (river basins) for analysis and planning.
- Operate through multi-sectoral, multi-jurisdictional organizations
- Pursue maximum efficiency in water use for irrigation and ensure that water use efficiency is also a priority in other sectors
- Use water resource planning to avoid conflicts between irrigation and other uses, and adopt an integrated soil water management approach in management
- Consider the future climate and monitor the situation carefully. Meanwhile, with respect to short-term use, determine flows in a conventional manner.
- Invest in drainage in the province since this one of the major obstacles that farmers face in their farming operations.

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