



Main Bayfield

Watershed Plan







**Main Bayfield
Watershed Plan
2013**



Cite as: Schnaithmann, J., A. Gutteridge, H. Brock, and M. Veliz. 2013. Main Bayfield Watershed Plan. Ausable Bayfield Conservation Authority. Exeter, Ontario. 39 pp.

ISBN number: 978-0-9781887-2-6

Copies of this publication are available online: www.abca.on.ca

Ausable Bayfield Conservation Authority (ABCA)
71108 Morrison Line, RR 3
Exeter, ON
N0M 1S5
519-235-2610 or 1-888-286-2610

Photos by Daniel Holm Photography, courtesy Rural Stormwater Management Model Project of the Healthy Lake Huron: Clean Water, Clean Beaches initiative (healthylakehuron.ca), and the Ausable Bayfield Conservation Authority.



Executive Summary

The Main Bayfield Watershed Plan was developed cooperatively between landowners, residents, and local organizations in the Bayfield and Clinton, Ontario area. It is hoped that the watershed plan will help the community understand the connections between the actions we take on the land, and the quality of our natural resources, such as our water, fish, and beaches. Actions that reduce nutrient and sediment runoff will also enhance the larger Lake Huron, as the Bayfield River flows directly into the lake. The community stakeholders that developed the watershed plan recommended the following vision and goal:

Watershed Vision

The Main Bayfield Watershed Plan will respect the long-term sustainability of all water systems and the life that depends on them. Our community vision is one of a healthy, resilient watershed where people, wildlife and habitat thrive. Taking pride in the quality of the Main Bayfield watershed; continuing to protect and enhance the watershed resource.

Community Goal

The goal of the Main Bayfield community is to improve the water quality and quantity within the Bayfield River by reducing total phosphorus, *Escherichia coli* (*E. coli*) and total suspended solids concentrations, and to increase forest cover, wetlands, and streamside cover.

Local Issues & Opportunities

In addition to supporting the numerous actions being undertaken by local landowners and community groups, the advisory committee for the Main Bayfield Watershed Plan developed several key issues for the area. With the watershed plan as a guiding document, the community can

effectively work towards addressing these challenges.

Urban Runoff Work with homeowners and the municipalities to implement innovative stormwater management solutions that will benefit water quality, as well as sustainable urban growth (e.g., improve and upgrade urban infrastructure with low impact development and green infrastructure principles - buffers, rain barrels, rain gardens, permeable pavement).

Agricultural runoff Implement site-appropriate Best Management Practices (BMPs) (e.g., create wetlands to hold water during rain events and release it during dry periods, maintain crop residue, follow nutrient management plans).

Aggregate extraction Monitor how aggregate extraction, particularly below the water table in the Trick's Creek subwatershed, is affecting water quantity levels and flow rates. Trick's Creek contributes cold water and baseflow to the Bayfield River. Share monitoring data with industry and government so that short- and long-term decisions related to aggregate extraction can be made.

Decreased forest cover Work with landowners to improve forest cover on their land in ways that support their agricultural operations (e.g., plant trees on marginal land, plant windbreaks, protect and manage established woodlots for long-term benefits).

Urbanization Direct development away from areas of provincial, regional and local ecological significance including agricultural and environmental resources (e.g., strengthen existing land use policies within Official Plan documents, improve and upgrade drinking water and wastewater facilities; link the economic and environmental benefits).

Acknowledgements

Main Bayfield Watershed Plan Advisory Committee:

Marilyn Broadfoot, Main Bayfield Landowner
Bill Dowson, Mayor, Municipality of Bluewater
Rick Kaptein, Main Bayfield Landowner
Marg Kroes, Main Bayfield Landowner
Jacqui Empson Laporte, Ontario Ministry of Agriculture and Food
Joe Laurie, Main Bayfield Landowner
Roger Lewington, Chair, Bayfield Chamber of Commerce
David Middleton, Main Bayfield Landowner
Jane Simmons, University of Guelph
Tom Sinclair, Roads/Public Works Manager, Municipality of Central Huron
Thea & Bill Trick, Main Bayfield Landowners
Ainslie Willock, President, Bayfield Ratepayers Association

Fred A. and Barbara M. Erb Family Foundation
Environment Canada
Ontario Ministry of the Environment

Thank you to all the landowners of the Main Bayfield watershed for your interest and willingness to participate in this process.



Table of Contents

Executive Summary	ii
Acknowledgements	iii
Table of Contents	iv
List of Figures	v
List of Maps	v
List of Tables	vi
Chapter 1: Introduction	
The Main Bayfield Watershed	1
Watershed Description	4
The Socio-Economic Landscape	7
Natural Areas	11
Aquatic Resources	13
Chapter 2: Vision, Goal and Communities in Action	
Watershed Vision	20
Community Goal	20
Local Recommendations	20
Communities in Action	20
Chapter 3: Watershed Plan Evaluation	
Watershed Plan Evaluation	28
Short-term Evaluation	28
Long-term Evaluation	28
Concluding Remarks	29
Glossary	31
References	34
Appendix A: Plant, mussel, fish, reptile and bird species at risk identified within the Bayfield River ANSI (ABCA 2012, Morris <i>et al.</i> 2012, Crins 1983).	37
Appendix B: Fish species identified in the Main Bayfield watershed (ABCA 2012)	38
Appendix C: Mussel species identified in the Main Bayfield watershed (Morris <i>et al.</i> 2012)	39

List of Figures

Figure 1: Principles of the Lake Huron-Georgian Bay Framework for Community Action (Anderson *et al.* 2007) (lakehuroncommunityaction.ca).....2

Figure 2: Industry sectors as an average for the municipalities of Bluewater, Huron East and Central Huron (Statistics Canada 2007)8

List of Maps

Map 1: The Main Bayfield watershed 1

Map 2: Topography of the Main Bayfield watershed 4

Map 3: Physiography of the Main Bayfield watershed 5

Map 4: Soils of the Main Bayfield watershed 6

Map 5: Land use in the Main Bayfield watershed 9

Map 6: Natural heritage features of the Main Bayfield watershed 10

Map 7: Existing and potential wetlands in the Main Bayfield watershed 11

Map 8: Significant groundwater recharge areas, municipal wells, provincial monitoring wells (PGMN), and wellhead protection areas of the Main Bayfield watershed..... 13

Map 9: Fish, mussel, water quality and level monitoring sites in the Main Bayfield watershed 17

Map 10: Classification of municipal drains and natural watercourses in the Main Bayfield watershed 19



List of Tables

Table 1: Crop types within the Main Bayfield watershed observed in 2011 and 2012 9

Table 2: Current percentage of forest, wetland and streamside habitat for the Main Bayfield watershed compared to recommended minimum percentages established by Environment Canada for healthy watersheds (Environment Canada 2013) and in the Ausable Bayfield Conservation Authority (ABCA) watershed jurisdiction 12

Table 3: Environmentally Significant Areas (ESAs) in the Main Bayfield watershed 12

Table 4: Nitrate and chloride concentrations for the Main Bayfield groundwater monitoring wells (2007-2011) 14

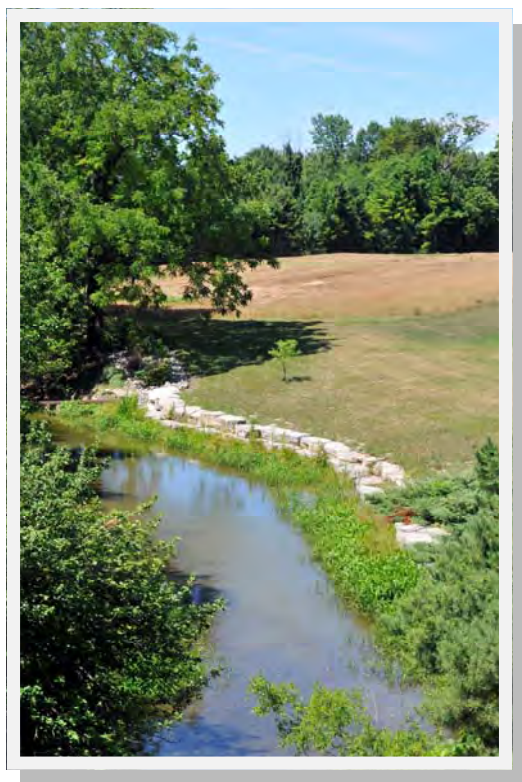
Table 5: Surface water quality indicators and grades for the Main Bayfield watershed and the entire Ausable Bayfield Conservation Authority (ABCA) area 15

Table 6: Local challenges and opportunities for environmental improvement 21

Table 7: Actions completed by community members in the Main Bayfield watershed..... 22

Table 8: Actions that community members in the Main Bayfield watershed want to complete 23

Table 9: Committed actions from local organizations in the Main Bayfield watershed..... 24



Chapter 1

The Main Bayfield Watershed

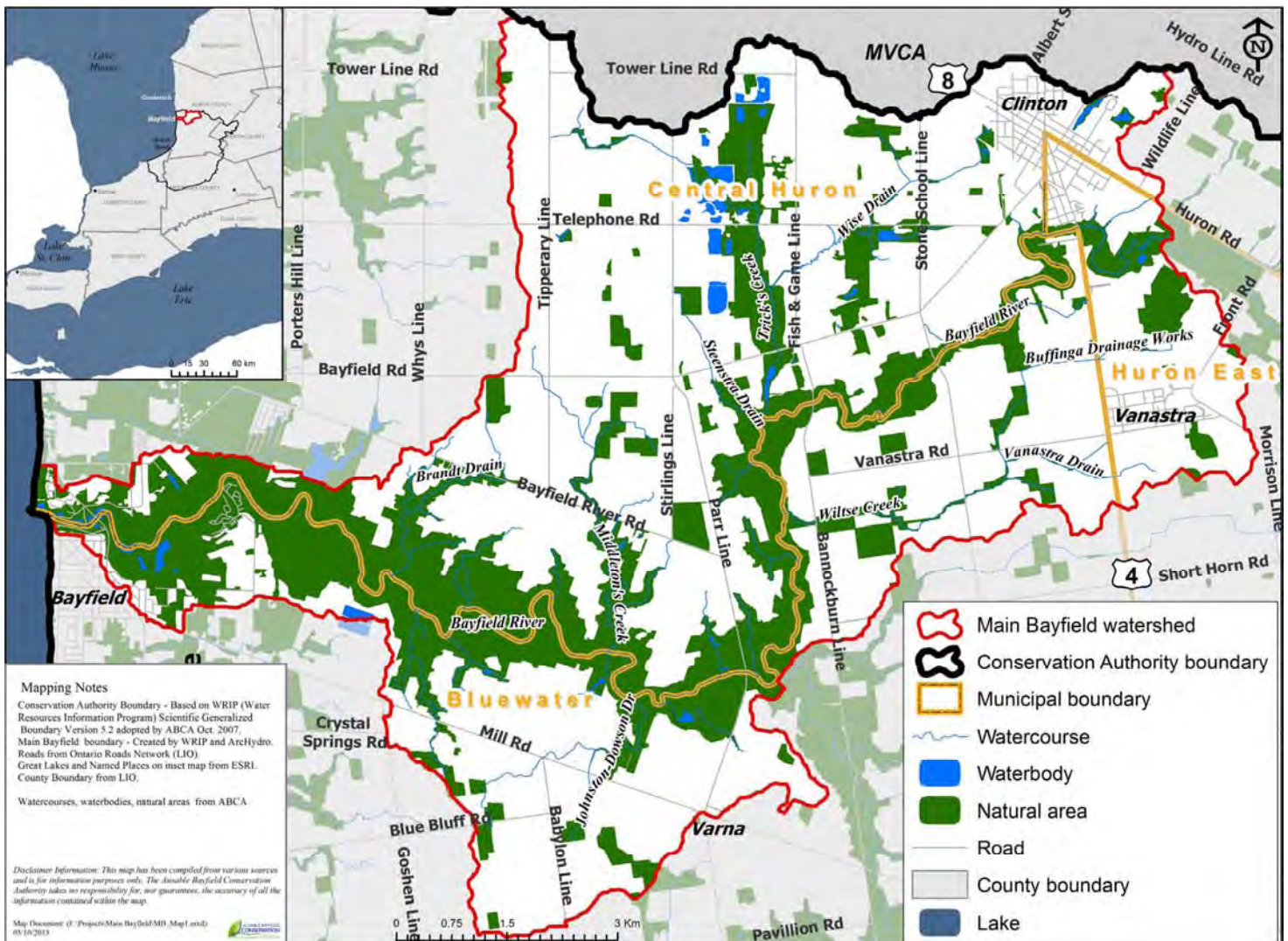
The Bayfield River is situated in southwestern Ontario between the Maitland and Ausable Rivers. The Bayfield River is approximately 65 km (40 mi) long, beginning above the village of Dublin and outletting into Lake Huron at the village of Bayfield. The watershed has a drainage area of 499 km².

For water management purposes, the Bayfield River has three sub-basins: the Bayfield Headwaters, the Bannockburn, and the Main Bayfield. The Bayfield Headwaters sub-basin

includes the main channel and all tributaries from the headwaters in Dublin (Perth County) to the town of Clinton (Huron County). The headwaters of the Bannockburn River arise northwest of the hamlet of Chiselhurst in the Municipality of Huron East, and meet the Bayfield River north of the village of Varna. The Main Bayfield sub-basin includes the main stem of the Bayfield River from Clinton to the mouth of the Bayfield River at the village of Bayfield on Lake Huron. This sub-basin includes tributaries such as Trick's Creek and Middleton's Creek (Map 1).

Why Focus on the Main Bayfield?

Protecting and enhancing an area in good environmental condition, such as the Main



Map 1: The Main Bayfield watershed

Bayfield watershed, is one strategy in ecosystem management. It is also important to protect and enhance an area that might experience increased land use stress, such as urbanization, as reconstructing degraded ecosystems is challenging.

According to the Ausable Bayfield Watershed Report Card, the Main Bayfield watershed has above average forest conditions compared to the other Ausable Bayfield watersheds (Brock and Veliz 2013). An Area of Natural and Scientific Interest (ANSI), which includes diverse forests, contributes to these conditions. In terms of water quality, the Main Bayfield watershed has had a measureable improvement in the last five years in concentrations of total phosphorus and *Escherichia coli* (*E. coli*). In order to protect both the forest and water quality conditions, continuing to enhance all aspects of this watershed is critical.

A Watershed Planning Approach

We all live in a watershed – an area that drains to a common waterbody, such as a stream, lake, estuary, wetland, or ultimately, an ocean (US EPA 2008). Recently there has been recognition of the importance of an ecosystem approach to land use planning. This approach requires that ecological goals be treated equally with economic and social goals. Under the ecosystem approach, the boundaries for land use planning are based on biophysical boundaries; the primary boundary being the watershed (Ontario Ministry of the Environment and Energy and Ontario Ministry of Natural Resources 1993).

A watershed management plan is created cooperatively by the community and local agencies to manage the water, land/water interactions and aquatic resources within a particular watershed to protect and enhance the health of the ecosystem as land uses change (Ontario Ministry of the Environment and Energy and Ontario Ministry of Natural Resources 1993). Watershed plans

typically comprise a section that explains important watershed characteristics (e.g., topography, soils, land use) and a section that outlines management strategies for identified issues. The process of developing a community-based watershed plan creates an opportunity to ensure that many local interests are addressed. As the plan is developed by the community, the interests expressed are locally relevant.

The development of a watershed plan for the Main Bayfield watershed also incorporates principles from the Lake Huron-Georgian Bay Framework for Community Action (Anderson *et al.* 2007) (Figure 1). Conservation partners from across the Lake Huron-Georgian Bay watershed, outlined principles that upon implementation will help to enhance and protect Lake Huron.

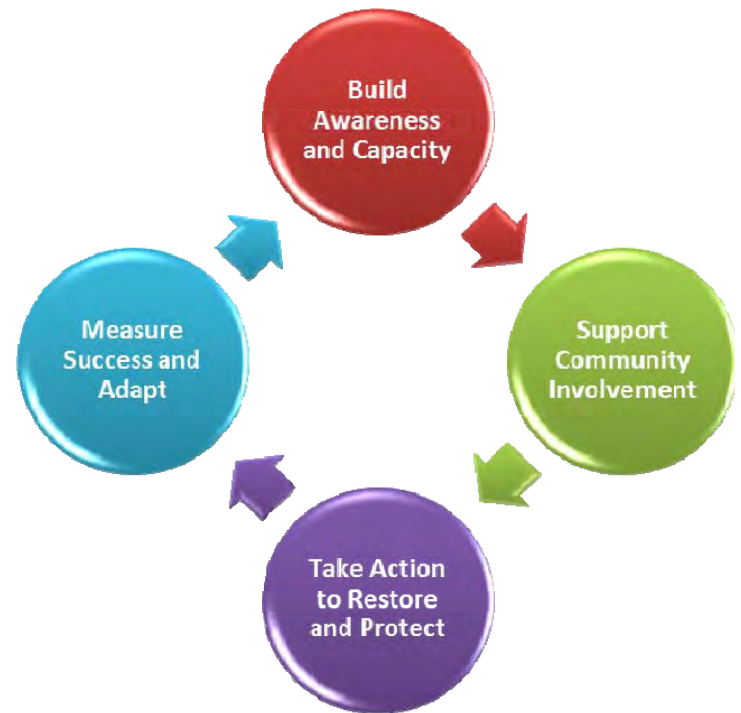


Figure 1: Principles of the Lake Huron-Georgian Bay Watershed Framework for Community Action (Anderson *et al.* 2007) (lakehuroncommunityaction.ca).

This community-led watershed plan for the Main Bayfield watershed has three components. Chapter 1 documents the current physical

conditions of the Main Bayfield watershed. Chapter 2 defines the watershed vision and goals, as well as local issues, approaches and recommendations for environmental protection and enhancement. These recommendations were developed in consultation with the community, and relate directly to the principles identified in Figure 1. Chapter 2 also highlights community actions that have taken place, or that will take place to help protect and enhance the Bayfield River. The final chapter outlines the evaluation of the watershed planning process, which is a requirement of successful environmental programming. To keep the Main Bayfield Watershed Plan a user-friendly size, the evaluation information will be compiled in a second evaluation document.

Relationship with Municipal Plan

Land use planning establishes legislative principles and policies that guide a community toward a common vision for the future. It is the responsibility of the province and the local municipalities to create these principles and policies, and update them as necessary. A municipality designates land for specific uses, and zoning by-laws assist in implementing the corresponding policies. Land use planning can become contentious, especially when changes occur to land use designations or policies.

Within the greater Huron County Official Plan are policies which deal with such issues as the protection of agricultural, mineral and environmental resources, as well as the assurance that growth is coordinated with, and meets the needs of the community. Through extensive public consultation, several key directions for the *natural environment* policy were identified as:

- Ensuring that planning for the natural environment considers all components of an ecosystem and the recommended approach would be ecosystem based;

- Community-based and pro-active pursuit of a healthy ecosystem; and
- Protection and enhancement of the health of the environment while pursuing economic opportunity (County of Huron 1999).

The Huron County Official Plan also made the recommendation that a community-based approach to addressing ecosystem issues is needed to bring about positive change in the area (County of Huron 1999). A watershed plan for the Main Bayfield watershed is an example of such community-based planning. Watershed planning provides current and appropriate information about natural resources and the community's interests in using and protecting these resources. Thus, it provides both a natural and community context to Official Plans, and helps to ensure that the county and member municipalities are creating appropriate policies concerning the natural environment.

Upon completion of the Main Bayfield Watershed Plan, the County of Huron and the municipalities that this watershed spans (Bluewater, Central Huron and Huron East) should consider the recommendations found in this document when they are updating their Official Plans.

Planning Process

The Main Bayfield Watershed Management Plan process was introduced to local residents in July of 2011. A newsletter was mailed to residents of the Main Bayfield watershed to generate interest, provide information, and encourage community involvement. An advisory committee was formed in the fall of 2011 and has guided the planning process. Landowners within the watershed were approached on an individual basis to complete landowner surveys, which provided invaluable information about current land use practices and approaches to address environmental issues. This document can be considered a springboard for sustained community action.

Watershed Description

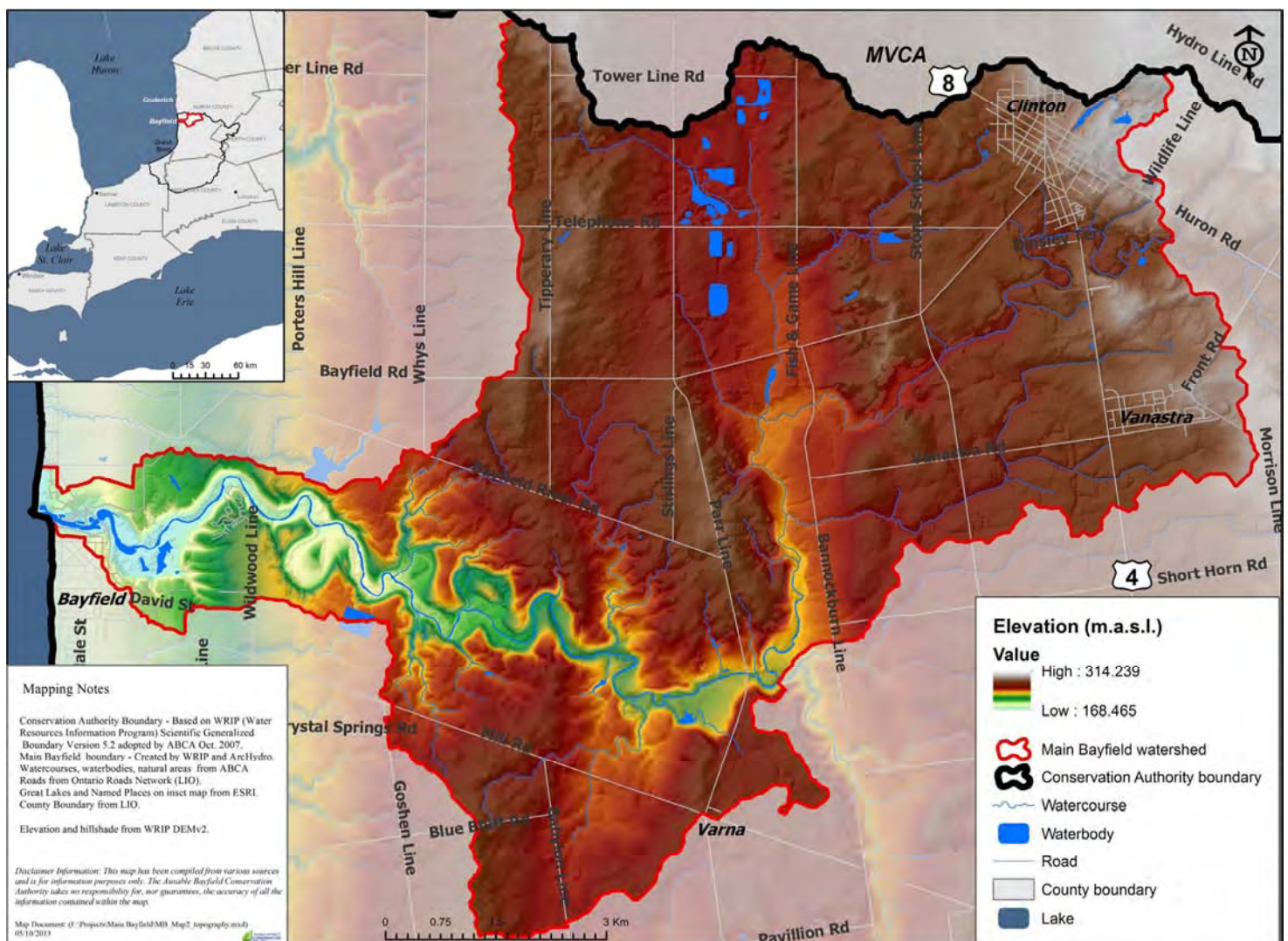
Location and General Description

The Main Bayfield watershed encompasses 92 km² - 19 per cent of the total area drained by the Bayfield River. This section of the Bayfield River stretches from west of Clinton, to its outlet at Lake Huron, and spans the municipalities of Bluewater, Central Huron, and Huron East (Map 1). Land use within the watershed area is predominantly agricultural (62%) and natural area (31%). The remaining area is comprised of urban centres (including the village of Bayfield, town of Clinton and communities of Varna and Vanastra), as well as some recreational and aggregate areas.

Numerous tributaries and municipal drains exist in this watershed with seven main branches. Trick's Creek (the largest), provides a significant amount of the baseflow to the Bayfield River, and provides cold water fish habitat. Other significant tributaries are the Wise Drain, Steenstra Drain, Wiltse Creek, Johnston-Dowson Drain, Middleton's Creek, and Brandt Drain (Map 1).

Topography

Generally the watershed is level with gently rolling hills along the moraines (Map 2). The average gradient of the Bayfield River is 2.3 m/km (Malone 2003); the slopes in the Bayfield watershed are less than two per cent with the steeper slopes more predominant in the Main Bayfield watershed (Giancola 1983).



Map 2: Topography of the Main Bayfield watershed

Physiography

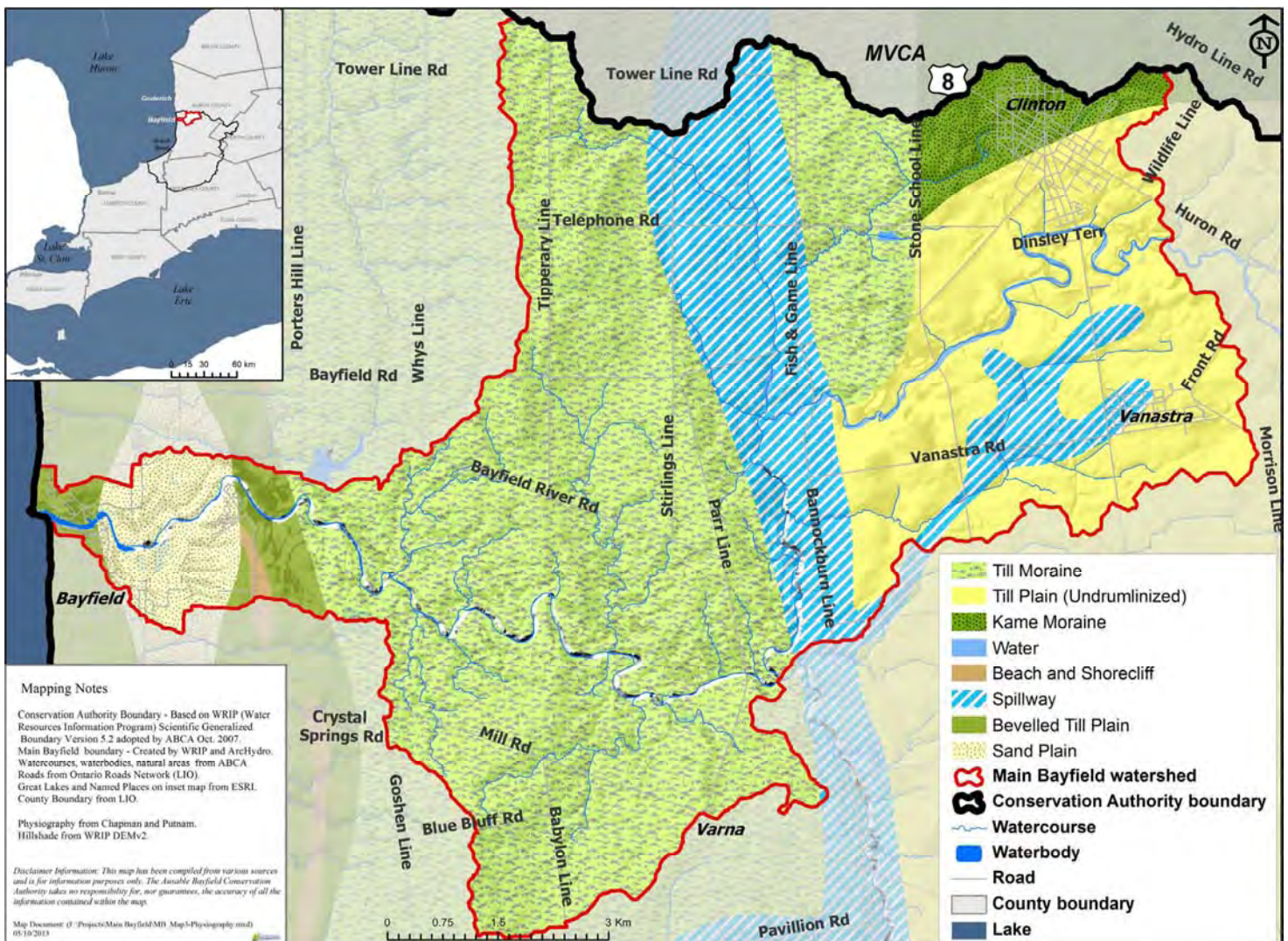
The Main Bayfield watershed is dominated by the Wyoming moraine with sand plains towards Lake Huron, and till plains towards the east (Map 3). The upper east portion of the watershed near Clinton originates as kame moraine. Northwest of Clinton, the Trick's Creek watershed drains a portion of the Wyoming moraine and its connected spillway composed of a large deposit of sand and gravel (Chapman and Putnam 1984). The Trick's Creek watershed has a large gravel deposit, giving rise to the groundwater-fed nature of this stream.

A portion of the Main Bayfield watershed is made up of a large valley complex that is approximately 30 m deep, and at many locations, up to 800 m

wide (Malone 2003), which resulted from the river cutting through the Wyoming moraine and its connected spillway. This large valley is home to high-level terraces, old oxbows and isolated meander cores giving the Bayfield River valley a striking resemblance to the Maitland River further north (Chapman and Putnam 1984).

Soils

The town of Clinton, a large area around and including the village of Bayfield, as well as the spillway associated with the Trick's Creek tributary are dominated by well-drained loam soils (Map 4). Poorly-drained pockets of silty loam surround the community of Vanastra, as well as a section east of the town of Clinton. Along several of the tributaries are bands of poorly drained clay



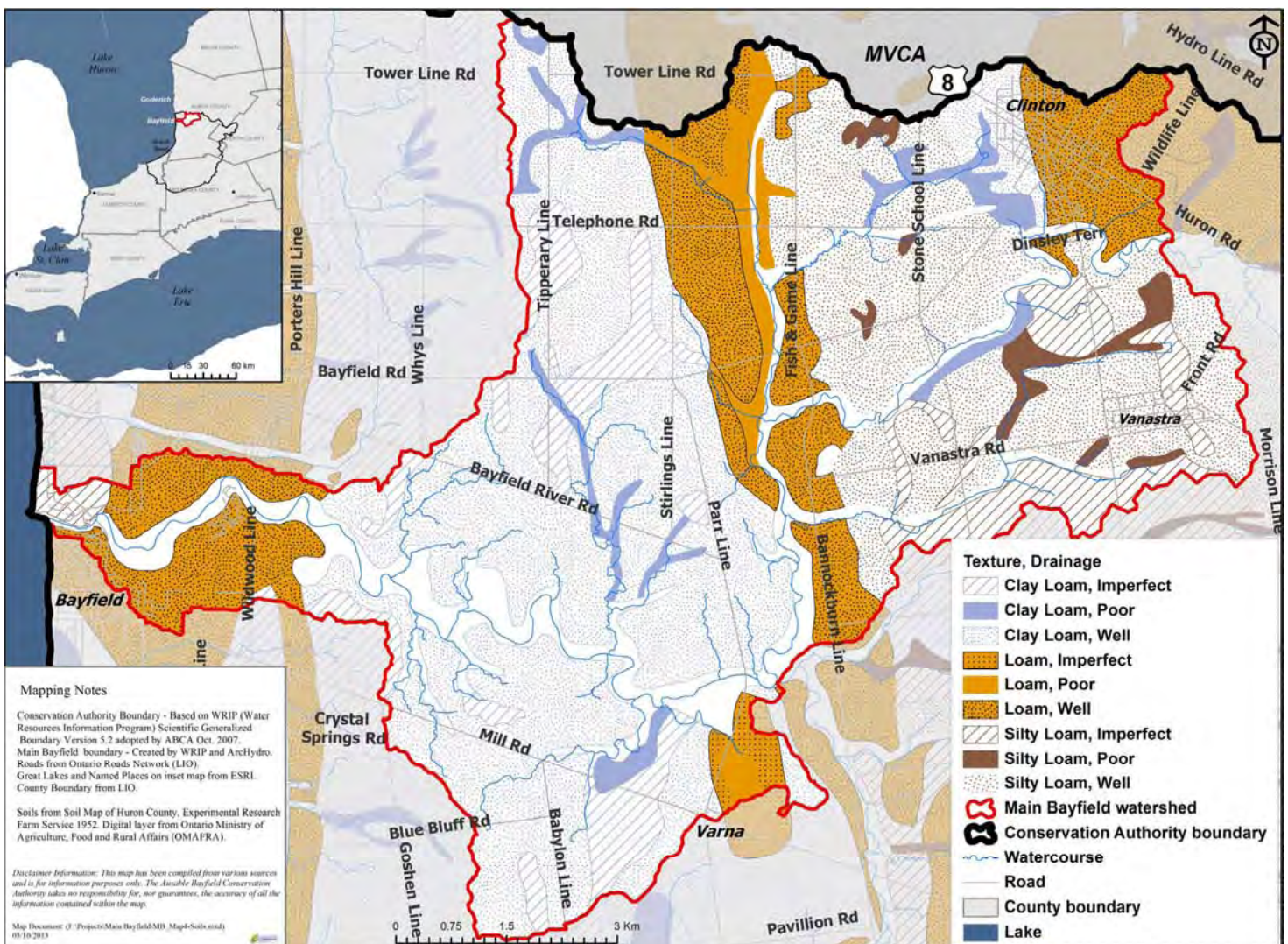
Map 3: Physiography of the Main Bayfield watershed

loam. There is a distinct pattern of increasing loam soils to the east, and increasing silty soils moving towards Lake Huron with imperfectly draining silty loam where the Bayfield River outlets into Lake Huron.

Aggregates

The subsurface geology in the Trick's Creek watershed is dominated by gravel deposits, which provide opportunities for groundwater discharge, and substrate suitable for spawning trout. Combined with the extensive forest conditions, Trick's Creek provides optimal cold water fish habitat (Veliz 2001). Gravel deposits and groundwater discharges are also often associated with aggregate resources.

A study completed in the Trick's Creek watershed determined that aggregate removal potentially impacts the temperature of the groundwater discharging to nearby watercourses. The increase in temperatures may negatively affect temperature-sensitive species, such as brook trout (Markle and Schincariol 2007). It was suggested that aggregate removal not occur within 250 m of adjacent watercourses as thermal plumes emanating from aggregate pits are able to migrate this distance. In the 2007 study, the extraction pit was approximately 750 m from Trick's Creek, which caused the authors to caution that impacts may occur as the extraction proceeds closer to the creek. Further investigation is required to determine if aggregate



Map 4: Soils of the Main Bayfield watershed

removal is closer to Trick's Creek than the recommended 250 m distance, as indicated in the 2010 aerial photography. Markle and Schincariol (2007) also noted the unknown consequences of the effects of several aggregate operations on this cold water stream. This study did not evaluate the effects of evapotranspiration from aggregate ponds on water quantity flow rates within Trick's Creek, and subsequently the Bayfield River.

The Socio-Economic Landscape

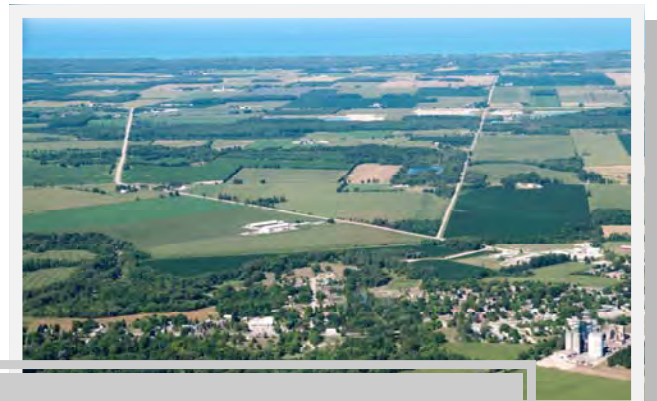
History

It was not the proximity to Lake Huron, but the high quality agricultural land that brought settlement to the Main Bayfield watershed (Scott 1954). The Canada Company, which was formed in the early 1800s by a group of English businessmen in order to promote the settlement of Upper Canada, encouraged the raising of capital by providing settlers with land and employment. The Canada Company purchased the Huron Tract in 1826, which in turn triggered the settlement of the Bayfield River watershed. When the settlers arrived, trees and vegetation were removed, particularly near the original homestead (Scott 1954). This is evident today in the forest cover patterns that exist in the watershed that are representative of the settlement patterns (Malone 2003).

The town of Bayfield is located on top of a bluff overlooking Lake Huron. In 1832 Carel Lodewijk, Baron van Tuyll van Serooskerken, a Dutch nobleman, purchased a large amount of property in the Huron Tract including 388 acres which he set aside for a settlement. This land became known as Bayfield, which was named after the nautical surveyor Henry Wolsey Bayfield. It quickly developed into the main hub for the surrounding agricultural communities. The 1840s saw Bayfield become a major shipping port for locally produced grain. However, once the railway came to Ontario, this busy shipping port was no longer needed. As a result, Bayfield turned to the fishing industry. Today, the Bayfield harbor has become one of the largest pleasure

craft marinas on the Canadian side of Lake Huron (Southern Ontario Tourism Organization).

Clinton, the largest inland urban centre within the Main Bayfield watershed, was named after Sir Henry Clinton, an officer in the Peninsular War. Originally, the area was settled in 1834 by Peter Vanderburgh, however, it was later known as Rattenbury's Corner, after William Rattenbury purchased corners of the main intersection. It was not until 1858 that the village actually became known as Clinton. This designation came in honour of Rattenbury's war hero friend (Southern Ontario Tourism Organization).



Town of Clinton (bottom right)
looking west towards Lake Huron

Demographics

The Main Bayfield watershed has a relatively low population density. According to the Statistics Canada census data from 2011, the populations of Bluewater, Central Huron and Huron East have seen a slight decline (1.1 per cent or less) over the last few years. The majority of the populations of all three municipalities are over the age of 45, with the average age ranging between 40 and 50. This suggests that much of the population of the watershed is still in the working force; however, there are a significant number of retired residents in this area (Statistics Canada 2012).

Industry

The residents within the Main Bayfield watershed participate in a wide variety of industries (Figure 2). Most of the population is involved with the

diverse agricultural sector and other resource-based industries. Manufacturing and other industries follow close behind, while business services, retail trade, construction, and health care and social services also contribute a significant percentage to the economy within each municipality (Statistics Canada 2007). Education and finance and real estate are lower contributors to the economy. Note that these statistics are an average of Bluewater, Central Huron and Huron East.

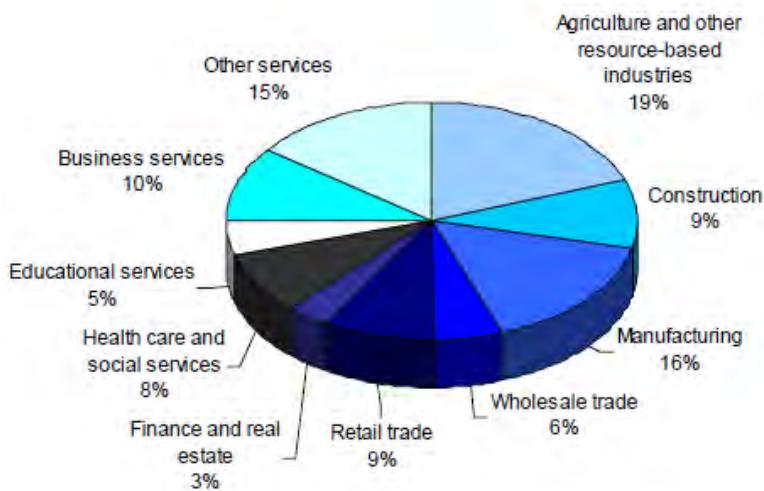


Figure 2: Industry sectors as an average for the municipalities of Bluewater, Huron East and Central Huron (Statistics Canada 2007).

Tourism

Approximately \$22 billion in revenue was created by the tourism industry in 2010 (Ontario Ministry of Tourism, Culture and Sport 2013), and it has a particularly important economic impact for people and areas near lakes, such as those communities along Lake Huron (Dodds 2010). In 2010, over 550 surveys were completed as part of a study, which determined that the level of satisfaction of beach visitors correlated with the health of the beach - water quality being a main concern. Due to the importance of lake tourism, it was recommended that beaches obtain Blue Flag status (an internationally recognized standard) to



The Bayfield Main Beach proudly flies the Blue Flag - an internationally-recognized eco-label

assist with water quality monitoring, and informing the public regarding the health of the beach (Dodds 2010).

Water quality in the Bayfield River can impact the quality of beaches along the southeast shore of Lake Huron, specifically the Bayfield Main Beach. The Main Beach has had consistently low *Escherichia coli* (*E. coli*) concentrations over the past 11 years (Huron County Health Unit 2011), and has achieved Blue Flag status consistently from 2010 to 2013, which most certainly has helped sustain tourism in this area.

Economic Development

Huron County has roughly 6,000 businesses. Primary industries, such as farms, make up 35 per cent of all of the businesses. As compared to other regions of Ontario, Huron County is unique in its large percentage of farming enterprises, and comparative lack of retail and service sector businesses. However, over the past decade the number of non-farm businesses has grown at a steady pace. While still having a significant number of farms and farmland, the actual number of farm businesses has decreased, possibly through farm consolidation. Mid-sized farms are decreasing, and larger farm operations are becoming more common.

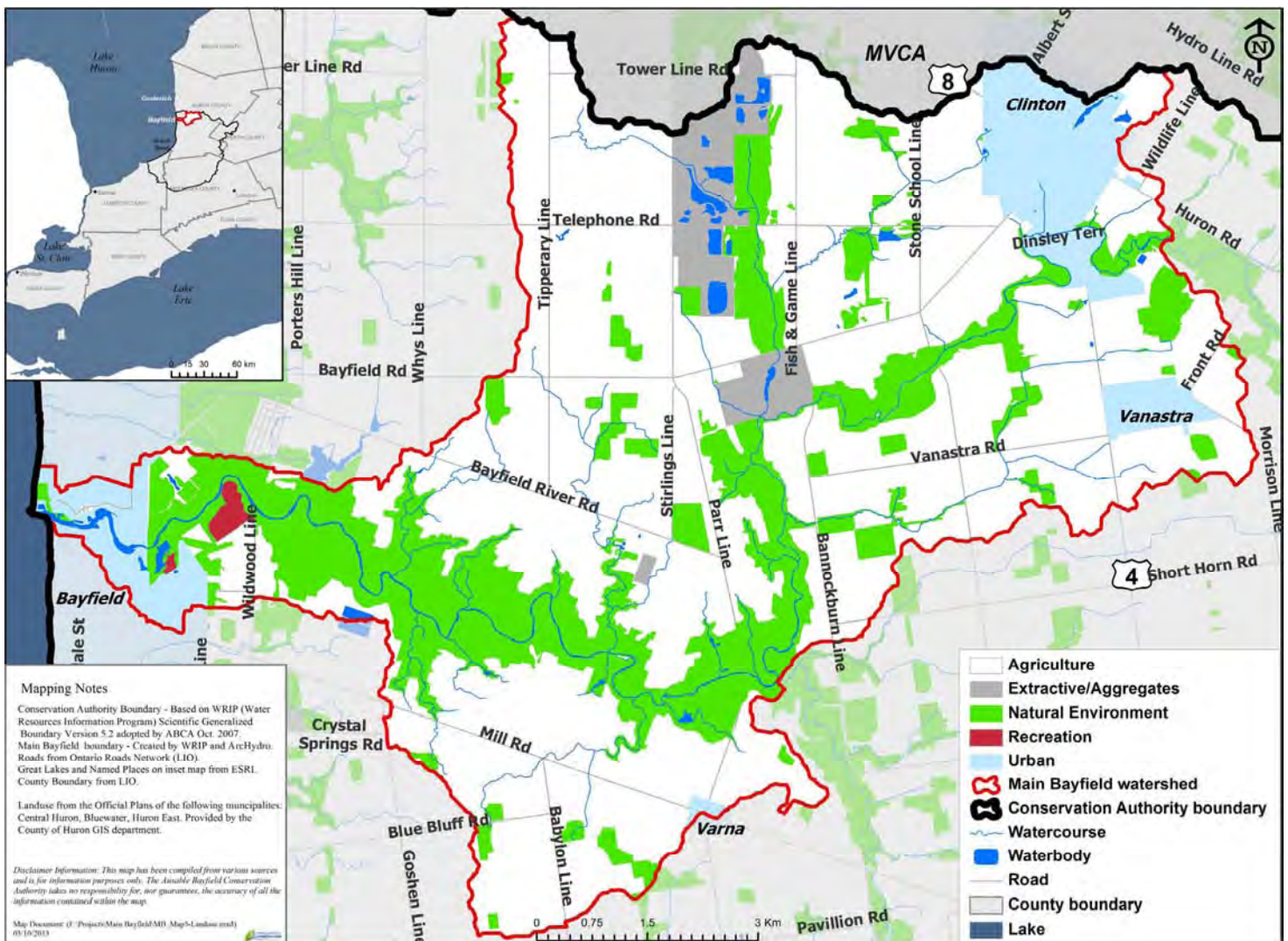
Additionally, there was a positive movement seen in the growth of the number of businesses relative to the number of employees within each business. Companies with fewer than 5 employees declined, while businesses with 5 to 50 employees increased, which points to a maturing of businesses as they increase their customer base, their revenues and their labor force (County of Huron 2010).

Land Use

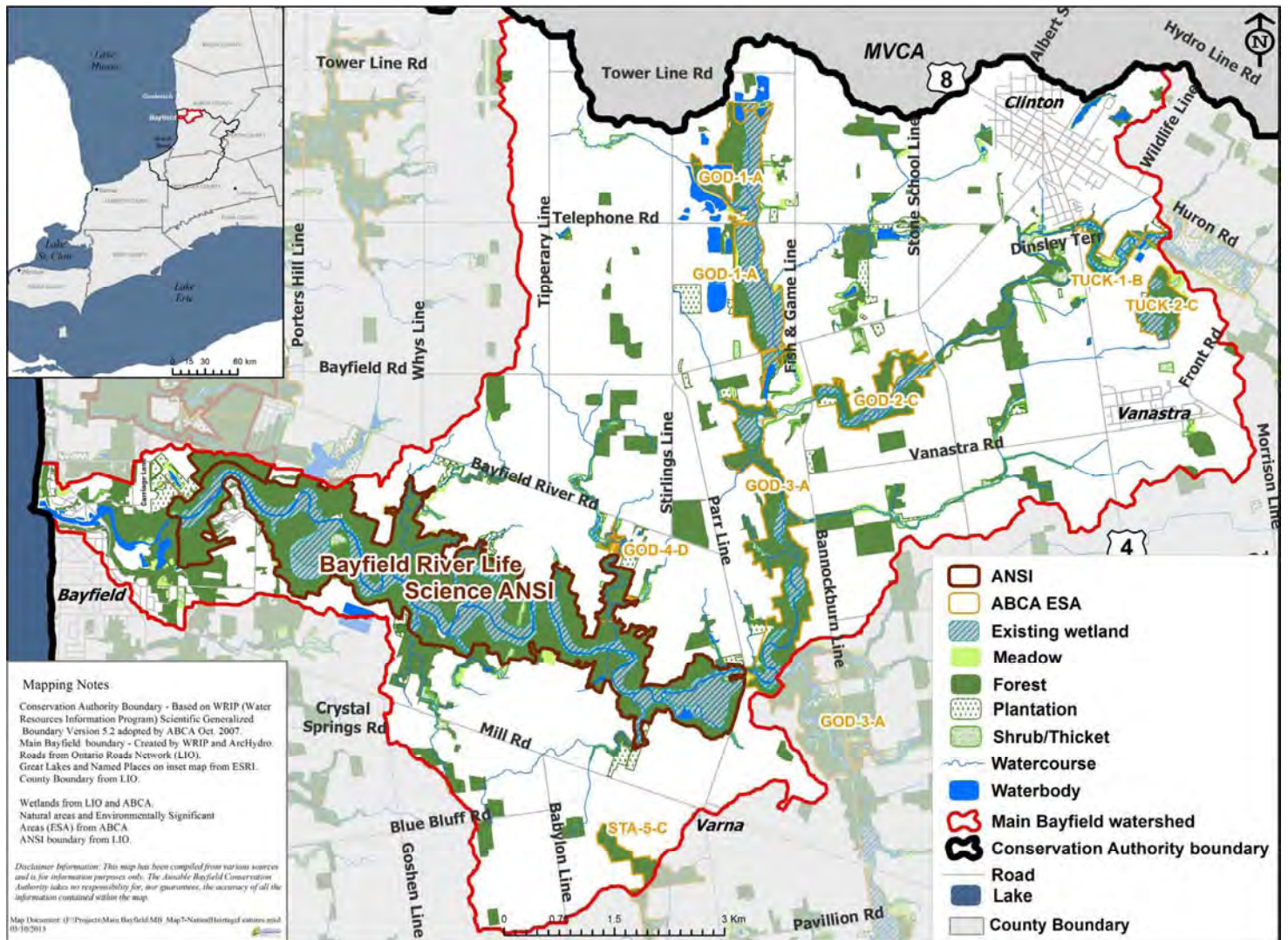
Agricultural land accounts for 62 per cent of land use in the Main Bayfield watershed (Map 5), with the majority of the land used for growing corn, soybeans and winter wheat (Table 1). These percentages were based on drive-by windshield

Table 1: Crop types within the Main Bayfield watershed observed in 2011 and 2012.

Crop Type	2011 (%)	2012 (%)
Canola	-	0.2
Corn	34.3	31.3
Edible Beans	2.9	6.6
Forages	12.3	8.8
Fruit	-	0.2
Pasture	2.3	1.8
Soybeans	37.5	26.4
Specialty Crops	0.2	1.1
Spring Cereal	-	2.0
Winter Wheat	10.6	21.7



Map 5: Land use in the Main Bayfield watershed



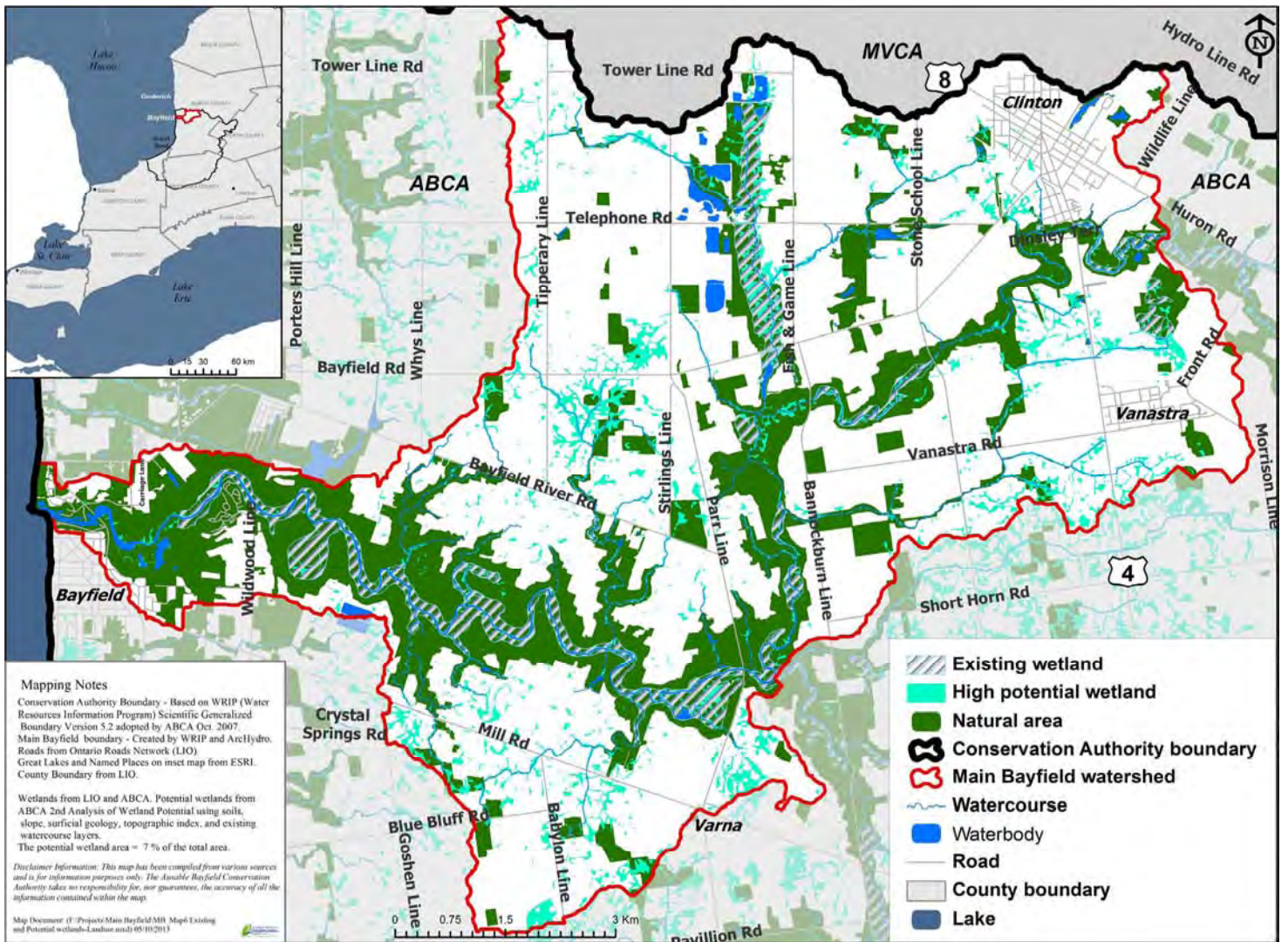
Map 6: Natural heritage features of the Main Bayfield watershed

surveys only. Specialty crops refers to vegetables. Drive-by surveys conducted in 2012 indicated that some degree of conservation tillage (either conservation tillage or no till) had been used on 37 per cent of the landscape.

Urban land use accounts for eight per cent, and is attributed to the four main urban centres (*i.e.*, the village of Bayfield, the town of Clinton, the community of Vanastra, and the village of Varna) (Map 5). Recreational land use accounts for less than one percent of the area and relates to recreational trailer park communities. Aggregate/extractive land accounts for four per cent of land use and is heavily concentrated along the Trick's Creek tributary. There has been an emerging

trend for green energy production with a number of solar panels constructed on private property, and a number of wind turbines proposed for the area.

Natural environment encompasses 31 per cent of the land use (Map 5), with six per cent of this being wetlands (Map 6, Map 7). For healthy, functioning watersheds, Environment Canada (2013) recommends restoring wetland cover to six per cent of a subwatershed, and to ten per cent of a major watershed. Within the Main Bayfield watershed, there is still potential for additional wetlands given the landscape characteristics (Map 7).



Map 7: Existing and potential wetlands in the Main Bayfield watershed

Forest cover accounts for approximately 23 per cent of the natural environment in the Main Bayfield watershed, and the remaining natural areas include ditches and streamside cover, fencerows, grass waterways and quarries.

Natural Areas

The Main Bayfield watershed includes significant natural areas, which are primarily concentrated along the watercourses (Map 5, 6 and 7). Amounts of forest, wetland and streamside cover are greater than the average for the entire ABCA jurisdiction (Table 2). Although these percentages are encouraging, they are still lower than the guidelines established by Environment Canada for healthy watersheds (Environment Canada 2013).

Area of Natural and Scientific Interest

The Bayfield River Area of Natural and Scientific Interest (ANSI) is a provincially significant area designated by the Ontario Ministry of Natural Resources (MNR), and selected based on the representation of certain biological features. This area was also chosen due to its relatively low degree of disturbance, and it is doubtful that other valley systems would be found nearby with the quality and quantity of natural features (Crins 1983).

For more information on the rare plants and animals within this ANSI, see Appendix A.

Table 2: Current percentage of forest, wetland and streamside habitat for the Main Bayfield watershed compared to recommended minimum percentages established by Environment Canada for healthy watersheds (Environment Canada 2013) and in the Ausable Bayfield Conservation Authority (ABCA) watershed jurisdiction.

Natural Feature	Current (%)	Environment Canada Recommendation (%)	ABCA Watershed** (%)
Forests	23	30	14
Wetlands	6	10	2
Streamside Cover*	57	75	33

*The calculations used to determine the percentages of streamside cover in the Main Bayfield watershed differ slightly from that used by Environment Canada, and therefore will not provide a direct comparison to their recommended percentage .

**The ABCA watershed jurisdiction is a roughly rectangular area of 2400 km². This includes the area west of Mitchell and London to Lake Huron, and south of Goderich to south of Port Franks.

Environmentally Significant Areas

Environmentally Significant Areas (ESAs) are sites of environmental importance as they represent a variety of habitats, including upland forests, wetlands and river corridors. For example, a wetland feature may support a rare plant or animal species, or serve a hydrological function. The ESAs are an integral part of Huron County's natural heritage system connecting valley lands, parks and other open spaces.

There are currently seven ESAs within the Main Bayfield watershed (Map 6, Table 3).

For further information, please see *Ausable Bayfield Conservation Authority's Environmentally Significant Areas* (Ausable Bayfield Conservation Authority 1995).

Table 3: Environmentally Significant Areas (ESAs) in the Main Bayfield River watershed.

ESA Name	Size (ha)	Significance
GOD-1-A	168	Includes a provincially significant wetland and provides cold water fish habitat.
GOD-2-C	77	Good mix of upland and lowland species, including wetland grasses, milkweeds and rushes.
GOD-3-A	283	Includes a provincially significant wetland and a high degree of diversity among vegetation communities.
GOD-4-D	31	Small marsh which was once a significant duck breeding marsh.
STA-5-C	60	Wet portions exist throughout this woodlot.
TUCK-1-B	100	Wetlands help to reduce erosion and stabilize river bank.
TUCK-2-C	42	Wetlands provide some recharge to the groundwater and augment flows to the Bayfield River.

Aquatic Resources

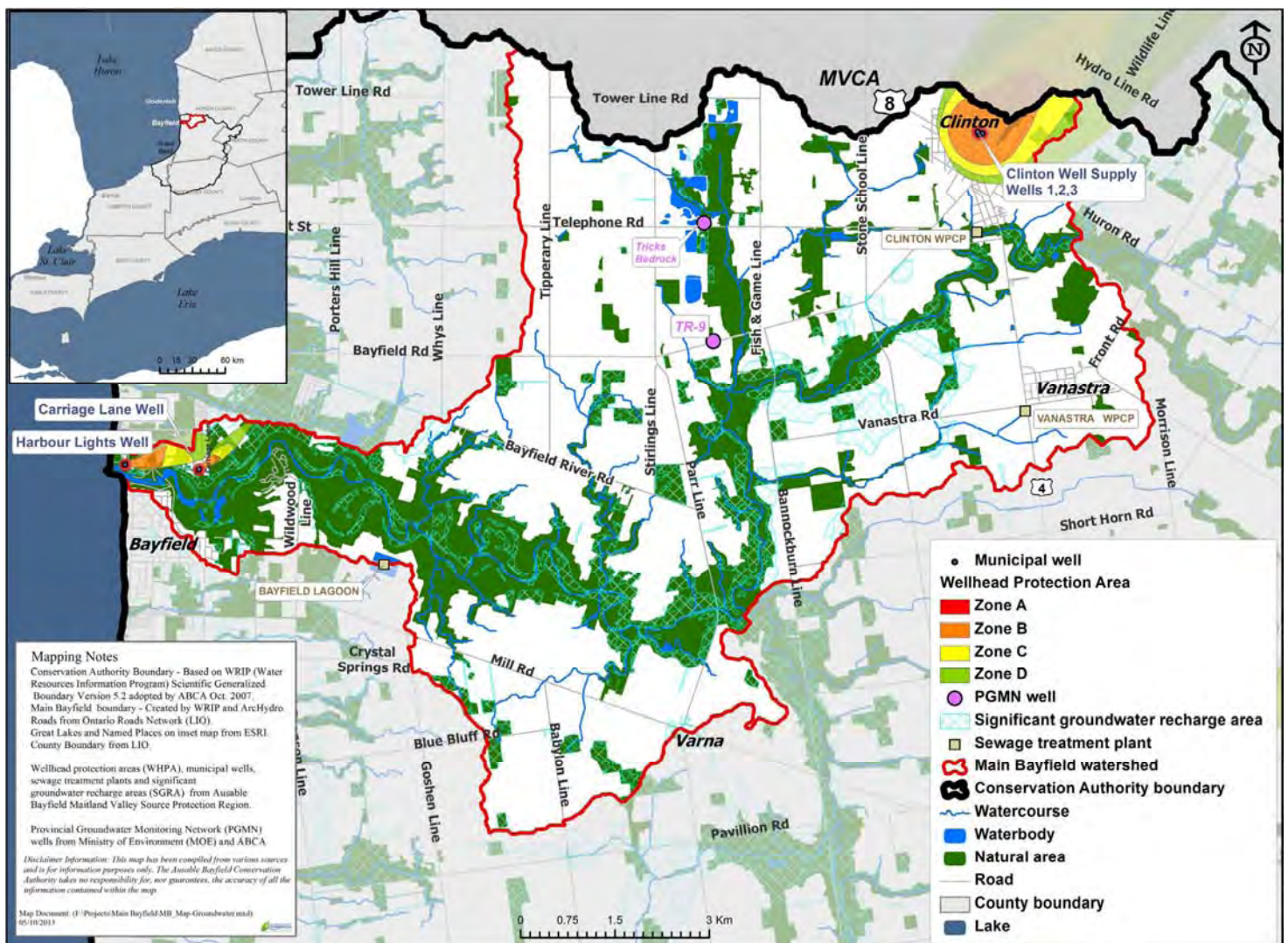
Groundwater Resources

Groundwater resources for the Main Bayfield watershed have been summarized by the provincial Drinking Water Source Protection project (Luinstra *et al.* 2007). The Main Bayfield watershed has areas of high sand and gravel deposits, which indicate high permeability. This allows water to infiltrate aquifers, and thus maintain a stable flow of cool water to streams throughout the year.

Within the Main Bayfield watershed there are five municipal wells (Map 8). Two are in the village of Bayfield (Harbour Lights and Carriage Lane wells)

and provide water to approximately 200 people. The three remaining municipal wells (Clinton 1, 2 & 3) serve the town of Clinton, and provide drinking water to just over 3100 people (Luinstra *et al.* 2007). The remaining watershed population use private wells, or Lake Huron surface water; however, there are plans to extend the Lake Huron Drinking Water Supply pipeline to service the remainder of Bayfield. For more information on municipal wells and Drinking Water Source Protection, visit sourcewaterinfo.on.ca

Groundwater is monitored by the ABCA in partnership with the Provincial Groundwater Monitoring Network (PGMN), which was initiated in 2003. Two groundwater monitoring sites



Map 8: Significant groundwater recharge areas, municipal wells, provincial monitoring wells (PGMN), and wellhead protection areas of the Main Bayfield watershed.

currently exist within the Main Bayfield watershed - a deep well (Trick's) along Telephone Road, and a shallow well (TR-9) along Bayfield Road (Map 8). Nitrate and chloride are two indicators that are measured at these provincial monitoring wells, which Conservation Ontario has recommended be used as indicators of groundwater quality through the watershed report card process (Conservation Ontario 2011).

The Ontario (and Canadian) Drinking Water Quality Standard for nitrate (nitrate + nitrite as nitrogen) is 10 mg/L. Concentrations above 10 mg/L in drinking water can have adverse effects on infants less than six months old (Nova Scotia Environment 2008a). This drinking water standard was exceeded at the shallow well (TR-9) during 2007-2011 (Table 4). Although nitrogen can occur naturally in rocks and groundwater, applying excessive amounts of fertilizer and manure, as well as faulty septic systems, can result in high nitrate concentrations.

The Canadian Drinking Water Quality Guideline for chloride is 250 mg/L. Chloride in drinking water is generally not considered harmful for consumption, although most people find water with concentrations above 250 mg/L unpleasant to drink (Nova Scotia Environment 2008b). Both monitoring wells in the Main Bayfield measured well below this drinking water guideline during 2007-2011 (Table 4).

Table 4: Nitrate and chloride concentrations for the Main Bayfield groundwater monitoring wells (2007-2011).

Well Name (type)	Indicator	75th Percentile Concentration (mg/L)
TR-9 (shallow)	Nitrate	12
	Chloride	10
Trick's (deep)	Nitrate	0.05
	Chloride	0.9

Baseflow Study

In 2007, the ABCA and the Maitland Valley Conservation Authority (MVCA) initiated a four-year sub-basin baseflow study for the Ausable, Bayfield, Maitland, and Nine Mile Rivers. Baseflow measurements are taken in low water periods of the year (*i.e.*, July and August) to characterize the water contributions from the major tributaries in each of the four watersheds. The measurements can then be used to calculate regional-scale water budgets, and to define the areas within a watershed with higher amounts of groundwater discharge. These areas are considered to correlate to significant recharge areas, assuming no change in storage within the groundwater system (Map 8).

Within the Main Bayfield watershed there were two sites monitored for baseflow: Trick's Creek (Bayfield Road) and the Bayfield River at the Lion's Club in Clinton. Over the four-year study, Trick's Creek had consistently higher baseflow contribution values than all of the sites in the Bayfield River. Soils in this subwatershed have a high gravel content, which allows precipitation to be easily absorbed and stored in the ground. The stored groundwater allows Trick's Creek to continually flow, even during dry periods. This indicates that the baseflow provided by Trick's Creek is significant in maintaining flow in the Bayfield River. The Lion's Club site in Clinton was not measured as often as the Trick's Creek site as it stops flowing during the monitoring season. Therefore, it was found to provide medium baseflow contributions to the Bayfield River (Hendry 2010).

Water Quantity

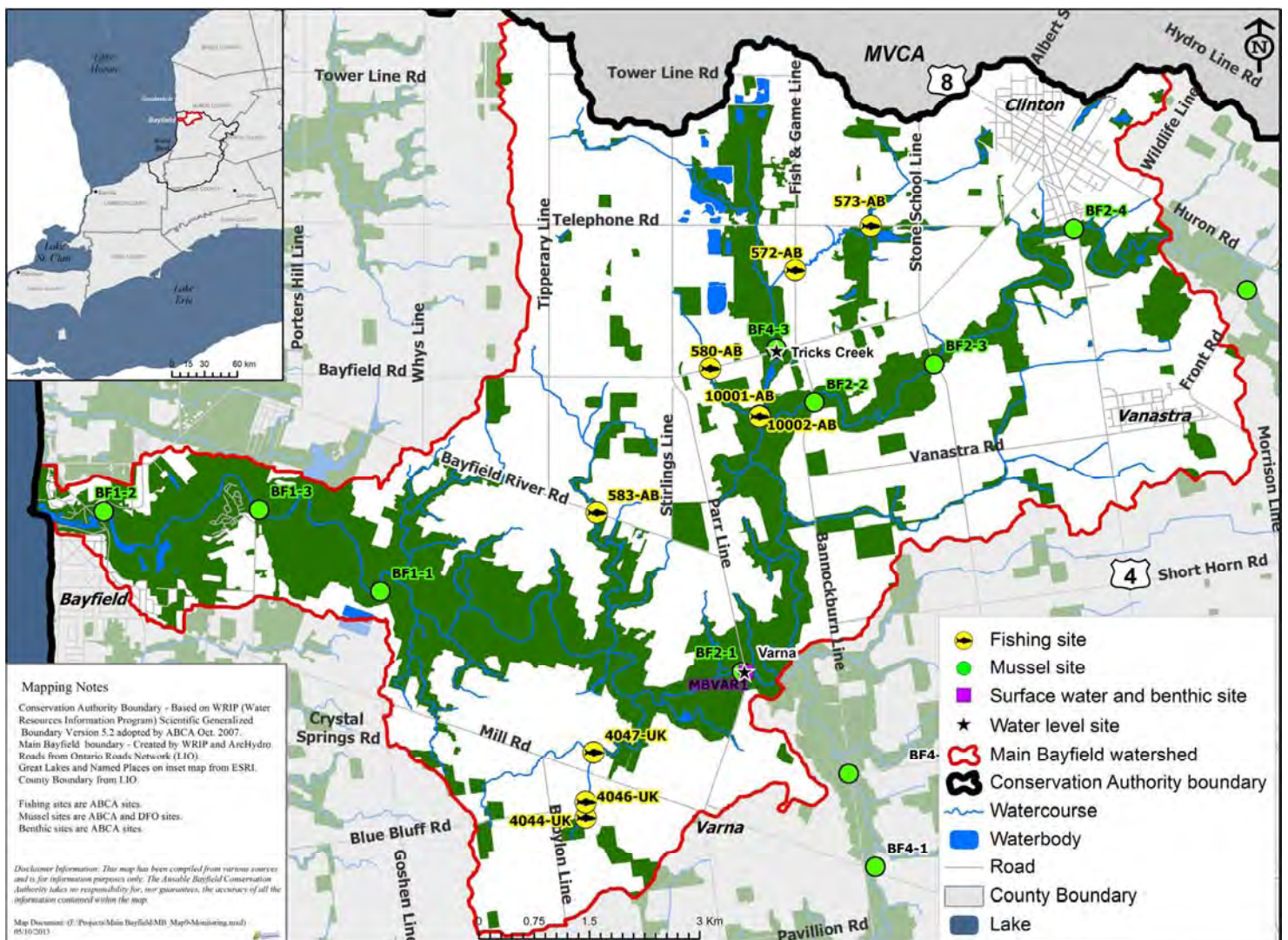
ABCA maintains and operates a network of water level stations throughout the watershed to be able to predict watershed response to precipitation and snow melt events. This information helps forecast stream flows and water levels which may affect watershed residents. The network also allows long-term monitoring of water supply conditions during low flow periods. Two of these stations exist within the Main Bayfield watershed: one north of Varna, and the other on Trick's Creek (Map 9).

Surface Water Quality

The United States Environmental Protection Agency (US EPA) has documented that for the water bodies listed as *impaired* in their National Water Quality Inventory, the three top pollutants are bacteria, suspended solids, and nutrients (*i.e.*, nitrate and total phosphorus) (US EPA 2012). Local reports such as the Ausable River Recovery Strategy (Ausable River Recovery Team 2005) and the Watershed Characterization for the Ausable Bayfield & Maitland Valley Source Protection Region (Luinstra *et al.* 2007) have also found that threats to local waterways are related to nutrient enrichment and erosion. These threats can be identified through bacteria concentrations, suspended solids, and nutrient (nitrate and phosphorus) concentrations.

In the Main Bayfield watershed, several water quality monitoring programs exist. However, for the purposes of providing information on the state of the watershed, data from the Provincial Water Quality Monitoring Network (PWQMN) are presented (Table 5). Results (2012) presented in Table 5 use data from 2007-2011, and the 2007 results use data from 2000-2005. For a more comprehensive review of water quality conditions in the Main Bayfield watershed, see the *Main Bayfield Water Quality Evaluation Report*.

Under the current watershed report card process developed for conservation authorities in Ontario, there are three indicators for surface water quality: total phosphorus (TP), *Escherichia coli* (*E. coli*), and benthic invertebrates (Conservation Ontario 2011). These indicators will be used as



Map 9: Fish, mussel, water quality and level monitoring sites in the Main Bayfield watershed

long-term evaluation tools for the Main Bayfield Watershed Plan.

Through the PWQMN, monthly grab samples were collected from March to November, near Varna (where the river crosses Parr Line) (Map 9) and analyzed for TP and *E. coli*. The 75th percentile TP concentration represents the value below which 75 per cent of the values occur. This value was used as opposed to a median value (50th percentile) to account for the tendency of PWQMN samples to be collected during dry weather periods. The Provincial Water Quality Objective (PWQO) for TP is 0.030 mg/L. The Main Bayfield watershed was below this value for 2007-2011, measuring 0.021 mg/L (Table 5). Concentrations of TP were also below the concentration for the entire Ausable Bayfield

watershed (0.073 mg/L), and they have decreased since the first watershed report card in 2007 (Brock and Veliz 2013).

Concentrations of *E. coli* in surface water can vary widely. Calculating a geometric mean as opposed to an average, eliminates the inflation of the typical *E. coli* concentration. The Recreational Water Quality Guideline for *E. coli* is 100 cfu/100 mL. For the years 2007-2011, the geometric mean *E. coli* concentration for the Main Bayfield was 68 cfu/100 mL (Table 5). As was the case with TP, this *E. coli* concentration was below the entire Ausable Bayfield watershed average. Furthermore, there was a decrease in the concentration of *E. coli* since the first watershed report card (Brock and Veliz 2013).

Table 5: Surface water quality indicators and grades for the Main Bayfield watershed and the entire Ausable Bayfield Conservation Authority (ABCA) area.

Indicator	Description	Result		2012 Grade	
		2007	2012	Main Bayfield	Entire ABCA Area
Total phosphorus	<ul style="list-style-type: none"> A nutrient that enhances plant growth and contributes to excess algae and low oxygen in streams. An A grade is a 75th-percentile total phosphorus concentration of less than 0.020mg/L 	0.043 mg/L	0.021 mg/L	B	D (0.073)
<i>Escherichia coli</i> (<i>E. coli</i>)	<ul style="list-style-type: none"> <i>E. coli</i> are bacteria found in human and animals waster. Their presence indicates water may contain other disease-causing organisms. An A grade is a geometric-mean <i>E. coli</i> concentration of no more than 30 colony forming units (cfu) per 100 mL. 	191 cfu/100 mL	68 cfu/100 mL	B	C (113)
Benthic invertebrates	<ul style="list-style-type: none"> Benthic invertebrates are small animals, without backbones, that live in stream sediments. A Family Biotic Index (FBI) summarizes the numbers and types of these animals in a sediment sample. Values reflect stream health, ranging from 1 (healthy) to 10 (degraded). An A grade is an average FBI value of no more than 4.25. 	5.04	4.55	B	C (5.51)

Benthic invertebrates (animals without backbones found in stream sediments) were also sampled at the Varna site in the fall each year (prior to 2007, sampling generally occurred every other year) (Map 9). Each species that makes up the sample has a different tolerance value to stressors and pollutants. Tolerance values range from one to ten, with one meaning intolerant to pollution and ten meaning tolerant. Tolerance values are used to calculate a biotic index, which in this case was the Family Biotic Index (FBI) as modified by New York State (Smith *et al.* 2009). The FBI provided a score for the watershed (4.55), which reflected the environmental quality within the area (Table 5). This score was less than the average score for the entire Ausable Bayfield watershed, indicating that the benthic invertebrates found in the Main Bayfield are less tolerant to pollution. The FBI for 2012 has also decreased since the first watershed report card in 2007 (Brock and Veliz 2013).

When comparing the watershed report cards from 2007 and 2012, there has been measurable improvements in the concentration of both TP and *E. coli*. These results are encouraging and landowner efforts to improve water quality are commended. New research however, is showing that we still need to work on improving land-water interactions during high flows. On-going studies will help determine where efforts need to be focused in order to make significant water quality improvements during periods of peak runoff and high flows.

Beach Water Quality

Water quality within Lake Huron is regularly monitored at 14 public beaches, including the Bayfield Main Beach, by the Huron County Health Unit. Water samples are collected on a weekly basis and analyzed for concentrations of *E. coli*. Concentrations of *E. coli* in the lake are typically low, with annual geometric means below 55 cfu/100 mL (2001-2011) (Huron County Health Unit 2011). Visit huronhealthunit.ca for beach sampling results which are posted biweekly during June, July and August.

Fisheries and Fish Habitat

The *Fisheries Act* defines fish habitat as “spawning grounds and nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly in order to carry out their life processes”. The quality of aquatic habitat depends on water quantity (*i.e.*, water depth and velocity), water quality (most specifically water temperature and dissolved oxygen concentrations and to some extent turbidity, nitrogen and phosphorus concentrations), aquatic plants, in-stream substrate type and structure, and benthic invertebrates (which are an important fish food source). Activities that alter these characteristics may potentially alter fish habitat. Due to the inherent connectivity of watercourses, the land use changes upstream can have significant impacts on the habitat downstream (Veliz 2001). Fish surveys have been completed by various agencies at nine sites throughout the Main Bayfield watershed (Map 9). At least 45 species



Aquatic resources are enjoyed by many and are economically valuable

have been confirmed including the Black Redhorse (*Moxostoma duquesnei*), which is classified as a species at risk (SAR). Trick's Creek, one of the few cold water fisheries within the ABCA area, provides the majority of habitat for cold water fish species such as the Rainbow Trout (*Oncorhynchus mykiss*). See Appendix B for a complete list of fish species that have been confirmed in the Main Bayfield watershed.

Mussel Habitat

In July of 2007, eight sites were monitored for mussels within the Main Bayfield watershed, with seven sites on the main stem of the Bayfield River and one site on Trick's Creek (Map 9). Each site was surveyed with the intensive time-search technique which included surveying the substrate at each site both visually and tactily.

Mussels were found at only four of the eight sites surveyed, with a total of 173 mussels collected representing 14 species (see Appendix C). Populations of Pink Heelsplitter (*Potamilus alatus*), White Heelsplitter (*Lasmigona complanata*), Fatmucket (*Lampsilis siliquoidea*) and Fragile Papershell (*Leptodea fragilis*) were most abundant. Fatmucket (*Lampsilis siliquoidea*) was found to be present at all four sites which contained mussel populations. Two SAR mussels were observed, which included the Mapleleaf (*Quadrula quadrula*) (photo at right) and Rainbow (*Villosa iris*) mussels. The presence of these mussels indicates a need to continue to monitor mussel populations within the Bayfield River (Morris *et al.* 2012).

Municipal Drains

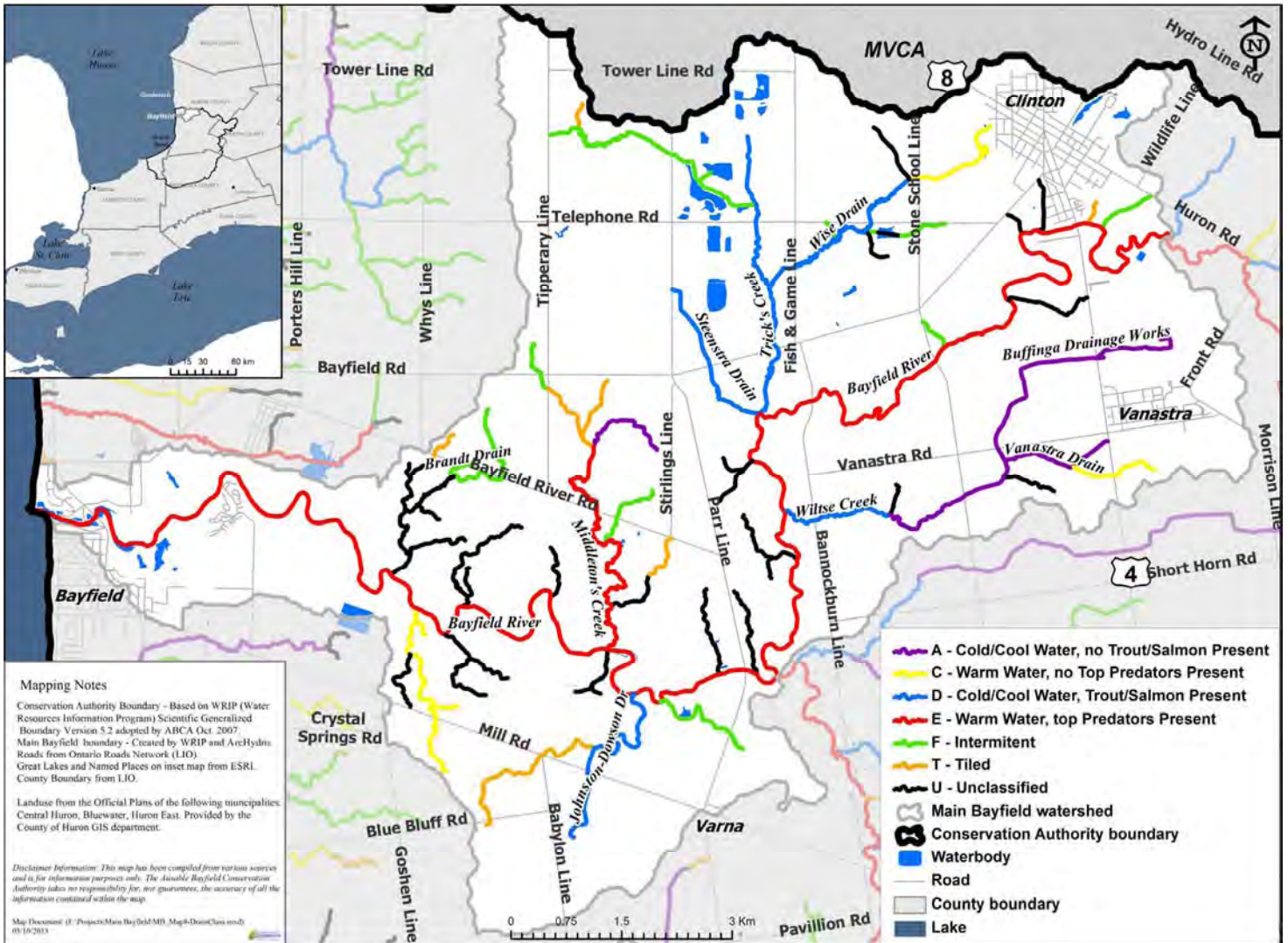
In rural Ontario many watercourses are municipal drains. These drains are either modified naturally occurring creeks, or have been constructed. Drains provide an outlet for subsurface drainage and improve drainage from wet areas on agricultural land. Periodically, deposited sediment and brush need to be cleaned out of a drain to help improve its function.

Mapleleaf mussels (below) are one of 14 mussel species found in the Bayfield River



As these drains provide potential habitat for fish, they are protected under the *Fisheries Act*. To help determine the level of protection required for each drain, a Municipal Drain Classification system was created. This classification system is comprised of six drain types, each type varying in the combination of flow, temperature, species present, and time since last clean out.

In the Main Bayfield watershed, the main channel of the river provides warm water with top predators present, while Trick's Creek provides significant cold water habitat (Map 10). Central Huron has been active in protecting this cold water habitat by upgrading a stormwater sedimentation pond on west side of the town of Clinton. This type of wetland allows any particles in the water to settle out, which provides clearer water downstream. Furthermore, clear water does not absorb as much sunlight as water laden with sediment, which therefore maintains the cold water habitat required by the fish species living in Trick's Creek.



Map 10: Classification of municipal drains and natural watercourses in the Main Bayfield watershed

The Clinton stormwater sedimentation pond helps protect cold water habitat by allowing sediment time to settle out of the water column



Chapter 2

The community-based Main Bayfield watershed advisory committee was formed in the fall of 2011, and has met several times to develop a vision and goal.

Watershed Vision

The Main Bayfield Watershed Plan will respect the long-term sustainability of all water systems and the life that depends on them. Our community vision is one of a healthy, resilient watershed where people, wildlife and habitat thrive. Taking pride in the quality of the Main Bayfield watershed; continuing to protect and enhance the watershed resource.

Community Goal

The goal of the Main Bayfield community is to improve the water quality and quantity within the Bayfield River by reducing total phosphorus, *Escherichia coli* (*E. coli*) and total suspended solids concentrations, and to increase forest cover, wetlands, and streamside cover.

Committee members also met with various local organizations, and individuals to develop recommendations to improve water quality within the Main Bayfield watershed. The advisory committee recommends working toward water quality and quantity improvements by using the values within the ABCA Watershed Report Card (Brock and Veliz 2013) as a starting point to measure success. The Watershed Report Card for the Main Bayfield has important water quality information which has already been collected and summarized for this area.

Local Recommendations

The Main Bayfield watershed's economic base is dependent on food production, recreational opportunities and tourism. Crop and livestock production require healthy soils and water management to be sustainable. Swimming, boating and fishing (all water-based activities) attract many people to the area. All community members have a need to protect local resources. When each resident in the watershed identifies

actions that can be taken to protect and restore the environment, the collective impacts are significant.

The advisory committee voiced several concerns over the course of their meetings, which can be categorized under several themes: pride in protecting the natural area in the community; nutrient management; emphasizing the value of adding BMPs to all property types; holding back runoff and silt; setting targets for natural areas and wetland; and specific concerns such as sewage treatment lagoons, industrial wind turbines, and aggregates.

Table 6 provides a summarized list of local challenges, and opportunities for environmental improvement that were developed by the Main Bayfield watershed advisory committee. The advisory committee also developed examples of each opportunity. These actions can be taken by individual landowners, by groups and organizations, or by local agencies, and are consistent with best management practices (BMPs) supported by ABCA.

Communities in Action

One of the first recommendations made by the community-based advisory committee was to speak with individual landowners to gain their input on concerns regarding their land and water. These one-on-one interviews also allowed landowners to highlight what they have already been doing (Table 7), or plan to do, to improve their land and the watershed in general (Table 8).

The landowner survey developed for the Main Bayfield watershed plan incorporated content and format from established surveys used in previous ABCA watershed planning processes. The survey was then refined to best reflect the high percentage of agricultural land use within the Main Bayfield watershed and reviewed by the advisory committee.

Members of the committee initiated contact with landowners in the Main Bayfield watershed community to introduce the project and inquire if they would be open to completing a survey with ABCA staff. Information from the one-on-one

Table 6: Local challenges and opportunities for environmental improvement.

Challenge	Opportunity	Example
Urban runoff	Work with homeowners and municipalities to implement innovative stormwater management solutions	<ul style="list-style-type: none"> Improve and upgrade urban infrastructure using low impact development and green infrastructure principles (e.g., buffers, rain barrels, rain gardens, permeable pavement)
Agricultural runoff	Implement site-appropriate Best Management Practices (BMPs)	<ul style="list-style-type: none"> Create wetlands to hold water during rain events and release it during dry periods Maintain crop residue Follow nutrient management plans
Aggregate extraction	Monitor how aggregate extraction near Trick’s Creek is affecting water quantity levels and flow rates	<ul style="list-style-type: none"> Share monitoring data amongst agencies so decisions related to aggregate extraction can be made Continue to monitor and measure water level and flow
Decreased forest cover	Work with landowners to improve forest cover on their land in ways that support their agricultural operations	<ul style="list-style-type: none"> Plant trees on marginal land Plant windbreaks Protect and manage established woodlots for long-term benefits
Development/Urbanization	Direct development away from areas of provincial, regional and local significance including agricultural and environmental resources	<ul style="list-style-type: none"> Strengthen existing land use policies within Official Plan documents Improve and upgrade drinking water and wastewater facilities, linking economic and environmental benefits

landowner surveys were documented while keeping identities confidential. The information gained from the landowner surveys helps to identify priority areas for future action and implementation of BMPs. Cropping information from the landowner surveys will be used with surface water quality information to obtain a better picture of the hydrologic function of the Main Bayfield watershed.

In addition to speaking with landowners, committee members also approached local community groups and organizations to introduce the Main Bayfield watershed plan, and to request committed actions for environmental improvement. Such actions can be practical (e.g., tree planting events, implementing other BMPs, and organizing public events) or educational (e.g., having committee members speak at group events, youth programming, and setting up displays at events). Many community organizations and groups have already taken

action, or have committed to ongoing actions for the next few years (Table 9).

Unlike prior watershed plans that the ABCA has been involved with, this plan summarizes actions or commitments gathered directly from individuals and the community to be used as recommendations for the larger Main Bayfield watershed. The advisory committee suggested this approach, and it is hoped that it not only provides relevant recommendations, but also a sense of ownership for this community plan.

Everyone is encouraged to look through these actions, and not only feel proud about how much we have accomplished, but also become inspired to continue to make improvements to the Main Bayfield watershed.

Table 7: Actions completed by community members in the Main Bayfield watershed.

Action	Timeframe for Completion	Status
Decommissioned three unused wells <ul style="list-style-type: none"> Permanently filling and sealing the wells eliminates them as a source of contamination to the aquifer 	2012	Completed
Retired fragile land at six different sites <ul style="list-style-type: none"> A total of over 700 trees were planted 	2012	Completed
Ordered trees to be planted on private properties <ul style="list-style-type: none"> Over 300 trees were ordered and planted 	2012	Completed
Decommissioned one manure storage facility	2012	Completed
Completed three erosion control projects <ul style="list-style-type: none"> Five earthen berms were installed to help with erosion in two low draws in a field Two berms with inlets and tiles were installed on two different properties One large tile with two catch basins was installed on one property to divert water and prevent erosion 	2012	Completed
Participated in three community tree planting projects <ul style="list-style-type: none"> Over 600 trees were planted (part of fragile land retirement) 	2012	Completed
Participated in elementary school programs to learn about the Bayfield River ecosystem, water quality, and human impacts on the watershed <ul style="list-style-type: none"> 132 students from Holmesville Public School, St. Joseph Public School, Huron Christian School, Clinton Public School and Huron Centennial Public School participated in the program 	2012	Completed
Participated in secondary school programs to learn about the Main Bayfield Watershed Plan, the use of GIS in watershed work, and how to get involved <ul style="list-style-type: none"> 72 students from Central Huron Secondary School and St. Anne's Secondary School participated in the program 	2012	Completed
Participated in a youth retreat to learn about water quality <ul style="list-style-type: none"> 30 elementary school students participated in the program 	2012	Completed
Held a rain barrel fundraiser (Huron Christian School) <ul style="list-style-type: none"> 200 rain barrels sold to local landowners throughout Huron County 	2013	Completed
Completed an erosion control project and natural channel design <ul style="list-style-type: none"> Bank stabilization and installation of Newbury weir 	2013	Completed

*Captured from the Huron Clean Water database as well as from landowner surveys.

Table 8: Actions that community members in the Main Bayfield watershed want to complete.

Action	Timeframe for Completion	Status
Retire fragile land through tree planting efforts <ul style="list-style-type: none"> 7 potential projects have been identified 	2014	Initial stages In progress
Complete erosion control projects on agricultural properties <ul style="list-style-type: none"> 13 potential projects have been identified 	2014	Initial stages In progress
Complete wetland projects on rural properties <ul style="list-style-type: none"> 3 potential projects have been identified 	2014	Initial stages
Complete clean water diversion projects on agricultural properties <ul style="list-style-type: none"> 2 potential projects have been identified 	2014	Initial stages
Complete wellhead protection and well decommission projects <ul style="list-style-type: none"> 1 wellhead to be upgraded and 1 well to be decommissioned have been identified 	2014	Initial stages



Individual and community efforts come together to have positive effects on watershed health

Table 9: Committed actions from local organizations in the Main Bayfield watershed.

Organization/ Company	Actions	Timeframe for Completion
Ausable Bayfield Conservation Authority	<ul style="list-style-type: none"> • Provide education and outreach • Find funding for landowners to take action • Monitor water quality within the watershed 	Ongoing
Avon Maitland District School Board and Huron Perth Catholic District School Board (Clinton Schools)	<ul style="list-style-type: none"> • Plant trees around the St. Joseph School wetland • Integrate the study of the wetland into their curriculum 	Ongoing
Bayfield Agricultural Society	<ul style="list-style-type: none"> • Request a display from the Ausable Bayfield Conservation Authority (ABCA) for the Bayfield Fall Fair weekend to promote continued care for the watershed • Provide recycling containers during the Bayfield Fall Fair • Remove and properly dispose of animal waste/bedding after the Bayfield Fall Fair and parade 	Ongoing
Bayfield Chamber of Commerce	<ul style="list-style-type: none"> • Potentially put an action pledge form in Bayfield stores • Potentially put information regarding the Main Bayfield Watershed Plan and an action pledge in the <i>Bayfield Breeze</i> newsletter (2000 subscriptions) 	Ongoing
Bayfield Guides	<ul style="list-style-type: none"> • Participate in Trout Unlimited Canada’s Yellow Fish Road program to educate the community on their responsibility to reduce stormwater pollution. 	Spring 2014
Bayfield Ratepayers Association	<ul style="list-style-type: none"> • Actively participate in the Main Bayfield Watershed Plan Advisory Committee • Conduct regular independent environmental audits of the beach facility and marina and submit them to Environmental Defence (ED) as a requirement of ED’s Blue Flag designations for Bayfield’s Main Beach and marina • Support the Bayfield Tree Project through web page co-management, promotion and help on tree planting days • Promote and implement a “green streetscape plan” for Bayfield’s Main Street through participation in the Bayfield and Area Revitalization Committee • Establish a new website for the BRA that includes a section on ways to improve water quality in the watershed • Apply for municipal grants to support the Ausable Bayfield Conservation Authority’s water quality monitoring program in the Bayfield River to establish annual base line measurements 	Ongoing

Table 9: Committed actions from local organizations in the Main Bayfield watershed (continued).

Organization/ Company	Actions	Timeframe for Completion
Bayfield River Valley Trail Association	<ul style="list-style-type: none"> • Support the Bayfield Tree Project • Promote awareness of the local natural environment and raise awareness of the relationship between a small stream and the quality of Lake Huron through an interactive website and Trail Guide for the Bayfield watershed • Organize annual public winter walk/BBQ at the Mavis Trail in Varna • Partner with the Ausable Bayfield Conservation Authority on future events to promote stewardship efforts and education opportunities • Add hard surface mobility to the trail in Varna 	Ongoing
Bayfield Town Hall	<ul style="list-style-type: none"> • Sign a motion of support for the Main Bayfield Watershed Plan 	Ongoing
Bayfield Tree Project	<ul style="list-style-type: none"> • Plant additional trees along the Heritage Trail, as well as adjacent trees within the Village of Bayfield, building on the efforts that saw 161 trees planted within the last two years 	Ongoing
Clinton Christian Reformed Church	<ul style="list-style-type: none"> • Provide environmental educational programming and opportunities to the youth group 	Ongoing
Ecological Farmers of Ontario - West Region Committee	<ul style="list-style-type: none"> • Maintain and increase soil organic matter in their fields • Maintain buffered areas around ditches and watercourses • Reduce or eliminate the use of pesticides to reduce the contamination of water entering the watercourses or groundwater supplies with these materials • Maintain woodlots and trees along watercourses and drains • Plant trees in vulnerable areas • Use pasture-based systems (<i>i.e.</i> grassed finished beef, pastured pork and poultry) when possible. This will encourage more forage in the farm crop rotation, keeping perennial cover on the land with a year round living root complex, which maintains soil biological activity and provides erosion control and water infiltration • Encourage members to choose deep bedding manure management systems and manure composting rather than liquid manure systems. This stabilizes soluble and volatile nutrients, reducing their movement in the water system • Encourage the Ausable Bayfield Conservation Authority to work with municipalities to explore the use of composting toilets and grey water management systems to conserve water, engineered wetlands to filter and purify water rather than current reliance on septic tanks and weeping beds or large scale lagoons, in rural households and rural villages 	Ongoing

Table 9: Committed actions from local organizations in the Main Bayfield watershed (continued).

Organization/ Company	Actions	Timeframe for Completion
Horticultural Society (Bayfield and Clinton)	<ul style="list-style-type: none"> • Arrange a presentation from the Auburn Horticultural Society on environmental actions in a village setting • Promote sustainable landscaping and gardening practices and methods for preventing invasive species 	<p>April & September 2013</p> <p>Ongoing</p>
Huron County Federation of Agriculture	<ul style="list-style-type: none"> • Encourage members to conduct individual property assessments • Support on-going research projects verifying the effectiveness of BMPs 	<p>Ongoing</p>
Huron County Library	<ul style="list-style-type: none"> • Continue to provide the Main Bayfield Watershed Plan Advisory Committee and the Ausable Bayfield Conservation Authority opportunities to set up displays throughout the year encouraging the public to participate in events and activities 	<p>Ongoing</p>
Huron-Perth Woodlot Association	<ul style="list-style-type: none"> • Promote the Main Bayfield Watershed Plan by inviting the Advisory Committee to speak at Annual General Meeting 	<p>April 2013</p>
Huron Tract Land Trust	<ul style="list-style-type: none"> • Sign a motion of support for the Main Bayfield Watershed Plan • Provide a means to preserve and enhance forest cover and wetlands within the Bayfield River watershed 	<p>Ongoing</p>
Lisa Thompson, Member of Provincial Parliament for Huron Bruce	<ul style="list-style-type: none"> • Promote the Main Bayfield Watershed Plan • Advocate for community watershed planning • Ensure that decisions being made do not have a negative impact on community watershed planning • Invite members of the Main Bayfield Watershed Plan Advisory Committee to policy planning sessions 	<p>2015</p>
Municipality of Bluewater	<ul style="list-style-type: none"> • Continue to support community water quality monitoring of local rivers and beaches to establish annual base line water quality measurements • Form a Beach Working Group to identify possible reasons/ actions to improve water quality • Conduct a “Gulls ‘n Geese” education program to identify actions beach goers can do to discourage birds from the Bayfield Beach to improve water quality 	<p>Ongoing</p>
Municipality of Central Huron	<ul style="list-style-type: none"> • Participate in a project to determine the environmental and economic effectiveness of different stewardship projects • Determine areas that could benefit from roadside tree planting and/or marginal land planting • Continue to enhance the Clinton Stormwater Management pond through community-involved tree planting projects • Upgrade the generator at the Clinton sewage treatment facility • Use silt-free sand and minimal salt for winter road control 	<p>Ongoing</p>

Table 9: Committed actions from local organizations in the Main Bayfield watershed (*continued*).

Organization/ Company	Actions	Timeframe for Completion
Municipality of Huron East	<ul style="list-style-type: none"> • Determine how many trees are planted annually • Determine areas that could benefit from roadside tree planting • Install a backup generator at the Seaforth sewage treatment facility • Upgrade the UV treatment process for the Seaforth sewage treatment facility (if funds granted) • Examine enhancement possibilities of the outlet into Crozier Drain • Complete Phase 1 of the Vanastra sewage treatment facility upgrades • Find funding for implementation of Phase 2 of the Vanastra sewage treatment facility upgrades • Apply for funding for a rain barrel project for approximately 275 residential units in Vanastra 	2015
National Farmers Union - Huron Local	<ul style="list-style-type: none"> • Maintain and increase soil organic matter in fields • Maintain buffer areas around ditches and watercourses • Plant trees in vulnerable areas • Encourage local municipalities to plant trees on road allowances or provide incentives to farmers to plant and maintain trees along road allowances • Participate in tours of exemplary farming practices for water quality 	Ongoing
Parker & Parker Ltd.	<ul style="list-style-type: none"> • Help landowners quickly identify tile outlet and inlet locations by providing and installing drainage outlet and drainage inlet signs and posts • Recommend controlled drainage and erosion control options to landowners, when appropriate • Arrange to have the drainage system, and other structures, such as erosion control structures, inspected and maintained on a regular basis 	Ongoing
United Church (Clinton United, St. Andrew's United, Brucefield Community)	<ul style="list-style-type: none"> • Provide worship services on the topic of water quality and invite the Main Bayfield Watershed Plan Advisory Committee to give a presentation • Provide environmental education programming at a youth retreat 	Ongoing 2015

Chapter 3

Watershed Plan Evaluation

Successful environmental programming requires evaluation. The Lake Huron-Georgian Bay Framework Committee recognized the importance of identifying goals and measuring the program against targets and indicators as one of the four principles outlined in The Lake Huron-Georgian Bay Framework for Community Action (Anderson *et al.* 2007).

Evaluation of environmental programs requires performance measures that can range from how much money was spent to direct environmental indicators such as nutrient concentrations. The most valued indicators are environmental indicators as they directly track changes in the health of humans, wildlife or the resource. Program and measurement indicators (*e.g.*, dollars spent on conservation programs, and number of acres retired) are important in providing a comprehensive understanding of a program's effectiveness, however they may not communicate what the public wants to know, which is, '*Is the water clean?*'

The use of environmental indicators is generally a more complicated, and potentially expensive approach. It also requires consideration of the scale at which the monitoring occurs. Traditionally, there has been an assumption that a site at the outlet of a watershed may reflect overall watershed conditions. At a broad, Lake Huron scale, this is a reasonable assumption, but if we are trying to evaluate the effectiveness of site-scale best management practices (BMPs) at the watershed scale, then a site-specific monitoring strategy is required. The spatial specificity of water quality indicators may mean additional monitoring sites, including monitoring sites at key locations that drain very small areas. To add to this, water quality indicators vary over time, which necessitates long-term monitoring programs in order to make informed conclusions. Unfortunately, in most cases it is not feasible, both logistically and financially, to monitor everywhere all of the time. Therefore, it must be recognized that an evaluation is only as good as the monitoring program.

Short-term Evaluation

The goal of the Main Bayfield community is to improve the water quality and quantity within the Bayfield River by reducing total phosphorus, *Escherichia coli* (*E. coli*) and total suspended solids concentrations, and to increase forest cover, wetlands, and streamside cover. For short-term evaluation of this goal, program indicators (*e.g.*, number of BMPs completed, number of meetings held, number of people attending), and measurement indicators (*e.g.*, acres of land retired, metres of grass waterway installed) will be collected.

The second method of evaluation will involve the hiring of an environmental consultant, who will evaluate the process and outcomes of the watershed plan. These findings will be summarized in a separate evaluation report.

Additional evaluation may be possible through the Rural Stormwater Management Model, a Ministry of Environment project which aims to better understand and manage rural stormwater runoff, and therefore reduce the nutrients entering Lake Huron. Models are built because it is impossible to collect sufficient monitoring data over the short term to show changes in water quality. This model will take into account things like hydrology (*i.e.*, water flow), precipitation, land use, management practices, topography and soil composition. Together, these factors will help more accurately reflect what is happening in a watershed. Once the model has been created, the goal is to be able to target BMPs where they will have the biggest impact for water quality.

Long-term Evaluation

Long-term evaluation of the Main Bayfield Watershed Plan will involve a two-pronged approach. The first will use the water quality indicators (*i.e.*, TP, *E. coli* and benthic invertebrates) used in the Ausable Bayfield Watershed Report Card. The report card is produced every five years and summarizes data from the long-term monitoring site near Varna. Data is then compared to the previous watershed report card.

In addition, concentrations of TP, *E. coli* and TSS will be evaluated at the ten sites that have been monitored since 2008. It is also anticipated that high flow conditions will be monitored, as this is when BMPs need to be effective.

Concluding Remarks

One of the goals of a community-based watershed plan is not to simply provide a report, but to provide the basis for the on-going dialogue required for making environmental improvements. This dialogue helps bring about positive changes, however, these changes can often take some time before they are implemented. It is important to keep this in mind, and to support those that are currently taking action, or those that want to take action. On-the-ground actions lead to more action, and together, the many actions of the watershed community will help to improve and enhance the Bayfield River.

Many of the positive actions taking place in your community are highlighted within this watershed plan. But, there are many other actions that have not been documented, and there are lots of other

actions that still need to be completed by all stakeholders.

All landowners in the Main Bayfield watershed should look at their own property and determine what actions are needed. The Ausable Bayfield Conservation Authority can provide technical and potentially financial support to make positive changes on your property. In turn, all of these positive changes will help protect and enhance the Bayfield River for everyone.

What can you do to enhance the Main Bayfield watershed?

- Establish buffers and rain gardens
- Install rain barrels and permeable pavement
- Create wetlands or berms to hold water during rain events and release it during dry periods
- Maintain crop residue
- Follow nutrient management plans
- Plant windbreaks and trees on marginal land
- Protect and manage established woodlots



Glossary

Afforestation

The conversion of land, not previously forested, to forested land through human activities such as planting, seeding.

Area of Natural and Scientific Interest (ANSI)

Significant representative segment of Ontario biodiversity and natural landscapes including specific types of forests, valleys, prairies and wetlands, native plants and animals, and supporting environments. ANSIs play an important role in the protection of Ontario's natural heritage since they best represent the spectrum of biological communities, natural landforms and environments across Ontario.

Aquatic

Of, or concerning water; an organism whose primary habitat for growth, reproduction and survival is on, in or partially submerged in water.

Aquifer

An underground geologic formation or structure that carries water.

Baseflow

The discharge of groundwater to surface water streams, rivers and other waterbodies.

Benthic Macroinvertebrates

Benthic macro-invertebrates are commonly used as indicators of aquatic environmental quality. 'Benthic' refers to the bottom of lakes and rivers whereas 'macro' refers to the subset of larger or visible invertebrates: generally ¼ to ½ mm in length. Invertebrates are animals without backbones such as insects, crustaceans, mollusks and worms.

Best Management Practices (BMPs)

A proven, practical and affordable approach to conserving soil, water and other natural resources in rural areas.

Conservation Authority

A local, community-based environmental agency which represents a grouping of municipalities on

a watershed basis, and works in partnership with others to manage watershed resources.

Conservation Ontario

The umbrella organization that represents Ontario's 36 Conservation Authorities.

Development

The creation of a new lot, a change in land use, or the construction of buildings and structures requiring approval under the *Planning Act* (RSO 1990). It does not include activities that create or maintain infrastructure authorized under an environmental assessment process or works subject to the *Drainage Act*.

Escherichia coli (E. coli)

Bacteria found in human and animal waste. Their presence in water indicates a potential for the water to have other disease-causing organisms.

Ecological Function

The natural processes, products or services that living and non-living environments provide or perform within or between species, ecosystems and landscapes. These may include biological, physical and socio-economic interactions.

Ecosystem

An interacting system of living organisms and their environment.

Ecosystem Approach

A holistic way of planning and managing natural resources; it means that the consequences of an action (including the cumulative effect of many small actions) on all other parts of the ecosystem will be considered and evaluated before the action is undertaken.

Environmental Farm Plan (EFP)

Environmental Farm Plans are assessments voluntarily prepared by farmers in order to highlight their farm's environmental strengths, identify areas of environmental concern, and set realistic action plans with time tables to improve environmental conditions. Environmental cost-share programs are available to assist in implementing projects.

Environmental Property Plan

Environmental Property Plans are property assessments that help landowners identify and mitigate environmental issues on their property. Examples of such plans are the Environmental Farm Plan for farmers, the Rural Landowner Stewardship Guide for rural non-farm landowners, and the Stewardship Guide for the Lake Huron Coastline for lakeshore landowners.

Environmentally Significant Area (ESA)

ABCA defines Environmentally Significant Areas as areas of woodlots that contain some wetland features that play an important role in supporting significant plant or animal species and/or serving hydrological functions. A site may also be significant if it supports a remnant or a threatened species of flora or fauna.

Family Biotic Index (FBI)

An index used to provide an evaluation of stream health based on pollution tolerance scores for families of benthic macro-invertebrates.

Forest Cover

The percentage of the watershed that is forested. Environment Canada recommends 30 percent of a watershed should be in forest cover.

Groundwater

The water found underground in the soil, wells, porous rocks, and subsurface reservoirs and channels.

Guideline (Water Quality)

Acceptable concentrations of substances in water that is used for drinking, recreational activities, agricultural uses and the protection of aquatic life.

Habitat

Food, water, shelter, cover, and other elements of the environment that living organisms need to survive.

Headwater Streams

Seemingly insignificant rivulets and seeps that upon convergence form recognizable streams.

Hydrologic Cycle

The cycle of water movement from the atmosphere to the earth and return to the atmosphere through various stages, such as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.

Indicator (Ecological)

Measures that provide information about the state or condition of a watershed and provide a means to assess progress towards an objective or target.

Non-Point Source Pollution

Non-point source pollution occurs when precipitation runs off fields, streets or backyards. As this runoff moves across the land surface, it picks up soil particles and pollutants.

Nutrients

Elements such as nitrogen and phosphorus, which stimulate growth of aquatic plants. The nutrients act as fertilizers and contribute to heavy weed growth and algal blooms.

Point Source Pollution

A source of contamination that originates in an identifiable location.

Reforestation

The planting of trees, saplings or seedlings on land that has been cleared of trees in the past.

Species at risk

Species that are at risk of extinction, extirpation or endangerment globally or within a jurisdiction or region. COSEWIC (Committee on the Status of Wildlife in Canada) and COSSARO (Committee on the Status of Species at Risk in Ontario) make the federal and provincial designations.

Substrate

Stream substrate is the material that is at the bottom of the stream (e.g., gravel).

Total Phosphorus

Total phosphorus refers to the total amount of phosphorus in a sample. Phosphorus is an element that enhances plant growth and contributes to excess algae, low oxygen in streams and lakes.

Tributary

A tributary is a stream or river that flows into another body of water.

Urbanization

The expansion of the proportion of total population or area in urban areas.

Watercourse

A channel in which a flow of water occurs.

Watershed

A watershed is an area of land that is drained by a river or a stream, and its tributaries, to a body of water such as a lake or ocean. It is often referred to as a drainage area, basin or catchment area for a watercourse.

Watershed Stewardship

Caring for our water, land, air and biodiversity on a watershed basis, recognizing that everything is connected in a watershed and is affected by natural and human activities.

Wetland

An area of land that is seasonally or permanently covered by water, or where the water table is close to the surface. Four types of wetlands are swamps, marshes, bogs and fens. Wetlands often have special plants and ecological, social and economic benefits which may make them important from a provincial perspective. They are dynamic ecosystems that can change over time, due to factors such as natural succession and changing water levels. They may be considered locally or provincially significant.

Wetland – Locally Significant Wetland (LSW)

A wetland which provides functions or exhibits characteristics that are pertinent to planning decisions, but has not been classified by the Ontario Ministry of Natural Resources.

Wetland – Provincially Significant Wetland (PSW)

A wetland that has been identified and classified as provincially significant by the Ontario Ministry of Natural Resources in accordance with the Wetland Evaluation System. These wetlands may contain critical habitat; provide a hydrologic role in the watershed; or have unique or provincially-significant features.

Wildlife Habitat

Areas where plants, animals and other organisms live and find adequate amounts of food, water, shelter and space needed to sustain their populations. Specific wildlife habitats of concern may include areas where species concentrate at a vulnerable point in their annual or life cycle, and areas that are important to migratory or non-migratory species.

References

- ABCA (Ausable Bayfield Conservation Authority). 2012. Biological surveys, 2002-2012.
- ABCA (Ausable Bayfield Conservation Authority). 1995. Environmentally Significant Areas, Appendix to: Environmentally Significant Areas Watershed Plan Report #2 (1984). Ausable Bayfield Conservation Authority. Exeter, Ontario. 111 pp.
- Ausable River Recovery Team. 2005. Recovery strategy for species at risk in the Ausable River: An ecosystem approach, 2005-2010. Draft Recovery Strategy
- Anderson, J., T. Briggs, P. Burtch, R. French and G. Mayne. 2007. Lake Huron - Georgian Bay Watershed A Canadian Framework for Community Action. Environment Canada. Burlington, Ontario. 15 pp.
- Brock, H. and M. Veliz. 2013. Ausable Bayfield Watershed Report Card 2013. Ausable Bayfield Conservation Authority. Exeter, Ontario. 102 pp.
- Chapman, L.J. and D.F. Putnam. 1984. The Physiography of Southern Ontario. 3rd Edition. Ontario Ministry of Natural Resources. Toronto, Ontario.
- Conservation Ontario. 2011. Guide to Developing Conservation Authority Watershed Report Cards. 90 pp.
- County of Huron. 2010. The State of the Huron County Economy 2010; Towards Sustainable Economic Renewal. <http://www.huroncounty.ca/econdev/downloads/StateofHuronEconomy10.pdf>
- County of Huron. 1999. Huron County Official Plan. http://www.huroncounty.ca/plandev/downloads/Huron_County_Official_Plan.pdf
- Crins, W.J. 1983. Life Science Inventory and Vegetation Survey of the Bayfield River Area of Natural and Scientific Interest. Ontario Ministry of Natural Resources, Parks and Recreation Section, Southwestern Region, Wingham District. OFER 8301. vi + 94 pp. + maps.
- Dodds, R. 2010. Determining the Economic Impact of Beaches: Lake Huron Shoreline from Sarnia to Tobermory. Ted rogers School of Hospitality and Tourism Management; Ryerson University. 17 pp.
- Environment Canada. 2013. How Much Habitat is Enough? Third Edition. Environment Canada, Toronto, Ontario.
- Giancola, J. 1983. Soil Erosion Study: Ausable River and Bayfield River Watersheds. Technical Report #3. Ausable Bayfield Conservation Authority. Exeter, Ontario.
- Hendry, G. 2010. Summer 2010 Baseflow Study. Ausable Bayfield Conservation Authority. Exeter, Ontario. 79 pp.
- Huron County Health Unit. 2011. Beach Water Monitoring Report 2011. Huron County Health Unit. Clinton, Ontario. 45 pp.

References

- Luinstra, B., L. Snell, R. Steele, M. Walker and M. Veliz. 2007. Ausable Bayfield Maitland Valley Source Protection Region - Watershed Characterization. Ontario Ministry of the Environment. 97 pp.
- Malone, P. 2003. Bayfield River Watershed Report. Honours Thesis, University of Waterloo, Ontario. 68 pp.
- Markle, J.M. and R.A. Schincariol. 2007. Thermal plume transport from sand and gravel pits - Potential thermal impacts on cool water streams. *Journal of Hydrology* 338: 174-195.
- Morris, T.J., K.A. McNichols-O'Rourke and A. Robinson. 2012. A preliminary survey of the freshwater mussels of the Bayfield river Watershed and Nearby Lake Huron Tributaries. Canadian Manuscript Report of Fisheries and Aquatic Sciences. 2993: v + 26 p.
- Nova Scotia Environment. 2008a. The Drop on Water - Nitrate. Government of Nova Scotia. 4 pp.
- Nova Scotia Environment. 2008b. The Drop on Water - Chloride. Government of Nova Scotia. 4 pp.
- Ontario Ministry of the Environment and Energy and Ontario Ministry of Natural Resources. 1993. Water Management on a Watershed Basis: Implementing a Ecosystem Approach. Queen's Printer for Ontario: Ontario, Canada.
- Ontario Ministry of Tourism, Culture and Sport. 2013. *Quick Facts 2010*. www.mtc.gov.on.ca/en/research/quick_facts/facts.shtml
- Scott, J. 1954. Huron County in Pioneer Times. Huron County Historical Committee. Seaforth, Ontario.
- Smith, A., D. Heitzman and B. Duffy. 2009. Standard Operating Procedure: Biological Monitoring of Surface Waters in New York State. New York State Department of Environmental Conservation, Division of Water.
- Southern Ontario Tourism Organization. *Bayfield, Ontario*. Southern Ontario Tourism Organization. www.soto.on.ca/lake_huron_and_georgian_bay_coastlines/bayfield.html
- Southern Ontario Tourism Organization. 2013. *Clinton, Ontario*. Southern Ontario Tourism Organization. www.soto.on.ca/lake_huron_and_georgian_bay_coastlines/clinton.html
- Statistics Canada. 2012. Central Huron, Ontario (Code 3540025), Huron East, Ontario (Code 3540040) and Bluewater, Ontario (Code 3540010) (table). Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released May 29, 2012. <http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E> (accessed May 30, 2012).
- Statistics Canada. 2007. Bluewater, Ontario (Code3540010), Huron East, Ontario (Code3540040) and Central Huron, Ontario (Code3540025) (table). 2006 Community Profiles. 2006 Census. Statistics Canada Catalogue no. 92-591-XWE. Ottawa. Released March 13, 2007. <http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-591/index.cfm?Lang=E> (accessed May 30, 2012).

References

US EPA (United States Environmental Protection Agency). 2008. A Handbook for Developing Watershed Plans to Restore and Protect our Waters. United States Environmental Protection Agency. Washington, D.C. 400 pp.

US EPA (United States Environmental Protection Agency). 2012. Watershed Assessment, Tracking and Environmental Results. <http://ofmpub.epa.gov/tmdl_waters10/attains_nation_cy.control#causes>

Veliz, M. 2001. Fish Habitat Management Plan. Ausable Bayfield Conservation Authority. Exeter, Ontario. 86 pp.

Appendix A: Plant, mussel, fish, reptile and bird species at risk identified within the Bayfield River ANSI (ABCA 2012, Morris *et al.* 2012, Crins 1983).

Type of Species	Species Name
Plants	Green Dragon (<i>Arisaema dracontium</i>), Tuberous Indian-plantain (<i>Arnoglossum plantagineum</i>), Chinese Hemlock Parsley (<i>Conioselinum chinense</i>), Eastern Green-violet (<i>Hybanthus concolor</i>), Butternut (<i>Juglans cinerea</i>), American Gromwell (<i>Lithospermum latifolium</i>), Scarlet Beebalm (<i>Monarda didyma</i>), Slim-flowered Muhly (<i>Muhlenbergia tenuiflora</i>), Large Round-leaved Orchid (<i>Platanthera macrophylla</i>), Hairy Valerian (<i>Valeriana edulis</i>)
Mussels	Mapleleaf mussel (<i>Quadrula quadrula</i>), Rainbow mussel (<i>Villosa iris</i>)
Fish	Black Redhorse (<i>Moxostoma duquesnei</i>)
Reptiles	Snapping turtle (<i>Chelydra serpentina</i>), Wood turtle (<i>Glyptemys insculpta</i>), Queensnake (<i>Regina septemvittata</i>)
Birds	Bobolink (<i>Dolichonyx oryzivorus</i>), Louisiana Waterthrush (<i>Seiurus motacilla</i>)

Appendix B: Fish species identified in the Main Bayfield watershed (ABCA 2012).

Common Name	Scientific Name	Common Name	Scientific Name
Alewife	<i>Alosa pseudoharengus</i>	Pink Salmon	<i>Oncorhynchus gorbuscha</i>
Atlantic Salmon	<i>Salmon salar</i>	Rainbow Darter	<i>Etheostoma caeruleum</i>
Black Bullhead	<i>Ameiurus melas</i>	Rainbow Smelt	<i>Osemerus mordax</i>
Black Redhorse*	<i>Moxostoma duquesnei</i>	Rainbow Trout	<i>Oncorhynchus mykiss</i>
Blacknose Dace	<i>Rhinichthys atratulus</i>	Redfin Shiner	<i>Lythrurus umbratilis</i>
Blackside Darter	<i>Percina maculata</i>	River Chub	<i>Nocomis micropogon</i>
Bluntnose Minnow	<i>Pimephales notatus</i>	Rock Bass	<i>Ambloplites rupestris</i>
Brook Stickleback	<i>Culaea inconstans</i>	Round Goby	<i>Neogobius melanostomus</i>
Brook Trout	<i>Salvelinus fontinalis</i>	Smallmouth Bass	<i>Micropterus dolomieu</i>
Brown Bullhead	<i>Ameiurus nebulosus</i>	Spottail Shiner	<i>Notropis hudsonias</i>
Brown Trout	<i>Salmo trutta</i>	Striped Shiner	<i>Luxilus chrysocephalus</i>
Catfish	<i>Pylodictis olivaris</i>	White Sucker	<i>Catostomas commersoni</i>
Central Mudminnow	<i>Umbra limi</i>	Yellow Perch	<i>Perca flavescens</i>
Channel Catfish	<i>Ictalurus punctatus</i>		
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	* Species at risk	
Coho Salmon	<i>Oncorhynchus kisutch</i>		
Common Carp	<i>Cyprinus carpio</i>		
Common Shiner	<i>Notropis cornutus</i>		
Creek Chub	<i>Semotilus atromaculatus</i>		
Emerald Shiner	<i>Notropis atherinoides</i>		
Fathead Minnow	<i>Pimephales promelas</i>		
Gizzard Shad	<i>Dorosoma cepedianum</i>		
Hornyhead Chub	<i>Nocomis biguttatus</i>		
Johnny Darter	<i>Etheostoma nigrum</i>		
Largemouth Bass	<i>Micropterus salmoides</i>		
Least Darter	<i>Etheostoma microperca</i>		
Longnose Dace	<i>Rhynichthys cataractae</i>		
Mottled Sculpin	<i>Cottus bairdi</i>		
Northern Brook Lamprey*	<i>Ichthyomyzon fossor</i>		
Norther Hog Sucker	<i>Hypentelium nigricans</i>		
Northern Pike	<i>Esox lucius</i>		
Northern Redbelly Dace	<i>Phoxinus eos</i>		

Appendix C: Mussel species identified in the Main Bayfield watershed (Morris *et al.* 2012).

Common Name	Scientific Name
Creeper	<i>Strophitus undulatus</i>
Cylindrical Papershell	<i>Anodontooides ferussacianus</i>
Deertoe	<i>Truncilla truncata</i>
Fatmucket	<i>Lampsilis siliquoidea</i>
Flutedshell	<i>Lasmigona costata</i>
Fragile Papershell	<i>Leptodea fragilis</i>
Giant Floater	<i>Pyganodon grandis</i>
Mapleleaf Mussel*	<i>Quadrula quadrula</i>
Paper Pondshell	<i>Utterbackia imbecillis</i>
Pink Heelsplitter	<i>Potamilus alatus</i>
Plain Pocketbook	<i>Lampsilis cardium</i>
Rainbow Mussel*	<i>Villosa iris</i>
Threeridge	<i>Amblema plicata</i>
White Heelsplitter	<i>Lasmigona complanata</i>

* Species at risk