Township of Sidney
Lower Trent Region Conservation Authority

SOUTH SIDNEY WATERSHED PLAN

FINAL REPORT

March 1995

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Mr. James Kelleher, General Manager
Lower Trent Region Conservation Authority
441 Front Street
TRENTON, Ontario
K8V 6C1

March 15, 1995

Dear Sir:

Re: South Sidney Watershed Plan
Final Main Report

We are pleased to submit the completed Final Report for the above noted Study. A complete set of Appendices are available with the Final Report.

The particular emphasis on field study and detailed hydrologic modelling made this a particularly interesting and gratifying undertaking for all Study Team members. Future monitoring will assure complete documentation of any impacts and demonstrate the effectiveness of mitigation measures recommended herein to protect and improve the natural environment of South Sidney.

TSH staff is available at your convenience to discuss the contents of this Report.

Yours truly,

totten sims hubicki associates

D. A. Marucelj, P.Eng.
Project Director

RW/DM/rd
encl.

pc: Technical Planning Team

TOWNSHIP OF SIDNEY

LOWER TRENT REGION CONSERVATION AUTHORITY

SOUTH SIDNEY WATERSHED PLAN

FINAL REPORT

TSH Project No. 24 14164

March 1995

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ACKNOWLEDGEMENTS

The following committees and their respective members provided valuable input and focused the preferred direction for this Study:

Technical Planning Team

James Kelleher (Lower Trent Region Conservation Authority)
Randy Vilneff (Lower Trent Region Conservation Authority)
Ernie Margetson (Moira River Conservation Authority)
Carl Cannon (Township of Sidney)
Chris Schaeffer (Ministry of Natural Resources)
Ray Valaitis (Ontario Ministry of Agriculture and Food)
Ted Reeves (Ministry of Environment and Energy)

Community Liaison Committee

Morris Douglas
Bill Robson
Anne Barber
John Halloran
Emile Masse
Arnold Vandermeer
Ron Hamilton
Lesley Simpson
John Stevens
John and Henny Bergveld
Ivan Sinclair
Les Stevens
Glenda Rodgers (Lower Trent Region Conservation Authority)

The Lower Trent Region Conservation Authority provided regular guidance for specific issues as they arose through the 1994 Study period, providing major assistance with various aspects of the mapping and public relations. The Moira River Conservation Authority provided continuing information and guidance with water quality and hydrology. All other Technical Committee members were consulted on numerous occasions.

We express our grateful appreciation to all the members of the Community Liaison Committee.

TOWNSHIP OF SIDNEY
LOWER TRENT REGION CONSERVATION AUTHORITY
SOUTH SIDNEY WATERSHED PLAN
FINAL REPORT

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1. INTRODUCTION

1.1 Purpose of Study

The South Sidney Watershed Plan builds upon a planning program put in place by the South Sidney Secondary Plan and the Official Plan of the Township of Sidney. Both these documents include policy requirements for consideration of the implications of development and redevelopment on drainage and stormwater quality and quantity prior to the approval of changes in land use.

The joint sponsorship of this project by Sidney Township and the Lower Trent Region Conservation Authority is evidence of a strong collaborative effort. The adjacent Moira River Conservation Authority also provided logistic and technical support. This report and the recommendations it contains builds upon and encourages this supportive approach.

The Municipal Planning Documents were developed with extensive agency consultation. During this consultation it was acknowledged that further detailed assessment would be required. In particular the resource management objectives, policies and designations require review to ensure that they support and complement the development and land use objectives. This Watershed Plan provides the means of guiding the detailed design and ensuring that resource related issues are addressed in a comprehensive manner. This will have the effect of avoiding costly delays while ensuring that all agency concerns are addressed.

A large portion of the development opportunity in this area is already in place. New development will be primarily of an infill nature, although this will involve several relatively large blocks of land. The range of stormwater solutions are thus limited. The need for an overall stormwater program in each watershed is illustrated by the need to maintain and, if possible, improve existing situations such as the drainage in the Montrose Road/Country Club Village area.

This Watershed Plan has been prepared to meet the environmental standards set, in part, by the Municipal Planning Documents, but principally based upon the Bay of Quinte Remedial Action Plan.

The identification and classification of natural resource features and systems will assist in their protection. This Plan undertook a program of wetlands classification and natural system identification based on available information and limited/selected field surveys. Section 4 provides an outline of the work conducted and an identification of issues. The Plan reviews the appropriateness of incorporating these features as protection areas, corridors and areas to be set aside to accommodate natural events and processes.

The establishment of policies and criteria for environmental issues, and for stormwater management in particular, will assist both the private and public sectors in achieving their development goals and the public sector in achieving prompt review of proposals. An understanding of the expectations of the review agencies will streamline the approval process

and ensure that development proceeds with adequate knowledge of the standards expected for development in the area.

There is a concern about the lack of historic data upon which to base design decisions. This Plan, and the research that has accompanied its preparation, provides only a snapshot of the current situation based on sampling through a single year. Detailed recommendations are provided in Section 7 for an ongoing monitoring program. This program is proposed being mindful of the budgetary and staffing limitations under which all agencies are currently working to continually update and refine the information natural resource features.

Throughout this program public comment has been solicited and considered. The Community Liaison Committee, a group of community residents concerned about resource management and development issues and recruited on a voluntary basis, have been instrumental in obtaining survey response as to the important issues in the Watershed. Follow-up meetings and opportunities for review and response have assisted in the preparation of this report.

1.2 Watershed Description

The South Sidney watershed includes all streams that drain into the Bay of Quinte through the South Sidney Secondary Planning Area. This was considered the overall Study Area for this project. The general location is illustrated on Figure 1.1. The Watershed is composed of 8 subwatershed basins. Five are streams with defined banks (watercourses 1-5) and a more or less continuous base flow and 3 are minor drainage areas where flows may be unconfined and seasonal. It comprises a total of 5,694 hectares (14,070 acres) and is located between the urban areas of Trenton and Belleville. The watershed slopes north to south across what was once the bottom of the post-glacial lake that pre-dates the current Lake Ontario. The bulk of the watershed is comprised of rural land uses. Urban development has occurred along the shore of the Bay of Quinte, and the Canadian Forces Base, with its airfield, have introduced additional significant land use changes. Also significant to the watersheds are the linear transportation corridors which cross the watersheds in an east-west direction, interrupting the natural north-south drainage.

1.3 Study Organization

Work Program

The Work Program for the preparation of this watershed plan was developed to provide sufficient information to establish an understanding of the natural (aquatic and terrestrial) processes at play in the watersheds. The work program was designed to act as the basis for the plan recommendations. Specifically the following analyses were conducted:

- hydrologic modelling (design event and continuous)
- hydraulic modelling (and floodline mapping)
- water quality sampling and analysis
- fisheries and aquatic resources sampling and analysis

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LOWER TRENT REGION CONSERVATION AUTHORITY

TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

STUDY AREA AND WATERSHED BOUNDARIES

DRAWN BY: F.B.	CHECKED BY: R.W.	DATE: SEPT 28/94
DESIGNED BY: R.W.	APPROVED BY: R.W. & B.R.	PROJECT: 24-14164-05
SCALE: 1:50000	FIGURE No.: 1.1	

- wetland evaluation
- other natural areas assessment.

Technical Planning Team

The study was directed by a Technical Planning Team consisting of representatives of the key agencies having an interest in the development of the watershed plan. The members of the Technical Planning Team are listed in the acknowledgements section of the front section of this report. Their assistance in the conduct of this study has been important to its completion.

1.3.4 Community Liaison Committee

At the first Public Open House, held in December 1993, a request for interested citizens willing to act as a Liaison Committee was answered by a number of volunteers. This initial committee has been augmented as other interested citizens joined. It is as a result of this committee's efforts that a public questionnaire received adequate response and the owners' permission to allow the Study Team to evaluate properties were obtained.

1.4 Study Objectives

As outlined in the Terms of Reference, the primary purpose of the South Sidney Watershed Plan is *"to resolve potential conflicts between resource management objectives and development and land use objectives, prior to requests for any planning approvals."*

The Terms of Reference outline a series of specific objectives which are instrumental in achieving the aforementioned goal. The following is a summary of these objectives:

- to identify the development opportunities, environmental targets and constraints within the subwatersheds;
- to identify and classify natural areas and systems requiring protection;
- to identify policies and criteria for the design of stormwater management systems;
- to examine and recommend a combination of Stormwater Management Practices;
- to recommend and develop a monitoring program to assess the success of implemented stormwater management systems;
- to maximize development opportunities and minimize future Municipal maintenance of stormwater management systems; and
- to involve the general public in the overall study process.

2. PRINCIPLES OF WATERSHED PLANNING

Watershed systems are managed to ensure that:

- water resources within a watershed are available in sufficient quality and quantity to provide optimal and continuous environmental, social and economic benefits to existing and future residents on a sustainable basis;
- the integrity of aquatic, riparian and related terrestrial communities are maintained or enhanced;
- human life and property are not threatened by water or water-related hazards.

2.1 The Watershed as a Planning Concept

The watershed is the basis by which natural systems are planned and managed to meet these objectives. Watershed planning is an assessment of the interactions of natural processes and man-made social and economic demands. Watershed Plans have evolved to mean the adoption of an ecosystem-based resources management strategy and the use of watershed boundaries for technical studies and planning.

This approach recognizes the natural systems and cycles. Water continuously moves through watersheds and influences numerous life cycles and physical processes throughout. An action or change in one location within a watershed has potential implications for many other natural features and processes that are linked by the movement of surface and ground water, the wildlife that live in the area and the human activities in these areas.

To paraphrase from the report entitled *Watershed* [1]:

"Not long ago, society believed that the environment was endlessly able to absorb the detritus of a modern, industrial-based economy. More recently, the assumption was that the environment and the economy were inevitably opposed: opting for one meant damaging the other.

Today, however, it is clear that the two, rather than being mutually exclusive, are mutually dependent: a good quality of life and economic development cannot be sustained in an ecologically deteriorating environment. The way we choose to treat our watersheds is crucial. Governments and individuals must recognize - and act on - the need to resolve past environmental problems and forge strategies to protect the watershed now and in the future."

Watershed-based management strategies progress from broad large-scale studies to more detailed studies covering smaller geographic areas within the watershed.

[1] Royal Commission on the Future of the Toronto Waterfront, 1990. *Watershed: Interim Report,* Ottawa.

2.2 Need for Watershed Planning

Despite the past planning efforts there is a need to develop another planning perspective which more directly addresses concerns about the environmental consequences of human actions and provides recommendations for the protection and development of natural systems. This need is highlighted by the following concerns:

- Jurisdictional Fragmentation - many agency mandates include environmental aspects and have implications on the environment. Without an overall coordinating plan at the local watershed level these efforts will not be effective.

- Lack of Ecosystem Thinking - most planning activities today consider the environment but lack the commitment and the mandate to provide leadership in the development of environmentally complete analysis and action plans.

- Lack of Accountability - the first two concerns result in a lack of an effective advocate for environmental concerns when decisions are made.

- Failure to Adopt a Preventative Approach - the best approach to environmental planning is to develop plans that involve land owners and residents in a process of life-style change that will ensure that new challenges be faced with an environmental perspective in mind. This may be termed a preventative approach rather than a regulatory approach.

- Lack of Information - one of the most serious limitations to watershed planning has been the lack of complete information on matters such as water quality, ground water, surface runoff, stream flow and land use. This information must be collected and analyzed to ensure that the actions recommended can be tested and evaluated to ensure that they have the desired effect.

- Lack of Adequate Resources - agency and public resources are scarce and cannot be expected to meet all the needs of the residents of an area. It is becoming increasingly obvious that creative means including use of local volunteers must be developed to meet these challenges.

- Lack of Enforcement - the lack of legal mechanisms reflects a lack of commitment in means and efforts to enforce even the limited regulations that apply to the environment. The attitude that property rights allow actions which will negatively effect the environment is a very real limitation to the efforts to protect and promote responsible stewardship of the environment.

- Lack of Responsibility - a true land ethic must be developed that does not depend on the enforcement of laws and the imposition of regulations by others. This land stewardship must be cultivated through public education and example. This approach will only be successful were it can be imbedded in the community culture.

2.3 Principles of Watershed Planning

All of the background studies and initiatives that have been reviewed at the initiation of this study indicate a concern about the future of the Bay of Quinte, and more specifically, concern about the future direction to be adopted for the South Sidney planning area and the watersheds that this area comprises/affects.

While there are a myriad of responses to the concerns raised by these previous studies, there is a need for coordination of the various undertakings and development of a framework that will make those initiatives in South Sidney more effective. The development of a Watershed Plan can achieve this by focusing on the healing and maintenance processes required to anticipate and prevent future environmental harm. This means adapting existing settlement patterns and designing new development to contribute to the health, diversity and sustainability of the entire ecosystem: the physical environment, human activities, and economic activities.

The Royal Commission on the Future of the Toronto Waterfront, in its second report entitled *Watershed,* identified nine principles that can be applied to the South Sidney Watershed to make it healthier and more sustainable: clean, green, connected, open, accessible, useable, diverse, affordable, and attractive. Applications are discussed below:

- **Clean**

  All activities and future development should work with the natural processes to contribute to environmental health. Air, land, sediments, and water should be free of contaminants that impair beneficial uses by people and other living things.

  Activities would include:

  - remediation of polluted sites
  - new development should be contaminant free
  - use of best possible means of controlling impacts
  - adaptation/retrofitting of existing development

- **Green**

  Natural features and topography should form a green infrastructure for the area, including: natural habitats such as wetlands, forests (woodlands and hedgerows), and other significant landforms such as beaches, valleys and open spaces.

  The diversity and productivity of ecological communities should be protected and restored through:

  - preserving genetic diversity of plants and animals
  - protecting and restoring healthy natural habitats and communities
  - maintaining natural ecological processes

- **Connected**

  Natural and cultural heritage should be restored and maintained including links to:

  - wildlife habitats
  - urban and rural settings
  - social communities
  - past and present
  - people and nature.

  This could be accomplished by a system of linkages such as greenways, pedestrian and bicycle pathways. When redevelopment is undertaken, cultural and built heritage should be respected.

- **Open**

  Existing vistas of The Bay of Quinte should be protected. These vistas should be treated as important values for new development. Waterfront structures should not be permitted to create a visual barrier or intrude to the water's edge.

- **Accessible**

  People should be able to get to and enjoy the waterfront and the valley lands. Where feasible portions of the waterfront and the valley lands should be open to the public and clearly identified as public access.

- **Useable**

  There should be a mix of uses along the waterfront and the valleys that:

  - are primarily water-related
  - permit water access
  - enhance the community
  - decrease the need for commuting by providing local employment
  - are environmentally friendly
  - minimize conflicts with adjacent communities
  - are designed and managed to improve microclimate and promote greater year-round comfort and use.

  Uses along the watercourses should be designed and managed to enhance the safety and minimize the risks caused by:

  - threats to personal safety from other users
  - flooding and erosion
  - incidents involving hazardous materials.

- **Diverse**

  The watershed should provide for diverse landscapes, places and wildlife habitats, uses, programs and experiences.

- **Affordable**

  Watershed development and management should provide opportunities for economic renewal and efficient use of limited government and private sector resources. Where possible social, economic and environmental objectives should be integrated with each other in order to achieve them more effectively. For example:

  - projects might be more affordable if partners co-ordinate activities and share resources
  - projects might be designed to yield multiple benefits
  - a healthy environment is a more productive setting for economic activities.

- **Attractive**

  Design should create, protect and enhance distinctive and memorable places in the watershed.

  This should include:

  - protecting vistas and views of the Bay
  - provide a sense of connection with the past
  - emphasize sensitive design and placement of buildings
  - use of harmonious colours and texture/materials
  - include a range of landscape types.

Watershed Planning is a means of evaluating human activities and their effects on the natural environment. The application of the above principles will not change plans that have previously been developed. Instead the consideration of the wide variety of development impacts at once will enable these plans to succeed in achieving more than if the impacts had been examined piecemeal.

3.0 BACKGROUND

3.1 Historical Data/Previous Studies

A number of relevant documents and reports were reviewed as input to the technical component of the study. These reports provided valuable background information concerning previous studies and watershed issues. Various mapping, photographic resources and planning documents were also reviewed to provide an indication of the existing and proposed future conditions within the watershed.

A brief summary of the various resources reviewed as part of this study is provided below.

a) *Bay of Quinte Remedial Action Plan* (various volumes); Various Authors 1989-1990.

The Remedial Action Plan (RAP) documentation for the Bay of Quinte outlines the various environmental concerns, potential sources and fates of contaminants and possible mitigative actions. These reports were used as a guide to the existing water quality problems and the sources which should be considered in the development of a stormwater management plan for the Study Area. (Section 3.2 has a more complete outline of RAP reference documentation).

b) *Modified South Sidney Secondary Plan* - Policies and Documents; Totten Sims Hubicki Associates, 1991.

Existing and proposed land uses within the South Sidney Secondary Planning Area were obtained from this report for the development of the hydrologic modelling parameters. The existing and future land uses were plotted by the LTRCA in their SPANS GIS system to generate the various land use areas.

c) *South Sidney Watershed Plan* - Hydrologic Overview; Hydroterra Limited, 1994.

This report presents a summary of the hydrogeologic data available for the Study Area. General information pertaining to the surface and subsurface geology and aquifer characteristics are included. The information in this report provided some data to assist in the development of the hydrologic model for the Study Area.

d) *South Sidney Watershed Plan - State of the Watershed Report*; Totten Sims Hubicki Associates, 1994.

A summary overview of the existing watershed conditions with regard to development, hydrogeology and the environment is summarized in this document to guide the development and implementation of the Watershed Plan.

e) 1:10,000 Scale Colour Stereo Aerial Photography; Airborne Sensing, 1993.

Topographic features, existing land uses and general watershed characteristics were obtained from the aerial photography.

f) 1:2,000 Scale Topographic Mapping; J. D. Barnes Ltd., 1994.

The aerial photography was used to generate 1:2,000 scale Ontario Base Mapping for the Secondary Planning Area. The mapping provided details for the generation of hydraulic cross sections of the watercourses, and the development of physical watershed modelling parameters. The mapping also provides the base for the Regulatory Floodline mapping.

g) *1986 Hydrogeological Monitoring Investigation, Aikens Road Landfill*, 1987.

This document was prepared to report on the results of groundwater quality monitoring undertaken in 1986 and also discusses the results of 5 other groundwater investigations since 1978. Report conclusions in summary state that the regional groundwater aquifer - a fractured shaley limestone bedrock - is recharged from the overburden till deposits; a small buried bedrock valley exists south of the landfill, oriented in a southwest direction; groundwater quality varies in general, from good in the upper layers of bedrock, to poor at depth; and contaminants from landfill leachate appear to be slowly moving as a plume towards the Bay along this Valley.

h) *Ground and Surface Water Monitoring Report for the Aikens Road Landfill*; Gartner Lee, 1987 and 1994.

These reports summarize a number of years of monitoring results for the Aikens Road landfill. Water quality and flows were monitored at several locations within the Massey Creek watershed and the unnamed watershed to the east. These results were used to guide the selection of hydrologic and water quality monitoring parameters.

i) *Aquatic Environment Assessment, Canadian Forces Base Trenton*; Gartner Lee, 1994.

This report summarized field assessments undertaken to determine whether conditions within the Bay in the vicinity of the Base have been impaired as a result of the activities at the Base. Water quality data collected was compared against results of the present Study and to guide the selection of hydrologic and water quality monitoring parameters.

3.2 Bay of Quinte Remedial Action Plan

The Bay of Quinte has been designated as a severely stressed ecosystem. Because of this, it has been recognized as an area of concern under the Great Lakes Water Quality Agreement (GLWQA). Under the GLWQA, recommendations on management of contaminants and nutrient loadings from inflowing watersheds are defined in the Bay of Quinte Remedial Action Plan (RAP). The RAP program, and the Project Quinte that preceded it, have undertaken

numerous studies on conditions in and around the Bay of Quinte. Several of these documents have been reviewed, including:

a) *Project Quinte: Point-Source Phosphorus Control and Ecosystem Response in the Bay of Quinte, Lake Ontario*. C. K. Minns, D. A. Hurley, and K. H. Nicholls (eds). 1986. Canadian Special Publication of Fisheries and Aquatic Sciences.

This document contains a number of valuable articles on the nature of phosphorus problems within the Bay of Quinte. It provides information about long term changes within the Bay through historic and prehistoric times and compares the Bay before and after phosphorus controls.

b) *Feasibility of Decreasing the Internal Phosphorus Loadings in the Upper Bay of Quinte*. 1989. Gore and Storrie/Beak. Technical Report No. 7. Bay of Quinte Remedial Action Plan.

Discusses the options available for the reduction of phosphorus loadings to the Bay of Quinte.

c) *Technical Evaluation of Landfills as Potential Sources of Persistent Toxic Contaminants in the Bay of Quinte*. 1989. Beak Consultants. Technical Report No. 8. Bay of Quinte Remedial Action Plan.

This document provides information on the sources of potential toxic contaminants. A short section on the Aikens Road Landfill is particularly relevant to this study.

d) *Bay of Quinte Remedial Action Plan: 1991 Annual Report* (Monitoring Report No. 3).

This document provides extensive information on the fish, benthos, and algal communities as well as information on commercial and ice fishing, and chemical and contaminant data.

e) *Effects of Habitat Degradation on the Species Composition and Biomass of Fish in Great Lakes Areas of Concern*. Randall, R. G. et al. 1993. Canadian Technical Report of Fisheries and Aquatic Sciences. No. 1941.

This study documents and provides data on fish species, biomass and abundance for the Bay of Quinte. The results of the study found that although fish biomass was positively correlated with eutrophication, the structure of the fish communities were negatively altered in degraded habitats.

f) *Macrophyte Surveys of Littoral Habitats in Great Lakes Areas of Concern: The Bay of Quinte, Hamilton Harbour, and Severn Sound - 1988 to 1991*. C. K. Minns et al. 1993. Canadian Technical Report of Fisheries and Aquatic Sciences. No. 1936.

This documents the species of aquatic vegetation found within the littoral regions of the Bay of Quinte.

g) *Summary of Nearshore Habitat: Inventory on the Bay of Quinte 1991-1993.* 1994. Bay of Quinte Remedial Action Plan. Ministry of Natural Resources.

This document provides additional background information on nearshore habitat along the Bay of Quinte.

h) *Stage 2 Report: Time to Act.* 1993. Bay of Quinte Remedial Action Plan.

This document, and its accompanying executive summary, outlines the problems, recommendations, and schedules for implementation of the "Big Cleanup of the Bay of Quinte".

3.3 1994 Field Programs

Field investigations were conducted throughout the Study Area in 1994 for a variety of purposes including collection of data for hydrologic and hydraulic modelling, fisheries analysis and habitat typing, water quality analysis, and wetland evaluation and mapping. This program, outlined briefly below, provides the opportunity for the establishment of baseline data in the areas of water quality and fisheries analysis.

For hydrological and hydraulic studies, photographs and measurements were taken along watercourses in order to accurately reflect the conditions and characteristics of the streams. This information was then inputted to the appropriate computer models establishing floodline maps for the South Sidney watercourses.

A fisheries and aquatic habitat study was conducted over the 1994 field season and consisted of several distinct tasks. A spring spawning survey was conducted at the mouths of the South Sidney watercourses. Later, spring and summer fish inventories were undertaken along with habitat assessments at selected stations along the watercourses. Field water chemistry studies were also undertaken at the time of assessment and collection of fish specimens.

With regard to water quality and the aquatic habitat assessment, benthic invertebrates were collected at stations throughout the Study Area. Samples were collected in the spring and summer periods to assess water quality and potential food sources as limiting factors for fish community sustainability.

As there was little information on water quality in the Study Area watersheds, the sampling program sought to characterize the condition of the watercourses. To achieve this a water quality sampling program was initiated in the spring and summer. An event sample was also taken.

Field investigations were also undertaken to identify and evaluate the wetland areas throughout the Study Area. Wetlands were visited throughout the spring and summer of 1994 by a

qualified evaluator. Wetland evaluations were conducted as per the MNR Wetland Evaluation Manual (3rd Edition), and subsequently ranked according to MNR's most recent guideline.

3.4 Existing Agency Legislation, Policies and Guidelines

The following tables summarizes applicable Municipal, Provincial and Federal Legislation (Table 3.4.1), document polices, procedures and guidelines administered by these agencies as they relate to identified watershed issues (Table 3.4.2). Internal policy documents of the Township of Sidney (excluding the Official Plan) and the Lower Trent Region Conservation Authority have also been included.

TABLE 3.4.1
APPLICABLE MUNICIPAL, PROVINCIAL AND FEDERAL LEGISLATION

Agency/Level of Government	Legislation
Municipality (Township of Sidney)	Township of Sidney Official Plan (including South Sidney Secondary Plan) Township of Sidney Zoning By-law
Conservation Authority	Conservation Authorities Act (Fill, Construction and Alteration to Waterways Regulations) LTRCA Plan Input and Plan Review Policy and Implementation Guidelines
Ministry of Municipal Affairs	Planning Act
Ministry of Natural Resources	Lakes and Rivers Improvement Act Beds of Navigable Waters Act Beach Protection Act Public Lands Act Fisheries Act (portions of)
Ministry of the Environment and Energy	Public Health Act Ontario Water Resources Act Environmental Protection Act Environmental Assessment Act Pesticides Act
Ministry of Transportation	Public Transportation and Highway Improvement Act
Ministry of Agriculture and Rural Affairs	Drainage Act
Federal	Canadian Environmental Protection Act Migratory Birds Convention Act Fisheries Act Navigable Waters Protection Act Canada Shipping Act Canadian Environmental Assessment Act Other: Great Lakes Water Quality Agreement Environmental Assessment and Review Process (EARP)

TABLE 3.4.2
AGENCY PROCEDURES AND GUIDELINES RELATED TO WATERSHED ISSUES

Issue	Guideline/Policy/Procedure	Implementing Agency
Flooding	Flood Plain Planning Policy Statement Implementation Guidelines (1988)	MNR
	Conservation Authorities Act (1977)	CAs
	Canada/Ontario Flood Damage Reduction Program Terms of Reference for Floodline Mapping Studies (draft, 1992)	Environment Canada/MNR
	Ice Management Manual (1982)	MNR
	Flood Plain Management in Ontario Technical Guidelines (1986)	MNR
Erosion/ Sedimentation	Guidelines on Erosion Sediment Control for Urban Construction Sites (1987)	MNR/MOEE/MMA
	Technical Guidelines, Erosion and Sediment Control (1989)	MNR
	Provincial Sediment Quality Guidelines (1991)	MOEE
	Urban Drainage Design Guidelines (1987)	MNR/MOEE/MMA /MTO
	Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (1993)	MOEE
	Fill Quality Control Guidelines for Lake Filling in Ontario (1992)	MOEE
Water Quality	Urban Drainage Design Guidelines (1987)	MNR/MOEE/MMA /MTO
	Stormwater Management Practices Planning and Design Manual (1994)	MOEE
	Interim Stormwater Quality Control Guidelines for New Development (1991)	MNR/MOEE
	Water Management - Policies, Guidelines, Provincial Water Quality Objectives (1994)	MOEE
	Bay of Quinte Stormwater Management Strategy	MOEE/MNR/CAs
Fisheries/ Environmental	Environmental Guidelines for Access Roads and Water Crossings (1990)	MNR
	Environmental Construction Guidelines for Municipal Road, Sewer and Water Projects (1987)	MOEE
	Guidelines and Criteria for Approvals under the Lakes and Rivers Improvement Act (1977)	MNR
	Guidelines on the Use of "Vegetative Buffer Zones" to Protect Fish Habitat in an Urban Environment (1987)	MNR
	MNR/MTO Fisheries Protocol (Draft, 1991)	MNR/MTO

Issue	Guideline/Policy/Procedure	Implementing Agency
Fisheries Environmental Continued	Fish Habitat Protection Guidelines for Developing Areas (1994)	MNR
	Wetland Policy Statement (1992)	MNR/MMA
	Manual of Implementation Guidelines for the Wetlands Policy Statement (1992)	MNR/MMA
	Policy for the Management of Fish Habitat (1986)	DFO
	Class Environmental Assessment for Remedial Flood and Erosion Control Projects (1992)	MOEE
	Class Environmental Assessment for Municipal Road Projects (1987)	MEA
	Provincial Highways Program Class Environmental Assessment (1985)	MOEE
	Class Environmental Assessment for Municipal Sewage and Water Projects (1987)	MOEE
	Interim Guidelines on Environmental Assessment Planning and Approvals (1989)	MOEE
	Towards Improving the Environmental Assessment Program in Ontario (1990)	MOEE
	Plan Input and Review Policy and Implementation Policy	LTRCA
	Environmental Sensitivity Mapping Project (1978)	LTRCA

MNR Ministry of Natural Resources
CA Conservation Authority
MOEE Ministry of the Environment and Energy
MMA Ministry of Municipal Affairs
MTO Ministry of Transportation, Ontario
DFO Department of Fisheries and Oceans

4.0 WATERSHED RESOURCES

4.1 Land Use

The documentation of existing and planned future human activities is the basis upon which computer modelling calibrates the existing runoff characteristics and predicts the implications of future development. For the South Sidney watershed the planning documents have been recently approved.

The opportunity to influence the form of development and its environmental implications during the approval stage for either development or redevelopment. (For ease of reference development in this discussion shall include redevelopment). Uses that are established and for which no changes are proposed present limited opportunity to correct or improve the existing situation. A possible exception is the existing development for which adjacent development presents an opportunity to address deficiencies or implications of the development already in place.

4.1.1 Existing Land Use

The South Sidney Watershed has a range of land uses from the urban uses located along the Bay of Quinte to the extensive rural uses located adjacent to and north of Highway 401. Essentially the watershed can be categorized by east-west bands generally delimited by the east/west transportation corridors. The band along the Bay of Quinte shoreline and extending to the railway line has been subject to the majority of past urbanization pressures. This area contains the bulk of the urban uses including the community facilities, residential housing, mobile home parks and the CFB Trenton air base.

The band of lands between the two railway lines is poorly drained and contains predominantly forested areas. This area includes some industrial uses and the Quinte Landfill Site.

Lands between the rail line and Highway 401 are primarily agricultural in nature. Few urban intrusions are present with the exception of the residential areas along White's Road.

The area north of Highway 401 is (generally) poorer quality agricultural land with some exceptions. The lands are more rolling in nature. Crossing these bands are the streams with their associated valleys. These stream valleys act as corridors linking the various land use bands and affording a natural link to the land uses. In certain areas the valley broadens to include large forested and open wetland areas.

4.1.2 Future Land Use

The recently prepared Sidney Township Official Plan and South Sidney Secondary Plan indicate the direction and form of future development within the Township. These plans represent an agreement between the Province and the Township regarding future development. Any significant deviation from these plans will require an Official Plan Amendment which must be passed by Council and approved by the Province.

An Official Plan for the Township of Sidney was completed in September of 1991 and approved by the Ministry of Municipal Affairs (July 1993). Prior to the approval of the 1991 Plan, land use in the Municipality was under the guidance of an Official Plan originally proposed by the Quinte Planning Area Board.

The Official Plan contains policies which are aimed at encouraging appropriate business opportunities, protecting viable agricultural land and maintaining and enhancing agriculture and associated industries. Protection of the natural environment and resources is also one of the goals of the Township Official Plan.

The South Sidney Secondary Plan, essentially covering the lands south of the CN railway embankment, was modified and approved by the Ontario Municipal Board in the Board's decision of January 27, 1992. The Secondary Plan forms part of the Official Plan for the Township of Sidney and is intended to guide future development and ensure growth takes place in an orderly and desirable manner while having regard to relevant social, economic and environmental matters.

4.1.3 Development Opportunities

A comparison of the existing land use and the future land use provides an indication of development opportunities. Figure 4.1 illustrates the development opportunities within the South Sidney watershed. The following is a description of the land uses including commentary on runoff characteristics, natural environment and water quality concerns of each land use.

a) Residential

There are a series of types of residential land uses represented in the Study Area. These include privately serviced large lot residential development, communally serviced small lot residential development, mobile home parks, clusters and strip development.

i) Privately Serviced Large Lot Development

There are some residential areas along the lakeshore and in the extreme northern section of the watershed which are privately serviced large lot development. These areas are generally considered to be self-sustaining from a servicing point of view, although in special circumstances leachate from private sewage disposal systems may be a concern. Generally, the extent of impermeable area does not change significantly from the undeveloped to the developed state. Significant areas of grassed and natural vegetation can be maintained to mitigate any increase in runoff resulting from the construction of houses and driveways, and to maintain natural environment features.

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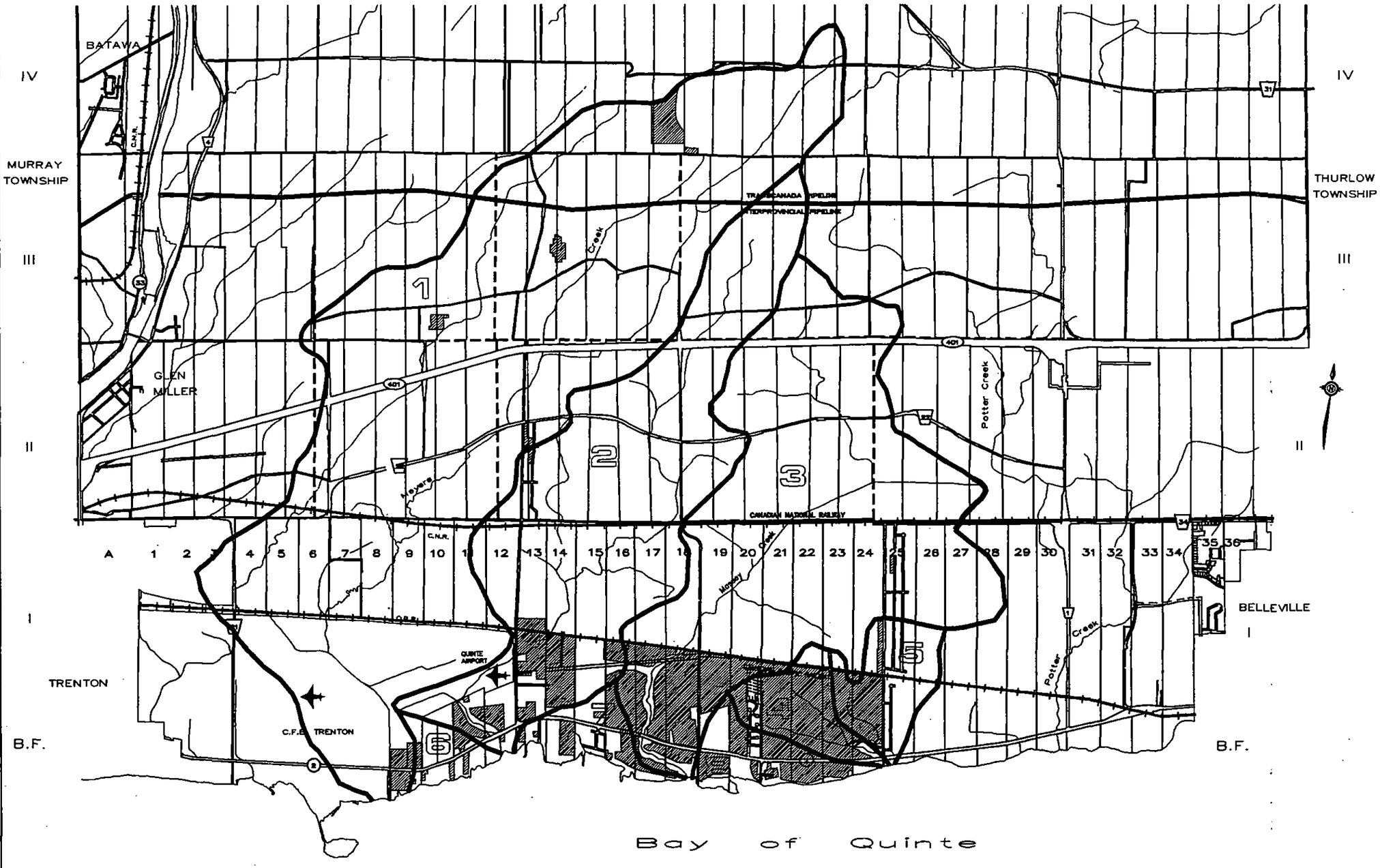

LEGEND

DEVELOPMENT OPPORTUNITIES

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LOWER TRENT REGION CONSERVATION AUTHORITY

TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

DEVELOPMENT OPPORTUNITIES

DRAWN BY:	CHECKED BY:	DATE:
F.B.	R.W.	SEPT 28/94
DESIGNED BY:	APPROVED BY:	PROJECT:
R.W.	R.W. & B.R.	24-14164-05
SCALE:	FIGURE No.:	
1:50000		4.1

ii) Small Lot Communally Serviced Residential

These areas are higher density residential development. This higher density results in more impermeable areas being established which results in higher rates and volumes of runoff. Increasing runoff generally effects the quality of the stormwater by introducing contaminants from impermeable areas, particularly parking areas, into the surface and groundwater. Increasing residential runoff can also cause increased erosion and result in a deterioration in the quality of water draining from areas which are developed in this manner.

Increased density often removes natural habitat and introduces levels of human activity which significantly alter natural patterns of use.

iii) Mobile Home Parks

The area along the Bay of Quinte has a number of mobile home parks. These areas of high density residential development have added significant impermeable areas. There is very little opportunity in these areas for any remedial action with regard to stormwater. Therefore, increased runoff and the introduction of contaminants, particularly from parking and roadway areas, effect water quality. In addition, the introduction of a significant number of residents relying on groundwater sources have caused concerns when these groundwater sources are threatened by other forms of groundwater contamination. Concerns have been raised about the ability of groundwater resources to handle communal servicing,

iv) Cluster and Strip Residential Development

There are limited areas of cluster and strip residential development in the watershed area. These areas are usually isolated and often surrounded by larger tracts of agriculture or vacant lands. These intervening land uses serve to mitigate any significant disturbances to the natural environment and minimize the impacts of increased runoff as a result of residential development in strips or clusters.

b) Commercial Development

The predominant form of commercial development throughout the watershed is highway related. These uses are usually automobile oriented and require large parking areas resulting in a significant portion of the lot area being covered with impermeable material. Anticipated results are increased velocities and volumes of runoff and often associated with these volumes of runoff are the introduction of contaminants from parking lot areas. Where these commercial uses are serviced by private sewage disposal systems, concerns have been expressed about the quality and capacity of older sewage disposal systems that were not subject to the stringent standards required today for new sewage disposal systems.

The large parking areas and their location along major transportation corridors often serve to accentuate the barrier to wildlife and other natural systems created by the transportation corridor.

c) Industrial

There are a limited number of industrial uses throughout the watershed, predominantly in the area south of the railway tracks. These industrial uses for the most part are storage and transport oriented uses which involve large parking areas. The implications from a stormwater point of view relate to increased runoff and the possible introduction of contamination either as a result of the servicing and storage of vehicles or the possibility of contamination as a result of spills resulting from the materials transported.

The large cleared areas devoted to storage and parking have often been created from natural areas.

d) Community Facilities

There are a number of community facilities scattered throughout the watershed area. The most significant of these is the school complex located in the Bayside area. For the most part, these community facilities are associated with large areas of grassed and natural vegetation. These larger areas of vegetation serve to reduce any increased volumes and velocities of runoff as well as any contaminants introduced as a result of the associated parking areas. Servicing for these community facilities, particularly where they accommodate large numbers of students, have possible implications with respect to introduction of contaminants into the surface water system and groundwater systems.

e) Department of National Defence, CFB Trenton

A substantial portion of the westerly watershed is impacted by the CFB Trenton Air Base. The stormwater management characteristics of this area have been significantly altered in order to insure the year-round, all-weather usage of the air strips. In addition to increased runoff volumes as a result of the extensive impermeable areas, there is also the possibility for spills of cargo, fuel and other materials used in the servicing of the aircraft.

f) Utilities

The Quinte Sanitation landfill site is the most significant utility located in the area with the largest apparent impact on natural communities. Other utilities include hydro, gas, telephone stations and distribution networks. Many of these sites contain potential contaminants if spills occur and migrate off site. This effluent migration could threaten the groundwater supplies and natural areas. Current standards for construction and monitoring significantly reduce this risk.

g) Agricultural

A band of good quality agricultural land exists north of the railway tracks on both sides of the Highway 401 corridor. Agricultural lands have potential stormwater drainage implications as a result of erosion plus the introduction of contaminants related to fertilizer and pesticide usage. The producers' groups have introduced an environmental farm plan program which encourages farm operators to develop an environmental audit and environmental farm plan for the use and management of their operation in such a way as to limit its implications on the environment. The land use survey distinguished between agricultural operations where animal husbandry was practised and where it was not. Where these operations are in close proximity to streams concerns for appropriate manure handling and storage and streambank protection may be raised.

h) Aggregate Operations

There are several licensed aggregate operations in the watersheds. They are generally of minor or limited nature. It is not expected that significant expansion of these operations will occur. Where these operations are conducted above the groundwater table, there is not anticipated to be any implication on stormwater drainage. Where groundwater is encountered, appropriate environmental techniques must be introduced in order to ensure that the aggregate removal will not impact on groundwater quality. Operation of aggregate extraction can serve to introduce certain contaminants into the area as a result of the equipment operation and the dust suppression chemicals used to make the area compatible with adjoining uses. Careful monitoring of these uses should limit the impacts on groundwater and the watershed.

i) Transportation Corridors

Significant impact to the watershed is often caused by the transportation corridors and their associated maintenance activities, particularly during winter sanding and salting operations. Also, transportation corridors involve a risk with regard to spillage of chemicals and materials transported. Emergency response techniques have been developed over the past several years which can monitor and manage these emergency situations. Transportation corridors still raise the risk of contamination, often in areas which are environmentally sensitive.

In the South Sidney watershed these corridors cross the natural flow of the watersheds and serve to disrupt or sever the riparian zones. This interferes with wildlife movement between important habitat zones.

j) Natural Areas

The watersheds have a number of natural areas. Identification of these natural areas and documentation of their contribution to the health of the watershed will serve to highlight their importance. The watershed plan will review methods of protecting, preserving and enhancing these characteristics.

4.2 Physiography and Bedrock Geology

The watershed area is divided into three physiographic areas. These are presented in Figure 4.2.

The extreme northern area is an elevated sand plain created as the result of wave and wind action during the era immediately after glaciation when the water in glacial Lake Iroquois (the precursor to Lake Ontario) was at a higher elevation. This sand plain is elevated and functions both as a source and recharge area for Meyers Creek and unnamed watercourse 2. This area has dramatic topographic variation and low potential for agriculture.

The area along the Highway 401 corridor is identified as a bevelled till plain. As part of the Peterborough Drumlin field, the till drumlins created by the glaciers' movement have been reworked by water and wave action. This has resulted in muted topographic variation and more gentle slopes as the valleys were partly filled with lacustrine deposits of sand and clay. The area has good farming opportunities with adequate drainage and fertile soils.

The shoreline area extending to the Canadian National Rail line is a flat clay plain. This area was scraped clear by the glaciers leaving the undulating limestone base. Fine soil materials settled in this area during the short lived glacial Lake Iroquois, leaving clay deposits of a shallow depth. This flat clay area has poor drainage that poses problems for development in this area. The underlying limestone deposit influences drainage and ground water movement much more in this area than in any other parts of the watersheds.

The immediate shoreline areas vary from steep back slopes to low shoreline areas. These areas and the areas along the stream valleys have been reworked by more recent action of water on the basic physiographic units described above.

The entire Study Area is underlain by a grey limestone with shaley interbeds and partings, deposited during the Middle Ordovician period. Generally the bedrock has been eroded to a southward sloping surface. An exposed bedrock knob is located immediately north of the Bayside Schools. This site has been used as a quarry. In addition, bedrock occurs at surface or shallow depth in the area of Aikens Road between the CN and CP rail lines. The bedrock has a greater influence on the drainage and water movement in these areas where it is close to the surface.

4.3 Soils

The deepest overburden depths above bedrock, over 30 metres, are found in the drumlinized upland area in the north part of the study area. Within the central Study Area the overburden thickness ranges from about 3 to 5 metres. In the southern portions of the Study Area overburden thickness is interpreted to exceed 7 metres except north of the Bayside Schools where exposed bedrock can be found.

According to the *Soil Survey of Hastings County* (Gillespie et al. 1962), the sandy and clay loam soils of the study watersheds subdivide the Study Area watersheds into two major

Township of Sidney

LEGEND

- SAND PLAIN
- BEVELLED TILL PLAIN
- LIMESTONE PLAIN
- DRUMLINIZED CLAY PLAIN

SOURCE:

CHAPMAN,L.J. AND D.F. PUTNAM 1984. THE PHYSIOGRAPHY OF SOUTHERN ONTARIO, ONTARIO GEOLOGICAL SURVEY, MAP 2226 1:253,440.

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LOWER TRENT REGION CONSERVATION AUTHORITY

TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

PHYSIOGRAPHIC FEATURES

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F.B.	R.W.	SEPT 28/94
DESIGNED BY:	APPROVED BY:	PROJECT:
R.W.	R.W. & B.R.	24-14164-05
SCALE: 1:50000	FIGURE No.: 4.2	

classifications which cover much of the area. Several other classifications are distributed to a much lesser extent. Soil types are illustrate on Figure 4.3.

Sandy loam soils are found in both the northern-most area and along the Bay of Quinte shoreline. These sandy loam soils represent a number of different soil series in the south including Berrien, Tioga, Wauseon, Bookton, Alliston and Granby types. The sandy loam soils in the north are members of the Bondhead series. These sandy loam soils have high infiltration rates when occurring in deep deposits as in the north. High infiltration will reduce runoff and result in lower flood flows but higher groundwater flows. These soils provide little protection for groundwater aquifers thus leaving the aquifers vulnerable to contamination. In the south these soils are often shallow and the drainage characteristics are determined by other factors.

Through the middle of the study watersheds, generally north of the Canadian Pacific Rail line and south of Highway No. 401, the major soil type ranges from clay loam to loam. The most common soil series is the Sidney Clay. Other clay soils include the Elmbrook series, South Bay series and Waupoos series. Clay loam soils include the Solmesville series and Waupoos series. Loam soils include Farmington series, Otonabee series and Bondhead series. These soils have much lower capacity for water transmission and thus infiltration and percolation. Higher runoff is likely, leading to greater stream flows. The loam type soils generally have the highest capability for agriculture. Deeper aquifers are protected from contamination. Site conditions are damper with less likelihood of droughtyness. Thus a higher biological diversity is possible and wet areas are more likely to develop. Topography tends to play an important role in site suitability. Low flat areas are more likely to experience high water tables either seasonally or year-round. With careful attention to drainage, development may be possible but some existing developments face a perennial drainage problem which can only be mediated through drainage onto adjacent lands.

4.4 Hydrogeology

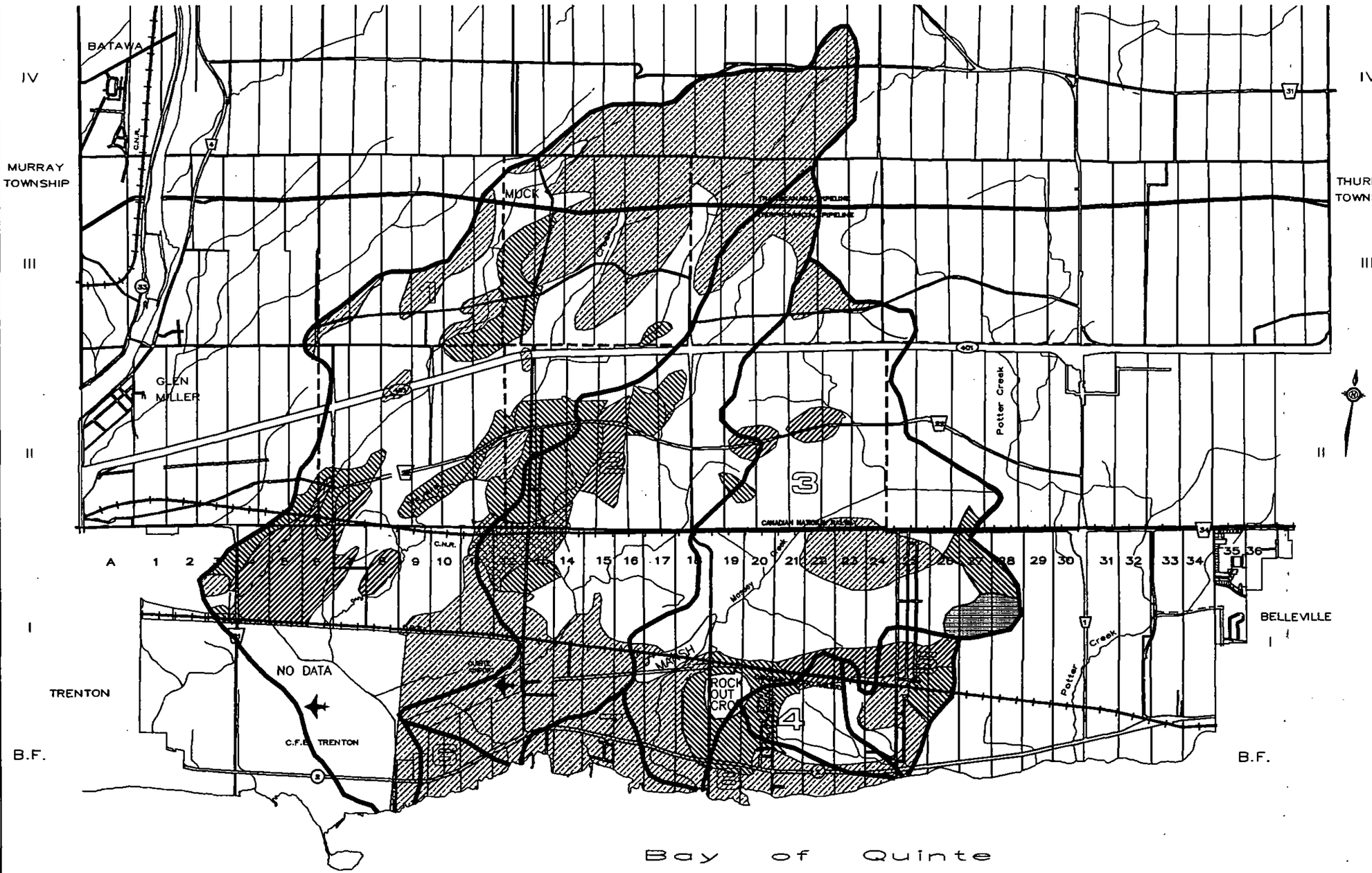
4.4.1 Overburden Aquifer

Within the Study Area most wells, whether bored or drilled, extend into the bedrock, essentially due to the limited thickness of the overburden.

Given the geologic conditions, reasonable potential for the successful establishment of wells exists only within Watershed 1 where the overburden exceeds 10 metres. Communal wells have been developed at the contact between the overburden and bedrock near the Montrose Subdivision. Because of the limited amount of deeper granular deposits, wells are unlikely to yield large volumes of water even though short-duration withdrawals may be high during the initial testing.

These overburden aquifers provide potable groundwater supplies, with elevated hardness. Some wells also have an elevated iron content.

Township of Sidney



LEGEND

- CLAY
- LOAM
- CLAY LOAM
- SANDY LOAM
- SILT LOAM
- GRAVELLY SAND

MODIFIED FROM : SOIL SURVEY OF HASTINGS COUNTY (GILLESPIE et al 1962)

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LOWER TRENT REGION CONSERVATION AUTHORITY

TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

MAJOR SOIL CLASSIFICATION

DRAWN BY: F.B.	CHECKED BY: R.W.	DATE: SEPT 28/94
DESIGNED BY: R.W.	APPROVED BY: R.W. & B.R.	PROJECT: 24-14164-05
SCALE: 1:50000	FIGURE No.: 4.3	

4.4.2 Bedrock Aquifer

The limestone bedrock is the principal groundwater source supplying more than 95 percent of the domestic and communal wells.

The bedrock is evenly fractured. The local fractures and bedding planes exhibit moderately low water-transmitting ability. The short-duration specific water transmitting capacities range from less than 0.1 to 60 litres/minute/metre with the mean being 2.6 litres/minute/metre. Within the confined aquifer system, the mean specific capacity equates to a relatively low transmissivity of about 0.5 m^2/day.

With the available drawdown generally exceeding 10 metres, the individual well yields reportedly average about 22 litres/minute and should adequately meet normal domestic demands. Yields exceeding 150 litres/minute have been reported for certain communal wells; however, such yields are typically based on short-duration testing and may not be perennially sustainable from the bedrock aquifer, based on the other well yield information and the limited recharge availability.

Dry wells have been sporadically reported through the central portion of the Study Area. This is likely due to the irregular fracture distribution in the bedrock. Dry wells are infrequent within the southerly area adjacent to and south of Highway No. 2. No specific area could be delineated where high-yield conditions are supported by the well records.

Groundwater is generally potable from drilled wells penetrating less than 15 metres of the underlying bedrock, and similar to that obtained from the overburden. However, groundwater containing elevated chloride and/or hydrogen sulphide gas is commonly reported in deeper wells. Consequently, water-supply wells are usually completed at shallow to intermediate depths.

4.4.3 Groundwater Movement

The groundwater moves southward in a direction perpendicular to the equipotential contours, and eventually discharges to the Bay of Quinte. Unusual conditions are indicated in the vicinity of Kenron Estates, where the groundwater movement is southwesterly, possibly due to the local fracture distribution.

The pressure change in the groundwater surface known as the lateral hydraulic gradient (illustrated by the contour spacing) gradually steepens near the Bay of Quinte. This indicates a large discharge of a regional groundwater flow system.

Most groundwater moves within the upper fractured interval of the limestone bedrock, This assumption is supported by the occurrence of mineralized water within the deeper bedrock. Even at the low lateral gradient, the groundwater movement may be relatively rapid, locally exceeding 20 metres/year. This is due to the low storage available in the bedrock fractures and the ease of movement in these fracture systems.

4.4.4 Groundwater Recharge/Baseflow

The fine-grained clay soils within the Study Area limit recharge to the underlying overburden and bedrock aquifers. This further limits the available groundwater to support base flows in the streams crossing the area.

Within the thinly veneered easterly catchment areas 3, 4 and 5, the groundwater contribution to stream flows may be similar to that monitored by Environment Canada in nearby creeks. If similar flows are applied to the easterly catchments, the low summer baseflow may range from less than 0.01 m^3/minute in Catchment 5 to about 0.1 m^3/minute in Catchment 3. These limited baseflows suggest that sustainable biological functions may be difficult within the easterly watercourses. Without surface contributions, these streams dry up during the summer.

Catchment areas 1 and 2 are interpreted to have higher groundwater recharge potential, as the catchments are underlain by thicker overburden sediments and locally veneered by granular sediments. The average annual baseflow is estimated to be about 2.8 m^3/day/ha. During the late summer months, the baseflow may decrease to about 0.25 m^3/day/ha.

Applying these flows to the westerly catchments, the low summer baseflow may range from about 0.20 m^3/minute in Catchment 2 to about 0.45 m^3/minute in Catchment 1. Minimal biological functions appear to be sustainable.

At an estimated infiltration of about 75 to 100 mm, the groundwater recharge may average about 14,000 m^3/day within the entire Study Area. At the interpreted lateral gradient and the mean bedrock-transmitting capacity, about one-tenth of the recharge contribution may directly outlet to the Bay of Quinte, with the remainder discharging to the local watercourses.

The capture area of existing communal-well systems must be extensive to balance the perennial groundwater withdrawals. For example, to sustain the average water demand of 300 m^3/day at Kenron Estates, the contributing groundwater catchment would be about 200 hectares at a 0.5 capture efficiency and an annual direct recharge of 100 mm. Due to the relatively-low bedrock transmissivity, several widely distributed wells are generally required to meet subdivision water demands. Seasonal water-supply deficiencies may be anticipated where subdivision/mobile homes production wells are closely spaced.

4.4.5 Contamination Potential

The overburden/bedrock aquifers are vulnerable to surface contamination sources, particularly within the thin-drift and/or extensively developed areas. As examples of this type of contamination, local sources indicate the former Quinte Sanitation landfill produced an extensive leachate plume that gradually spread toward communal groundwater sources. Similarly tile-bed effluent - which can cause elevated nitrates, has been a concern dependent on the overburden permeability/thickness, water-table proximity and groundwater underflow.

In the short term, the completion of the Municipal water supply will eliminate the concern with respect to vulnerable domestic water supplies. Longer term solutions include the provision of sanitary sewers and the control of leachate generation including proper capping of the landfill site. Additional local well-contamination potential exists in the residential subdivisions along White's Road north of the CN railway and in the strip development along roads within the upper catchment areas.

4.5 Climate

The watersheds of the South Sidney Study Area lie within the South Slopes climatic region which stretches from Kingston in the east to London in the west. It is characterized by an annual mean temperature of 7.5°C (45°F). The region experiences an annual mean precipitation between 80-85 cm (32-34 inches) and an annual growing season of between 200-210 days. Climatological differences in the South Sidney watersheds can be expected due to influences of local physiography, land use, and the nearshore effects of both Lake Ontario and the Bay of Quinte.

While long term recorded climate appears to be stable, short term fluctuations and events can cause significant environmental impacts.[2] These impacts can affect primary and secondary production, species composition in waterbodies, and agricultural outputs.

4.6 Hydrology

4.6.1 Introduction

This section of the report outlines the hydrologic and hydraulic analyses of the watershed which were undertaken for existing and proposed development conditions. Recommendations outlined herein deal with the stormwater management practices necessary to address the adverse impacts of development on the watershed and identify those areas which should remain undeveloped due to unacceptable risks from flooding and erosion.

4.6.2 Modelling Objectives

Agency Policy and Criteria

Stormwater management and floodplain management within the Province of Ontario are governed through the cooperation of a number of provincial and Municipal bodies. The relevant regulating agencies for the watersheds within the South Sidney area, and their respective interests are outlined below.

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[2] Sly, P. G. 1986, Review of post-glacial environmental changes and cultural impacts on the Bay of Quinte, p. 7-26 in C. K. Minns, D. A. Hurley, and K. H. Nicholls [ed.] Project Quinte: point source phosphorous control and ecosystem response in the Bay of Quinte, Lake Ontario. *Can. Spec. Publ. Fish. Aquat. Sci.* 86:270 p.

(i) MNR's objectives relate to the protection and conservation of valuable soil, aquatic resources, forest and wildlife resources as well as their biological foundations; the continuing availability of natural resources for the long-term benefit of the people of Ontario, present and future; the protection of natural heritage and biological features of provincial significance; and the protection of human life, the resource base and physical property from the threat of forest fires, floods and erosion.

(ii) The Lower Trent Region Conservation Authority (LTRCA) is responsible for the administration of the Fill, Construction and Alteration to Waterways Regulation which controls development and construction near watercourses in the interest of preventing risks from flooding and erosion. The Conservation Authority works in cooperation with the local Municipalities in controlling development within the floodplain.

(iii) The Township of Sidney plays a role in floodplain management and stormwater management through Official Plan land use designations and zoning regulations. Generally land uses are restricted within the floodplain and areas susceptible to severe erosion problems. Recent changes to the Planning Act (Bill 163) confer on Council the authority to regulate filling in any class of land (section 52). The Municipality also has the ability to establish and maintain drainage works under the Tile Drainage Act - usually in agricultural areas. In urban area the Municipality ultimately becomes responsible for the operation and maintenance of communal stormwater management facilities.

(iv) The Ontario Ministry of Energy and the Environment (MOEE) is responsible for the regulation of Municipal servicing, especially in regards to the health of the public and the environment and the delegation of private servicing review to the Health Unit. Therefore, they have an important role in the approval of proposed stormwater management facilities and stormwater services. The MOEE is a lead agency in the implementation of the Bay of Quinte RAP.

(v) The Ontario Ministry of Transportation (MTO) is responsible for the maintenance and operation of provincial highways and works with local Municipalities on transportation planning and construction activities. Their main influence with respect to stormwater management and drainage involves roadway crossings and the associated hydraulic design criteria.

The various stormwater management objectives, policies and criteria, constitute the measure against which proposed stormwater management practices are evaluated. The hydrologic and hydraulic models discussed herein offer a method of evaluation, and as such were developed to provide sufficient information for a comprehensive alternative evaluation process.

4.6.3 Hydrologic Modelling Overview

The hydrologic model used for this Study is QUALHYMO (Rowney, A. C. and Macrae, C. R. 1992), presently supported by the Technical University of Nova Scotia (TUNS). The model is a derivative of the original HYMO model developed in 1973 and the subsequent

OTTHYMO and INTERHYMO models. The model is developed primarily for the evaluation of stormwater management facilities, specifically ponds, and includes capabilities for continuous simulation and modelling of sediment and a single pollutant exhibiting first order decay.

The model has been utilized in this study to generate design flows from a number of design rainfall events and continuous flows from an hourly rainfall record spanning 6 years for the evaluation of proposed stormwater management facilities in the context of the "four bypass events rule". Every effort has been made to use the limited low flow data available from the *1986 Hydrogeological Monitoring Investigation Aikens Road Landfill* (1987), extreme flow data from local watersheds with similar hydrologic characteristics and Regional Frequency Analysis techniques to provide confidence in the modelled flows.

The design flows and continuous flows generated are utilized to develop floodlines for the existing and proposed development areas and for the evaluation of proposed stormwater management facilities.

Water Quality

Water quality parameters modelled include sediment and bacteria (*Escherichia coli*). The water quality modelling component of this Study attempts to attain an order of magnitude estimate of the potential delivery and removal of these parameters to assist in the evaluation of alternative stormwater management practices. Alternative stormwater management schemes were evaluated to assess their ability to meet the stormwater effluent targets established by the Quinte Remedial Action Plan.

Limited water quality data from the 1994 Aquatic Environment Assessment at CFB Trenton, 1985-86 Surface Water Investigations Aikens Road Landfill Site, 1993 Ground and Surface Water Monitoring Report for the Aikens Road Landfill as well as the TSH/Loyalist College sampling program for the study were utilized where possible for the development of the water quality modelling.

The potential for streambank erosion within the four main watercourses was also estimated under pre-development and post-development conditions. The erosion analysis has been based on typical soil characteristics and from channel cross-sections, modelled flows and modelled water levels.

The results of the hydrologic analysis as discussed in the following sections were used to evaluate the impact of the proposed development from an environmental and hydrologic perspective and to guide the selection of appropriate stormwater management practices. A more detailed discussion of the development of the hydrologic modelling parameters and their verification is included in the "South Sidney Watershed Plan - Hydrology Report" (Appendix A).

4.6.4 Event Modelling

The design flows generated for the major watercourses provided the basis for establishing regulatory floodlines and related regulations within the Secondary Planning area. Design flows are necessary to establish:

i) Risks to development from flooding, especially in areas adjacent to watercourses.

ii) The adequacy of existing hydraulic structures including culverts and bridges.

iii) Design criteria for new hydraulic structures or floodproofing where necessary.

iv) Development areas and appropriate grading of new development to maintain adequate freeboard.

The design flows within the Study Area were generated assuming a 12 hour Atmospheric Environment Services (AES) 30% distribution of design rainfall volumes from the Trenton Airport rain gauging station. Flows were computed at a number of points throughout the Study Area, as located on Plates 1 and 2 at the rear of this report.

Design flows for existing and proposed development conditions for the 2 year, 100 year and Regional floods are tabulated in Table 4.6.1. These flows are supported by the results of various Regional Frequency Analysis techniques as discussed in the Hydrology Report for this Study.

The proposed development does not significantly increase flows throughout the watershed. Although the proposed development will increase the runoff due to the increased impervious area, the development is concentrated within the lower reaches of the watershed. The accelerated peak flows from this area run off before peak flows from the upstream areas.

Control of runoff to reduce the increased flows may therefore not be feasible because the downstream area's runoff would have to be contained until the upstream flows have left the system. The volume requirements to achieve this effect would be prohibitive.

Floodlines generated from the design flows are discussed in more detail in Section 4.8.

4.6.5 Continuous Modelling

A continuous rainfall record was modelled to evaluate the impact of the proposed development on surface and baseflow runoff volumes, instream erosion potential and to evaluate the effectiveness of various stormwater management alternatives.

The rainfall record selected includes the years 1986 through 1991. This record was selected for a number of reasons:

TABLE 4.6.1
SUMMARY OF DESIGN FLOWS

Location*		2 Year		5 Year		10 Year		25 Year		50 Year		100 Year		Regional	
		Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)
Watercourse No. 1 @ Perimeter Road	(1A)	5.64	6.37	7.87	9.02	9.63	11.14	12.04	14.01	14.00	16.35	16.14	18.89	69.26	80.15
Watercourse No. 1 @ Hwy. No. 2	(1B)	5.78	6.48	8.05	9.19	9.86	11.35	12.32	14.27	14.33	16.67	16.52	19.24	72.48	83.27
Watercourse No. 2 @ CP Rail	(2A)	2.93	3.37	4.13	4.83	5.07	5.94	6.35	7.50	7.39	8.71	8.50	10.06	32.81	37.27
Watercourse No. 2 @ Whites Road	(2B)	2.98	3.47	4.18	4.96	5.14	6.12	6.44	7.72	7.49	8.99	8.63	10.36	34.27	39.36
Watercourse No. 2 @ Hwy. No. 2	(2C)	2.95	3.43	4.11	4.89	5.05	6.03	6.31	7.61	7.36	8.88	8.49	10.26	35.79	40.92
Watercourse No. 2 @ Bay of Quinte	(2D)	2.95	3.43	4.12	4.89	5.05	6.04	6.32	7.61	7.36	8.88	8.49	10.26	35.93	41.05
Watercourse No. 3 @ CN Rail near Montrose Rd.	(3A)	0.64	0.77	0.85	1.07	1.02	1.32	1.26	1.65	1.45	1.90	1.66	2.17	6.05	7.47
Watercourse No. 3 @ CP Rail	(3B)	4.36	4.71	6.15	6.84	7.49	8.41	9.22	10.52	10.68	12.19	12.20	14.02	47.47	52.74
Watercourse No. 3 between CP Rail and Hwy. No. 2	(3C)	4.38	4.70	6.15	6.82	7.47	8.37	9.19	10.46	10.64	12.12	12.14	13.96	48.27	53.76
Watercourse No. 3 @ Hwy. No. 2	(3D)	4.47	4.78	6.24	6.90	7.57	8.45	9.30	10.54	10.74	12.21	12.24	14.04	49.63	55.34
Watercourse No. 3 @ Bay of Quinte	(3E)	4.46	4.76	6.21	6.85	7.51	8.39	9.22	10.45	10.65	12.10	12.14	13.91	49.52	55.43
Watercourse No. 4 @ West End of Parkside Dr.	(4A)	0.96	1.11	1.34	1.51	1.62	1.81	2.00	2.20	2.28	2.49	2.59	2.80	10.26	10.77
Watercourse No. 4 @ Hwy. No. 2	(4B)	1.01	1.21	1.44	1.64	1.74	1.98	2.15	2.41	2.45	2.73	2.79	3.09	10.16	12.78
Watercourse No. 4 @ Bay of Quinte	(4C)	1.05	1.25	1.49	1.70	1.80	2.05	2.22	2.49	2.54	2.82	2.88	3.19	10.44	11.07
Montrose Rd. Crossing 300 m North of CP Rail	(5A)	0.36	0.36	0.49	0.50	0.58	0.59	0.71	0.72	0.80	0.81	0.90	0.91	3.36	3.40

Location*		2 Year		5 Year		10 Year		25 Year		50 Year		100 Year		Regional	
		Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)	Exist. Flow (cms)	Prop. Flow (cms)
Montrose Rd. Crossing @ Parkside Drive	(5B)	0.63	0.75	0.86	1.03	1.04	1.24	1.27	1.51	1.44	1.71	1.63	1.94	5.54	6.58
Outlet to Bay of Quinte 150 m East of Montrose Rd.	(5C)	0.81	0.95	1.11	1.30	1.34	1.56	1.64	1.90	1.86	2.16	2.11	2.44	7.32	8.49
Drain Outlet to Bay of Quinte West of Watercourse No. 2	(6A)	0.28	0.31	0.37	0.40	0.43	0.47	0.51	0.56	0.58	0.62	0.65	0.69	2.59	2.66
Drain Outlet to Bay of Quinte East of Watercourse No. 2	(7A)	0.14	0.14	0.18	0.18	0.20	0.20	0.24	0.24	0.26	0.26	0.29	0.29	0.98	0.98
Drain Outlet to Bay of Quinte East of Dorothy Dr.	(7B)	0.11	0.11	0.15	0.14	0.19	0.17	0.23	0.21	0.26	0.25	0.30	0.28	1.38	1.28
Hwy. No. 2 Crossing @ Main Entrance to Kenron Estates	(7C)	0.06	0.05	0.08	0.08	0.10	0.10	0.11	0.11	0.13	0.13	0.14	0.14	0.54	0.55
Hwy. No. 2 Crossing @ Bay Lea Dr.	(7D)	0.04	0.04	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.10	0.09	0.11	0.46	0.46
Drain Outlet to Bay of Quinte East of Bay Lea Dr.	(7E)	0.24	0.25	0.31	0.35	0.37	0.41	0.44	0.49	0.50	0.56	0.55	0.62	2.14	2.40
Hwy. No. 2 Crossing East of Whites Rd.	(7F)	0.13	0.20	0.17	0.25	0.20	0.30	0.24	0.35	0.27	0.39	0.30	0.43	1.12	1.45
Drain Outlet to Bay of Quinte West of Bay Lea Dr.	(7G)	0.19	0.25	0.25	0.33	0.29	0.39	0.38	0.46	0.39	0.51	0.44	0.57	1.61	1.86
Hwy. No. 2 Crossing West of Burns Ave.	(8A)	0.05	0.05	0.07	0.07	0.08	0.09	0.10	0.11	0.11	0.12	0.12	0.14	0.59	0.62
Hwy. No. 2 Crossing East of Bayside Secondary School	(8B)	0.18	0.23	0.26	0.30	0.31	0.36	0.37	0.43	0.42	0.48	0.43	0.54	1.97	2.06
Drain Outlet to Bay of Quinte East of Aikens Rd.	(8C)	0.22	0.30	0.29	0.39	0.34	0.46	0.41	0.55	0.47	0.61	0.52	0.68	2.11	2.45
Hwy. No. 2 Crossing East of Burns Ave.	(8D)	0.15	0.16	0.20	0.22	0.24	0.26	0.29	0.31	0.33	0.35	0.36	0.40	1.46	1.49
Drain Outlet to Bay of Quinte East of Frost Rd.	(8E)	0.19	0.21	0.26	0.28	0.31	0.33	0.37	0.40	0.42	0.45	0.47	0.50	1.74	1.83

* See Plates 1 and 2 of Hydrology Report for Flow Points (e.g. (1A))

i) A minimum of 6 years of data is considered necessary to evaluate the effectiveness of stormwater management facilities based on a maximum of four allowable exceedences during the bathing season;

ii) The chosen record includes years during which most of the background water quality data was collected;

iii) Rainfall volumes for the bathing season (June 1 - September 15) are relatively large in comparison to other years; and

iv) There are few missing data in the record.

Verification of the continuous model was attempted on the basis of baseflows and runoff volumes from flow records for Bloomfield Creek and Consecon Creek. A general agreement was obtained between the model and the measured flow volumes and baseflows for these hydrologically and climatologically similar watersheds, thereby providing support for the volume based modelling parameters.

The concurrence of the Regional Frequency Analysis based design flows and modelled design flows as noted in Section 4.6.4 supports the parameters which shape the runoff hydrograph and determine the peak flow.

This general agreement in volumes and peak flows was considered adequate verification of the hydrologic model in absence of any flow records within the Study Area.

A summary of runoff volumes for existing development and proposed development conditions is presented in the following table. The values shown are for the months of April through October, 1986 to 1991 inclusive. The winter months were not modelled in the continuous simulation due to a lack of existing data for model verification.

TABLE 4.6.2
SUMMARY OF RUNOFF VOLUMES
APRIL THROUGH OCTOBER - 1986-1991)

Watershed	Existing Development		Proposed Development	
	Surface Runoff	Baseflow Runoff	Surface Runoff	Baseflow Runoff
1.	6.05×10^6	1.69×10^7	6.80×10^6	1.65×10^7
2.	2.26×10^6	7.20×10^6	3.08×10^6	6.89×10^6
3.	3.11×10^6	8.16×10^6	4.08×10^6	7.72×10^5
4.	3.93×10^5	8.78×10^5	6.69×10^5	8.19×10^5
5.	4.01×10^5	7.55×10^5	5.24×10^5	7.21×10^5

The continuous modelling shows that the proposed development will increase surface runoff and reduce baseflow runoff. The change is more pronounced in watersheds 4 through 8 where the majority of the watershed is to be developed. The shift is a result of the increased impervious areas within the watershed which reduce the opportunity for groundwater recharge.

This trend is of concern especially within watersheds 1, 2 and 3 where fish and invertebrate habitat areas are dependent on baseflows for sustenance. Opportunities for maintaining groundwater recharge are therefore important in the identification of potential development areas and in the identification and evaluation of viable stormwater management alternatives.

4.6.6 Instream Erosion

Streambed erosion potential is typically a function of channel materials and the hydrologic regime of the watershed. As development proceeds the hydrologic response of the watershed changes and peak flows are increased at certain points throughout the watercourse. The increased flows can lead to new or increased erosion and flooding problems if left unaddressed.

Instream erosion potential was estimated at a number of sections throughout the Study Area under existing and proposed development conditions.

The erosion potential was estimated by establishing a critical shear stress, based on soil conditions, at which erosion of unprotected channel banks and streambeds may begin. The shear stress for a number of flow rates within each of the sections considered was established on the basis of the flow depth and energy slope of the flow profile. Where the shear stress associated with a given flow exceeds the critical value, a threshold flow rate was defined and input to the continuous model.

The duration of time that these threshold flows are exceeded during the continuous modelling period is summarized in Table 4.6.3 below.

TABLE 4.6.3
CRITICAL SHEAR STRESS EXCEEDANCE
(1986-1991 CONTINUOUS SIMULATION*)

Section No.	Critical Discharge (m^3/s)	Exceedence Duration and Associated Flood Frequency			
		Existing Development		Proposed Development	
		Exceedance Duration (Hrs.)	Approximate Flood Frequency of Critical Discharge	Exceedance Duration (Hrs.)	Approximately Flood Frequency Range (Yrs.)
1.006	Q>3.8	92	<2 Yr.	113	<2
1.038	Q>16.6	7	≈100 Yr.	8	≈50 Yr.
1.106	Q>25.0	0	>100 Yr,	0	>100 Yr.
2.026	Q>8.6	4	>100 Yr.	6	≈50 Yr.
2.0575	Q>25.0	0	>100 Yr.	0	>100 Yr.
2.0855	2.0<Q<10.0	52	<2 Yr. to >100 Yr.	64	<2 Yr. to 100 Yr.
2.139	Q>25.0	0	>100 Yr.	0	>100 Yr.
3.005	Q>0.5	1770	<2 Yr.	1758	<2 Yr.
3.08	Q>0.5	1706	<2 Yr.	1712	<2 Yr.
3.097	Q>5.7	13	2-5 Yr.	17	2-5 Yr.
3.148	Q>2.0	221	<2 Yr.	199	<2 Yr.
4.05	Q>25.0	0	>100 Yr.	0	>100 Yr.
4.33	Q>25.0	0	>100 Yr.	0	>100 Yr.

* April 1st through October 31st

The modelling results indicate that the proposed development does increase the duration of excess shear stress. Although this fact does not necessarily indicate an imminent erosion problem, especially where vegetation and coarse cobbles protect the streambank and bed, it does warrant the consideration of potential preventative measures.

Construction of quantity control facilities will generally reduce the duration of excess shear stress by providing some volume control and reducing the overall peak flow. This philosophy sometimes does not work, however, where the critical shear stress is relatively low. A stormwater management facility in this instance may prolong periods of excess shear by releasing flows during the recession of a larger flood in the receiving watercourse and prolonging an excess shear stress period.

Given the minimal increase in peak flows and excess shear periods with uncontrolled development, quantity control for the sake of instream erosion may not be necessary. The results presented herein should be used as a guideline for the design of proposed stormwater management facilities. An assessment of local erosion potential and existing erosion problems should be considered during the development of stormwater management plans for the individual development areas.

4.6.7 Water Quality Modelling

Stormwater management criteria for the Bay of Quinte is based on requirements to protect fisheries habitat as well as the body contact recreational areas. As such, water quality objectives have been established in the form of maximum concentrations for runoff from new developments. Maximum concentrations have been established for total suspended solids and *E. coli*.

Various sampling programs throughout the Study Area in the past have provided a number of water quality data for different parameters and dates. Unfortunately, very few of the data included TSS and none included *E. coli*. TSH and Loyalist College students also collected a number of samples during the Study to provide a better data base. Every effort was made to obtain a continuous sample over a significant storm event. No such event occurred during the bathing beach period, however, a relatively significant rainfall event occurred in the fall of 1994 and a continuous sample was taken. The flows at the sampling station were so small, however, that no accurate measurements could be obtained.

Therefore, there is no water quality data suitable for attempted verification or calibration of the water quality model. Derivation of water quality modelling parameters was based on typical literature values. Slight adjustments to the modelling parameters were made to ensure concentrations and loadings in the same order of magnitude as the sporadic samples.

Interpretation of the background water quality data and samples collected during the Study is presented in Section 4.8. Generally, previous studies have indicated that bacteria is a problem in various watercourses as is phosphorous. The bacteria loadings have been speculated to be originating from septic beds in the low lying development, and from agricultural activities upstream. The phosphorous is generally believed to originate from inadequate land management practices in the agricultural areas within the Study Area.

The water quality model was set up to best represent this situation without unjustly deviating too far from generally accepted empirical modelling parameters. A detailed discussion of the development of water quality modelling parameters is provided in the Hydrology Report. A summary of modelled loadings and mean concentrations for pre-development and post-development conditions is provided in Table 4.6.4.

TABLE 4.6.4
WATER QUALITY MODELLING SUMMARY

Location	Pre-Development				Post-Development			
	TSS		*E. Coli*		TSS		*E. Coli*	
	Mean (mg/l)	Loading (kg/Yr.)	Mean #/100 ml	Loading #/Yr.	Mean mg/l	Loading (kg/Yr.)	Mean #/100 ml	Loading #/Yr.
1. Watercourse #1 u/s CFB Trenton	4.62	1.63×10^4	11.5	4.05×10^{11}	5.84	2.09×10^4	11.5	4.19×10^{11}
2. Watercourse #1 Bay of Quinte	6.86	2.62×10^4	13.4	5.12×10^{11}	8.40	3.25×10^4	13.9	5.40×10^{11}
3. Watercourse #2 u/s CP Rail	5.91	7.61×10^3	6.3	8.13×10^{10}	7.80	1.02×10^4	6.5	8.51×10^{10}
4. Watercourse #2 Bay of Quinte	5.56	8.76×10^3	9.3	1.45×10^{11}	7.84	1.30×10^4	14.0	2.33×10^{11}
5. Watercourse #3 u/s CP Rail	7.56	1.24×10^4	8.2	1.34×10^{11}	9.69	1.60×10^4	8.1	1.35×10^{11}
6. Watercourse #3 Bay of Quinte	5.90	1.11×10^4	8.6	1.62×10^{11}	8.55	1.68×10^4	13.0	2.57×10^{11}
7. Watercourse #4 Bay of Quinte	9.97	2.11×10^3	8.6	1.83×10^{10}	18.20	3.57×10^3	31.4	6.15×10^{10}
8. Watercourse #5 Bay of Quinte	3.82	2.59×10^3	5.0	3.37×10^{10}	18.00	3.74×10^3	26.1	5.42×10^{10}

The modelling results show a considerable increase in both mean concentrations and loadings under post-development conditions. Mean concentrations in all cases are greater than the objectives set out by the Quinte Remedial Action Plan, thereby indicating the need for stormwater management facilities for proposed development areas.

4.7 Hydraulics

The hydraulic modelling component of this study provides the floodwater elevations within natural watercourses throughout the Study Area. The U.S. Army Corps of Engineers' Water Surface profile Model HEC-2 was utilized for this purpose. The model assumes uniform steady state flow within the watercourse and uses the standard step (energy and momentum) equations to predict upstream floodwater elevation based on downstream conditions.

Floodwater elevations were established for the 2, 5, 10, 25, 50 and 100 year and Regional design floods for existing and proposed development conditions. Floodlines for the 25 year and Regional design floods under proposed development conditions were plotted for the major watercourses within the Secondary Plan area as noted in Figure 1.1. These floodlines were

plotted on 1:2,000 scale topographic mapping and are available at the Lower Trent Region Conservation Authority on Plates 1 through 13.

The 25 year floodline serves to delineate the limit outside which any proposed stormwater management facility should be located. Development in general is restricted to areas outside the Regulatory floodline.

Overall, the floodlines throughout the Study Area in the major watercourses are relatively well confined below the abandoned railway embankment just south of the CP Rail. Upstream of this embankment, the land is relatively flat and low lying and is therefore subject to much greater flooding.

The west bank of Meyers Creek downstream of CFB Trenton is also an area of concern from a flooding perspective. The Regulatory (Regional) flood spills from the channel upstream of Highway 2. There is insufficient topographic information available to accurately define the limits of the spill or the ultimate outlet of the spill.

Generally, the major hydraulic crossing structures are adequately designed to convey pre-development or post-development flows without compromising the design criteria. The freeboard, vertical clearance and structure data for the various crossings is summarized in Table 4.7.1. As noted in the table, the only major structures which do not meet design requirements for hydraulic capacity are located on the Perimeter Road immediately downstream of Whites Road within CFB Trenton property.

4.8 Surface Water Quality

Investigations were conducted to document the existing water quality conditions in several watercourses and their associated watershed areas draining the South Sidney planning area from the winter of 1993 to the fall of 1994. This section relates the results of these water quality studies and provides recommendations for the long-term protection and enhancement of water quality in South Sidney and the Bay of Quinte. The results of the 1993-1994 sampling program are compared to data collected through water quality monitoring programs and special investigations undertaken by others in the watershed.

4.8.1 Objectives

The objectives of the Water Quality Study are as follows:

- to collect water samples from established sampling stations to obtain information on the quality of surface waters for spring runoff, summer base flow and a representative runoff producing storm event;

- to consider a variety of water quality parameters including nutrient and trace metals loading, dissolved oxygen levels, suspended solids concentrations and bacteria;

4.7.1

HYDRAULIC CAPACITY OF MAJOR STRUCTURES

Watercourse	Location	Type*	Size (m)	Road Class	Design Flood Yrs.	Freeboard (m)	Vertical Clearance (m)	Overtopping Flood (Yr.)
1	Hwy. 2 - Meyers Ck.	CBC	6.4 x 3.6	Arterial	50	1.95	1.40	—
1	u/s Hwy. 2 - Meyers Ck.	Twin CBC	2.5 x 2.1	Local	10	2.99	0.30	Regional
2	Hwy. 2	CBC	6.0 x 2.0	Arterial	50	2.42	0.60	Regional
2	Access to Mobile Home Park	Twin CSPs	2 m dia.	Local	10	1.68	0.68	Regional
2	u/s Access to Mobile Home Park	CSP	2.5 m dia.	Local	10	2.16	0.66	Regional
2	Perimeter Rd. (S)**	CSP	1.6 m dia.	Local	10	1.00	-0.40	25
2	Perimeter Rd. (N)**	CSP	1.8 m dia.	Local	10	1.63	-0.27	Regional
2	Whites Road	CSP	2.5 m dia.	Collector	25	1.57	0.47	Regional
3	Local Crossing u/s Bay	Twin CP	2.0 m dia.	Local	10	-0.13	-0.33	5
3	Local Crossing 2 u/s Bay	Bridge	4.73 x 1.1	Local	10	-0.42	-0.22	5
3	Local Crossing 3 u/s Bay	Bridge	2.9 x 1.2	Local	10	-0.40	-0.40	2
3	Local Crossing 4 u/s Bay	Bridge	Failure	Local	10	—	—	2
3	Local Crossing 5 u/s Bay	Twin CSPs	1.0 m dia. 1.4 m dia.	Local	10	-0.30	-0.30	2
3	Local Crossing d/s Hwy. 2	Bridge	2.4 x 1.3	Local	10	-0.30	-0.60	2
3	Hwy. 2	CBC	6.2 x 2.0	Arterial	50	1.64	0.54	Regional
4	Hwy. 2	CBC	4.8 x 1.7	Arterial	25	2.37	0.87	Regional

*CSP = Corrugated Steel Pipe
*CBC = Concrete Box Culvert
*CP = Concrete Pipe
**(S) = Southern Crossing
**(N) = Northern Crossing

- to compare data gathered with most recent Provincial Water Quality Objectives (PWQO) for the support of healthy aquatic communities (January 1994) and previous historical data where available;
- to provide recommendations based on data and analysis that will protect and enhance longer term water quality in South Sidney and the Bay of Quinte.

4.8.2 Sampling Methodology

Figure 4.4 illustrates the location of the sampling stations and the nature of the sampling conducted at each station. The water quality field program includes not only collection and analysis of surface water quality samples but also a sampling and assessment of benthic macroinvertebrates from permanent flowing sections of tributary watercourses. The invertebrate sampling program is discussed separately in Section 4.9.

As previously indicated, one of the objectives of the Watershed Planning exercise is to develop stormwater management alternatives which address the recommendations of the Bay of Quinte RAP. The RAP identified phosphorous loading as one of the most significant pollutant problems in the Bay of Quinte. Rural runoff has been identified as being among the most significant sources of phosphorous loadings.

As phosphorous loading is closely related to suspended sediment, sediment loads can be used to estimate phosphorous loadings. The QUALHYMO pollutant washoff modelling routine (see Section 4.6) was used to estimate the sediment delivery rate to the Bay of Quinte from the South Sidney watercourses.

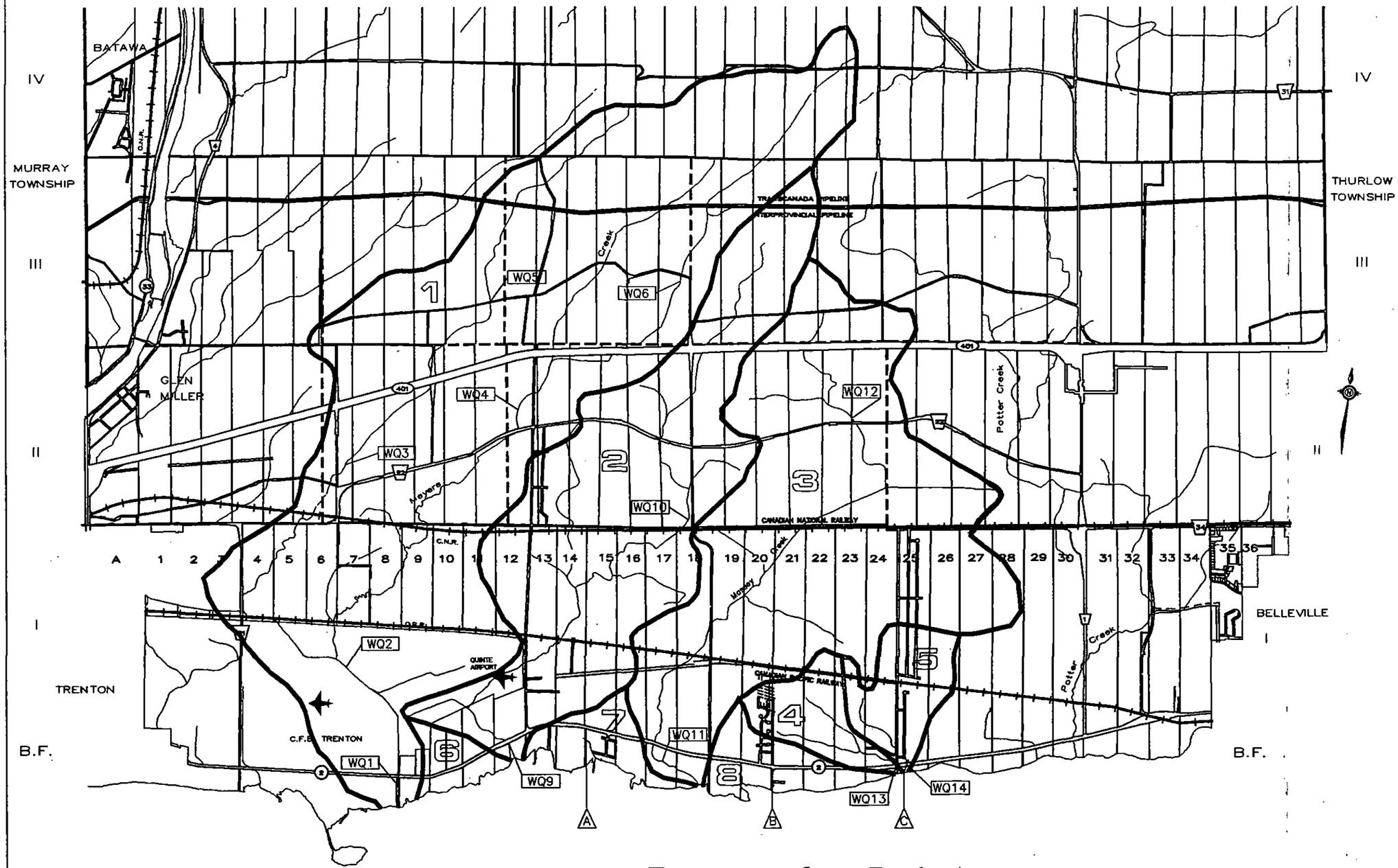
4.8.3 Sampling Results

General

Surface water quality sampling was conducted on March 29, 1994 and July 20, 1994. A continuous sampling event was conducted on October 19, 1994. During each sampling event surface water was collected for shipment to the Ministry of Environment and Energy laboratories in Kingston and Toronto.

The spring and summer sampling results can be found in Tables 4.8.1 and 4.8.2 respectively. The shaded cells indicate values that exceed Provincial Water Quality Objectives (PWQO)/Guidelines (PWQG) or other relevant guidelines (Canadian Water Quality Guidelines (CWQG)). Total phosphorous exceeds the PWQG at most stations in both the spring and summer. Total Kjeldhal nitrogen (TKN) exceeded CWQG at most stations in the spring and summer. Turbidity was high, in relation to other values obtained at the South Sidney sampling stations, at two stations on Meyers Creek (WQ 2 and WQ 3) in the summer and at catchment area 4 (WQB) in the spring. Metal parameters, Biological Oxygen Demand (BOD_5) and suspended solid levels are not available for the summer sampling event due to sampling problems. In addition, a sampling was undertaken at the unnamed catchment 2

Township of Sidney



LEGEND

WQ# SURFACE WATER QUALITY STATION

A FLOW PROPORTIONATE SAMPLING STATION

totten sims hubicki associates
ENGINEERS ARCHITECTS AND PLANNERS
513 Division St., P.O. Box 910, Cobourg, Ontario K9A 5G6

LOWER TRENT REGION CONSERVATION AUTHORITY

TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

SURFACE WATER QUALITY SAMPLING STATIONS

DRAWN BY:	CHECKED BY:	DATE:
F.B.	R.W.	SEPT 27/94
DESIGNED BY:	APPROVED BY:	PROJECT:
R.W.	R.W. & B.R.	24-14164-05
SCALE:	FIGURE No.:	
1:50000		4.4

watercourse and Massey Creek (WQ 10 and WQ 12) due to dry conditions during the summer period.

Bacterial levels exceeded provincial guidelines for swimming and bathing use at all stations during the summer sampling period. Levels were particularly high (> 1500 counts per 100 m*l*) for *E.coli* at Stations WQ 3, WQ 4, WQ 5, WQ 6, WQ 9 and for fecal *streptococcus* at all Stations except WQ 12. Based on existing documentation and field observations the results for the rural stations, WQ 3 - WQ 6, and the CFB Trenton station WQ 1 and WQ 2, can likely be attributed to agricultural sources (livestock) and improperly functioning septic systems upstream. The high levels at WQ 9 are possibly due to contamination from sewage lagoons and livestock upstream. The levels at WQ 11, WQ 12 and WQ 14 may also be due to upstream influences such as septic systems.

4.8.4 Spatial Comparisons

Comparisons were made between the various water quality stations to ascertain whether there are significant differences in water quality within the watersheds. Comparisons were made between the stations of Meyers Creek East and West Branches, and the stations upstream and downstream of the Aikens Road landfill.

Comparisons made between the upstream stations of Meyers Creek West and the mouth stations found significant differences in water quality, even over relatively short distances. In the spring sample, in general, there was better water quality upstream, though by the mid-reaches the water quality values declined somewhat, comparable to the outlet stations. The water quality data for the summer stations for West Meyers Creek showed no consistent trend. Each station was high in bacterial and nutrient parameters.

For the East stations of Meyers Creek the difference between the upstream and downstream stations was far more pronounced for the spring freshet sampling. Upstream stations (WQ 4 and WQ 6) were lower in all parameters as compared to those stations closer to the mouth (WQ 1 and WQ 2). The water quality appears to improve more rapidly as you go upstream in the East Branch. The summer water quality collection was far more variable. WQ 4 and 6 were high in alkalinity, conductivity, and *E. coli* whereas stations WQ 1 and 2 were higher in chloride, nitrate and nitrite. No obvious trends were noted in the data.

Stations upstream and downstream of the Aikens Road Landfill were also compared to see whether any trends were indicated. The results were mixed. The upstream station (WQ 10) was high in nitrates and nitrites, alkalinity, conductivity, and bacterial counts, while the downstream station (WQ 9) was higher in lead, TKN, phosphorous, turbidity, and suspended solids. The results for the other parameters were similar at both stations. No clear trend is apparent in the results. As no sampling was possible at WQ 10 for the summer collection, no comparison was possible at that time.

4.8.5 Comparison With Other Water Quality Data

The TSH obtained spring and summer data was compared with recent water quality data collected by others to ascertain trends over time. Comparisons were made with data gathered by Loyalist College students in the winter of 1994, data gathered as part of ground and

surface water monitoring of the Aiken's Road Landfill from 1985 through to 1993, and data gathered as part of an aquatic environment assessment of CFB Trenton, 1994. Comparative tables can be found in the Water Quality Report, Appendix B. The summary of results is presented here.

Loyalist College Data: Winter 1994

In the winter of 1994 students from Loyalist College in Belleville sampled water quality at Stations WQ 1, 2, 3, 4, 9, 10, 11, 12, 13 and 14 on February 23, March 16, March 23, March 29 and April 6, 1994. The Loyalist data is generally similar to the data from TSH's spring and summer samples. Like the TSH data, total phosphorous was high. Variable pH values for Station WQ 1 may be due to glycol from runoff at CFB Trenton.

CFB Trenton Data: 1993

As part of a study investigating the condition of the aquatic environment at CFB Trenton, Gartner Lee Limited sampled surface water at selected stations. One station, A-1, coincides with Station WQ 1. The TSH data was similar to that found in the 1993 CFB data. Phosphorous, Total Kjeldhal Nitrogen, and bacterial (*E. coli*) levels were high in both data sets indicating consistent trends over time. The Gartner Lee study found that the sewage treatment facility at CFB Trenton had total phosphorous levels in the effluent below provincial objective levels. From this data they concluded that high phosphorous levels were possibly derived from agricultural sources further up the watershed. Total Kjeldhal Nitrogen (ammonia and organic nitrogen) levels were attributed to use of urea on airport runways. Gartner Lee also suggested that bacterial contamination indicated by high levels of *E. coli*, were likely derived from inputs of fecal matter. The levels of bacterial contamination are probably due to animal waste and septic leakage entering the stream course further upstream.

Aiken's Road Landfill Data: 1985-1993

Three stations from TSH's sampling program are directly comparable with water quality stations sampled as part of the surface water quality monitoring program for the Aiken's Road Landfill by Gartner Lee from 1985-86 through to 1993. Stations QS50, 70 and 40 are directly comparable to TSH's sampling Stations WQ 9, 10 and 11 respectively on unnamed watercourse 2 and Massey Creek. Station QS50 (WQ 9) was not sampled later than 1986 so only a couple of years of data is comparable.

The TSH data for WQ 9 (QS50) for 1994 indicates similar conditions to that indicated in the Gartner Lee data (given mean $\pm$ 1 standard deviation) for most parameters. Mean levels were exceptionally high for lead and copper while well within acceptable levels in the TSH data. Gartner Lee attributed these high levels to automobile emissions along Highway 2 (Gartner Lee 1987). Also in contrast to the Gartner Lee data, which had elevated levels of chloride and alkalinity attributed to a leachate plume from the landfill, the TSH 1994 data did not show elevated values of these parameters.

Surface water quality sampling for QS70 (WQ 10) extends from 1985 through to 1994 (with the exception of 1993). The TSH data for WQ 10 (QS70) also indicates similar water quality conditions over the study period.

TABLE 4.8.1
WATER QUALITY RESULTS SPRING SURVEY - MARCH 29, 1994
SOUTH SIDNEY

Parameter	Station Number												Evaluation Criteria*
	1	2	3	4	5	6	9	10	11	12	13	14	
Copper µg/l	.87	.77	.64	<.50	<.50	<.50	1.0	.78	.95	.86	1.1	.82	5 µg/l[1]
Nickel µg/l	4.3	5.6	5.5	4.8	5.1	5.9	5.2	6.2	5.8	2.0	1.7	2.0	25 µg/l[1]
Lead µg/l	.29	.20	.10	.07	<.05	<.05	.22	.08	.17	.08	.30	.17	3 µg/l[1, 2]
Zinc µg/l	7.6	3.9	2.6	5.2	1.1	1.9	4.6	4.7	3.2	4.4	3.1	9.0	20 µg/l[1]
Unionized Ammonia mg/l	.003	<.001	<.001	<001	<.001	<.001	<.007	<.001	<.001	<.001	<.001	<.001	.02 mg/l[1]
Nitrite mg/l	.96	.14	.14	.004	.004	.004	.024	.18	.14	.3	.16	.12	1 mg/l[3]
Nitrate mg/l	1.54	1.19	1.45	.16	.24	.24	.72	1.22	1.17	1.75	1.18	.89	10 mg/l[3]
Total Kjeldhal Nitrogen mg/l	1.2	.9	.7	.4	.4	.3	.8	.5	.5	.6	1.0	.8	.1-.5 mg/l[3]
Total Phosphorus P mg/l	.04	.08	.04	<.04	<.04	<.04	.12	.04	.04	<.04	.04	<.04	.03 mg/l[4]
Turbidity NTUs	2	2.5	1	.6	.6	.45	2.1	.6	1.5	.6	8.0	1.8	[5]
Chloride mg/l	24	24.2	28.4	17.1	6.5	4.7	23.9	26.6	25.4	56.8	29.7	49.2	250 mg/l[6]
BOD_5 mg/l	5.6	1.2	.8	.9	.9	1.0	1.9	1.5	1.3	1	1.1	9	N/A
Suspended Solids mg/l	11	13	4	<1	1	<1	18	2	9	<1	16	7	N/A
pH	7.9	7.9	7.8	7.6	7.5	7.9	7.8	8.0	7.8	7.9	7.9	8.0	6.5-8.5
Alkalinity	209.8	208.3	202.5	197.2	192.8	213.6	183	215.1	174.8	228.9	179.8	208	30-500[7]
Conductivity	447	440	447	393	350	380	402	459	421	571	421	519	N/A
E. coli per 100 ml	10	10	<10	<10	10	<10	<10	50	30	<10	<10	60	100/100 ml[8]
Fecal strep per 100 ml	20	40	10	<10	30	20	20	60	10	10	90	30	100/100 ml[8]

Weather: overcast, windy, no precipitation

1. PWQO
2. PWQO dependent on alkalinity
3. CWQG
4. PWQG to prevent excessive plant growth in rivers and streams
5. Value compared with upstream and other locations in region
6. CWQG (maximum acceptable chloride concentration)
7. Range Value to CWQG
8. Based on recreational water quality guideline published by Ministry of Health

TABLE 4.8.2
PRELIMINARY WATER QUALITY RESULTS SUMMER SURVEY - JULY 20, 1994
SOUTH SIDNEY

Parameter	Station Number												Evaluation Criteria
	1	2	3	4	5	6	9	10	11	12	13	14	
Copper $\mu g/l$	N/A												5 $\mu g/l$[1]
Nickel $\mu g/l$													25 $\mu g/l$[1]
Lead $\mu g/l$													3 $\mu g/l$[1, 2]
Zinc $\mu g/l$													20 $\mu g/l$[1]
Ammonia mg/*l*	.002	.002	.003	.001	<.001	<.001	<.001	—	.002	—	.001	<.001	.02 mg/*l*[1]
Nitrite mg/*l*	.158	.011	.066	.023	.002	<.002	.065	—	.006	—	<.01	.061	1 mg/*l*[3]
Nitrate mg/*l*	1.84	.07	.34	.84	.06	<.02	2.6	—	.17	—	<.1	2.43	10 mg/*l*[3]
Total Kjeldhal Nitrogen mg/*l*	.8	.8	.91	.64	1.25	1.65	.94	—	.80	—	.90	.8.54	.1-.5 mg/*l*[3]
Total Phosphorus P mg/*l*	.02	.04	.086	.044	.18	.29	.072	—	.062	—	.084	.038	.03 mg/*l*[4]
Turbidity NTUs	2.5	6.3	8.4	3.4	4.9	2.0	1.2	—	4.0	—	.76	2.3	5 NTU[5]
Chloride mg/*l*	30.5	42.4	92.6	27.7	5.3	5.6	57.4	—	77.0	—	22.3	128.2	250 mg/*l*[6]
BOD_5 mg/*l*	N/A												
Suspended Solids mg/*l*													
pH	8.0	8.0	7.9	8.1	7.5	7.7	7.9	—	7.9	—	7.7	7.9	6.5-8.5
Alkalinity	177	145.6	237.2	248.1	234	280.2	181.0	—	314.5	—	104.1	283.3	30-500[7]
Conductivity	460	413	737	525	420	493	546	—	807	—	271	931	N/A
E. coli per 100 m*l*	490	390	>1500	>1500	>1500	>1500	>1500	—	370	—	30	400	100/100 m*l*[8]
Fecal strep per 100 m*l*	340	700	410	750	460	330	530	—	100	—	330	1600	100/100 m*l*[8]
Pseudomonas aeruginosa	10	<10	10	<10	10	<10	<10	—	<10	—	<10	<10	100/100 m*l*[8]

Weather: sunny, hot, humid

1. PWQO
2. PWQO dependent on alkalinity
3. CWQG
4. PWQG to prevent excessive plant growth in rivers and streams
5. Value compared with upstream and other locations in region
6. CWQG (maximum acceptable chloride concentration)
7. Range Value to CWQG
8. Based on recreational water quality guideline published by Ministry of Health

There is also a continuous record for QS40 (WQ 11) from 1985 through to 1994 (with the exception of 1986). The TSH data for WQ 11 indicates similar water quality conditions from 1983 through to 1994.

4.8.6 Flow Proportionate Event Sampling

Flow proportionate event sampling allows for determination of mass loadings conveyed via storm and runoff events to the Bay of Quinte. It is instrumental in assessing the relative importance of specific areas in the delivery of contaminants as well as determining the amount of contaminants delivered.

A continuous sampling procedure was attempted on October 19, 1994 during a fall storm event. The precipitation amounted to approximately 6.8 mm over several hours. Little rainfall had occurred throughout the summer and fall so it was expected that the first flush would contain elevated concentrations of contaminants. Originally, three sites were located at convenient culvert collection points immediately upstream of Highway 2. They were to be sampled every 30 minutes for approximately 2 hours in order to capture the first flush response and subsequent changes in concentrations and loadings. The sites were located within the South Sidney Secondary Planning Area to compare and contrast the concentrations of contaminants in urban stormwater with runoff from the rural parts of the Study Area from which earlier data had been collected. The three sites are located in Figure 4.4. At each sampling time additional measurements were taken to estimate flows to be used in the mass loading calculations.

Two of the original three stations were sampled. Unfortunately the limited precipitation did not generate surface runoff at Station B (located at Burns Avenue). Throughout the sampling period, no flows were observed. Samples were taken at Stations A (Kenron Estates) and C (Montrose Road) commencing at approximately 1 pm. Only 2 samples for each station were obtained. By the third sampling period flows were negligible. The first sample appears to have been equivalent to the peak flow generated by the brief rainfall event. The second sample indicates decreasing flows and discharges.

An interpretation of the results follows below.

Station A: Kenron Estates

The concentration and loading of contaminants during the monitored rainfall event can be found in Table 4.8.3. Due to a lack of adequate sampling, inferences with regard to patterns of solute concentrations or loadings must be made with caution. Depending upon the nature of the developed landscape different relationships between discharge, concentrations and loadings will be exhibited. Different patterns of solute behaviour result from different flow generation mechanisms.

The stormwater flows from Kenron Estates had elevated concentrations of *E. coli*, fecal *streptococcus*, total Kjeldhal nitrogen (TKN), phosphorous, suspended solids, and turbidity. In addition, the stormwater runoff had concentrations of various metals that exceeded

Provincial Water Quality Objectives (PWQOs) including: copper, zinc, cobalt, lead, iron, aluminum. All these parameters exceeded PWQOs in the second sample, with the exception of lead. In the second sampling period, however, most parameters, with the exception of calcium, magnesium, strontium, titanium, nitrite, phosphorus, TKN, turbidity, chloride and *P. aeruginosa* decreased in concentration. All loadings decreased by the second sample period.

The high metal concentrations at the Kenron Estates are likely due to the nature of development in the subwatershed. The Kenron Estates subwatershed is an urbanized area with a high impervious surface percentage (35%). Residues from cars, road sediments, and salts, are likely responsible for the high metal concentrations. This high impervious surface area also results in a quicker concentration time for both flows and the contaminants they transport. The drop in discharge, far more pronounced than from Station C at Montrose Road (see below), is a result of the small watershed area (7.1 ha) and its highly impervious nature. The predominate type of flow is overland surface flow. Characteristics of this type of flow include rapid increases in runoff once rain begins and reduction in flows once rain ends, a short time of concentration, and rapid flushing of contaminants. Declines in loadings for all parameters measured reflect this expected trend as contaminants are washed from the surface.

Station C: Montrose

The stormwater flows from the Montrose area had similar elevated levels of *E. coli*, fecal *streptococcus*, total Kjeldhal nitrogen (TKN), suspended solids, phosphorus and turbidity, as those from Kenron Estates. In terms of metals, the stormwater flows had elevated levels of zinc, cobalt, iron, aluminum, calcium and strontium. In the second sample period all concentrations and loadings dropped although zinc, aluminum, calcium and strontium concentrations remained high. Only the concentration of *E. coli* and chloride increased from the first sampling period to the next.

Station C (at Montrose culvert) was downstream of a much larger subwatershed area ($\sim$77 hectares) with a lower imperviousness ($\sim$12%). This results in a longer time of concentration for flows and contaminant loading. The lower percentage of impervious area combined with little antecedent rainfall in the month, resulting in more of the rainfall infiltrating. Therefore only the nearby impervious areas were contributing to flows at the station (i.e. road surfaces) which accounts for the high parameter concentrations and drops in loading as rainfall progressed.

The increase in *E. coli* concentrations may also be attributed to runoff from surface sources, and less probably to increases in septic system discharge as the storm proceeded. This is common for more urbanized areas.

TABLE 4.8.3
SOUTH SIDNEY FLOW PROPORTIONATE EVENT SAMPLING AT KENRON ESTATES
(STATION A)

Parameter	Sample 1 - Discharge 0.00006 (m^3/s)		Sample 2 - Discharge 7.8E-06 (m^3/s)	
	Concentration	Loading	Concentration	Loading
E. coli	> 1500		> 1500	
Fecal *strep*	> 1500		> 1500	
P. aeru.	12	7.2	22*	1.716
BOD	6	0	5	
SS	71	0	50	
TKN	1.35[1]	0.081	1.75*[1]	0.01365
Phosphorus	0.425[2]	0.0255	0.47*[2]	0.003666
Ammonia (un-ionized)	0.001	0.00006	0.001	7.8E-06
Nitrite	0.186	0.01116	0.24*	0.001872
Nitrate	0.31	0.0186	0.14	0.001092
Turbidity	80		49	
Conductivity	371		413*	
pH	7.8		7.6	
Chloride	45.6	2.736	51.7*	0.40326
Copper	0.014	0.00084	0.01	0.000078
Nickel	0.0023	0.000138	0.0012	9.4E-06
Zinc	0.041	0.00246	0.023	0.000179
Cadmium	0.0005	0.00003	0.0005	3.9E-06
Cobalt	0.001	0.00006	0.00063	4.9E-06
Chromium	0.011	0.00066	0.01	0.000078
Lead	0.0089	0.000534	0.0026	0.00002
Iron	0.84	0.0504	0.65	0.00507
Manganese	0.052	0.00312	0.32	0.00025
Aluminum	0.91	0.0546	0.68	0.005304
Calcium	33	1.98	34*	0.2652
Magnesium	3.1	0.186	3.5*	0.0273

Parameter	Sample 1 - Discharge 0.00006 (m^3/s)		Sample 2 - Discharge 7.8E-06 (m^3/s)	
	Concentration	Loading	Concentration	Loading
Vanadium	0.005	0.0003	0.005	0.000039
Molybdenum	0.001	0.00006	0.001	7.8E-06
Barium	0.035	0.0021	0.028	0.000218
Beryllium	0.0005	0.00003	0.0005	3.9E-06
Strontium	0.099	0.00594	0.11*	0.000858
Titanium	0.0091	0.000546	0.012*	0.000094

Note:
- Asterisk indicates increases in concentration during second sample period
- Shaded cells indicate values for exceedence of PWQO/PWQG/CWQG
- Concentrations are in mg/*l* except for *E. coli*, fecal strep, and *Pseudomonas aeruginosa* (per 100 m*l*)
- Loadings are in mg/s

[1] Exceeds Canada Water Quality Guideline
[2] Exceeds Provincial Water Quality Guideline for nuisance algae growth

TABLE 4.8.4
SOUTH SIDNEY FLOW PROPORTIONATE EVENT SAMPLING AT MONTROSE (STATION C)

Parameter	Sample 1 - Discharge 0.00063 (m^3/s)		Sample 2 - Discharge 0.00054 (m^3/s)	
	Concentration	Loading	Concentration	Loading
E. coli	160	1008	190*	1026*
Fecal *strep*	> 1500		> 1500	
P. aeru.	1	6.3	1	5.4
BOD	3		2	
SS	50		15	
TKN	0.52[1]	0.3276	0.26	0.1404
Phosphorus	0.178[2]	0.11214	0.136[2]	0.07344
Ammonia (un-ionized)	0.0006	0.000378	0.0006	0.000324
Nitrite	0.076	0.04788	0.082*	0.04428
Nitrate	1.92	1.2096	1.52	0.8208
Turbidity	6.2		2.9	
Conductivity	1053		1051	

Parameter	Sample 1 - Discharge 0.00063 (m^3/s)		Sample 2 - Discharge 0.00054 (m^3/s)	
	Concentration	Loading	Concentration	Loading
pH	8.4		8.4	
Chloride	147	92.61	152.4*	82.296
Copper	0.0039	0.002457	0.0023	0.001242
Nickel	0.0016	0.001008	0.0013	0.000702
Zinc	0.11	0.0693	0.017	0.00918
Cadmium	0.0005	0.000315	0.0005	0.00027
Cobalt	0.00075	0.000473	0.0005	0.00027
Chromium	0.0012	0.000756	0.00062	0.000335
Lead	0.0025	0.001575	0.001	0.00054
Iron	0.62	0.3906	0.25	0.135
Manganese	0.45	0.2835	0.08	0.0432
Aluminum	0.2	0.126	0.091	0.04914
Calcium	110	69.3	95	51.3
Magnesium	17	10.71	17	9.18
Vanadium	0.005	0.00315	0.005	0.0027
Molybdenum	0.001	0.00063	0.001	0.00054
Barium	.086	0.05418	0.065	0.0351
Beryllium	0.0005	0.000315	0.0005	0.00027
Strontium	0.29	0.1827	0.27	0.1458
Titanium	0.0019	0.001197	0.0021*	0.001134

Note:
- Asterisk indicates increases in concentration or loading during second sample period
- Shaded cells indicate values in exceedance of PWQO/PWQG or CWQG
- Concentrations are in mg/*l* except for *E. coli*, fecal *strep*, and *Pseudomonas aeruginosa* (per 100 m*l*)
- Loadings are in mg/s

[1] Exceeds Canada Water Quality Guideline
[2] Exceeds Provincial Water Quality Guideline for nuisance algae growth

4.8.7 Discussion

The water quality results from both the spring and summer sampling, as well as the flow proportionate sample results indicate some areas of concern within the South Sidney watercourses. First and foremost it should be noted that the 1994 water quality results did not differ to any great degree from previous quality sampling programs where previous data exists. This indicates that water quality has been for the most part consistent over the last few years (at least dating back to 1986). In general, the same parameters that were found to exceed Provincial Water Quality Objectives Guidelines in earlier years continue to exceed recommended maximum values.

The results of both TSH and other sampling indicate two quality regimes - that of the rural portions of the watersheds and that of the urban areas. The rural portions, where agriculture predominates, were consistently high in their delivery of nitrogen and phosphorus with occasional high levels of turbidity, in addition to *E. coli* during summer base flows.

The urban area, essentially that area corresponding with the Secondary Planning Area, produces runoff that contains high levels of metals (for example, zinc, cobalt, strontium) in addition to high phosphorus and bacteria levels. The metals are likely derived from residues from automobiles - gasoline and oil in particular.

The difference in urban and rural runoff, while not an unexpected result, can have repercussions for development of stormwater facilities under future development scenarios and development of strategies to reduce delivery of contaminants to the Bay of Quinte. Stormwater management techniques incorporated into new development in the Secondary Plan area can only address contaminant loadings generated locally. This may result in decreased metal loadings to the Bay of Quinte in the future; however, nutrient and bacterial loadings will continue to be high until upstream agricultural practices are modified, poorly functioning septic systems are repaired and the existing sewage lagoons are replaced or removed.

4.9 Benthic Invertebrate Sampling

4.9.1 Benthic Invertebrates as Indicators of Ecosystem Health

There are several reasons why invertebrates were chosen as indicators of ecosystem health, including:

- Invertebrates are found in all aquatic environments and can therefore be affected by environmental perturbations in aquatic systems;
- Invertebrates come in a large number and variety of taxa offering a wide spectrum of responses to environmental change. Some are more sensitive to stress while others are not;
- Invertebrates are essentially sedentary allowing for spatial analysis of environmental conditions;

- Invertebrates can have long life cycles of up to several years which allows for examination of effects over time; and finally,

- Invertebrates are easy to collect in most streams and wetland areas.

4.9.2 Measures of Ecosystem Health

Several measures were used in concert to assess benthic community health. For the South Sidney analysis the results were examined using species richness, total individuals, the Shannon-Wiener diversity index, indicator taxa approach, and the Bode's Index including the Hilsenhoff Biotic Index. These measures should supply enough information on the invertebrate community to determine its health (Kelly and Harwell 1990). A short description of each evaluation technique follows.

Total individual and taxa counts are frequently used to evaluate community health. As the count of both decreases it is generally assumed that water quality also decreases. However, the opposite condition is sometimes true, especially in the case of huge increases in certain pollution tolerant taxa e.g. chironomid larvae or tubificid worms. These measures are therefore best used in conjunction with several others.

The most widely used impact assessment technique is the Shannon-Wiener diversity index. It is a versatile index used in assessing the taxonomic diversity of a locale. It has the advantage of lending itself to statistical analysis due to its quantitative nature, and it remains dimensionless. It also does not require assumptions about sensitivities of species, often a criticism of indicator approaches (Reynoldson and Metcalfe-Smith 1992). The reduction of information to one number is also advantageous in its transferability to resource managers. This reduction of information, however, can make the index somewhat dubious as the sole method of assessing change in a community (Winget 1985). Since species specific information is lost, the actual health can be masked. Slight changes in taxonomic makeup may not be reflected in diversity changes. Hence, it is not always possible to equate diversity with either ecosystem health or damage (Metcalfe-Smith 1991).

The indicator taxa approach monitors selected taxa in a community (Kelly and Harwell 1990). An indicator is a species that has certain requirements with regard to a known set of physical or chemical factors such that changes in the presence, numbers, or behaviour can indicate a stressed environment outside preferred limits (Johnson et al. 1993). The presence of certain taxa indicates conditions of environmental stress or conversely, undisturbed conditions. For example, species of Plecoptera (stoneflies) indicate relatively clean water conditions typically associated with headwater areas, whereas an abundance of tubificid worms can indicate pollution-stressed communities (Cairns and Pratt 1993).

Bode's Index uses a variety of measures to give a single value for each station. It was originally designed for use in headwater, and second and third order streams which are normally cold water habitats. Included in the analysis are total individuals, total taxa (species richness), a count of taxa representing the pollution sensitive insect orders (Ephemeroptera, Plecoptera and Trichoptera, EPT), the Hilsenhoff Biotic Index using information on tolerance

to organic pollution for the taxa present, and the Shannon-Wiener diversity index. The derived values are then measured against 'standard' values to determine the health of the station. When applied to the Sidney Township streams which are warm water systems, the values it indicates tend to be generally in the fair to poor range, but nevertheless it provides a relative measure of stream water quality and hence the quality of fish habitat.

4.9.3 South Sidney Invertebrate Study Methodology

Two invertebrate collections were made in the South Sidney watersheds. A spring collection was made between May 30 and June 2, 1994. A summer collection was made between July 21 and July 25, 1994. Twelve stations were sampled in the spring. Due to dry conditions at some stations only nine of the original twelve were sampled in the summer. The location of all stations can be found on Figure 4.5.

Two replicate samples were taken per station per collection using a Surber sampler. The Surber sampler is the most appropriate sampling tool for benthic invertebrates in shallow streams. Each sample was field sorted using a series of decreasing mesh size sieves. Collected specimens were then preserved in Kahle's solution and retained for identification and enumeration by qualified TSH staff. Physical factors such as temperature, turbidity, current velocity and water depth at time of collection were noted. Invertebrate data sheets recording general habitat conditions at each sampling station can be found in the Appendix B: Water Quality Report.

The invertebrates collected were identified to order, family, and genus where possible. For each replicate sample total individuals, total taxa and the Shannon-Wiener Diversity Index (H') were calculated. EPT counts, total taxa per station, the Hilsenhoff Biotic Index and the Shannon-Wiener diversity index were also calculated per station using the pooled replicate samples.

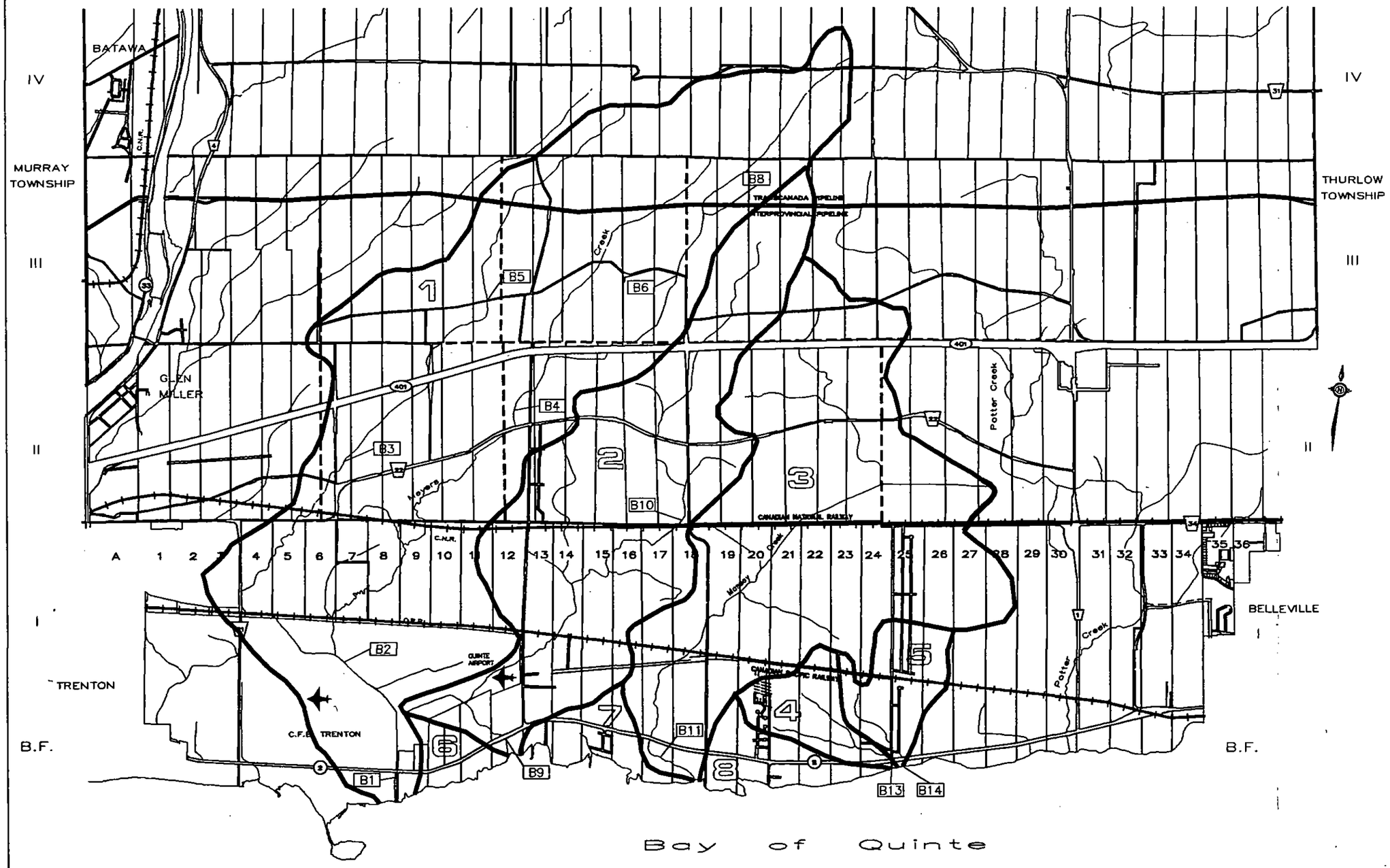
Analysis of data proceeded in two parts: characterization of stations per each collection, and comparison between collections (wherever possible). Relevant statistical procedures were employed where warranted to assess significance of results.

4.9.4 Results

The benthic invertebrate taxa list and number per sample, station, and collection can be found in Appendix B: Water Quality Report. The summary data from this report is presented here.

The spring and summer invertebrate collections were analyzed using Bode's Indices. The ranges for the indices and associated water quality values are presented in Table 4.9.1.

Township of Sidney



LEGEND

B# BENTHIC INVERTEBRATE STATION

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LOWER TRENT REGION CONSERVATION AUTHORITY

TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

BENTHIC INVERTEBRATE SAMPLING STATIONS

DRAWN BY:	CHECKED BY:	DATE:
F.B.	R.W.	SEPT 27/94
DESIGNED BY:	APPROVED BY:	PROJECT:
R.W.	R.W. & B.R.	24-14164-05
SCALE:	FIGURE No.:	
1:50000		4.5

TABLE 4.9.1
RANGES FOR INDICES AND ASSOCIATED WATER QUALITY VALUES
(from Bode 1988)

Water Quality	HBI	EPT Count	Richness	Shannon-Wiener Diversity
Excellent (non-impacted)	0-3.5	>10	>26	>4
Very Good	3.5-4.5			
Good (slightly impacted)	4.5-5.5	6-10	19-26	3-4
Fair	5.5-7.0			
Poor (moderately impacted)	7.0-8.5	2-5	11-18	2-3
Very Poor (severely impacted)	8.5-10.0	0-1	0-10	<2

Parameters such as the total number of taxa and the number of species of Ephemeroptera, Plecoptera, and Trichoptera (EPT), should increase from mouth to headwaters. In addition, taxonomic diversity as measured by the Shannon Diversity Index within a good quality stream should reach a maximum near the mid-reaches tailing off slightly in the headwaters (Vannote et al. 1980). This is due primarily to the greater level of thermal and substrate heterogeneity found in these areas. A stream with this diversity pattern would indicate some semblance of a healthy ecosystem. Alternative patterns could be indicative of stressed conditions within watercourses. The size of a watershed, and hence the size of the stream flowing from it, can be a factor in determining the level of invertebrate diversity. For example, a sample station in a stream outletting from a small watershed (e.g. catchments 4 and 5) should exhibit similar diversity to that of a station within the mid-reaches of a larger watershed. This is due to factors such as water velocity, water depth, temperature, discharge and spatial heterogeneity. Stressed small watersheds, regardless of their size, would exhibit similar ranges of invertebrate diversity at their mouths to those of larger watershed outlet stations. The analysis and interpretation were made with respect to these concepts of stream ecology.

The results of Bode's assessment for all stations in the South Sidney spring collection are shown in Table 4.9.2.

TABLE 4.9.2
RESULTS OF BODE ANALYSIS FOR SPRING COLLECTION OF INVERTEBRATE
SOUTH SIDNEY

Station No.	Total Individual	EPT (Rating)	Richness (Rating)	Diversity (Rating)	Hilsenhoff Biotic Index (Rating)
B1	274	2 (poor)	11 (poor)	0.83 (very poor)	5.88 (fair)
B2	207	3 (poor)	15 (poor)	1.76 (very poor)	6.07 (fair)
B3	125	5 (poor)	16 (poor)	2.14 (poor)	5.94 (fair)
B4	122	6 (good)	25 (good)	2.69 (poor)	5.93 (fair)
B5	54	3 (poor)	15 (poor)	2.43 (poor)	6.09 (fair)
B6	123	7 (good)	24 (good)	2.68 (poor)	4.23 (good)
B8	184	1 (very poor)	11 (poor)	1.08 (very poor)	7.35 (poor)
B9	125	2 (poor)	14 (poor)	1.80 (very poor)	5.98 (fair)
B10	155	5 (poor)	14 (poor)	1.62 (very poor)	5.43 (good)
B11	128	3 (poor)	19 (good)	2.10 (poor)	6.08 (fair)
B13	131	3 (poor)	16 (poor)	2.24 (poor)	5.73 (fair)
B14	320	0 (very poor)	9 (very poor)	1.18 (very poor)	7.47 (poor)

In general, all stations within the Study Area in the spring sample exhibited poor to fair water quality ratings when evaluated in this manner. Comparisons between stations were made on a watershed by watershed basis. In all, four comparisons were made, between:

- stations in the Meyers Creek-West Branch;
- stations in the Meyers Creek-East Branch;
- stations in Watershed 2, and;
- stations located at the mouths of the Study Area watersheds.

In determining the type of pattern the invertebrate diversities follow in the South Sidney watersheds, benthic stations were compared by use of an Analysis of Variance (ANOVA) statistical test. An ANOVA comparison is used to compare the variability of several samples at once. The test utilizes the original replicate diversity values setting up a matrix whereby the effects of a variable, in this case, location, can be tested. Essentially, it answers the question are there one or more significant differences in invertebrate diversity values over the watershed? (or between the watersheds?) If the differences are not statistically significant the diversity values are essentially the same. Calculations for the ANOVA tables followed standard statistical procedures (see Kvanli 1988). The ANOVA tables can be found in Appendix B: Water Quality Report. The results of the analysis are presented here in text form.

For the Meyers Creek West Branch (Stations B1, B2, B3, and B5) all Bode Index parameters, with the exception of the Hilsenhoff Biotic Index, which remained relatively constant throughout, increases from mouth to headwaters. The increase in species diversity and EPT rating likely reflects increases in substrate heterogeneity, riparian cover, and food sources upstream. The Shannon-Wiener diversity values indicate that while there is a trend towards increasing diversity upstream in the watershed, the trend is not statistically significant meaning that the diversity values are, for all intents and purposes, the same throughout the watershed. Dominance by large numbers of chironomid (midge) larvae, a tolerant taxa, indicates stressed conditions in the lower watershed (B1 and B2), whereas the presence of ephemeropteran (mayfly) and plecopteran (stonefly) species, stress intolerant taxa, in the upper reaches (B3) indicates better quality conditions.

For the Meyers Creek East Branch (Stations B1, B2, B4, B6 and B8) all parameters increased moving upstream, with the exception of the Biotic Index. The trend towards increasing diversity further up the watershed has been determined to be statistically significant, Station 8 notwithstanding. Station B8 is an anomaly and requires some explanation. As a headwater station, it should have slightly less diversity and richness then the mid-reach stations due to thermal homogeneity; however, it has considerably fewer species and a correspondingly much poorer diversity than would be expected. This is likely due to recent (<2 years) beaver activity upstream of the station which creates conditions immediately downstream that are more akin to lower reaches, such as the mouth of a stream, than to headwaters areas. This is due to organic enrichment and thermal alterations. Organic enrichment usually results in a high Biotic Index value for a station. Organisms downstream of this beaver dam would be organically tolerant. This is exactly what is found at Station B8. The effects of the beaver dam on the invertebrate community, however, tend to be localized. By Station B6, the community reverts to one characteristic of headwaters reaches. The east branch of Meyers Creek follows, more typically than its poorer quality west branch, a pattern indicative of better quality streams.

The stations of the unnamed watershed 2 creek system (B9 and B10) do not differ in any great degree in terms of water quality. Station B9 has a slightly poorer water quality as indicated by the poor number of EPT taxa and the poorer Biotic Index value. The diversity values, however, were similar. In general, diversity values for invertebrates between a mouth station and a mid-reach station should differ. The results could be indicative of stressed or disturbed conditions.

No comparison of downstream versus headwaters was possible in this Study. The upstream station established for this purpose was dry through the evaluation period.

A comparison of the outlet (mouth) stations of each watershed included comparison of Stations B1, B9, B11, B13, and B14. Taxa from Stations B13 and B14 (relatively small catchments) are indicative of more marsh type conditions. Both streamlets, though small, contain abundant algae and aquatic vegetation. The parameters for the stations were markedly similar with all values indicating poor water quality. The diversity values were not significantly different and therefore the diversities were considered the same. This indicates

some significant disturbances resulting in some alteration of habitat conditions at Stations B13 and B14.

Overall, the results of the spring invertebrate collection indicated that there is poor to fair water quality in the South Sidney watersheds. The analysis suggests that all watersheds are stressed to varying degrees. Based on in-watershed comparisons, the east branch of Meyers Creek is in a better condition than that of the west branch. Of note in the headwater regions of the west branch of Meyers Creek there were areas where cattle were allowed uncontrolled access to the creek. This can result in higher organic enrichment and lower water quality. In the lower reaches of the watershed, Meyers Creek flows through more urbanized areas and the C.F.B Trenton Air Base. Runoff from these areas contribute to the poor diversity and water quality ratings found here.

The summer invertebrate collection sampled only 9 of the original 12 stations. This was due to lack of water at Stations B10 in Watershed 2, B11 in the Massey Creek watershed, and B13 in Watershed 4. The results of the Bode analysis for the summer stations can be found below in Table 4.9.3.

TABLE 4.9.3
RESULTS OF BODE ANALYSIS FOR SUMMER INVERTEBRATE COLLECTION SOUTH SIDNEY

Station No.	Total Individuals	EPT (Rating)	Richness (Rating)	Diversity (Rating)	Hilsenhoff Biotic Index (Rating)	Water Quality (Relative to Spring)
B1	317	3 (poor)	16 (poor)	1.41 (very poor)	6.08 (fair)	Up marginally
B2	243	3 (poor)	18 (poor)	2.15 (poor)	5.80 (fair)	Up
B3	381	2 (poor)	14 (poor)	0.96 (very poor)	5.95 (fair)	Down
B4	155	4 (poor)	19 (good)	1.87 (very poor)	7.13 (poor)	Down
B5	51	0 (very poor)	8 (very poor)	1.57 (very poor)	6.10 (fair)	Down
B6	69	3 (poor)	18 (poor)	2.54 (poor)	6.00 (fair)	Down
B8	59	2 (poor)	15 (poor)	2.28 (poor)	5.54 (fair)	Up
B9	174	3 (poor)	22 (good)	2.36 (poor)	5.81 (fair)	Up
B14	288	1 (very poor)	15 (poor)	1.21 (very poor)	7.39 (poor)	same

The results, as in the spring sample, indicate fair to poor water quality conditions throughout the South Sidney watersheds. Comparisons similar to those undertaken with the spring collection were made where possible. It was not possible to compare the stations of Watershed 2 (B9 and B10) due to dry conditions at B10. Similarly, the comparison of the mouth stations had to exclude Watersheds 3 (B11) and 4 (B13) for the same reason.

The summer collection had roughly similar results to the spring collection. While approximately four of the stations were up in terms of overall water quality, an equal number were down, with one being about the same. No widespread improvement/decrease in water quality was evident. There were, however, localized changes in water quality.

The water quality at stations of Meyers Creek west branch improved in the lower reaches but decreased in the upper reaches probably due to organic enrichment and reduction of suitable habitat due to low flow conditions. Station B1 and B2's improvement is probably due to increases of in-stream food resources for invertebrates coupled with decreases in runoff of urban contaminants into the stream. Further upstream, however, invertebrate diversities decreased. Drops in water depth, velocity, increases in water temperature and decrease in spatial heterogeneity were the likely causes. Increased silt deposition was noted at B3. Organisms tolerant of such conditions flourished.

The Meyers Creek east branch likewise experienced some changes in water quality. Stations B1 and B2 have improved whereas Stations B4, and B6 have worsened. Station B8 also improved in water quality although it is still considered poor. These changes could be due to an increase in the proportion of ground water contribution in the headwaters during the summer months. The water pooled behind the beaver dam, mostly from spring runoff, has lowered and remained so due to low summer precipitation. Statistical comparison of station diversities found that there were no significant differences among the stations. Changes at the top and the bottom of the watershed in terms of decreased water contribution has resulted in the alteration of the east branch's overall water quality regime in the summer months.

The summer results for the Study Area outlet stations indicate a slight improvement in water quality for B1. Station B9 likewise had an improvement whereas Station B14 remained the same. Again, the species present at B14 were indicative of marshy conditions with abundant in-stream algae. Station B9's improvement is possibly due to moderate increases in algal abundance and reduction in runoff influence from Highway 2. The change, however, is moderate and could be within the range of natural variation. Statistical analysis for the three stations found no significant differences between the stations in terms of diversity, again suggesting stressed conditions in the small catchment of Station B14.

4.9.5 Discussion

Benthic invertebrates perform a wide variety of functions within streams including nutrient cycling, organic processing, and sources of food for fish populations. Their distribution is predominately determined by current velocity, substrate heterogeneity, water temperature, nutrient and metal loads, and organic food sources (Schlosser and Ebel 1989). As a result, some temporal variation in invertebrate abundance can be attributed to natural cycles of temperature, supply of organic material, growth rate and development. Species diversity, however, should remain relatively constant throughout the year (Vannote et al. 1980).

This has some important ramifications for the assessment of water quality in streams in South Sidney. Natural fluctuations of invertebrate populations are exacerbated by anthropogenic impacts such as reduction of baseflow through interruption of hydrologic cycle, increased

runoff, erosion and sedimentation during rain events, channelization of watercourses, and reduction of organic detrital inputs through removal of riparian vegetation. The result is reduced invertebrate populations and diversities. For example, where there has been a reduction in area of coarse cobble and gravel within a riffle/run habitat due to siltation, there will be a decreased abundance and density of invertebrates. This is because fine substrates, such as silt and sand, are inherently unstable and generally support fewer invertebrates. Those that do remain flourish because they are tolerant of these conditions. Poor diversity and abundances of invertebrates in streams can also limit fish abundance and diversity. Excessive organic loading through fecal inputs from farm animals or from defective septic systems can stress invertebrate communities downstream and impact upon the suitability of fish habitat.

Establishment of improvements to water quality may include the application of some of the following measures:

- Riparian plantings stabilize banks reducing erosion and sediment and nutrient loadings. Riparian vegetation can act to mitigate the effects of lands uses on waterbodies. It can act as a filter for runoff, removing sediment, minerals, and excess nutrients such as nitrates, calcium, phosphorous and magnesium. Streambank vegetation also increases organic detrital inputs to the streamcourses. Organic detritus in the form of leaves, twigs, and branches can significantly alter in-stream habitat diversity especially substrate heterogeneity, as well as provide food resources for invertebrates.

- Canadian Forces Base Trenton has indicated a willingness to explore the possibility of naturalizing areas adjacent to Meyers Creek south of Highway 2 as part of an initiative to reduce gull habitat. (The seagulls are a significant hazard to aircraft). The naturalization would take the form of reintroduction of riparian vegetation.

- The reduction of fecal organic loads, especially from farm animals, as well as repair and maintenance of septic systems, is another means to improve water quality. The presence of large numbers of chironomid larvae often can indicate an over abundance of fecal loads in streams. Many organisms such as mayflies and stoneflies are extremely intolerant of excessive organic loads in streams. As these two groups of organisms are significant components of a salmonoid's diet, their presence can influence fish presence and abundance. The lack of these taxa in great numbers can indicate excessive organic loading.

- Effective stormwater treatment to remove sediment, nutrient and metal loadings will improve the quality of the water and hence the quality of the habitat for invertebrate species.

- As a further measure to help maintain and rehabilitate in-stream habitat for invertebrates and fish, and to improve water quality, there should be an effort to restore the natural meander pattern to channelized stream reaches wherever possible.

4.9.6 Comparison of Surface Water Data and Benthic Invertebrate Data

Because surface water quality data gives a snapshot in time, and benthic community sampling assesses the longer term trends in water quality, a direct comparison of the data sets must be made with caution. Similar trends are apparent in both the data sets for Meyers Creek only. For the spring collection the results of comparing the lower and upper reaches indicate that the upper reaches of the east branch has a slightly better water quality than that of the west branch. This is also apparent for the upper reaches in the water chemistry data. The summer data results do not indicate any consistent trend for Meyers Creek in either data set.

The stations upstream and downstream of the Aikens Road landfill did not show any consistent trend in terms of water chemistry or benthic data. No summer data was available for the stations due to dry conditions.

4.10 Fisheries and Aquatic Resources

4.10.1 Objectives

The purpose of the inventory and assessment program was to determine resident fish species and aquatic habitat quality in the Study Area in order to determine appropriate measures required to limit the impact of development on the habitat components.

The specific objectives of the inventory and habitat assessment are to:

- Document and provide an assessment of the existing significant aquatic habitats in the Study Area;
- Identify habitat types as per MNR *Fish Habitat Protection Guidelines for Developing Areas* (March 1994);
- Determine natural channel design parameters and classify watercourses using Rosgen Classification system (1994);
- Determine potential effects of development on the aquatic habitats and fish populations;
- Provide recommendations for the mitigation of any possible adverse effects caused by development.

4.10.2 Inventory and Assessment Methodology

Information compiled in the inventory and assessment was obtained using a variety of existing information sources, combined with field investigations. Data collected as a result of public input and contact with government agencies were incorporated into the report where appropriate.

It was necessary to conduct extensive field investigations to determine the existing conditions within the Study Area due to the lack of previously obtained data for these streams. This project represents an opportunity to establish a baseline data set for fish investigations. Detailed data sheets associated with these field investigations and used as reference material to the enclosed text may be found in Appendix C: Fisheries Inventory and Habitat Assessment document.

Aquatic Habitat Assessment and Fisheries Inventory

Investigations into the existing conditions of the aquatic environment focused primarily on a review of inhabiting fish species and benthic invertebrate communities at 7 representative stations throughout the Study Area. The station locations were selected following an initial site inspection December 8, 1993 and discussion with MNR on December 21, 1993.

Fish populations were initially sampled throughout the watershed in late May and early June and again in August of 1994. Stations 1, 2, 3, 4 and 8 are in Subwatershed 1, Meyers Creek. Station 9 is in Subwatershed 2, an unnamed creek, and Station 11 is in Subwatershed 3, locally known as Massey Creek. Because of the small watershed and stream sizes, no sampling was conducted in catchments 4 and 5. Fish capture was conducted using minnow traps, dip nets, and a back pack electrofisher. Figure 4.6 shows the location of stations within the watersheds.

Benthic Invertebrate Sampling

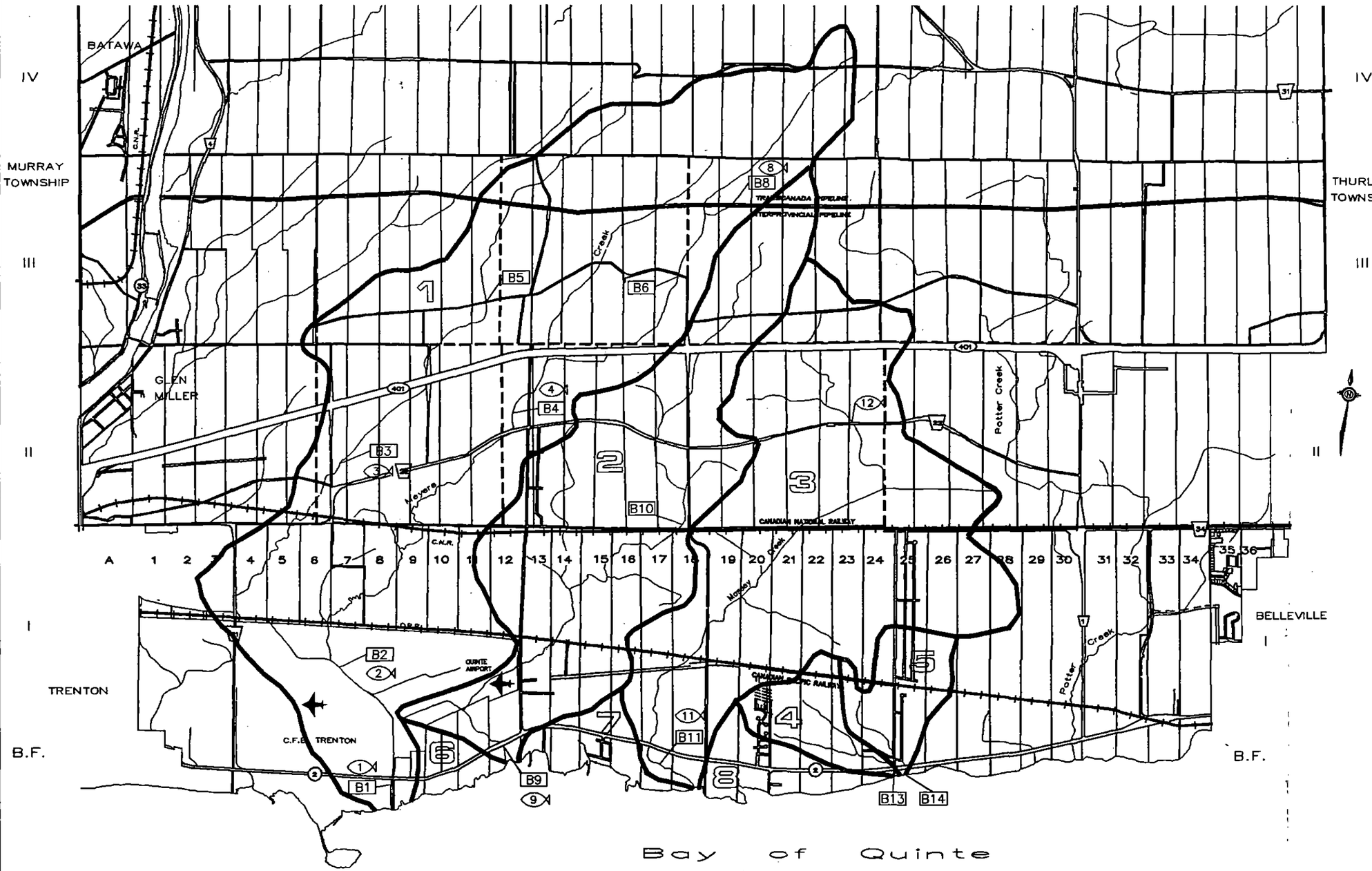
Aquatic invertebrates were sampled at selected sampling stations (see Figure 4.5) on two occasions, in late May/early June and late July of 1994. Replicate samples were collected at each station to permit application of a variety of biotic indices. A complete discussion of the invertebrate sampling methodology is contained in Section 4.9.

Habitat Assessments and Stream Classification

Assessments were completed at all fish sampling stations using accepted techniques and recorded on standard MNR stream assessment forms (Dodge 1987). A sketch was made of each station with notations identifying dominant aquatic macrophytes, substrate composition and surrounding fluvial geomorphological and terrain characteristics. Standard field tests of various water chemistry parameters including water and air temperatures, dissolved oxygen content, pH, alkalinity, total dissolved solids, conductivity and turbidity were also conducted at these sites.

Natural channel design parameters were determined using a combination of existing mapping, habitat assessments and hydrologic modelling. Streams were classified using Rosgen's Classification (Rosgen 1994).

Township of Sidney



LEGEND

B# BENTHIC INVERTEBRATE STATION

FISH INVENTORY AND HABITAT STATION

totten sims hubicki associates
ENGINEERS ARCHITECTS AND PLANNERS
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LOWER TRENT REGION CONSERVATION AUTHORITY

TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

AQUATIC HABITAT ASSESSMENT AND FISH INVENTORY STATIONS
Spring , Summer 1994

DRAWN BY: F.B.	CHECKED BY: R.W.	DATE: SEPT 28/94
DESIGNED BY: R.W.	APPROVED BY: R.W. & B.R.	PROJECT: 24-14164-05
SCALE: 1:50000	FIGURE No.: 4.6	

4.10.3 Field Investigation Results

Four visits to the Study Area were made for various fisheries related investigations. These visits were conducted April 12, May 30 to June 2, June 20, and August 26, 1994.

The purpose of the April 12 visit was to determine presence/absence of Rainbow Trout (*Oncorhynchus mykiss*) in the Study Area during the spring spawning period and note activities related to spawning of other species. Subsequent visits were undertaken to conduct full Aquatic Habitat Assessments and Fisheries Inventories.

Although Rainbow Trout were reported to spawn in the watercourses of the Study Area, none were observed. Spawning activity was limited to White Suckers (*Catastomus commersoni*) at Stations 1 and 2, and Stonecats (*Notierus flavus*) and Northern Pike (*Essox lucius*) at Station 11. No fish were observed at Station 9.

A Bay of Quinte 1994 Spawning Survey conducted on April 14, 1994 by Moira River Conservation Authority staff indicated the presence of Northern Pike in the wetland west of the outfall below Station 11, and in a pool at the outfall below Station 9. More detailed spawning observations from this survey are available in the Fisheries Inventory and Aquatic Habitat Assessment Report.

Tables 4.10.1 and 4.10.2 show the results of the fisheries inventories for the spring and summer samplings respectively. No species listed as threatened or vulnerable by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 1993) were identified in either survey.

TABLE 4.10.1
FISH CAPTURE SOUTH SIDNEY WATERSHED
MAY/JUNE, 1994

Sta. No.	Sub-watershed No.	Date	Common Name	Genus/Species	No. Caught
1	1	5/30/94	Central Mudminnow [1]	*Umbra limi*	6
			Northern Redbelly Dace	*Phoxinus eos*	1
			Spottail Shiner [2]	*Notropis hudsonius*	1
			Bluntnose Minnow	*Pimephales notatus*	1
			Blacknose Dace	*Rhinichthys atratulus*	2
			Brown Bullhead	*Ameiurus nebulosus*	19
			Banded Killifish	*Fundulus diaphanus*	1
			Rock Bass	*Ambloplites rupestris*	3
			Pumpkinseed Sunfish	*Lepomis gibbosus*	9
			Yellow Perch	*Perca flavescens*	1
			Log Perch [3]	*Percina caprodes*	1

Sta. No.	Sub-watershed No.	Date	Common Name	Genus/Species	No. Caught
2	1	6/20/94	Central Mudminnow	*U. limi*	22
			White Sucker	*Catastomis commersoni*	13
			Minnow	Cyprinidae	1
			Brassy Minnow	*Hybognathus hankinsoni*	1
			Bluntnose Minnow	*P. notatus*	16
			Fathead Minnow (1)	*Pimephales promelas*	3
			Blacknose Dace	*R. atratulus*	4
			Creek Chub	*Semotilus atromaculatus*	1
			Banded Killifish (2)	*F. diaphanus*	11
			Brook Stickleback	*Culaea inconstans*	2
3	1	6/20/94	Central Mudminnow	*U. limi*	5
			White Sucker	*C. commersoni*	43
			Northern Redbelly Dace	*P. eos*	1
			Common Shiner	*Luxilus cornutus*	5
			Bluntnose Minnow	*P. notatus*	35
			Blacknose Dace	*R. atratulus*	29
			Creek Chub	*S. stromaculatus*	17
			Pearl Dace	*Margariscus margarita*	20
			Brook Stickleback	*C. inconstans*	28
4	1	6/20/94	Central Mudminnow	*U. limi*	4
			White Sucker	*C. commersoni*	1
			Northern Redbelly Dace	*P. eos*	1
			Common Shiner	*L. cornutus*	1
			Bluntnose Minnow	*P. notatus*	1
			Blacknose Dace	*R. atratulus*	1
			Brook Stickleback	*C. inconstans*	1
8	1	6/2/94	Northern Redbelly Dace	*P. eos*	5
			Creek Chub	*S. atromaculatus*	2
			Brook Stickleback	*C. inconstans*	1
9	2	6/20/94	Central Mudminnow	*U. limi*	3
			White Sucker	*C. commersoni*	95
			Banded Killifish	*F. diaphanus*	1
11	3	6/20/94	Northern Pike	*Esox lucius*	7
			Central Mudminnow	*U. limi*	187
			White Sucker	*C. commersoni*	13
			Golden Shiner	*Notomigonus crysoleucas*	2
			Fathead Minnow	*P. promelas*	1
			Brook Stickleback	*C. inconstans*	9
			Pumpkinseed Sunfish	*L. gibbosus*	1
			Yellow Perch	*P. flavescens*	3

TABLE 4.10.2
FISH CAPTURE SOUTH SIDNEY WATERSHED
AUGUST, 1994

Sta. No.	Sub-watershed No.	Date	Common Name	Genus/Species	No. Caught
1	1	8/26/94	White Sucker	*Catostomus commersoni*	14
			Creek Chub	*Semotilus atromaculatus*	10
			Banded Killifish	*Fundulus diaphanus*	2
			Central Mudminnow	*Umbra limi*	1
			Blacknose Dace	*Rhinichthys atratulus*	1
			Common Shiner	*Luxilus cornutus*	4
			Bluntnose Dace	*Pimephales notatus*	4
			Largemouth Bass	*Micropterus salmoides*	1
			Yellow Perch	*Perca flavescens*	5
			Tessellated Darter	*Etheostoma olmstedi*	2
2	1	8/26/94	White Sucker	*C. commersoni*	1
			Common Shiner	*L. cornutus*	12
			Bluntnose Dace	*P. notatus*	41
			Fathead Minnow	*P. promelas*	20
			Blacknose Dace	*R. atratulus*	
			Banded Killifish	*F. diaphanus*	17
3	1	8/26/94	White Sucker	*C. commersoni*	12
			Bluntnose Dace	*P. notatus*	16
			Fathead Minnow	*P. promelas*	3
			Blacknose Dace	*R. atratulus*	1
			Creek Chub	*S. atromaculatus*	5
			Pearl Dace	*Margariscus margarita*	3
			Brook Stickleback	*Culaea inconstans*	1
4	1	8/26/94	White Sucker	*C. commersoni*	17
			Central Mudminnow	*U. limi*	29
			Brook Stickleback	*C. inconstans*	4
			Creek Chub	*S. atromaculatus*	10
			Northern Redbelly Dace	*Phoxinus eos*	7
			Brassy Minnow	*Hybognathus hankinsoni*	1
			Bluntnose Dace	*P. notatus*	2
			Blacknose Dace	*R. atratulus*	1
			Pearl Dace	*M. margarita*	1
8	1	8/26/94	No flow		
9	2	8/26/94	White Sucker	*C. commersoni*	16
			Creek Chub	*S. atromaculatus*	9
			Banded Killifish	*F. diaphanus*	1
11	—	—	No flow		

All watercourses in the Study Area are considered warm water streams. They are very productive in general, as noted by the large diversity of fish species and numbers captured during the field inventories. Base flows, although very modest, appear to be year-round, at

least at Subwatersheds 1 and 2. Twenty-two species of fish were captured at the 7 sampling stations, including 6 species considered sport fish.

The substrate is consistent throughout the three watercourses, beginning with fine sand in the headwater areas, grading to coarse sand and gravel travelling downstream. Once south of the CP Rail line the overburden lessens and the Creeks run on limestone bedrock with coarse sand, gravel and cobble as substrate.

Field water chemistry tests were also conducted with each survey, the results of which can be found in the Fisheries Inventory and Aquatic Habitat Assessment Report. Of interest to note are the high turbidity values found which may cause some stress to fish species. Dissolved oxygen and pH were within acceptable limits for warm water species.

Table 4.10.3 details the life history characteristics of the fish species captured in the Creeks of the South Sidney Watershed. As well as the temperature and habitat requirements listed, all fish present rely heavily on aquatic insect larvae and other benthos as diet items at some stage of their life cycle. Conditions suitable for the production of these invertebrate prey types, such as riffle areas, well aerated water, presence of leaf litter and other organic matter, and partial shading must be maintained in any future development.

TABLE 4.10.3
LIFE HISTORY CHARACTERISTICS OF FISH SPECIES CAPTURED IN CREEKS OF SOUTH SIDNEY TOWNSHIP

Yellow Perch	
Preferred Habitat	Open water of lakes with moderate vegetation, clear water, with muck to sand and gravel substrate.
Spawning Area	Near rooted vegetation, submerged brush or fallen trees. Sometimes over sand and gravel.
Spawning Activities	Late April to mid-May when water temperature reaches 6.7°C. No nest is built. Eggs semi-buoyant until attach to submerged vegetation or bottom.
Important Food Items	Omnivorous. Food shifts from crustacea to aquatic insect larvae to fishes as the Perch grow.
Rock Bass	
Preferred Habitat	Rocky areas in shallow water of lakes and lower warm reaches of streams.
Spawning Area	Diverse. From swamps to gravel shoals.
Spawning Activity	Probably June, when water temperature reaches 16.6°C. Male builds nest and guards eggs and broods young for a short time.
Important Food Items	Omnivorous. Food shifts from aquatic insect larvae to fish fry to crayfish as the Rock Bass grow

Log Perch	
Preferred Habitat	Sand, gravel or rocky bottoms in lakes and large rivers, offshore in waters deeper than 1 m.
Spawning Area	Sand shoals in depths between 0.1 and 2.0 m.
Spawning Activity	In late June large schools of males gather over sandy shallows. Spawning act partially buries adults in sand and eggs are dispersed below the substrate level and abandoned. Non-spawning males devour eggs not buried.
Important Food Items	Cladocerans and copepods, graduating to aquatic invertebrate larva as grow.
Brown Bullhead	
Preferred Habitat	Shallow, warm water situations with abundant vegetation over sand to mud bottoms.
Spawning Area	Mud or sand bottom or among aquatic vegetation roots, usually near a rock, tree, or stump.
Spawning Activity	May to June when water temperature reaches 21.1°C. One or both sexes build a nest. Eggs cared for by both parents. Young are shepherded in a loose sphere by one or both parents for several weeks until about 50 mm long.
Important Food Items	Bottom feeders. Young feed primarily on chironomid larvae and other aquatic invertebrates, graduating to small fishes. Adults eat anything.
Central Mudminnow	
Preferred Habitat	Heavily vegetated ponds or pools of small creeks with a thick bottom layer of organic material.
Spawning Area	Upstream to shallow cool headwaters of streams.
Spawning Activity	Occurs in mid to late April at water temperatures of 13°C, No nest is built and no care provided for eggs or young.
Important Food Items	Carnivorous bottom feeders, larvae and adults of aquatic invertebrates.
Pumpkinseed	
Preferred Habitat	Clear water with cover of submerged vegetation or brush in small lakes, ponds, shallow weeded bays of larger lakes, as well as slow moving streams.
Spawning Area	Near shore in water 150 mm to 300 mm deep. Can be on clay, sand, gravel or rock.
Spawning Activity	Late spring to early summer, when water temperature reaches 20°C. Male builds a nest and guards the eggs and young for about 10 days, returning young to the nest in his mouth if they stray.
Important Food Items	Young fish are insectivorous, shifting to other invertebrates and some fishes when mature.
Banded Killifish	
Preferred Habitat	Quiet waters of lakes and ponds. School over sand, gravel or detritus bottom with patches of submerged aquatic plants.
Spawning Area	Quiet waters of weedy pools.
Spawning Activity	When water temperature reaches 22°C. No nests are built and no protection provided for eggs or young.
Important Food Items	Aquatic invertebrates and insects.

Brook Stickleback	
Preferred Habitat	Clear, cold densely vegetated waters of small streams and spring-fed ponds.
Spawning Area	Shallow water with grass or reeds.
Spawning Activity	Spawning begins when water temperatures are above 19°C. Male builds a nest and defends territory until the young swim away. May build 2 nests each season.
Important Food Items	Carnivorous, feeding on larvae of aquatic insects and crustaceans, as well as eggs and larvae of other fishes.
Northern Pike	
Preferred Habitat	Clear, warm, slow, meandering heavily vegetated rivers, or warm weedy bays of lakes.
Spawning Area	Heavily vegetated floodplains of rivers, marshes and bays of larger lakes.
Spawning Activity	Begins as soon as the ice is out, April to May at water temperatures of 4.4°C and up. A larger female, accompanied by one or two smaller males broadcast fertilized eggs over vegetation in water as shallow as 175 mm.
Important Food Items	Omnivorous carnivores. Young feed on larger zooplankton for 7-10 days then fish enter the diet. At 50 mm length, (5 weeks old), fishes are predominant food.
Golden Shiner	
Preferred Habitat	Schools in clear, weedy, quiet waters with extensive shallow areas.
Spawning Area	Quiet water over filamentous algae.
Spawning Activity	June to August at water temperature of 20°C. Eggs are scattered over the vegetation and abandonment.
Important Food Items	Cladocera, chironomid pupae, flying insects, and filamentous algae
Northern Redbelly Dace	
Preferred Habitat	Beaver ponds, small lakes or quiet pool-like expansions of streams, with a substrate of finely divided brown detritus or silt.
Spawning Area	Within mosses of filamentous algae.
Spawning Activity	May to August. No nest is built. Females may spawn at least twice in the summer season.
Important Food Items	Mainly diatoms and filamentous algae, but includes some zooplankton and aquatic insects.
Spottail Shiner	
Preferred Habitat	Shallow area with sandy bottoms, usually in large lakes and larger rivers.
Spawning Area	Sandy shoals in water 1 m to 1.5 m deep.
Spawning Activity	June to early July. No information available beyond this.
Important Food Items	Plankton, filamentous algae and aquatic insect larvae

Bluntnose Minnow	
Preferred Habitat	Sand and gravel shallows of clear lakes, rocky or gravelly creeks or streams.
Spawning Area	The underside of flat stones (or other objects), lying directly on the bottom.
Spawning Activity	May to August after temperature passes 20°C. Male hollows out a space beneath a stone.
Important Food Items	Organic detritus, algae, chironomid larvae and cladocera.
Blacknose Dace	
Preferred Habitat	Small, clear, swiftly flowing streams with gravelly substrate.
Spawning Area	Gravel bottoms in the fast water of shallow riffles.
Spawning Activity	May and June, when temperature reaches 21.1°C. Do not build a nest. Eggs are vigorously defended by the male.
Important Food Items	Aquatic insect larvae.
White Sucker	
Preferred Habitat	Warmer, shallow lakes or warm, shallow bays, and tributary rivers of larger lakes.
Spawning Area	In shallow water of streams with a gravel bottom.
Spawning Activity	Early May to early June when water reaches 10°C. No nest is built.
Important Food Items	Aquatic invertebrates.
Brassy Minnow	
Preferred Habitat	Cool, dark acid waters of silt-bottomed bog ponds, does occur in creeks and brooks.
Spawning Area	Probably quiet water over a silt bottom.
Spawning Activity	Not known.
Important Food Items	Probably algae and zooplankton with some aquatic insects.
Fathead Minnow	
Preferred Habitat	Still waters of ponds.
Spawning Area	Underside of a rock, log, or branch in shallow water.
Spawning Activity	May to July after temperature passes 15.6°C. No nest is built but the male aggressively drives intruders from eggs.
Important Food Items	Algae, zooplankton, organic detritus, bottom mud. Some aquatic insect larvae.
Creek Chub	
Preferred Habitat	Small, clear, streams and brooks.
Spawning Area	Small gravelly streams just above or below a riffle.
Spawning Activity	May to June, when temperature reaches 12.8°C. Male builds a nest.
Important Food Items	Omnivorous. Young eat plankton, consuming larger organisms as they grow. Aquatic and terrestrial insect larvae and adults. Crayfish and small fishes.

Common Shiner	
Preferred Habitat	Clear lakes and streams.
Spawning Area	Gravel beds in flowing water.
Spawning Activity	Male may build a nest or use nests of other fishes.
Important Food Items	Omnivorous. Aquatic plants, algae, aquatic insect larvae and adults, and small fishes.
Pearl Dace	
Preferred Habitat	Cool bog ponds, creeks, and lakes.
Spawning Area	Sand or gravel in a weak to moderate current of clear, shallow water.
Spawning Activity	Spring spawner when temperature exceeds 17.2°C. No nests but male defends a territory about 200 mm wide.
Important Food Items	Carnivore. Copepods, cladocerans, and chironomid
Largemouth Bass	
Preferred Habitat	Upper levels of warm water in small shallow lakes, and rivers; similar to Pike.
Spawning Area	Gravelly sand (more rare) to marl and soft mud in reeds, bulrushes or water lilies.
Spawning Activity	Late sprint to mid-summer. Nest building after temperature reaches 15.6°C and spawning at 16.7°-18.3°C.
Important Food Items	Fish eating predators but may include plankton, invertebrates and frogs.
Tessellated Darter	
Preferred Habitat	Most common in waters of moderate or no current over bottom of sand, mud or silt.
Spawning Area	Underside of rocks; considerable variation in place.
Spawning Activity	Occurs in spring.
Important Food Items	Consume copepods, small midge larvae and mayflies.

Benthic Invertebrate Sampling

Results of analysis for the spring collection can be found in Table 4.10.4. Section 4.9 provides the complete results and analysis of the invertebrate investigations. For the purposes of this section, presentation and discussion of results were limited to relationships to fish habitat and fisheries resources only. Please see Water Quality Section 4.9 for further information.

TABLE 4.10.4
RESULTS OF BODE ANALYSIS FOR SPRING COLLECTION OF INVERTEBRATES
SOUTH SIDNEY

Station No.	Total Individuals	Richness (Rating)	Diversity (Rating)	Hilsenhoff Biotic Index (Rating)
B1	274	11 (poor)	0.83 (very poor)	5.88 (fair)
B2	207	15 (poor)	1.76 (very poor)	6.07 (fair)
B3	125	16 (poor)	2.14 (poor)	5.94 (fair)
B4	122	25 (good)	2.69 (poor)	5.93 (fair)
B8	184	11 (poor)	1.08 (very poor)	7.35 (poor)
B9	125	14 (poor)	1.80 (very poor)	5.98 (fair)
B11	128	19 (good)	2.10 (poor)	6.08 (fair)

Note: Only stations corresponding with fish habitat assessment stations are presented

There were increases in taxonomic diversity at stations from the mouth to the headwaters with the Meyers Creek watershed. A more diverse community of invertebrate species represents a more diverse food source for fish species. In addition, increases in invertebrate diversity indicate changes in habitat as measured by riparian cover, in-stream organic debris (logs and leaf packs) and substrate type, changes that are also beneficial to fish species.

For the stations in the other watercourses (Watershed 2 and Massey Creek watershed) invertebrate diversity and species richness (total taxa) indicates fair habitat conditions (B9 and B11 respectively). Diversity was somewhat consistent at these lower stations. Habitat conditions were also similar.

The results for the summer collection can be found in Table 4.10.5. Invertebrate diversity indicates that habitat conditions have improved slightly within the lower reaches of the Meyers Creek system. Increases in diversity are likely due to an increase in spatial diversity which is, in turn, due to a moderate increase in algae and instream aquatic vegetation at these stations. These changes result in greater invertebrate diversity and biomass (as measured by total individuals)which are beneficial to insectivorous fish species. Further upstream, however, invertebrate diversities decreased. Drops in water depth, increases in baseflow water temperature, and decrease in overall spatial heterogeneity are the likely causes.

TABLE 4.10.5
RESULTS OF BODE ANALYSIS FOR SUMMER INVERTEBRATE COLLECTION SOUTH SIDNEY

Station No.	Total Individuals	Richness (Rating)	Diversity (Rating)	Hilsenhoff Biotic Index (Rating)	Water Quality Up/Down (In relation to spring)
B1	317	16 (poor)	1.41 (very poor)	6.08 (fair)	Up marginally
B2	243	18 (poor)	2.15 (poor)	5.80 (fair)	Up
B3	381	14 (poor)	0.96 (very poor)	5.95 (fair)	Down
B4	155	19 (good)	1.87 (very poor)	7.13 (poor)	Down
B8	59	15 (poor)	2.28 (poor)	5.54 (fair)	Up
B9	174	22 (good)	2.36 (poor)	5.81 (fair)	Up

Note: B11 was dry and could not be sampled in the summer
Only stations corresponding with fish habitat assessment stations are presented

Due to dry conditions, sampling was not possible at Station B11; however, Station B9 was sampled. Its' diversity increased, as did the total number of organisms. This may be due to increases in algal abundance at the site and decreases in runoff contaminants entering the stream course.

4.10.4 Discussion

Habitat Assessment

The fish communities within the streams of the South Sidney Study Area tend to follow patterns common with small warm water streams in general (Schlosser 1987). In areas with poorly developed pools, predominantly shallow depths, and a low habitat volume, taxonomic richness and density tend to be low due to the absence of deeper habitat required by older fish and pool species. Larger fish tend to stay in the lower reaches where pools have developed. This is important for an accurate assessment and determination of habitat type. It is also important to recognize those species that are not only present through surveys and collection, but also those that would not inhabit certain habitats for variety of reasons such as low flow, reduced habitat space, and simpler trophic structure.

With this in mind, and in addition to the fish habitat assessment, spawning surveys, invertebrate collections, and the examination of surrounding land uses and vegetational composition, it is possible to identify the type of fish habitat according to MNR's *Fish Habitat Protection Guidelines for Developing Areas* (March 1994). The identification of habitat type is particularly important in the selection and sizing of stormwater Best Management Practises as per the Ministry of the Environment's *Stormwater Management, Practises, Planning and Design Manual* (June 1994). Future works that may impact fish

habitat conditions may or may not be permitted depending on habitat type. Figure 4.7 illustrates the habitat types designated for the South Sidney watercourses.

Meyers Creek is the largest watercourse in the Study Area. It rises in heavily wooded eskers in the vicinity of the 4th Concession Road between Flying Club Road and Mackenzie Road. From its source to the hydro right-of-way, both branches are heavily impeded by a continuous series of beaver dams. The effect of these dams is to rapidly raise water temperatures over the short distance. The streambed substrate in this area is characterised by sand and silt. This is unlike the rest of the stream which is dominated by boulders, cobbles and gravel. The upper reaches are also dominated by riffle/run type habitat. The wooded areas of the headwaters are composed primarily of mixed upland hardwoods and conifers in the higher areas, and swamp hardwoods and conifers in the bottomland. As both the east and west branches cross south of the hydro corridor the land becomes principally agricultural in use. In this area the stream is contained within a slightly incised channel. Where not passing through a swampy woodlot, the Creek is fringed with swamp hardwood and wetland understorey. In open areas grassed banks provide some shading.

After crossing the CP line, Meyers Creek enters the property of Canadian Forces Base, Trenton. This area of the Creek has been straightened, channelized and extensively enclosed under the runway/hanger area. Much of the channelized area has been rip-rapped with broken concrete, rock, etc. However, a good morphological sequence of pool-riffle-run exists through this area. There is little canopy in this area and adjacent terrain is open fields or residential lawns.

Habitat Typing

From the foregoing, and in consideration of the fish species and aquatic organisms found through the sample programs, it is possible to identify Meyers Creek as a candidate Type 2 (altered but restorable) fishery. A small portion of the creek piped under the CFB runway has been tentatively identified as Type 3 (unrestorable).

The unnamed tributary (catchment 2) and Massey Creek are similar in physical setting to the central portion of Meyers Creek. The watercourses rise in flat, open areas south of the esker and travel through swamp areas and slightly incised channels across agricultural lands. At present, there is a negligible amount of residential, commercial or industrial development along these two watercourses with the exception of Quinte Sanitation Landfill site on Massey Creek. Both creeks had similar results from the habitat assessments with moderately stable banks and partly open to open overhead tree and shrub canopy. Both creeks had riffle and pool areas with runs and flats present. Bottom substrates were also similar with a range of substrate material from boulders to silt and clay. Massey Creek and the catchment 2 watercourse, with the presence of spawning Northern Pike, have been identified as candidate Type 1 fisheries at Highway 2 and below, Type 2 fisheries above Highway 2, and are intermittent streams in the summer.

Watercourses in subwatersheds 4 and 5 having insufficient flow to support fish populations and as such were therefore not assessed with regard to habitat type.

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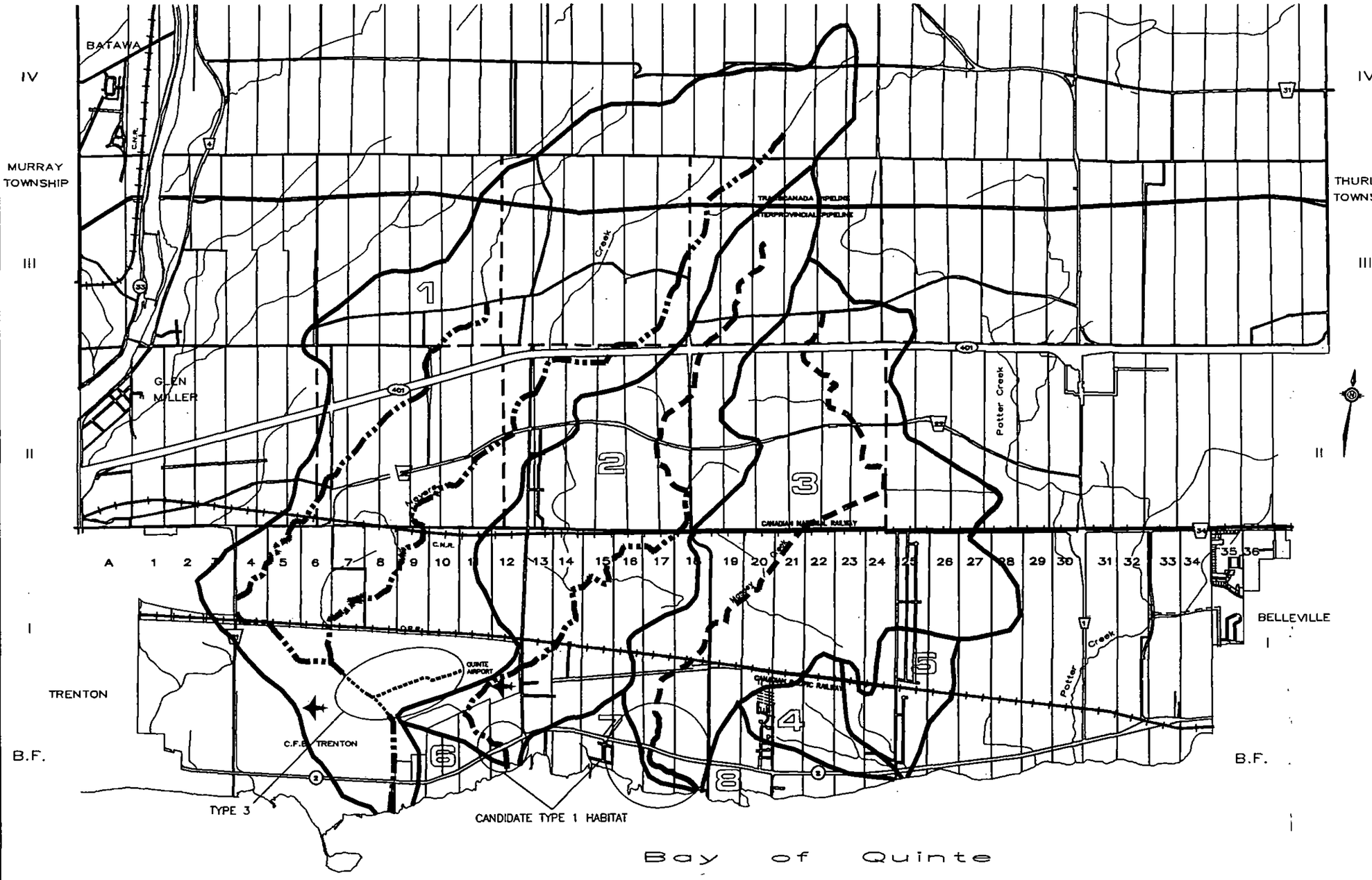

LEGEND

- CANDIDATE TYPE 1
- TYPE 2
- CANDIDATE TYPE 2
- UNCLASSIFIED
- TYPE 3

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TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

FISH HABITAT TYPE

DRAWN BY:	CHECKED BY:	DATE:
F.B.	R.W.	SEPT 28/94
DESIGNED BY:	APPROVED BY:	PROJECT:
R.W.	R.W. & B.R.	24-14164-05
SCALE:	FIGURE No.:	
1:50000	4.7	

Figure 4.7 illustrates this recommended typing.

Natural Channel Design Parameters

In addition to habitat typing, the three main watercourses were classified as per Rosgen's stream classification system (1994). Natural channel design parameters calculated can be found in Table 4.10.6. Bankfull widths and heights were determined using hydrologic modelling and field survey information. Sediment characteristics were calculated from corresponding habitat assessments. The designated stream type is a result of analysis of these various parameters. It should be noted that these streams have been extensively manipulated in the past especially within the Secondary Planning Area.

TABLE 4.10.6
NATURAL CHANNEL DESIGN PARAMETERS

Parameter	Meyers Creek	Watercourse 2	Massey Creek
Stream Type	E5	E4	E4
Belt width (m)	20	10	18
Meander amplitude (m)	11.6	10	12.5
Meander length (m)	61	49	51.25
Stream gradient (m/m)	.007	.004	.004
Bankfull width (m)	9.63	10.07	11.59
Bankfull depth (m)	1.06	.9188	1.02
Width to depth ratio	9.09	10.96	11.42
Sinuosity	1.5	1.36	1.11
Meander width ratio	2.07	.993	1.55
Meander length/bankfull width	6.33	4.87	4.42
Amplitude to bankfull width	1.20	.993	1.08
Base flow (m^3/s)	.15	—	.14
Sediment d_{84} d_{50} d_{16}	gravel clay clay	rubble gravel sand	gravel gravel silt

Fish Habitat Improvement Recommendations

Through examination of the fish habitat and aquatic resources, it is also possible to advance some proposals and recommendations that seek to improve fish habitat throughout the South Sidney watersheds.

Improving fish habitat generally improves habitat for benthic invertebrates. Invertebrates are an important source of food for fish populations. Theories regarding their relationship vis-a-vis fish populations have undergone considerable research and alteration in recent years. The effect of predators on prey, and vice-versa, was once believed to be relatively straightforward - fish predation determines invertebrate population densities - essentially a 'top-down' effect. However, more recent study (Karr et. al. 1992, Wilson 1987) has found that invertebrates can exert a 'bottom-up' effect on growth rates and abundance in some fish species.

Poor diversity and abundance of invertebrates in streams limits fish abundance and diversity. In addition, excessive organic loading through fecal inputs from such sources as livestock and improperly functioning septic systems will stress aquatic communities downstream and impact upon the suitability of fish habitat.

Improvements to habitat, in order to maintain and augment fish populations, include restoration and establishment of riparian plantings to increase organic detrital inputs and cleanse surface runoff to the streamcourses. Organic detritus in the form of leaves, twigs, branches can significantly alter in-stream habitat diversity, especially substrate heterogeneity, as well as provide food resources for invertebrates, and through trophic interactions, fish. The reduction of fecal contaminant loading, especially from livestock and faulty septic systems, is another means to improve water quality and therefore habitat. Many organisms such as mayflies and stoneflies, are extremely intolerant of excessive organic loads in streams. As these organisms are significant components of many of the resident fish diets, their presence can influence fish presence and abundance. Stream shading offered by riparian vegetation can reduce or eliminate thermal stress.

The use of infiltration techniques wherever possible in stormwater management practices can help maintain the hydrologic pathways, possibly augmenting baseflows in streams. Enhancement of baseflow will result in increased habitat space during low flow periods, especially in the summer, and reduce thermal stress.

Effective stormwater treatment to remove sediment, nutrient and metal loadings will improve the quality of the water, and hence the quality of the habitat for aquatic organisms. As well, as a further measure to help maintain and rehabilitate in-stream habitat for fish there should be an effort to restore the natural meander pattern to stream reaches. This could be particularly effective for the lower reaches of Meyers Creek where there has been extensive channelization. As noted previously, the Department of National Defence (DND) is considering a re-naturalization initiative for the portion of Meyers Creek below Highway 2.

4.11 Wetlands

This section briefly summarizes features of the wetland evaluations that were conducted in the spring of 1994 within the South Sidney watersheds. MNR wetland classification scorings have determined that all are not Provincially Significant. Reference should be made to the actual evaluations and their respective figures for additional detailed information (Appendix D). Also included in the mapping and Appendix is an evaluation for the Bayside Wetland, maintained as Provincially Significant.

These wetlands have been located on the attached Figure 4.8.

Meyers Creek Wetland Complex

Meyers Creek Wetland Complex has a permanent inflow to its eastern part, so this[3] section was evaluated as riverine while the section to the west was determined to be palustrine, as its inflow dries up in the summer. The western part is currently flooded quite high by beaver dams at the southern end, and a colony of great blue herons nests in the drowned trees. The owner of this area intends to take out the beaver dams to protect his silver maples from further dieback.

There is a hectare or so of wetland north of Highway 401, between the east and west sections, too small to be included in the complex. Some small shrubby damp areas at the inflow to the west part were also omitted as too small.

This complex was rated as Not Provincially Significant wetland but important nevertheless because of its high hydrological value in flood attenuation, water quality improvement, and groundwater recharge.

Flying Club Road Wetland

The site of this wetland north of the hydro/gas utility line, east to the Flying Club Road, is very wet because of a large beaver dam. Another dam holds back water at the southern wetland outflow. Although it has a small permanent inflow at the north end, west of the Flying Club Road the wetland is better considered palustrine: it looks as if much of the water comes from an intermittent stream or runs off surrounding land. East of the Flying Club Road, the wetland is riverine.

Since permission was not granted to enter Lots 11-13, Concession 3, this wetland could only be viewed from adjacent properties, or by studying it from a distance using a telescope. Thanks to excellent aerial photographs the boundaries and vegetation communities assigned are reasonably accurate. However, the biodiversity, resource products and special features components may have been underestimated. For instance, a telescope view only allowed duckweed to be scored for Marsh W4. There may also have been submerged aquatic vegetation there, which would lead to a few extra fish habitat points. This wetland was rated as Not Provincially Significant wetland.

Montrose Wood Wetland Complex
Aikens Road East Wetland Complex

These two complexes are part of a more or less continuous wooded area. Its natural hydrology has clearly been altered by the construction of a deep central ditch over 20 years ago, together with the many drains and ditches in surrounding fields. Most of the wood is

[3] See Wetland Evaluation Map for Sub-units, Appendix D: Wetland Evaluations.

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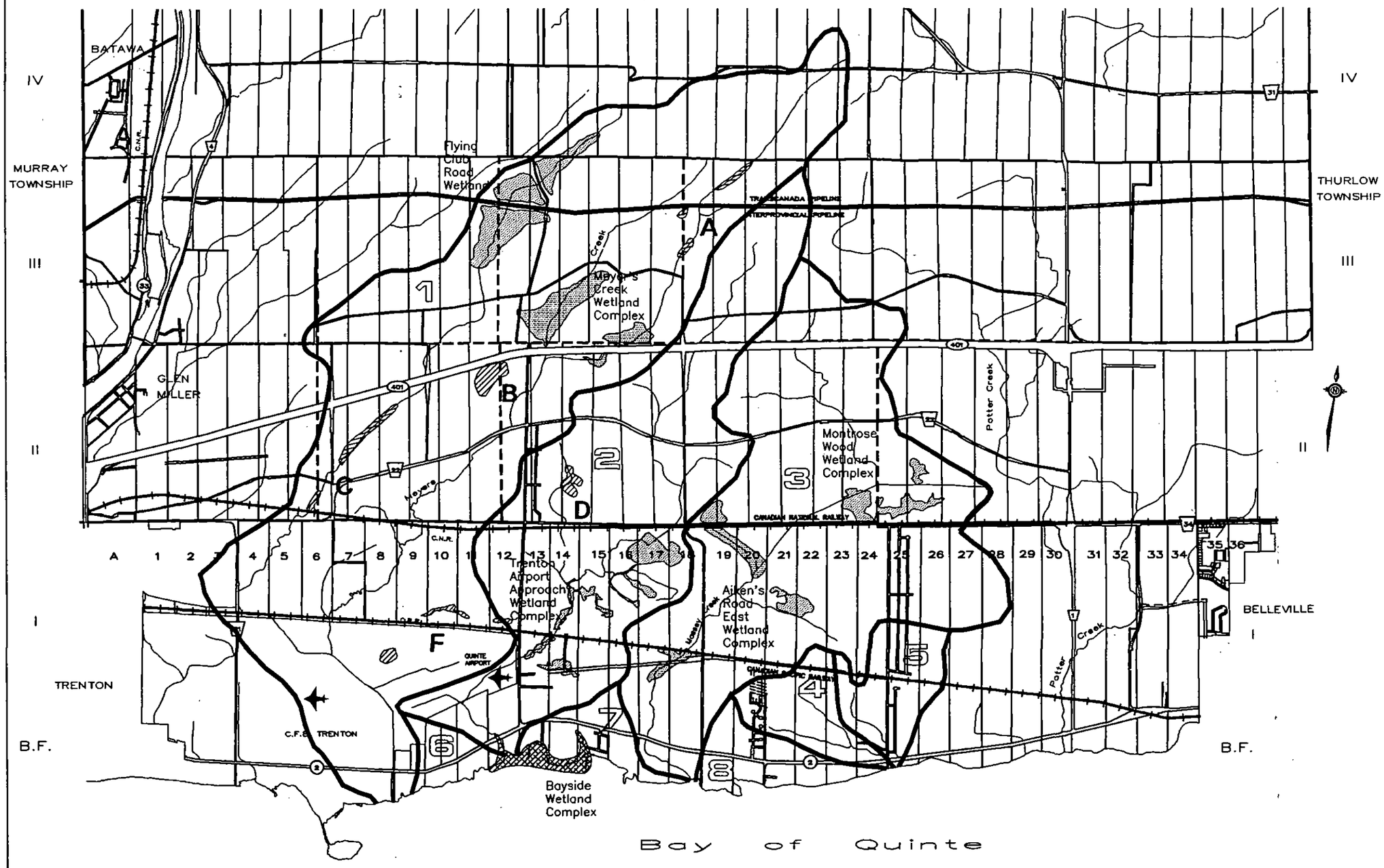

LEGEND

- A — UNEVALUATED WETLAND (see text for discussion)
- EVALUATED WETLAND (Provincially Significant)
- EVALUATED WETLAND (Not Provincially Significant)

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SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

WETLANDS

DRAWN BY:	CHECKED BY:	DATE:
F.B.	S.R.S.	DEC 15/94
DESIGNED BY:	APPROVED BY:	PROJECT:
S.R.S.	S.R.S.	24-14164-04
SCALE:	FIGURE No.:	
1:50000	4.8	

rather low and wet, but not quite wetland; "green" ash (*Fraxinus pennsylvanica*) is the dominant tree species. Areas have been mapped as wetland where there was also substantial amounts of wetland indicators such as silver maple (*Acer saccharum*) and black willow (*Salix nigra*). These areas of wetland were sometimes ill-defined.

The wetland areas were split into two complexes because of the Wetlands Evaluation Manual's 750 metre rule (3rd Edition). Ignoring wetland patches of less than 2 hectares, the wetland areas were scattered too far apart to be all included in the same complex.

The woods to the west of the Montrose subdivision includes some wet areas, but all are less than 2 hectares, and were not evaluated.

The two units of the Aikens Road East complex were taken together simply on the basis of their proximity. They lie on opposite sides of the main ditch.

Both complexes scored quite low, and were rated Not Provincially Significant.

Trenton Airport Approach Complex
(Including Aikens Road Landfill)

The watershed for this wetland does not extend west of Lot 11 in Concession 1. In Lot 12 there are about 4 hectares of wetland draining east, but this cannot be included in the complex because it is over 750 metre distant.

This small wetland appears riverine, but the streams that feed it dry up in the summer. In late July, the only continuous flow was from groundwater seeping from fields where treated sewage from the Kenron Mobile Home Park is sprayed. Because of the continuous flow, albeit partly artificial, and the creek topography, Unit 1 was evaluated as riverine.

According to a landowner, ducks flying up from the wetland are seen as a hazard to planes using CFB Trenton airfield, and air base personnel periodically remove beaver dams in the wetland to discourage the ducks. Nevertheless, the dieback in trees in the wetland south of the CPR line suggests that recent water levels continue to be quite high. This wetland was rated as Not Provincially Significant.

Preliminary Survey of Further Wetlands In the South Sidney Watershed Plan Area

Wetland surveys were conducted in the summer of 1994 at four locations in the South Sidney Watershed Plan area, yielding five evaluated wetlands. The purpose of this brief report is to outline other potential wetlands in the Study Area for possible future evaluation.

Candidate sites were located by searching 1:10000 aerial colour photographs taken in spring 1993. Determinations of wetlands were helped by experience gained in ground-truthing the photographs during the 1994 wetlands evaluations. Sites were then viewed from nearby lands, as far as was possible without trespassing. Seven wetland areas were identified which

are discussed below. With one possible exception, they are all small sites of well under 10 hectares in area.

Site A

Upstream from unit 3 of Meyers Creek Wetland Complex, beavers have flooded three areas, creating wetlands. These are all quite small, probably under 2 hectares each and not worth evaluating.

Site B

A marshy swale of maybe 7 hectares, feeding Meyers Creek. It looks like it dries out in the summer, and does not appear promising biologically.

Site C

There is a long riverine wetland which cannot be seen well from the road, but is probably dominated by grasses or cattails. It cannot be larger than 5 hectares. It looks affected by ditching. Nearby is a small 2 hectare stretch of the creek where dead trees suggest a beaver flood.

Site D

This area may or may not be wet. There may be a marginally swampy area of up to 8 hectares, but it might be more or less all upland ash/oak forest.

Site E

Field work this summer revealed a few patches of marginally wet land west of Whites Road, which drains west through the CFB golf course. The areas north of the CPR line are probably not worth mapping, as they are under 2 hectares. There is one ditched low wood in the golf course area which is wet in the spring. To judge from the photograph, it probably does not contain a worthwhile area of swamp.

Site F

This is a marshy area of grasses, cattails and scattered trees, of about 6 hectares or less. Water drains into this area from the landfill site, where there may be another small patch of swamp.

Conclusions

There are no wetlands larger than 10 hectares still unevaluated in the Study Area. Nevertheless, as per Conservation Authority policy, it is encouraged that all wetland areas be protected regardless of size.

4.12 Natural Areas

In the preparation of the land use mapping, areas that exhibited natural features were included as forestry and vacant lands. This included pasture lands, scrub lands and wooded areas. In many cases these natural areas exist because they are associated with wetlands and are therefore too wet to be actively cultivated, or they have been allowed to regenerate by the current owner as a result of circumstances that make their active use uneconomic. Woodlots and naturally regenerating areas can be found in Figure 4.9. These areas were identified from air photo interpretation and field observations.

Our review suggests that many of these areas were actively cultivated a decade ago or longer. Their current natural state provides wildlife habitat and in many cases serves to extend and connect significant natural areas such as the wooded wetlands discussed above.

Numerous studies have indicated that avoiding fragmentation of forested areas, wetlands and other natural areas increases the diversity of the local natural system. An important network of natural corridors and protective habitats that are not identified as significant in and by themselves currently exists in the more northerly reaches of the Study Area consisting of riparian corridors and small woodlots. These corridors do play an important role in the support and protection of wildlife populations and the addition of diverse habitats.

These corridors are augmented by hedgerows/fencerows in the agricultural areas which also offer protective cover for wildlife and provide a diverse habitat. Where these areas are located in the stream valleys they represent areas of dual significance, providing diverse habitat for wildlife and shading and food sources for fish and aquatic biota. Figure 4.10 delineates the treerows, hedgerows and other forested resources within the Secondary Planning Area. It is within these areas where most of the development opportunities have been identified.

Most woodlots are found in the northern sector of the Study Area. Their location pattern is strongly associated with agricultural practices, physiography and topography.

Woodlots can be considered any contiguous expanse of wooded land, containing fairly mature tree species which form an overhead canopy. Two basic types of woodlot are found: those containing deciduous hardwoods characteristic of mature climax or near-climax forests, and those containing mixed softwooded deciduous species common to younger second growth occurring on more recently logged or cleared land.

Species of the deciduous hardwood stands include:

Acer saccharum	Sugar Maple
Carya ovata	Shagbark Hickory
Fraxinus americana	White Ash
Juglans cinera	Butternut
Quercus rubra	Red Oak
Quercus alba	White Oak

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LEGEND

WOODED / NATURAL REGENERATION AREAS

NOTE: HEDGEROW AND TREEROW FENCELINE ARE DELINEATED FOR THE SOUTH SIDNEY PLANNING AREA IN FIGURE 4.10

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LOWER TRENT REGION CONSERVATION AUTHORITY

TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

WOODED / NATURAL REGENERATION AREAS

DRAWN BY: F.B.	CHECKED BY: R.W.	DATE: SEPT 28/94
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SCALE: 1:50000	FIGURE No.: 4.9	

Species found in younger mixed tree stands include:

Acer saccharinum	Silver Maple
Betula papyrifera	White Birch
Fraxinus sp.	White and Black Ash
Populus deltoides	Eastern Cottonwood
Populus gradidentata	Bigtooth Aspen
Populus tremuloides	Trembling Aspen
Prunus serotina	Black Cherry

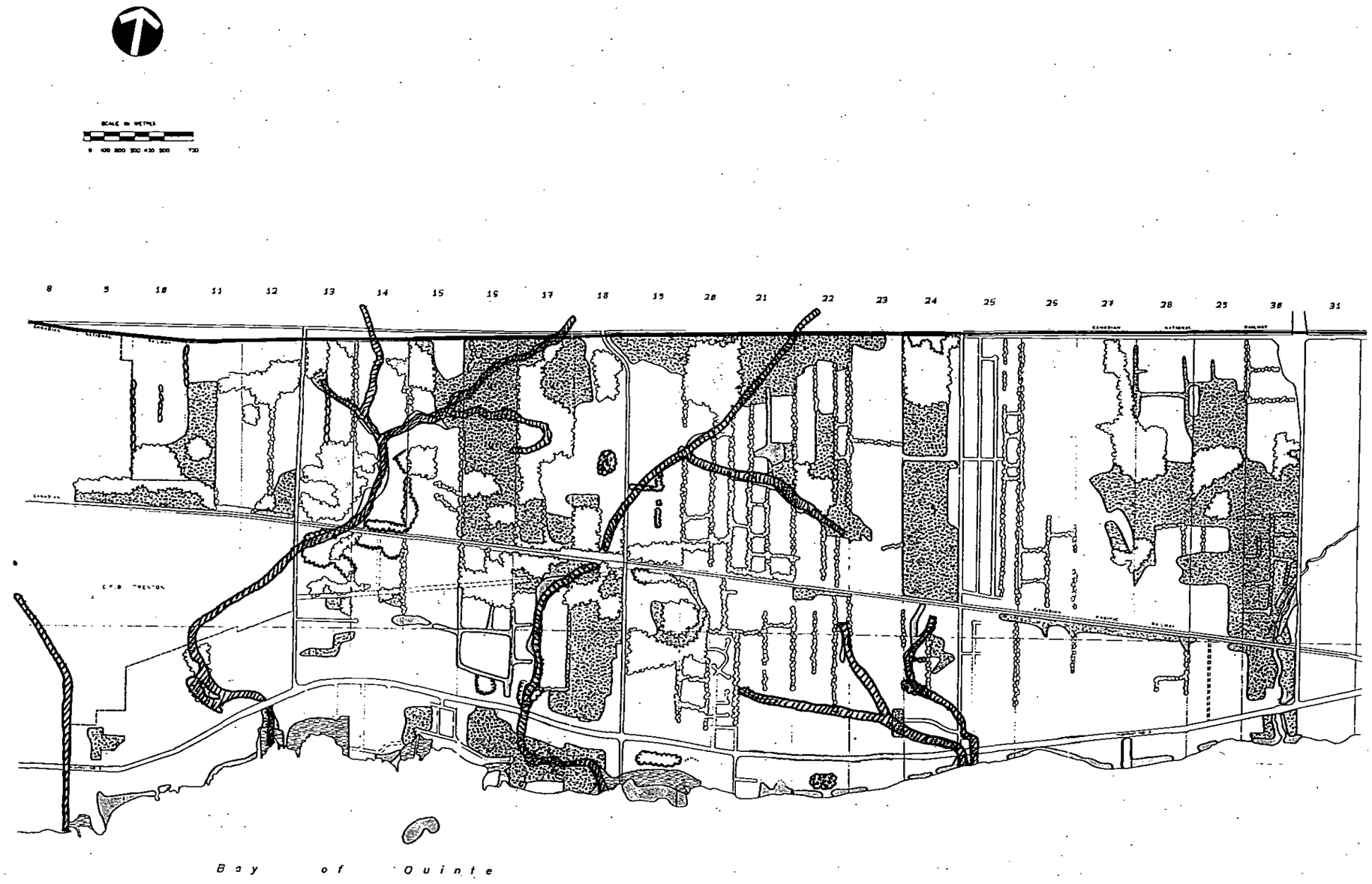
Strong efforts should be made to preserve woodlots, particularly within the framework of possible urbanization. Woodlots serve an extremely important role as groundwater recharge areas, contributing to flood control and water quality. Strategically located development can capitalize on the wind buffering capacity of woodlots, as well as benefit from the cooling effect of evapotranspiration and wind channelling during the summer. Besides the ecological advantage of retaining woodlots, they may in the long term perform a mixed use function of supplying fuel wood and accommodating recreation and nature interpretation activities.

Figure 4.10 clearly reveals the distinct rural landscape pattern created by treerows throughout the Secondary Planning Area. These linear growths of trees and shrubs are largely a product of historic land ownership. Natural regeneration of trees and shrubs would evolve along fence lines and stone piles, delineating farm lot lines in a north-south direction. Where farmers wished to subdivide farmland into smaller fields, treerows were often allowed to grow. The resultant grid pattern is the predominant element of an historic agricultural landscape characteristic of Southern Ontario single family farms and mixed cropping. Although many treerows have been removed for the sake of modern farming techniques and subdivisions, the basic framework still exists within the Study Area, particularly north of Highway No. 2.

Typical treerow species include:

Acer negundo	Boxelder
Crataegus sp.	Hawthorn species
Juniperus virginiana	Red Cedar
Prunus virginiana	Common Chokecherry
Rhamnus cathartica	Common Buckthorn
Syringa vulgaris	Common Lilac
Tilia americana	American Basswood
Ulmus americana	American Elm
Ulmus rubra	Slippery Elm
Viburnum lentago	Nannyberry

Treerows serve an important ecological role in rural landscapes because of their role as "ecotones" - a boundary or transitional zone between communities. They function to provide cover and forage for a variety of birds and small mammals. Treerows are also valuable in controlling wind and surface water runoff, thus reducing soil erosion. Lastly, treerows



LEGEND

VEGETATION

- MATURE WOODLOT
- NATURAL REVEGETATION/ OLD FIELD
- LOWLAND VEGETATION
- TREE ROW
- MARSH / WETLAND
- WATERCOURSE

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LOWER TRENT REGION CONSERVATION AUTHORITY

TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN

TOWNSHIP OF SIDNEY

VEGETATION / FOREST RESOURCES IN SECONDARY PLANNING AREA

DRAWN BY:	CHECKED BY:	DATE:
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SCALE:	FIGURE No.:	
		4.10

function to define space, especially in the flat topographic context of South Sidney. This attribute can be taken advantage of in accommodating possible future urban development patterns, internal roads and pedestrian paths.

Three types of lowland vegetation areas can be identified in the Study Area: vegetation associated wetlands, vegetation along creeks and swales, and shoreline vegetation along the Bay of Quinte.

A great diversity of species can be identified in these areas, the most prominent being.

Acer negundo	Boxelder
Fraxinus nigra	Black Ash
Populus deltoides	Eastern Cottonwood
Salix alba	White Willow
Salix nigra	Black Willow
Cornus sp.	Dogwood species

Wetlands and inland drainage courses are important in conducting surface runoff to the Bay of Quinte and as water retention areas. Vegetation along watercourses and the Bay of Quinte serve to control erosion, while providing forage and cover for a wide range of birds and mammals. Shade provided by shoreline trees and shrubs contributes to the productivity of adjacent aquatic habitat, particularly for warm water fish. Any future development should attempt to retain these areas for their flood and erosion control attributes and for their potential as an ecological and recreational resource.

Large expanses of land in South Sidney are currently undergoing revegetation in areas which were previously farmed or cleared for other activities such as aggregate extraction and land speculation. Growth is typically sparse and shrub-like, with evidence of pioneer species and young hardwoods, including:

Crataegus sp.	Hawthorn species
Juniperus virginiana	Red Cedar
Malus sp.	Apple species
Populus deltoides	Eastern Cottonwood
Populus tremuloides	Trembling Aspen
Prunus virginiana	Common Chokecherry
Ulmus americana	American Elm

Revegetated areas provide habitat for songbirds and small mammals. Given time and proper silvicultural tending, such areas can develop into viable woodlots. With inter-plantings of longer lived hardwoods or evergreens, the process of succession can be accelerated, allowing revegetated areas to fit into the open space pattern of urban development.

4.13 Identification of Issues

A number of issues and concerns can be identified from the preceding discussions of watershed resources.

- A contaminant plume has been identified as emanating from the Aikens Road landfill site which is slowly moving in a southwesterly direction towards the Bay within the upper strata of sub-surface bedrock. (Gartner Lee, 1987).
- Erosion-prone areas have been identified as a result of the hydraulic analysis that could require protection if existing vegetation cover is disturbed.
- Flood susceptible areas have been identified on the floodplain mapping.
- Hydraulically deficient crossing structures have been identified on Meyers Creek within CFB Trenton.
- Bacterial contamination, occasional elevated turbidity levels and excessive nutrient concentrations were identified as regular occurrences in the South Sidney watercourses.
- Water quality of the watercourses sampled in other studies (Meyers and watercourse 2) does not appear to have changed over the past several years.
- The west branch of Meyers Creek appears to be more impacted with contaminant loadings than the east branch.
- High concentrations of bacteria, nutrients, suspended solids and a number of metals were detected in the event first flush sampling for urbanized areas of South Sidney (Kenron Estates and Montrose).
- Benthic invertebrate sampling confirmed that all watersheds are stressed to varying degrees.
- Candidate Type 1 fish habitat has been identified at the outlets to the catchment 2 watercourse and Massey Creek as a result of identified fish spawning activities.
- Six wetlands were evaluated, none of which were identified as Provincially Significant.
- The Bayside Wetland was reevaluated and remains a Provincially Significant wetland.

A detailed questionnaire analysis was conducted for the South Sidney Watershed study. Six hundred questionnaires were distributed with 44 questionnaires received and analyzed. The following is a summary of items/issues summarized from Appendix E: Public Consultation.

Question 1: This question asked participants to identify their location with the watersheds. The majority of the 44 responses were from Watersheds 1, 2 and 3 with an even distribution for the remaining watersheds.

- 68% of the respondents were resident landowners.

Question 2: This question requested information regarding flow levels, flooding and drainage. Poor drainage has been experienced on a frequent basis by 60% of the respondents with over half of these respondents coming from Watersheds 2 and 3.

- Basement/home flooding was experienced by 46% of the respondents, half of which are located in Watershed 2.
- 31% of the respondents indicated Selected Drainage Improvements as a management preference.
- 21% of the respondents indicated Clear Channel Debris as a management preference.

Question 3: Question 3 requested responses on a variety of environmental issues including fish and wildlife habitat, recreation and pollution. A wide variety of wildlife was identified by the respondents.

- Habitat degradation was identified as a concern for the Bay of Quinte in Watershed 2.
- There were several comments regarding the proposed dump site which concerned the respondents.
- 36% of the respondents have observed areas of pollution in the streams.

Question 4: This question asked participants questions of a general nature regarding availability of improved guidelines, policies and information. Stormwater runoff management and site grading and drainage were the #1 responses for improved guidelines, policies and information.

- The majority of respondents indicated the cost of implementation of the water management techniques should be shared between the Developer and the Municipality, although other opinions suggested that the Developer, Conservation Authority, Provincial Government and Municipality all share in costs.

5.0 WATERSHED ISSUES AND ANALYSIS

5.1 General

In Section 2 a number of Watershed Principles were proposed. Subsequent sections have presented findings and preliminary conclusions about the environment, its significance and measures of its current status. Section 4.1 presents the approved land use as determined through the land use planning process. This section identifies the significant issues raised in the last chapter, reviews how well the current situation meets the principles provided in Section 2 and develops an action plan to address these concerns.

The identified related RAP recommendations are currently in various stages of implementation.

5.2 Themes

The various themes introduced in Chapter 2 have been carried through to this chapter in order to organize issues in major categories. A summary of each theme is repeated to precede the discussion.

- **Clean**

  "All activities and future development should work with the natural processes to contribute to environmental health. Air, land, sediments and water should be free of contaminants that impair beneficial uses by people and other living things."

  Nutrient Enrichment

  Nutrient enrichment of the Bay of Quinte is most obviously manifested as algal blooms particularly during the summer months. In the mid 1960's the algal blooms were so dense that the algae could be scooped by hand from the surface of the Bay. This dense algal cover limited sunlight penetration to rooted aquatic plants which in turn disappeared. The plant losses reduced available fish habitat and contributed in part to the decline in the Bay's walleye population. Drinking water taken from the Bay was unpalatable because of odour and taste problems.

  In reviewing the sources of phosphorous contribution entering the Bay as they apply to the South Sidney watershed, there are several that require attention. These include: urban runoff, to be addressed through current standards for new development; and improvements to existing storm drainage, which will require retrofitting of existing storm drainage facilities. The contribution of phosphorus from atmospheric sources cannot be addressed. Furthermore, it is anticipated that the water treatment plant currently under construction will not contribute phosphorus to the Bay.

  Tributary inputs contribute the bulk of the nutrient loading to the Bay of Quinte; however, the South Sidney watershed is quite small when compared to the whole of the Bay of

Quinte watershed. Nevertheless, nutrient reductions should be an objective of the Watershed Plan. The Bay of Quinte Remedial Action Plan calls for a return to 1930 water quality conditions.

Specific objectives of the Remedial Action Plan for the Bay include :

- Reduce the average water concentration of total phosphorous from the existing level of about 40 $\mu g/l$ to a new level of 30 $\mu g/l$;
- Reduce the average algal density from an existing level of between 7 and 8 mm^3/l to a new range between 4 to 5 mm^3/l; and,
- Increase the area of submerged aquatic macrophytes so that 30 percent of the upper Bay has a macrophyte coverage greater than 50 percent.

Most of the nutrient load from tributary sources is from surface runoff. The tributary area to the Bay is large - greater than 17,000 km^2. The main sources are agriculture, inland sewage treatment plants, private sewage and septic systems, and rural land runoff. Phosphorous reaching the Bay in the spring is flushed out of the Bay due to the high flows. Late spring and summer inputs stay in the Bay. The RAP Coordinating Committee estimates that about 25 percent of the phosphorous from agricultural sources could be controlled by controlling erosion through tillage practices. This would have the effect of reducing the phosphorous loading by 10 percent if implemented for the entire tributary area. Other agricultural based actions to achieve 25 percent reduction target include buffer strips, grassed waterways, terraces, manure storage facilities, crop rotations, fertilizer application guidelines and retirement of fragile lands.

Related RAP Recommendations

#7 Responsible parties should cooperate in the development of innovative and cost effective strategies for achieving and maintaining the Quinte RAP total phosphorous loading limits.

#8 Official Plans in the Bay of Quinte drainage basin should be amended at the time of their next cyclical review to include a strategy to prevent increased phosphorous loading to the bay associated with each jurisdiction's planned growth and development.

#9 Tributary loadings of phosphorous delivered to the Bay from agricultural diffuse sources should be reduced by a further 12,500 kg per year.

#15, 16, 17 Spreading of waste during the winter months should be discouraged or prohibited.

Bacterial Contamination

Despite significant improvements in water treatment from the early 1960's, bacterial contamination still threatens human health and water contact recreational opportunities continue to be restricted. During the summer months, Bay of Quinte beaches are posted periodically, particularly adjacent to urban areas and after storm events. The primary sources of bacterial contamination are urban land runoff, poor agricultural practices and faulty septic systems. Combined sewer overflows, sewage by-passing, urban runoff and other uncontrolled sources contribute to the problem in urbanized areas. Outside the urban centres, bacterial contamination increases wherever cattle access surface waters for drinking. Drainage from manure handling facilities and waste water from milk houses are other significant agricultural sources of surface water contamination, particularly at farms located along streams within the Bay of Quinte watershed area. Faulty private sewage systems are also a source of bacterial contamination in rural areas.

Actions by the Ministry of Energy and Environment's Clean Up Rural Beaches (CURB) Program focus on identification and assistance in remediation of bacterial contamination.

Bay of Quinte stormwater quality management guidelines for new urban development introduced in January 1992 require that urban development demonstrate that bathing beach criteria (100 *E. coli* per 100 m*l* of water) will be realized at the point of stormwater discharge to the Bay.

Agricultural sources of bacterial contamination can be reduced. Direct livestock watering in surface waters can be managed or eliminated. Manure storage and handling practices can be improved. Milk house wastewater can be disposed of properly.

The Our Farm Environmental Agenda (OFEA) program launched by a consortium of Ontario's farming organizations consisting of the Ontario Federation of Agriculture (OFA), the Christian Farmers Federation of Ontario (CFFO), the Agriculture Groups Concerned about Resources and the Environment (AGCare) and the Ontario Farm Animal Council (OFAC) is seeking to have all farmers develop and maintain individual environmental farm plans. The consortium's agenda is a highly promising initiative that warrants support.

Cost effective means of achieving the requirements of stormwater quality for new development will be reviewed in upcoming sections of this Plan.

Related RAP Recommendations

#26 All Municipalities should implement water conservation programs to reduce the wastage of water.

#27 Municipalities should enact and enforce domestic pet litter by-laws

#29 Municipalities and road authorities should undertake programs of routine street and catch basin cleaning (cleaning includes the pickup, removal and proper disposal of street and catchbasin, waste, garbage and contaminated sediments).

#33 Stormwater quality control must be provided for new urban development in Municipalities with frontage on the Bay of Quinte.

#34 The Province of Ontario Subwatershed Planning Process should be adopted and employed by the Municipalities to provide direction for the preparation of Secondary Official Plans for areas slated for new urban development.

#35 Livestock access to the Bay and its tributaries for watering purposes should be minimized and alternative on-land watering facilities provided.

#36 Farmers should develop and implement farm conservation plans to reduce the potential surface water contamination associated with (1) their manure storage and handling systems, (2) their practices concerning nutrient applications and (3) other farm sources and activities.

#37 The CURB program or its equivalent should be continued.

#38 An inspection program should be undertaken to investigate private waste disposal systems.

Persistent Toxic Contaminants

In general, historic sources of contributing trace metals to the Bay of Quinte include tanning and plating industries, arsenic based pesticides, mercury based fungicides, lead emissions from automobile exhausts, and inputs from municipal wastewater discharges and waste disposal sites. More specific to South Sidney, leachate from the Aikens Road waste disposal site and contaminated soil at industrial and commercial sites and in areas where spills have occurred (e.g. abandoned gas stations), are the sources of toxic inputs to watershed streams, and ultimately, the Bay.

Runoff from urbanized areas is high in concentrations of various trace metals associated with automobile usage.

The domestic use and improper disposal of pesticides is another source of toxic organic compounds. Individuals, Municipalities, Ontario Hydro, pipeline companies and road authorities use herbicides to control undesired plant growth. The agricultural use of herbicides and pesticides for food production also introduces organic compounds into the area. The loads or percent contributions from these sources have not been determined.

Related RAP Recommendations:

#40, 41, 42 Federal and Provincial levels of government should pursue the goal of elimination and zero discharge of persistent toxic contaminants.

#43 OMAF should vigorously pursue its pesticide reduction goal for the Bay of Quinte.

#44 The basin's Municipalities and other jurisdictions should cooperatively develop permanent programs, facilities and schedules for the collection and safe disposal of household hazardous wastes. (These are already in place in South Sidney).

#50 All snow disposal sites should be properly designed to retain solids and prevent off-site release of persistent toxic contaminants.

- **Green**

"Natural features and topography should form a green infrastructure for the area."

Since the early European settlement the ecosystem has experienced an almost continuous process of change and instability. Settlement has changed the landscape and ecosystem of the watershed. The review of The Bay of Quinte the Remedial Action Plan indicated that the aquatic community has lost stability and diversity. Natural tributary flows that maintained summer water exchanges and the self-cleaning capacity of the Bay have been disrupted. The natural water level fluctuations required to maintain the diversity of wetlands have been permanently eliminated. Siltation of fish spawning areas has occurred; wetland and low lying areas have been dredged, drained and filled; and shoreline alterations have destroyed critical fish habitat.

The Bay has been adversely influenced by biotic disturbances such as the invasion of non-indigenous carp, Eurasian milfoil and white perch. In summary, significant destruction of aquatic habitat has occurred because of human changes, compounded by invasions of non-indigenous biota, which have altered the Bay's ecosystem and affected its stability.

The removal of streambank vegetation has been identified as potentially resulting in erosion of susceptible areas. This will have direct negative impacts to fish habitats which have already been impacted with past development. Remaining intact wetlands have been delineated and evaluated for future protection.

Until recently, habitat concerns have been attributed to poor water quality. Now programs to improve damaged habitats are being developed that emphasize direct action, stewardship, local action and awareness. These include:

- reforestation
- erosion control
- stream clean-up
- enhancement of fish habitat

- regulation of all shoreline works by MNR (Public Lands Act/Lakes and Rivers Improvement Act)
- development review (Planning Act)
- habitat compensation agreements (Fisheries Act).

Related RAP Recommendations

#60 support for the establishment of tributary improvement associations.

#61 complete the inventory and classification of wetlands

- develop a comprehensive management plan for littoral zone and wetlands rehabilitation
- undertake wildlife inventories
- develop wildlife protection strategies.

#63 vigorously enforce the fish habitat protection provisions of the Fisheries Act.

#64 these should be cooperative effects among government agencies, native groups, non-government organizations, Developers and individuals to prevent any further loss of the integrity of the basins' remaining wetland ecosystems.

#65 Province of Ontario should establish appropriate legislation and implement policies to provide a level of wetland protection equivalent to the protection and potential enhancement of fish habitat currently provided under the Fisheries Act and its implementation policies.

#66 encourage individuals to restore and protect their shoreline by planting native vegetation.

#67 Municipalities should provide protection for shorelines and streambanks through setback provision of their planning documents.

#68 maintain existing natural wildlife corridors and explore opportunities to create additional corridors.

- **Connected**

"Natural and cultural linkages should be restored and maintained including links to:

- wildlife habitats
- urban and rural areas
- social communities.
- past and present
- people and nature".

In the process of development design and as part of the overall review, linkages should be protected. The most significant linkage is the stream valleys, particularly in the developing areas. The areas along these valleys subject to flooding will be protected from development by Municipal planning documents. The protection of these natural corridors should ensure that the flood-prone lands are incorporated into a pattern of connected natural spaces. In this regard hedgerows, woodlots and natural areas should be evaluated prior to development design to assess their significance as natural corridors and their ability to withstand the stress of development. The final development plan should ensure that there will be no net loss of natural areas and that the diversity and significance of existing natural areas is maintained and enhanced. Connections along stream valleys and shoreline areas, where possible, should be preserved and protected.

- **Open**

"Existing vistas of the Bay of Quinte should be protected. These vistas should be treated as important values for new development. Waterfront structures should not be permitted to create a visual barrier or intrude on the water's edge."

A preliminary assessment of views and vistas within the South Sidney Planning Area revealed relatively few significant views and vistas. The most critical were:

- The Highway 2 Corridor

  There are limited views of the Bay of Quinte available to travellers and residents (except shoreline residents). Existing views should be considered in the siting of new buildings. Avoiding end of street sites would maintain views of the Bay from Highway No. 2.

- Height of Land

  Several significant heights of land provide excellent long-range views and vistas. These sites are not proposed for development and in any event would not be threatened by building location.

- **Accessible**

"People should be able to get to and enjoy the waterfront and the valley lands. Where feasible, portions of the waterfront and valley lands should be open to the public and clearly identified as public access."

Very little land is available for public access along the waterfront of the Bay of Quinte or along the stream valleys. An overall program of public access points and connecting links should be prepared as part of an open space system to support the existing and proposed development of this area. The means discussed above for the establishment of linkages should be used where appropriate to acquire these important community lands.

- **Useable**

  "Uses along the streams and the Bay should be designed and managed to enhance the safety and minimize the risks caused by:

  - threats to personal safety from other uses
  - flooding and erosion
  - excess and prolonged dampness (lack of appropriate drainage)
  - incidents involving hazardous materials".

  Flood Plain

  As part of the Watershed Plan detailed floodline mapping has been prepared for the South Sidney Secondary Planning Area and flood susceptible areas identified. These detailed flood lines should be used to regulate building construction and grade alteration. Changes to the Official Plan and Zoning Bylaw will be required.

  For other areas of the watershed the Municipality and the Conservation Authority should consider the use of fill regulations either as presently available under the Conservation Authority mandate or as proposed under changes to the Planning Act (if approved in its present form).

  Drainage

  There are several areas of existing development for which drainage has been identified as a significant concern. The Watershed Plan has reviewed the alternatives available to improve the drainage in these areas. In addition the degree of hazard associated with the poor drainage has also been assessed.

- **Diverse**

  "The watershed should provide for diverse landscapes, places and wildlife habitats, uses, programs and experiences."

  This principle encourages a willingness to accept alternatives rather than requiring consistency for all aspects of the watershed. It will require an openness to new ideas and vigilance to avoid dismissing proposals or the updating of uses merely for purposes of modernization or ensuring that the aspect is consistent with current thinking. This approach will rely heavily on the establishment of guidelines and standards against which to evaluate changes and the issue of enforcement.

  There should be a mix of uses along the Bay and the streams that are primarily water related and:

  - permit water access
  - enhance the community

- decrease the need for commuting by providing local employment
- are environmentally friendly
- minimize conflicts with adjacent uses
- are designed and managed to improve microclimate and promote greater year-round comfort and use.

- **Affordable**

  "Watershed development and management should provide opportunities for economic renewal and efficient use of limited government and private sector resources."

  This consideration has broad implications. For purposes of the Watershed Plan an evaluation of alternatives considered both the initial capital costs, maintenance costs, life expectancy, and periodic maintenance requirements of recommended stormwater management systems.

- **Attractive**

  "Design should create, protect and enhance distinctive and memorable places in the Watershed."

  In areas of multiple ownership, the design process should be coordinated among the owners. Ideally the owners would accomplish this coordination and involve the required agencies. In the absence of owner's cooperation, the Municipality should assume this role.

  The establishment of guidelines for each area as the basis for design would assist in this coordination. Such guidelines could take the form of cost sharing arrangements, identification of linkages, the coordination of services and the establishment of focus.

6.0 EVALUATION OF STORMWATER MANAGEMENT PRACTICES

An important objective of the Watershed Plan was to develop an approach to storm drainage which will address existing and future needs of the community and the natural environment. A practical implementation plan and comprehensive set of recommendations are included as Sections 7 and 8.

In this section, a variety of stormwater management options are reviewed. These are the basic approaches, techniques or activities which when combined will either resolve existing drainage problems or provide for future development that will meet the storm drainage objectives as outlined in Section 2.

It is important to note here that specific policies are being implemented by the Department of National Defence (DND). Within the South Sidney Planning Area new stormwater management facilities over 1 ha. in size will require approval from the DND. DND approval will be required for any stormwater management facility, regardless of size, within a 2 kilometre long "cone" starting at the end of the runway (see Figure 7.2 for approximate location of "cone"). Stormwater management facilities should be designed to be wildlife neutral to discourage use by gulls and waterfowl. Specific guidelines and procedures are still being formulated at time of writing. In addition, stormwater management practices must follow design guideline and criteria established by the Quinte RAP (Appendix H).

6.1 Evaluation Criteria

The criteria established for evaluation of various stormwater management alternatives are as follows:

a. Feasibility of Implementation

   This criteria consists of a general review of site characteristics and technical considerations related to physical likelihood that the proposed measure could be satisfactorily implemented given any existing physical, environmental and legislative constraints. The feasibility considers the known limitations of the design and the concerns that will need to be addressed in detailed design. Some of these concerns include public acceptance and availability of site area to accommodate the facility.

b. Effectiveness in Addressing Stormwater Related Issues (Quantity and Quality Management)

   The mitigation measure (stormwater management system) is evaluated as to its effectiveness in consistently meeting the established guidelines. Some measures may achieve modest success in only specific circumstances. Others may consistently satisfy the design requirements.

c. Potential Cost

Each measure is reviewed in terms of the order of magnitude costing for comparative purposes only. Consideration is given to both capital and operating/maintenance costs.

d. Impacts on the Natural Environment

An assessment is made of each measure to determine its anticipated impact on the environment based on the background information collected as part of this plan. All impacts are documented.

All alternatives have been evaluated for each criteria.

6.2 Review of Stormwater Management Measures

This review consists of a description of each option, together with a general evaluation and commentary on the application of the option. The options have been grouped into three categories, namely:

- Lot level
- Conveyance
- End of Pipe

6.2.1 Lot Level Controls

Lot level controls treat stormwater before it reaches a conveyance system. The following is a short description of each lot control measure and an evaluation of its applicability in the South Sidney Study Area.

a. Reduced Lot Grading

One of the significant criteria in establishing and controlling the extent of runoff from any land area is the nature and design of the site grading. Positive site grading is required to provide adequate site drainage. Measures to promote infiltration include minimizing drainage slopes and soil compaction.

i. Evaluation

Reduced site grading is to be encouraged. The Municipality does maintain certain controls on lot slopes and elevations which must be considered, but all efforts to minimize runoff should be made where feasible. Negative effects of limiting site grading are potential site development cost increases due to site specific servicing needs and occasional inconvenience from wet area.

ii. Application

We see the need to encourage limited and positive site grading for all new development and redevelopment. It will be particularly effective in areas where drainage is predominantly overland sheet flow and prolonged wet areas will not cause undue inconvenience (i.e. low use areas).

b. Roof Runoff (Roof Leaders)

Roof runoff should be directed onto grassed or other pervious areas, dry wells, ponding areas or to soaking pits to encourage infiltration wherever possible.

i. Evaluation

This approach requires careful assessment and design to ensure that any overflows are directed to grass swales and do not interfere with other uses or cause local flooding problems. Due to the private ownership there is no Municipal control or liability.

This method is effective in reducing flooding because it directs clean water to infiltration firstly and secondly into grassed swales and other systems which also encourage infiltration. There is relatively low capital and operating cost. The use of this measure will have a positive effect on water quality by encouraging infiltration and directing waters into more appropriate drainage channels. There will be limited negative environmental effects of such systems.

ii. Application

This measure should be encouraged in all development and redevelopment where soil/drainage conditions permit.

c. Pumping of Foundation Drains to Infiltration Areas

This measure is designed to promote infiltration by discharging foundation drainage to the surface or to soakaway pits. Both options are a slight improvement on discharge of the foundation drains directly to Municipal ditches.

i. Evaluation

The measure is effective in areas where soils will permit the infiltration of the pumped water, and the process will not be a continuous cycle of pumping the foundation drainage to surface infiltration areas where it eventually enters the foundation drain again.

ii. Application

This measure should be implemented in areas where adequate infiltration can be established and the temporary surface ponding will not cause undue inconvenience.

d. Buffer Strips/Filter Strips

Where drainage flows into a natural area such as a grassed swale or a watercourse, the possibility of introducing buffer strips or filter strips should be considered. These consist of natural vegetation or vegetation introduced for the specific purpose of retaining soil and water in a relatively low flow circumstance and providing a minimal treatment of this water as it travels across the buffer or filter strip. Filter strips, more formally established water quality cleansing facilities integrate flow spreaders and specific vegetation types. More woody vegetation may be considered where concentrated flows are an issue.

i. Evaluation

Buffer strips and filter strips are effective particularly in flat terrain where development areas abut natural areas such as the stream valleys. They have no effect on reducing flows. They represent low capital and operating costs; however, there is a requirement for the dedication of the land for this purpose which will reduce the development opportunities of these lands. There is an opportunity to address public open space requirements particularly if these strips are used in conjunction with trails and walkways. These strips are effective in flat terrain in improving water quality and can provide very good wildlife habitat and serve to protect fish habitat.

ii. Application

This measure has a number of local applications. The most obvious community wide application of natural buffer strips is along the stream valley and the shoreline of the Bay.

6.2.2 Conveyance

a. Grassed Swales

Water from individual lots can be directed to grassed swales usually located across the rear of residential properties to ultimately be collected by ditch inlet structures into the storm drainage system. Grassed swales can be maintained in a manicured lawn setting or they may be located in natural areas or allowed to revegetate with trees and shrubs.

i. Evaluation

This measure is feasible and should be encouraged. It requires ongoing policing to ensure that individuals do not fill the grass swale and thus redirect water onto other properties. This measure is somewhat effective in reducing flood damages and

flooding. It has a low capital cost and a low operating and maintenance cost. Where these lands are incorporated with other public open space uses such as walkways, they can have a limited effectiveness in adding to the public open space system. Grassed swales are effective in assisting in maintaining high standards of water quality, particularly in flat terrain. Grass swales have very limited negative environmental effects.

ii. Application

Because the existing and proposed development will be drained by open ditch, grass swales can be easily incorporated in all subdivision design and into the redevelopment of lots. Maintenance of grassed swales is an ongoing requirement. There is low capital cost and low maintenance cost assuming that the regular maintenance is already budgeted. With respect to water quality, regular semi-annual maintenance, particularly sediment removal and vegetative cover maintenance, is effective in achieving water quality objectives. Important considerations include appropriate selection of vegetation (e.g. wetland type grasses), reduction of drainage slopes, and length of swale.

6.2.3 End of Pipe

a. Extended Detention Dry Ponds

An extended detention dry pond is a facility designed to be dry at all times except when it is in use. Detention times typically vary from 24 to 72 hours to achieve a desired level of water quality control.

i. Evaluation

The feasibility of establishing extended detention ponds depends almost exclusively on the nature of the area and the extent of lands available to establish such a facility. It can be effective in achieving a reduction in flood flows, often represents a moderate capital cost and does involve certain operating and maintenance expenditures. Such structures can be effective in addressing the establishment of public open space and can produce a considerable improvement in water quality if properly designed. Negative effects on the environment are relatively limited except where existing vegetation must be removed to establish the pond. The most significant negative water quality impact of extended detention ponds is the increase in water temperature due to warming during detention periods.

ii. Application

Extended detention dry ponds are applicable in almost any soil condition and provides adequate stormwater quality control for residential areas and light commercial and industrial development where sediment control is the primary concern.

b. Wet Ponds

A wet pond is an area which is not designed to be dry at any time but rather maintains a permanent pool.

i. Evaluation

It is often more feasible and desirable to establish wet ponds where local water table permit or through the use of impermeable liners. These ponds can be effective in reducing flood flows downstream and represent a moderate cost in terms of both capital and operating. They can assist in establishing public open space as they should be located on publicly owned lands. They are quite effective in addressing water quality issues and are preferred to extended detention ponds in their ability to remove some contaminants from stormwater flows and maintain cooler discharge. They often introduce wildlife habitat to an area and encourage the retention of other wildlife features.

The most significant negative aspect of wet ponds is public liability due to the inherent dangers of open water on public lands.

ii. Application

Wet ponds are a preferred stormwater quality management option in that they are able to address the maximum range of inflow contaminants with the highest operating effectiveness. They do require larger land areas and need a carefully monitored establishment period. Wet ponds may be restricted in their application due to DND air base regulations.

c. Artificial Wetlands

As a variant on the wet pond, it may be possible to establish grassed swales or artificial wetlands in areas suitable for wet ponds. An artificial wetland where biological treatment processes have been engineered to achieve certain pollutant removal criteria are subject to a Schedule C Class Environmental Assessment under the Municipal Class EA for Municipal Water and Wastewater Projects (1993). Wetlands which are designed on hydrologic/hydraulic criteria would not be subject to a Schedule C Class EA.

i. Evaluation

This practice is feasible in a number of locations throughout the watersheds, especially where existing natural wetlands are situated. Public open space can be accommodated and water quality would be effectively treated by such a measure. Wildlife habitat would be improved and would probably be more extensive than that provided in a wet pond.

Negative aspects of artificial wetland facilities include the amount of area required to establish a given storage volume given the typically shallow depths. The potential for waterfowl attraction should also be considered carefully in light of the proximity of the CFB Trenton Air Base as well as the long-term accumulation of contaminants in sediment and vegetation and the potential to harm wildlife.

ii. Application

Artificial wetlands should be considered where local conditions permit and wetland planting should be considered in any proposed stormwater management facility where storage depths and fluctuations permit.

d. Infiltration Trench

An infiltration trench can be a useful option in small contributing areas.

i. Evaluation

The feasibility of this option depends on drainage area, slope and quality of runoff and is especially sensitive to local soil conditions. It may also be used in conjunction with other means. As an outlet, it should be last in a series of stormwater management practices to avoid sediment clogging problems, thereby being used primarily to maintain base flows, temperature fluctuations, and enhance groundwater recharge.

Negative aspects of any infiltration facility is the maintenance requirement. The filter materials tend to clog after a period of time and require replacement or flushing to ensure continued effective quality management.

ii. Application

This should be considered for new small sub-catchment developments where local soils permit and where there is a commitment to maintain the facility. Infiltration trenches may be subject to approval of the Ministry of Environment and Energy under the Environmental Protection Act.

e. Oil and Grit Separators (Water Quality Inlets)

These systems are specially designed to retain the initial runoff from such areas as parking lots and other areas susceptible to spills. These facilities are often required in industrial or commercial areas or in areas with potential for spills of other materials such as along transportation corridors.

i. Evaluation

Water quality can be positively impacted where these water quality inlets are introduced and sites are designed to incorporate the retention of any spills. Capital

costs of the more modern designs for inlets are typically substantial but maintenance is simple and with moderate costs.

ii. Application

The opportunity to introduce water quality inlets in industrial areas as a result of development or redevelopment of these areas and in commercial areas where large parking lots are involved should be considered. Water quality inlets at critical locations along major traffic routes would be beneficial to the local water quality.

f. U-V Treatment

Where water can be collected in a pond and where bacterial concerns are paramount, it is possible to provide for ultra-violet treatment of stormwater, particularly for the first flush of stormwater in a storm situation.

i. Evaluation

The feasibility of such a situation is dependent on establishing a well functioning retention system which can achieve a fairly clean discharge at a predictable standard velocity and volume. The capital cost is high and operating costs are also high. Water quality can be positively affected for bacteria.

ii. Application

On the basis of the water quality modelling exercise and the acceptable water quality treatment provided, there does not appear to be a specific need for U-V treatment.

7.0 IMPLEMENTATION

7.1 Environmental Farm Plan

The Environmental Farm Plan was developed by a group known as the Farm Coalition. The plan consists of a manual divided into 23 modules, each of which has worksheets on various topics.

The program is conducted in two parts: the first part is a self assessment of the farm which is 17-18 modules. During this assessment the various portions of the farming operation are categorized into one of four categories: 1, 2, 3 or 4, with 1 representing a poor state and 4 representing the best state. The objective is to improve all of the modules and farm operating elements to a 3 or 4. The action plan which is the second part of the process then identifies those areas which are categorized as either 1 or 2 and develops a plan for moving these to a 3 or 4. Affordable solutions are sometimes difficult to find but the process focuses the farmer's attention on areas in which improvement is required. Government assistance is available both in workshops and in the preparation of detailed plans.

In the past the workshops have been sponsored by the Ontario Soil and Crops Association with funding provided by the Federal Green Plan. The Soil and Crops Association hired field representatives (1 per County) to organize the workshops. One government representative was also identified to help with the technical aspects of the workshop. The workshop then proceeds to provide an opportunity for discussion among the participants and to work through two worksheets related to water wells and soils.

A second day is scheduled approximately one week later. The farmer is expected to come back with the plan complete or to have identified areas in which he needs help. The farmer, after the second day of problem solving, is left to complete the plan.

The farmer is free to submit the plan to the Soil and Crop representative who then reviews and summarizes the plan and identifies his summary by number only. Confidentiality is a critical aspect of this part of the program. The Soil and Crop representative also tabulates information which is provided to a central facility at Guelph which is monitoring the nature of problems identified and the extent of development work in order that an assessment may be made of the need for further resources and assistance. The Soil and Crop Association representative then submits the plan for peer review by a committee appointed by the Soil and Crop Association, usually 3 or 4 representatives, all of which are farmers. No government representative is included.

The purpose of this committee is to evaluate the plan. If the plan is found to be acceptable, it is then approved. In certain circumstances the plan may be referred back to the farmer for further work or it may be rejected. In any event, the plan is submitted back to the farmer and no record of his participation is kept by either the peer review committee or the Soil and Crop representative. The only individual who knows the identity of the farmer is the Soil and Crop representative.

The EFP is voluntary. The plan will not be available for any kind of government review.

Completion of the plan ensures eligibility for a $500 grant for improvements, as well as a commitment by the government that any future environmental assistance programs would require cross compliance. This means that in order to be eligible for funding a farmer would have had to complete an Environmental Farm Plan.

The Environmental Farm Plan is an excellent example of a cooperative effort designed to assist individuals to understand the environmental implications of their land management decisions and develop a specific program to improve the environment. This plan supports the objectives of the Watershed Plan. The process will benefit the watershed and could be expanded beyond the farm community.

7.2 Surface Water Quality Monitoring

Although the sampling program conducted for this Plan did not identify point sources of water quality contamination, there are several areas of concern, namely:

- the west branch of Meyers Creek appears to receive higher loadings of contaminants, including nutrients and bacteria, than the east branch or the other watercourses;
- urbanized areas within the South Sidney Secondary Plan Area appear to be contributing greater loadings of contaminants, particularly metals, to the Study Area watercourse than the upper reaches. Excess levels of nutrients and bacteria are also evident;
- 1994 water quality sampling results did not differ significantly from the results of other monitoring carried out since 1985;
- surface monitoring does not indicate impact from the Aikens Road Landfill at this time. There are, however, concerns regarding leachate plumes emanating from the Aikens Road Landfill based on previous studies.

In order to provide additional water quality information an ongoing monitoring program is recommended. This program should focus on the following:

- water quality stations WQ 1, WQ 9 and WQ 11 at the mouth of Meyers Creek, watercourse 2 and Massey Creek should be monitored for nutrients (nitrogen, phosphorous), bacteria (*E. coli*) and metals (zinc, cobalt, lead, iron, aluminum, calcium, strontium, copper). Sampling should occur in mid-winter (base flow), spring freshet, summer (base flow) and if possible a summer storm event;
- Station WQ 10 should be sampled in the mid-winter and summer base flow periods for metals, as above, on an on-going basis (perhaps in association with the Aikens Road Landfill water quality sampling program) to detect any surface breakout of the leachate plume.

7.3 Land Use Planning

Environmental Constraint Areas

Environmental Constraint Areas are delineated in both the Official Plan and the Secondary Plan for the South Sidney Secondary Planning Area in a separate land use designation. This designation includes floodplains, wetlands, sensitive fish habitats and poorly drained lands. Figure 7.1 shows environmental constraint areas. The Official Plan provides a separate designation for Provincially Significant Wetlands. All other wetlands are included in the Environmental Constraint designation. The Zoning By-law is being updated to comply with the Official and Secondary Plans. The following are recommended changes to planning documents resulting from the information developed in this Watershed Plan.

7.3.1 Floodlines

a. Official Plan

The Official Plan, in Section 4.2.3 (n), provides a listing of available floodlines. In an updating Amendment this list should be changed to include floodlines within the South Sidney Secondary Plan area.

b. South Sidney Secondary Area

i) Bay of Quinte Regulatory Shoreline

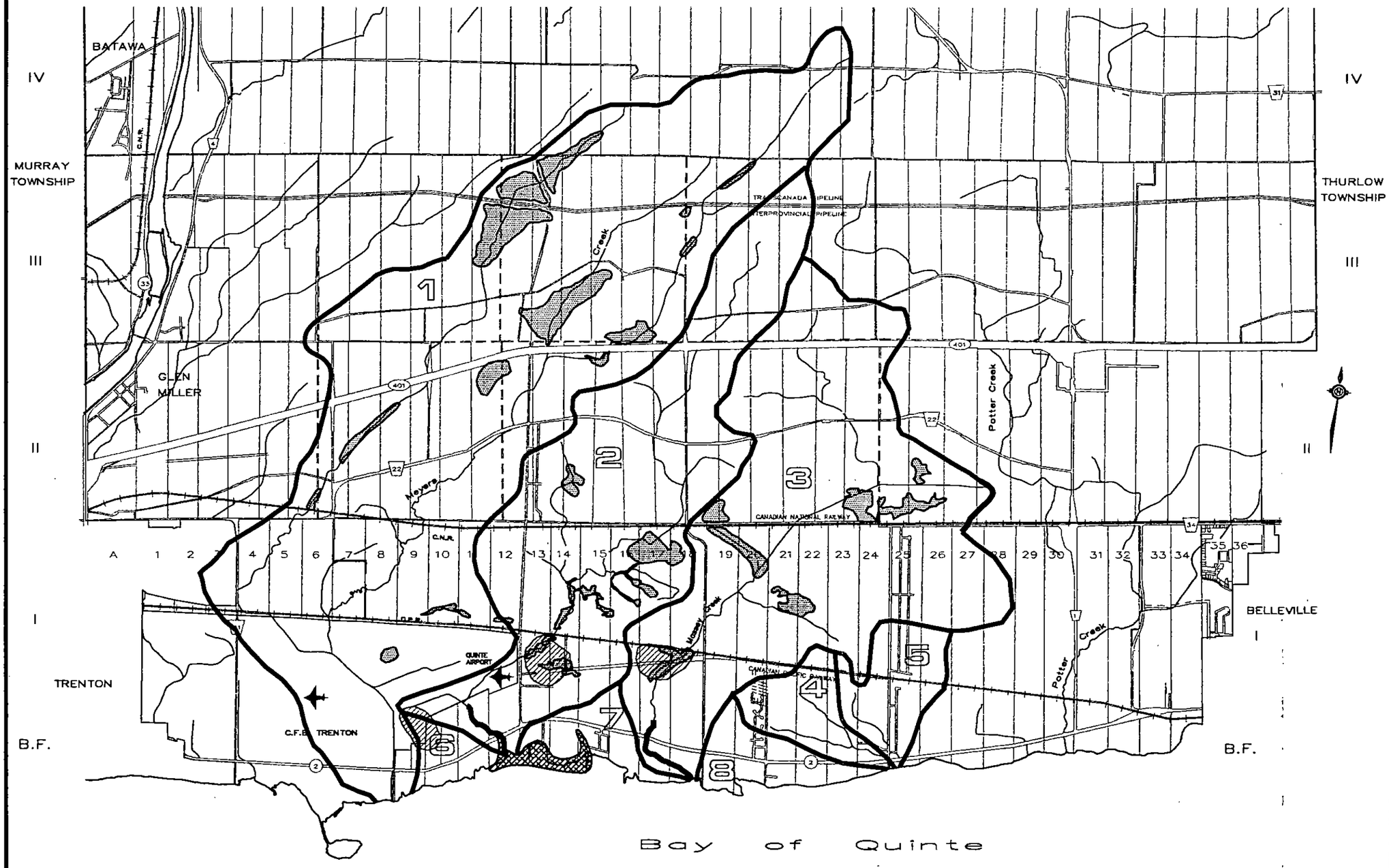
The Secondary Plan references a floodline and setbacks along the Bay of Quinte shoreline. Detailed mapping is available. The setback is the greater of the regulatory dynamic beach, the regulatory flood standards and/or the regulatory erosion standard. No change in the document is required, however, in subsequent updates the actual location could be used for information purposes.

ii) Streams

The computed floodlines prepared for this project should replace the photo interpreted environmental constraint areas on Schedule A. The text of the Secondary Plan refers to the lack of computed floodline elevations. This reference should be amended to indicate that the floodlines are now available. Floodline elevations have not been computed for the smaller streams but the existing Environmental Constraint designation should be retained as an indication of the low lying areas. Some manipulation of these areas could be allowed during design consistent with the policy for non-engineered floodlines.

For the most part the computed floodlines follow stream valleys and do not represent a dramatic departure from the airphoto interpreted Environmental Constraint designations used to develop Schedule A. The exception is the area immediately south of the CN Rail line between Whites Road and Aikens Road.

Township of Sidney



LEGEND

- PROVINCIALLY SIGNIFICANT WETLAND
- LOCALLY SIGNIFICANT AND UNEVALUATED WETLANDS
- POTENTIAL RECHARGE AREA
- CANDIDATE TYPE 1 FISH HABITAT

NOTE:
FLOODPLAIN AREAS ARE IDENTIFIED ON THE ASSOCIATED FLOODPLAIN MAPPING

30m SETBACK CONSTRAINTS (15m ON EACH SIDE) ALONG WATERCOURSES ARE ALSO REQUIRED TO PROVIDE: BUFFERING FOR STREAMS; IMPROVEMENTS TO FISH HABITAT THROUGH NATURAL VEGETATION, AND; POTENTIAL WILDLIFE CORRIDORS LINKING LARGE HABITATS THROUGHOUT THE WATERSHEDS.

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LOWER TRENT REGION CONSERVATION AUTHORITY

TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

ENVIRONMENTAL CONSTRAINT AREAS

DRAWN BY:	CHECKED BY:	DATE:
F.B.	S.R.S.	DEC 15/94
DESIGNED BY: S.R.S.	APPROVED BY: S.R.S.	PROJECT: 24-14164-04
SCALE: 1:50000	FIGURE No.: 7.1	

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This area may be a candidate for a two-zone approach to floodline protection. Such an approach will require further assessment but may assist in freeing-up lands which otherwise will be constrained by the computed floodlines.

c. Zoning By-law

The EP Zones in the implementing Zoning By-law for the South Sidney Secondary Plan area should be reviewed to determine compliance with the floodline mapping and the Regulatory shoreline along the Bay of Quinte. The Municipality may wish to consider the addition of a suffix to the Environmental Constraint Zone to indicate that the zone is based on detailed floodline mapping. In some circumstances the addition of a reference to elevation may be desirable. This possibility should be reviewed as part of the Zoning By-law review.

7.3.2 Wetlands

Bayside Wetland is identified as a provincially significant wetland. It should be delineated in the Secondary Plan as a Wetland designation with specific policies consistent with Goal 2 of the Comprehensive Set of Policy Statements issued by the Ministry of Municipal Affairs. The inclusion of restrictions on uses within the 120 metre adjacent lands in accordance with Policy 2.5 will have implications for the landowners affected. Policy should be added to the Secondary Plan to address the nature of concerns to be addressed prior to any development approvals for these adjacent lands. In view of the built up areas already present on the adjacent lands the proposed holding zones should be sufficient to comply with the Policy Statement. The Ministry of Natural Resources have indicated that development review should suffice in this area.

All other wetlands within the South Sidney Secondary Plan, except for the Bayside Wetland, have been identified as not Provincially Significant. These wetlands would therefore be included in the Environmental Constraint designations of both the Official Plan and the South Sidney Secondary Plan. We would also recommend that a setback be added to these wetlands of 15 m and that a Policy be added to the Official Plan and the South Sidney Secondary Plan with respect to wetlands and the need for regulation of fill within these wetlands. The Schedule of both the Official Plan and the South Sidney Secondary Plan should be reviewed in view of the boundaries of the wetlands delineated in this Watershed Plan.

The Zoning By-law should be revised to include an Environmental Constraint Zone for these wetlands so that zoning of the wetlands is specifically identified within the Zoning By-law. A regulation should be added to explain the use of the suffix and also to add a requirement for a minimum 15 m setback from the wetland boundary. Discussions with Municipal staff have highlighted their preference that no distinction be provided in zoning. The Bayside Wetland, a provincially significant wetland, would normally require zoning for both the wetland and the adjacent Bayside lands. However, MNR has acknowledged the relationship to areas having historical or pre-approved development. In view of the presence of built up areas already present around the wetland no special zoning is warranted according to correspondence with

the Ministry of Natural Resources. Development review should include consideration of the implications of development on the wetland.

7.3.3 Fish Habitat

The Type 1 fish habitat areas should not be permitted to be channelized, blocked or otherwise disturbed without concurrence and the appropriate work permits from the Ministry of Natural Resources.

7.3.4 Natural Areas

The natural areas within the South Sidney Secondary Plan and in the remainder of the Watershed Plan area have been reviewed through aerial photo interpretation. Mapping of these lands outside the South Sidney Secondary Plan area is available from the Municipality. We have reviewed this interpretation and find it to adequately represent the major naturally vegetated riparian areas along the streams. No change is required for Official Plan policy or schedule in view of the general nature and policy which allows variation of the lands designated based upon updated information. In the Zoning By-law Update, which implements the Official Plan, the boundaries provided by the aerial photo should be used.

7.4 Development Review

Conditions for development are included in the Official Plan and the South Sidney Secondary Plan. We recommend the following policy changes:

- That the Official Plan policies be amended to expand the Vision Statement to include policies with respect to environmental issues.
- That Section 6.2, Stormwater Management, should be revised to reflect the completion of the South Sidney Watershed Plan.
- The recommendations of the South Sidney Watershed Plan should be included in specific policies in Section 6.2 and should be referenced in Section 6.7 which provides for the various implementation and development review techniques.

The nature of changes to the Zoning By-law have been referred to in the previous section.

Subdivision and Condominium Approval Reviews are referenced in Section 7 of the Official Plan. An additional reference should be added to this Section to indicate that where these developments occur within the South Sidney Watershed reference should be made to the Watershed Plan for recommendations with respect to protection of the natural environment.

In a similar manner, reference should be made in Section 7 and Section 7.13 in the Official Plan for Site Plan control. Collaborative review should be emphasized.

7.5 Servicing

The Official Plan contains general policies with respect to stormwater management. These policies, with the amendments suggested above, will reflect the recommendations of the Watershed Plan. The South Sidney Secondary Plan should be revised to reference the completion of the Watershed Plan. The document currently refers to the need for such a Watershed Plan and therefore this amendment is not critical unless other amendments to the Secondary Plan as referred to above are made. Specific references should be made to the findings, particularly with respect to the nature of the Stormwater Management Practices identified in the Watershed Plan for this area.

On a related matter, in the areas designated as Water Only Residential in the Secondary Plan, the use of individual sewage disposal systems is anticipated. In view of the possible concern with respect to bacterial contamination, and the current Provincial policies requiring a review of servicing options, Developers within this area will be required to justify the use of individual sanitary sewage disposal systems. In preparing the Watershed Plan the possibility of communal sanitary services has been considered. This type of service will not significantly change either the yield in terms of residential density or the nature of stormwater runoff.

7.6 Stormwater Management Practices

7.6.1 General

The selection of stormwater management practices depends on a number of factors: the type of development, the percentage of impervious surface, the size of the catchment area, soil types and the habitat type of the receiving waters, as well as the site specific physiographic conditions. These factors are used to identify the appropriate type of facility.

Due to the various sizes of the development opportunity areas within the South Sidney Planning area, some stormwater management practices become more feasible than others from an implementation perspective as well as an operation and maintenance perspective. General recommendations for implementation of stormwater management measures on an individual site basis and on a communal basis are discussed in the following sections.

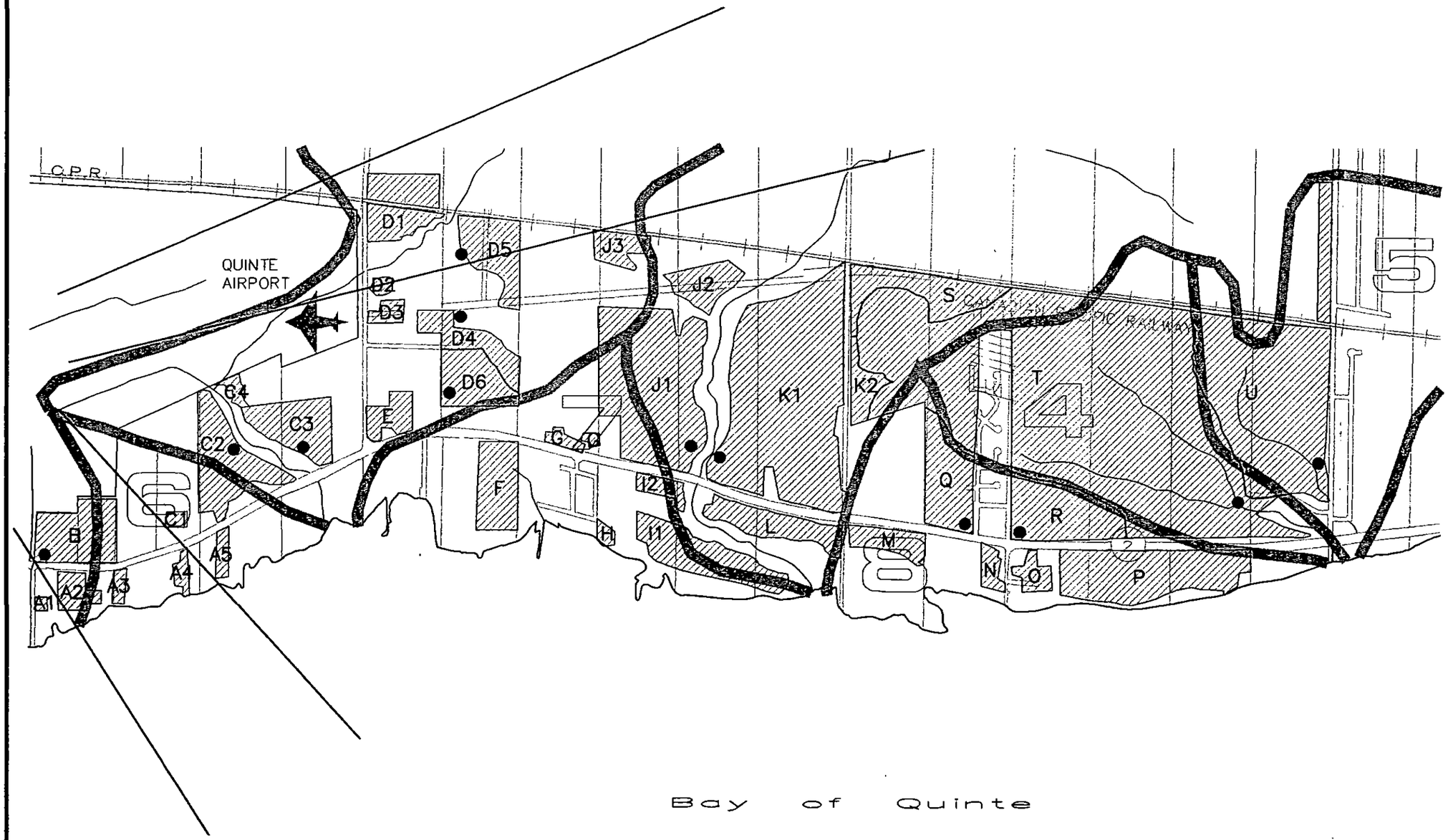
A summary of proposed stormwater management measures for each of the individual development areas is found in Section 7.6.4. Reference should be made to Figure 7.2 for location of the specific development areas.

Procedurally, we recommend that the Conservation Authority be the lead agency in providing comments on the nature of the stormwater measure required.

7.6.2 Individual (Non-communal) Stormwater Management Facilities

There are a number of sites in the Development Area where the construction of a communal stormwater management facility is not practical or is not a prerequisite of development. Many of these sites are small single lots that cannot be connected to the proposed communal

Township of Sidney



LEGEND

- A1 DEVELOPMENT OPPORTUNITIES
- COMMUNAL STORMWATER MANAGEMENT FACILITY
- APPROXIMATE BOUNDARY OF DND REQUIRED APPROVAL "CONE"

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LOWER TRENT REGION CONSERVATION AUTHORITY

TOWNSHIP OF SIDNEY

SOUTH SIDNEY WATERSHED PLAN
TOWNSHIP OF SIDNEY

LOCATION OF COMMUNAL STORMWATER MANAGEMENT FACILITIES

DRAWN BY: F.B.	CHECKED BY: R.W.	DATE: SEPT 28/94
DESIGNED BY: R.W.	APPROVED BY: R.W. & B.R.	PROJECT: 24-14164-05
SCALE: 1:20000	FIGURE No.: 7.2	

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sites or lots whose development will not affect the long term creation of a communal system. These sites are discussed in more detail in the following paragraphs.

In considering the nature of stormwater provisions to be applied to these sites, the following ideas were suggested:

- The nature and sensitivity of the receiving stream should be determined, particularly with respect to the quantity conditions downstream. This determination will assist in evaluating the importance of the stormwater facilities to be required.

- The extent of the area contributing to the runoff from upstream of the site and the upstream drainage conditions must be considered. This is intended to provide an appreciation of the area contributing stormwater to the site and any quantity related impacts. This stormwater and its characteristics must be considered in the design of the site drainage system.

- The natural environment on-site and on adjacent lands. This should consider the need for protection and/or enhancement to the environment.

- The stormwater improvements will be limited to lot level controls or small individual stormwater quality/quantity management facilities. Section 6.2 provides a review of available measures. The specific nature of controls will depend on the feasibility and the effectiveness of addressing the site specific drainage characteristics.

The type of development and proposed land cover will dictate the type of stormwater management facility necessary to satisfy the Stormwater Management Design Criteria/Guidelines for the Bay of Quinte Stormwater Management Implementation Area. Suggested approaches for the individual development opportunity areas are presented in Section 7.6.3.

Any proposed stormwater management scheme must be shown to meet the Stormwater Management Design Criteria/Guidelines to the satisfaction of the Conservation Authority, the Ontario Ministry of Natural Resources and the Ontario Ministry of Engergy and the Environment.

Maintenance of proposed stormwater management facilities for indivdual developments will be the responsibility of the property owner in perpetuity. The Developer of the property must guarantee to the satisfaction of the Municipality and the Conservation Authority that the maintenance requirements will be fulfilled. The Municipality and Conservation Authority may require that the Site Plan or Subdivision Agreeement make allowance for significant fines or monetary penalties should the maintenance agreement not be fulfilled. Should the Developer, Municipality and the Conservation Authority agree to a maintenance program, continuance of the program should be a condition of sale of the property in the future.

Generally, it is the intent of the Quinte RAP and the policy of the Southeastern Region of the MOEE that maintenance responsibilities for stormwater management facilities eventually be

turned over to the Municipality. Therefore the maintenance philosophy suggested in the preceeding paragraph is not consistent with the intent of the Quinte RAP or the policy of the Southeastern Region of the MOEE.

An alternative may therefore be offered to the Developer at the discretion of the Municipality and the Conservation Authority. This alternative would permit the Developer to provide a cash contribution to the Municipality in lieu of providing on-site stormwater management facilities. The cash contribution would be used by the Municipality to establish a communal facility downstream of the proposed development such that some water quality benefit may be achieved for a larger drainage area (i.e. bigger 'bang for the buck'). The amount of the cash contribution should be based on the capital cost of an acceptable on-site facility for the individual development and the present value of the related operation and maintenance costs of that facility for a period of 50 years.

7.6.3 Communal Stormwater Management Facilities

The evaluation of communal stormwater management facilities (specifically detention facilities) within the scope of this Study assumed a configuration typical of an extended detention dry pond in continuous operation mode. This assumed configuration does not necessarily imply that an extended detention dry pond is the preferred communal facility for any of the communal development areas.

Detailed stormwatermanagement plans for each of the communal development areas will be necessary as development proceeds. The stormwater management process should consider the full range of stormwater management measures within the context of the proposed development plan and any existing natural features, habitat opportunities or environmental constraint areas.

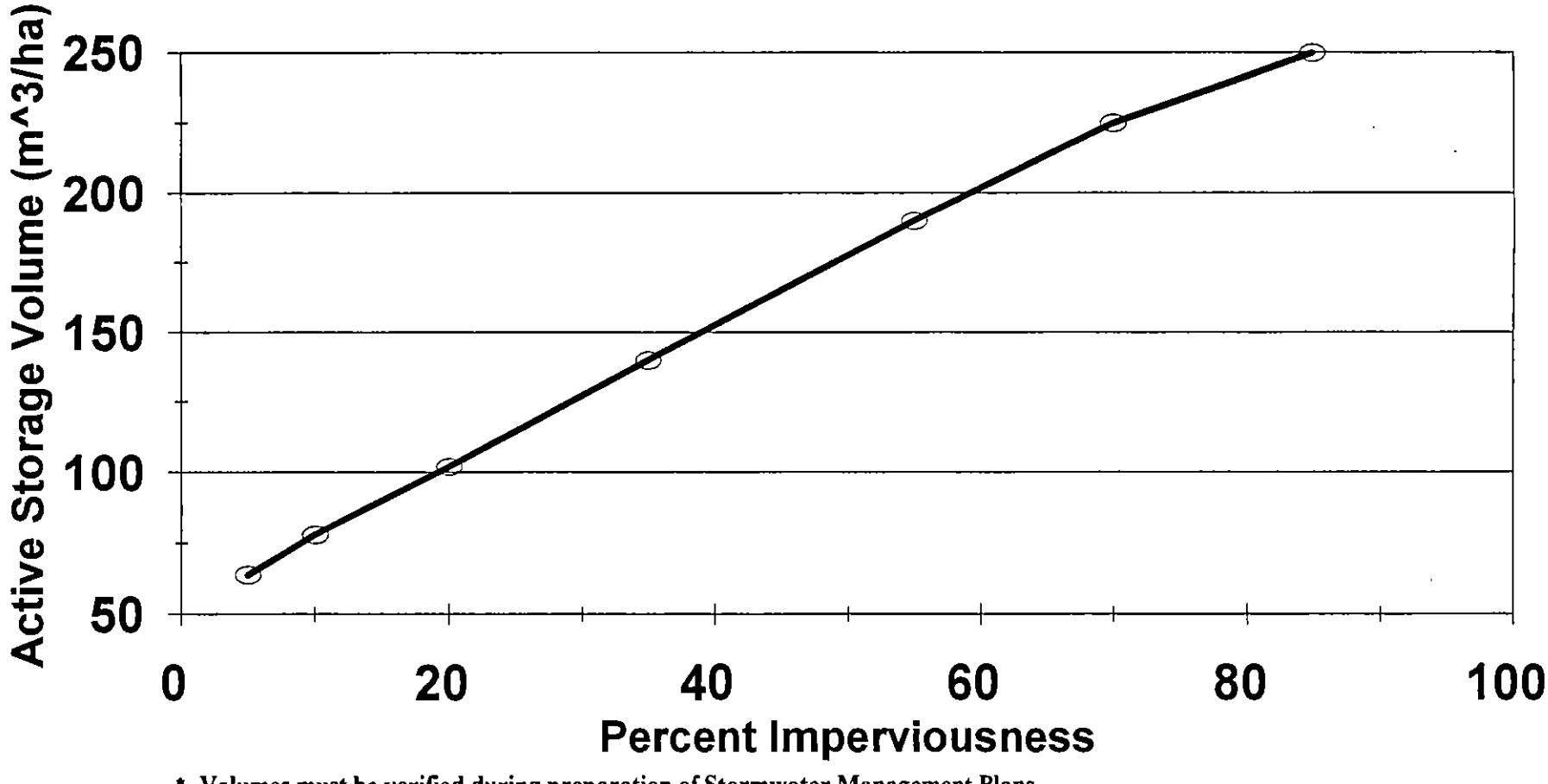
The recommendations presented herein are based on a watershed scale analysis and should be "tuned" to enhance the natural environment where possible. Should development occur such that the stormwater management facilities suggested herein are not consistent with the development concept and alternative facility locations and configurations are more consistent with water management objectives, preliminary facility sizing should be based on the general guidelines presented below.

The hydrologic, hydraulic and water quality modelling exercises performed as part of this Study indicate that the following design criteria should be used in designing communal stormwater management facilities:

i) Active storage volumes should be provided in accordance with those specified for Level 1 habitat protection by the MOEE "Stormwater Management Practices Planning and Design Manual" (June 1994) for wet ponds. Figure 7.3 depicts the volume requirements per hectare based on the imperviousness of the proposed development.

ii) The facility should be designed to provide a drawdown time of 72 hours.

Recommended Active Storage Volumes For Stormwater Management Ponds *



* Volumes must be verified during preparation of Stormwater Management Plans

Figure 7.3

iii) The outlet invert elevation of any stormwater quality facility must be constructed above the 25 year flood elevation with the emergency spillway elevation set above the 100 year flood elevation. This criteria will ensure that the facility operates without impact from receiving waters the majority of the time.

iv) Stormwater quality management facilities may be located outside the 25 year floodline provided that:

- there are no detrimental impacts to valley land values or corridor processes;
- the facility must not affect fluvial processes in the floodplain;
- the cumulative effects resulting from changes in floodplain storage do not adversely affect existing or future development.

v) Quality control from communal facilities outletting to the major watercourses (No's. 1, 2, 3 and 4) is not necessary from a flood risk perspective. Local erosion conditions and site specific constraints should be considered in these locations during Stormwater Managmeent Plan preparation to confirm that quantity controls are not necessary.

Any stormwater management facility constructed for quantity control purposes along the major watercourses must be situated outside the Regional storm floodline.

vi) Communal facilities outletting to Municipal drains will require quantity controls to prevent downstream flooding.

vii) Any stormwater management facilities situated along the Bay of Quinte shoreline must remain outside the Regulatory Shoreline.

In those areas to be serviced by a communal facility where development will proceed slowly, interim stormwater management measures may be required with off-site improvements (construction of the commnal facility) to take place some time in the future. Under these circumstances the Municipality, with the assistance of landowners, should consider development of a privately supported fund from lots developed in advance of the communal system. It may be possible to use an area service program to facilitate if a voluntary program cannot be established through development agreements. The legislative authority for such a fund should be explored. Such a fund would also provide a mechanism to facilitate cooperation between adjoining development interests where the communal stormwater facilities are sited on one owner's lands to the benefit of others.

7.6.4 Specific Stormwater Managment Recommendations

A summary of the proposed stormwater management facilities recommended for each of the Development Opportunity areas identified in Figure 7.2 is provided below.

A1. This area is currently vacant. Due to the small size and type of proposed development (low intensity residential), lot level controls are suggested. These would include reduced lot grading, roof leaders discharging onto pervious areas (or to infiltration trenches or

soakaway pits) and establishment of filter strips along the watercourse. The sandy soils are appropriate for infiltration-type stormwater management facilities if a commitment for maintenance can be established.

A2. This development area is also small and is currently vacant. The type of development, urban residential, requires similar controls to A1 (reduced lot grading, roof leaders discharging to pervious areas and filter strips). The filter strips should be established along the Bay to intercept the surface drainage. All development, including stormwater management facilities, will be directed to areas outside of the Regulatory Shoreline.

A3. This development area is also small and currently has low intensity residential development. It will be commercially developed and could therefore have a highly impervious surface. Should a large parking area be associated with this development, runoff should be concentrated to an oil grit separator, sand filter or some other small storage facility. Pervious drainage system components (i.e. pervious catchbasins to infiltration pits) may be appropriate. A significant buffer/filter strip should be planted to mitigate the erosive potential of runoff from this long, narrow site. All development, including stormwater management facilities, will be directed to areas outside of the Regulatory Shoreline.

A4. Development Area A4 is a small proposed low intensity residential area located between Highway 2 and the Bay of Quinte. It is currently vacant. Drainage is primarily south towards the Bay. Lot level controls and buffer/filter strips should be incorporated to minimize sediment delivery to the Bay. All development, including stormwater management facilities, will be directed to areas outside of the Regulatory Shoreline.

A5. This proposed low intensity residential development area is situated between Highway 2 and the Bay of Quinte. This area, like Area A4, drains south to the Bay. Lot level controls and appropriate vegetative buffer/filter strips should be implemented as stormwater management techniques. All development, including stormwater management facilities, will be directed to areas outside of the Regulatory Shoreline.

B. Development Area B is a proposed industrial development situated northeast of the Highway 2 crossing of Meyers Creek. Part of the area has low intensity residential development. The development is situated on sandy loam soils and is drained under existing conditions by the ditch along Highway 2 and a small drain approximately 300 m north of Highway 2. A portion of the proposed development area would necessitate filling a low lying area which presently has no defined outlet and is situated on the sandy loam plain. This area is identified as a potential recharge area. There is also a small wooded/natural regeneration area. Therefore development proposals should give consideration to this fact.

A communal facility is proposed assuming that the entire area will be developed as presently planned. Should the potential recharge area be maintained in its natural state, a reduction in the size of the proposed facility could be warranted.

The optimum location for the proposed facility has been identified at the outlet of a small drain approximately 50 m north of Highway 2.

C1. Development Area C1 is a small existing commercial development which lies on the drainage divide between watercourses 1 and 2 just north of Highway 2. The area could be drained to facility B or C2 depending on development phasing.

Should the area develop individually before a facility is established at location B or C2 an individual outlet may need to be established. Opportunities for use of the small depressed area immediately north of the site as a component of the stormwater management plan (e.g. infiltration) may be considered. Should this option be pursued, pre-treatment of runoff with an oil/grit separator is recommended.

C2. Development Area C2 is a large area proposed for industrial development adjacent to the Bayside Wetland. The Ministry of Natural Resources should be consulted to determine if an EIS will be required for development on these adjacent lands. It is currently vacant. Presently, a significant portion of the Bayview Estates area outlets through a small draw in this area.

A communal extended detention facility is proposed at the outlet of this draw to provide the most effective capture of the development area. Therefore some of the existing Bayview Estates development will be treated by the proposed stormwater management facility.

The proposed facility may be located within the Regional floodline and integrated with the natural corridor produced by the floodline. Protection of riparian vegetation is a priority.

C3. Industrial development is also planned south of the existing mobile home park area east of watercourse 2 adjacent to the Bayside Wetland. The Ministry of Natural Resources should be consulted to determine if an EIS will be required for development on these adjacent lands. Presently, this vacant area outlets through an existing ditch approximately 150 m upstream of the Highway 2 crossing.

An extended detention facility is proposed at the outlet of this ditch to maximize drainage potential. About 60% of the existing development immediately north of the proposed industrial development must be treated by this facility if it is located at the outlet of the small ditch.

The proposed facility should be integrated within the protected floodplain in a natural setting with buffer and filter strips and appropriate vegetation. The facility may be located within the Regional floodline but outside the 25 year floodline, provided that all relevant regulations are satisfied.

It is not clear where surface runoff (if any) from the existing sewage lagoons will outlet. Due to the nature of any potential runoff from the lagoons, it is recommended that

drainage for the proposed industrial development does not permit sewage lagoon runoff to flow to the stormwater management facility. In the event that surface drainage from the lagoons does presently drain through the proposed development area, special measures should be taken to address the situation.

C4. Development Area C5, currently vacant, is a small proposed low intensity residential area at the west end of the existing mobile home park on the east side of watercourse 2. It is not likely that this area can be drained to the stormwater management facility in Area C3 because of a small ditch draining from the existing mobile home park.

Should this area develop, lot level controls and conveyance controls would be appropriate. Reduced lot grading, discharge of roof leaders to pervious surfaces and buffer/filter strips along the watercourse are suggested. Development should consider the wooded/natural regeneration areas that exist on site. Should a small conveyance system be established for this area, it should be designed to promote sediment removal.

D1. Development Area D1 is a small proposed industrial development at the southeast corner of the intersection of Whites Road and the CP Rail tracks. It is currently vacant. This area is separated from watercourse 2 to the immediate south by a ridge of land. There is no apparent existing outlet and the area has become a localized wet pocket.

Appropriate stormwater management facilities for this area should be identified by a site specific stormwater management plan. End of pipe facilities such as an oil/grit separator or a small storage facility will likely be necessary. These facilities should be integrated with the adjacent floodplain and wetland where possible. The natural creek corridor and its riparian vegetation should be protected and enhanced where possible.

D2. Development Area D2, currently partly vacant and commercial, is a small proposed commercial site at the northeast corner of Whites Road and an extension of Perimeter Road. A portion of this area is within the Regional storm floodline and some wooded/natural regeneration areas are on site.

Any future development of the site should provide appropriate stormwater quality management as identified by an individual stormwater management plan. An oil/grit separator with appropriate buffer and filter strips within the Regional floodplain may be appropriate.

D3. This existing institutional area at the southeast corner of Whites Road and the Perimeter Road extension drains to watercourse 2 through an existing ditch along Perimeter Road. Appropriate stormwater management facilities should be identified by an individual stormwater management plan, and may include an oil/grit separator or a small detention facility on-site. There is little opportunity for buffer strips or filter strips in this area.

D4. A communal extended detention facility is proposed for Development Area D4. This area is currently vacant. Proposed development in this area is industrial. A small area of existing residential development along Quinte Street would naturally drain to this area.

The proposed facility may be incorporated with the existing low lying area within the Regional floodplain using appropriate plantings and filter strips. The outlet from this area is very poorly defined and should be investigated before any stormwater management options are approved.

D5. Development Area D5 is located south of the CP Rail tracks and west of Kenron Estates. This vacant area drains to the east towards the large floodplain area. An extended detention facility is recommended to service this area, and it should be integrated with the existing Regional floodplain and wooded/natural regeneration areas through riparian plantings and integration of buffer/filter strips.

This facility would collect a small area from Kenron Estates unless a by-pass ditch is constructed in conjunction with the proposed development.

D6. Development Area D6, currently vacant, is a proposed industrial area east of Kenron Estates and north of Highway 2. This area is connected to the area proposed to drain to Area D4 but separated hydrologically by an elevated section of land.

An extended detention facility is proposed for this area at the southwest corner of the development. Some channelization work will be required to establish connection to the defined ditch to the south. Some form of quantity control may also be necessary depending on the hydraulic capacity of the culverts under Highway 2 and private entrances downstream.

A local depressed area immediately west of the proposed development appears to outlet across the development area. This area must be accommodated in the stormwater management facility or in a by-pass channel under ultimate development conditions.

It may be possible to drain the proposed industrial Development Area D4 to this facility for economic efficiency. However, quantity control would most likely be necessary. The small diversion would have insignificant hydrologic impacts from a watershed perspective.

E. This proposed commercial development at the northeast corner of Highway 2 and Whites Road is a small site which drains to the existing ditch along Highway 2, ultimately outletting to the Bayside Wetland. Low intensity residential and commercial development currently exists on site. Lot level controls where feasible and an oil/grit separator or small detention facility may be necessary for this site.

F. Development Area F, currently vacant, is a relatively large area of proposed low density residential development. The area presently drains to a few existing natural draws which ultimately outlet to the Bayside Wetland. A proposed stormwater management plan has received Draft Plan approval for this area. Details of the design of the facility should be in accordance with the MOEE Stormwater Management Practices Planning and Design Manual, volumes should be consistent with Level 1 habitat protection requirements and

detention should be provided for a period of 72 hours to achieve the desired water quality management objectives.

Specific development restriction including recognition of the 120 m "adjacent area" and EIS requirements should be considered in subsequent plan reviews wherever possible, given the Provincially Significant Status of the Bayside Wetland.

All development should be directed to areas outside the Regulatory Shoreline if opportunities for such restrictions are possible in subsequent plan review processes.

G. This small commercial development along Highway 2 drains to the existing Highway 2 ditches, ultimately outletting to the Bayside Wetland complex at the Bay of Quinte. It is currently vacant with some commercial development. Individual development specific stormwater quality management measures such as oil/grit separators or storage facilities may be necessary to control pollutant runoff from the site.

H. Low intensity residential development is proposed for this small vacant area situated along the Bay of Quinte. The MNR should be consulted to determine if any EIS will be required for development on these adjacent lands.

All development will be directed to areas outside the Regulatory Shoreline.

I1. Development Area I1 is located along the southern side of watercourse 3 as it runs parallel to the Bay of Quinte. It is currently vacant with some agricultural development. Collection of stormwater from this development may not be feasible depending on the development configuration. If this is the case, lot level controls with filter/buffer strips along waterfront areas are recommended. Development should be integrated with the wooded/natural regeneration areas on site.

If centralized collection is feasible, a small storage area to promote sedimentation would be appropriate.

All development will be directed to areas outside the Regulatory Shoreline.

I2. Development Area I2 is a small vacant area of proposed low intensity residential development immediately south of Highway 2 along watercourse 3. The area drains to watercourse 3 through a small local depression to the south.

Lot level controls and filter/buffer strips would be appropriate for this area. It may be possible to incorporate runoff from the development area to the south (part of I1) and provide centralized stormwater management within the small depression provided that this area is not a spawning or habitat area for local fisheries. 1994 fisheries studies did not confirm this type of usage but it will require further investigation.

J1. Development Area J1 is a large proposed low intensity residential area along the west side of watercourse 3 (Massey Creek) north of Highway 2. It is currently agricultural with low density residential development.

An extended detention facility is proposed on the existing natural draw about 150 m north of Highway 2. This facility could be integrated within the natural area designated as the Regional storm floodplain provided that all relevant fill regulations are met and the facility is maintained outside the 25 year floodplain. Preservation and improvement of the riparian zone should be a component of any development.

J2. Development Area J2 is a small proposed industrial development area draining to watercourse 3. It is currently vacant with some agricultural development. Drainage of this area is relatively undefined and the Regional storm flood spills to an area along the north and west sides of the site.

A small detention facility or large oil/grit separators may provide acceptable stormwater management for this site. It is possible to incorporate a detention facility within the Regional storm floodline with appropriate vegetation, buffers and filter strips.

J3. Development Area J3 is a small proposed industrial area immediately east of the existing sewage lagoons at the north end of the Kenron Estates development. It is currently vacant with some agricultural development. It has large wooded/natural regeneration areas. The Regional storm floodlines cover a large portion of this area north of the old abandoned CP Rail embankment. Drainage outlet from this area is not well defined. This issue should be addressed by a stormwater management plan for the development.

Small detention facilities or oil/grit separators may provide adequate stormwater management for the proposed development. Should a detention facility be proposed, it may be incorporated within the adjacent Regional storm floodplain through the use of vegetative buffers and filter strips.

K1. Development Area K1 is a large proposed urban residential area (with small areas of commercial and low intensity residential) along the east side of watercourse 3 extending east to Aikens Road. It is currently agricultural and vacant with some low intensity residential and institutional development. An extended detention facility is proposed for this development area. A potential location for the facility is near the extreme southwest corner of the development where there is an existing natural draw approximately 150 m north of Highway 2.

Part of the stormwater facility could be incorporated within the Regional storm floodline above the 25 year floodline using appropriate vegetative techniques (buffer and filter strips). Riparian vegetation preservation and enhancement is recommended.

A very small portion of the development area along Highway 2 cannot be drained to the facility. Should these areas develop or redevelop, appropriate lot level controls should be implemented.

K2. Development Area K2 is a moderate sized proposed institutional development along the east side of Aikens Road. It is currently vacant and has some extractive operations on site. There is also some wooded/natural regeneration areas. Due to the potential high percentage of impervious area, an end of pipe facility such as an oil/grit separator or small detention facility would be necessary.

Quantity control may also be necessary to ensure that no downstream culverts along Aikens Road towards Highway 2 are affected by the proposed development.

L1. This small proposed urban residential area lies between Highway 2 and watercourse 3 where they parallel one another. This area has low intensity residential and commercial development. Drainage is generally to the south of the watercourse and therefore a communal facility is not feasible.

Recommended stormwater management practices include lot level controls with buffers and filter strips along the watercourse. All development must remain outside the Regional storm floodline and recognize the importance of maintenance of the riparian vegetation areas.

L2. This development area is a small proposed commercial area south of Highway 2 and west of Aikens Road. It currently has some industrial development. Due to the potential impervious areas, oil/grit separators or a detention facility would be appropriate stormwater management practice alternatives.

All development must remain outside the Regional storm floodline on watercourse 2 and all development, including stormwater management facilities, will be directed to areas outside the Regulatory Shoreline along the Bay of Quinte.

M. Development Area M is a moderate sized proposed commercial area which generally drains south to a low lying area along the Bay of Quinte shoreline. It is partially vacant with some institutional development. Recommended stormwater management practices include oil/grit separators and/or detention facilities with appropriate buffering and filter strips along the Bay.

All development, including stormwater management facilities, will be directed to areas outside of the Regulatory Shoreline.

N. Development Area N is a small proposed low intensity residential development between Highway 2 and the Bay of Quinte. It is currently vacant. Drainage is generally south to the Bay. Therefore, lot level controls with appropriate buffers and filter strips are recommended along the Bay.

An existing drainage problem has been reported in this area. Therefore, identification of any runoff control requirements will be an important component of the stormwater management plan for this area.

O. Development Area O is a small area along the south side of Highway 2. It is currently vacant. Proposed development in this area is a mix of residential and commercial. Drainage to the site is presently via a small natural ditch at the southeast corner of the development.

Appropriate stormwater management practices for this area include oil/grit separators or detention facilities with appropriate filter strips at the outlet to the existing ditch. Lot level controls would be the minimum requirement for the residential development. An optional approach would place a small detention facility at the southwest corner of the property capturing both commercial and residential drainage such that the existing east-west ditch could be converted into a flat bottomed vegetated swale. (The natural channel must not be disturbed).

P. Development Area P is a relatively large area designated as low intensity residential along the south side of Highway 2. It is currently vacant with low intensity residential development. Drainage of the area is generally to the south as overland flow. Collection of this drainage is probably not feasible or justified.

Recommended stormwater management practices include lot level controls with appropriate buffers and filter strips along the Bay of Quinte. Utilization of grassed swales for internal drainage wherever possible is suggested. All development will be directed to areas outside of the Regulatory Shoreline.

Any stormwater runoff concentrated by roadway ditches etc. should be directed to a small end-of-pipe facility.

Q. Development Area Q is a proposed urban residential area north of Highway 2 immediately west of Quinte Heights. It is currently vacant with some agricultural and low intensity residential development. An extended detention facility is recommended at the southeast corner of this development. The facility will outlet to the existing ditch along Highway 2.

Although the proposed quality facility will provide some reduction in peak flows, the capacity of the downstream culverts should be assessed as part of site stormwater management planning. Quantity control may be necessary.

R. This moderate sized proposed low intensity residential area is located north of Highway 2 to the east of Quinte Heights. The area is under agricultural development with some low intensity residential development. An extended detention facility is proposed at the southwest corner of the development area.

The facility will capture the majority of the catchment area at this location except perhaps for a small strip along Highway 2. A local depression in the centre of the area may provide for some open space opportunities. Recharge potential for this depressed area is low due to the clay soils and shallow overburden.

The proposed facility will outlet to the existing ditch on Highway 2. The capacity of the downstream culverts should be assessed to determine if additional storage is required for quantity controls.

S. Development Area S is a small proposed industrial development at the southeast corner of Aikens Road and the CP Rail line. It is presently vacant with some agricultural development. Some wooded/natural regeneration areas are present on site. This is a low lying area without a clearly defined outlet. Recharge potential for the area is minimal due to the small drainage area and shallow overburden.

Recommended stormwater management practices include oil/grit separators or a detention facility. The location of the facility will be dictated by the location of an optimum outlet.

T. Development Area T is a large proposed low intensity development constituting the majority of drainage area for watercourse 4. It is currently vacant with some agricultural activity and an old extractive quarry.

An extended detention facility is proposed near the outlet of watercourse 4. This facility will capture a small portion of the Quinte Heights development area. The design of facility outlets and by-pass should consider existing erosion problems immediately upstream of the Highway 2 culvert. The capacity of this culvert is adequate to accommodate the increased runoff without jeopardizing the freeboard and vertical clearance requirements. Conveyance controls could be very effective in this area given the long flow paths.

Development of Area T will occur in phases. A comprehensive storm management scheme will be required prior to development. Initially this may take the form of a reservation of lands, in early phases, sufficient to permit siting of ultimate facilities, as well as the participation of Developers in a fund to compensate those owners required to provide a disproportionate part of their lands in constructing facilities serving lands beyond their own holdings. Initially this scheme should be designed and funded by the ownership interests. The Municipality, with other agencies, may be willing to play a more aggressive role in resolving the scheme in order not to disadvantage owners.

Discussion of a potential diversion from watershed 5 to watershed 4 is considered with stormwater management options for Development Area U.

U. Development Area U is also a large proposed low intensity residential development immediately west of Montrose Road south of the CP Rail tracks. It is presently vacant with agricultural development. There are some wooded/natural regeneration areas north of the railway tracks. An additional strip of proposed low intensity residential lands north of the tracks would ultimately contribute stormwater management facilities within Development Area U.

Under existing development conditions, drainage from this area is conveyed to the southeast across Montrose Road and Highway 2 to outlet east of watercourse 4. There is some evidence of existing erosion at this outlet. Any proposed stormwater management scheme for this development area must address this existing erosion problem and identify possible mitigative measures to ensure that conditions are not worsened by increased flows or runoff volumes.

An extended detention facility has been proposed immediately north of Parkside Drive. Without drainage modifications this facility would capture a large portion of the existing Montrose Road development as well. This facility will most likely require a quantity control component as well because the drainage passes through two large corrugated steel pipes (CSPs) and a few private entrance culverts before outletting to the west of watercourse 4.

The opportunity for diversion of this area towards Development Area T has been raised to alleviate the demand on these CSPs and take advantage of the additional capacity of the large concrete box culvert on watercourse 4. This alternative is feasible but would necessitate a facility with the combined volume of facilities T and U as proposed herein.

An additional potential diversion was considered from some of the Montrose Road development to the north of the presently proposed low intensity residential development. This diversion would bring a considerably larger drainage area to the proposed stormwater management facilities. Therefore, although there is sufficient topography to provide for this drainage, an intermediate storage area for drainage from the existing northerly development may be necessary to avoid providing additional water quality treatment storage in the already large downstream facilities. This detention area would serve to delay the flows from existing development to ensure that the contaminated "first flush" from the proposed development areas is captured and treated.

In a similar manner to Area T, the owners of this area should attempt to resolve the storm drainage system themselves, prior to actively involving the Municipality or other agencies. No interim development should be contemplated until an initial agreement for the resolution of this matter has been reached.

A proposal for diversion of existing development from the north should also consider the effect of the considerably shorter flow path to the Bay of Quinte on water quality parameters.

Table 7.6.1 below provides a very preliminary cost estimate for the various communal stormwater management facilities. These costs do not include the cost of the land required.

TABLE 7.6.1
PRELIMINARY COSTS AND SIZING FOR COMMUNAL STORMWATER PONDS IN THE SOUTH SIDNEY SECONDARY PLANNING AREA

Location	Drainage Area (ha)	Previous Impervious %	Storage (m^3)	Depth (m)	Area m^2	Total Cost $
B	38.7	36	5750	1.2	6500	115,000
C2	18	39	2800	1	3850	72,000
C3	13.2	33	1900	1.2	2400	58,000
D4	8.2	33	1200	0.5	3000	50,000
D5	6.7	45	1150	0.5	2850	49,000
D6	8.4	36	1250	1	1900	49,000
J1	23.2	10	2300	1.2	2850	64,000
K1	56.5	34	8200	0.80	118100	290,000
Q	5.9	25	800	1.2	1150	41,000
R	12.3	10	1250	0.5	38300	83,000
T	139.2	13.7	14800	1.2	15750	245,000
U	121.4	12.6	12650	1.2	13500	212,000
TOTAL	**451.7**	—	—	—	**210,150**	**$1,328,000**

Note: The costs of general construction materials for inlet and outlet structures was assumed to be around $30,000.
The costs include vegetative plantings in pond; grass/seed (at 5% of area); shoreline and trees (at 1% of area) and capital costs for excavation and earthworks.
The per unit costs were derived from the 1994 MOEE Stormwater Management Practices Planning and Design Manual.

7.7 Stormwater Management Monitoring

Monitoring of stormwater management facilities is recommended to progress in three phases. The initial phase will involve monitoring of the operation and effectiveness of development specific stormwater management facilities as they come on-line. It will be the responsibility of the Developer/Contractor to demonstrate to the satisfaction of the Municipality (with input from the Conservation Authority, MNR and MOEE) that the facility adequately controls runoff volume, if applicable, to the pre-development level. As well, it must be demonstrated that from the monitoring of inflow and outflow storm drainage, that facilities are reducing contaminant levels of suspended solids, nutrients, bacteria and target metals (copper, zinc, cobalt, lead, iron, aluminum, calcium) to meet the Bay of Quinte stormwater management design criteria.

Finally, in this first phase it will be necessary that the Developer document operational requirements in the fine tuning of the operation of the facility to achieve the required operating efficiencies. The Developer must also ensure the successful establishment and growth of terrestrial and aquatic vegetation that is integral to the proper and optimal operation of the particular facility and must document the accumulation of sediments to establish an appropriate facility cleanout schedule. Testing of accumulated sediments will be necessary to determine the appropriate disposal of material. It is anticipated that a minimum two year warranty period will be necessary before a stormwater management facility is turned over to the Municipality.

Phase 2 of the stormwater management monitoring program will be the responsibility of the Municipality. A program to monitor inflow and outflow water quality parameters during storm events should be conducted on a continuing basis in accordance with the Certificate of Approval. Assistance in this regard may be available through the Bay of Quinte Remedial Action Plan Program of MOEE.

The watershed monitoring phase should be the responsibility of the Lower Trent Region Conservation Authority. In conjunction with the surface water quality monitoring program, it is recommended that water quality stations WQ 11, WQ 13 and WQ 14 be monitored on a continuous event basis. An effort to collect samples every 15-20 minutes during a summer storm, if possible on two occasions per year, is recommended. All sampling should involve flow measurements with date and time of reading such that the data may be used to adjust hydrologic modelling parameters in the future. It is also recommended that Station WQ 14 be moved to upstream of Highway 2 at the outlet of the CSP at the road ditch (at the location of Station C of the event sampling).

8.0 RECOMMENDATIONS AND IMPLEMENTATION

8.1 Recommendations

The following specific recommendations are in addition to those RAP recommendations presented in Section 5.0 and are presented within the framework already discussed elsewhere in the text (see Section 2.0 and Section 5.0). The recommendations are numbered after the principle under which they fall.

Clean

1.1 Determine the actual loading of phosphorous delivered to the Bay by each watershed. Preliminary loading estimates have been established through water quality modelling. These estimates should be verified on the basis of the proposed surface water quality sampling program.

Implementing Agencies: Quinte RAP, LTRCA, Township of Sidney
Timeframe: 1-2 years as funding allows

1.2 Review each land use to identify means of reducing phosphorous loadings.

Implementing Agencies: Quinte RAP, LTRCA, Township of Sidney
Timeframe: 1-2 years as funding allows

1.3 Develop design guidelines for new development to include techniques for nutrient reduction.

Implementing Agencies: LTRCA, Township of Sidney
Timeframe: 1-2 years

1.4 Sidney Township should consider the implementation of water conservation programs to reduce the wastage of water.

Implementing Agencies: Township of Sidney
Timeframe: immediate

1.5 Stormwater management facilities are recommended for all new developments. Specific stormwater management techniques for each development area are recommended in Section 7. The stormwater management facility monitoring program as presented in Section 7.7 should be adopted to ensure proper functioning of facilities.

Implementing Agencies: individual developers, overseen by Township of Sidney and LTRCA
Timeframe: as individual developments proceed

1.6 Sidney Township should enact and enforce domestic pet litter by-laws in the South Sidney Secondary Planning Area to reduce loadings of fecal matter.

Implementing Agencies: Township of Sidney
Timeframe: immediate

1.7 Sidney Township, the County of Hastings and the Ministry of Transportation should monitor programs of routine street and catch basin cleaning (cleaning includes the pickup, removal and proper disposal of street and catch basin dirt, waste, garbage and contamination) to ensure regular maintenance.

Implementing Agencies: Township of Sidney, County of Hastings, Ministry of Transportation
Timeframe: immediate

1.8 Livestock access to the Bay and its tributaries for watering purposes should be minimized and alternative on-land watering facilities provided.

Implementing Agencies: individual farmers, farming associations, MNR, OMAFRA
Timeframe: immediate

1.9 Farmers should be encouraged to develop and implement Environmental Farm Plans to reduce the potential surface water contamination associated with (1) their manure storage and handling systems, (2) their practices concerning nutrient applications and (3) other farm sources and activities.

Implementing Agencies: individual farmers
Timeframe: immediate and ongoing

1.10 The CURB program or its equivalent should be continued. →

1.11 The possibility of a comprehensive or selective inspection program should be undertaken to investigate private waste disposal systems.

Implementing Agencies: Township of Sidney, MOEE
Timeframe: 1-2 years as funding and staff will allow

1.12 Regulatory control of persistent toxic contaminants throughout the area should be implemented.

Implementing Agencies: MOEE
Timeframe: immediate

1.13 Remediation of known contaminated sites such as the Aikens Road Landfill Site should be undertaken. Control of leachate generation may require proper capping of the landfill site.

Implementing Agencies: landowner, overseen by Township of Sidney, MOEE
Timeframe: longer term 1-10 years

Green

2.1 The Watershed Plan identifies and evaluates wetland areas. These wetlands should be identified in planning documents as environmentally sensitive and protected from development.

Implementing Agencies: Township of Sidney, LTRCA
Timeframe: 1-2 years

2.2 There are no Areas of Natural and Scientific Interest (ANSI) identified. However, this study has identified other sensitive natural areas. The degree of protection available for these areas is limited. Development proposals should afford the opportunity to protect certain areas as part of the natural system of the area. The Municipality and the Conservation Authority should promote protection of natural areas as part of development proposals.

Implementing Agencies: Township of Sidney, LTRCA, individual landowners through Woodland Improvement Agreements (with MNR), Conservation Easements, Stewardship programs
Timeframe: immediate

2.3 The significant natural features identified by this study should be used as reference for review of any planning applications. These natural features should be protected as far as possible through design and, where necessary, through dedications and other arrangements to ensure protection. The possibility of private land trusts could also be explored. The features include:

- farm woodlots
- remnant treed areas
- other features such as mature fence rows
- riparian corridors.

Implementing Agencies: individual developers, Township of Sidney, LTRCA
Timeframe: immediate

2.4 Riparian plantings should be established along watercourses wherever streambank cover has been removed in order to stabilize banks, thereby reducing erosion and nutrient loadings, and improve conditions for fish habitat.

Implementing Agencies: public interest groups and individual landowners, through MNR's Community Fishery Involvement Program (CFIP) and Community Wildlife Involvement Program, and Tree Plan Canada and Global Releaf initiatives; LTRCA
Timeframe: immediate

2.5 Efforts should be made to examine the possibility of restoring natural meander patterns to channelized stream reaches.

Implementing Agencies: public interest groups, individual landowners through MNR's CFIP, federal Department of Fisheries and Oceans
Timeframe: 1-5 years

Connected

3.1 Identify the stream valleys and the associated flood plains as important natural linkages.

Implementing Agencies: LTRCA, Township of Sidney, MNR, individual landowners through Stewardship programs, Conservation Easements, Woodland Improvement Agreements.
Timeframe: immediate

3.2 Identify hedgerows, woodlots and other natural areas as candidate areas for linkage/protection. As part of the design process conduct an evaluation of these candidate areas to assess:

- their health and significance to the natural system of wildlife corridors in the immediate area;
- their ability to withstand the stress of development.

Implementing Agencies: Developers, Township of Sidney, LTRCA
Timeframe: Immediate and ongoing

3.3 Establish 30 m buffer (15 on each bank) around streams for the protection of fish habitat and promotion of wildlife corridors, where not provided by defined floodlines.

Implementing Agencies: MNR, LTRCA, Township of Sidney
Timeframe: immediate and short term, 1-2 years

3.4 A "no-net-loss" principle should be applied to any design solutions to ensure that the natural system is protected during and after development.

Implementing Agencies: Township of Sidney, LTRCA
Timeframe: immediate and ongoing

3.5 the extent and responsibility for maintenance and ownership should be determined during the development design process. In this regard a significant corridor with well defined protection should be preferred to a series of minor corridors with reduced capacity for protection and maintenance. The major corridor system should focus on the existing stream valleys.

Implementing Agencies: Township of Sidney, LTRCA
Timeframe: immediate and ongoing

3.6 Explore means of acquiring and/or protecting natural linkages. Possible approaches include incorporating this objective with other programs and functions such as:

- reforestation
- erosion control
- stream clean-up
- enhancement of fish habitat
- review of all shoreline works by MNR (Public Lands Act)
- development review (Planning Act)
- habitat compensation agreement (Fisheries Act).

Of particular interest will be areas adjacent to waterways such as streams and the Bay of Quinte.

Implementing Agencies: LTRCA, Township of Sidney, MNR, individual landowners through Stewardship programs, Conservation Easements, Woodland Improvement Agreements.
Timeframe: immediate

Diverse

4.1 Establish the principle of diversity as an objective in the planning and regulating frameworks of the agencies and regulators.

Implementing Agencies: individual builders and developers, Township of Sidney, LTRCA
Timeframe: immediate

4.2 Actively encourage the development of locally appropriate design rather than the importation of design concepts.

Implementing Agencies: LTRCA, Township of Sidney
Timeframe: As required

4.3 Promote the use of locally appropriate solutions through design guidelines and the recognition and promotion of examples of locally appropriate solutions.

Implementing Agencies: Township of Sidney
Timeframe: 1-5 years

Accessible

5.1 Develop an open space linkage plan consistent with the linkages principle. Development designs should be cognizant of natural features.

Implementing Agencies: Township of Sidney, LTRCA
Timeframe: with next Official Plan amendment or update

5.2 Review available tools and funding sources to establish this plan.

Implementing Agencies: Technical Monitoring Committee of South Sidney Watershed Plan, in conjunction with federal government agencies, provincial ministries, public interest groups
Timeframe: 1-5 years as funding allows

Open

6.1 Significant vistas should be considered in the review of development proposals.

Implementing Agencies: Township of Sidney
Timeframe: immediate and ongoing as development proceeds

8.2 Monitoring of Plan Implementation

To monitor the status of various recommendations provided within this Watershed Plan, it is important to establish a monitoring program to guide its implementation over time. Therefore, it is recommended that a Technical Monitoring Committee comprised of the personnel from the Township of Sidney, the Lower Trent Region Conservation Authority, and the Bay of Quinte Remedial Action Plan be formed to assess the plan's status. The LTRCA would be the lead agency in the initiative. This committee should also include members from the MNR, MOEE and OMAFRA, and other agencies, as warranted, to deal with issues of direct concern to their mandates.

This committee should meet immediately to set an agenda for the coming year. Subsequent meetings can be held on a yearly basis to assess the status of the Plan and to further determine agendas for the following year.

9.0 REFERENCES

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10.0 GLOSSARY

Aquifer	permeable underground rock stratum which holds water
Benthos/Benthic	the biota living on or in the surface sediment of a waterbody (i.e. stream, lake, or wetland)
Biomass	the quantity of living tissue and/or dead organic matter; measured as matter per unit volume or area
Biotic Index	numerical representation of an organisms tolerance to environmental stress e.g. Bode's Index
Communal Servicing	Municipal services provided to service multiple lots or development
Contaminant	a toxic substance that occurs at a concentration greater than the normal background concentration; synonymous with pollutant
Diversity	a numerical index that incorporates both the number of species in a given area and their relative abundance
Draw	a depressed area which collects runoff water and conveys it to a depression, watercourse or waterbody
Effluent	the discharge or outflow from a lake, river, or human made facility such as a stormwater management facility
Eutrophication	over-enrichment of a waterbody with nutrients, resulting in excessive growth of certain organisms and depletion of oxygen for others
Hydraulics	the physical behaviour of water flowing in open channels, governing flow velocity and water levels
Hydrology	the study of the physical and meterological processes involved in the transformation of precipitation to runoff
Indicator Species	a species specific to a particular set of environmental factors such that by its presence or absence it indicates a degree of environmental quality
Influent	the flow into a lake or river, or human made facility such as a stormwater management facility
Interbeds	a typically thin layer of rock material alternating with contrasting thicker bed of rock
Lacustrine	pertaining to or living in a lake or pond

Littoral	pertaining to the shore; shore of a lake to depth of 10 metres
Macrophyte	a large plant; as opposed to and differentiated from single celled plants and algae; plant visible without the aid of magnification
Marsh	a wetland type characterized by the presence of primarily herbaceous aquatic macrophytes
Nutrient	a chemical that is a requirement for the growth and development of an organism
Organic Matter	the carbon-containing molecules and or tissue that make up or are derived from living organisms
Overburden	layer of soil and rock that covers deposits of desirable minerals; or covering bedrock
Palustrine	pertaining to a wet marshy or wetland area
Parting	a small joint in rock
Regulatory Shoreline	a regulatory standard comprised of the regulatory flood standard, the regulatory dynamic beach standard and the regulatory erosion standard
Riffle	shallow areas of streams characterized by accelerated velocities and coarse substrates
Riparian	pertaining to, or living in, or situated by the banks of rivers and streams
Riverine	pertaining to or living in a river; formed by the action of a river
Sediment	the soils/substrate at the bottom of a waterbody, i.e. stream, lake or wetland
Species	the population of organisms that actually or potentially interbreed and produce fertile offspring
Species Richness	the number of different species that occur in a given defined area
Stress	the physical, chemical and biological constraints that limit the productivity of an organisms or group of organisms
Swale	an engineered drainage ditch vegetated and graded to optimize conveyance capacity and velocity or water quality benefits

APPENDIX G

BAY OF QUINTE STORMWATER MANAGEMENT DESIGN CRITERIA/GUIDELINES

STORM WATER MANAGEMENT DESIGN CRITERIA/GUIDELINES

BAY OF QUINTE
STORM WATER MANAGEMENT
IMPLEMENTATION AREA

PREPARED BY THE INTER AGENCY STORM WATER MANAGEMENT WORKING COMMITTEE

MINISTRY OF THE ENVIRONMENT
MINISTRY OF NATURAL RESOURCES
QUINTE CONSERVATION AUTHORITIES

JANUARY 1992
(AMENDED MAY 1993)

BAY OF QUINTE STORMWATER MANAGEMENT DESIGN CRITERIA/GUIDELINES

GENERAL STORMWATER DRAINAGE GUIDELINES

- Integrate with Watershed Plan(s) or Master Drainage Plan.
- The retention of existing tree cover or natural vegetation and the provision of significant grassed areas to facilitate absorption and adsorption of surface water, where infiltration will not contaminate groundwater.
- Developments which have significant impact on surface drainage shall provide comprehensive drainage plans showing methods of mitigating impacts on adjacent or affected properties, as well as the subject property.
- Outline alternatives and preferred option with reference to constraints, objectives, findings, recommendations, and rationale for selected stormwater management scheme.
- Definition and delineation of the study area watershed parameters and the development parameters for both pre and post conditions.
- Define maintenance requirements for all stormwater management facilities, natural or mechanical.
- Provide erosion and sedimentation control plan for major and minor stormwater management system which addresses bank stability, energy dissipators at outlets, and effective construction practices to control on and off site impacts during and after site alteration.

WATER QUALITY

- Stormwater quality management facilities shall be designed to achieve the following event mean concentrations on the basis of flow proportional sampling:
  - Suspended Solids not greater than 25 mg/l
  - Escherichia coli (E. coli) not greater than 100/100 ml
- Specific parameters for fishery concerns may include:
  - Dissolved oxygen to be not less than 5 mg/l (5 ppm) in summer and 4 mg/l in winter

design event ? store first 10 mm for 72 hr - see ref doc.

- Emulsified oils not to exceed 0.05 of the 96 hour LC 50
- pH to be greater than 6.2
- Concentration of hexane extractable substances (exclusive of sulphur) in air dried sediments not be increase above 100 mg/kg on a dry weight basis
- No discharge temperatures in excess of 20 C

Note: Compliance with suspended sediment and E. coli concentration objectives should achieve desired nutrient and toxin reductions. The 25 mg/l suspended sediments is also necessary to achieve effective ultra-violet disinfection.

- Stormwater quality management facilities shall be sized so as to permit not more than four (4) bypass events during the body contact recreation season.

  Note: Sizing of a facility is normally carried out using continuous simulation. The facility is on-line and should have an inlet bypass once it is full.

- If a stormwater quality management facility is designed and approved with effluent disinfection, the disinfection component need only be operated during the body contact recreation season. The remainder of the works must, however, be maintained operational year round.

- Pond design must include a specific sediment storage volume. the operation of the facility must also reflect the necessity of assessing the sediment quality in compliance with O. Reg. 309 and disposing of sediment in a suitably approved site.

- Municipal ownership and operating responsibility will be mandatory for all stormwater quality management facilities. As the operating authority for the works, the municipality will be responsible for the certificate of approval, compliance reporting, and the preparation and submission of annual reports (which would address operation, maintenance and monitoring with recommendations to address any identified deficiencies, problems, non-compliance situations, etc.)

WATER QUANTITY

- No increase in flood risks. Applies to all peak return events from a 2 year return event to regulatory event.

- Stage-discharge relationships for all stormwater management facilities designed for the regulatory event.

- Overland flows, depths, and velocities supplied at key points on roads and at outfall of major system for regulatory event.
- Elevations of the hydraulic grade line at critical points for minor system design storm and regulatory event.
- Define impacts on groundwater discharge or recharge areas and provide measures to mitigate or minimize impacts to groundwater flow (Hydrogeologic report may be requested).

GUIDELINES FOR PRELIMINARY STORM WATER MANAGEMENT & CONSTRUCTION MITIGATION PLANS

BAY OF QUINTE
STORM WATER MANAGEMENT
IMPLEMENTATION AREA

PREPARED BY THE INTER AGENCY STORM WATER MANAGEMENT WORKING COMMITTEE

MINISTRY OF THE ENVIRONMENT
MINISTRY OF NATURAL RESOURCES
QUINTE CONSERVATION AUTHORITIES

FEBRUARY 1992

GUIDELINES FOR PRELIMINARY STORM WATER AND CONSTRUCTION MITIGATION PLANS

A. INTRODUCTION

The following guidelines outline the basic requirements for the preparation of a **preliminary** storm water management plan by a qualified, certified engineer. The application of these guidelines will vary depending on the development proposal and the specific site characteristics as well as the need for storm water management and construction mitigation measures. At this stage, the plans provide an initial assessment of storm water management requirements for the property in order to establish the impacts of post development flows versus pre-development flows with respect to both water quantity and quality, as well as to ensure that the design of the development will be able to accommodate the necessary storm water management and construction mitigation measures.

The preliminary information will generally not require the level of detail required in a final storm water management plan. In all cases, consultation with the Moira River Conservation Authority (MRCA) should be undertaken prior to the site assessment and preparation of the preliminary plans to identify any initial concerns. Consultation with other effected agencies (MNR, MOE, Area Municipalities) will be liaised through the MRCA to identify any site specific concerns with respect to Storm Water Management. The preliminary storm water management plan will form the basis for the final design stage.

B. BASIC REQUIREMENTS

1. Identify the existing topographic features. In many cases, existing topographic mapping such as OBM maps or that prepared for a draft plan of subdivision may be adequate.

2. Identify the existing drainage basins and vegetative characteristics on and off site that should be considered.

3. Identify the historic run-off characteristics of the drainage basin. Normally 1 hour for urban and 12 hours for rural.

4. Identify the associated water/habitat sensitivity in the potentially affected area. The Ministry of Natural Resources should be contacted in this regard.

5. Establish the storm water management quantity and quality criteria that must be applied to the site development to prevent negative environmental impact. Criteria may vary depending on urban or rural development, site-specific concerns, or the availability of a Master Drainage Plan for the watershed.

6. Identify the proposed storm water management measures required to accommodate the development and confirm how the proposed post development conditions (volume, peak, quality) will equal pre-development conditions for all storms up to and including the 100 year storm event. This should include a description of the proposed major and minor storm management systems but not the actual design of any storm water management structures or works.

7. Conceptually show the significant storm water management measures on a plan which also indicates the proposal. Additional sketches as needed should be included.

8. Identify the construction mitigation measures necessary to control on and off site impacts (e.g. erosion control siltation control) both prior to and after the initiation of any site alteration as well as a contingency plan to address the failure of these measures. The design must address winter stabilization of the site and spring run off volume conditions.

C. DESIGN CRITERIA

Due to the impaired state of the Bay Of Quinte ecosystem, some minimum criteria and guidance has been established. Master Drainage Plans for a sub-watershed should be consulted for details of handling storm water drainage. The ***Bay of Quinte Storm Water Management Implementation Strategy*** should be reviewed for specific design criteria for both a preliminary and final Storm Water Management Plan. Generally, urban development over an area of 1 hectare will require designed quality control to protect and restore Bay Of Quinte water quality. Site conditions with respect to habitat sensitivity will dictate other criteria in either rural or urban developments. A list of reference documents is attached for guidance in preparing Storm Water Management Plans.

REFERENCES AND NOTES

1) STORM WATER QUALITY BEST MANAGEMENT PRACTICES, JUNE 1991 (MOE, MNR, MTO,ACAO,MEA, UDI)

2) GUIDELINES ON EROSION AND SEDIMENT CONTROL FOR URBAN CONSTRUCTION SITES, MAY 1987

3) GUIDANCE DOCUMENT FOR WATERSHED PLANNING, DRAFT 1992 (MOE, MNR, MMA, ACAO)

4) INTERIM STORM WATER QUALITY CONTROL GUIDELINES FOR NEW DEVELOPMENT, MAY 1991 (MOE, MNR)

5) BUFFER ZONE GUIDELINES, MNR, 1987

6) URBAN DRAINAGE DESIGN GUIDELINES, APRIL 1987

7) MTO DRAINAGE MANAGEMENT TECHNICAL GUIDELINES

8) MOE GUIDELINES FOR THE DESIGN OF STORM SEWERS

9) SPECIFIC DESIGN CRITERIA - RURAL ROAD CROSSINGS
- ROAD DITCHES

5th

DB —
Rw —
Bc —

BAY OF QUINTE STORMWATER MANAGEMENT IMPLEMENTATION STRATEGY

The impaired state of the Bay of Quinte ecosystem has resulted in the Bay of Quinte Remedial Action Plan (RAP), which is taking a holistic approach to evaluating problems, their ~~causative factors~~ causes, and the measures required to restore and protect this ecosystem. The Bay of Quinte RAP has identified nutrient enrichment, bacteriological contamination, and toxic contaminants as the major water quality concerns, resulting in the recognition of stormwater management and treatment as a primary remedial action to prevent further deterioration and aid in the restoration process. The implication for Bay of Quinte municipalities is that they must incorporate stormwater treatment as a requirement for new urban development.

IMPLEMENTATION PLAN

The various governing agencies that approve and regulate stormwater quality and quantity have formed a steering committee to streamline the process. The initial goal of this steering committee was to define the limits, both physical and technical, that are inherent in the action statement; 'Bay of Quinte municipalities must incorporate stormwater treatment as a requirement for new urban development.' It is evident that 'Bay of Quinte municipalities', 'stormwater treatment', and 'new urban development' must be defined at the outset to form the foundation of the implementation plan.

IMPLEMENTATION AREA

Establishing the physical boundary for implementation of specific stormwater criteria was naturally facilitated by selecting areas fronting on the Bay of Quinte. Areas closest to the Bay would have the greatest impact on pollution loadings as non-point source discharges would undergo minimal natural enhancement before entering the Bay. These areas also have the most to gain from protection and restoration of this valuable resource. Municipal boundaries form a jurisdictional limit in which specific stormwater criteria can be applied. This boundary focus takes precedence over a Bay of Quinte watershed-wide approach which is impractical in physical terms. Municipalities are fundamental to the integration of stormwater management into the existing planning process, so their boundaries form the optimum delineation. This implementation area is outlined in Figure 1.

STORMWATER CRITERIA

The quality criteria for stormwater treatment within the implementation area are based on the recommendations and conclusions that have resulted from the RAP. These quality criteria were combined with stormwater management guidelines from Conservation Authorities and the Ministry of Natural Resources to form a joint set of criteria for stormwater management. These

criteria are appended hereto as Appendix A. These criteria should be utilized in the design of stormwater management systems as they directly reflect the desired uses of the Bay and the goals established for the watershed as a whole. To comply with these standards within the drainage planning process, direction is provided in the guidelines outlined in Ministry of Environment and Ministry of Natural Resources Interim Stormwater Quality Control Guidelines for New Development, May 1991, appended hereto as Appendix B. These guidelines stress the importance of matching the pre-development hydrologic response of any drainage area. This is the first and most critical step in effective stormwater management.

PLANNING CONTEXT

1991 Interim SWQ Control Guidelines for New Development

For all parties to achieve this goal most practically, a cooperative approach between watershed planning and municipal planning is essential. The provision of stormwater treatment for new urban development is a key action in conjunction with municipal planning of future growth and land use change. The relationships between drainage planning and land use planning are outlined in Figure 1 of Appendix B. Stormwater management must be incorporated into the planning process at all levels and with increasing amounts of detail, starting with the formation of the Watershed Plan and continuing to the Master Drainage Plan and Stormwater Management Plan level. Municipalities will be requested to amend Official Plan policies or incorporate into new Official Plans these established criteria for stormwater management. The Watershed Plan should be linked to the Official Plan; the Master Drainage Plan should be in place prior to Secondary Plan approval; and the Stormwater Management Plan should precede the approval of plans of subdivision.

NEW URBAN DEVELOPMENT

Although this may be recognized as the optimum process, there are numerous situations where the opportunity to implement stormwater planning has past. New urban development must be qualified so that all cases may be examined to fit into the implementation plan. New urban development will be defined as municipally serviced development of an area equal to or greater than one hectare. In the absence of a Watershed Plan or a Master Drainage Plan for a greater area, site specific development of this nature must supply stormwater management plans that comply with the criteria outlined in Appendix A. This approach to defining new urban development takes into account small size proposals and infilling which ultimately have a cumulative effect on receiving water quality and also reinforces the importance of comprehensive proactive planning. Rural development, of an area equal to or greater than one hectare within the implementation area, must also address stormwater management, and will be reviewed within the proposed administration.

BEST MANAGEMENT PRACTICES

Development in the future must utilize Best Management Practices (BMP's) to address stormwater runoff. "Best Management Practices" specifically refer to water management facilities such as infiltration systems, constructed wetlands, extended detention and wet ponds, and various vegetative practices. The design of BMP facilities must rely upon the professional judgement of designers and approval staff and would not normally be subject to compliance reporting or discharge monitoring. It is hoped that the use of these structural tools in conjunction with BMP's in the planning context such as land use restrictions or limitations, conservation programs, and source control of pollutants will result in future development forms which provide for human needs while protecting the natural environment. 7*

ADMINISTRATION

To aid in the phasing in of the criteria associated with stringent stormwater management and to offer a 'one-window' approach to administration, it has been decided that one agency will co-ordinate, implement, and monitor the stormwater management component of the Quinte RAP in conjunction with existing policies dealing with stormwater. Although the one-window approach is an attempt to streamline the approval process, it does not relieve the proponent from acquiring other necessary approvals or from taking all appropriate steps. This collective unit will be represented at the local level through the Moira River Conservation Authority office.

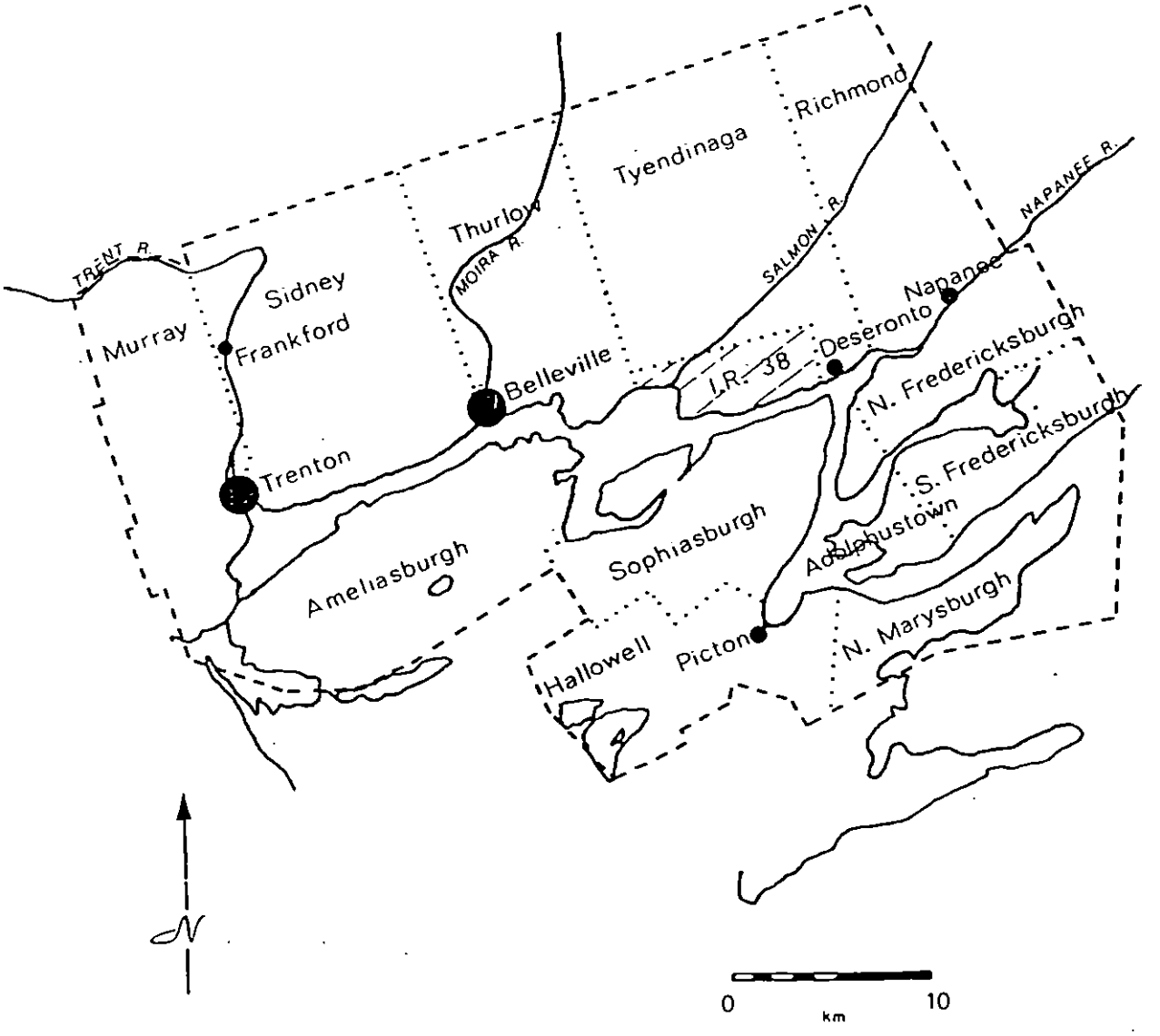
In summary, effective stormwater management as a remedial measure to restore the Bay's ecosystem will require cooperation and substantial commitment from all jurisdictions and agencies before restoration and protection of the Bay of Quinte is realized. Municipal involvement throughout will be critical. Municipalities must recognize their essential role both in an advisory capacity and through the municipal planning process which will govern development control, and they must also recognize their role in assuming direct responsibility for operation, maintenance and monitoring of stormwater management systems, which underlies the importance of sound, advance planning.

Through cooperation and commitment it will be possible to protect the Bay and restore water quality, and having done so, maintain the ecosystem's integrity for future generations while allowing the region to achieve its goals for economic growth and development.

* Refer to MJWSC for paper on Maintenance of BMPs.

FIGURE 1

BAY OF QUINTE STORMWATER MANAGEMENT IMPLEMENTATION AREA



IMPLEMENTATION AREA BOUNDARY ------

TOWNSHIP BOUNDARY .....

MNR - Eastern Region

GENERAL GUIDELINES
FOR DEVELOPMENT & PREPARATION OF STORMWATER MANAGEMENT PLANS

PARAMETERS	MNR REQUIREMENTS - WATER QUALITY, QUANTITY AND TEMPERATURE, FLOODING, FISHERIES HABITAT, WILDLIFE HABITAT, STORMWATER, WORK TIMING, WETLANDS
WATER QUALITY	- No adverse affect
	- Not create or increase erosion or sedimentation (suspended solids not to exceed 25 mg/l)
	- Shoreline setback of at least 30m for disturbances (buildings, septic systems, etc.)
	- Maintain vegetation where possible along shorelines
	- Revegetation /stabilization of disturbed shoreline to protect from erosion and reduce potential for temperature increases
	- Dissolved oxygen to be not less than 5 mg/l (5 p.p.m. in summer and 4 mg/l in winter)
	- Lead concentrations to be less than 0.03 mg/l
	- pH to be greater than 6.2
	- No visible oils on the surface. Emulsified oils not to exceed 0.05 of the 96 hour LC 50
	- Concentration of hexane extractable substances (exclusive of sulfur) in air dried sediments not to increase above 1,000 mg/kg on a dry weight basis
WATER QUANTITY	- No reduction in base flows in watercourses
	- Stream flows not reduced or increased through wetlands
	- No significant reduction of water table in areas of recharge to watercourses
WATER TEMPERATURE	- No increase
FLOODING	- Development not to increase flooding of or create flooding at existing or adjacent downstream structures or roads
	- Applies to all peak return events from a 2 year return event to regulatory event

...2

- Design to meet MNR/CA requirements for buildings

- All new development must be located safely above the regulatory or 100 year return flood level with the lowest building openings and first floor elevations at least 0.3 metres above the regulatory flood level

- Drainage facilities should be designed so that basement flooding does not occur under the regulatory event

- Designs to ensure no surface or basement flooding for all events up to the regulatory event to the satisfaction of the municipality/local C.A./MNR (where outside a C.A.)

FISHERIES HABITAT

- No destruction or harmful alteration of existing fisheries habitat or aquatic life (sediments, water quality impairment, base flows reduction, water temperature, etc). Applies during construction and in the long term

- Mitigation or compensation may be required if alteration is proposed

- Proponent may be responsible for obtaining and providing information on fisheries habitat to the satisfaction of MNR

WILDLIFE HABITAT

- Impact of development must be kept to a minimum

- Sensitive or significant areas of habitat must be given consideration and protection

STORMWATER

- No direct inflow to watercourse

- Store first 10 mm of generated runoff for 72 hours

- Stormwater fish habitat watercourses not to be covered by underground piping other than those required for roads (culverts and bridges)

TIMING OF WORK

- No inwater and near shore work between March 15 and June 30 along warmwater water courses

- No inwater and near shore work between September 15 and March 15 along coldwater water courses

...3

- Any inventories to be carried out must cover all seasons

WETLANDS

- Class 1 ~~and~~ to 3 ~~2~~ wetlands of provincial significance are to be protected. New land uses permitted on, or adjacent to these wetlands should be compatible with the wetland so that the wetland values are maintained or improved

- The Ministry urges Regional and Local municipalities to protect Class 3, 4 and 7 wetlands are to be protected in an appropriate manner in planning documents

- Development should not lower the quality of significant wetlands by destruction of native vegetation and/or fish and wildlife habitat, by alteration of flow regimes and/or water tables, or by otherwise adversely affecting those features that are essential to the functioning of the wetland ecosystem

September 27th, 1990