Evaluation of Water Resources Management Strategies and Flood Damages

Ontario

Ministry of Natural Resources

Ministère des Richesses naturelles

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This Report has been prepared for:

Ministry of Natural Resources
Lands & Waters Policy Branch
300 Water Street, 5th Floor
Peterborough, Ontario
Tel: (705) 755-2000
Fax: (705) 755-1267

Authors:

Karen Wianecki, M.Pl., MCIP, RPP
Director of Practice
Planning Solutions
8 Buggey Lane, R.R.#1
Ajax, Ontario L1S 4S7
Phone/Fax: (905) 428-6113
Pager: (416) 329-3559
Email: karen.wianecki@sympatico.ca
Website: www.e-planningsolutions.ca

&

Ed Gazendam, P.Eng., M.Eng.
Principal
Manager, Water and Environmental Resources
Planning & Engineering Initiatives Ltd.
379 Queen Street South
Kitchener, Ontario N2G 1W6
Tel: (519) 745-9455 x 1301
Fax: (519) 745-7647
Email: egazendam@peil.net
Website: www.peil.net

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This Report was prepared under the direction and guidance of the Ministry of Natural Resources' (MNR) Water Resources Section. The report was authored by Karen Wianecki, Planning Solutions and Ed Gazendam, Planning & Engineering Initiatives Ltd. who worked in conjunction with Carl Seider and Rob Fox of the Lands and Waters Policy Branch.

This report presents the current state of MNR's water resource management strategies based on the review of several key studies. It also summarizes the key findings associated with flood damages from 1996 - 2003, based on the collection of base line data from Ontario's Conservation Authorities and MNR District Offices outside of CA jurisdiction. The report presents a number of key findings based on that two-fold analysis and draws conclusions concerning the options and future opportunities for continued flood damage intelligence gathering by the Ministry.

The authors of this report would like to acknowledge the support and contribution of in-kind efforts by a number of individuals and organizations with an interest in floodplain management in the Province of Ontario. Special thanks in this regard are extended to the following organizations:

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- Emergency Management Ontario
- Insurance Bureau of Canada
- The Canadian Natural Hazards Assessment Project
- Public Safety and Emergency Preparedness Canada (PSEPC)

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This report is intended to provoke thought and discussion about the future of floodplain management in Ontario. Building on past success, the report identifies the need for some critical decisions concerning future flood damage data collection and program delivery. Future comments or questions concerning the content of this report are invited and may be directed to Rob Fox.

While many individuals have contributed in a variety of ways to this report, the authors assume responsibility for its content.

EXECUTIVE SUMMARY

"**Of all the natural hazards encountered in the world, floods are the most frequent, they cause the largest number of deaths, and they generate the largest economic losses…No other natural hazard has claimed more human lives in past decades, ruined more fertile land, destroyed more houses."**[1]

Globally, research conducted by the Institute for Catastrophic Loss Reduction points to the alarming increase in the incidence of natural disasters world wide, and the need to better manage catastrophic risk through collaborative efforts and actions. The Insurance sector - or perhaps more accurately - the reinsurance sector has estimated that **since the 1960s, damage on a global scale from catastrophic risk, including flooding has been doubling every seven (7) years or so on average. Over a 40 year period, this represents a 14-fold increase in damages.**[2]

South of our border, flood damage receives widespread attention, largely because "floods are more destructive to the United States than any other natural disaster."[3]

The U.S. Army Corps of Engineers estimates that flooding costs the U.S. an average of $5.1 billion in damage each year. According to the Federal Emergency Management Agency, responsible for administering the National Flood Insurance Program[4] that operates in the U.S., the facts are alarming:

> "43% of businesses affected by natural disasters never reopen. And almost 29% close within two years of experiencing disaster. This means they…their employees…their entire communities suffer financial loss."[5]

Canada has not been without its share of flood disasters. According to an Emergency Preparedness Canada Report completed in 1997, "flooding is the most common type of disaster occurring in Canada this Century."[6] Environment Canada suggests that Canadians have experienced a substantial increase in the number and cost of weather-related events. Since 1970, Federal Disaster Financial Assistance for flooding has amounted to almost $714 million dollars, with a notable increase in payments since 1995.[7] The majority of Federal disaster assistance has been provided to Quebec and Manitoba, in recognition of the devastating Saguenay and Red River floods. Predictions for the future instill even greater concern.

[1] Flooding & Insurance. Munich Reinsurance Company.
[2] Ibid.
[3] FEMA. Flood Insurance. US/Canada Consultative Group Meeting. Remarks by Jo Ann Howard, Federal Insurance Administrator. Ottawa, Canada. August 30-31, 2000.
[4] The National Flood Insurance Program is a federal program that enables property owners to purchase flood insurance. Designed to provide an alternative to disaster assistance, the program's intent is to mitigate future losses.
[5] FEMA. Flood Insurance. US/Canada Consultative Group Meeting. Remarks by Jo Ann Howard, Federal Insurance Administrator. Ottawa, Canada. August 30-31, 2000.
[6] Reference to the 1997 EPC Report Contained in: Ministry of Natural Resources. Provincial Hazard Identification and Risk Assessment Draft Report. March 27, 2003.
[7] Since 1975, Ontario has not received any Federal Financial Assistance and flood damage costs have been borne by the Province.

"Despite our best efforts, Canadian's are and will become more vulnerable to extreme flood hazards."[8]

Ontario has not been without its share of flood disasters. Hurricane Hazel was the worst flood in Canadian history, causing an estimated $133 million dollars damage. However, we don't have to go too far back in time to realize that Ontario, like Quebec and Manitoba, appears to be vulnerable to catastrophic flood events. **Severe flooding, particularly in northwestern Ontario has become commonplace, evidenced by the 49th Parallel storm and the ensuing catastrophic damage to the Rainy River area.** There is evidence to suggest that across Ontario, flooding occurs so frequently in specific locales that it has become part of the local culture to expect high water and disruption on an annual basis.

In Ontario, flooding emergencies have been declared virtually every year since 1996. In 2002 alone, Ontario provincial disaster assistance to municipalities for flood related damages amounted to over $5 million dollars, while private landowners, farmers and businesses received over $4 million in disaster relief payments.

In Ontario, large scale damage is the result of an increasing number of major flood events. In the urbanized south, studies by the Toronto and Region Conservation Authority ***project an increase in flood damage costs between 20 and 60%***, attributed to the increased frequency of flood events, population growth and development, escalating property values as well as an aging infrastructure.

Despite these trends, *there are no uniformly accepted guidelines for estimating flood losses*.

This Report summarizes the results of a six-week study that examined Ontario's approach to floodplain management and began work to update the Ministry's flood damage database between 1990 and 2003. Timing for this undertaking was particularly short and consequently, the parameters for the review were limited. Time did not permit detailed assessment or critical review of individual flood events. The study did not address issues associated with infrastructure deficiencies, and did not explore in detail, the impact that land use planning has had on preventing development in flood susceptible areas. To obtain a truly comprehensive perspective, these issues (and more) would have had to be factored into the original Terms of Reference.

This study examined several key benefit cost studies completed for selected Canadian and U.S. jurisdictions. The purpose was to draw conclusions from that body of existing knowledge regarding the value provided by floodplain management. These studies focused on the Grand River (by examining the hypothetical damage that could have occurred from the Saguenay River flood), the Red River Flood in Winnipeg, the 49th Parallel Storm that hit northwestern Ontario in June 2002 and the comparative analysis completed by Environment Canada concerning the four storms that hit Michigan and Ontario in 1986.

The study also updated the provincial picture on flood damages for the period 1996-2003.

The study found that while much progress has been made with respect to the reduction of flood risk, much work remains to be done. Little effort at data collection and analysis has occurred since 1990. Previously, the Ministry of Natural Resources had a regular practice of collecting information from Conservation Authorities and MNR District Offices on flood events and flood damages. Those results were tabulated and published in an Annual Flood Damage Report. The practice of collecting base data on flooding however was discontinued in 1990. This work

[8] Shrubsole, Dr. Dan, Flood Management In Canada At the Crossroads. Institute for Catastrophic Loss Reduction. ICLR Research Paper Series - No. 5. Toronto, 2000.

represented the first time in thirteen years that the practice of collecting that data was undertaken. Attempts were made to locate the pre-1990 flood damage statistics. Despite exhaustive efforts to locate the database, the flood damage information for pre-1990 flood events could not be located. Having a complete picture of flood damage in Ontario is vital to effective program management. The Ministry of Natural Resources should consider reviewing all Flood Damage Reports prepared before 1990 and develop one standard database for flood event and flood damage information.

The emerging focus on hazard identification and risk assessment, also supports the need for and importance of baseline flood event information. Given the trends, this information is even more critical today than it was thirteen years ago.

Ontario is information rich, but data poor when it comes to flood damage and flood cost information. While many agencies are involved with various aspects of floodplain management, no agency at the provincial or federal level has exclusive authority for collecting flood information in general, or flood damage information in particular. There is at present, no central clearinghouse to collect, evaluate and report flood damage. **Flood damage data that does exist are rough approximations that have been reported in many different ways. Generally speaking, available literature presents flood damage data in aggregate terms.**

Without basic information, how can we determine if Ontario's approach to floodplain management is cost effective? How can accurate assessments be made concerning the value of investments in capital works and infrastructure initiatives? How can we assess how much flood damage has been avoided as a result of non-structural measures that limit development in flood prone areas? How can the true cost of flooding be noted if measures are not taken to assess the physical, social and environmental impacts of flooding?

An ongoing commitment to data collection and analysis is critical to the success of any floodplain management program. Sustained investments in data collection, mitigation works and public education are required to continue to reduce flood damage and flood risk. Updated, accurate floodplain mapping is needed to accurately define flood vulnerable areas. Climate change and the rapid pace of development particularly in the urbanized south has emphasized the importance of updated and reliable floodplain mapping.

This Report represents a first step toward improving our knowledge about and understanding of flooding in Ontario. Having a comprehensive and reliable flood loss database will enable the Province and it partners to better manage flood risks, and to make better sense of flood causes and effects.

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1.0 INTRODUCTION

Flooding has a long history of occurrence in Ontario.

Rivers and waterways have figured prominently in the evolution of settlement in Ontario. Providing a source of water supply, power and transportation, these river systems have had a profound influence on the way in which settlement in Ontario has developed. This pattern of settlement has had a direct influence on the need for and importance of effective floodplain management.

1.1 Flood Management - Roles & Responsibilities

The management of water transcends jurisdictional boundaries. As a result, virtually all levels of government participate in floodplain management. Unfortunately, the involvement of many has lead to a situation where no one has full responsibility.

Legislative authority for navigation, fisheries, defense, inter-provincial and international issues are assigned to the Federal Government. At the Provincial level, the approach to water management varies across Canada. In general, Provincial authority "is derived primarily from…exclusive authority to legislate over property and civil rights, over matters of a local and private nature and over local works."[9] As Shrubsole notes:

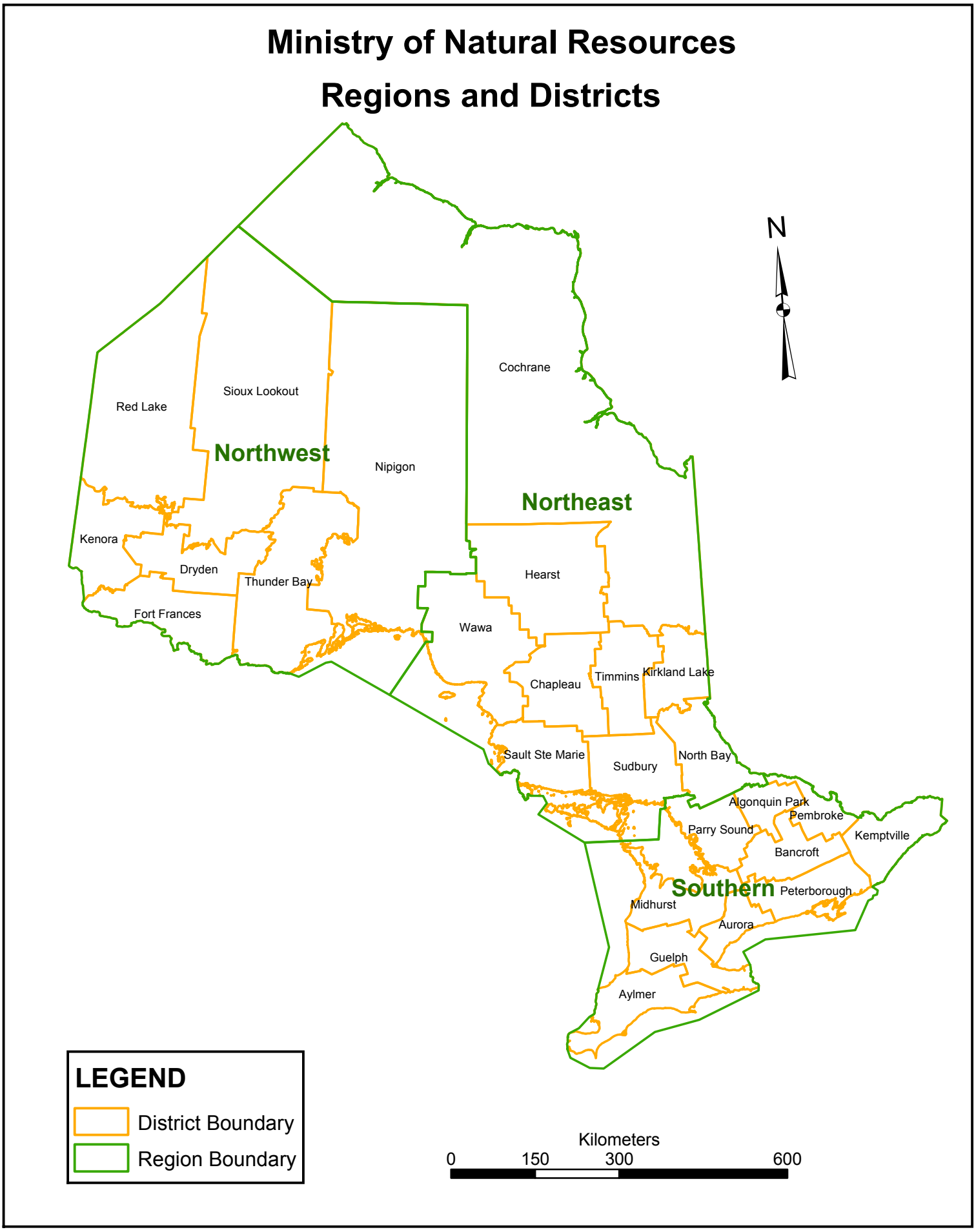
> "Provinces can establish specific regulatory flood levels, set building standards, and advise municipal governments in flood mitigation. Municipal governments must comply with provincial building codes through the passage of local by-laws."[10]

In Ontario, water management responsibilities are fractured among a number of Provincial Ministries and agencies. The Ministry of Natural Resources retains responsibility for water quantity, for providing policy direction and emergency management on matters relating to flooding (among other things), for taking the lead with respect to the Province's Surface Water Monitoring initiatives and for providing liaison services between the province and the 36 Conservation Authorities. Given the often critical nature of flood events, emergency response services are also provided by a different arm of the Ministry of Natural Resources. Maps 1 and 2 detail the location of the various MNR districts and regions and the Conservation Authorities in Ontario respectively.

The overall Emergency Response Program has been managed through MNR's Aviation Forest Fire Management Program. The Provincial Response Centre serves a dual function within the Ministry of providing central coordination and command for fire operations and emergency response. The Surface Water Monitoring Centre of MNR works in cooperation with the Provincial Response Centre to provide water level monitoring services and issues water level information services relating to both flood and drought situations. Within MNR, delivery of emergency response, in the provincial context, remains the responsibility of AFFMB with direct involvement with MNR Districts and Regions, respectively.

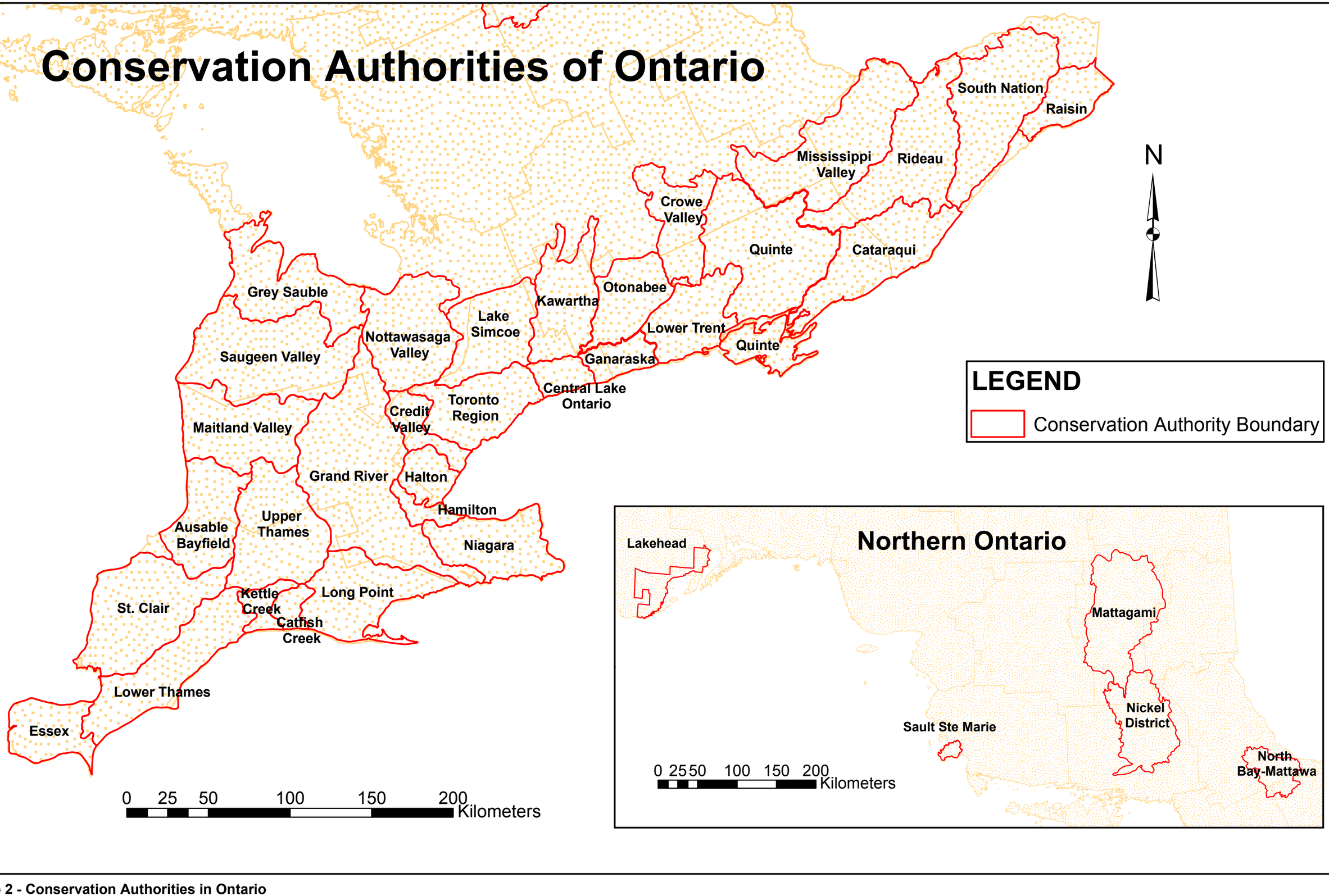
Ontario's Conservation Authorities have a statutory mandate for conservation and water management on a watershed basis. Matters relating to water quality are the responsibility of the Ministry of the Environment. Land use planning, the administration of the Planning Act and the

[9] Shrubsole, Dan. Flood Management At the Crossroads. Institute for Catastrophic Loss Reduction. ICLR Research Paper Series 5 – Toronto, 2000.
[10] Ibid



Map 1 - MNR Districts and Regions

Conservation Authorities of Ontario



Map 2 - Conservation Authorities in Ontario

articulation of matters of provincial interest (including natural hazards like flooding) are the responsibility of the Ministry of Municipal Affairs and Housing. Emergency Management Ontario (affiliated with the Ministry of Community Safety and Correctional Services) is responsible for coordinating emergency response to natural and man-made hazards where a multi-Ministry response is required.

The Ministry of Agriculture & Food has an interest in water management from the perspective of agricultural production and administers several programs aimed at providing insurance coverage for crop loss due to flooding and other perils. Despite the involvement by many agencies and organizations, there is little coordination or information sharing. There is also no agency at the provincial level that collects comprehensive information or reports on flood damage.

Similarly at the Federal level, there are a number of agencies with varied responsibility for flood management and emergency response. Some of these agencies include: Public Safety and Emergency Preparedness Canada (PSEPC) – formerly the Office of Critical Infrastructure Protection and Emergency Preparedness (OCIPEP), Natural Resources Canada, Indian & Northern Affairs Canada (where First Nations communities are affected), Public Works, Transport Canada and the list goes on. Again however, it would appear that a holistic approach to flooding is lacking at the Federal level. Work is being done however to develop a National Disaster Mitigation Strategy and efforts at assessing Natural Hazards across Canada has emphasized the need for collaboration and coordination.

1.2 Ontario's Approach to Floodplain Management

Over the years, Ontario's approach to floodplain management has taken different forms.

Ontario has a history of severe flood events, beginning in 1954 with the devastating Hurricane Hazel flood that has been estimated to have caused $133 million damage. Largely in response to that flood disaster, the Province enacted legislation to create Conservation Authorities who were charged in part with the responsibility for mitigating the impact of flooding and for protecting human life and property from flood damage. Initial efforts to map flood susceptible areas were undertaken in the 1950s by the Province and the Conservation Authorities – an exercise that would be expanded in scope and focus some 28 years later under the Canada/Ontario Flood Damage Reduction Program.

For the most part, the early years of floodplain management were characterized by the construction of large scale engineering projects designed to contain flood waters and mitigate the impact of flooding on nearby communities. Large scale dams and multi-purpose reservoirs were widely used to control flooding. Increasing concern over the environmental impact of reservoirs led to greater use of dykes and channelization. The decade of the 1960s and 1970s was characterized by structural mitigation measures. Very little attention, at least at the outset, was given to preventing flood damage by discouraging development in flood prone areas. The underlying philosophy of the early years focused on finding built solutions to flooding problems.

Despite the massive investment in infrastructure, flood damage costs continued to escalate. Devastating flooding overtopped many dykes and widespread damage resulted, not only in Ontario, but elsewhere across Canada. Between 1975 and 1999, disaster assistance payments from the Federal Government topped $720 million for flood related damages.[11] Governments at all levels began to rethink the structural approach to floodplain mitigation. This led to the

[11] Shrubsole, Dan, Greg Brooks, Robert Halliday, Emdad Haque, Ashij Kumar, Jacinthe Lacroix, Haron Rasid, Jean Rousselle, Slobodan Simonovic. An Assessment of Flood Risk Management in Canada. Institute for Catastrophic Loss Reduction. Research Paper Series No. 28. January 2003. ISBN 0-9732213-6-4.a

development of the Federal Flood Damage Reduction Program (FDRP) in 1975. Aimed at discouraging future flood vulnerable development, the Flood Damage Reduction Program was carried out as a joint Federal/Provincial and Municipal cost-sharing partnership. Extensive floodplain mapping delineated flood susceptible areas and future development was encouraged to be located outside of these areas. More than 900 communities were mapped at a total cost of $50 million. As the most active participant in the program, Ontario joined the FDRP in 1978 and, over the course of the next ten years, more than 270 communities were mapped and designated across the Province. Municipalities or Conservation Authorities entered into agreements with the provincial and federal governments and paid a portion of the cost associated with mapping. For the first time, the Canada/Ontario Flood Damage Assistance Program promoted a comprehensive and holistic approach to flood hazard mitigation.

In Ontario, the flood risk area is defined by the flooding hazard limit. Depending on the location in the province, the flooding hazard limit is determined by either the 1:100 year peak flow, a regional storm (e.g. the Timmins Storm for Northern Ontario) or the highest observed flood event. In some areas, a two-zone approach is used to define the floodway and the flood fringe. There is also provision to delineate Special Policy Areas, where communities have had a history of development in the floodplain and where preventing future development from occurring in the floodplain would cause economic and social hardship. Special Policy Areas allow controlled development to occur on the condition that structures are flood-proofed to an established minimum flood level. In Ontario, a number of municipalities qualified for and implemented Special Policy Areas. Little research has been conducted into the nature of SPAs and whether the Province is providing disaster assistance funding to municipalities to cover damage to development that was permitted to occur in the floodplain. As noted in the final section of this report, this is an area for future study.

Since the late 1970s, Ontario has recognized the importance of a dual approach to floodplain management – one that promotes both structural and non-structural mitigation measures. The benefits of the FDRP were further realized in Ontario in 1983 when the Province enacted a new Planning Act that permitted the articulation of matters of provincial interest and called for municipalities to have regard to these in local planning documents and development applications. The release of the Provincial Floodplain Planning Policy Statement in the mid 1980s recognized the importance of preventing development in flood prone areas. Municipalities across Ontario reacted positively to identifying flood hazards in their municipal planning documents and for the most part, directed development away from flood vulnerable areas.

The passage of time has also necessitated a greater need to respond to natural hazards and other types of emergencies. Flooding disasters in Manitoba and Quebec, damage from the Quebec/Eastern Ontario Ice Storm, biological emergencies associated with the SARS outbreak in Toronto and the power grid failure in Ontario and the northeastern seaboard during the summer of 2003, have raised public awareness of the importance of emergency planning. In Ontario, a risk-based approach to emergency management has been launched based on the four internationally-recognized pillars of emergency management: mitigation, preparedness, response and recovery. This approach is discussed more fully in Section 1.4.

1.3 Why the Concern with Flooding? What Are the Trends Indicating?

The facts speak for themselves:

> **"Of all the natural hazards encountered in the world, floods are the most frequent, they cause the largest number of deaths, and they generate the largest economic losses."**

> **"No other natural hazard has claimed more human lives in past decades, ruined more fertile land, destroyed more houses.**[12]

Throughout Canada, damage from flooding has continued to escalate.

In 1948, the Fraser River in British Columbia flooded and forced 16,000 people from their homes. Disaster assistance payments totaled $22 million. In 1950, Manitoba's Red River flood required $25 million in disaster assistance from various levels of Government. In 1954, Hurricane Hazel flood victims in Southern Ontario received almost $25 million in flood damage assistance. In total, immediate flood damage assistance throughout Canada up to 1970 had climbed above the $100 million mark. As Environment Canada has noted, payments continue to spiral.[13]

An Increase in Severe Flood Events in Ontario:

In Ontario, the incidence of severe flooding appears to be on the increase. While fatalities from flooding appear much lower, damage to personal property and community disruption from flooding is on the rise.

Flood emergencies across Ontario have risen significantly since 1996. **In fact, states of emergency/flood disaster have been declared virtually every year in Ontario since 1996.** As the following table demonstrates, a total of 46 flood emergencies have been declared since 1992 – 90% of these have occurred since 1996.

Table 1 - Number of Flood Emergencies Declared By Municipalities 1992 - 2003

Year	Number of Flood Emergencies
1992	2
1993	2
1994	0
1995	1
1996	9
1997	9
1998	12
1999	1
2000	1
2001	3
2002	5
2003	1

From the data in Table 1, it can be seen that there are on average approximately 3.8 flood events per year over the study period. However, the length of the study period does not make this a particularly valid statistic. In fact, many people can recall that the mid 1990s were relatively wet while the late 1990s and early 2000s were relatively dry. As a result, sheer numbers don't tell the whole picture since significant flooding can occur during drier periods. In fact, some of the most severe flooding to occur in Ontario's history has occurred in the last two years. In addition, those

[12] Flooding and Insurance. Munich Reinsurance Publication. Munchener Ruckversicherungs-Gesellschaft. Germany. 1997.
[13] Environment Canada Website. The Management of Water - Costs of Flooding, Disaster Assistance Payments. www.ec.gc.ca.

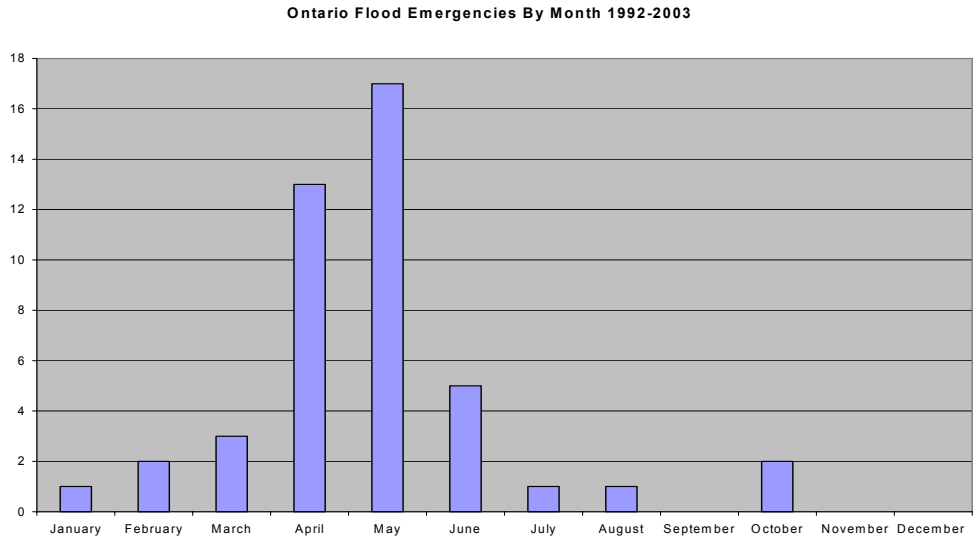
floods have occurred in the less populated parts of the Province – primarily in Northwestern Ontario.

Information obtained from Emergency Management Ontario also suggests that flood events, while concentrated in March and April, can and do occur year round as shown in Table 2 and the associated graphic:

Table 2 - Number of Flood Emergencies Declared By Municipalities By Month (1992 – 2003)*

Month	Number of Flood Emergencies Declared
January	1
February	2
March	3
April	14
May	17
June	5
July	1
August	1
September	0
October	2
November	0
December	0

*Source: Emergency Management Ontario - Flood Damage Data.



In Ontario, flooding has caused severe community disruption as depicted in **Table 3**:[14]

Table 3 - Number of Flood-Related Evacuations in Ontario 1996-1998			
Year	**Number of Flood Evacuees**	**Total Number of Evacuees**	**Flood-Related Evacuees as a Percentage of Total Evacuees**
1996	2141	2338	91.5%
1997	551	736	74.9%
1998	210	1563	13.4%

* Source: Ministry of Natural Resources, Flood & Fire Management Evacuation Statistics.

Most of the flood-related evacuations occurred in the less populated parts of the Province. In 1996, flooding occurred in the Cochrane and Moosonee area of northeastern Ontario, a pattern that repeated itself the following year. In 1998, extensive flooding along the Goulais River and in Huntsville and Parry Sound proved particularly disruptive. In 2001 and 2002, widespread community disruption in the Rainy River and Atikokan resulted from extensive flood events. Acres International has estimated total damages from the 2002 storm have topped $31 million.[15] Had these events occurred in the more populated south, the resulting damage and disruption would have been astronomical.

Ontario Flood Damage Costs on the Rise:

In Ontario, damage assistance to municipalities has been on the rise since the mid-1990s. In 2002 alone, over $5.7 million in direct ODRAP funding was provided to municipalities, with an additional $4.5 million being provided to individual landowners, businesses and farmers for damage caused by flooding.

This increase in flood damage disaster assistance to municipalities mirrors the escalating concern expressed by communities in relation to natural hazards. In a comprehensive study conducted by Dr. John Newton for the Office of Critical Infrastructure Preparedness and Emergency Response, Newton explored the relationship between community planning in Ontario and natural hazard mitigation.[16] **Among the communities who responded, Newton notes that flooding was the top natural hazard of greatest concern at the municipal level.**

Rapid Growth & Land use Change - Implications for Flooding:

Rapid growth rates in many parts of the Province – not just the Golden Horseshoe – are having a dramatic impact on rates of runoff in general and flooding in particular.

[14] The Ministry of Natural Resources collected information of flood and fire-related evacuations for a five-year period from 1993 to 1998. Data during this period however is not comprehensive and no data has been collected on evacuations since that time – a practice that should be reinstated.
[15] Acres International Limited. Evaluation of the Storm and Flood of June 2002 in Northern Ontario. Prepared for the Ministry of Natural Resources. November 2003.
[16] John Newton, Building Resilient Communities Through Disaster Mitigation: Planning for Natural Hazard Mitigation in Ontario Communities. Office of Critical Infrastructure Protection and Emergency Response.

> "The reduction of woody vegetation, the urbanization of watersheds, increased areas of impermeable surfaces for highways, and some other land use changes, increase the amount of precipitation that quickly becomes surface runoff. Small rivers and streams in affected regions become increasingly "flashy" with higher peak floods and less flow in dry periods."[17]

Some areas of the Province are showing growth rates of 11% - virtually double the Provincial average.[18] New residential construction is up and the result is rapid and dramatic change in land use, particularly along the rural-urban fringe. The establishment of a Greenbelt Task Force by the Province within the last month, points to the rapid pace of rural to urban land use change and the need to better manage this growth, for a variety of social, economic and environmental reasons.

The Regional Impact of Climate Change:

Regionally observed trends in climate data suggest an increase in the frequency of extreme rainfall events, particularly in northwestern Ontario. Research completed by Global Change Strategies International Inc. on behalf of Emergency Preparedness Canada, Environment Canada, the Insurance Bureau of Canada and the Institute for Catastrophic Loss Reduction suggest that climate change leads to a destabilization of the atmosphere and an intensification of the hydrologic cycle.

In short, additional climatic warming changes the distribution of heat and consequently, the flow of energy through the climate system. The atmosphere's circulation patterns are altered which in turn, could dramatically shift the position of many of the storm tracks that occur throughout the world. A warmer atmosphere is better able to hold more moisture and, as the research suggests, "the precipitation is expected to become more intense over small areas, which suggests greater flooding problems, especially in smaller catchment areas."[19] Dr. Gerhard Berz and Thomas Loster, on behalf of Munich Reinsurance, provide a succinct assessment of the impact of climate change:

> "Climate history teaches us that a globally warmer climate means more precipitation generally. The increase in humidity as a result of increased evaporation must be considered just as grave because it exerts a decisive influence on all precipitation and convection processes. We must expect not only more torrential rain, flash floods, and debris flows, but more thunderstorms, hail and lightening."[20]

In summary, the escalating incidence of severe flooding in Ontario, increased disaster assistance payments to municipalities for flood damage and the fact that flooding is the top-of-mind concern from a natural hazards perspective at the local level, all point to the importance of examining Ontario's approach to floodplain management.

[17] Bruce, James & Ian Burton, I.D. Mark Egener. "Disaster Mitigation and Preparedness in a Changing Climate." A Synthesis Paper Prepared for Emergency Preparedness Canada, Environment Canada, the Insurance Bureau of Canada and the Institute for Catastrophic Loss Reduction. GCSI – Global Change Strategies International Inc. p. 9.
[18] Statistics Canada. Demographic Profiles for Durham Region.
[19] Ibid., p.9.
[20] Berz, Dr. Gerhard & Thomas Loster. Climate Change – Threats and Opportunities for the Financial Sector. Munich Reinsurance Company. Geoscience Research Group. Munich, Germany. September 2001.

Hazard Identification & Risk Assessment

Ontario is entering a new era in hazard identification and emergency management. With the introduction and passage of Bill 148 and the proclamation of the Emergency Management Act, municipalities and provincial ministries in Ontario are required for the first time to adopt a risk-based approach to emergency management program delivery.

Under the Risk Management Framework for the Government of Ontario, the Hazard Identification and Risk Assessment (HIRA) approach actively promotes the development of comprehensive emergency management program standards. Under the program, the Province has shifted focus away from emergency management to the causes of risk and thereby, adopted a strategic and comprehensive approach to emergency preparedness.

As a result of a special designation through Order-in-Council, MNR is identified as the ministry having lead provincial responsibility for flood, fire and drought-related emergency management.[21]

From a floodplain management perspective, many of the underlying principles behind HIRA have been in place for some time. There is now an opportunity to capitalize on the good work completed to date, and build on the foundation of knowledge respecting flood hazards. Information on flood events and flood damages is an important starting point to better managing flood risk. Gathering information on flood trends, understanding the nature of flooding in Ontario and assessing the benefits of Ontario's flood forecasting and early warning system is a critical first step toward effective flood hazard identification and risk assessment.

[21]According to Mark Bett, Project Leader and author of the Report on Emergency Management in MNR prepared in Draft December 2003, MNR is also identified as a potential lead ministry for several other identified hazards including erosion, dam failures, landslides and oil and natural gas wells.

2.0 METHODOLOGY

2.1 General Project Approach

The project had two key objectives:

1. To update flood damage statistics from 1990-2003, with particular emphasis on the 1996-2003 time period.
2. To collect information on the benefit vs. cost of Ontario's approach to floodplain management, with particular emphasis on examining those studies that provide realistic examples where floodplain management activities have resulted in reduced flood damages and to develop recommendations and estimated costs for the Ministry of Natural Resources to carry forward future flood damage data collection and annual updates. A detailed Benefit Cost Analysis of Ontario's floodplain management program was not part of this study.

The two study objectives were markedly different in their focus and orientation. It was therefore decided that *two Reports would be produced* to address each objective separately:

i. Report 1: Flood Damage Report 1996-2003; and
ii. Report 2: Evaluation of MNR's Water Resource Management Strategies & Flood Damages.

General Methodology:

Although discussed in more detail in the section to follow, the methodology employed in carrying out this work followed a series of specific steps:

- Web-based Research.
- Distribution of Flood Damage/Cost Surveys.
- Request for Comments on the Surveys.
- Evaluation of Responses.
- Assessment of Existing Benefit Cost Studies.
- Preparation of the 1996 to 2003 Flood Damage Report.
- Preparation of the Overall Evaluation Report.

Initial efforts focused on a review of key websites and contact with key informants in various provincial and federal agencies, as well as private sector organizations. Existing benefit cost studies that demonstrated the effectiveness of Ontario's water resource management strategies were also examined. A Flood Damage/Cost Survey was distributed to all Ontario Conservation Authorities and MNR District and Regional Offices. A newspaper search was initiated to secure additional flood damage data to supplement the survey information provided by Conservation Authorities and MNR District Offices. In addition, statistical information was secured from the Ministry of Municipal Affairs on flood damage relief assistance, as well as information on the number of flood-related emergencies declared across the Province. The latter information was supplied by Emergency Management Ontario. Contact was also made with the Federal Government, in particular with PSEPC - Public Safety and Emergency Preparedness Canada (formerly Office of Critical Infrastructure Protection and Emergency Preparedness – OCIPEP) as well as with Environment Canada. The study methodology is discussed more fully in the section that follows.

2.2 Information & Data Sources

This study relied on a mix of data sources.

The initial search for flooding events and benefit cost studies began with a web-based search of government agency reports, journals and documents. This provided some background information on global trends with respect to flooding and identified some areas where current research is ongoing. The web-based search confirmed a groundswell of information on the topic of natural hazards in general and flooding in particular. Information was downloaded from fourteen websites (see Appendix A).

Contact was made with over 28 individuals in 9 Ministries and Agencies, primarily at the Provincial level. These individuals were identified as key informants with critical knowledge in the area of flood damage. The information obtained from these individuals provided an important starting point for the collection of additional event-based flooding information. A subsequent request was sent to the same recipients requesting a sober review of the data collection form, having gone through the exercise of preparing and submitting the forms as part of the data collection process.

To obtain specific information on flood events in Ontario from 1990-2003, two data sources were used:

i. Flood Damage Data from Conservation Authorities & MNR District Offices; and
ii. Flood Damage Data from Newspapers.

To obtain flood damage data from Conservation Authorities and MNR District Offices (outside of CA jurisdiction), a standard Flood Damage/Cost Survey was distributed. (See Appendix B) Data on individual flood events was completed by each Authority/MNR District Office and returned electronically for assessment and evaluation. While the study focused on flood occurrences between 1990 and 2003, the study deadline necessitated an emphasis be placed on data collection for the period from 1996-2003. It was assumed that flood event information would be more readily accessible for more recent flood events, a theory that proved accurate once the data has been assembled.

Secondly, to supplement the flood damage survey data, a newspaper search was undertaken. As floods are often associated with damage and monetary losses to both individuals and municipalities, they are often worthy of reporting in local or national press. The documentation of these events often provides an accurate account of timing and locations of flood events. To provide a focus, information obtained from the Ministry of Municipal Affairs and Housing (with respect to the payment of Disaster Relief Assistance to municipalities) as well as data from Emergency Management Ontario (respecting the declaration of flood emergencies by Ontario municipalities) provided a basis for the newspaper search of flood events. As per the Report on Ontario Flood History (The Water Network, 1991), it was originally believed that the Globe and Mail, London Free Press, Sault Daily Star and Ottawa Citizen would provide both regional and local coverage. This was inadequate for the current study as coverage was limited. Ultimately, a web-based newspaper search was undertaken, supplemented with a review of several newspaper sources at the University of Guelph. The ProQuest® Database system accessed through the University of Guelph, University of Waterloo, and Ryerson University was used to access electronic versions of publications including the Montreal Gazette, Ottawa Citizen, Sault Star, Windsor Star, and the Peterborough Examiner. The Globe and Mail was available through a separate database, with articles available back to the late 1800s. The Globe and Mail database includes digital versions of articles up to the year 2000, with an available search of citations only from 2001 to 2003. Citations of articles believed to identify a relevant flood event were recorded, and a manual microfiche search of that article was completed. Although not all issues of each

paper were available, it was believed that major flood events would be covered by the available publications. A complete list of publications searched, and the range of dates available are summarized in **Table 4**.

Table 4 - Publications searched for reports of flood events in Ontario

Publication	Available Period Searched
Barrie Examiner	2000-2003
Chatham Daily News	1999-2003
Enterprise - Bulletin, Collingwood	2000-2003
Globe and Mail	1990-2000
Globe and Mail	2000-2003 (Citation Only)
Kingston Whig Standard	1990-2003
Montreal Gazette	1990-2003
Niagara Falls Review	1999-2003
North Bay Nugget	1999-2003
Ottawa Citizen	1990-2003
Owen Sound Sun Times	1998-2003
Pembroke Observer	2000-2003
Peterborough Examiner	2000-2003
Sault Star	1997-2003
Sudbury Star	1999-2003
The Daily Press, Timmins	1999-2003
Windsor Star	1990-2003

Keyword searches were initiated for each publication. Keywords, including *flood, damage, high water, storm, and water level* were used to identify relevant articles. Words such as *flood* and *damage* were truncated to include any forms of these words (For example, *Flood** would generate articles containing the forms flood, flooding, flooded, etc). The results of the keyword searches were manually filtered to find articles pertaining only to naturally-caused flooding, and those events occurring within Ontario. Appropriate articles were then printed from either PDF images or ASCII text.

The available electronic databases allowed for related newspaper articles to be located relatively quickly and accurately. It would be impossible to manually search through newspaper microfiche over the entire range of dates for the study. A minor limitation was that not all publications have been entered into an electronic database for the entirety of the yearly parameters (1990 to 2003). It was assumed then that major flood events in all regions were sufficiently covered by the publications available back to 1990.

Although many resulting articles included estimates of flood damage, many articles were non-technical in that quantitative data was often left out of the publication. Even though many articles were qualitative in nature, the results of the database search provide confirmation of flood events acquired from other sources, provided additional information to these events, and documented smaller, isolated flood occurrences.

3.0 STUDY FINDINGS

3.1 Definitions of Flood and Flood Damage

In order to meet the study objectives, initial decisions had to be made respecting the definition of "flood", "flood event" and "flood damage."

Definition of "Flood"

This study is primarily limited to riverine flooding and does not comprehensively address flooding or erosion hazards along the Great Lakes. Some isolated instances where lakeshore flooding has occurred (i.e. Lake Nipissing, Lake Erie and Lake St John) have been included in the Flood Damage Report (1996-2003). While they are noted in the dataset, the information is limited. Given the timeframe of this study and the limited lake-related data provided by the agencies, lake flooding data is not complete with respect to Great Lake and interior lake flooding and erosion hazards. As a result, we have limited our investigations primarily to riverine flooding.

Accordingly, the Ministry of Natural Resources defines a flood as follows:

> "A flood is an overflow or inundation that comes from a river or other body of water and causes or threatens damage. It can be any relatively high streamflow overtopping the natural or artificial banks in any reach of a stream. It is also a relatively high flow as measured by either gauge height or discharge quantity."[22]

Definition of "Flood Event"

There are essentially two ways in which a riverine flood or flood event can be defined. The first focuses on hydrological factors and high water levels. The other is based on community disruption and damage caused by flooding. While attempts have been made to look at both factors, flooding information supplied by Conservation Authorities and MNR Offices is largely based on hydrological information. Some information is available on flood damage but this varies by geography and the scale of the flood event, hence the rationale for relying on hydrological factors.

In addition, initial decisions had to be made on the method of counting floods. This study relied on a classification system adopted by the Water Network in their analysis of Ontario's flooding history. Using the typology adopted in that review, the options for counting floods are three-fold:

(i) consider the temporal aspects and causes of a flood;
(ii) focus on the river basin;
(iii) focus on the impact from a human settlement/community perspective.

The first option would consider major storms as one flood event, despite the impact that a major storm may have at the individual community level. In this way, the 49th Parallel Storm would have been considered as one flood event, and would not have been considered in terms of its impact on numerous communities in northwestern Ontario.

The second option would consider flooding on a river basin basis. In this case, flooding would be counted on a watershed basis. The third approach focuses on the impact of flooding from a community-based perspective. Using this approach, flood events would be counted on the basis

[22] Ministry of Natural Resources Website. Glossary of Terms.(www.mnr.gov.on.ca)

of their impact at the local/community level. Flood Damage Relief Assistance is provided on a municipality-by-municipality basis and for this and other reasons, it was decided that the community-based approach would be used for counting flood events. Data submitted by Conservation Authorities and MNR District Offices reflects this approach.

Definition of "Flood Damage"

Despite the groundswell of interest in the topic, there does not appear a standard, recognized and accepted definition of the term "flood damage." Several definitions of damage permeate the insurance literature though perhaps the most comprehensive definition comes from the Environment Canada website. Here, flood damage is defined as:

> "The economic loss caused by floods, including damage by inundation, erosion, and/or sediment deposition. Damages also include emergency costs and business or financial losses. Evaluation may be based on the cost of replacing, repairing, or rehabilitating; the comparative change in market or sales value, or the change in the income or production caused by flooding."[23]

Flood damage can be direct and indirect, as addressed in the above definition. Flood damage can be physical and economic. The above definition however, does not address the social and/or human damage caused by flooding. Evidence of widespread disease or illness as a result of the after-effect of flooding (e.g. prevalence of mould) is a cost that is problematic to quantify. Nevertheless, these social implications need to be considered in order to arrive at true flood damage costs**.**

Findings:

1. *There is no standard definition of flood damage that appears universally accepted. Most definitions focus on direct physical/economic costs and do not address the social/human costs of flooding. It is recommended that a definition be adopted for flood damage that is all encompassing and includes both the direct physical costs of flooding as well as the social and human costs associated with flood events.*

3.2 Summary of Previous Benefit Cost Analysis Studies

One of the primary purposes of this study was to evaluate the findings of selected key benefit cost studies already completed for Ontario. Various studies were reviewed as requested by MNR and the result of study team research. Several key studies that were reviewed included the 49th Parallel Storm, the Indian and Northern Affairs study (Review of Historical Flooding in Northern Ontario Indian Communities, March 1988) and floodplain assessments studies in London and Glen Williams, Ontario. While these studies strongly supported the benefits of an effective floodplain management program, they did not constitute specific Benefit Cost Studies. As a result of our investigations into various reports, the following key studies were selected and summarized below:

- A Preliminary Assessment of the Effectiveness of Flood Damage Reduction Programs in Canada (OCIPEP, 1998) (Red River)
- A Comparison of Flooding in Michigan and Ontario. Soft Data to Support Soft Water Management Approaches.

[23] Environment Canada Website. Informational Resources and Services. Glossary of Terms. (www.ec.gc.ca)

- Grand River (model application of Saguenay Storm to Grand watershed)

The Red River Example:

OCIPEP (1998) discusses the effectiveness of flood damage reduction programs across Canada, focusing on the Red River in Winnipeg, the Credit River in Ontario and the Chaudiere River in Quebec.

The Red River, flowing north from the North Dakota and Minnesota area of the United States into the prairies at Winnipeg has been the site of numerous floods in the past and documented or anecdotal information is available as far back as the late 1700s. Flooding can be due to a variety of factors including heavy rain, heavy frost or snowfall, a quick thaw, ice problems or a combination of these. However the end result is always flooding in the Winnipeg area. Structural and non-structural flood mitigation measures were implemented to remedy the flooding. Structural solutions consisted primarily of the Red River floodway, the Portage Diversion, the Shellmouth Reservoir, general channel conveyance improvements and diking. Non-structural solutions consisted of legislation which limited funding of flood hazard prone projects, legislation limiting flood disaster assistance where proper floodproofing has not been provided and municipal land use designations limiting development within floodprone areas. Enhanced flood forecasting and warning and post-flood recovery efforts have aided the reduction in flood damages.

In spite of the fact that the study concluded that the benefits of the flood works greatly outweighed the costs, there are several critical shortcomings in the program. First and foremost is that any structural works that have been designed to a particular standard (i.e. a return period event) will eventually be overwhelmed by a larger event. This is particularly the case in the Red River system where the 1979 floodproof standard was exceeded in 1997. Regardless, where communities had floodproofed to the 1979 standards, flood damages where reduced during the 1997 event. Secondly, there is not a standard approach to non-structural flood damage reduction approaches. Thirdly, there is a disparity between rural and urban protection strategies. Obviously, rural areas are being impacted to protect urban areas. The authors also conclude that there still issues regarding relocation and reconstruction (with the emphasis on the latter rather than on former) and with inadequate enforcement and application of land use regulations. Additional concerns are also voiced by Shrubsole (ICLR, 2000) who notes weaknesses in institutional and jurisdictional flood warning arrangements, particularly with First Nations communities.

The benefit cost analysis completed during the predesign process of the three primary structural works concluded that, while the cost of construction of the three components would be in the order of $72 million, the average annual benefits would be in the order of $11 million with a benefit cost ratio of 2.73 (in 1958 and based on a 50 amortization period). This was updated in 1981 during a post construction review when it was determined that the benefits were actually higher. In fact, the 1981 study, as noted in OCIPEP, 1998, was that by 1979 there were already over $1 billion in reduced flood damages.

Ultimately, the OCIPEP study concluded that flood damage reduction works had been effective.

The Grand River Example:

The Saguenay River flood that caused extensive damage to the Quebec area was modeled by Boyd (ICLR, 2000) to the Grand River. Boyd's results showed that reservoirs reduced flows between 4% and 13%, dykes reduced flood damage by over $120 million, and land use regulations prevented an additional $5 million in damages.

The Michigan Example:

In 1986, four storms occurred in Michigan and Ontario and a comparative analysis of the ensuing damage concluded that despite higher flood yields in Ontario, much less damage occurred - largely attributed to the success of Ontario's floodplain management policies. Estimates of flood damage suggest that in Michigan, damage topped $500,000,000 while in Ontario, damage levels were kept to $500,000.00. As the Institute for Catastrophic Loss Reduction concludes, "there is little doubt that the combination of structural adjustments, building codes and floodplain regulations has reduced economic losses from what would have occurred without their presence."[24]

Findings:

2. *Existing Benefit Cost studies, based on the limited number of case studies evaluated, overall demonstrate that Ontario's floodplain management program has generally been effective.*
3. *As MNR moves toward a Risk Management Approach, the need for advancing Ontario's floodplain management program is critical.*

Despite the existence of several benefit cost studies, there has been virtually no work completed in Ontario that assesses the social/human impacts of flooding. The Ministry of Natural Resources embark on a socio-economic impact study and that consideration be given to assessing the impact of the 49th Parallel storm, given that this was the largest storm in Ontario's history. [25]

3.3 Flood Damage Statistics

There are a number of agencies and organizations who collect flood damage data for various purposes. The Ministry of Natural Resources monitors streamflow and retains statistical information on the number of flood and fire related evacuations. MNR District and Regional Offices (outside of Conservation Authorities) retain information on individual flood events, though this data is not of uniform quality and accuracy. By far the most comprehensive data on individual flood events is retained by the 36 Conservation Authorities across Ontario, though individual flood damage statistics vary in quality from one CA to another.

The Ministry of Municipal Affairs administers disaster relief assistance programs under the guise of the Ontario Disaster Relief Assistance Program (ODRAP) and Special Assistance to Municipalities (SAM). Under ODRAP, municipalities who declare flood emergencies are eligible to receive financial assistance for rebuilding after a flood event. Funds can be directed to an identified municipality or to individual landowners, farmers or business owners, In addition, special assistance funding can also be provided to municipalities under the SAM program where emergencies have not been declared but disaster relief is required.

The Emergency Management Ontario office of the Ministry of Community Safety and Correctional Services has statistical information relating to flood emergencies where a multi-Ministry response is required.

[24] Shrubsole, Dr. Dan. Flood Management in Canada at the Crossroads. Institute for Catastrophic Loss Reduction. ICLR Research Paper Series - No. 5. Toronto, 2000.

[25] The 49th Parallel Storm was reviewed but this evaluation, completed by Acres International did not constitute a benefit cost study. It evaluated the storm and flood of June 2002 and provided MNR with technical information, documentation, and analysis in order to determine whether the design flood criteria standard needs to be modified and if so, to what extent.

AGRICORP also retains information on crop damage resulting from flooding. Information is available through AGRICORP for crop damage/acre/year however this data is difficult to obtain. Concerns expressed by AGRICORP with respect to the integrity of the data prevented the release of those statistics for this undertaking. Under the Canadian Agricultural Income Stabilization Program (CAIS), Ontario's farmers are able to protect themselves from large and small income losses. The CAIS replaces the former Ontario Farm Income Disaster Program.

The Ministry of Environment (MOE) retains no data on flooding or flood events.

Flood damage data is also available through Pubic Safety and Emergency Preparedness Canada (PSEPC) - formerly the Office of Critical Infrastructure and Emergency Preparedness Canada (OCIPEP). Web-based information is available for over 700 natural, technological and conflict-related disasters that have affected Canadians over the past 100 years. Launched in 1990, the Canadian Disaster Database has developed into an internet based resource for Canadian disasters. The Canadian Disaster Database contains historical data on Canadian disasters, including flood events.

The Federal Government has identified certain criteria for including flood event data in their database. Only those floods that meet the following parameters are identified for inclusion:[26]:

- 10 or more people killed
- 100 or more people affected/injured/evacuated or homeless
- an appeal for national/international assistance
- historical significance
- significant damage/interruption of normal processes such that the community affected cannot recover on its own

Although an excellent compendium of historical flood events, the website does not include up-to-date or real-time flood event information. The database is updated infrequently (usually by undergraduate students during the summer months) and consequently, cannot be relied upon to present a current picture of flood damages. The database for Ontario is missing key flood events including the disastrous 49th Parallel storm that hit the northwestern part of the Province in June 2002. Discussions with staff responsible for maintaining the site indicated that no data had been included on the site after 2000. Efforts are being made to update the website and to generate real-time data capabilities, though this work is some way off from completion. From this, we can only conclude that the database is an excellent starting point for information sharing but at present contains sporadic information and cannot be relied upon to provide a holistic picture of flooding.

Findings:

4. *Flood damage data is not of uniform quality and accuracy.*
5. *Methods of calculating flood loss are not consistent across the Province, within MNR Districts or Conservation Authorities.*
6. *Flood damage data for Ontario is currently of poor quality overall.*
7. *Flood damage information is collected by a variety of agencies and organizations but is neither shared nor coordinated.*
8. *Existing data sources are not reliable and do not present a comprehensive picture of flood damage.*

[26] Critical Infrastructure Protection and Emergency Preparedness. Disaster Database. EPC website. www.epc-pcc.gc.ca

9. *Information on agricultural losses are not readily available. Insured crop loss information is collected by AGRICORP but concerns with data integrity exist.*

Procedures should be put in place by the Ministry of Natural Resources to ensure regular and consistent reporting of flood events by all Conservation Authorities and MNR District Offices. The Ministry should take the lead to establish the necessary linkages to allow for data exchange and information sharing.

3.4 Issues Respecting the Data

Information on flood damage was much better thirteen years ago, despite escalating flood damage costs and the increased incidence of flood events since that time.

Data on flood losses was much more comprehensive thirteen years ago, when flood damage information was regularly collected by the Ministry of Natural Resources.

Presently there is no agency in Ontario with sole responsibility for collecting, evaluating and reporting on flood loss. Despite the availability of information on declared flood emergencies, disaster relief assistance to municipalities and landowners, there is no central clearinghouse to report flood losses.

Data on flood losses is much better reported on in the U.S., largely as a result of the National Flood Insurance Program. Here in Ontario, there is a lack of information on flooding in general and flood loss in particular. In addition, there is no standard methodology employed across Ontario (or Canada for that matter) for accurately estimating flood damages.

Data on flood damage has an urban bias. Very little information is publicly available on the damage and benefits to agricultural lands from flooding. Most damage reports focus on disruption to communities, business and residences. There is virtually no information on the social costs of flooding - e.g. the impacts on human health and the after-effects of flooding. This is an area that is little understood and one for which little research is available.

Flood loss data obtained from Ontario's 36 Conservation Authorities and MNR District Offices (where no CAs exist) varied dramatically in terms of its comprehensiveness. Some CAs were able to provide extremely detailed damage data. These however, were among the minority. In most instances, direct flood damage figures were unavailable and virtually no information was collected on the indirect cost of flood events (e.g. loss of business income, etc.). Ironically, Environment Canada and MNR developed flood depth-damage curves for a variety of land uses in 1990 (Environment Canada and MNR, 1990) with the fairly simple intent of assessing flood damages based on flood depths. With the exception of the two CAs, the use of this tool appears to have been discarded. In the case of one CA, a test watershed has been targeted for this relatively simple process whereby flood depths are cross-referenced to known structures impacted at the corresponding depth and subsequently cross-referenced again to depth-damage tables. At a second CA, updated depth-damage tables have been prepared simply based on the increase in Consumer Price Index. MNR should investigate the possibility of updating the depth-damage tables and expanding them to include general municipal infrastructure and industrial/commercial land uses.

At best, we can conclude that damage estimates do not comprehensively include all damages. Direct damages can be more easily quantified than indirect costs of flooding. In addition, social costs associated with disruption and the after-effect of flooding are frequently not considered in the flood damage equation. How for example, can the social/human costs of mould (resulting from flooding) be calculated?

There are significant impediments to the accurate determination of flood losses. In 1990, MNR published the Flood Damage Estimation Guide, a report that identified flood damage curves and the methodology for calculating flood damage. This undertaking revealed that while some CAs were relying on this guide to estimate flood damage, many were not.

Findings:

10. *The level of flood damage information has declined over the last thirteen years – at a time when good data is even more critical, given the evidence of increasing number of flood events.*
11. *There is no agency in Ontario with sole responsibility for collecting, evaluating and reporting on flood loss.*
12. *In Ontario, there is a lack of information on flooding in general, and flood loss in particular.*
13. *There is no standard system for accurately estimating flood damages Province-wide.*
14. *Flood loss data has a distinctly urban bias.*
15. *Most flood damage data focuses on the physical/economic impact of flooding. Very little information exists on the social/human impacts of flood events.*
16. *Information on flood events varies dramatically from one Conservation Authority to another and from one MNR District to another. The wide range in data quality makes comparative analysis of flood events difficult.*
17. *Flood depth-damage tables are out-dated and should be updated to ensure that proper tools are available to CA and MNR offices.*
18. *Flood losses can be direct and indirect. Direct losses are reported more succinctly than indirect losses.*

3.5 Flood Data Collection Review

Prior to 1990, the MNR collected flood damage reports from the various MNR and CA offices utilizing the data collection format found in Appendix B. Typically this involved the CA or MNR office filling out the report and faxing the report to MNR for inclusion into the summary document and flood database. An annual report (or amalgam of annual reports) was then produced which was based on this information. The last year this was prepared was 1990 and, unfortunately, the database on which the past reports were based has been misplaced. Since then, flood managers are typically unaware of the historicity of the form or the data collection process.

As noted in Section 1, MNR is re-evaluating its mandate with respect to flood damage reporting and flood hazard management. This report is being prepared to note the past, present and future of flood damage reporting and give direction to MNR as to how this may be implemented. As part of this, the data collection form and process was also evaluated to determine currency. As noted in Section 2, the CAs and MNR offices were polled as to the adequacies of the current data collection form.

Comments received from agencies on the Survey of Flood Damages/Costs were as follows:

<u>Timing of Data Collection:</u>

- Flood event data should be collected at the time of the event, together with a calculation of flood damages.

Method of Data Collection:

- There is a need for a guidance document on how to estimate flood damages or a simplified form that can be used by property owners to provide estimated flood damages to the CAs.
- There needs to be a standard official claim process for residential landowners related to flood claims.
- There needs to be a method of accessing flood damage information from municipalities and insurance companies so that actual flood damage costs can be calculated and reported on.

Points on the Survey Requiring Clarification:

- Scale of Flood Event – include the classification system along with the survey in future.
- Identify what is meant by the term "Maximum Flood Elevation"
- Define specific criteria that would be used to determine:
    i. what the damage would have been without warning; and
    ii. what the damages would have been without fighting flood.

Future Data Collection:

- Provincial Ministries and Conservation Authorities strongly supported the collection of flood event data and felt a standard template was extremely useful.
- Additional information is required on the Ministry responsible for distributing the disaster financial assistance.
- The survey did not address dam failure as a potential cause of flooding. This should be included on future surveys.

Findings:

19. *The approach taken by Conservation Authorities and MNR District Offices to address flood damage costs varies. A consistent approach is needed for calculating flood loss. Flood damage curves and tables need to be updated.*
20. *The survey needs to be updated to include additional information as noted above. It may be advisable to consult directly with Conservation Ontario, MMA, MAF concerning any additional changes to the survey prior to any revisions being made.*

3.6 Options for Future Data Collection - Implications for MNR

Since the early 1990s, technology has changed considerably with monitoring, computing, data transfer and data storage abilities increasing exponentially. As a result, the past system of faxing forms, completed by hand, to a central agency seems straightforward but archaic.

Options for future submissions include the following:

1. Continued manual preparation of flood damage reports and submission by fax or pdf email to a central MNR repository where data is manually transcribed into a larger database (perhaps by student help when available).
2. Submission of electronic versions of the document to a central MNR repository where data is automatically assimilated into a larger database with no additional manual transcribing.

3. Web-based input of data by individual CA or MNR offices directly into database with minimal data quality control and immediately available to all users.

The Canadian disaster database (PSEPC), while not perfect, is being re-examined by federal staff and in the future may be brought into quasi-real time reporting mode. This web-based database is an excellent example of how information can be uploaded, shared and utilized effectively. An excellent prototype for consideration is the U.S. Federal Emergency Management Agency website that contains comprehensive and real time data on flooding. An exceptional web-based resource, the FEMA site provides detailed flood event information on a state by state basis. Number of flood related losses, total insurance payments and average claim paid are all accessible through FEMA. In addition, the site is capable of generating flood loss statistics reports either geographically or annually. The National Insurance Program is operated by the Mitigation Division of the Federal Emergency Management Agency and represents a public/private partnership. Almost 100 insurance companies sell and service the Federal Government's standard flood insurance policies and under the program, almost 4.2 million American homes and businesses are insured against flood damage.[27] In addition to baseline information on flood damage, FEMA has also created a database of Mitigation Success Stories from communities across the U.S. The FEMA site may provide an excellent example of the type of data collection, storage and retrieval as well as information sharing capabilities that could be put into place.

As technology and resources are available, the preferred approach would see web-based input of data by individual offices as events occur. With quality control procedures in place, the data is immediately available to network and web-based users for analysis and reaction. Other agencies (e.g. Municipal Affairs) for additional data input related to flood damages, evacuations, or disaster relief funding. The information can also be directly uplinked to the PSEPC database to form part of a larger network. It is unsure how the federal database acquires its information and assigns responsibilities but should this be the preferred methodology, it would be necessary for MNR to retain responsibility for its portion of the data.

The Ministry of Natural Resources, as established above, needs to take the lead to reactivate the collection of flood event data in general and flood damage information in particular. Having a comprehensive and holistic picture of Ontario flood event information is a necessary first step to ensuring the identification of flood hazards and the assessment of risk.

The ultimate collection and reporting of future flood damage information would involve several key initiatives:

- Develop a standard methodology for the calculation of flood damage (i.e. update the Flood Damage Estimation Guide).
- Develop the Flood Damage/Cost Survey.
- Undertake educational/training to ensure all CAs and MNR Districts are aware of the data requirements, their role & responsibilities for submitting information on a flood event basis and the value of this exercise from their perspective.
- Use a web-based data collection system or distribute the Flood Damage/Cost Survey to all CAs, MNR District and Regional Offices.
- Follow up with CAs and MNR Offices to ensure the data set is complete.
- Compile the data into an Excel spreadsheet for data analysis
- Undertake the data analysis on an annual basis.
- Produce the Annual Flood Damage Report.

[27] Howard, Jo Ann. Remarks to the US/Canada Consultative Group Meeting by the Federal Insurance Administrator. Ottawa, Canada. August 30-31, 2000. www.fema.gov/nfip/jahsp12.shtm

- Distribute the Annual Flood Damage Report to all CAs, Conservation Ontario and MNR District, Regional and Main Office locations, as well as other partners (ICLR, PSEPC, etc.)

There are several options available to the Ministry in carrying through on future flood damage data collection and reporting:

(i) Use of In-house Resources;
(ii) Outsource data collection to a private sector firm;
(iii) Adopt a partnership approach.

Perhaps the most cost effective method of data collection would utilize in-house MNR resources. This option however must be considered in light of existing staff resources and current workload. A second option could involve the use of external resources - a private sector firm retained on an annual (or longer) basis to develop the methodology and produce the Report. Finding an annual allocation for completion of this work on a regular basis may present a challenge. It is estimated that the cost of completing this exercise on an annual basis would be in the order of $20,000. The other alternative would be for the Ministry to collect flood damage data using a partnership approach - the delivery model could involve MNR collecting the flood damage data and a private sector company analyzing the data and producing the final Flood Damage Report on an annual basis. The costs would be considerably less and are estimated at $10,000.

3.7 Additional Discussion

Given the original Terms of Reference and the timeframe associated with this review, there was a considerable body of work that was not examined. In particular, this study did not examine:

a. issues respecting dam safety and the potential for infrastructure failure from flooding;
b. where flood damage is occurring (e.g. within Special Policy Areas);
c. the impact that the Policy Statement has had on directing development away from flood susceptible areas;
d. the extent of existing flood line mapping across the Province and the need for revised and/or new mapping, particularly in Northern Ontario;
e. the number of areas/communities demonstrating “repetitive loss”;
f. the extent to which education and outreach efforts have been made with respect to the Natural Hazards Policy and how well these are understood by CA and MNR staff.

Aging Infrastructure:

As noted above, the original Terms of Reference did not include an analysis of dam safety issues. However, concerns respecting Ontario’s aging infrastructure have significant bearing on the risk of flooding. The most important natural hazards which threaten dams include flooding from excessive precipitation and flooding from upstream dam failure, earthquakes and landslides. In Ontario, “floods are perhaps the most significant events which threaten the safety of the dams.”[28] According to data from the Ministry of Natural Resources:

> “History of past dam failures shows that the majority of dams have failed due to flood flows having exceeded their design capacity, and thereby exceeding the capacity of the spillways.”[29]

[28] Ibid., p. 2-5
[29] Ibid., 2-5, 2-6.

These concerns become even more alarming when issues respecting an aging infrastructure are factored into the equation, along with the fact that the design flood flows, particularly in designated areas of the Province are on the increase. The 49th Parallel Storm providing an excellent case in point.

Across the U.S., there have been 576 reported dam failures from September 1994 to 2003.[30] In Ontario, detailed inventory information on the age of each dam is not available. According to the Ontario Dam Safety Guidelines, "there are approximately 2200 dams in Ontario; of these, nearly 1000 are privately-owned, while the remainder is owned by the two levels of government, Ontario Power Generation, and Ontario's Conservation Authorities."[31] In Ontario, a detailed understanding of the age of each dam is not available but what is clear is that dams across the Province, as elsewhere in Canada, are aging. Furthermore, according to MNR staff and supported by Ontario Power Generation, Great Lakes Power and various dam-owner and industry groups, once dams reach 40 to 50 years of age, major rehabilitation work is required to avoid dam failure. In Ontario, 65% of all MNR owned dams will reach this critical age in the next 10 to 15 years. The age of the Province's infrastructure could well have a significant impact on the increase of flood events over time. This is an area that warrants further study.

The Location of Flood Damage

The study did not examine whether flood damage was occurring in Special Policy Areas across the Province. Having this information would have provided valuable insight with respect to Ontario's approach to floodplain management. Conservation Ontario is undertaking a survey of all Conservation Authorities to develop performance standards. Some of the data to be secured through this performance measure exercise would provide insight as to the number of "at risk" structures, the number of buildings located in flood prone areas, etc. MNR should partner with Conservation Ontario in support of this extremely valuable initiative and look at information sharing. This is an area that warrants future study.

The Impact of the Policy Statement

Part of assessing the benefit cost of Ontario's water resource management strategies is to consider how many floods have been avoided as a result of the Provincial Policy Statement. Time did not permit the analysis of this key aspect but clearly considerable development across the Province has been redirected away from flood susceptible areas as a result of the "non-structural approaches" provided by the Policy. Developing appropriate measures of success for the Policy Statement are not easy but they are necessary, particularly from a benefit cost perspective. This is an area that warrants future study.

The State of Floodplain Mapping

In recent years there has been some updated floodplain mapping completed by Conservation Authorities across Ontario but there has been no concerted effort to undertake updated floodplain mapping on a large scale since the early 1990s. Some areas of northern Ontario do not have flood line mapping. This report did not examine those areas where flood mapping is needed, nor did it examine those areas where updated floodplain mapping is required. This is an important areas for future consideration, particularly given the implications of the 49th Parallel Storm.

[30] Hydro Review. Dam Safety & Security. The Magazine of the North American Hydroelectric Industry. Vol. XXIII, No. 1. February 2004.
[31] Ontario Dam Safety Guidelines. Ministry of Natural Resources, Lands & Natural Heritage Branch. Draft Document Dated September 21, 1999.

The Extent of "Repetitive Loss"

There is virtually no data available at the Provincial level that would provide insight into the number of areas demonstrating "repetitive loss." In some instances, repeated flooding in designated communities is available though this information should be secured for the Province as a whole. This is an area that warrants future study.

Education & Outreach

Although not part of the original Terms of Reference, the study determined that the last comprehensive effort at education and outreach with respect to the Policy Statement took place in 1997. At that time, the Ministry of Municipal Affairs coordinated a major education and training effort around the Natural Hazards Policy but no efforts have been made on a comprehensive basis to provide education and training to Conservation Authorities and/or MNR District or Regional Staff since that time. Renewed efforts are required to ensure that staff dealing with the Policy Statement are familiar with its contents and comfortable with its application. This is an area that warrants future study.

4.0 DISCUSSION, RECOMMENDATIONS AND CONCLUSIONS

4.1 Discussion & Recommendations

I. Flood Definition

Finding:

1. *There is no standard definition of flood damage that appears universally accepted. Most definitions focus on direct physical/economic costs and do not address the social/human costs of flooding. It is recommended that a definition be adopted for flood damage that is all encompassing and includes both the direct physical costs of flooding as well as the social and human costs associated with flood events.*

Based on this finding, the following recommendation is made:

Recommendation #1: That the following definition of flood damage be adopted:

"The economic and social loss caused by floods, including damage by inundation, erosion, and/or sediment deposition. Damages also include emergency costs and business or financial losses, as well as social and community disruption and impacts on human health and safety resulting from flooding. Evaluation may be based on the cost of replacing, repairing, or rehabilitating; the comparative change in market or sales value, or the change in the income or production caused by flooding."

II. Benefit Cost Analysis

Findings:

2. *Existing Benefit Cost studies, based on the limited number of case studies evaluated, overall demonstrate that Ontario's floodplain management program has generally been effective.*
3. *There has been virtually no work completed in Ontario that assesses the social/human impacts of flooding.*

Based on these findings, the following recommendation is made:

Recommendation #2: That the Ministry of Natural Resources conduct a detailed analysis of the social/human costs resulting from flooding in Ontario and that consideration be given to examining the socio-economic cost of the 49th Parallel Storm in particular as this was the largest storm in Ontario's history.

III. Flood Damage Statistics 1996-2003

Increasing our knowledge about flood events in Ontario is critical. Having the ability to collect and analyze comprehensive and consistent baseline information about flooding is the foundation of effective floodplain management. Adopting a holistic and strategic approach to managing flood risk relies heavily on good data and a sound understanding of flood damages, risks and vulnerability. Assessing the direct and indirect social, economic and environmental impacts of flooding will enable decision makers to better understand the benefits and costs of reducing flood risks.

Findings:

4. *Flood damage data is not of uniform quality and accuracy.*
5. *Methods of calculating flood loss are not consistent across the Province, within MNR Districts or Conservation Authorities.*
6. *Flood damage data for Ontario is currently of poor quality overall.*
7. *Flood damage information is collected by a variety of agencies and organizations but is neither shared nor coordinated.*
8. *Existing data sources are not reliable and do not present a comprehensive picture of flood damage.*
9. *Information on agricultural losses are not easily available for review. Insured crop loss information is collected by AGRICORP but concerns with data integrity exist.*

Based on these findings concerning the existing flood damage data, the following recommendations are made:

Recommendation #3: **That the Ministry of Natural Resources re-institute the practice of regularly collecting flood event data on an event-by-event basis from Conservation Authorities and MNR District Offices. As the Ministry moves toward a risk based approach to hazard management, the need for comprehensive and accurate flood damage information will become even more critical.**

In keeping with the above recommendation, that the Ministry of Natural Resources institute procedures for the regular submission of electronic versions of the Flood Damage/Cost Survey to a central MNR repository where data is automatically assimilated into a larger database with no additional manual transcribing. Over the longer term, the Ministry should consider developing a real-time web-based database (similar to the FEMA site) where flood event data could be entered directly into a centralized database, immediately available to all users.

Recommendation #4: **That the Ministry of Natural Resources analyze the flood event data and produce an Annual Flood Damage Report to be distributed to Conservation Ontario, all Conservation Authorities, MNR District & Regional Offices, Ministry of Municipal Affairs, Emergency Management Ontario, Ministry of Agriculture & Food as well as appropriate agencies at the Federal level and other private sector organizations with an interest in flooding.**

Recommendation #5: **That the Ministry take the steps necessary to develop a standard methodology for the calculation of flood loss, including the**

updating of flood damage curves and tables. It is further recommended that the Ministry consider updating the 1990 Flood Damage Estimation Guide to reflect the current Consumer Price Index, and that this document be used as the template for calculating flood damage across the Province by all Conservation Authorities and MNR District Offices.

Recommendation #6: That the Ministry of Natural Resources work with its partners including Conservation Ontario to explain the Flood Damage Estimation Guide to Conservation Authorities and MNR District Offices and to promote its use by all CAs and MNR Districts. This will ensure a standard methodology for the calculation of flood damage across Ontario, and will result in more detailed and accurate information on flood loss.

Recommendation #7: That the Ministry of Natural Resources support the work of Conservation Ontario to obtain detailed bench mark data on flooding, including: the number of buildings located in the floodplain and the amount of new development directed away from flood susceptible areas.

Recommendation #8: That the Ministry of Natural Resources strengthen existing and foster new alliances with its partners to promote the sharing of flood-related information. In this regard, it is recommended that the Ministry take the lead to develop procedures to promote the sharing of best management approaches relating to floodplain management, planning and emergency response.

Recommendation #9: That the Ministry of Natural Resource, in moving toward a Risk Management Approach, recognize the importance of good data and a sound understanding of flood damages, risk and vulnerability as the basis for advancing Ontario's flood plain management program.

IV. Issues Respecting the Data

In Ontario, much progress has been made in reducing flood risks. Projected increases in flood damage suggest that more effort is required. Regular reporting of flood events and the collection of detailed flood damage information on a sustained basis is a necessary first step. Greater emphasis on public education, awareness and outreach will continue to drive home the importance of restricting development in flood susceptible areas. Partnering with agencies like Conservation Ontario to deliver floodplain policy education sessions for both MNR and CA staff will ensure new staff are informed and aware of the key policy directives and approaches.

There are a real need for better data management, within MNR and the CAs, within the Provincial Government, between various levels of government and with agencies like the Institute for Catastrophic Loss Reduction and Environment Canada's Natural Hazards Assessment Project. MNR should take the lead role in facilitating the exchange of information and ideas among those who have an interest in floodplain management. By working collaboratively, there is opportunity to better manage flooding and thereby reduce flood risk.

Findings:

10. *The level of flood damage information has declined over the last thirteen years – at a time when good data is even more critical.*
11. *There is no agency in Ontario with sole responsibility for collecting, evaluating and reporting on flood loss.*
12. *In Ontario, there is a lack of information on flooding in general, and flood loss in particular.*
13. *There is no standard system for accurately estimating flood damages Province-wide.*
14. *Flood loss data has a distinctly urban bias.*
15. *Most flood damage data focuses on the physical/economic impact of flooding. Very little information exists on the social/human impacts of flood events.*
16. *Information on flood events varies dramatically from one Conservation Authority to another and from one MNR District to another. The wide range in data quality makes comparative analysis of flood events difficult.*
17. *Flood depth-damage tables are out-dated and should be updated to ensure that proper tools are available to CA and MNR offices.*
18. *Flood losses can be direct and indirect. Direct losses are reported more succinctly than indirect losses.*
19. *Flood damage focuses almost exclusively on physical and economic loss and rarely considers the social and human aspects associated with flood events.*

Based on these findings, the following recommendations are made:

Recommendation #9: That the Ministry of Natural Resources take the lead in establishing a Provincial Flooding Working Group, with representation from the Ministry of Municipal Affairs, Emergency Management Ontario, Conservation Ontario, Ministry of Agriculture and Food and any other Provincial Government agency with an interest in and/or responsibility for flooding. The mandate of this Working Group will be to develop a consistent approach for collecting and reporting on flood events and flood damages at the Provincial level and to develop a system for information sharing and reporting on best management practices with respect to floodplain management.

Recommendation #10: That the Ministry of Natural Resources take the necessary steps to develop better linkages with the Federal Government on issues relating to flooding, with a view to developing a standardized database for the collection of information on flood events and flood loss.

Recommendation #11: That the Ministry of Natural Resources take the necessary steps to develop better linkages with the Institute for Catastrophic Loss Reduction as well as other research organizations to ensure that the Ministry has the most up-to-date information on flooding in general and flood damage in particular.

V. Other Ancillary Issues of Concern

This study did not examine:

i. issues respecting dam safety and the potential for infrastructure failure from flooding;
ii. where flood damage is occurring (e.g. within Special Policy Areas and Great Lakes);
iii. the impact that the Policy Statement has had on directing development away from flood susceptible areas;
iv. the extent of existing flood line mapping across the Province and the need for revised and/or new mapping, particularly in Northern Ontario;
v. the number of areas/communities demonstrating "repetitive loss";
vi. the extent to which education and outreach efforts have been made with respect to the Natural Hazards Policy and how well these are understood by CA and MNR staff.

The study found that these issues have an important bearing on understanding Ontario's flood hazards and consequently have an important affect on managing flood risk. Based on these findings, the following recommendations are made:

Recommendation #12: That the issue of dam safety vis-à-vis flooding potential be examined more fully by the Ministry of Natural Resources. Implementation of a dam safety program would reduce the potential risk associated with flooding by decreasing the potential for dam failure. All dams will need to be reviewed on a periodic basis based on changes to design flow standards, changes in water flows upstream of dam and changing downstream development that result in increased risk. Also a review of regional storm and flood standards is required to address climate variability and policy requirements.

Recommendation #13: That the Ministry examine whether flood damage is occurring in Special Policy Areas across Ontario, with a view to determining the number of "at risk structures" in flood susceptible areas, as well as those areas/structures demonstrating "repetitive loss". Some of this information is being collected by Conservation Ontario in its efforts to develop performance standards and it is recommended that MNR partner with Conservation Ontario to support this effort.

Recommendation #14: That the Ministry of Natural Resources work with Conservation Ontario and the Ministry of Municipal Affairs to develop performance targets to determine the effectiveness of the Policy Statement.

Recommendation #15: That the Ministry of Natural Resources determine the extent of floodplain mapping in Northern Ontario (particularly unorganized territory) and identify those areas requiring new and/or updated mapping and consider developing mapping priorities for same.

Recommendation #16: That the Ministry of Natural Resources take the lead to coordinate an education and training program for Conservation Authorities, MNR and provincial planning staff in relation to the Provincial Policy Statement. MNR should partner with Conservation Ontario and the Ministry of Municipal Affairs to deliver this training.

VI. Options for Future Data Collection - Implications for MNR

The study, though completed in six weeks, demonstrated clearly the overwhelming need for regular, standardized, consistent information on flood events in general and flood damage in particular. The Flood Damage/Cost Survey was distributed to all Conservation Authorities and

MNR District and Regional Offices but time did not permit a detailed examination of that survey prior to its distribution. The same survey that had been distributed up to and including 1990 was used. Comments received from several Provincial Ministries and agencies, as well as several Conservation Authorities, indicated the need for some changes to be made to the survey itself.

Findings:

20. *The approach taken by Conservation Authorities and MNR District Offices to address flood damage costs varies. A consistent approach is needed for calculating flood loss. Flood damage curves and tables need to be updated.*
21. *The survey needs to be updated to include additional information as noted above. It may be advisable to consult directly with Conservation Ontario, MMA, MAF concerning any additional changes to the survey prior to any revisions being made.*

Based on these findings, the following recommendation is made:

Recommendation #17: That the Ministry of Natural Resources incorporate the recommended changes to the Flood Damage/Cost Survey and further, that the Ministry consult with Conservation Ontario, the Ministry of Municipal Affairs, Emergency Management Ontario and AGRICORP to ensure all relevant information has been identified for inclusion on the Survey.

Recommendation #18: That the Ministry of Natural Resources determine the most appropriate form of data collection and reporting of annual flood damages and further its implementation.

4.2 Conclusions

There is a need for better information on flooding in general, and flood damage costs in particular. A central database for information sharing is desperately needed - one that is regularly updated and maintained and one that includes data on all flood events, not just those of catastrophic proportions. There is also a need for better information sharing among all levels of government as well as between the public and private sector. Extensive research in the natural hazards arena is underway through the Natural Hazards Assessment Project and the Institute for Catastrophic Loss Reduction. In addition, the Federal Government through Public Safety and Emergency Preparedness Canada has completed extensive public consultations on a National Disaster Mitigation Strategy and intend to bring the Strategy forward for Cabinet endorsement this Fall.

The Ministry of Natural Resources needs to strengthen existing partnerships and forge new alliances at all government levels as well as with private sector organizations and agencies to ensure the best possible flood-related information is available. In addition to those recommendations cited above, the study also found that while it is well studied, flooding as a subject area is little understood. Regular data collection on individual flood events is critical for effective and efficient program delivery. Understanding flood risk is an essential first step in building a foundation of effective flood management. Working collaboratively with others who share an interest in flooding will lead to enhanced knowledge and a better understanding of flood risks and hazard management. There is an overwhelming need for leadership in floodplain management. MNR is perfectly poised to take on this leadership role. Given the trends, it would appear particularly prudent that these efforts be made in the short term.

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Appendix A
Information Contacts & Websites Visited

- **Directly spoke with over 28 individuals re: information on flood damage in Ontario & flood event statistics; and,**
- **Visited and downloaded reports and documentation from >16 websites, as follows:**

Organization/Agency	Name of Key Contact
Ministry of Natural Resources: Lands & Waters: Flood & Fire Management Field Services:	 D. Greer R. Fox C. Seider T. Woods G. Gordon Bob Griffiths, DM Parry Sound Nick Paroschy, Bracebridge Engineer Les Pataky, Regional Engineer, SR Allan Chow, Regional Engineer, NOR Malcolm MacDonald, Ops Mgr. NER Jim MacLean, ADM
Ministry of Municipal Affairs – Disaster Assistance Review Office	D. Jardine D. McArthur-Rogers
Ministry of the Environment : Science & Standards Division Air Policy & Climate Change Water Policy Branch	 Fred Fleischer Tony Rockingham Brian Nixon
Ministry of the Solicitor General Emergency Management Ontario	 Christine Kowalyck Tom Kontra Dan Zakydalsky
OMAFRA	L. D'Onofrio – Emergency Management Brad Carberry – AGRICORP
Conservation Ontario	Dick Hunter Gayle Wood
Grand River Conservation Authority	Dwight Boyd
Institute for Catastrophic Loss Reduction	Office of Paul Kovacs, E/D (Tracey Wattington) Slobodan Simonovic
Insurance Bureau of Canada	Consumer Information Centre

Organization/Agency	Name of Key Contact
Environment Canada – Natural Hazards Assessment Project	David Etkin
John Newton & Associates	John Newton
Websites Visited:	
Insurance Information Institute	www.iii.com
Institute for Catastrophic Loss Reduction	www.iclr.org
IJC	www.ijc.org
Munich Re	www.munichre.com
American Re	www.amre.com
Natural Hazards Centre – University of Colorado	www.colorado.edu
NOAA Satellites and Information – National Environmental Satellite, Date & Information Services	www.ngdc.noaa.gov
Earth Satellite Corporation – Floodcast	www.earthsat.com
Environment Canada – Flooding Events in Canada – Ontario	www.ec.gc.ca
Conservation Ontario	www.conservation-ontario.on.ca
Grand River Conservation Authority	www.grandriver.ca
Association of State Floodplain Managers	www.floods.org
Federal Emergency Management Agency – U.S.	www.fema.gov
Office of Critical Infrastructure Protection and Emergency Preparedness (OCIPEP)	www.ocipep.gc.ca
Public Safety & Emergency Preparedness Canada – Canadian Disaster Database	www.epc-pcc.gc.ca
Department of Transport and Regional Services – Economic Costs of Natural Disasters in Australia	www.bte.gov.au

Appendix B
Flood Damage / Cost Survey

FLOOD DAMAGE / COST REPORT

(This report should be completed and submitted for each flood. If filing electronically, save each event as a separate file. Double-click on boxes to enter mark.)

LOCATION

MNR Area _____ MNR District _____
MNR Region _____ C.A. _____
Municipality _____ Watercourse _____
Watershed or Great Lake _____
Flood Damage Location _____

TIMING

Date of Flood Peak _____ Time _____

MAGNITUDE

Maximum Flood Elevation _____ m Maximum Depth of Flooding _____ m

Area inundated _____ km^2 Scale of Flood Event ☐ ☐ ☐ ☐ ☐ ☐
0 1 2 3 4 5

Provincial Emergency Declared Yes ☐ No ☐

CAUSE OF FLOOD

Ice Jam ☐ Snowmelt ☐ Rain on Snowmelt ☐ Rain ☐

Wind ☐ Other _____

EFFECTS

No. Houses Effected _____ No. Houses or People Evacuated _____
No. of Basements only Flooded _____ No. of 1st Floors Flooded _____
No. Houses Flooded 1m over 1st Floor _____ No. of Roads Flooded _____
Other Things Flooded _____
No. of Injuries _____ No. of Deaths _____

DAMAGES

Business/ Industry $ _____ Agricultural Enterprises $ _____
Private Residences $ _____ Recreational Property $ _____
Utilities $ _____ Public Facilities $ _____
Cost of Fighting Flood $ _____ Loss to Local Economy $ _____

TOTAL DAMAGES $ _____

What would damages have been without warning? $ _____
What would damages have been without fighting flood? $ _____

FLOOD DAMAGE / COST REPORT

FLOOD PLAIN REGULATIONS

Flood Plain Mapping in Place?	Yes ☐	No ☐	Proposed?	Yes ☐	No ☐
Flood Plain Regulations in Place?	Yes ☐	No ☐	Proposed?	Yes ☐	No ☐
Recognized in Municipal Official Plan?	Yes ☐	No ☐	Proposed?	Yes ☐	No ☐

DISASTER ASSISTANCE

Is there documentation for this flood event? Yes ☐ No ☐ Where? _____

Are there photos / videos of this flood? Yes ☐ No ☐ Where? _____

FILING THIS REPORT

Name _____ Date _____

Verified by _____

Attachments if any: Maps, Sketches, Photos, Descriptions, Comments?

_____

_____

_____

For more information contact _____

Please send this report to _____