EVOLUTION OF ONTARIO'S

SEDIMENT

MONITORING NETWORK

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EXECUTIVE SUMMARY

The last fifteen years has seen a steady evolution in Environment Canada's monitoring network for fluvial sediments in Ontario. Over this period the network has grown from 14 to 126 stations, concurrent with a shift in emphasis from long term detailed, to short term records. Spatially, the network has expanded beyond the published western regions to include the northern sparsely populated basins.

These shifts in network character and dimensions are in response to several factors. First, the simple economics of fiscal restraint has led to the streamlining of sampling strategies. Second, Departmental interest in the northern basins, and our interest in contributing to the State of the Environment reporting, has prompted an expansion in the network. Third, an increasing interest in understanding and managing contaminants transported by sediments also has prompted an expansion in southern areas.

In Ontario, sediment quality, not quantity is the primary concern. Today major programs exist, for example, to reduce phosphorous loadings to the Great Lakes, and to monitor other sediment associated contaminants transported into these same water bodies. The whole issue of non-point source pollutants is expected to have a significant impact on this monitoring network and how it is managed in the coming years.

Within fiscal restraint, our ability to respond to these increasing demands for sediment data and information has come primarily from a major shift in sampling strategies. We are reducing the number of continuously sampled stations (19 in 1975 to 0 in 1990) and using more seasonally operated ones. The number of samples can be reduced by as much as 85 percent per year. Also the increase in our use of miscellaneous stations, where only a few samples are collected each year has permitted a rapid economical expansion of the network. In 1975 there were 5 miscellaneous, today there are 75 and we have plans to increase this number by a further 50 stations in 1990/91. The sampling strategies, costs and operational management requirements for these stations will be discussed. The supporting data base and products (data publications, study reports, reference indexes, user brochures and guides) will also be discussed.

Details on the range of sediment issues in Ontario, and their implications for our sampling strategies and network design (particularly opportunities for integration with water quality programs) also will be discussed.

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INTRODUCTION

What have we learned about sediment conditions and processes in Ontario? To what extent, and how can we make use of acquired knowledge to resolve issues concerning sediment?

The development of an effective program for Ontario requires consideration of such questions in order that existing information can be put to best use and that knowledge gaps requiring attention can be identified, prioritized and pursued.

The last eighteen years has seen a steady evolution in Environment Canada's monitoring network for fluvial sediment in Ontario (Figure 1). Over this period the network has grown from 14 stations to 130 stations, concurrent with a shift in emphasis from long term detailed, to short term records. Spatially, the network has expanded beyond the published southwestern regions to include the northern sparsely populated basins.

The rapidly accelerating pace of Water Resources development in Canada led to growing demands for more complete, more accurate and wider spatial coverage of information on hydrological and geomorphological processes in rivers and watersheds. As time progresses, the availability of basic sediment data becomes more and more important in the planning and design of water development projects. A comprehensive sediment survey program is vital in order to cater to the growing demands for sediment data, especially in areas of alluvium.

WATER RESOURCES BRANCH REGIONAL OFFICES

FIGURE 1

THE ISSUES

The direct and most certainly indirect economic significance of fluvial sediment problems are usually ignored because many fluvial sediment process are related to, or are part of natural phenomena, that often occur in an unnoticed manner. Hence they are rarely considered for evaluation, except where serious consequences can be easily noticed and where corrective action is necessary.

Clarifying sediment issues has revealed that sediment data is being used and is required in the province of Ontario for the exploration of a wide variety of topics, involving both quantitative and qualitative issues. The issues addressed, focus attention on where the sediment is coming from, what it is carrying in the form of potential contaminants, where it is going, and how both the volume and quality of sediments affect downstream water quality and quantity.

In Ontario, sediment quality, not quantity is the primary concern. Today major programs exist, for example, to reduce phosphorous loading to the Great Lakes, (SWEEP), and to monitor other sediment associated contaminants transported into these same water bodies. The whole issue of non-point source pollutants is expected to have a significant impact on this monitoring network and how its managed in the coming years. Sediment is most closely related to quantity from the point of view of measurement when related to such problems as erosion of channels, banks and dykes, deposition in reservoirs and navigational channels and aggradation of fish spawning beds. Sediment is most closely related to the quality aspect in problems related to irrigation return flows, transport mechanisms for toxic substances and heavy metals and the filtering treatment of potable water. Because of this dual aspect, the justification of sediment activities may be derived from either quality or quantity mandates according to the problem being addressed.

Even thought the word "sediment" does not appear in Federal legislation and other official Government documentation, that does not mean that the Federal government has no responsibilities in this area. There are areas of clear responsibility where the Federal government must undertake sediment data collection and interpretation activities to meet its obligations.

THE PURPOSE

The purposes of collecting sediment data are: evaluating sediment yields with respect to different conditions (i.e., geology, soils, climate, land use etc.); determining temporal distributions of concentration and transport rates; evaluating erosion and deposition; and determining particle size distributions, characteristics of sediment deposits and the relationship between sediment and water quality.

Suspended sediment loadings in Ontario are only a fraction of those recorded in the mountainous and alluvial regions of Canada and orders of magnitude smaller than sediment loadings observed in major rivers of the world. However, even though the Sediment program should not focus solely on determination of sediment volume, it should address existing gaps in sediment loadings, seasonal variability, extreme events, spatial variability, sediment sources and sediment-water quality.

In Southern Ontario (Figure 2), there appears to be no simple relationship between annual sediment load and geomorphological parameters. Annual sediment yields from agricultural watersheds in Southern Ontario are linked to land use and surface soil characteristics, while yield variations are attributed to differences in quantities of sheet and rill erosion, in the transport system and in the amount of stream bank erosion. Suspended sediment in rural Southern Ontario streams result from material delivered from sheet and rill erosion. Only minor amounts result from stream bank erosion.

WATER RESOURCES BRANCH
ONTARIO REGION

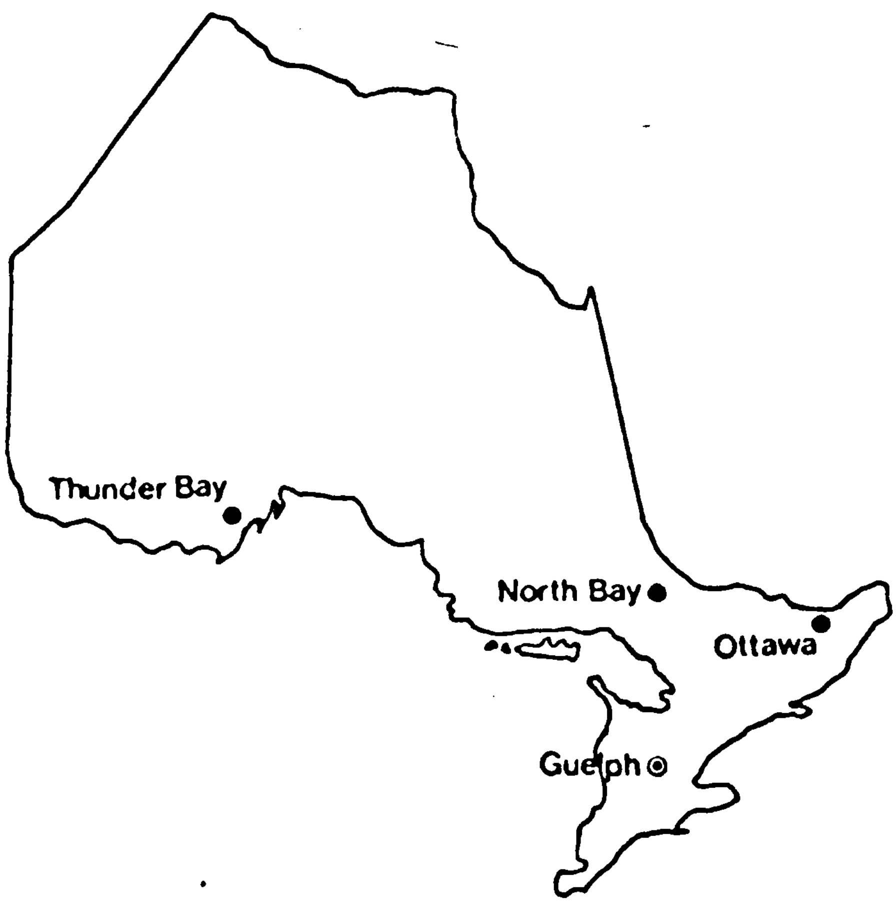

FIGURE 2

THE LANDSCAPE

The Ontario landscape evolved from glaciation of the pre-glacial landscape. Basically the pre-glacial landscape was dominated by two topographic features: The Canadian Shield and the peripheral zone of Sedimentary rock. The glacial period and the last deglaciation molded the landscape as we know it today.

Glacial sediments (laid down by glacial ice); glacio fluvial sediments (laid down by glacial melt waters and glacio lacustrine (ice contact-lake) predominate the Southern portion of Ontario and certain areas along the shores of the upper Great Lakes.

Drainage divides in Ontario were determined by the last deglaciation when the Great Lakes, as we know them today, were established. Glacio fluvial deposits predominate the channels in Southern Ontario with mixtures of sand and gravel deposits in old melt water channels. Glacio lacustrine deposits exist primarily in eastern and south western Ontario where glacial lakes had deposited fine silts and clays. Areas such as these, along with the lower portions of the lower Great Lakes river channels are identified as potential hazard areas for transportation of toxic contaminants due to their fine grained material.

Post glacial processes have influenced the landscape of Ontario through such processes as: aggradation and degradation (due to isostacy and changing base levels); changes in sediment supply rates (due to urbanization, agricultural mismanagement, logging); decreased flows (storage, diversion, consumptive use, land use changes); increased flows (urbanization, logging, diversion) and encroachment and channelization (flood control, road railway embankments) are other processes that have altered the landscape and decreased or increased sediment loads to the major river systems and Great Lakes.

The relatively small volume of material moving through Ontario streams and rivers has been confirmed by local reservoir studies and from sediment budget data for the Great Lakes. Bottom surveys of reservoirs surveyed in the late 1960's and early 1970's have revealed insignificant deposition. The Pollution from Land Use Activities Reference Group (P.L.U.A.R.G.) in 1978 acknowledged that stream sediments entering the Great Lakes affected nearshore areas through localized siltation of drainage channels, harbours and bays. It also concluded that the quantity of sediment transported to the lakes does not constitute a problem in terms of volume of material but can provide a transport medium for significant pollutant levels.

NETWORK EVOLUTION

Shifts in Ontario's network character and dimensions are in response to several factors. First, the simple economics of fiscal restraint has led to the streamlining of sampling strategies. Second, Departmental interest in the northern basins, and our interest in contributing to the State of the Environment reporting has prompted an expansion in the network. Third, an increasing interest in understanding and managing contaminants transported by sediments also has prompted an expansion in southern areas..

Within fiscal restraint, our ability to respond to these increasing demands for sediment data and information has come primarily from a major shift in sampling strategies. We have reduced the number of continuously operated stations (19 in 1975 to 0 in 1990) and used more seasonally operated ones. This also reduces the number of samples taken and of course, the overall cost of the program from laboratory costs is reduced. In addition to seasonal stations, the increase in the use of miscellaneous stations, where only a few samples are collected each year, has permitted a rapid spatial and economical expansion of the network. In 1975 for example, there were 5 miscellaneous stations in the northern part of Ontario. Today (1990) there are 130 stations - (51 in the north and 79 in the south).

Most of the sediment data in Ontario have been collected and analyzed during the past 15 years (Figures 3,4). In 1975, there were published data on only 14 rivers; the longest period of record was about 10 years; the average period of record was approximately 4 years; and the spatial distribution of sites was largely restricted to Southern Ontario (Figure 3). It is primarily since 1975 that the need for and collection of sediment data has been addressed by the Sediment Survey Section in Ontario.

In 1975 the Great Lakes International Surveillance Program (G.L.I.S.P) was developed to address sediment loading problems from Great Lake outflows, interconnecting channels and major tributaries. From this, 5 miscellaneous stations were introduced into Northern Ontario where no previous sediment loads (by Water Survey of Canada standards) were available. This approach continued until the early 1980's with little concern given to spatial coverage, costs or usefulness of the data to the user.

The Inland Waters Directorate policy for Sediment quantity surveys and studies was established from the 1978 task force which prepared a report providing the rationale for Water Resources Branch (WRB) involvement in surveys and studies of sediment quantity in Canadian waters and the associated erosion and deposition aspects embodied in the existing WRB program. After its release in 1979, little progress was made beyond the collection and dissemination of data from a weak network of project and baseline stations (Figure 4).

In 1982 the Ontario region attempted to address the need for improved sample coverage of drainage basins and evaluation of existing sediment station data through its report entitled, "Ontario Region Miscellaneous Sediment Station Network Proposal." This proposed network would supplement the need for increased sample coverage; serve as baseline data from which new continuous sediment stations could be proposed and complement environmental assessment and baseline studies. The basic purpose of a regional sediment network is to

EVOLUTION OF ONTARIO'S SEDIMENT MONITORING NETWORK

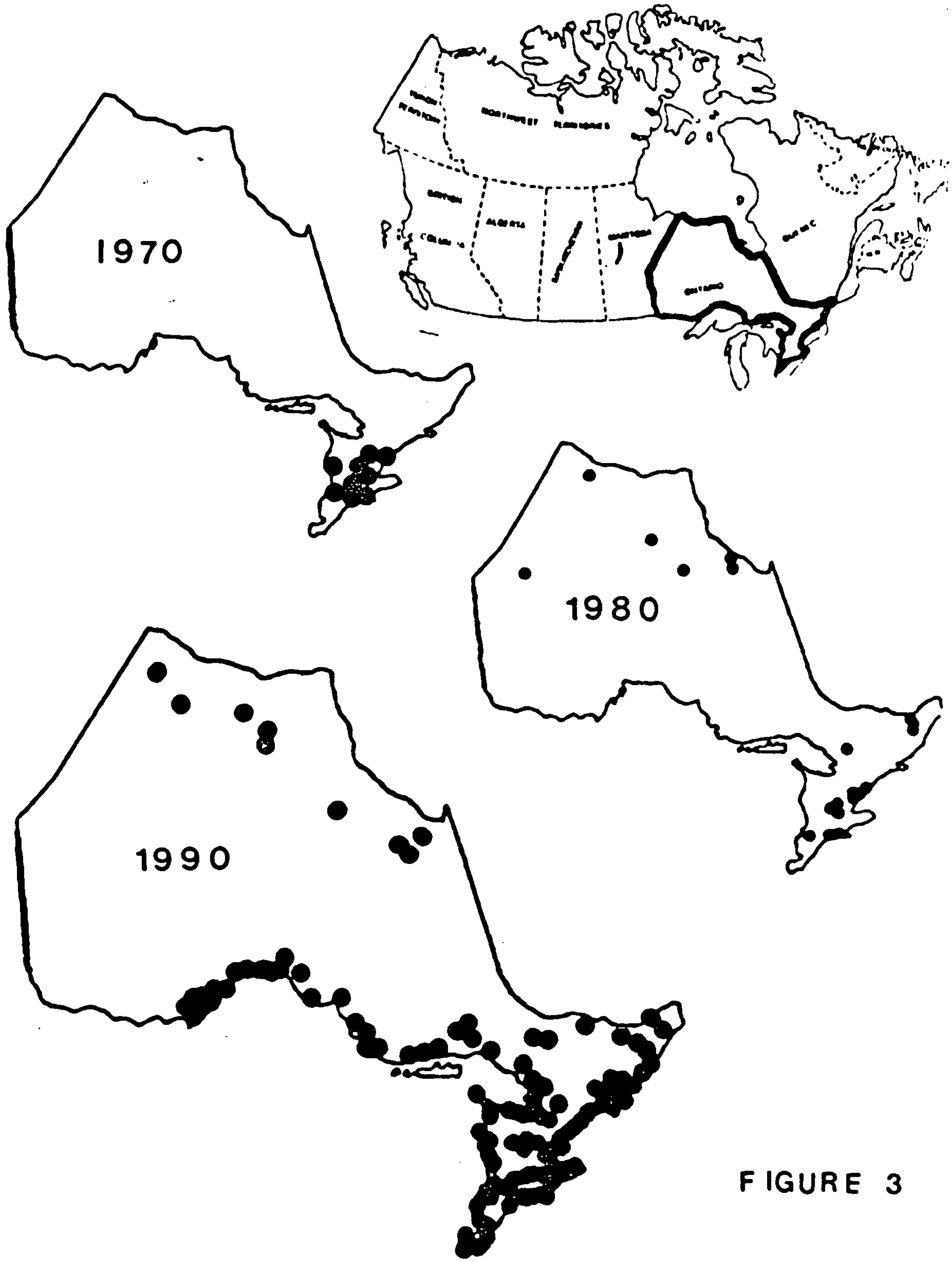

FIGURE 3

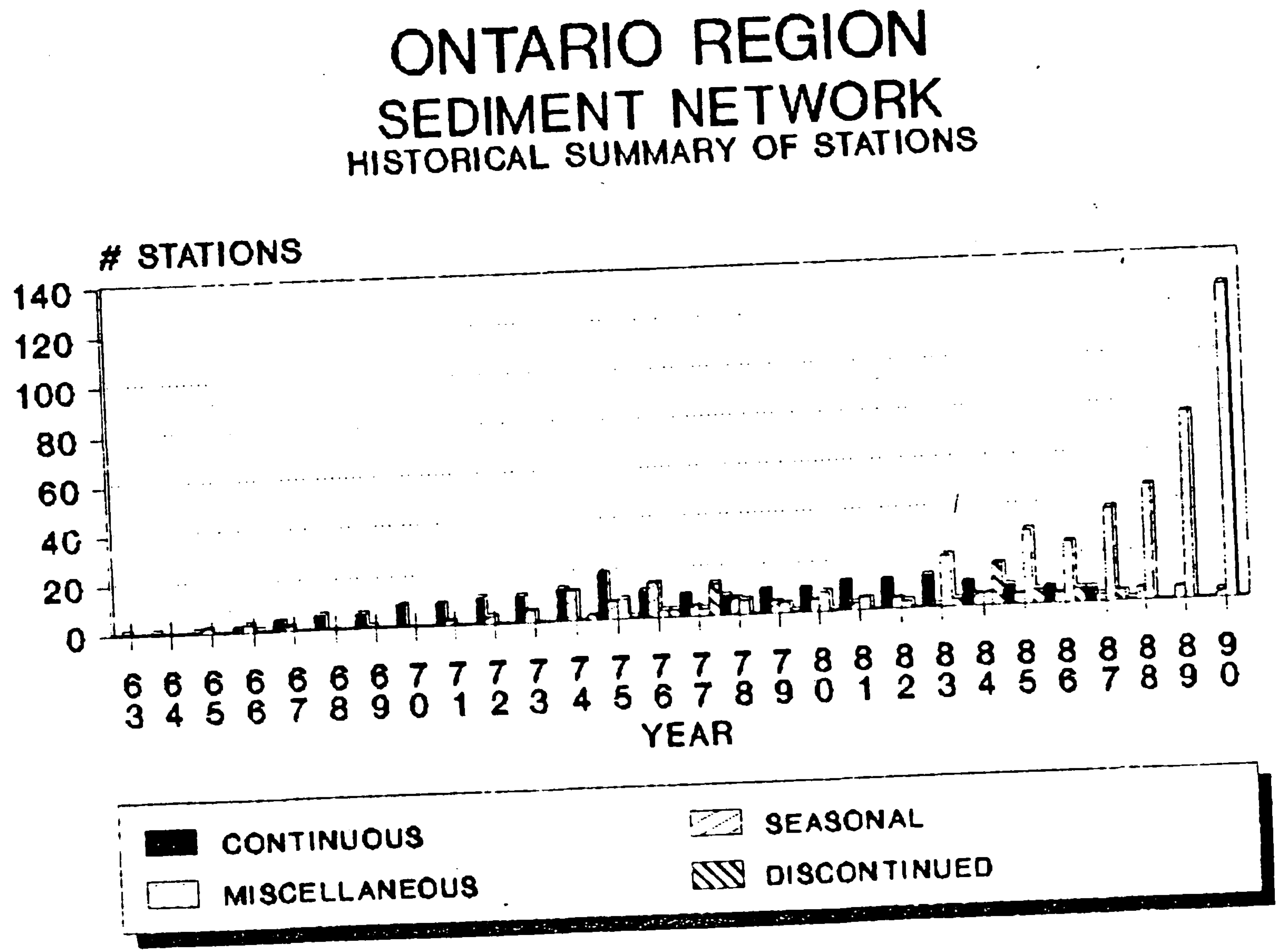
ONTARIO REGION
SEDIMENT NETWORK
HISTORICAL SUMMARY OF STATIONS
STATIONS
140
120
100
80
60
40
20
0
63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
YEAR
CONTINUOUS
MISCELLANEOUS
SEASONAL
DISCONTINUED

Figure 4

provide the data required to synthesize sediment transport to an acceptable degree of accuracy over as extensive a region as possible and provide the data necessary to establish a useful relationship between sediment yield and the basic factors affecting sediment production within the basin.

A result of this network proposal was an expansion of the miscellaneous sediment network, a reduction of continuous stations and the reintroduction of seasonal stations. Cost analysis played an integral role in the above decision making, as an attempt at achieving wider spatial coverage for the monetary and physical resources available to the program. As the seasonal and miscellaneous approach to sampling became more acceptable, management skills to monitor the network became more vital. Even though considerable cost savings were achieved using this approach, the trend that had persisted of having data available for all days of the year had to be overcome. Preliminary data analysis in 1983-84 provided evidence showing that the majority of sediment (often up to 80-90%) was transported in 10-20% of the time. Therefore data collected by the seasonal or miscellaneous approach needed to be well managed and controlled.

In addition to the Ontario Regional network evaluation, selected consultants were asked in 1984 across Canada to critically evaluate the program on a national perspective and provide recommendations for future directions and data needs. As a result of this assessment in Ontario, an additional network expansion in 1985 occurred to partially address these concerns.

In 1986, under the terms of the Great Lakes Water Quality Agreement, the Remedial Action Plan (R.A.P.) and the Upper Great Lakes Connecting Channel Study (U.G.L.C.C.S.) were formed resulting in identification of 42 local areas of concern (L.O.C.). In addition the first report of Canada under the 1987 Protocol to the 1978 Great Lakes Water Quality agreement was written and released in late 1988. From this, the 1987 Protocol commits all levels of Government to the development and implementation of systematic ecosystem based strategies (R.A.P.'s) to restore and protect beneficial uses in the areas of concern.

THE CHALLENGE

The programs and measures for abatement and reduction of non-point sources of pollution from land use activities include efforts to further reduce non-point source inputs of phosphorous sediments, toxic substances and contaminants contained in drainage from urban and rural lands in the Great Lakes system. Sediments deposited in rivers and lakes are generally derived from land. In addition to particles of terrestrial origin, bottom sediments also contain materials precipitated from chemical and biological processes occurring in water. Contaminants deposited in bottom sediments may persist long after the original sources of contamination are eliminated. The Great Lakes are predominantly supplied with fine grained sediments. Fine grained particles provide a larger surface area for absorption of different contaminants and therefore their dynamics play an important role in the transport of sediment-associated contaminants.

River monitoring programs whether for sediment quantity or quality data continue to face an array of challenges. IWD responses to these challenges are the reshaping of objectives, output and management of these programs. We must now seek to extract the information content from our existing data base and apply this to departmental priorities, to integrate quantity and quality activities where necessary, and in keeping with the concept of sustainable development, manage the environmental stress on our river systems. The need to manage river systems from the sustainable development perspective will demand more attention be given to coordination of program activities. In addition to integrated approaches, is the modeling and prediction of interrelationships, impacts, and consequences. The need to model the physical system on geomorphologic, hydraulic and hydrologic aspects on a basin system scale also exists.

Blachford and Day in 1988, identified many cases where sediment data is essential for conducting water quality assessments. An understanding of sediment dynamics of specific systems is essential for designing water quality monitoring programs and for interpretation of the resulting data. An expanded data base is required which contains information relating to both the quantity and quality of aquatic sediments. Particle size descriptions for suspended and bed sediments are essential for toxic substance assessments. Many water quality variable are directly related to suspended sediment concentrations. Understanding variable loadings with season or discharge events maybe more critical in understanding water quality than annual loading estimates.

There are 17 Areas of Concern on the Canadian side of the Great Lakes for which the Federal and Provincial governments are developing Remedial Action Plans. Twelve of seventeen L.O.C's are wholly within Canada and five are shared with the United States.

The Ontario sediment program was quick to address these above areas (Table 1 a,b) (Figure 5), and in 1987 expanded its southern network. 1988 and 1989 had a number of changes in the Regional approach to Sediment Survey data. A contract employee was hired to prepare an instantaneous database (previously mentioned) of present and historical sediment data - both suspended and from the bed material program. This was initiated due to a demand for a careful annual review of the data. It was felt that only through careful management could the number of samples be reduced while successfully maintaining a viable expanding network.

ONTARIO REGION
SEDIMENT NETWORK
HISTORICAL SUMMARY OF STATIONS 1980-1990

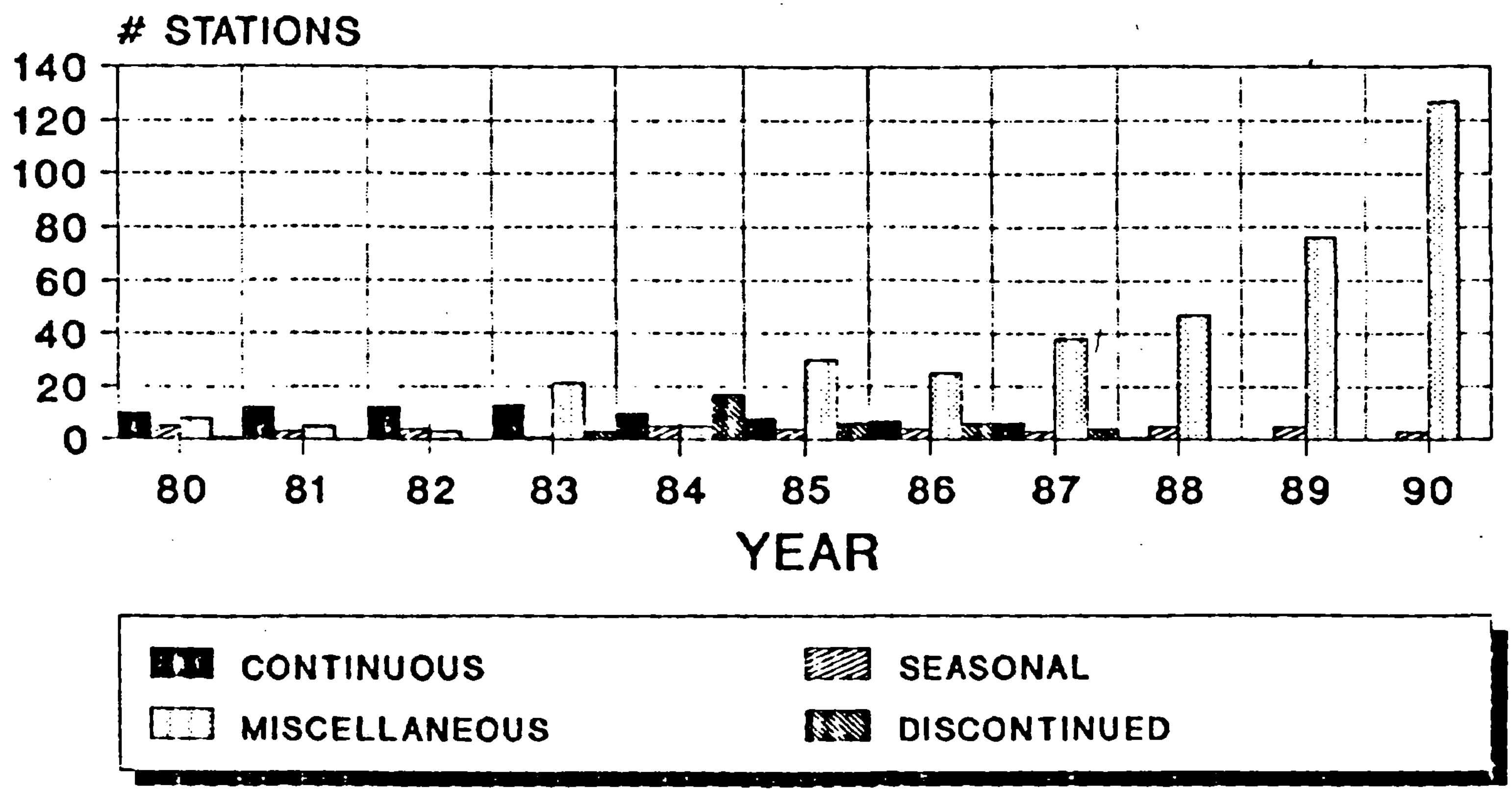

FIGURE 5

TABLE 1a

ONTARIO REGION SEDIMENT NETWORK RESPONSE TO LOCAL AREAS OF CONCERN

AREA OF CONCERN	SEDIMENT STATIONS	
1. Thunder Bay	02AB008	Neebing River near Thunder Bay
	02AB021	Current River at Stepstone
	02AB020	McIntyre River at Thunder Bay
	02AB017	Whitefish River at Nolalu
2. Nipigon Bay	02AC001	Wolf River at Highway 17
	02AC002	Black Sturgeon River at Highway 17
	02AE001	Gravel River near Cavers
3. Jackfish Bay	02BA002	Steel River near Terrace Bay
	02BA003	Little Pic River near Coldwell
	02BA005	Whitesand River near Schreiber
4. Peninsula Harbour	02BB002	Black River near Marathon
	02BB003	Pic River near Marathon
5. St. Mary's River	02CA002	Root River at S.S. Marie
	02BF004	Big Carp River near S.S. Marie
	02BF002	Goulais River near Searchmont
6. Spanish River	02CE002	Aux Sables River at Massey
	02CD001	Serpent River at Highway 17
	02CC008	Mississagi River at Mississagi Chute
	02CF009	Nolin Creek at Sudbury
	02CF011	Vermillion River near Val Caron
7. Penetang Bay to Sturgeon Bay	02EB011	Moon River at Highway 69
	02ED013	Wye River near Wyevale
	02ED017	Hog River near Victoria Harbour
	02ED018	Sturgeon River at Sturgeon Bay
	02ED019	Copeland Creek near Penetanguishene
8. Collingwood Harbour	02FB009	Beaver River near Clarksburg
	02ED025	Black Ash Creek near Collingwood
9. Detroit River	02GH004	Turkey Creek at Windsor
	02GH003	Canard River near Lukerville
10. Hamilton Harbour	02HA014	Redhill Creek at Hamilton
	02HB012	Grindstone Creek near Aldershot
	02HA022	Stoney Creek at Stoney Creek
	02HB023	Spencer Creek at Highway 5
	02HA023	Redhill Creek at Albion Falls

TABLE 1b

ONTARIO REGION SEDIMENT NETWORK RESPONSE TO LOCAL AREAS OF CONCERN

AREA OF CONCERN	SEDIMENT STATIONS	
11. Toronto Harbour	02HC024	Don River at Todmorden
	02HC030	Etobicoke Creek below QEW
	02HC013	Highland Creek near West Hill
	02HC003	Humber River at Weston
	02HC025	Humber River at Elder Mills
	02HC027	Black Creek at Weston
	02HC033	Mimico Creek at Islington
12. Port Hope	02HD012	Ganaraska River above Dale
13. Bay of Quinte	02HE002	Consecon Creek at Allisonville
	02HE001	Bloomfield Creek at Bloomfield
	02HK004	Trent River at Glen Ross
	02HL001	Moira River near Foxboro
	02HM007	Napanee River at Camden East
	02HM003	Salmon River near Shannonville
	02HM004	Wilton Creek near Napanee
	02HM005	Collins Creek near Kingston
	02HM006	Millhaven Creek near Millhaven
	02HM009	W.B. Little Cataraqui River near Kingston
14. St. Lawrence river	02MC001	Raisin River near Williamstown
	02LB004	S. Nation River near Plantagenet Springs
15. St. Clair River Lake St. Clair	02GD016	Thames River at Ingersol
	02GE003	Thames River at Thamesville
	02GG009	Bear Creek near Brigden
	02GG003	McGregor Creek near Chatham
	02GH002	Ruscom River near Ruscom Station

Sediment quality guidelines were also developed in 1988 which identified potential problem areas requiring further study and data before the remedial action plans could be implemented. Within these guidelines, types of sediment data needed were: physical and geochemical characteristics, bulk chemistry etc. In addition biological components, known and potential contaminant sources and relevant sediment water quality and quantity data were also needed.

EVALUATION AND MANAGEMENT

With an introduction of the Water Resource Branch Sediment Station Management Plan (S.M.P) and an evalutation of past data sets (using the Station Analysis Review Package S.A.R) and costs of analysis, collection and evalution, (Tables 2,3) it was decided to again reduce the continuous and seasonal portions of the program and expand the miscellaneous network (Table 4, Figure 3). Therefore, in 1988, 1989 and 1990 the Ontario Sediment network expanded from 47 to 75 to 127 miscellaneous stations respectively. The latter two years have had stations located at all but two L.O.C's and most U.G.L.C.C.S. sites.- Evaluations of past records by the S.M.P process determined that many discontinued sediment stations were to be reactivated as miscellaneous status to monitor previously unsampled regimes.

As outlined in Table 2 and 3, the cost savings in a miscellaneous versus continuous/seasonal network are overwhelming. Use of the S.M.P. and S.A.R. plot packages provide an annual mechanism for reviewing progress on a station's sampling strategy and for evaluating the data collected. With an annual assessment, the data is continually resummarized to enable the direction of resources and time to provide an overall picture of the stations' sediment regime.

Continual miscellaneous station data review permits sediment programs to be directed towards extending sampling of sediment related events to even higher events and to fill gaps in the seasonal patterns. As the relations of concentration to instataneous discharge are established, sediment rating curves can be used to compute loadings. During the initial years of station operation, the representativity of samples collected at the single vertical location should be donfirmed by collecting standard equal width increment measurements (E.W.I.) to cover the different ranges of flow conditions. After the representativity of single vertical sampling has been ascertained, one measurement should be collected each year for quality assurance purposes. This annual measurement should be collected on a rotation basis to represent the low, medium and high flow conditions. As a result of concerns over toxic loading and toxic sinks, particle size data is being collected over the range of discharges to determine what sizes of material are carried in suspension. When it is certain through application of the S.M.P process that a reasonable range of years have been sampled, the program can be terminated or revised, although the option to sample infrequent high discharges is maintained.

TABLE 2

EXPECTED

PROGRAM COST

Continuous Seasonal:

			(1)
1. Laboratory Costs (100-150 samples/yr)	= $	4,950	2,850
2. Salary to sample (technician)	=	600	600
3. Gauge reader sample pay	=	450	450
4. Salary for computer, computations, approval	=	500	500
5. Capital costs depreciation	=	1,900	190
6. Utilities, materials, supplies	=	150	150
Total Cost	= $	6.0K	4.7K

Miscellaneous:

			(1)
1. Laboratory costs (10-20 samples/yr)	= $	300	300
2. Salary to sample (techician)	=	70	70
3. Salary for computations-analysis	=	40	40
4. Capital purchases-samplers	=	1,600	160
5. Utilities, material, supplies	=	10	10
Total Cost	= $	2.0K	0.6K

NOTES:

1. Capital purchases for samplers would be depreciated over 10 years (therefore cost would be $160) (assumes purchase of DH48, DH59 samplers).

2. to set up a continuous/season and miscellaneous sediment station costs are as per above.

TABLE 3

ACTUAL 1989 PROGRAM COSTS

Continuous Seasonal: (5 stations)

1.	Laboratory Costs (270 samples)[1]	= $ 4,950
2.	Salary to sample (technician)[2]	= 1,260
3.	Gauge reader sample pay	= 950
4.	Salary for computer, computations, approval	= 2,500
5.	Capital costs depreciation[3]	= 800
6.	Utilities, materials, supplies	= 1,000
	Total Cost	= $ 11,460
	Cost/station	= $ 2,290

Miscellaneous: (75 stations)

1.	Laboratory costs (20 samples)	= $ 5,180
2.	Salary to sample (techician)	= 1,035
3.	Transportation to lab of Sub-office samples	= 500
4.	Salary for SMP computations approval	= 4,200
5.	Utilities, material, supplies	= 200
6.	Capital cost depreciation	= 3,500
	Total Cost	= $ 14,615
	Cost/station	= $ 200

NOTES:

1. based on Laboratory Cost Study 1989, Ontario Region

2. based on EG-ESS-06 technician salary, 15 minutes/sample

3. based on sampler cost depreciation, $160/station

TABLE 4

ONTARIO REGION

SEDIMENT NETWORK COSTS-STATISTICS

YEAR	# SAMPLES	# STATIONS	STATION CLASSIFICATION C	S	M(1)	LAB COSTS	PROGRAM COSTS
1979	1,169	19	10	5	4	--	--
1980	1,310	23	10	5	8	--	--
1981	1,660	20	12	3	5	19,720	46,796
1982	1,524	19	12	4	3	15,185	--
1983	1,109	35	13	1	21	12,406	--
1984	1,200	20	10	5	5	18,354	--
1985	1,739	42	8	4	30	19,819	57,536
1986	1,109	36	7	4	25	13,969	54,730
1987	1,025	47	6	3	38	11,939	56,017
1988	471	53	1	5	47	9,950	72,502
1989	484	81	0	5	76	10,040	56,734
1990	500(E)	130	0	3	127	--	--

Note:

(1) C = Continuous; S = Seasonal; M = Miscellaneous

THE FUTURE

As a new decade begins, what future direction will the Ontario Regional sediment network embark upon? From 1963 to 1990 (Table 5), the Ontario sediment network has progressed from a hit and miss type of program which often collected unnecessary or repetitive data, to a network that is poised to answer many of the data user needs and current environmental questions. Three key D.O.E./C&P priorities relating to river monitoring which we must address are: sustainable development, state of the environment and regional water issues of federal interest. The data base the Ontario Regions' sediment network will produce, will allow it to respond to these priorities. Environmental assessment studies and review situations and site specific areas of study will dictate that we develop the capabilities to respond to these situations. The situation of proposed sediment quantity/quality integrated studies is one method of answering the needs expressed in three key priority areas. The positioning, expansion and designation of the Ontario sediment network in the late 1980's early 1990's is a beginning at solving some of the important and vital future needs and issues.

If we focus on the issue of sediment transport through a drainage basin we invision three components: field, transfer and stream. We also see sources, sinks and sources mixing. We know the sediment issues in Ontario, we understand or are attaining the knowledge, all we must do is collect, produce and supply the sediment data in various forms to address present and future issues in these areas.

With S.M.P. and S.A.R. procedure, we can identify the sediment regimes (annual loads, seasonality, events, spatial variability) and somewhat the sources (natural, anthropogenic) in order to address the current issues. The approach be it specific or integrated will be the answer to an effective Ontario Region sediment program.

TABLE 5

HISTORICAL SUMMARY OF ONTARIO

SEDIMENT PROGRAM

1963-74	-	continuous stations - gauge attendant, expensive 3-4K, watershed isolated, dominant in Southern Ontario.
1975-77	-	continuous stations - increase in project oriented sites, small miscellaneous northern network established in response to G.L.I.S.P.
1978-82	-	continuous stations - still northern miscellaneous network still project E.A.P. stations.
1983	-	fiscal restraint and program cost increases, result in network re-evaluation by Ontario Region - cost review results in seasonal station or open water concept - no winter sampling - as a consequence of review, 20 additional miscellaneous stations were established on Great Lakes major tributaries.
1984	-	direction from Sediment Headquarters Ottawa results in all samples included in annual publication.
1985	-	the year of Sediment Issues and Data Needs contract in Ontario and elsewhere across Canada. Miscellaneous network continues to expand on Great Lakes Tributaries.
1986	-	Sediment section responds to ETMP, RAP, LOC and Great Lakes Tributary loading programs by maintaining its increasing miscellaneous network.
1988-89	-	miscellaneous network now constitutes 75 stations with many tributaries over all the Great Lakes being monitored.
	-	decision now made to review longterm data sets.
	-	All historical data (under contract) was coded and inputted such that Ontario Region becomes the only one across Canada to have an instantaneous sediment database at a cost of 2.8K - 3.2K.
	-	With a completed database - 3 longterm stations were reviewed using the station Analysis Review Package.
	-	Introduction of new network management tools (Station Management Plans (SMP) and Station Profiles)
1988-90	-	SMP's completed for all existing and historical data base stations which allowed definition of areas in concentration discharge relations that lacked samples.
	-	SMP allowed annual network to be reviewed and recommendations made for future sampling strategies.
1990	-	Miscellaneous network expands to 130 stations with all but a few major tributaries not monitored. This will allow a base line data set to serve the needs of the International Joint Commission, Great Lakes Tributary Loading Program, Remedial Action Plans, and Local Areas of Concern on the Great Lakes.