SOCIAL, INSTITUTIONAL & TECHNOLOGICAL TRENDS AFFECTING THE UPPER GREAT LAKES TO THE YEAR 2000

Interim Report Prepared for
The Canadian Centre for Inland Waters
April, 1975

by

L.J. D'Amore & Associates Ltd.

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April 20, 1975

Mr. John Batteke
Social Sciences Division
Canada Centre for Inland Waters
P.O. Box 5050
Burlington, Ontario

Dear Mr. Batteke:

We are pleased to submit to you our interim report, Social, Institutional and Technological Trends Affecting the Upper Great Lakes to the Year 2000.

The report consists of three parts:

I - Delphi Survey Results (previously submitted)
II - Literature Search Results
III - Integrated Scenarios

The literature search culminates an extensive search of relevant books, articles and reports in each of the three topic areas. Both Canadian and U.S. literature was successfully retrieved. U.S. reports were identified through the Smithsonian Science Information Exchange. Their data bank file CA02C, "Social Aspects of Water Resources", December, 1974 was obtained and letters sent requesting copies of some twenty reports.

Futures research was another area of review included in our report.

Significant assistance in our technology review was obtained through the cooperative efforts of the U.S. National Aeronautical and Space Agency (NASA).

Regional Development in northern Ontario is based on a series of interviews with planners in the Ontario Government as well as a review of reports from various Provincial Departments.

The existing water quality situation, existing monitoring procedures, the industrial situation and part of the municipal situation are virtually verbatim from the 1973 Annual Report of the IJC.

Institutions, the Public and Media are based heavily on research done at Urban Affairs related to Urban Pollution. Of particular assistance is the work of Steve Shatzouw and Jim Parlour.

Part III represents the integration of both the delphi survey and the literature review into a series of future scenarios around nine topic categories. These are:

Development In Northern Ontario
The Scientific Community
Scientific Knowledge
Technology - General
Technology - Water Related
Monitoring
The Public and the Media
Institutions
Industry

In each topic category there are usually three scenarios, sometimes two, sometimes four. Generally, they correspond with the curves A, B, C and C^1 in Part I, Section C which represent the clusters of expert opinion based on the response of our panelists.

In some cases, where there are gaps or required linkages in the integrating process, the closure is provided by me.

I hope you will find the report satisfactory and perhaps even interesting reading in some places. The exercise has been an interesting one to date and I look forward to the interaction with yourself, Dave Robinson and the other members of our team in the final stages of the project.

Respectfully submitted,

L.J. D'Amore

LJD:kd
cc: Mr. E. Carey

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PART I

DELPHI SURVEY RESULTS

A. INTRODUCTION

Delphi interviews dealt with the Future out ot 1985 and 2000. We have obtained both quantitative and qualitative responses from our panel of experts. The questions were derived from the flow chart which is attached and which we have discussed sufficiently in our meetings.

The first part of the report is presented as a question by question analysis of both quantitative and qualitative response. The quantitative response indicates the over-all average. Where one response was completely inconsistent with the others, it was not included so as to not skew the average. We have also indicated the range of the response and major clusters (3 or more) and minor clusters (2).

The qualitative response presents "mini scenarios" for each question. Frequently, they fall into categories which can be classified as optimistic, pessimistic and neutral or "it depends".

We have also preserved the integrity of individual responses where the response presents a point of view which is diverse from all the others. This is true in both the quantitative and qualitative analysis.

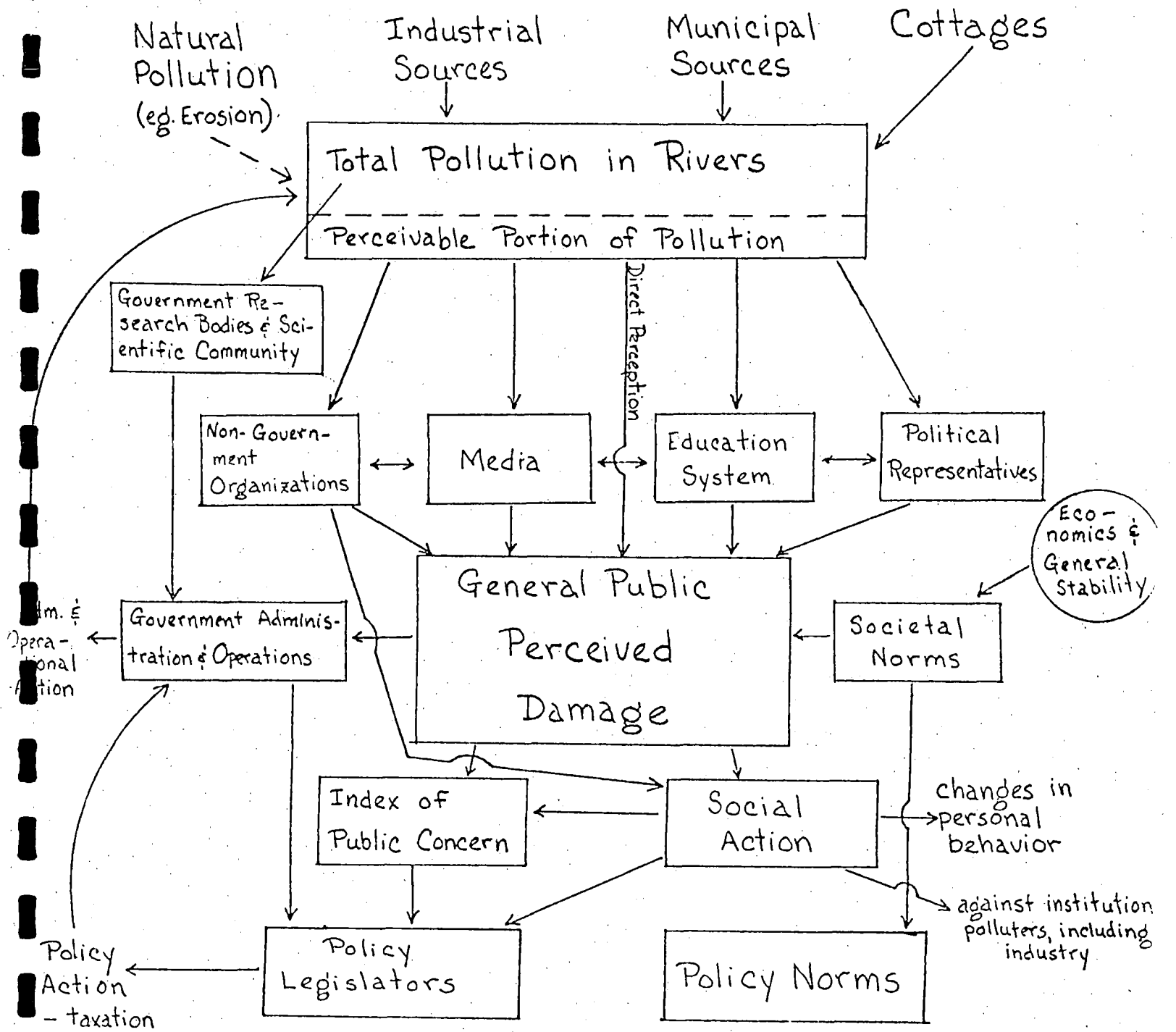
Following the analysis of questions is a series of graphs (Section B). Each expert panelist was asked at the end of the interview to draw a curve, considering everything that was discussed during the interview, that was his view of the amount of effluent that would continue to be discharged into the Upper Great Lakes out to the year 2000.

1974 was taken as the reference year with the base reference point as 1.0. This is also the case with each of the quantitative responses to the questions. Therefore a 2.0 in 1985 would indicate a doubling of whatever exists today.

In order to gain a historical perspective, we asked for ratings in 1964 as well. Therefore a .5 in 1964 would indicate ½ of whatever exists today.

Section C is the statistical analysis in one complete section.

SOCIAL-LEGISLATIVE MODULE



Question 1a - Incentives to locate industry and population in N. Ontario to relieve Metro pressures

1b - Effectiveness

Quantitative response

		1964	1985	2000
1a	Average	.6	2.0	4.3
	Range	.1-1.0	1.2-5.0	1.0-25.0
	Maj. clusters	.2, .8	1.3,3.0	1.5,2.6
	Min. clusters	.5	-	-
	(if non-development ethic prevails	-	1.5	1.8)*
1b	Average	.6	1.2	2.5
	Range	.1-1.2	1.0-1.5	1.0-10.0
	Maj. clusters	.1,1.0	1.0,1.3	1.1,1.3,5.3
	Min. clusters	-	-	-
	(if non-development ethic previals	-	1.3	1.8)*

Qualitative response

Incentives take many forms, positive and negative. They include political, tax, economic and access incentives. The "Roads to Resources" program in the early 1960's was the most effective program to date. The only real incentive to go to northern Ontario up til now has been for resource development. Improved accessibility was the biggest boost that government could provide for the development of the North.

Currently, what the government does relative to INCO and Texas Gulf is insignificant. It is the economic incentive of private enterprise that draws people to the North.

Government is committed to growth away from major metro centres. Decentralization will be the emphasis but it will occur first and with greater momentum in southern Ontario - to the west and east of Metro Toronto. Development in Thunder Bay and Sault Ste. Marie will likely be encouraged between now and 1985.

Despite these efforts, the growth of Metro Toronto will continue. The amenities of the big city (including the non-quantifiable ones) are still relatively inexpensive - i.e. shopping, culture, entertainment, career opportunities.

Longer term (1985-2000) policies regarding immigration, agriculture, housing and energy will be major determinants in the re-allocation of industry and population.

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*Conditional response

On a national scale, immigrants may be encouraged to locate in under-populated regions. However, if a continued influx to Ontario continues, efforts will likely develop to steer their settlement away from major urban centers.

Land-use priorities will be rationalized and major policy emphasis will be placed on conserving the remaining prime agricultural land in southern Ontario. The land-use conflict between housing and agriculture has already occurred in the new city of North Pickering and at least for the short term, prime agricultural land will be preserved.

Government is also determined to reduce the cost of housing or minimally to prevent further increases. Serviced lots in metro fringes (i.e. Mississauga, North Pickering) are currently about $30,000.

The large scale of metro Toronto also creates energy inefficiencies such as excesses of energy consumed in commuting to and from work.

The combination of the above three factors will induce Government to encourage the expansion of existing towns and cities in northern Ontario to absorb future population growth and possibly the development of new cities. A lag of ten to fifteen years will probably occur before the effects of policies and incentive programs are realized. Transportation corridors, existing and proposed, will be major determinants as to where development actually occurs.

Question 2 - No. of professionals employed in "water quality community" (i.e. research, monitoring, technology, administration, legal)
academic, government, private enterprise

Quantitative response

	1964	1985	2000
Average	.4	1.5	2.3
Range	.1-.8	1.0-2.5	1.2-5.0
Major clusters	.1,.4,.7	1.4,2.1	1.5,2.1
Minor clusters	.7	1.1	4.5
Academic	.6	2.5	2.5 *
Government	.3	2.5	2.8 *
Private enterprise	.8	1.5	1.8 *

Qualitative response

With the exception of one respondent whose department will double its staff in the next two years, the major growth period has occurred in the last ten years for professionals in water-related fields.

There has been a doubling of effort since 1964. Academic increases and government increases have been particularly noticeable. There are two contradictory views with regard to industry. One states that "industry has come on strong and will continue to do so." Another view states that "Private enterprise hasn't increased at all and won't go up much in the foreseeable future." Industry sees Government doing more in the way of monitoring and letting them do it. However, they will want to check the results of government laboratories. The incentive of private enterprise is to make a profit. They won't do anything willingly. Whatever they do will have to be forced upon them.

Rather than more growth in people, what is envisioned is "making better use of the people we have". Equipment will be used more efficiently and effectively. There is currently a lot of inefficiency and ineffectiveness. In the future there will be better use of computers; more automatic and better monitoring. "The need is not for more people; too many people in the field are now under-utilized. The need is for better equipped people."

There is not much room for government expansion or more university professors. Much could be done with the data,

* Conditional response

information and technology that now exist. A need for an overview exists. There is a desire among many researchers for more data and information which "is comparable to drinking salt water - the more you drink the thirstier you get." "Rather than chasing ants, we must stand back and watch the direction of the column."

It appears that the environment has gone through its growth period in all sectors and has now become institutionalized. Future growth and changes will be marginal. Some feel that the number of people may even go down. Relative to other issues and priorities, the environment has lost its relative share of committment.

Question 3 - Scientific data and knowledge - re: water environment and pollution

Quantitative response

Average	1964	1985	2000
Average	.5	2.8	5.6
Range	.1-1.4	1.2-5.0	1.3-10.0
Maj. clusters	.2,.6	1.5,2.1,5.0	1.9,3.5,9.3
Min. clusters	1.2	-	-
Data	.3	3.0	6.0 *
Knowledge	.8	1.3	2.0 *

Qualitative response

Responses to the growth in scientific data and knowledge fall into three categories.

The first response is that knowledge will continue to grow at a steady progression and with no major breakthroughs.

The second response is one that foresees enormous increases in the amount of scientific data and knowledge as well as major, significant breakthroughs. There is likely to be a great breakthrough in automatic monitoring. ERTS (Earth Resources Technology Satellite) is now being used to forecast crop production, health of forests, ground water, etc. Sixty thousand feet photography is now being used as a matter of course. By 1985, a satellite might be directed to look at mercury, lead or other pollutants, with results being indicated on a cathode ray tube. Environmental monitoring will become like daily stock market quotations. There are already daily indices of air quality in a number of areas. They will have the same for water. Crisis situations will be identified immediately; trends will be identified indicating probability of future water damage and corrections made before water damage occurs.

Also knowledge will become more inter-related. For example, we will learn the effects of atmospheric pollution on water pollution. Knowledge won't necessarily be directly of water, but also land, air and industrial processes and their effects on water pollution.

Knowledge is an exponential thing. Understanding of the environment is exploding. The knowledge will allow us to set specific limits within which we must manage the environment and enable us to maximize the necessary balance between socio-economic factors and the environment.

Data especially will increase. A lot of data is being

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*Conditional response

generated and a lot more will be. There will be networks across Canada with data related to water quality.

The third response differentiates between data and knowledge. There has been an incredible increase data but knowledge has not substantially increased. What causes water pollution and the effects of water pollution and the technology to abate pollution have yet to be sufficiently understood. Neither do we understand what is harmful and what is not harmful. The data we are accumulating is not going to lead to a breakthrough in knowledge. We are probably in pretty good shape about knowing how to build sewage treatment plants by removing phosphorous, but we are deficient in knowledge of toxic substances such as heavy metals.

There is also a problem of "data lag". That is the data we have lags the problem solving requirements that face us. Also new problems develop for which no data at all exist. For example, there should be a big growth in medical data and knowledge regarding the effects of environmental pollution on human beings.

Of even greater deficiency is knowledge and understanding of the basic hydrologic system which will enable us to do a better job of planning for the future. Federal science policy is becoming more dedicated to short range research, i.e. "brushfire" accumulation of data to get what is needed to resolve immediate problems rather than basic understanding for long term solutions. Long range planning and fundamental research must go hand in hand. How to inspire and manage research in a more creative and fundamental manner will eventually emerge. A number of dedicated scientists are recognizing this problem and are looking for a better approach to fundamental research.

Another dimension to the lack of an adequate knowledge base is the lack of knowledge of the social sciences and how social trends will be effecting water quality. Further, more knowledge is required and understanding how to manage our environmental institutions.

Question 4 - Training of broad range of professionals in planning, re: basic ecology.

Quantitative response

	1964	1985	2000
Average	.3	2.3	5.0
Range	>.1-.9	.7-4.0	.7-15.0
Maj. clusters	.2,.8	1.2,2.0,3.2	1.7,4.1
Min. clusters	-	-	12.5
(one response	.05	2.0	4.0 → ∞)

Qualitative response

The training of the broad range of professionals in planning regarding basic ecology: there are two basic responses to this question.

The first is that there will be enormous breakthroughs in education and trans-disciplinary professionals. Discipline barriers will break down. Further, there will be an increase in training on how to make better decisions. There is a need for understanding of the dynamic balance between, for example, energy - economics - resources.

Training in ecology has increased tremendously in the last ten years. In 1964 there was very little. Today every university in Canada is trying to accomplish some form of training in the environment for professionals to be involved in planning. This type of training is self-perpetuating - the more we probe, the more we know what we don't know. Therefore, we keep digging deeper and deeper.

We are getting more professionals who are trained in environmental studies going into, for example, urban planning for their Master's degree and similarly those who get a Bachelor degree in urban planning going into a Master's program in environment.

The second point of view is that by and large interdisciplinary education has not been effective. It is a function of the nature of instruction and institutions that courses offered to engineers, political scientists, etc. will revert back to greater specialization.

In conventional training, students are learning more and more about less and less. Specialization is needed to get ahead initially, however the broad overview in education is lacking.

We are not doing all that much in training planners regar-

ding ecology. University training is all motherhood. The concern is too frequently uni-dimensional. For example, ecological startegies must also consider the economic consequences. University courses are given with a gross slant toward ecological protection at all costs. There is an over-emphasis on disaster if we don't keep everything spotlessly clean. For example, the aerosol can issue - smoke stacks have been putting up more than all the aerosol cans we could possibly produce.

Question 5 - Appropriate environmental courses and themes at all levels of education.

Quantitative response

	1964	1985	2000
Avearge	.3	2.5	5.2
Range	.1-.8	1.2-5.0	1.5-15.0
Maj. clusters	.2,.6	1.4,2.4	1.7,3.3
Min. clusters	-	5.0	15.0

Qualitative response

The majority response here is that there has been a significant improvement and that education in environmental matters will continue to increase in the future. This education will enhance environmental values and awareness. Saskatchewan, as an example, has a whole environmental education programme from elementary grades on up that began about 1972.

It is felt that environmental education at the university level is also a key factor because it is from here that graduates feed into the system of government and private enterprise employment.

There will be an increase in environmental education, but one respondent questions whether we have sufficiently evaluated courses to know whether or not they are appropriate. What are the criteria for appropriateness? What is education? How do you start an environmental ethic at a very early age to provide a base of knowledge of man in relation to his history, culture, environment incorporating all of the knowledge we've accumulated?

The minority response is that environmental education expanded in the 1960's and won't expand that much more.

Question 6a - Mass media attention to environmental problems, issues and crises

6b - Environmental education

Quantitative response

		1964	1985	2000
6a	Average	.3	2.4	3.2
	Range	.1-1.0	.6-7.0	.4-10.0
	Maj. clusters	.1,.6	1.2,5.0	1.3
	Min. clusters	.3	-	3.8,10.0
	(based on 1974 as 1.4	.3	1.4	1.8)*
	One response noted:	Planning paradigm and therefore media message to shift to a "stable state" concept.		
6b	Average	.2	2.4	4.5
	Range	.05-.5	1.3-5.0	1.5-10.0
	Maj. clusters	.1,.5	1.4,2.0,4.0	1.8,9.3
	Min. clusters	-	-	3.5

Qualitative response

There has been a substantial increase in environmental reporting since 1964. In 1964 reporting on environmental matters was sporadic and in bits and pieces. The most noteworthy news item in the 50's and 60's was "dying Lake Erie".

A clipping source on environmental articles was begun by Environment Canada in 1969. Since then there has been a doubling of articles. A peak of reporting was reached in 1970-71 - much of it sensationalistic in style. Since then it has waned.

Legislation depends on the amount of coverage in the media. The peak of media coverage correlates positively with the bulk of legishtion, both Federal and Provincial. The significant legislation on the environment dates mostly from 1970 forward.

The general public has been saturated with news of environmental problems. People no longer want dramatic "scare" copy. They have become immune to it. The opinion therefore is that the amount of reporting will level off, but the quality of in-depth reporting and comprehansive coverage of environmental

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*Conditional response

issues will increase. This will be enhanced by public broadcasting on television networks such as the Ontario Educational network.

Citizens want information and knowledge about the environment. They want to develop an environmental ethic and desire the necessary information to do it. New ways will be found to package and present information so that it is a learning experience. The media audience will begin to understand the complexities of environmental issues.

As more people are educated in environmental matters (see Question 5), they will desire more and better coverage of environmental issues and the media will respond.

A second perspective is that environmental reporting is an "up and down" situation. When there are newsworthy items, they will be reported. On the other hand, as future "Watergates" emerge, environment will be pushed into the back pages.

A separate viewpoint is that there will be a series of environmental crises in the next ten years on a scale not now anticipated, i.e. food problems, energy problems, etc. These are all environmentally bases. By 2000 we will either have attended to our environmental problems and reporting will be low, or we will not have attended to them and the reporting will be "off the scale".

Question 7a - Number of citizen groups concerned with environment

7b - Intensity of activity

7c - Effectiveness

Quantitative response

		1964	1985	2000
7a	Average	.3	1.5	1.7
	Range	0-.7	1.0-3.0	1.0-4.0
	Maj. clusters	.05,.3,.6	1.2,1.5	1.0,1.6
	Min. clusters	-	2.5	3.0
7b	Average	.4	1.9	2.7
	Range	0-1.0	1.0-5.0	1.0-6.0
	Maj. clusters	.1,.4,.9	1.3,2.1	1.4,2.3
	Min. clusters	-	-	5.0
7c	Average	.3	2.0	3.4
	Range	0-.8	1.0-5.0	1.5-10.0
	Maj. clusters	.25	1.4,2.1	2.4
	Min. clusters	.05,.7	-	8.5

Qualitative response

There were no organized urban environmental groups prior to the late 1960's. What existed was traditional conservation groups such as the Canadian Naturalist Federation, the Canadian Wildlife Federation, the Canadian Audubon Society and other groups such as Rod and Gun Clubs. In mid 1960's Rate Payer groups became concerned with local environmental issues such as sewage treatment. But they did not form environmental groups as such.

Groups such as GAS, Pollution Probe, STOP, SPEC, etc., formed specifically around environmental issues, began to be organized in the late 1960's. The highest number of groups was realized in 1970. Since then they have decreased as the result of mergers and normal attrition.

The number of groups has reached a saturation point and won't increase any further. However, the number of members may increase.

There will be a trend toward more "umbrella groups" which take up specific issues as they arise. At the same time, certain additional groups will be created on a specific issue basis, such as the James Bay Committee.

Citizen groups are becoming much more effective. They are

becoming more realistec; more objective; interested in affecting legislation, not just getting publicity.

Citizen groups will take a larger part in the assessment of major projects before they are undertaken. All alternatives will be taken into account. Groups will consist increasingly of professionals and knowledgeable citizens. Consequently, their sophistication will increase and, along with that, their capability for the assessment of data.

Groups are less "noisy" but much more knowledgeable about whom to approach on various issues and the effective presentation of their case. They are developing an image with the right people that they know what they are doing.

Groups therefore are shifting their strategy from one of arousing the general public to in turn affect decision making, to a strategy of affecting decision making directly themselves. They are more mature, more experienced, more knowledgeable of whom the influentials are, and are beginning to be regarded as important.

On the other hand, governments are increasing formal opportunities to hear citizen groups through consultation, public meetings, etc. There will be increases in advocacy planning, environmental impact studies, Green papers and White papers regarding the environment. As governments become more comfortable with citizen perticipation, some of the bureaucratic barriers and walls of secrecy will come down.

The long term trend will be for environment to be put into a different context. Citizen groups are moving into the broad issues of resources, energy, food, ets. of which environment is a part. By 1985 they will be doing a lot more of their own research and a lot of synthesizing of other research. Governments will by supporting more research bodies as well as research by citizen groups.

Separate viewpoints are:

There will not be that much of an increase. Media will pick up the role of citizen groups and more political activity which will sense the public to pick up issues. It will be handled differently. There's a need for new approaches.

Groups will become more concerned with local issues such as property values and concerns regarding their every day environment. There won't be much more development in our current economic climate. Also, many are disillusioned - the "system", as far as they are concerned, has not responded.

Citizen groups are turning their attention to consumerism. They'll be more active but won't really get to the "crunch" until the energy crisis really hits. Then there will be a push to recycling, conservation, etc.

Question 8 - Relative priority of environmental protection vis a vis economic development (social norm)

local government decisions
Provincial government decisions
Federal government decisions

as a relative priority in the spectrum of societal issues

Quantitative response

		1964	1985	2000
8a	Average	.5	1.4	2.4
	Range	0-1.2	1.0-3.0	1.0-6.0
	Maj. clusters	.2,.8	1.0,1.4	1.2,4.7
	Min. clusters	-	2.5	1.9
	(after use concept	.3	1.5	2.0)*

One response notes: 1970 = 1.8; the rating then went down and then back up to 1.0 by 1974.

8b	Average	.6	1.8	2.9
	Range	0-1.0	1.0-4.0	1.0-8.0
	Maj. clusters	.5,.9	1.2,2.1	1.2,2.5,5.7
	Min. clusters	-	-	-
8c	Average	.5	1.7	3.0
	Range	0-.8	1.0-5.0	1.0-8.0
	Maj. clusters	.5,.8	1.2,2.2	1.3,3.3
	Min. clusters	.2	1.5	6.5
	(pre-planning concept	.9	5.0	50.0)*

Qualitative response

Economic development and environmental protection must be reconciled. There is a need for more sophistacated products and services, but they must be clean. There must be a recognition by the industrial sector that it's in their own best interest to manufacture products that are not harmful to the environment.

There will be a distribution of concern where environment will be a new dimensional tension as related to energy self-

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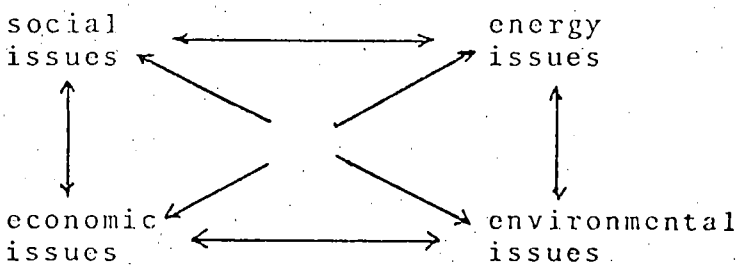
*Conditional response

sufficiency, global economics and global environmental concerns. Environment will have to maintain its level of attention as issues such as world hunger arise. The long range future will see an emphasis on planning and inter-relationships. Efforts will be on obtaining a "balanced dynamic tension" on a global scale among:



Another way of thinking about it is as a resources management question where the resources are:

labour
capital
energy
clean air
clean water
other renewable and non-renewable resources

There will be trade-offs involved but eventually environmental, social and econimic values will evolve and stabilize. It is conceivable that energy, economics and environment could be on common ground. These forces could serve to change life styles which tend toward conservation, less wasteful consumption, re-cycling, environmentally compatible products, etc.

A separate perspective is that, in the long run, the inherent capacities of the environment will dominate over economic considerations. For example, the capacity of the earth to produce food will dominate economic mechanisms for the pricing of food. There will be a shift in perception from economics to the inherent capacity of the earth to sustain human population.

A third viewpoint is that the economic - environment balance depends on the state of the economy. If the economic slump continues, there will be a swing away from environmental values. Everything will be done to stimulate the economy. There is some evidence currently of an environmental backlash. That is, people are concerned with high food prices, energy problems, etc. and placing the blame for these problems on environmentalists. By 1985 we might be back to today's level of ceoncern for the environment.

Alternatively, the economic slump may witness a quick recovery and environmental concerns remain at the current level.

There are differing viewpoints regarding the relative priority of environmental criteria at each level of government. Research done by urban affairs indicates that concerns grow as the level of gevernment decreases. At the local level you have idealogical actors (citizen groups), private actors and civic actors. As things affect people personally and negatively, they become concerned. On the other hand, economic considerations are also important. Conflicts at the local level are much more prevalent and touch people directly.

One point of view is that environment is more a consideration at the Federal level. They are definitely committed to the environment. Senior government has the broad perspective, knows what is happening nationally and internationally. Federal Government has turned down economic development for the sake of the environment in Lake Louise as a prime example. They also spent $10 to $15 million to get the Eddie Company out of Hull. In some cases there may be a deferrment of economic time tables rather than a displacement of economic goals.

A contrary point of view is that the Federal Department of the Environment was set up to placate enviornmentalists, but, in fact, the Federal Government has continued the economic imperative. The economic imperative will increase further in the short term because of the recession. Environmental protection is currently one of the lowest priorities in the Cabinet, while economic development is a top priority. The theme of water resources management is to manage in a way that enhances economic development.

The Government of Ontario is perceived as being a leader in environmental criteria and decisions. Ontario is giving high priority to environmental protection as an adjunct to social betterment. It has been involved in creating standards on cutting out detergents and making decisions regarding exhaust equipment on cars, smoke stacks, harvesting in Algonquin Park, etc. Environmental factors will be considered in all major provincial government decisions. The Provincial Government has been quite active and will probably move further than the Federal Government. "However, there is still no question that the Provincial Government would opt for a pulp and paper mill over environmental protection to gain the social and economic benefit from it." A separate point of view is that environmental protection has achieved equal status with economic development.

In the 1950's and 1960's a lot of attention way given to pollution at the local level. Pollution was perceived as a local problem and, therefore, there were local solutions. But local governments are more narrow in their perception of problems. During a recession, local governments feel the revenue - cost squeeze more than any other governments. Therefore they lack the funds for environmental programs more than usual. Local governments will react on the basis of how much they can get out of senior governments. They may rely on senior governments to "bail them out" of serious environmental problems.

Economic considerations will continue to govern in attempts to attract industry. In many cases it may not be economic development, but economic maintenance that is the key question. The question that we usually face is; do we protect the environment or do we build a McKenzie pipeline; do we protect the environment or build a James Bay or a Lake Louise?

The harder question is do we protect the environment or close an existing pulp and paper mill. Old pulp and paper mills operate on marginal profits and would have to close down if standards are enforced. There is legislation now that requires certain standards of new mills and standards of old mills on a negotiated basis. So far there has been little restrictive negotiation. The government has come out with the principle that the polluter must pay. This puts them into a bind when you have a pulp and paper mill that operates in international markets. The mill cannot meet these standards and government does not provide funds to help them come up to standards. Pollution abatement costs can be written off as an expense. But this doesn't help if the company isn't making a profit.

Are we willing to have fines raised? Are we willing to take on increased unemployment? These are the questions that are voided and no one is prepared to tackle them now. Particularly unemployment, inflation, and energy issues will be the important issues of the day because they are felt very directly. People do not feel the environmental issue directly as they do the energy issue, inflation, housing, etc.

Question 91 - Private enterprise efforts to manufacture products compatable with environment. Environmental values of private enterprise

Quantitative response

	1964	1985	2000
Average	.4	2.5	7.3
Range	0-.8	1.0-10.0	1.0-40.0
Maj. clusters	.09,.8	1.4,3.0	1.4,2.0,5.7
Min. clusters	-	-	35.0

Qualitative response

One response is that there has been more of an environmental ethic in private enterprise than most people appreciate. For example, INCO has spent several million dollars learning how to grow products on tailings. In the future, there will be further development of an environmental ethic in private enterprise as a network of long range planners who are environmentally conscious begin to swing decisions in this direction. There will be a greater emphasis on internalizing waste that is now externalized, re-cycling and utilization of what is now waste.

A second response is that we can expect more efforts but not because of environmental values. Some companies will be able to "make money off the environment", eg. producers of abatement equipment, consultants, products promoted with an environmental sales pitch. Products compatible with the environment will be produced because it is profitable and companies will jump on the bandwagon. Also, energy and materials shortages will cause greater efforts to conserve.

A third viewpoint is that before companies produce environmentally compatible products, the public must be educated to demand them and the public doesn't seem to care. We don't have an environmental ethic in Canada because of the abundance of resources, land, water, air, etc. and it will take a long time for environmental values to be developed (eg. pop bottles and cans). Private enterprise has not had environmental values in the past and they will not in the future. Public pressure and government regulations will be necessary before they will act or alternatively they will act if they see money to be made (or saved).

A fourth response is that private enterprise does not have a moral obligation to do this. Further, that they can only correct their present industrial system up to a certain point before they become non-competitive in international markets. There is a much higher capital cost now to start a new paper mill; for example, the company must bear the full cost of pollu-

tion abatement. If standards are enforced in old mills, a lot of people would be put out of work because they would no longer be competitive.

Question 9-II - Cooperative strategies for improvement of water quality.

Municipal-Provincial
Provincial-Federal
International

Quantitative response

		1964	1985	2000
9-IIa	Average	.5	2.0	3.7
	Range	.2-1.0	.8-5.0	1.2-11.0
	Maj. clusters	.3,.5	1.3,2.0	1.5,2.3,8.0
	Min. clusters	.9	4.5	-
9-IIb	Average	.5	2.1	2.9
	Range	.1-.9	1.3-5.0	1.5-10.0
	Maj. clusters	.2,.5,.8	1.5,2.0,3.7	1.6,2.5
	Min. clusters	-	-	7.5
9-IIc	Average	.4	1.5	1.8
	Range	.1-.5	.9-2.0	1.4-3.0
	Maj. clusters	.1,.5	1.2,1.6,2.0	1.5,2.5
	Min. clusters	.4	-	-

Qualitative response

Decision-making between governments in a co-operative framework has improved and will continue to. What each level of government can do best in its own jurisdiction and how it can complement the other levels of government is being recognized. The Great Lakes Agreement provides positive objectives and problems are being solved with the direction it provides. It in turn is tied in with the Canada Water Act which is a flexible act providing for joint definition of problems, planning and strategy.

The Fisheries Act, on the other hand, is more of a "controlling" act. Up until now, it has been used more, but a shift will occur to a greater use of the ~~Fisheries~~ Canada Water Act.

Co-operation will continue to grow to 1985 and then the need for it will taper off.

In the long term there will be a continental approach to management of the Great Lakes. The Canada-U.S. Agreement is the first step in this direction. International Field Year in the Great Lakes began with scientists, and has since included operational and management people at all levels. The work IJC is doing brings it all together. They began with water quantity and are now into water quality.

Europeans are now talking about co-operation among themselves. By 1985 there will be an exchange of scientific information between Europe and the IJC.

Between Federal and Provincial Governments a substantial increase in co-operation has occurred since 1964. CMHC has provided sewage loans, regional economic expansion programs have been implemented and the Canada Water Act has enhanced relationships.

Provincial - local government co-operation is good in Ontario. Municipalities all have considerable opportunity for assistance from the Province. This will improve further as the Province puts more money into environmental protection. There must be good co-operation between these two levels if citizen participation is to be effective. As municipalities get stronger and bigger, there will be a re-allocation of political power between the province and large cities. The large cities will tend more towards making their own decisions.

An alternative viewpoint expressed by some respondents in the areas of co-operation among the different levels of government are more negative. At the international level there is a question of the actual effectiveness. At conferences, for example, it is felt that the wrong people attend. People who should be at international conferences are too busy to be there. Immediate practicalities don't get translated into future needs, even though there is information and knowledge to build on. It is felt also that the International Joint Commission has been a situation of "all show and no go".

Canada and U.S. co-operation has gone up in the last ten years but is now on a downward trend. There are an increasing number of problems between Canada and the United States. There is an increasing trend for Canada to be independent. Canada's energy policy is causing a backlash. If the Canadian economy remains stable and the U.S. economy takes a dip, this will create several pressures. Therefore things won't be quite as good and will effect relations on the IJC and subsequently Great Lakes water quality. If the Canadian economy is stronger, enabling us to have more of an environmental ethic, then arguing a point with them when an economic trade-off is called for will be much more difficult. The international area will not change because of serious long term economic problems in the United States until the end of this century. The auto industry, the defense industry and others have reached the limits of expenditures for environmental matters.

In terms of municipal-provincial co-operation, there has historically been substantial tension between the agencies involved. This may improve with regional governments.

Generally, we must look not only at stated co-operation but also real co-operation. That is, team relationships and approaches

to problem solving on the basis of shared perceptions of what the problems are and approaches to their solution. Real co-operation will begin with the politicians, putting aside jurisdictional barriers which give rise to legal disputes and counter productivity.

It is also a function of dollars available. As funds increase there will be more co-operation. However there won't be too much more progress in terms of increasing budgets for environmental issues. The general public is becoming satisfied with the progress that is being made and there is no longer a continuing alarm.

Question 10a - Adequacy of legislation

10b - Adequacy of policies

10c - Adequacy of programs

10d - Adequacy of criteria/standards

Quantitative response

		1964	1985	2000
10a	Average	.6	1.7	2.6
	Range	0-2.0	1.0-3.0	1.2-10.0
	Maj. clusters	.1,.5,.7	1.0,1.6,2.7	1.4,2.6
	Min. clusters	-	-	-
	(v.s. economy	.5	1.2	1.4)*
10b	Average	.6	1.9	2.9
	Range	0-3.0	1.0-5.0	1.0-12.0
	Maj. clusters	.2,.6	1.2,3.0	1.4,2.6
	Min. clusters	-	-	9.0
10c	Average	.4	2.1	3.3
	Range	0-.8	1.0-5.0	1.0-10.0
	Maj. clusters	.2,.6	1.3,2.3	1.4,2.2,7.3
	Min. clusters	-	5.0	-
10d	Average	.3	2.5	3.8
	Range	0-.7	.8-5.0	1.0-10.0
	Maj. clusters	.2,.5	1.3,2.0,4.0	2.0,3.7
	Min. clusters	-	-	8.5

Qualitative response

One response is that there has been a substantial improvement in all categories (a,b,c, & d) since 1964. All Federal legislation has been passed since 1970:

Fisheries Act and Amendments
Canada Water Act
Northern Inland Waters Act
Arctic Waters Pollution Prevention Act
Clean Air Act
Environmental Contaminants Act.

The same has been true by and large for the Provinces. There have been marked changes and some things contemplated now will improve it further. In the next ten years, pollution control legislation will be consolidated. By 2000, the legislation for water quality will be captured into broader social legislation. Policies have improved more than legislation. There is a direction that has been given. Programs have been very effective and many have gone further than policy or legislation called for.

*Conditional response

Programs will continue to improve depending on the availability of funds. Standards and objectives will improve as we improve our scientific information.

A second response is that the question must be considered in terms of adequacy for the period, 1964, 1974, 1985 or 2000. Legislation, policies, programs and standards will all be better but "pressures" on water quality will be greater and therefore the relative adequacy of a, b, c and d will remain at 1. Legislation in itself is not sufficient, it depends on how it is used. Existing legislation and policies must be tested before they are improved again. Criteria and standards did not exist in 1964 and still have not been worked out for a number of substances. Universal standards are not the answer. There is an extreme diversity of individual situations depending on the assimilative capacity of the water body and its intended use. Therefore, criteria must be developed for each local situation, in consort with local interests and their relative willingness to forego future alternatives.

Criteria and standards must be based on what the environment can absorb and what will do damage. Knowledge in this area is constantly improving.

A third response category is much more negative. There was very little legislation in 1964 and it was not used. The legislation has not improved that much. We've been inadequate in all these areas. By 1985, they will be improved but still poor relative to the requirement since policies and legislation are basically re-active. You can't have policy or legislation before there is a publicly recognized need for them.

The "Canada Water Act" is enabling legislation only with a few regulations (e.g. for phosphorous). "It's a toothless old woman that says let's be friends and do some joint research." The Fisheries Act is being used for something that was never intended: "If fish are harmed, we'll go after you."

There should be much more to say about the environmental rights of the individual - qualitatively and quantitatively. How do we protect the individual's social and environmental rights? The panelist quoted Gandhi, "the world has enough resources to meet man's need, but not his greed." Rational man will seek to satisfy man's need; the real man is seeking to satisfy his greed.

Policies have been short term; programs are incrementally designed, fragmented and motivated by empire building.

A fourth response is that if you get true accord among

governments (question 9 II), these things will follow naturally. The more we define, the more bureaucratic and inflexible we become. This is counter-productive, more complicated to administer. It is necessary instead to devote energies working with people. We don't need more government and institutional process. We need more problem identification and solution. The test of programs is their ability to respond to and solve problems. We have generally been inefficient in solving problems but the situation is positive and improving.

Question 11a - Adequacy of monitoring procedures - effluents

11b - Ambient water quality

Quantitative response

		1964	1985	2000
11a	Average	.5	3.4	3.7
	Range	.01-1.0	1.0-10.0	1.0-12.0
	Maj. clusters	.06,.5,.8	1.3,2.7	2.2,4.0
	Min. clusters	-	10.0	1.3
11b	Average	.5	2.4	3.0
	Range	.01-1.0	1.0-5.0	1.0-7.0
	Maj. clusters	.1,.6	1.3,2.4	1.3,2.3,4.0
	Min. clusters	-	4.5	-

Qualitative response

Until relatively recently, there has been no system of monitoring. It has been basically spot checks. We are now moving towards a system of monitoring. There will be much more precision and accuracy. We'll be monitoring in remote areas where there is no monitoring now. Most of this will be done by automatic monitoring procedures. For example, the St. John's River System has automatic sensors which run continuously. As these become more reliable and simple, they will be used more. There will also be more remote sensing by aircraft and satellite. This will increase substantially and will become routine eventually. Industry will also be doing more of their own monitoring.

An alternative viewpoint is that information on effluents is our weakest knowledge base. Further, monitoring of ambient water quality depends on broad surveys and there is less of an urgency for it. It is not used to identify specific polluters and therefore there is less money available for it. Relative to the need, it will remain fairly constant.

A third perspective is that monitoring will not have to improve significantly if we move towards a "Conservation Society." We'll be re-cycling, there will be less polluting. Existing technology is not being fully exploited, it will be used more fully to improve monitoring.

Question 12 - Implementation

Effectiveness

Quantitative response

		1964	1985	2000
12	Average	.6	2.3	3.3
	Range	0-1.0	1.0-5.0	1.0-10.0
	Maj. clusters	.5,.8	1.4,2.0,5.0	1.5,2.3,7.0
	Min. clusters	-	-	-

Qualitative response

Sewage treatment in 1964 was not "environment oriented." It simply kept the "green scum" off the water. Implementation is quite effective now. It takes more time, but better plants are being built. B. O. D. removal, the removal of toxic substances, nutrient removal are all better. Introduction of chemical treatment or tertiary stage is increasing. C. C. I. W. is working to improve the state of the art. Research is being conducted and break-throughs are possible.

A more negative viewpoint is that despite increased legislation, policies and programs, there has not been substantial implementation effectiveness up until now. There will be slow progress. Lead times will continue to be long unless there is a crisis. Implementation effectiveness responds only to public pressures. It takes twice as long to do things now. More is being done but each incremental improvement requires more red tape, discussion, etc., and this will continue.

Question 13 - Speed of Response (getting mun'y-industry to act)

(Define time for 1.0)

industry
mun'y

Quantitative response

		1964	1985	2000
13	Average	.8	1.8	4.8
	Range	.3-1.3	.8-5.0	.6-20.0
	Maj. clusters	.4,.9	1.2,3.3	1.0,3.0
	Min. clusters	1.3	-	15.0

Qualitative response

The speed of response is getting to a break-through point. For municipalities, it takes at least 18 months now for a problem to be defined, a report written and to get action initiated. There hasn't been much improvement since 1964. With satellite monitoring, we should be capable of a quicker response time and eventually on a "real-time" basis, i.e. before any damage is done. Industries usually plan ten years ahead, e.g. for a new steel mill. Therefore, industrial standards must be developed with a ten year lead time as well. As there is an improvement in the effectiveness of implementing programs, there will be parallel increases in speed of response.

A second point of view is that the speed of response is slower now than in 1964. It was three years then and is four years now (five to ten years). With all the requirements that are coming and the red tape, it won't be improving unless we face a crisis situation. Government responds only to public pressures.

A third viewpoint is that it depends on local circumstances and how much is given in the way of grants or loans. Also depends on the extent to which policies and legislation are enforced. Neither municipalities or industry will respond unless enforcement takes place. Therefore it depends on the resolve of Governments to share the financial burden and the resolve of Governments to enforce.

Question 14 - Available financing for pollution control measures

			private Government	
			1964	1985	2000
Quantitative response					
14a	Average		.3	1.8	3.1
	Range		0-.8	1.0-3.0	1.5-6.0
	Maj. clusters		.2,.7	1.4,2.3	2.5,4.5
	Min. clusters		-	-	1.6
	after use pollution control		.5	1.3	-*
	pre-planning prevention		-	3.0	7.0*
14b	Average		.4	1.8	2.6
	Range		.1-.9	.8-5.0	.6-7.5
	Maj. clusters		.3,.8	1.3,3.3	1.4,2.0,3.8
	Min. clusters		-	-	-
	after use pollution control		-	2.0	-*
	pre-planning prevention		-	5.0	20.0*

Qualitative response

There is almost unanimous agreement that Government spending increased substantially since 1964 and that in the last ten years, most of the money spent was by Government. Currently, Provincial funds are drying up. Dollars available have been high. A lot of tertiary treatment exists. In the future, government will try to impose most costs on industry and will succeed. There is a need for better solutions. "The Government shouldn't always be bailing everyone out."

A shift will occur from after-use pollution control measures to more emphasis on prevention of pollution and pre-planning to reduce the need for pollution control. More private controls will be implemented and costs internalized.

The extent of spending by both Government and industry

*Conditional response

will depend on the state of the economy. There may be a levelling until the economy takes an upswing, expenditures on pollution abatement will pick up again. By and large, Ontario has completed its "Catch-up" program and therefore expenditures will continue to remain fairly level.

Government has been financing capital expenditures up until now. There may be a shift towards operating and maintenance expenditures. There are some situations where a municipality obtains a loan from CMHC to install a sewage plant and it then remains idle because of lack of funds for operating and maintenance expenditures.

A separate viewpoint is that industry made a big jump in the last ten years because in 1964, there was virtually nothing. This trend will continue and then taper off. Government has not increased so rapidly in the last ten years but will in the next ten. Expenditures in both categories will increase and government at a faster rate.

Question 15 - Funding of research
re: pollution abatement

private enterprise
Government
(basic applied?)

Quantitative response

		1964	1985	2000
15a	Average	.3	2.0	2.6
	Range	.01-.9	1.0-5.0	1.0-6.0
	Maj. clusters	.1,.6	1.5	1.1,2.1,4.7
	Min. clusters	-	4.5	-
15b	Average	.3	2.1	3.3
	Range	.1-.5	1.3-4.0	1.5-6.0
	Maj. clusters	.1,.2,.5	1.4,2.1	1.8,3.2,4.6
	Min. clusters	-	3.5	-

Qualitative response

A lot of research is done which is inefficient and ineffective. Research has not been impressive to date. A lot of money is spent but there is uncertainty as to whether or not it has been helpful or necessary. Improvement in effectiveness and management is all that is required.

The curve will go up but at a slower rate than population growth or industrial growth. Growth will not occur until the economy improves.

A lot of research is done by certain industries, such as the chemical industries on toxic substances, but it is done by the parents, not in Canada. Private enterprise is doing what they can. There won't be a big jump.

Future research in Canada will be done mostly by Government. Government efforts have gone into CCIW laboratories across Canada and there will likely be increases in the funding of CCIW. The Environmental Contaminants Act when passed will give a boost to the funding of research.

In terms of the split between basic and applied research, one viewpoint is that there is a tendency to apply science to "brush-fine" situations. Applied research should be for the current problem context; basic research for tomorrow's problems. In the future there will be a change in proportions. If we were to allocate effort on the basis of a 10 point scale, it would be as follows:

	1964	1974	1985	2000
Basic	2	2	3	4
Applied	8	8	7	6

A contrary viewpoint is that the difference between basic and applied research is a non-problem. We are talking basically about applied, i.e. we just keep digging until enough information is obtained to solve the problem.

Question 16 - Self-contained processes; Waste -- raw material processes (& other changes in industrial processes)

Quantitative response

		1964	1985	2000
16	Average	.5	2.9	8.2
	Range	<.1-.9	1.4-10.0	1.8-50.0
	Maj. clusters	.2,.6,.8	1.5,2.1,3.8	2.1,4.7,10.0
	Min. clusters	-	-	-

Qualitative response

Performance in this whole area has been poor to date. However, we will move into it rapidly, and see a "breakthrough" in the next ten years and another in the ten years after that. By the year 2000, performance in this area will be "spectacular." Events in energy and material shortages will force a much more comprehensive approach to resources and environmental management. There will be a 360" change towards self-contained processes and re-cycling.

"There has to be by 1985 or we'll be up to our ass in sanitary land fill sites."

Speed and direction will be dictated by government response, the economy and resource realities. It will vary with each industry. Enough sulfur dioxide goes up in Sudbury to produce all the sulfuric acid that Canada could use; sugar could be produced from paper by-products; waste will be used to produce methane; the National Research Council has had a house running on a self-contained water unit for several years.

A separate viewpoint is that industry will give this lip service; if it pays, they'll do it. Their business is to make a profit and they are governed by the economics of the situation.

An additional comment is that these processes may occur for new plant developments but there will be no retro-fitting.

Question 17 - Land disposal techniques

Quantitative response

		1964	1985	2000
17	Average	.6	2.0	7.5
	Range	.01-1.0	1.0-5.0	.7-50.0
	Maj. clusters	.6,.8	1.3,2.0,3.7	1.2,2.4
	Min. clusters	-	-	8.0

Qualitative response

There hasn't been much progress in this area in the last ten years and still not much innovation. It will soon become a crucial problem particularly before re-cycling is developed.

There will be more use of waste as a fertilizer - "Spray irrigation" of agricultural areas and entire forests. We might conceivably have a sewage system that uses a vacuum rather than water. Sewage (sludge cake) containing micro organisms could be used to feed algae, (which are 80% protein) which would then be harvested and dried for consumption as a food product.

Techniques for disposing hazardous wastes are not very sophisticated. There will be maps of land disposal areas to show where waste of different firms is located. They will be in "boxes" rather than seeping through the ground and will be re-claimed and re-processed when they are required.

There will be a much broader definition by Government in terms of what it will finance for waste processing. For example, Government may finance transport trucks for a spray irrigation process.

Question 18 - Development and application of new technology in treatment processes

Quantitative response

		1964	1985	2000
18	Average	.8	2.2	4.8
	Range	.5-1.0	1.2-6.0	1.6-15.0
	Maj. clusters	.8,1.0	1.5,2.4	1.9,4.5
	Min. clusters	.6	-	12.5

One response noted: by-products, yes - not treatment per se

Qualitative response

Up until now, there has only been changes and adjustments to existing systems. But there are likely to be breakthroughs by 1985. A lot of research is now being done and knowledge gained is beginning to have a pay off. New technologies are now being developed which are likely to be applied in the 1980's. There is a new system for cottages which in effect is a mini sewage treatment plant. The University of Toronto has developed a new process for the pulp and paper and mining industries that has already been applied in Finland. Plants in Canada developed in the 1980's will likely have this process.

Question 19-I - Remedial programs for abatement of existing pollution

Quantitative response

		1964	1985	2000
19-I	Average	.5	2.8	3.3
	Range	0-1.0	1.2-10.0	1.2-10.0
	Maj. clusters	.3,.8	1.6,3.0	1.8,4.3
	Min. clusters	-	-	-

Qualitative response

Knowledge gained in research at CCIW is determining the necessity for remedial programs.

Generally the trend will be a shift from abatement to prevention. The next few years will maintain the status quo.

Up until 1985, there won't be much money for programs in this area. Beyond that point, remedial programs will be tied in as an integral part of planning and management.

There will be remedial programs which include weed harvesting, ph adjustment, phosphorous removal, aeration of lakes approaching utrophic conditions and land management to control the quality of water run-off.

A second viewpoint would accelerate the timing of the above so that a "quantum leap" will occur before 1985.

A third viewpoint is that a number of systems are being treated right now. There has been a fairly ambitious program. Once a certain level of control is reached, it will flatten out.

Question 19-II - Accountability of polluters

Quantitative response

		1964	1985	2000
19-II	Average	.4	2.6	5.3
	Range	.01-.9	1.2-5.0	1.2-15.0
	Maj. clusters	.1,.3,.8	1.4,2.3,4.7	1.5,4.8,10.8
	Min. clusters	-	-	2.8

Qualitative response

In the 1960's, this was quite low. Waste was generally externalized. There's been a considerable increase in the principle "the polluter must pay." Legally, polluters are now accountable. The important aspect is enforcement of existing legislation. This will increase substantially by 1985, the concept of accountability is accepted and industry is also beginning to feel it is accountable. Fines are being used more.

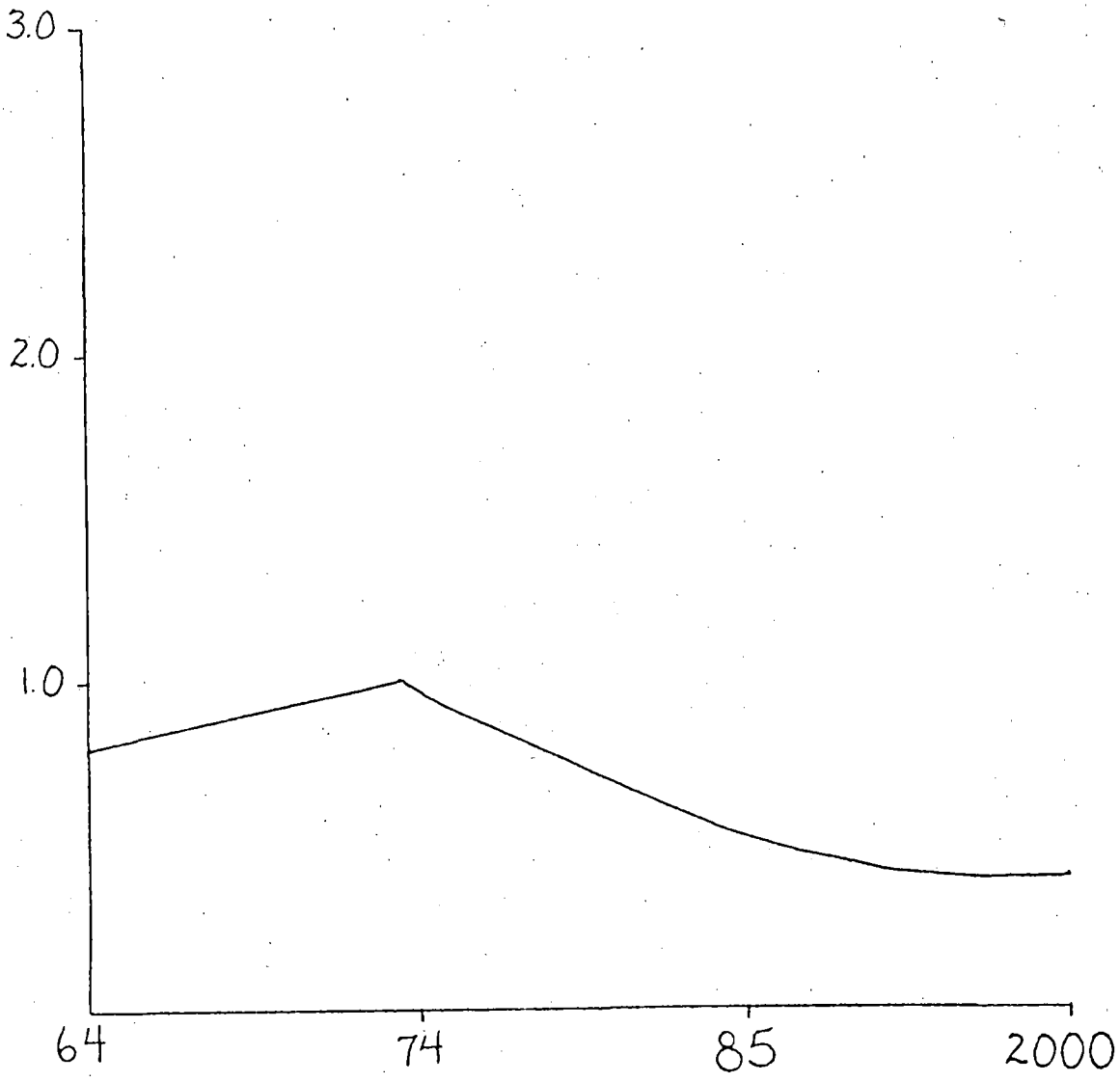
By 1985, there will be more re-cycling; waste will be internalized. The onus will be on the polluter to show why he should pollute. Prices rather than taxes will be used to control pollution. Pollution control costs will be built in to the cost of doing business.

The motivator that "drives the model" is public awareness. Without it, the model doesn't work. If the media is not reporting, government will just its effort on other issues.

A more negative scenario is that an attitude exists of "we've got so much water there, why worry about it." The pressures aren't there yet and a lot more damage will be done before their concern is manifested. Also, there's little industry there to begin with and there won't be that much more industrial growth. When effects of pollution are more visible, we'll get more reaction.

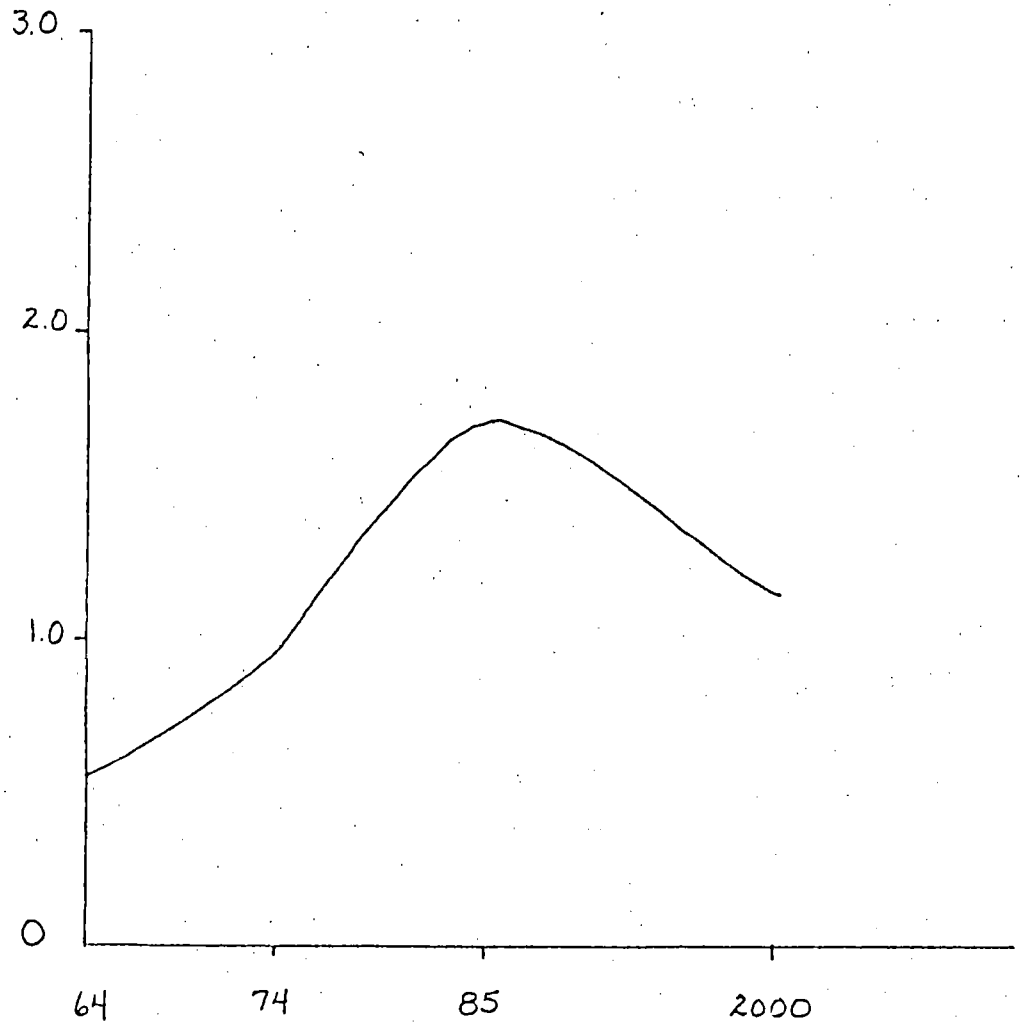
SCENARIO A

OPTIMISTIC



SCENARIO B

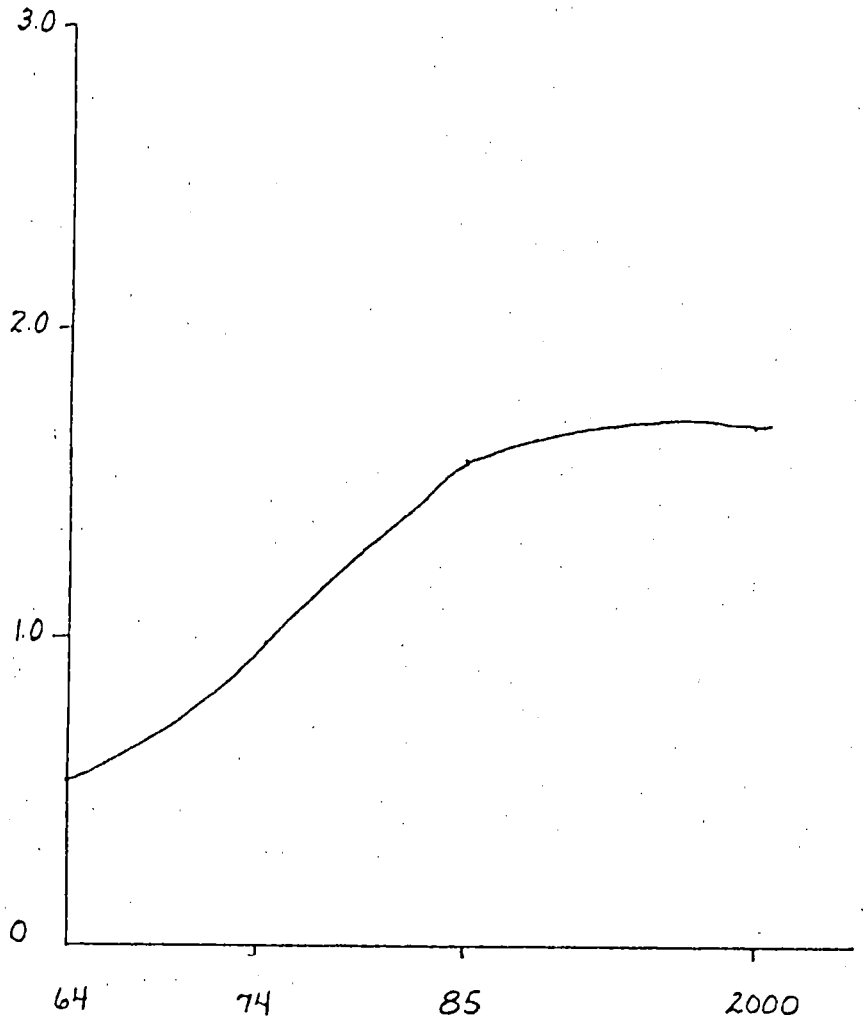
MEDIUM TERM – WORSENING
LONG TERM – IMPROVING



SCENARIO C

MEDIUM TERM - WORSENING

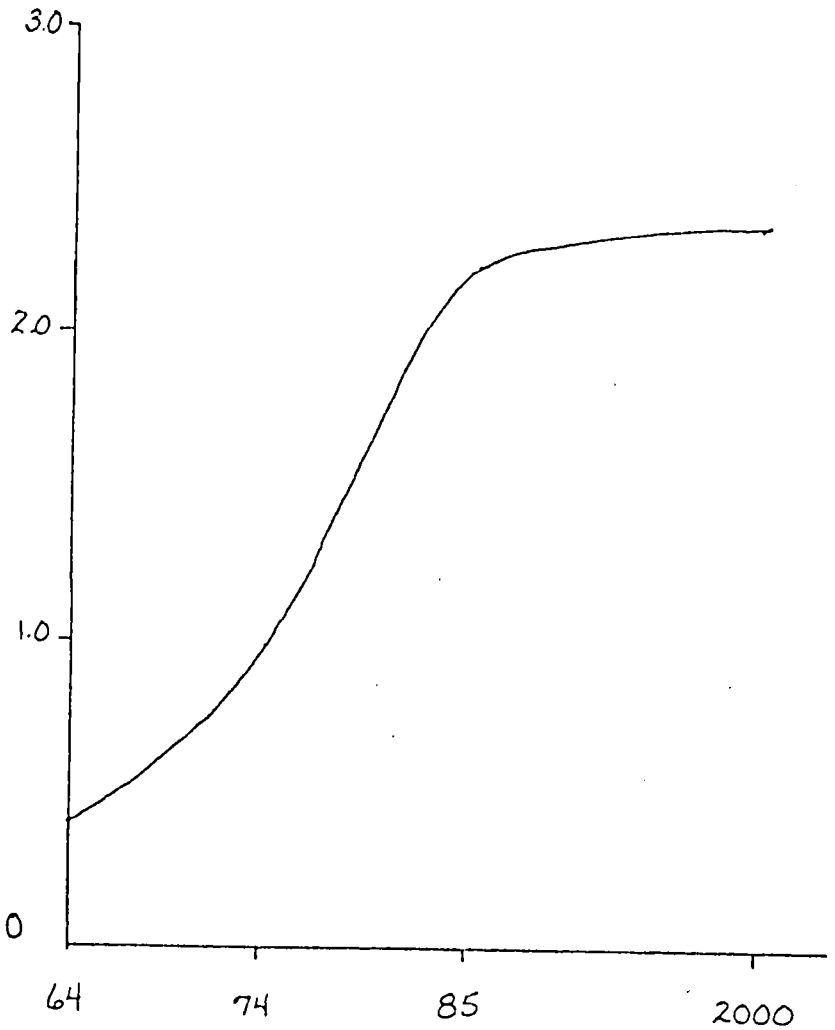
LONG TERM - LEVELLING



SCENARIO C^1

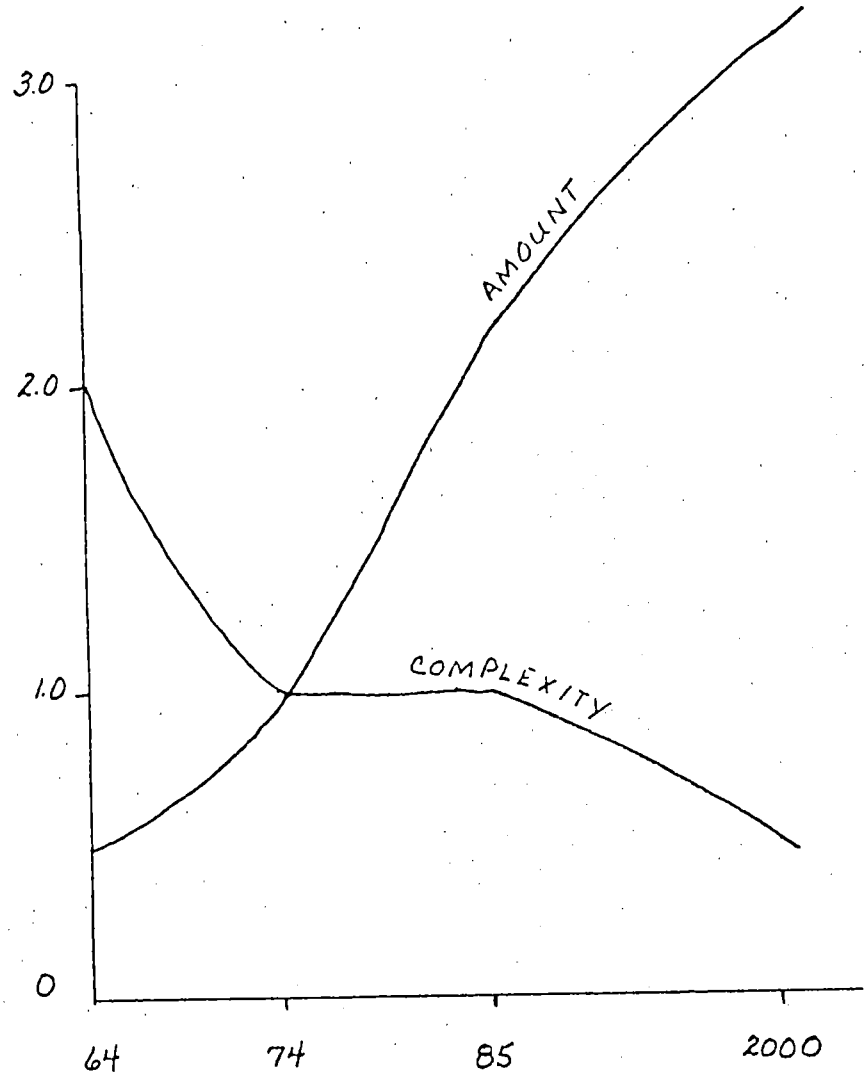
MEDIUM TERM - WORSENING

LONG TERM - INCREASE PROPORTIONATE TO POPULATION



INDIVIDUAL VIEWPOINT

AMOUNT OF EFFLUENT GREATER BUT LESS COMPLEX (i.e. easier for waters to assimilate)



Statistical Analysis of Quantitative Responses

QUESTION		1964	1985	2000
		DEVELOPMENT		
1a	Average	.6	2.0	4.3
	Range	.1-1.0	1.2-5.0	1.0-25.0
	Maj. clusters	.2,.8	1.3,3.0	1.5,2.6
	Min. clusters	.5	-	-
	(if non-development ethic prevails	-	1.5	1.8)*
1b	Average	.6	1.2	2.5
	Range	.1-1.2	1.0-1.5	1.0-10.0
	Maj. clusters	.1,1.0	1.0,1.3	1.1,1.3,5.3
	Min. clusters	-	-	-
	(if non-development ethic prevails	-	1.3	1.8)*
		KNOWLEDGE		
2	Average	.4	1.5	2.3
	Range	.1-.8	1.0-2.5	1.2-5.0
	Maj. clusters	.1,.4,.7	1.4,2.1	1.5,2.1
	Min. clusters	.7	1.1	4.5
	Academic	.6	2.5	2.5 *
	Government	.3	2.5	2.8
	Private enterprise	.8	1.5	1.8
3	Average	.5	2.8	5.6
	Range	.1-1.4	1.2-5.0	1.3-10.0
	Maj. clusters	.2,.6	1.5,2.1,5.0	1.9,3.5,9.3
	Min. clusters	1.2	-	-
	Data	.3	3.0	6.0 *
	Knowledge	.8	1.3	2.0

---

*Differentiated response

QUESTION		1964	1985	2000
		EDUCATION		
4	Average	.3	2.3	5.0
	Range	>.1-.9	.7-4.0	.7-15.0
	Maj. clusters	.2,.8	1.2,2.0,3.2	1.7,4.1
	Min. clusters	-	-	12.5
	(one response	.05	2.0	4.0→∞)
5	Average	.3	2.5	5.2
	Range	<.1-.8	1.2-5.0	1.5-15.0
	Maj. clusters	.2,.6	1.4,2.4	1.7,3.3
	Min. clusters	-	5.0	15.0
		MEDIA		
6a	Average	.3	2.4	3.2
	Range	.1-1.0	.6-7.0	.4-10.0
	Maj. clusters	.1,.6	1.2,5.0	1.3
	Min. clusters	.3	-	3.8,10.0
	(based on 1974 as 1.4	.3	1.4	1.8)*
	One response noted:	Planning paradigm and therefore media message to shift to a "stable state" concept.		
6b	Average	.2	2.4	4.5
	Range	.05-.5	1.3-5.0	1.5-10.0
	Maj. clusters	.1,.5	1.4,2.0,4.0	1.8,9.3
	Min. clusters	-	-	3.5
		CITIZENS GROUP		
7a	Average	.3	1.5	1.7
	Range	0-.7	1.0-3.0	1.0-4.0
	Maj. clusters	.05,.3,.6	1.2,1.5	1.0,1.6
	Min. clusters	-	2.5	3.0
7b	Average	.4	1.9	2.7
	Range	0-1.0	1.0-5.0	1.0-6.0
	Maj. clusters	.1,.4,.9	1.3,2.1	1.4,2.3
	Min. clusters	-	-	5.0
7c	Average	.3	2.0	3.4
	Range	0-.8	1.0-5.0	1.5-10.0
	Maj. clusters	.25	1.4,2.1	2.4
	Min. clusters	.05,.7	-	8.5

QUESTION		1964	1985	2000
		LEGISLATION		
8a	Average	.5	1.4	2.4
	Range	0-1.2	1.0-3.0	1.0-6.0
	Maj. clusters	.2,.8	1.0,1.4	1.2,4.7
	Min. clusters	-	2.5	1.9
	(after use concept	.3	1.5	2.0)*
	One response noted:	1970 = 1.8; the rating then went down and then back up to 1.0 by 1974.		
8b	Average	.6	1.8	2.9
	Range	0-1.0	1.0-4.0	1.0-8.0
	Maj. clusters	.5,.9	1.2,2.1	1.2,2.5,5.7
	Min. clusters	-	-	-
8c	Average	.5	1.7	3.0
	Range	0-.8	1.0-5.0	1.0-8.0
	Maj. clusters	.5,.8	1.2,2.2	1.3,3.3
	Min. clusters	.2	1.5	6.5
	(pre-planning concept	.9	5.0	50.0)*
9-I	Average	.4	2.5	7.3
	Range	0-.8	1.0-10.0	1.0-40.0
	Maj. clusters	.09,.8	1.4,3.0	1.4,2.0,5.7
	Min. clusters	-	-	35.0
9-IIa	Average	.5	2.0	3.7
	Range	.2-1.0	.8-5.0	1.2-11.0
	Maj. clusters	.3,.5	1.3,2.0	1.5,2.3,8.0
	Min. clusters	.9	4.5	-
9-IIb	Average	.5	2.1	2.9
	Range	<.1-.9	1.3-5.0	1.5-10.0
	Maj. clusters	.2,.5,.8	1.5,2.0,3.7	1.6,2.5
	Min. clusters	-	-	7.5
9-IIc	Average	.4	1.5	1.8
	Range	.1-.5	.9-2.0	1.4-3.0
	Maj. clusters	.1,.5	1.2,1.6,2.0	1.5,2.5
	Min. clusters	.4	-	-
10a	Average	.6	1.7	2.6
	Range	0-2.0	1.0-3.0	1.2-10.0
	Maj. clusters	.1,.5,.7	1.0,1.6,2.7	1.4,2.6
	Min. clusters	-	-	-
	(v.s. economy	.5	1.2	1.4)*

QUESTION		1964	1985	2000
10b	Average	.6	1.9	2.9
	Range	0-3.0	1.0-5.0	1.0-12.0
	Maj. clusters	.2,.6	1.2,3.0	1.4,2.6
	Min. clusters	-	-	9.0
10c	Average	.4	2.1	3.3
	Range	0-.8	1.0-5.0	1.0-10.0
	Maj. clusters	.2,.6	1.3,2.3	1.4,2.2,7.3
	Min. clusters	-	5.0	-
10d	Average	.3	2.5	3.8
	Range	0-.7	.8-5.0	1.0-10.0
	Maj. clusters	.2,.5	1.3,2.0,4.0	2.0,3.7
	Min. clusters	-	-	8.5
	MONITORING - IMPLEMENTATION			
11a	Average	.5	3.4	3.7
	Range	.01-1.0	1.0-10.0	1.0-12.0
	Maj. clusters	.06,.5,.8	1.3,2.7	2.2,4.0
	Min. clusters	-	10.0	1.3
11b	Average	.5	2.4	3.0
	Range	.01-1.0	1.0-5.0	1.0-7.0
	Maj. clusters	.1,.6	1.3,2.4	1.3,2.3,4.0
	Min. clusters	-	4.5	-
12	Average	.6	2.3	3.3
	Range	0-1.0	1.0-5.0	1.0-10.0
	Maj. clusters	.5,.8	1.4,2.0,5.0	1.5,2.3,7.0
	Min. clusters	-	-	-
13	Average	.8	1.8	4.8
	Range	.3-1.3	.8-5.0	.6-20.0
	Maj. clusters	.4,.9	1.2,3.3	1.0,3.0
	Min. clusters	1.3	-	15.0
14a	Average	.3	1.8	3.1
	Range	0-.8	1.0-3.0	1.5-6.0
	Maj. clusters	.2,.7	1.4,2.3	2.5,4.5
	Min. clusters	-	-	1.6
	after use pollution control	.5	1.3	- *
	pre-planning prevention	-	3.0	7.0 *
14b	Average	.4	1.8	2.6
	Range	.1-.9	.8-5.0	.6-7.5

QUESTION		1964	1985	2000
14b	Maj. clusters	.3,.8	1.3,3.3	1.4,2.0,3.8
	Min. clusters	-	-	-
	after use pollution control	-	2.0	- *
	pre-planning prevention	-	5.0	20.0 *
	RESEARCH & TECHNOLOGY			
15a	Average	.3	2.0	2.6
	Range	.01-.9	1.0-5.0	1.0-6.0
	Maj. clusters	.1,.6	1.5	1.1,2.1,4.7
	Min. clusters	-	4.5	-
15b	Average	.3	2.1	3.3
	Range	.1-.5	1.3-4.0	1.5-6.0
	Maj. clusters	.1,.2,.5	1.4,2.1	1.8,3.2,4.6
	Min. clusters	-	3.5	-
16	Average	.5	2.9	8.2
	Range	<.1-.9	1.4-10.0	1.8-50.0
	Maj. clusters	.2,.6,.8	1.5,2.1,3.8	2.1,4.7,10.0
	Min. clusters	-	-	-
17	Average	.6	2.0	7.5
	Range	.01-1.0	1.0-5.0	.7-50.0
	Maj. clusters	.6,.8	1.3,2.0,3.7	1.2,2.4
	Min. clusters	-	-	8.0
18	Average	.8	2.2	4.8
	Range	.5-1.0	1.2-6.0	1.6-15.0
	Maj. clusters	.8,1.0	1.5,2.4	1.9,4.5
	Min. clusters	.6	-	12.5
	One response noted:			by-products, yes - not treatment per se
19-I	Average	.5	2.8	3.3
	Range	0-1.0	1.2-10.0	1.2-10.0
	Maj. clusters	.3,.8	1.6,3.0	1.8,4.3
	Min. clusters	-	-	-
	ACCOUNTABILITY			
19-II	Average	.4	2.6	5.3
	Range	.01-.9	1.2-5.0	1.2-15.0
	Maj. clusters	.1,.3,.8	1.4,2.3,4.7	1.5,4.8,10.8
	Min. clusters	-	-	2.8

PART II

LITERATURE SEARCH RESULTS

Within the literature of the technological forecasters there appears to be a general unanimity that industrial society as we know it is soon to be replaced by a new society. Jacques Ellul calls it "technological society", Marshall McLuhan asserts that the "mechanized" environment of the industrial age has been replaced by the "totally new environment" of the "electronic age". Zbigniew Brzedzinski writes of the "technotronic era"; Amitai Etzioni of the "post-modern period". Others simply speak of the vast changes that will take place by the "year 2000" or "tomorrow". The most popular term is probably Daniel Bell's "Post Industrial Society".

The technological advances offer the possibility to humanity to attain new powers over itself and the environment that can fundamentally alter its nature. Robert Heilbroner asserts that "technology is altering life to its existential roots before our very eyes". Man, through his technological genius has almost infinite power to change the world and himself. In the words of Emmanuel Mesthene, director of the Howard Program in Science and Technology, "We have now, or know how to ac uire, the technological capability to do very nearly anything we want. Can we transplant human hearts, control personality, order the weather that suits us, travel to Mars or Venus? Of course we can, if not now or in five or ten years, then certainly in 25 or in 50 or in 100."

Victor Ferkiss, in the Technological Man: The Myth and The Reality sums up some of the fundamental changes that the "prophets of the new" are predicting:

> The key to these changes lies in the fact that communications in the broadest sense of that term is replacing work as the foundation of the technological system. Energy is still utilized but increasingly it is used to affect states of consciousness rather than to move physical objects. Though machines abound, there is a sense, not clearly grasped by the prophets of the new, that the age of mechanization is over. Not levers and pulleys exerting force but sounds in the air, lights flashing on the dial of the computer are the archetypal symbols of the new era, and electronics rather than mechanical physics is supreme. The overshadowing of the blast furnace and the assembly line and the bulldozer by the laser and the transistor and the chip is not merely a change in the appearance or incidental aspects of technology, it is basic . . .
>
> . . . a shift of economic activity from production and work to communication and interaction.
>
> . . . the rise of the knowledge isdustry to a position

of prominence in - some would even say to virtual dominance of - the American economy.

. . . that the decreasing importance of physical production and old style property rights will lead to more attention being paid to technical expertise in social decision-making, perhaps even to the domination of our society by a scientific elite in place of the present political or business elite.

. . . many anitcipate an era of mass leisure and/or unemployment created by automation and marked by affluence for the developed nations at least.

. . . some see decentralization and a new foundation for human dignity.

. . . others fear the unblinking stare of Big Brother.

. . . some see politics desappearing as technology becomes completely autonomous and technicians making decisions on purely rational-technological grounds.

. . . others envision the possibility of politicization of all life, with politics becoming more ubiquitous and unstable as planning becomes more extensive and "style" or cultural questions increasingly supercede today's more mundane issues as the principal subject matter of politics.

These prophecies, even after the contradictory elements have been factored out, together constitute a formidalbe, far-reaching and basic set of social changes.

The predictions generally rest on assumptions about how much effort will go into certain lines of research. There seems to be a shared set of orientations among most planners but that may be the result that a furturist Establishment has developed which tends to dominate most sutdies and conferences.

In any event, the population growth in the world necessitates that (Ferkiss again) "the kind of civilization capable of supporting a significantly larger number of men through technological advance would necessarily have to be a new civilization, one based completely on rational calculation, maximum social discipline, recycling of resources and so on. Its institutions and culture would be utterly at variance with the blind procreative urges that have led to the population explosion as well as with most of man's customs and attributes as they have hither to existed."

The profound technological revolution, the environmental rethinking and the population crisis all appear to be coming together and forcing a major reshaping of modern society.

The following are a few more relevant predictions from the rather large number of books and articles which are beginning to proliferate on the subject of futures.

--- Laser beams to dispose of garbage and sewage.

--- Lasers for sensing, measuring, communication, cutting, heating, welding, power transmission, illumination.

--- New and more reliable educational and propaganda techniques for affecting human behaviour.

--- Algae which is 60-70% protein will be produced in quantity.

--- Transportation improvements will open up recreation areas now too distant for most city dweller.

--- Desalination of water will be in wide use.

--- Fusion nuclear power will be in wide use.

--- New methods of water transportation including large submarines, flexible and special purpose "container ships", more extensive use of large automated single-purpose bulk cargo ships.

--- New or improved uses of the oceans for mining, extraction of minerals, controlled "farming", source of energy.

--- More sophisticated architectural engineering of geodesic domes, thin shells, pressurized skins, esoteric material.

--- Design and extensive use of responsive and super controlled environments for private and public use for pleasurable, educational and vocational purposes.

--- Permanent, inhabited undersea installations and perhaps even colonies.

--- Floating cities will be located on large bodies of water.

--- There will be intensive farming in northern areas with a widespread system of hothouses, artificially illuminated, and with heated soils that use special methods to induce growth.

SOCIAL CHANGES

--- There will be less than ½ the farms and farm workers in Canada by 1985.

--- To handle population growth in Canada, the equivalent of a city the size of Regina (30,000 dwellings) has to be built every month.

--- 90 to 95% of the population will be living in cities by the end of the century.

--- By 2000 there will be the Great Lakes Megalopolis:
Primary - Chicago, Detroit, Cleveland, Pittsburg (45 million)
Secondary - Toronto, Hamilton, Rochester, Syracuse, Utica, Albany, Ottawa, Montreal, Quebec.

--- Toronto will have a population of 7 million by the year 2000 going to 10 million and more thereafter. A fifty mile strip around Toronto including Welland, Niagara Falls, Hamilton, Guelph, Barrie will become one relatively continuous urban area.

--- Close to half of Canada's population will be living within 50 miles of Toronto and Montreal.

--- 40-50% more land will be opened up in northern forested areas in Canada.

--- The major factor in this period will be change itself. It will be a period of unprecedented change and people will have to learn to live in a state of flux.

--- There will be a revolution in communications that will affect everyone in a fundamental way. Access to information and entertainment will be widely available and within the reach of everyone regardless of residential location.

--- There will be increasing leisure time. The work week will be less than 50 hours a week.

--- Education will be a major industry and knowledge and skills of greater value.

--- A growing percentage of elderly will have to be cared for.

--- There will be a widespread understanding of ecology which will be a very important issue of the future.

--- The economy will be mainly service oriented.

--- There will be a movement towards collectivism at the expense of the individual.

ENERGY RELATED TRENDS AND POSSIBILITIES

--- Nuclear and fossil-fueled electric powerplants may proliferate around the perimeters of the Lakes because of the availability of cooling water. Disposal of the waste heat may result in increasing quantities of warm water being discharged into the Lakes.

--The warm water will probably change the ecology of the Lakes, but may or may not be detrimental to it.

--The warm water plumes might be used to support a new mariculture industry in the Lakes region.

--Process industries might be established that rely on the waste heat.

--A large number of warm water plumes issuing into the Lakes and the establishment of industries relying on waste heat utilization could bring about changes in the flow of lake currents, particularly along the coasts.

--- The emergence of a hydrogen economy could focus attention on lake water as a raw material from which to recover hydrogen.

--- The development of an oil shale industry in the western U.S. might require enormous quantities of water to be pumped from the Great Lakes to the western states for use in the processing of oil shale.

--- The growth of a solar or wind energy industry and widespread consumer use around the Great Lakes could reduce pollutants dumped into the Lakes from energy processes, as well as altering air currents affecting Lake ecology.

--- The development and use of new fertilizers requiring less energy consumption in their manufacture could lead to reduced or different pollutants being carried into the Lakes.

--- International nuclear-powered merchant ships may be introduced into trade on the Great Lakes.

--- Solar reflectors placed in earth orbit for concentrating sunlight on the earth could be used to heat the Great Lakes (and perhaps prevent ice formation), as well as provide a more concentrated source for earth-based solar collectors.

Herman Kahn and Bruce Briggs in their book, Thinking About the Seventies and Eighties present some highly pessimistic possibilities for the future. Some mixed blessings of progress might include:

1. Defunctionalization - partial (but increasing) loss of meaning of many traditional activities through the development of shortcuts to gratification: erosion of "traditional societal levers"

2. Loss of privacy and solitude

3. Increase of governmental and/or private power over individuals

4. Loss of human scale and perspective

5. Dehumanization of social life or even of the psycho-biological self

6. Acceleration of changes that are too rapid or cataclysmic to permit successful adjustment

7. Posing of choices that are too large, complex, important, uncertain, or comprehensive to be safely left to fallible humans

They go on to forecast that by 1985 the following areas are likely to give rise to special technological dangers.

1. Intrinsically dangerous technology

2. Gradual and/or national contamination or degradation of the environment

3. Spectacular and/or multinational contamination or degradation of the environment

4. Dangerous internal political issues

5. Upsetting international consequences

6. Dangerous personal choices

7. Bizarre issues

1. Intrinsically Dangerous Technology

a. Modern means of mass destruction
b. Nuclear reactors - fission or fusion
c. Nuclear explosives, high-speed gas centrifuges, etc.
d. Research missiles, satellite launchers, commercial aircraft, etc.
e. Biological and chemical "progress"
f. Molecular biology and genetics
g. "Mind control"
h. New techniques for insurgency, criminality, or ordinary violence
i. New techniques for counter-insurgency or imposition of order
j. New "serendipities" and synergisms

2. Gradual and/or National Contamination or Degradation of the Environment

a. Radioactive debris from various peaceful nuclear uses
b. Possible greenhouse or other effects from increased CO_2 in the atmosphere
c. Waste heat
d. Other special wastes

e. Other wastes, debris, and just plain garbage
f. Noise, ugliness, etc., associated with many modern activities
g. Excessive urbanization
h. Excessive overcrowding
i. Excessive tourism
j. Insecticides, fertilizers, growth "chemicals", food additives, etc.

3. Spectacular and/or Multinational Contamination or Degradation of the Environment

a. Nuclear war
b. Nuclear testing
c. Bacteriological and chemical war or accident
d. Artificial moons
e. Projects West Ford, Storm Fury, etc.
f. Supersonic transportation (shock waves)
g. Weather control/modification
h. Big "geomorphological" projects
i. Million-ton tankers (Torrey Canyon was only 111,825 tons) and million-pound planes
j. Other enterprise or mechanism of "excessive" size

4. Dangerous Internal Political Issues

a. Computerized records
b. Other computerized surveillance
c. Other advanced techniques for surveillance
d. Excessively degradable (or unreliably reassuring) centralized capabilities
e. Improved knowledge of and techniques for agit-prop and other means of creating disturbances
f. Improved knowledge of and techniques for preventing disturbances
g. Complex or critical governmental issues leading to either "technocracy" or "Caesarism"
h. Nuclear weapons affecting internal politics
i. Excessively illusioned attitudes
j. Other dangerous attitudes

5. Upsetting International Consequences

a. Both new and "traditional" demonstration effects
b. Technological obsolescence of "unskilled" labor
c. New synthetics - e.g., coffee, oil, etc.
d. Forced modernization
e. Growing guilt feelings by many in wealthy nations - particularly among the alienated or young

f. Inexpensive and widely available "realistic" communications and physical travel
g. Accelerated "brain drains"
h. Cheap (synthetic?) food
i. Cheap education
j. Control and exploitation of the oceans, space, moon, and even the planets

6. Dangerous Personal Choices

a. Sex determination
b. Other genetic engineering
c. Psychedelic and mood-affecting drugs
d. Electronic stimulation of pleasure centers
e. Other methods of sensual satisfaction
f. Excessive permissiveness and indulgence
g. Dropping out and other alienation
h. Excessive narcissism or other self-regard
i. Super-cosmetology
j. Lengthy hibernation

7. Bizarre Issues

a. Generational changes; e.g., extended longevity
b. Mechanically dependent humans; e.g., pacemakers, diabetics
c. Life and death for the individual; e.g.,artificial kidneys, etc.
d. New forms of humanity; e.g., "live" computers
e. "Forcible" birth control for "impossible" groups or nations
f. Other external controls or influence on what should be a personal or even institutionally private choice
g. Life and death or other control of "outlaw" societies which, however, have not yet committed any traditional crime
h. Even the continuation of the nation-state system
i. Controlling and limiting change and innovation
j. Radical ecological changes on a planetary scale
k. Interplanetary contamination

Robert M. Skirkanich in an article appearing in The Futurist, "Ocean Platforms: Extending Man's Domain Into the Seas" gives a pessimistic overview of the man-made ecological changes being forced on large bodies of water.

> Man's intrusion in the sea with large-scale structures and activities has the long-term potential of directly altering important circulation and sedimentation of systems which, in turn, can have enormous impact on

the biota of the sea, and eventually on man himself.

The "physical pollution" of the sea is likely to intensify, as public and political pressures increasingly force ecologically unpleasant projects into the sea (e.g., solid waste disposal, nuclear power plants, jetports, etc.). The economics of sea transportation dictates the use of larger and larger super-vessels which, in turn, require the dredging of tremendous shipping channels and/or the construction of major terminals far from the coast. The prognosis for development of the sea is exciting and, at the same time, a little frightening when one considers that we now are placing structures in the sea almost indiscriminately. Ocean platforms are being situated in ever deeper water, and they are getting steadily bigger. In both size and number, these structures now are rapidly becoming significant geographical features, and the end is nowhere in sight. Schemes for offshore islands, floating airports, offshore shipping terminals. hurricane barriers, sea bottom oil storage units, etc. - all of enormous size - have passed the conceptual phase and are in various stages of developemnt. In certain areas, existing large groupings of structures (e.g., oil platforms off the Louisiana coast) when considered as a single unit, have long been significant features.

The construction of offshore facilities is on the verge of an explosive expansion that may have serious consequences not yet assessed. We have, at this time, the unique opportunity to study and appriase this problem before it overwhelms us.

Ocean platforms represent physical intrusions in the marine environment that interact with currents, waves, sedimentation processes, etc., and modify these natural processes in various ways. The ocean environment is also altered by:

1. Artificial lifting of water from depth (vertical mixing), resulting from mining, dredging, effluent pumping, aquaculture (churning of nutrient-rich waters), and production for power and fresh water (pumping cold bottom water).

2. Artificial sedimentation produced by the disposal of solid wastes and sludge, mining wastes, dredging spoils, injection of mud and sand in petroleum production, bottom churning by deep-draft vessels, and scouring and deposition due to placement of breakwaters.

3. Influx of physically and chemically altered

water from power plants (thermal effluent), desalination plants (brine), outfalls (sewage effluent) and mining, drilling, dredging, etc. (waste water).

The result of all this activity is to alter almost every characteristic of ocean water, including its optical, physical, chemical, geological and biological properties. And we don't know what harm - or what good for that matter - we are doing. We don't know how widespread the effects are, and we kno't know how far into the future they will be felt.

There is little doubt that man will spend more and more time at sea - working, playing, even living in the oceans. The time has come to assess the effects of man's physical intrusion into the marine environment so that he will not seriously harm the ocean and can sucessfully use its enormous resources.

B. TREATMENT TECHNOLOGY

Most sewage treatment facilities employ either primary or primary along with secondary treatment processes. Both rely heavily on biological degradation of organic matter. The choice of processes or facilities at each level depends upon the composition of the wastewater, the required quality of the discharge stream, and factors such as land availability.

Primary treatment usually removes more than half of the suspended solids and some oils which are concentrated and disposed of by digestion, burning or land fill. This treatment, however, removes only ¼ of the BOD.

Secondary treatment involves the biological aerobic degradation of the soluble organics and the adsorption and settling of the colloidal organics. The long established trickling filter and activated sludge processes are the basic means of the secondary treatment. These standard methods can be hastened by aids such as aeration or addition of chemicals particularly alum, lyme and organic flocculants. The effluent from a combination of primary and secondary treatment contains 10% to 20% of the BOD and suspenced solids of the initial wastewater, and 30% to 50% of the COD.

Advanced treatment processes have application in the removal of nutrients and other dissolved solids from water. Some advanced processes were used originally for desalination. Until recently, advanced treatment was commonly considered to be tertiary treatment because of assumptions that it would be applied only to the effluent from secondary treatment. Continuing R & D on advanced treatment has shown it has broader potential application and may indeed even replace, rather than follow, the biological processes used for secondary treatment. Advanced treatment thus indicates technology beyond that traditionally used in wastewater precessing and, when applied to the effluent from secondary treatment, is also known as tertiary treatment. Although some detoxification occurs in biological (secondary) treatment, complete control of the discharge of toxic and hazardous materials will require use of advanced treatment methods.

The major categories of pollutants and the effectiveness of present methods in romoving them from waste water are indicated on the table on the following page.

Several other advanced waste treatment processes are being evaluated with two overall objectives: water renovation to separate all pollutants from water to such a degree that the effluent is suitable for agricultural, recreational, industrial, or even municipal reuse; and additional pollution control (tertiary treatment) to reduce pollution of the receiving water bodies.

The principal problems encountered have included finding

POLLUTANT	STATUS OF DEVELOPMENT
Suspended Solids	
Settleable	3
Colloidal	3
Dissolved Solids	
Inorganic	
Total dissolved solids	2
Nitrogen compounds	1
Phosphates	2
Heavy metals	3
Acidity	3
Alkilinity	3
Radioactive elements	1
Organic	
Biochemical oxygen demand	3
Refractory materials	
Detergents	2
Pesticides	1
Residues	1
Industrial	1
Thermal Pollution	3
Living Organisms	
Infectious agents	
Bacteria	3
Viruses	2
Plants	
Attached	2
Algae	3
Slimes	1

3 - Technology is now available to achieve generally acceptable results.

2 - The technology is known but its practicality depends upon economics and the results required.

1 - The technology is clearly inadequate.

Sources: National Academy of Sciences, National Research Council.

technical and economical methods of removing refractory organic and inorganic dissolved salts.

Complete biological purification and removal of most oxidizable organic materials are possible with present methods, but costly, as is the removal of the dissolved salts. Each reuse of water adds from 200 to 300 ppm of dissolved salts. After three or four uses or less the dissolved salts in the water could be too high to permit further reuse as potable water and in other application.

During the past few years, the research effort sponsored by the Robert A. Taft Sanitary Engineering Center has produced some advanced processes which seem to offer promise for large scale use to improve the quality of conventially treated waste waters. THese processes include: adsorption by activated carbon for removal of organic compounds; foam separation to remove surface-active organic impurities; electrodialysis to separate ionized materials from water; and distillation to process waste containing certain volatile contaminants. Other processes which may be suitable include reverse osmosis, ion exchange, and adsorption with the use of bauxite, fly ash, and modified coal. Other advanced waste treatment methods studied to date are coagulation, electrolysis, emulsion, foam separation processes, evaporation, foaming, freezing, hydration, liquid-liquid extraction, oxidation, and the use of recoverable algae which remove nutrients from waste water.

Of these, adsorption, foam separation, evaporation and electrodialysis appear to be the most feasible technically and economically at the present state of development, and will be evaluated on a larger scale. Prelimianry studies have indicated that reverse osmosis has promise as a possible method for complete renovation of municipal waste waters.

The cost of producing high quality water by present renovation processes is about 50-60¢ per 1000 gallons for a plant producing 10 million to 20 million gallons per day. These costs compare favorably with the cost for desalination of sea water for the same size range and with the cost of developing some sources of fresh water.

Disposal Methods

Ultimate disposal of concentrated wastes resulting from waste water treatment is also being studied. Several methods are being evaluated, including: wet oxidation; incineration; injection to porous underground formations; placement in natural of man-made underground cavities (salt cavities, mined or nuclear blast cavities); and pipeline conveyance to the ocean.

The problems and costs of sludge collection, concentration, treatment, and disposal are among the most serious at larger treatment plants. The large volumes of sludge and its relatively low value make it difficult to get rid of by present methods,

which include incineration, lagooning, landfill, and fertilizer use. The marketing of fertilizers made from sewage sludge has not been successful because of the limited or seasonal demand for this type of material and the high cost of distribution. Though there has been progress in wet oxidation, spray drying and a new dewatering method, the need is for more economical solutions. Present land costs have increased the desirability of disposing of sewage sludges by incineration and without digestion.

Renovation is, in part, dependent upon the availability and price of water from natural sources, but stricter pollution control standards will make water reuse more attractive.

Treatment Processes

During the past ten years NASA has developed several methods for reclaiming waste water for reuse aboard manned spacecraft and to process human waste and food scraps so they can be stored safely for long periods. These systems are now being applied to a household situation. Instead of dumping wastes into sewage linge, they are collected for processing. Bath and laundry water is filtered and sterilized for reuse as toilet flush water. This single reuse can reduce a typical household's water consumption (255 gallons for a family of four) by about 60 to 100 gallons a day. Experiments found that household water consumption can be reduced by 70%.

NASA also experimented with collecting garbage and sewage solids at their source, conveying them to an incinerator where they are burned to produce a small amount of ash.

Future measures will include:

- Joint treatment of industrial and municipal wastes permitting economies of scale and maximum facility use
- Employment of improved methods of waste treatment that provide more effective treatment per dollar of outlay
- Process improvements that reduce or eliminate pollution at the source
- Greater emphasis on re-cycling and re-use of water.

By 1985 human excrement will be used as a resource and recycled. Possible uses are methane gas production and fertilizer. Domestic water will be self-contained. Clivus toilettes will be used to produce compost from human and kitchen wastes.

Future plants will be designed for treatment of all effluents and economic installation of waste water collection, treatment and reuse. Industries will be required to remove pollutants that cannot be handled by municipal facilities before they

can discharge their effluent into a municipal sewer system. Waste requiring special treatment will be kept separate to reduce and control costs.

Re-evaluation of manufacturing processes will prove to be economical and effective in many cases. A major part of pollution will be eliminated at the source by renovating and re-using waste water. A forerunner of such a facility is Monsanto installation near Alvin, Texas which circulates an average 1.5 billion gallons of water per day through the plant, but requires a make-up of only 1% of this volume.

In many cases changes in processing equipment and raw materials have reduced the amount or hazard of pollutants and have proven more economical than extensive treatment operations. For example, textile finishing mills substituted cellulosic sizing agents - which have little toxic effect in streams - for starch. The metalplating industries introduced beneficial changes in electroplating techniques, such as reducing cyanide strengths, and switching from copper-cyanide plating solutions to acid-copper solutions. The metal industry has adopted mechanical methods of cleaning, such as shot blasting, in place of pickling with acid, and has substituted hydrochloric acid for sulfuric. Such companies have also replaced soluble oils and other short term rust-preventive oils with "cold" cleaners which inhibit rust mechanically rather than by a film of oil or grease.

Recovery of effluents can offset pollution control expenses to some degree. Some sewage sludges are burned to generate steam, although in most cases the cost of the equipment to recover the heat is not justified by the fuel saved. Oil and fats can be recovered in settling basins. Metalplating industries have used ion exchange and evaporation techniques to recover metals and other chemicals from plating baths and rinse water.

Pulp and Paper

The pulp and paper industry will direct major efforts toward improving existing processes to cut down on both volumes and pollutant loadings of effluents. For example some mills may partially replace chlorine with exygen to bleach kraft pulp thus reducing the BOD and dissolved salts in plant discharges.

Specialty paper mills recover caustic soda from cooking liquors with the aid of multiple-effect evaporators. Chemical plants and metal fabricators concentrate and recover acid by spraying dilute waste acid into hot, lead-lined, brick-faced towers.

Sulfite waste liquor by-products from paper mills are used in fuels, road binders, briquetting cattle fodder, fertilizer, insulatind compounds, as boiler water additives and flotations, and in the production of alcohol and artificial vanillin.

The industry is under pressure to rid effluents of colour and in some cases dissolved solids such as sulfates, chlorides and phosphates. Chemical precipitation, activated charcoal adsorption, and reverse osmosis or electordialysis may provide some of this additional treatment before 1985.

Food Industry

The food industry will modify its processes from harvesting through processings, through recycling to the discharge of wastes. For example, tomatoes will be initially processed in the field leaving dirt and culls behind. Tomato juice will be recovered at in-field stations so that the pulp from cores, seeds and skins could also be disposed of by spreading on the fields and disking into the soil.

Recovery and utilization of whey from dairy wastes will be accomplished by evaporation and spray drying. This high protein food supplement is used in baby food and is being tested in baked goods and beverages.

Nearly all food wastes are amenable to conventional biological treatment and are compatible with domestic wastes. Therefore, joint treatment with municipal wastes will expand, but, in many cases, with pre-treatment at the food processing plant to reduce the load.

Consolidation

The consolidation of wastes from both industrial and municipal sources has economic advantages of scale. Even though these costs vary widely, depending on the volume, pollutant concentrations and process employed, the lower unit costs of larger plants is apparent. As a rough rule, unit investment costs decline by 40% to 45% and unit operating costs by 25% to 35% with a tenfold increase in waste water volume.

There are also other benefits. Industrial wastes frequently contain excess organic carbon relative to other nutrients (nitrogen, phosphorous and potassium) required to cultivate sludge for secondary treatment. So the latter must be provided by addition of chemicals. Municipal wastes on the other hand, contain more nutrients than the sludge can assimilate and the surplus ends up in the sewage plant effluent, contributing to eutrophication. Consolidation wastes from the two sources achieved a balance. Moreover, buffering and neutralization can result from combining wastes from many sources.

Another benefit relates to required size. The maximum flows from industry seldomly coincide with the maximum flows from households, hence a consolidated plant to handle both loads need not equal the cumulative capacity of two separate plants. However, the consolidated facility will be larger

than either of two separate facilities and thence could afford well trained operators, properly equipped laboratories and automated controls to achieve more reliable operation.

The disadvantages of consolidated treatment include the costs of longer sewers, accidental poisoning of biological systems with industrial wastes and disputes over jurisdictions and allocations of cost.

C. MONITORING

By 1985 it should be possible to:

1. Determine, assess and interpret water quality trends on a national and regional basis;

2. Detect and quantify water pollution in surface waters;

3. Determine or forecast the effect of man-made activities and developments on resources;

4. Measure the effectiveness of remedial measures to control pollution;

5. Understand better the pathways, behaviour and fate of of pollutants in the environment and their effect on physical and biological systems;

6. Contribute through better understanding to improved water resource and pollution control program planning and implementation.

The Water Quality Branch of the Department of Environment provides ambient water quality data, interpretative information and scientific reports. Research is aimed at:

1. Obtaining a better understinding of the chemical-physical-biological relationships of substances and organisms in water;

2. Development of new and improved methods of chemical analysis;

3. Development of new approaches to water and wastewater treatment;

4. Recycling and re-use of waste water.

By 1985 there will be a uniform national system used by all water resource agencies, Federal and Privincial. Paramenters are divided into five main groups:

1) major ions and general chemical and physical characteristics; 2) nutrients (life stimulating materials); 3) toxic and hazardous substances (life regressive agents); 4) organic matter; 5) hydrometric data.

Water quality on major surface waters in Canada is carried out by the Water Quality Branch through its regional offices at 483 sampling stations. This is regarded as a long-term, on-going monitoring program for the purpose of obtaining an inventory of chemical baseline data on surface waters and observing water quality trends. Samples are analyzed for major ions,

colour, turbidity, pH, specific conductance and suspended solids. More recently, tests for heavy metals, trace elements, nutrients and pesticides have been added.

In depth surveys will be initiated in selected river drainage basins where specific or potential water quality problems exist to determine water quality characteristics and relationships between sources of pollution and suitability for use. They will provide a broad range of physical, chemical and biological data which should relate to the inputs and impacts of municipal and industrial wastes, land run-off, local geological conditions, etc. The findings of these surveys should provide better understanding of the major influences of water quality on the production of aquatic plants and animals and the measures needed to improve water quality.

Automatic Water Quality Monitors

Eight automatic quality monitors have been in use on the St. John River Basin in the Province of New Brunswick since 1970. The monitors measure on a continuous basis specific conductance, pH, dissolved oxygen, tempreature and chlorides and hourly data are transmitted by telemetry. Computer programs produce graphs of daily and monthly readings for each parameter. Another monitor is on the Red River between North Dakota and Manitoba.

Problems have been experienced with the telemetry system and pump failures. Because of high cpaital and operating costs and limited capability in measuring a wide range of parameters, a careful assessment of costs and benefits will be made before expanding automatic monitoring in the near future.

Future monitoring and survey programs will be directed towards acquiring information on pollution characteristees, destribution patterns and assimilative capacities of surface waters in Canada. Monitoring programs are being modified to increase measurements of nutrient materials, organic compounds, organochlorine and other pesticides and trace elements.

Work is proceeding in the development of a water quality index in Canada based on water use. A numerical index will indicate a water quality condition in respect to any specific use of that water. By 1985 such an index on a national scale will indicate the effectiveness of water quality management programs across Canada.

NASA Flight Experiments for Remote Measurement of Water Pollution

The measurement requirements for water pollutants are more difficult to prescribe than those for air pollutants. Because of the particular spectral characteristics of water itself and the characteristics of the pollutants, the number of pollutants that can be directly detected in water by remote means is limited.

Fortunately, there exist several indicators other than the pollutants themselves, which reflect the conditions and health

of the marine environment and may signal the presence of pollutants. For example, chlorophyll may indicate pollution from sewage or other waste material, and changes in the emissivity of the water's surface may indicate the presence of oil.

At present, the effectiveness of the various indicators as quantities to be measured for inferring thepresence of pollutants is difficult to assess. The accompanying table lists pollutant indicators and/or quantities that can be remotely sensed to determine the presence of various pollutants.

Pollutant	Problems	Pollutant indicators; quant. remotely sensed
Oil pollution	a) Damage to aquatic life & recreational areas b) Monitor tanker spills & off-shore drilling leaks	Wave structure-smoothing of ripples Brightness, temp., or surface emissivity Ocean colour Luminescence UV reflection
Sediment	a) Damage to fresh water streams & lakes b) Damage to estuarine & salt marsh habitats	Turbidity Colour Reflected polarized light
Chemical & toxic wastes (e.g., industrial wastes, biocides - DDT)	a) Damage to aquatic life b) Destruction of some food supplies c) Damage to human health & recreational property	Thermal patterns Colour
Solid & nutrient wastes (e.g., sewage, feed lot run-off, fertilizer runoff, detergents)	a) Eutrophic impact on fresh water lakes b) Damage to aquatic life & recreational areas c) Developing alt. waste disposal methods	Chlorophyll Algae blooms Luminescence Colour (visible) Colour (false IR)
Thermal effluents (e.g., powerplant cooling, large ocean currents)	a) Damage to desirable aquatic life b) Enhancement of undesirable aquatic life	Water surface temp. Thermal patterns
Living organisms (e.g., bacteria, red tide, cultural effluent)	a) Productivity variations b) Severe ecological upset due to explosive growth or destruction of various species	Colour (visible) Bioluminescence

Remote sensing techniques for water quality have already been developed by NASA and have been flown aboard various aircraft. In addition, many other water quality experiments have been or are being developed for using the Multi-Spectral Scanner (MSS) and Return Beam Vidicom (RBV) systems aboard the Earth Resources Technology Satellite (ERTS) and the Radar Scatterometer (S-193) system aboard Skylab. These and other water quality experiments being developed by NASA depend on techniques that show promise for several different measurement needs. Four of the experiments and their techniques follow:

ALOPE

Airborne Lidar Oceanographic Probing Experiment uses a laser radar technique to remotely determine chlorophyll a, found in all plants. The helicopter-mounted laser is directed to a body of water that contains phytoplankton, a small single-cell plant that forms the basis for much of the marine food chain. Analysis of the signal determines the concentration of the various groups of phytoplankton, a potential source of food for the world.

MOCS

The objective of the Multichannel Ocean Color Sensor experiment is to establish the accuracy of using ocean color sensing from space to indentify types of ocean organic matter, particularly plankton, and to map their distributions and concentration. Sensing capabilities for sediment, nutrient up wellings, oil slicks and certain forms of pollution also will be established. Data are obtained using an electronically scanned multispectral line scanner whose line scan is commensurate with the forward progress of the flight vehicle to form a continuous spectrometric image of the underlying ocean area.

FLD

The Fraunhofer Line Discriminator is a technique used in an experiment to detect luminescing materials for determination of oil spills, paper mill efflux, general plant vigor and geochemical stress induced in plants.

S - Band Radiometer

This is a satellite microwave radiometer of a modified Dicke type. The purpose of the experiment is to develop a day/night nearly all weather remote sensing instrument for the measurement of sea surface temperature on a global basis.

Remote sensing, though it may be less accurate presently than in situ point sampling, is capable of providing the wide aerial coverage with a single instrument of known precision. This allows investigations of the movements of contaminated air and water, the relationships between pollution levels and meteorological events, the dispersal of pollutants, and the

causes of episodical and long term buildings of pollution.

Future NASA flight opportunities for these sensors will occur in programs like ERTS (Earth Resources Technology Satellite), Skylab, and Shuttle as well as in the R & D satellites such as Numbus G and EOS.

By looking at the earth from satellites in space, information can be provided regularly, repetitively and relatively inexpensively after launch. Repeated observations will show slow changes which may reveal danger or opportunity. Information can be obtained from places that are too remote, too dangerous, or too expensive for regular surveys. From satellite altitudes, large scale features came into view that might be overlooked in mosaics taken from pictures taken at lower altitudes.

Earth survey satellites in the future may help man to farm, fish and prospect for minerals more effectively. They may help discover fresh water under desert sands, measure the magnitude of air and water pollution and the effectiveness of measures to reduce it, alert man to other environmental dangers and contribute to the more efficient use of land.

In the twelve year period of 1980-1991, NASA plans to have 810 payloads of which 753 are destined for earth orbit in what is referred to as the "Shuttle Era". These spacecraft will be much more advanced and more productive operational versions of the experimental scientific and applications spacecraft being flown in the 1970's. Large earth observatory satellites weighing 3½ tons will use advanced remote sensing techniques to monitor environmental quality, observe the weather and the oceans, survey earth resources and facilitate land use planning.

D. POPULATION AND REGIONAL DEVELOPMENT IN THE UPPER GREAT LAKES

The object of this section of the report is to provide a spatial image of future activities in the study area. The following activities are discussed: urbanization, industry, mining, forestry, agriculture and recreation.

The potential of the land for various activities at various costs will influence the distribution of activities in the future, e.g., mining and forestry in the Canadian Shield; recreation in the Shield, along the Great and smaller lakes and rivers and in select areas such as the Niagara Escarpment; agriculture and urbanization in South Ontario, the two competing essentially for the same land.

Present trends are problematic because:

1) The sprawl of Toronto-generated growth and land uses is using up valuable agricultural land.

2) Unstructured growth is putting urbanization pressure on the southern parts of the Lake Simcoe and Severn River basins in such places as Aurora, Newmarket and even as far as Barrie and Lake Simcoe.

3) The large population in the urbanized areas of South Ontario, from Windsor to Toronto, is putting great pressure for recreation areas on the waterfront areas of Simcoe County, Georgian Bay and the more accessible lakes in the Canadian Shield.

4) The huge population south of the basins around Lake Simcoe is putting great pressure upon these areas and various development controls have had to be instituted.

At the same time that rapid development is occurring in Southern Ontario, the regions of Northwestern and Northeastern Ontario have been stagnating. Planning is taking place presently to develop the economies of these areas, raise standards of living, increase population and industrialize.

The Totonto-Centered-Region (TRC) plan of 1970 aimed at structuring the development pressures emanating from Toronto-Hamilton and pushing some of it into the northern watershed communities of Barrie and Midland. Thus the basins of the Severn River (including Lake Simcoe) and the Nottawasaga would have seen substantial increases in both urban and recreational development.

The TCR plan was based upon a notion of the urban field which assumed a relevant radius of under 100 miles. Current planning, some four years later, sees this as too small an horizon, and, in the long run up to 2020, the aim is to push

some of the development pressure, not up to Barrie-Midland, but even further north. Therefore, southern development pressure would jump an intermediate zone (Barrie-Midland, the Nottawasaga beach area and Lake Simcoe) which would be preserved as recreational areas for the southern population. Development strategies and incentives would also be used to develop the Northern Ontario areas.

In the process, a million people, who by 2020 would have been living in Toronto-oriented areas (whether within the metropolitan area or in such sattelite communities as Mississauga or Brampton), will be living in Northern Ontario and the areas of Eastern Ontario.

Intermediate areas such as Barrie-Midland, the development of which has now become part of trends rather than plans, would also grow.

The regional horizon of Ontario planners has widened and Toronto generated growth is seen as best oriented not 100 miles away but 200 miles away and more in Northern Ontario, which has become the main focus for re-orienting provincial growth, and, to some extent, in the less developed areas of Eastern Ontario-Belleville, Brockville, Cornwall.

There will be an intensification of recreational activity along shores of Lake Huron and Georgian Bay. The trend will continue up along Georgian Bay and on to Lake Superior. An increased demand for recreational space in all areas near water can be expected.

The likely improvement of Route 11 will increase recreation uses up to North Bay.

Tremendous pressure for recreation areas is now being felt north of Toronto. Land available for cottaging, the most sought-after form of recreation, is increasingly difficult to obtain.

Conflict is beginning between farmers and "ruralites" and the encroaching urbanites.

There will be emerging conflict between private recreational space and the needs of younger families who, unable to afford cottages, require extensive parks and public facilities.

This will result in increasing demand for cottage lots in the whole northern area. Basins from Spanish west will have proportionately more cottaging than before. Saturation of rural residential development (cottaging, etc.) will occur around Lake Simcoe. This will necessitate construction of sewage facilities as septic tanks begin to affect the water table.

The use of recreational areas in all basins from the French west will increase more than trends would indicate.

The importance of the resource base in terms of world markets will increase. A strong development policy will emerge and resource processing will join resource extraction as major activities.

Increasingly planning and intervention will shape the future and modify trends and autonomous developments. A rational use of the land can be expected.

The emphasis upon planning in Ontario is a result of the pressing trends experienced there in the last 15 years:

- rapid population growth
- economic development resulting in high incomes
- affluent lifestyles reflected in an extensive use of the land.

Main growth centers and estimated future population, given strong incentives and plans for Northern development, are as follows:

	1971	1981	2001	2021
Thunder Bay	107,000	115,000	130,000	145,000
Sudbury	130,000	150,000	200,000	250,000
North Bay	30,000	40,000	75,000	125,000
S.S. Marie (secondary)	80,000	89,000	100,000	120,000

To the degree that the future will be dissimilar to the present, especially with respect to population growth (immigration and demographic growth having slowed considerably) and with respect to real disposable income, some of these trend pressures (to which interventions have and will respond) will change.

The following trends can be expected to have an impact on the future uses of land.

1. Low and stabilizing fertility rates - The most important effect, should we approximate zero population growth, will be the progressive slowing of expansion of the south Ontario metropolitan areas.

   Recent pressure for housing, cottaging and recreation facilities was, in part, a product of the 1945-50 "Baby-boom". The low birth rates of 1966-74 will be felt by 1990 when family formation rates will be

lower and so will demand for land, housing and space.

2. Since 1972, terms of trade seem to be shifting in favour of producers of primary goods, from mineral to food stuffs. In the future the relative lucrativeness of agriculture as opposed to urbanization and recreation (its two main competitors for land) will increase. The Ontario government will move even more strongly than it has now to protect its farming.

   Mining and metal production will become more lucrative as the world price of all resources increases.

   Forest products, slow now because of the economic downturn, will be strong in the long term. However, Northern Onterio does not offer much opportunity for the expansion of this industry.

3. Northern Ontario has immense and relatively accessible recreation areas. Two possibilities can be identified:

   - If the North American economy continues to grow, Canada, to a large extent, will play the role of continental recreation area and North Ontario will host cottagers, hunters and canoists from as far away as Chicago and Detroit.

   - On the other hand, energy shortages and inflation may encourage vacations nearer to home.

E. THE MEDIA

In North America nine out of ten adults read a newspaper daily; there are more radios than people, and television has become the major free time activity. The public relies heavily on mass media particularly for information of regional, national and international significance.

Mass media coverage can be very important in certain situations in informing society, shaping attitudes and values, and perhaps even behaviour. This is especially true with regards to new issues.

Until the late 1960's, it appears the public had little interest in, or knowledge of, environmental problems. Surveys in the U.S. and Canada showed that approximately 2/3 of respondents became concerned about pollution as a result of mass media coverage. Surveys have indicated that Government decision makers also rely heavily on the media as an important source of information.

With the exception of sporadic newspaper reports, media coverage of pollution was virtually non-existant in Canada before 1960. Between 1960 and 1965 there was scattered spot coverage of pollution issues. Media pollution coverage began to rise steadily from 1965 peaking in the period 1969-1971 and falling somewhat since then (but remaining at a fairly high level).

In all the media water pollution was covered more fully than any other type of pollution , and in particular, sewage problems, the Canada Water Act and problems of the Great Lakes.

The environmental "boom" in Canada in 1969 can be closely related to a number of events such as oil spills and the mercury scare which received a great amount of media coverage. Perhaps the most important event was the publication of an International Joint Commission report which stated that the Great Lakes were undergoing a rapid entrophication process and that phosphates were the primary factor in such aging.

This report was immediately picked up by the media with news coverage and editorials calling for action by government. The media coverage provided the major impetus to public concern and a basis for the formation of such instrumental environmental citizen's groups as S.T.O.P. (Montreal) and Pollution Probe (Toronto). It provided the incentive to decision makers to not merely include a new provision in the Canada Water Act to deal with phosphate problems but also to more agressively advocate a whole package of environmental legislation.

Prior to 1969, most coverage by the mass media was concerned with specific, isolated events of local concern. Since that time, the media have tried to present a more comprehensive view of environmental problems including a national and sometimes international perspective.

The media (led by newspapers) have also become more "activist" in their approach. There have been more critical articles and editorials about environmental problems and the lack of solutions by government and/or private enterprise. There has been increased coverage of activities of citizen's groups. Investigative reporting on environmental issues has increased and in some cases the media have initiated action with their own monitoring of rivers and drinking wells and reporting of pollution indices.

Despite improvements in the quality of reporting, there remains to some extent absence of trained, committed environmental reporters; lack of access to appropriate expert knowledge and lack of expertise to evaluate scientific material or translate it for broader public consumption. This has led to continued claims that media environmental reporting is often inaccurate, incomplete, misleading or sensationalized. Specialists claim that the media is unable to deal with specialized scientific information. Industrial polluters claim that the media has been prejudiced against them and presented a very biased view of their pollution involvement. Some decision makers feel that the media has unfairly presented environmental news and has unjustly criticized government in editorials.

Original, investigative reporting requires investment of both time and money. The Canadian media, with its relatively smaller audience, relies heavily on American media. An estimated 50% of Canadian news coverage is written outside of Canada. While a few major environmental investigative reports have been produced by the CBC, Canadian coverage has generally been lacking in depth.

Some of these difficulties are being overcome by assignment of writers, editors and producers to cover the environment; by the involvement of environmental experts and scientists with the mass media; and efforts by both government and citizen groups to inform the media.

F. THE PUBLIC

Although industrial pollutors produce much waste as a by-product of the production of goods, it must be kept in mind that it is the public which places demands on industry for such goods. The public, besides indirectly promoting pollution through product demand, contributes directly to environmental pollution in its use of certain goods, such as automobiles and high phosphate detergents. Apparently solution to environmental problems will necessitate changes in public behaviour, either voluntarily or through government action.

However, by implication (in a democracy), government action itself should reflect public opinion and, by extension, behaviour. Through public election of representatives to government, the elected representatives' views should reflect, to some degree, the desires and concerns of their constituencies. Advisory boards, public hearings and referendums afford the public a more direct participation in the decision making process. Public influence on decision making may also be exerted through correspondence, the mass media and public opinion polls.

That influence is exerted through the above mentioned channels in obvious. Whether or not it succeeds is more difficult to ascertain. The increasing demand over the past ten years for greater public participation in government planning, policy making and program development would seem to indicate public dissatisfaction with the results of their exertions to influence government in the past.

The influence of the public on environmental decision making has been predominantly in the area of definition of environment as a social concern. It was the high level of public concern which made environment a priority issue in 1969 and 1970 and spurred Federal involvement in a heretofore Provincial matter. The great concern for environment grew out of earlier concerns about conservation, wildlife, public health and natural resources development. Small and varied segments of society began to meet together (ca. 1966), to exchange ideas and to write for a broader audience. Their efforts to elicit widespread public reaction began to see results in the late 1960's. By 1970 Gallup Polls revealed that the environment was becoming a subject within the public consciousness, 91% of the respondents indicating awareness of pollution problems.

Ontario studies in 1968 and 1969 found water pollution as second to the rising cost of living among perceived problems and a mid-1969 study suggested that pollution was considered the most important problem by residents of five Canadian cities.

The Federal government, influenced by high public concern and extensive media coverage of environmental issues, became involved in regional planning through the Canada Water Act and began dealing with pollution problems in the Cabinet. A separate Department of the Environment was created.

In late 1969 through 1971 local, urban-oriented environmental citizens groups provided focus and leadership for the general public concern. Groups such as SPEC, STOP and Pollution Probe were formed and then enlarged. Specialists formed their own environmental concern groups. While the groups all met with varying levels of success, they provided an outlet for "eco-activists" and served to focus both government and public attention on particular issues, especially at the local level.

Locally, the public becomes more involved with regard to specific programmes and exerts its greatest influence over issues which more directly affect its interests.

In such instances, the following scenario appears to apply: A local governmental body makes a decision which has environmental implications. The decision is usually made without public participation; usually there are no formal channels for involving the public in the decision. A small group within the public becomes concerned about the decision. This small group is unsuccessful in their initial attempt to change the decision. The small group then appeals to the general public for support. The support of the general public, aided by the mass media, is successful in changing the initial decision. Most municipal decision makers, aware of their environmental constituency, have developed some degree of environmental consciousness. On this level of government, the legislators are influenced by private citizens expressing personal concerns, civic-minded citizens and environmental citizens groups.

However, citizens groups have placed their major emphasis not on influencing decision makers, but rather on educating the public. For this purpose, Federal and Provincial governments have briefed citizen groups on various issues, provided speakers for meetings and supplied information not widely available.

It is ironic that, despite their emphasis on public education, citizens groups have probably been more effective in influencing decision makers. The general public is still woefully ill-informed about environmental problems and it is therefore not surprising that the public has not made major changes in "environmental" behaviour. Unfortunately, there are no indications that Federal information concerning environmental problems is improving.

Aside from lack of funds and haphazard administration, the greatest stumbling block for citizen groups was that the public's rapidly rising environmental concern fell about as fast as it rose. Exposure to mass media coverage rather than personal experience with environmental degradation had been a primary stimulus to public concern. Much pollution is not visible per se, and the "out of sight, out of mind" syndrome seems to have taken effect. Membership in environmental citi-

zen groups would seem to indicate that environment has become predominantly a "leisure issue" for the middle class.

The "polluter must pay" principle has the potential to dramatically effect the marginally unemployed and increased prices will have the greatest impact upon those with low income. It is no doubt that this publicly accepted principle will backlash on the public pocketbook.

Rising concern about inflation and unemployment, both public and government, have added to the decline in interest in the environmental issues.

Because of the gradualism of environmental degradation, few Canadians have changed recreation patterns or purchase patterns (e.g., high phosphate detergents), but have rather accomodated themselves to the decline in environmental quality. Environment is perceived as an issue in which the individual is powerless, in which technical and legal solutions rather than changes in values and life-styles are necessary, and in which voluntary action leads to increased costs with negligible benefits.

Surveys in 1969-71 suggested the willingness of the public to support more stringent environmental legislation and to pay relatively small amounts of money, in the form of increased taxes, to improve envrionmental quality.

Federal environmental legislation has been developed almost exclusively by Federal agencies with no explicit process for public participation, although two Federal programmes include the possibility for such participation in water quality planning activities. Regional planning experiments represent the most intensive efforts by governments in North America to encourage public participation in environmental decision making.

The Canadian environmental movement has never had a national focus. The Canadian Nature Federation did not gain local support and maintains its focus on conservation and non-urban environmental planning. As a result of financial difficulties, the Canadian Association for the Human Environment never actually functioned. Thusly, environmental problems in Canada were perceived to have more of a regional or local focus while in the U.S. these problems became national concerns.

Desire to satisfy the public played some part in the development of certain strategies, often resulting in speed, drama and general attractiveness being decision making criteria rather than long range practicality and effectiveness.

Public participation was encouraged on a national level through public hearings in 1972 and a conference of elected delegates in 1973. In both instances one major complaint arose - public participation was irrelevant. A Canadian Environmental Advisory Council has been designated and consists of appointed prominent Canadians from industry, academia,

anti-pollution groups and the scientific community who report directly to the Minister of the Environment.

Increased public participation might have resulted in four major benefits: a more explicit policy process with greater consideration of alternatives; a more educated and involved Canadian public (perhaps a national environmental lobby); an explicit consideration of major issues; and a sense of public involvement to counter some of the apathy and alienation which exists in our society.

On the other hand, difficulties arise out of this increased participation. It is unclear if the public really desires to more actively participate in decision making. Government officials are generally suspicious and distrustful of public participation. Officials fear that exposing the decision making process to public scrutiny will provide forums for radical, "unrepresentative" groups to spout their concerns and will lead to conflict and obstruction.

Government not only has no affirmative programme designed to inform the public, but actually limits public access to much of the information which forms a basis for decision making.

Even if these impediments could be overcome, it is doubtful that most of the public would participate more actively in environmental decision making.

With "environment" institutionalized within the government, one can expect that organized special interest groups, particularly industry, will exert the major influence upon environmental decision making. Public participation and influence is likely to remain marginal.

G. INSTITUTIONS

The first venture by Government into the environmental area was the establishment in 1909 of the Canadian Conservation Commission composed of Federal, Provincial and university representatives. During the twelve years of its existence, the Commission considered forestry, lands, fish, wildlife, water, minerals, fuels and public health. Papers were published and annual reports issued. It was abolished by Cabinet in 1919 as a result of having antagonized a number of Government Departments with related jurisdictions.

The Commission had provided a national forum for the discussion of issues, sparked research, disseminated information, generated wildlife and forestry groups and encouraged government to address issues.

During the same period, an emphasis on the control of water resources for public health purposes evolved, spurred on by the medical profession as well as the Conservation Commission. Typhoid fever death rates were used as guides to progress in water pollution control. Such disease rates drastically dropped between 1910 and 1930. Thus, by the early 1930's, a basic level of public health protection had been established; water treatment facilities installed in most larger Canadian cities and sanitation was a less important public issue.

Environmental efforts were not manifest again until after World War II when the Government set up an Advisory Committee on reconstruction with a sub-committee on natural resources. The early post war effort was marked by an emphasis on Federal-Provincial cooperation and upon a broader approach to natural resources. The emphasis with regard to water was no longer on public health and furnishing domestic supplies only, but as a resource for industry, agriculture, recreation, fishing and wildlife. In 1956 Ontario created the Ontario Water Resources Commission for these purposes.

By the late 1950's concern about water pollution problems was growing again. Urban and industrial development required that municipalities develop new plans and facilities for water and sewage treatment. In 1960, the Federal Government launched the Municipal Sewage Treatment Programme to provide funds for these requirements. Both the Federal and Provincial Governments began placing increased emphasis on pollution related problems. The Province of Ontario (along with British Columbia) took the lead in beginning to regulate industry and encouraging municipal pollution abatement action. The Federal Government established an Environmental Health Services Centre and undertook major research programmes.

The 1961 Montreal Conference, "Resources For Tomorrow", marked the beginning of a new emphasis on resource management

and conservation. It brought together selected decision makers and specialists who suggested the need for a focus on resource problems and identified themselves as a group of people who were ready to begin coordinating resource management activities.

In the period 1966-69, emphasis began to shift from resource management and conservation to the "environment" and ecology. Concerned individuals began to exert influence in regard to environmental matters, particularly within Government. While there was little public discussion or media coverage of environmental issues, specialists' research and funding dramatically increased and governmental agencies began to plan more extensive environmental interventions.

Between 1965 and 1969 over 300 scientists and engineers participated in the International Joint Commission's investigation of the Great Lakes. The Freshwater Institute in Winnipeg and the Canadian Centre for Inland Waters were formed. External research accelerated and within Federal Government new branches, sections, committees and task forces were developed to deal with various aspects of environmental problems. The National Advisory Committee on Water Resources Research (NACWRR) was created to encourage interdisciplinary research in water resources in the universities and to establish "Centres of Excellence" for teaching and research.

To coordinate the Federal approach to research and to stimulate research and the training of specialists, an Associate Committee on Water Pollution Research developed at the National Research Council.

In 1966 the Federal Government established the Department of Energy, Mines, and Resources with a Water Sector with responsibility for mounting a concerted coordinated attack on water pollution problems on a nationwide basis. Later that year, a conference on "Pollution and Our Environment" was held in Montreal. The Conference brought together for the first time on a nationwade basis a broad cross-section of those individuals, governmental as well an non-governmental, who occupied important positions in which to make or influence decisions about pollution. In their papers and discussions, the 600 participants emphasized the need to view pollution as a national problem, requiring a national, coordinated response.

However, the approach to pollution problems remained fragmented and uncoordinated. The EMR Water Sector proposed coordinated programmes and policies and emphasized the need for comprehensive river basin planning while developing the Canada Water Act. Nevertheless, other Federal departments proceeded independently to develop water pollution strategies. The Department of Transport was developing new regulations to control oil pollution under the Shipping Act and the Department of

Fisheries was developing amendments to the Fisheries Act which would enable it to set national standards for industrial effluents. Similarly, the Provinces were developing their independent approaches with little consultation with other Provinces or with the Federal Government.

Ontario, along with British Columbia, took the lead on setting guidelines and controls to regulate industry and to force municipalities to install sewage treatment facilities. Appropriations under the Federal Sewage Treatment Loan Programme increased from approximately $35 to $75 million per year.

In the period 1969 to 1971, the public at large "discovered" with alarm the environmental crisis. Oil spills, mercury pollution, the dying Great Lakes, the DDT problem all became headline topics of the media.

Rising public concern generated the formation of environmental citizens groups beginning with STOP (Montreal), Pollution Probe (Toronto) and SPEC (Vancouver). They directly questioned the environmental practices of government and industry and sought more information.

An environmental bandwagon began to roll with seminars and teach-ins; members of Parliament and labour organizations speaking out; consumer and rate-payer groups becoming involved and universities developing programs in Environmental Studies.

Prodded by the public and the media, the Federal Government accelerated the introduction of its environmental legislation, putting six environmental initiatives before Parliament during 1969-1970. In 1970 the Fisheries Act was amended to allow the government to promulgate national standards for the regulation of industrial effluents and to require approval for major industrial undertakings which might substantially effect water quality. Subsequently, in 1971 regulations to contral pulp and paper and chlor-alkali effluents were promulgated under the amended Act. Negotiations with other industries such as petroleum and food processing were begun. The Canada Water Act was also pushed through by government in 1970. In addition to the major provisions of the act which provided for joint Federal-Provincial water basin planning and management, a special provision for nutrient control was hurriedly added to the legislation. This provision enabled the government to limit phosphate concentration in detergents as suggested by the IJC report. Regulations providing for such limitation were promulgated immediately after the passage of the act.

Other Federal legislation initiatives during this period included the Northern and Inland Water Acts, the Arctic Waters Pollution Prevention Act, and amendments to the Shipping Act designed to reduce oil spills. Although no water basin management authorities were developed under the Canada Water Act,

three major Federal-Provincial bilateral agreements for the planning of specific water basins (Okanagan, Qu'Appelle, and St. John) were instigated.

By 1971, federal funding of water pollution research had increased to a level ten times that of 1965; in particular, research in the ecological/biological sciences and pulp and paper pollution was given major increase in support. Federal support for industrial pollution abatement also increased markedly with new programs of subsidies and incentives, and modifications of existing programs to encourage industrial research and development.

Perhaps the greatest evidence of a Federal commitment to the environment was the creation of the Department of the Environment in 1971. By bringing together the disparite elements within the federal establishment which had environmental concerns, the government not only sought greater coordination of its environmental activities, but also sought to create an environmental spokesman in Cabinet, the highest level of government decision-making.

Since late 1971, there has been sharp decline in the importance of environment as a social problem. Societal concerns have reverted to issues of unemployment, inflation and energy. From its peak in 1970, media coverage of the environment has dropped. Public concern as measured through opinion polls has declined. In late 1970, 65% of the population felt pollution was Canada's main problem. This dropped to 6% by mid 1972. With the decline in public concern, environmental citizens groups lost their membership and many smaller, less organized groups floundered and disappeared.

Environmental concerns were relegated to lower priorities by governments and there have been few major initiatives by the Federal Government since 1971. Programmes, structures and policies developed in the 1969-71 period have been institutionalized. The few efforts to implement the river basin management provisions of the Canada Water Act and to develop new bilateral planning agreements with the provinces have met with little success.

The Department of the Environment curtailed its support for social science research, disbanded its section on public participation, reduced liaison with citizens' groups and stopped its support of attitude and value surveys.

Although the Fisheries Act was clearly identified as the government's major anti-pollution legislation, utilization of the Act was slow and sporadic. The number of prosecutions under the Act actually decreased from 1970 to 1972. Despite government intentions to have pulp and paper companies in compliance with the regulations by 1977, no compliance schedules had even been arranged by late 1974, although negotiations with many

companies were underway. Despite government expectation that regulations under the Fisheries Act would be developed for a host of Canadian industries, only regulations for the petroleum industry were actually promulgated after 1971.

The development of standards for Canadian industry under the Fisheries Act has required not merely time to gather the best scientific evidence, but time to reconcile environmental objectives with objectives of industrial expansion, economic growth, and increased energy supply. Similarly, the development of an environmental assessment program has been slowed by the need to encourage new economic activities.

Stringent environmental controls on industry require large industrial capital expenditures on treatment facilities and modernization. Some companies would be forced to close (leading to unemployment), while most can be expected to pass on the increased costs to their consumers (leading to inflation). It appears also that one response of society to the energy "crisis" has been to relax environmental standards and programs.

H. PROVINCIAL LEGISLATION

While the above relates to institutions on a more national scale and particularly to trends in the Federal Government, the following appear to be the main trends occurring in Provincial legislation.

a) Provincial legislation is progressing from a focus on water pollution control to water resources management to environmental management.

b) Legislation is moving away from an "independent agency" concept to concepts of interdepartmental coordination and departmental base administration.

c) Allowance for greater public participation in the decision making process through an Environmental Council. Duties include providing advice to the Minister respecting current research on pollution and the natural environment and providing a ready source of expertise to deal with any matter the Minister deems advisable.

d) The development of Province-wide planning respecting planning for the environment.

Accompanying the shift to a total perspective of the environment are greater powers of enforcement with stop and control orders, tougher fines and provincial offices to carry out the provisions. Financial assistance is being provided to all forms of pollution abatement schemes.

I. MUNICIPAL SITUATIONS

Municipalities in Ontario are charged with the responsibility of enacting legislation to provide adequate sewage facilities and acceptable sewage level effluents. They are also responsible for the quality of industrial wastes wherever industries are connected to and utilize municipal sewage facilities as a depository for their effluents.

Municipalities are all different in terms of their social, economic and political settings as well as the pollution problems which they face. However, a survey of ten Ontario municipalities during the summer of 1971 (four of which were the Lake Superior municipalities of Thunderbay, Sault Ste. Marie, Terrace Bay/Schreiber and Marathon) found the following common characteristics:[1]

1. Most municipalities have inadequate sewage treatment facilities.

2. The most crucial problem concerns the antiquated combined sewer systems.

3. Most municipalities lack the financial base to independently improve sewage control facilities.

4. Municipal sewage control is quite recent, and has begun in earnest only within the last ten years.

5. Initiative and supervisory control of sewage control policy have in most cases come from the provincial level (OWRC).

6. On the whole, local legislation reflects local problems. Similarly, local enforcement patterns must be seen in the context of local settings.

"The primary purpose of the sewage use by-law in Sault Ste. Marie is to regulate effluents from commercial, institutional and residential outlets. While the legislation permits the city to enter into formal agreements with industry, there are no major industries discharging industrial wastes into the municipal sewer system. As in most municipalities, the major industries discharge directly into open watercourses. Commercial wastes have posed a problem for the treatment facilities and the municipality, though its legislation which is almost identical to the OWRC model by-law, has taken adequate steps to remedy the situation. The by-law has never been formally enforced. Contraventions have been dealt with in an informal manner where the municipality has advised contravenors to take adequate precautions against future violations.

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[1] The Role of Ontario Municipalities in Water Pollution Control, Report of the Erie and Superior Communities Project, Sept. 30, 1971.

"The major water pollution problem in the city of Thunder Bay originates from two sources. The first is a problem over which the city has no control or legislative authority. All the major resource industries discharge directly into open water. The second problem is one over which the municipality has direct responsibility but has neglected in exercising its authority. Sewage facilities are, for the most part, inadequate. Roughly thirty per cent of domestic sewage is untreated. To some extent, the municipality's inability to cope with its problems is understandable. The process of amalgamation is not yet complete, and the new municipality is still plagued with the problem of integrating its sewage use facilities. For the present, plans are being considered for the improvement of these facilities, and once completed much of the problem of untreated sewage will be eliminated. . .

"In the communities of Terrace Bay and Marathon, water pollution originating from the municipal sewer systems is not a serious problem. Both communities are "company dominated" and the sole industry in each of these communities is the primary contribution to the serious problem of water pollution in the immediate vicinity of the discharge areas. Both industries in these two communities are involved in pulp and paper production and their wastes are discharged directly into open water. Thus, the two communities have no control over the discharge of these two industries. Considering the source of economic livelihood in these two communities, it is just as well that the wastes are regulated by the OWRC since it is doubtful that local authorities would have any control over effluent levels."[2]

Small communities lack the technical expertise and the necessary personnel to handle treatment problems. It is obvious that in smaller communities, especially in the North, Provincial authorities play a more significant supervisory role than in the larger urban centres.

Municipal officials have, for the most part, a better understanding of domestic wastes and municipal systems as sources of water pollution than they do of industrial wastes. There is a tendency in several communities to consider domestic and industrial wastes as separate problems.

Communities with combined sewers experience flooding problems during periods of heavy rainfall. Overloading of treatment facilities results in raw sewage by-passing these facilities and directly entering receiving waters. The result is also sewer backups and flooded basements.

The report on Ontario municipalities concludes that most municipalities are not effective water pollution control agents without the knowledge, financial assistance and enforcement powers of Provincial authorities. Nonetheless, municipal officials show a relatively high concern for the pollution problem and feel that pollution control is an important local priority.

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[2] Ibid.

The Province of Ontario has completed or is presently negotiating with communities throughout the Great Lakes Basin for scheduled programs for the abatement of pollution. In the Lake Superior Basin the communities are the City of Thunder Bay, the Township of Schreiber, the Township of Marathon, the Township of Terrace Bay, the Improvement District of Red Rock, and the Township of Nipigon. On the St. Mary's River, enlargement of the sewage treatment plant at Sault Ste. Marie was expected to be completed in early 1974. In Lake Huron-Georgian Bay, the municipalities of Penetang and Midland were required to complete nutrient removal by December 31, 1973.

Notable Exceptions to Municipal Control Programs

Lake Superior

The City of Thunder Bay: The City is served by two primary sewage treatment plants with a combined capacity of 10.0 mgd. Negotiations between municipal officials and the Ministry have led to a sheeduled program of improvement. By 1975 a 24.0 mgd capacity treatment plant, financed under a Ministry-municipal agreement, is expected to be operational. It will be located at the existing Thunder Bay South sewage treatment plant site. The Thunder Bay North plant will be phased out and utilized as a pumping station. Biological studies are presently underway to determine the nutrient removal requirements for the installation. Treated effluent is to be discharged eventually to the outer harbour area; however, an interim inner harbour outfall will be utilized until approximately 1980.

In addition to the above an extensive sewer interception program is presently being implemented in Thunder Bay. The Current River interceptor sewer has been extended to pick up the Clark Street sanitary sewer which discharged untreated sanitary wastes directly to the harbour area and will be further extended to pick up the Lillian Street sewer by 1976. With completion of the Kam River interceptor, it is expected that by 1980 all municipal wastes in the Thunder Bay area will be transferred and treated in the one central location.

The Township of Schreiber: Presently serviced by municipal septic tank and individual private septic tank systems. Pollution surveys of the community of 600 persons have shown that untreated domestic wastes are reaching storm sewers and causing adverse effects on water quality in the area.

Under the direction of the Ministry, a provincially financed program to construct a 0.3 mgs capacity extended aeration plant and sewage collection system is well underway. Final design has begun on the project and construction is expected to commence in 1973 with tentative completion in 1974.

The Township of Marathon: Pollution surveys have shown that the .25 mgd primary plant now serving the Township is hydraulically overloaded. With the assistance of the Ministry, municipal officials have hired a consultant to evaluate and propose a program to correct these conditions. At present a brief has been presented to the Ministry for review; however, no firm commitments or deadlines have been negotiated. A reasonable target date for this project would be 1975.

Township of Terrace Bay: The 5.5 acre lagoon serving Terrace Bay is in compliance with Ministry effluent criteria.

The Improvement District of Red Rock: This District, population 1,900 persons, is presently served by individual septic tanks and sewers. Discharges of untreated domestic wastes reach the lake and impair its quality. A consultant has been hired by the municipality to evaluate the present system and is expected to submit a report to the Ministry before the end of 1972 outlining a corrective program.

The Township of Nipigon: The Township has hired a consulting engineer to investigate the feasibility of plant expansion. The proposal calling for a .36 mgd expansion to the existing primary facilities has been reviewed and accepted by Ministry officials. This improvement, expected to be completed by 1974, will bring the total capacity to .54 mgd.

St. Mary's River

The City of Sault Ste. Marie: this major municipality on the St. Mary's River is served by an 8.0 mgs primary sewage treatment plant operated by the Ministry. Construction of a 4.0 mgd extension is expected to begin in the spring of 1973 with completion tentatively scheduled for early 1974.

Lake Huron

In places where there is expanding municipal and industrial development, some impairment of water quality has resulted. The southern parts of Georgian Bay which experience impaired water quality are generally the result of expanded shore development which influences the local bacteriological and nutrient levels in the Bay. Water movement in Penetang Harbor and Midland Bay is somewhat restricted involving little interchange with Georgian Bay. Increased inputs of nutrients, particularly phosphorus have promoted growths of blue-green algae during late summer periods. Storm runoff due to sewage bypassing has also influenced the coliform level of Penetang Harbor. Nutrient removal is required at Penetang and Midland by December 13, 1973.

J. THE INDUSTRIAL SITUATION

Standards

Both the Federal and Provincial Governments have shared jurisdiction over water. The federal responsibilities are focussed in concerns about fish and other aquatic life, and navigation, as well as transboundary pollution problems.

National effluent regulations incorporating the principles of "best practicable technology" have been developed for the pulp and paper industry, for mercury discharges from the chlor-alkali industry, and for the petroleum refining industry. Regulations are under development for other industrial sectors. The national effluent regulations which represent minimum levels of control to be implemented across Canada are promulgated under the aegis of the Federal Fisheries Act and limit effluent losses as a function of production units.

The national regulations are being developed by a joint Federal/Provincial/Industrial task force in order to quantify "best practicable technology" for any given industrial sector.

Control and abatement of industrial water pollution in Ontario is effected by implementation of relevant sections of the Environmental Protection Act and the Water Resources Act. The Industrial Wastes Branch of the Ontario Ministry of the Environment manages the industrial program and is responsible for obtaining and maintaining compliance with the water quality objectives of the Ministry.

In general, the program includes the assessment of the nature and magnitude of industrial pollution, the development of abatement and control schedules, the appraisal and approval of treatment and disposal facilities, surveillance and effluent monitoring. Industries are encouraged to evaluate their facilities and monitor their effluents. A voluntary system of reporting on effluent quality has been in operation for some time and this is being extended.

Sources of Industrial Wastewater

Lake Superior

The major Ontario sources of industrial wastewater discharged to Lake Superior are the pulp and paper, food processing, chloralkali and mining industries. Included in these are industries located on the Kaministikwia River within the municipal boundaries of the City of Thunder Bay.

Pulp and Paper Industry

Within the Ontario portion of the basin, the pulp and paper industry is comprised of seven mills. Four of the mills are

located in the City of Thunder Bay, with the others located at Red Rock, Terrace Bay and Marathon. The seven mills produce a total of about 4300 tons per day of pulp. About 3000 tons per day are used to produce newsprint, container-board and fine paper, with the remaining 1300 tons per day of pulp produced for further processing elsewhere. The average pulp production by process is:

Groundwood pulp	1700 tons/day
Sulphite pulp	600 tons/day
Kraft pulp	2000 tons/day

The pulping process or combination of processes used varies from mill to mill and is summarized as follows:

Pulping Process or Processes	Mill Locations
Kraft only	Kimberly Clark - Terrace Bay
	American Can - Marathon
Groundwood and Kraft	Domtar - Red Rock
Groundwood and Sulphite	3 Abitibi Mills - Thunder Bay
Groundwood, Sulphite & Kraft	Great Lakes Paper - Thunder Bay

The present level of control required of the industry has been established in three program stages. The first stage has involved study of wastewater sources within each mill to establish waste characteristics. The mills were also requested to reduce fibre losses and water usage and eliminate or treat many of the gross discharges of suspended solids such as bark from woodroom operations. The second stage requirement is for external primary treatment of effluents to reduce suspended solids to acceptable levels. The construction of treatment facilities to implement the second stage at the seven mills discharging to Lake Superior will be completed in December when the clarifier installations at the Domtar, Red Rock mill is expected to be placed on line.

The third stage of the Ministry's water pollution control program for the industry includes, where needed, reduction of BOD_5, elimination or destruction of taste and odour producing substances, toxic wastes and elimination of remaining aesthetic problems by 1975. At present, the Ministry has commitments for major expenditures on the third stage of the program from three of the four kraft mills.

Food Processing Industry

There are two food processing plants in Thunder Bay with effluent discharges to Lake Superior and the Kaministikwia River. Canada Malting produces malt from barley grain and Industrial Grain Products produces starch and protein products from wheat flour.

The effluents from these plants are expected to be discharged to the City of Thunder Bay municipal sanitary sewerage system when the trunk sewer programs are completed. The

sewer connection to the starch plant is expected to be completed in 1973. Present municipal plans porvide for installation of the truck sewer to the malting plant vicinity by 1978.

Chloralkali Industry

American Can at Marathon discharges its effluent to Lake Superior, while Dow Chemical, located at Thunder Bay, discharges its effluent to the Kaministikwia River.

Both plants produce caustic soda (sodium hydroxide) and chlorine by the electrolysis of salt (sodium chloride) solution in mercury cells. The only characteristic considered to be of environmental significance in the effluent from these plants is the mercury content.

With imposition of Ministry regulations in 1971, mercury levels discharged in the wastewaters from these plants were reduced to levels currently regarded to be acceptable.

Mining Industry

The only operative mining operation in the northern portion of the basin is the Algoma Ore Properties Ltd., at Wawa. The iron mining and sintering operations discharge an effluent of 3.3 million gallons per day to the Magpie River, some ten miles above the river mouth, comprising large quantities of iron and solids.

The company recently received Ministry approval for improved treatment facilities. These changes are expected to achieve improved suspended solids removal and pH control.

St. Mary's River

Abitibi Paper Co. Ltd., - Sault Ste. Marie
Algoma Steel Corp. Ltd., - Sault Ste. Marie

Lake Huron

The uranium mining region of Eliott Lake, drained by the Serpent River, affects the local water quality of Serpent Harbor entering the North Channel where levels of Ra_{226} approximate 3pCi/1.

Tainting of flesh in fish taken from the North Channel adjacent to the Spanish River has been linked to pulp and paper industrial waste effluents discharged upstream to the Spanish River.

The most significant industrial development on the shore of Lake Huron centres round the nuclear generating complex under development at Douglas Point. This comprises an existing experimental generating station, a heavy water extraction plant

and a major nuclear generating station which is not yet operational.

In 1972 an inter-Ministry Task Force on Generating Station Siting was established to provide a review of future siting recommendations of Ontario Hydro thereby ensuring adequate consideration of all environmental aspects related to site selection and operation of generating stations in Ontario. Concerns at Douglas Point centred around the ability to control losses of hydrogen sulphide from the heavy water extraction plant, which uses the gas in an isotope exchange process, and the potential thermal pollution problem. Present indications are that hydrogen sulphide losses can be effectively controlled. Recently the Ministry approved a cooling water discharge program which is not expected to present a problem.

K. FUNDING OF RESEARCH

A study of Federal Funding of Water Pollution Research and Development, 1945 - 1972, was done by James W. Parlour for the Ministry of State for Urban Affairs. Findings of the study indicate that the strongest support for external research funds has been the National Research Council with a total of $1.6 million. Since 1960 this leading role has now been taken over by Energy, Mines and Resources (Department of the Environment since 1970) which has provided approximately $1.6 million since 1968 ($4.4 million if NACWRR development grants to universities for water resources teaching and research are included).

The accompanying table illustrates the growth of research by research topic from 1960 to 1972. Noteworthy is the steep rise from 1966 to 1971 from $190,000 to $1,331,000 and the abrupt drop in the following year to $692 million.

Also significant is that 99% of the funds have gone to the physical sciences. (See Table on next page)

The study was not able to determine internal funding for research.

CMHC has also been a major source of federal funds for support of R & D in sewage treatment and recycling. Since 1956 they have promoted the concept of totally self-contained sewage and water recycling systems. They have funded the Ontario Research Foundation for the development of a small self-contained sewage recycling system for single family dwellings. Since 1962, they expanded research efforts on recycling systems to include all solid and liquid wastes. The two major objectives of this research are to reduce the substantial costs of laying down pipes to transport sewage from source to the treatment plant and secondly to conserve and re-use water and other waste materials within the context of a totally enclosed system.

They are currently conducting R & D for a recycling unit for apartment buildings as well as alternative sewage treatment systems and storm sewer and sanitary sewer separation.

The total amount of CMHC funding for external R & D related to sewage treatment and waste recycling has amounted to $1.8 million between 1957 and 1971.

The most definitive document on past, present and future support for industrial R & D is the report by the Lamontagne Commission on Science Policy. The Commission was established to review the whole field of science policy in Canada and to make specific recommendations for future government, industry and university action on the Canadian R & D front.

Topic	Total	%
Ecological/biological	1735.0	36.0
Sewage	1302.4	27.0
Pulp and Paper	471.8	9.8
Phosphates & eutrophication	378.9	7.9
Monitoring & measurement	248.0	5.1
Planning and management	112.3	2.3
Socio-economic	62.1	1.3
Others	506.8	10.5
	4817.3	

The conclusions of the Senate Report show that there are definite and very serious weaknesses in Canada's science efforts, particularly with relation to support for industrial R&D. The lack of a well defined science policy with R&D components has, in the opinion of the Commission, resulted in a serious neglect of industrial research and development. The main target for the Commission's criticism is the federal government for its emphasis on fundamental research at the expense of technology and innovation. The government is also blamed for failing to stimulate industry and for performing far too much R&D in its own laboratories.

In its criticisms the Commission specifically mentioned the serious gap in research on pollution problems. In 1969 Canada's gross expenditures for R&D amounted to only 1.3 percent of its GNP. The Commission recommended that the level of expenditure of R&D should reach 2.5 percent of GNP by 1980, which would mean that spending on R&D must grow at a compounded rate of about 15 percent per year, over the next decade. If this level were to be attained it would mean a national R&D expenditure of some $4.75 billion by 1980.

In addition to being extremely critical of the lack of R&D funding from government, the Commission was also very critical of the way in which the meagre funds which had been spent had been allocated in the past. It recommended a reallocation of funds in order to reduce the emphasis placed on basic research and to divert research projects from government facilities to industry and universities. The Commission specifically recommended that the level of basic research be reduced from its level of 23 percent in 1971 to 10 percent by 1980. The Commission also noted that, at the present time, industry research receives only 40 percent of the present R&D expenditures whereas, in the opinion of the Commission, it should receive 60 percent.

The Commission also points to the fact that industry in Canada has not used the results of scientific research carried out in government and universities because, on the whole, discoveries made in isolation from industry cannot be transformed easily into successful market oriented innovation. Meanwhile, development activities which are absolutely essential to produce inventions and innovations have been neglected. As a result, a good deal of the research effort has been wasted, at least in terms of economic and social benefits for the country, and Canadians have had to depend on the importation of new technology, innovations, or new products developed abroad.

The creation of the Ministry of State for Science and Technology in August, 1971 resulted from the Commission's recommendations.

The most significant effort towards joint industry and government sponsored research to date came into being in 1970 with the creation of the Cooperative Pollution Abatement Research Programme. Guided by a joint industry - government committee, funds are allocated for water pollution abatement research to universities, private research agencies and industry. The basis for government aid under CPARP is that up to $1 million will be made available each year until 1975-76, provided the industry's annual expenditures for this type of work are increased by a similar amount over 1970 expenditures.

L. FINANCING FOR POLLUTION CONTROL

Assistance from the Federal Government for pollution control works has been made available to all of Canada since 1960 through the Central Mortgage and Housing Corporation (C.M.H.C.) under a Revision to the National Housing Act. The net effect is to provide long term loans at government interest rates for two-thirds of the eligible project value, and a subsidy of one-sixth of the value at the end of the re-payment period. The recent Canada-Ontario Agreement provides for an additional $10 million to be allocated for the accelerated construction of pollution control facilities in Ontario through the existing C.M.H.C. programme up to March 31, 1972, and total of $250 million up to December 31, 1975. Also up to $6 million is available for related research studies until December 31, 1975.

Assistance from the Federal Government for pollution control works has been made available to all of Canada since 1960 through the Central Mortgage and Housing Corporation under a revision to the National Housing Act. Thereby, long-term financing is provided at government interest rates for 2/3 of the eligible project value, and a subsidy of 1/6 of the value at the end of the repayment period. The canada-Ontario Agreement provides for up to $167 million of C.M.H.C. funds and $95 million of Ontario Treasury funds to be allocated on a cash flow basis for the construction of pollution control facilities in the lower lakes basin up to December 31, 1975.

Financing of sewage works in municipalities in the Upper Lakes basin is at present carried out in a similar manner through C.M.H.C., but on a project by project basis as these are developed year by year. Through the Ministry, Ontario acts as an agent for 30-year, low interest rate financing and construction and operation of sewage treatment facilities. Municipalities availing themselves of this program can discharge their liabilities by repayment of the funds and become owners of the facilities.

Area facilities designed to serve more than one municipality are subsidized to the extent of 15% of the captial cost. The Province of Ontario also provides financial assistance up to 75% of the capital cost of sewage facilities where these costs exceed $130 per lot with the remaining capital costs being amortized over a period of 40 years. This Provincial Scheme of financing allows the Province to own and operate the facilities in perpetuity.

FINANCING FOR POLLUTION CONTROL

Estimated Capital Expenditures for Industrial Treatment Works for Lakes Superior and Huron

(Millions $)

Industry	1957-65	1965-73	Projected Required Costs (1973)
Basic Iron & Steel	$ 5.4	$34.2	$ 5.0
Chemicals	8.6	15.7	.2
Food Processing	1.0	7.0	.3
Metal Working, Plating and Finishing	.4	9.9	.2
Mining & Metallurgical	21.9	62.2	- 20.2
Miscellaneous Manufacturing	3.4	12.0	--
Petroleum & Petrochemical	22.6	17.1	--
Pulp and Paper	34.0	39.8	56.1
Service	.2	14.1	.2
Tanning and Rendering	.6	.3	--
Textiles	.1	.2	--
Total	98.1	212.5	82.2

(document provided by Tom Muni letter of January 23rd)

Relatively little money has been spent on the installation of secondary treatment facilities. Only one pulp and paper mill in the province has biological secondary treatment facilities. This is a relatively new Kraft mill for which the waste treatment facilities were installed as a requirement prior to the mill becoming operational.

M. WATER QUALITY CONDITIONS

Lake Superior

In general, the quality of the water of Lake Superior is considered excellent due to the extremely low dissolved and suspended solids, the extreme clarity, the high oxygen concentrations, and the low concentrations of chemical nutrients and other ions.

One possible problem with excessive levels of DDT, PCB's and mercury in lake trout has been suggested from a preliminary sampling program conducted by Michigan.

The harbour areas at Thunder Bay, Red Rock (Nipigon Bay), Terrace Bay (Jackfish Bay), and Marathon (Penninsula Harbour), are considered areas of non-compliance with the water quality objectives. Sediment surveys and benthic fauna studies in these areas have shown the accumulation of oxygen-consuming pulp and paper mill solids and undesirable changes in the benthic communities. Sheens of oil and other floating materials are encountered at those locations; as well, aesthetic impairment of water quality is couses by the discharge of highly coloured industrial wastes, while tainting of fish flesh has also been observed. Contamination of fish by mercury has been observed in samples taken from Thunder Bay and Penninsula Harbour.

Untreated municipal sewage discharges from conbined sewers contribute to local impairment in parts of Thunder Bay, while elevated levels of coliforms and nutrients are encountered in Nipigon Bay at Red Rock and Penninsula Harbour at Marathon.

Data on basin waste loading parameters are presented in Table 1.

The total phosphorus load to the lake is 2,385 tons per year, of which 73% is from tributaries. Direct municipal sources contribute 21% and industrial sources the remaining 6%. Altogether the U.S. contributes 62% of the total tributary load. Not unexpectedly, the largest municipal phosphorus loading is from the Duluth - Superior area, corresponding with the largest center of population.

The total annual BOD loading is 201,320 tons per year. Of this total, the amount contributed by industry, 47%, almost equals the 51% entering the lake through the tributaries. The Canadian contribution is considerably larger than the U.S. contribution, being 81% of the total. The principal industrial contributors are the pulp and paper industries and, to a lesser extent, grain handling industries in Canada, and the forest products industry in the U.S.

TABLE 1

LAKE SUPERIOR - SUMMARY OF WASTE LOADINGS
(Short tons per year)

	Flow (cfs)	Total P	BOD_5	TDS	SS
CANADA					
Tributaries	23,780	670	73,990	2,618,720	130,650
Industrial	280	130	88,460	366,400	26,110
Municipal	15	105	900	3,940	890
UNITED STATES					
Tributaries	9,380	1,080	28,710	644,800**	212,610
Industrial	1,435	*	5,780	ND	24,526,840
Municipal	30	400	3,480	ND	2,250**
TOTAL:	34,920	2,385	201,320	3,633,860	24,899,350

* - Total phosphorus discharged to Lake Superior by Reserve Mining Company at Silver Bay is not included because the amount of available phosphorus as a nutrient has not been determined.

** - Incomplete information.

ND - No data.

From the Great Lakes Water Quality, Annual Report to the International Joint Commission; Great Lakes Water Quality Board; April, 1973.

The annual reported loading of total dissolved solids is 3,633,884 tons per year to the lakes, with approximately 89.8% entering through the tributaries. The industrial contribution is 10%. Of the total load, 82% enters from the Canadian side, with 72% of the total load being from the Nipigon River basin.

The total annual reported loading of suspended solids is 24,899,350 tons per year with the vast majority, 98.6%, being contributed by a single source in Minnesota, the Reserve Mining Company, jointly owned by Republic and Armco Steel Companies.

The St. Mary's River

The St. Mary's River receives municipal waste effluents from the sewage treatment plants of Sault Ste. Marie.

Algoma Steel Company, Abitibi Paper Company and Mannesman Tube Company located in the vicinity of the locks at Sault Ste. Marie, Ontario, are the major water users and discharge wastes to the river.

The water quality of the St. Mary's has improved in recent years because of better treatment by municipal waste treatment plants on both sides of the river and a reduction in industrial effluents from the Michigan side.

Table 2 presents the waste loading data from both Canadian and U.S. tributary, industrial and municipal sources.

Lake Huron

In places where there is expanding development, some impairment of water quality has resulted. This has been seen in such places as Honey Harbor, where there are some elevated bacteriological levels due to inadequately treated private sewage inputs, and Penetang Harbor and Midland Bay where there are elevated levels of phosphorus (believed to be from municipal sources) contributing to enrichment of the area. Penetang Harbor also has elevated levels of coliform bacteria (due to bypass during rainstorms).

The impairment of the water quality of the southern regions of Georgian Bay is generally the result of expanded shore development and the consequent elevation of bacteriological and nutrient levels. Penetang Harbor and Midland Bay have restricted water movement with Georgian Bay. Increased inputs of nutrients, particularly phosphorus have raised levels of blue-green algae production during late summer periods. Sewage overflows during periods of heavy run-off result in elevated levels of coliform bacteria in the harbor at Penetang.

Table 3 lists the flow data and loading rates of a number of parameters into Lake Huron-Georgian Bay.

TABLE 2

ST. MARY'S RIVER - SUMMARY OF WASTE LOADINGS
(Short Tons per year)

	Flow (cfs)	Total P	BOD_5	TDS	SS	Total N
CANADA						
Tributaries	64	1	45	4,340	380	35
Industrial*	255	19	11,510	23,610	4,760	ND
Municipal	16	85	1,370	4,410	1,120	350
UNITED STATES						
Tributaries	----------	----------	NONE	----------	----------	----------
Industrial	----------	----------	NONE	----------	----------	----------
Municipal**	5	25	390	ND	240	ND
TOTAL:	340	130	13,315	32,360	6,500	385

* Other Waste Constituents include:

Iron (Fe)	710	(Short tons per year)
Phenol	240	" " " "
Oil	1,790	" " " "
NH_3-N	9,700	" " " "
HCN	760	" " " "

** Data for period June 1971 to June 1972

ND - No data.

From Great Lakes Water Quality, Annual Report to the International Joint Commission; Great Lakes Water Quality Board; April, 1973.

TABLE 3

LAKE HURON-GEORGIAN BAY - SUMMARY OF WASTE LOADINGS
(Short tons per year)

	Flow (cfs)	Total P	BOD_5	TDS	SS	Total N**
CANADA						
Tributaries	27,120	1,259	45,350	3,508,500	266,500	18,600
Industrial	*	1	700	500	*	*
Municipal	20	85	1,100	7,100	900	200
UNITED STATES						
Tributaries	10,280	1,531	35,300	3,585,600	137,700	ND
Industrial	170	ND	11,900	14,200	2,000	ND
Municipal	5	4	200	14,200	200	ND
SUB TOTAL:	37,595	2,880	94,550	7,131,100	407,300	18,800
Input Lake Superior (includes St. Mary's River)	99,000	975	58,500	5,600,000	146,000	21,400
Input Lake Michigan	52,000	255	76,800	7,300,000	170,000	21,700
TOTAL:	188,595	4,110	229,850	20,031,100	723,300	61,900

* - Negligible

** - Incomplete data

ND - No data

From Great Lakes Water Quality, Annual Report to the International Joint Commission; Great Lakes Water Quality Board; April, 1973.

N. WATER QUALITY MONITORING

The Canadian government conducts extensive water quality assessment programs on the Great Lakes. In conjunction with this program, ships of "Environment Canada" from the Canada Centre for Inland Waters have occupied monitor stations in Lakes Ontario, Erie, Huron, Gerogian Bay, and northern Lake Michigan several times per year. In 1972 the M/V Martin Karlsen was used to carry out 9 monitor cruises and occupied 1,026 monitor stations. The Water Quality Survey monitored selected stations on the connecting channels.

Many other cruises by CCIW vessels provide data on lake quality while engaged primarily in research programs. These included the International Field Year for the Great Lakes (IFYGL) and sediment geochemistry sampling. The total cruise program for CCIW in 1972 amounted to 100 cruises covering in excess of 40,000 miles; the collection of 20,412 water samples, and 1,065 plankton hauls, from 2,594 monitor stations as well as many other observations and scientific activities.

The Ontario Ministry of the Environment has, since 1964, conducted an extensive water quality monitoring and surveillance program in the Great Lakes drainage basin. Information is gained on developing problems and the extent of compliance of waste discharges with the water quality standard. At present, some 2,000 locations on the Great Lakes and inter-connecting channels are monitored up to seven times a year with an additional 650 locations on tributary streams monitored 12-18 times a year.

In the Great Lakes system the monitoring locations place emphasis on areas of ctitical water use especially the lower lakes portion. Starting at the head of the system, the breakdown of sampling locations is as follows:

Lake Superior	200
St. Mary's River	90
Lake Huron, Georgian Bay and North Channel	295
St. Clair River	140

More recently a sediment sampling program has been employed to determine the extent of contamination of lake and river beds by such metals as mercury, lead and zinc and by organic matter orginating from municipal and industrial waste discharges.

Amont the parameters determined routinely are temperature, pH, alkalinity, turbidity, conductivity, nitrogen (kjeldahl, ammonia, nitrate and nitrite), phosphorous (total and soluble), chlorides, phenols and total and fecal coliforms with the majority of analyses being performed at on-shore laboratories in London and Toronto. Additional paramentrs such as ether solubles, cyanides, iron, sulphates and sulphites are examined to define the nature and extent of the effect of waste inputs

on the receiving waters.

Other programs include aerial surveillance and vessel patrols of sources of industrial wastes and sites where spills of oil and other materials may occur.

In 1965, the Ontario Ministry of the Environment began a phyto-plankton inventory program involving sample collection from near shore Canadian waters. This information is used for water quality control at the water works and will be most useful in tracing the progress of future nutrient pollution control programs. Considerable effort has been devoted to mapping the distribution and abundance of the green alga, Cladaphora.

Shorter term studies of the environmental response of major tributary streams to discharges of treated wastes and modelling studies of despersion patterns in the vicinity of tributaries, water intakes and waste discharges are also carried out by the Province. The information from these studies provides the basis for establishing standards and effluent requirements for all receiving waters in the Province.

Since 1966, the Ministry of the Environment, in cooperation with the Ministry of Natural Resources or their predecessor organization and the Ontario Pesticides Laboratory, has analyzed fish for DDT and dieldrin in several lakes of the Province, including the Great Lakes. This program was expanded in 1969 to include the effects on fish of heavy metals including mercury. Commercial fisheries on these waters where mercury contaminated fish have now been identified, have been closed and sport fishermen have been warned not to eat their catches.

The Radiation Protection Laboratory of the Ministry of Health carries out analyses of radioactive substances in water.

In evaluation of operation of municipal waste treatment facilities in Ontario, monthly samples of the influent and effluent from each water pollution control plant are analyzed at Ministry Laboratories for BOD, Suspended Solids, Total Phosphorous, and Total Phosphorous and Total Nitrogen, etc. In addition to this, each plant is inspected at least once a year and the operation evaluated by Ministry staff. Special sampling programs have been set up at certain plants in order to assess parameters such as Total Solids, Dissolved Solids, Soluble Phosphorous, Ammonia, Chlorids and certain Heavy Metals. Effluent chlorination is mandatory from May to October each year and where water re-use practices are concerned, has been implemented on a year-round basis. Close contact is maintained between Ministry staff and municipal officials so that operational problems can be corrected as quickly as possible.

The Ontario Ministry of the Environment maintains surveillance of municipal treatment works discharges and major overflows through its receiving water monitoring program. Monitoring stations immediately downstream of discharges to tributary watercourses and in the vicinity of direct municipal

discharges are sampled tri-weekly on tributaries, monthly on the interconnecting channels and bi-monthly in the lakes (the latter two during the ice-free period).

Intensive surveys have been carried out in many heavy use areas to determine the effect of municipal discharges on the receiving water as the first step in defining abatement requirements.

PART III

INTEGRATED SCENARIOS

A. DEVELOPMENT IN NORTHERN ONTARIO - A

Both Federal and Provincial Governments make a concerted effort to control growth and develop comprehensive plans for development of regions away from existing population concentrations in Southern Ontario.

An intermediate zone centred approximately one hundred miles from Toronto is the Barrie-Midland, Nottawasaga Beach and Lake Simcoe area, i preserved as a "recreational belt" for the Great Lakes urban megalopolis (primarily for Southern Ontario but also Chicago, Detroit, Buffalo, etc. in the U.S.). All existing agricultural land is preserved for intensive farming.

Development plans and incentives shift to the more northern areas and are centred on a strategy of growth in existing centers. Accordingly, Thunder Bay, Sudbury and Sault Ste. Marie are each designated as growth centres and their populations double their present size sometime in the period between 2000 and 2020.

DEVELOPMENT IN NORTHERN ONTARIO - B

Federal and Provincial plans and incentives are formulated but are ineffective. Growth continues to occur north of Toronto but on an "urban sprawl" basis. The "sprawl" has spread as far as the Barrie-Midland area and is creeping northward. However, the pace of the crawl has slowed because of the lower birth rates, family formations and immigration policies.

Government has made feeble attempts to preserve farm lands and recreational lands but they have been ineffective. As a result, these lands are fragmented and the remaining operational farms are small and inefficiently managed.

As a result of sporadic and piecemeal growth, sewage treatment and water management problems have become more complicated. The government remains "behind" the water pollution problem until 1985.

By the mid-1980's, the problems of "creeping growth" to the Barrie-Midland area are manifest and a determined effort is made toward planned and controlled growth in the more northern regions around Thunder Bay, Sudbury and Sault Ste. Marie.

DEVELOPMENT IN NORTHERN ONTARIO - C

The same as B up to 1985.

While government and the public are aware of the problems created from the "creeping growth" emanating from Southern Ontario, Government structures have also grown in numbers and complexity and have become increasingly inefficient. The "bureaucratic maze", combined with the increasing number of trade-offs required in regional planning, has brought comprehensive regional planning to a virtual "stand-still".

Growth continues to spread into the more northern reaches of Ontario out to 2000 and 2020 in an inefficient and uncontrolled manner.

DEVELOPMENT IN NORTHERN ONTARIO - D

Both Governments continue to encourage growth in northern Ontario but their plans and incentive programs are ineffective. New mines have been discovered but because of problems with labour unions and the higher prices for extracted resources, mining companies have been encouraged to automate their operations for both extraction and processing.

Forest harvesting and pulp and paper mill operations peaked in 1980 and have levelled. With less opportunity available to them, young people have left the area to live in more urban regions of Ontario. The forces of population growth and its concommittant problems of housing, urban growth, etc. have diminished as a result of immigration policies and the passing of the "baby boom" era.

Growth in the north therefore stabilizes in the 1980's and begins to decline thereafter.

B. THE SCIENTIFIC COMMUNITY - A

The Ministry of State for Science and Technology, formed in 1971, is effective in formulating a sound science policy for Canada. It receives support for the policy from Cabinet and many of the recommendations originally formulated by the Lamontagne Commission on Science Policy are implemented.

The level of gross expenditure for R & D, which was 1.3% of GNP in 1969 (one of the lowest rates among developed countries of the western world), rises gradually following the recovery from economic recession in 1976 to 2.5% of GNP by 1985. This represents a 15% compounded growth per year.

Efforts shift more towards applied research and to those areas which domonstrate a high cost/benefit ratio in terms of societal needs. The importance of environmental quality is given a high priority throughout the period. The Government also gives substantially more support to cooperative research with industry in programs such as the Cooperative Pollution Abatement Research Program. These types of cooperative programs stimulate matching research grants by industry thereby doubling the research efforts that may have occurred with the same funds expended within government. Further, research done in this manner proves to be much more relevant to the "real world" problems than the earlier "ivory" tower research done in the 1960's and early 1970's.

Results from the CPARP efforts begin to become manifest in the late 1970's and an exponential development of applied scientific knowledge evolves in the 1980's and 1990's.

While the number of persons in the scientific community only increases marginally, there are sharp increases in their effectiveness and "output". There is a more favourable ratio of "productive" scientists vis a vis "administrative" scientists; social science research learns what kinds of "environments" scientists work most effectively in and these findings are applied; computer technology is used more creatively; increased knowledge of ecological systems makes applied research more efficient and effective.

THE SCIENTIFIC COMMUNITY - B

The Ministry of State for Science and Technology has difficulty as a new governmental organization in gaining Cabinet support for its programmes. Morale problems result among staff who consequently lose their effectiveness. External communications with other Federal Departments, Provincial Governments, Universities and private enterprise breaks down. Research remains fragmented, non-problem oriented and unused. The poor performance in terms of unable scientific research results in a further cut-back of government funds instigated by the prolonged recession of the mid-1970's. That research which is done is channeled towards new sources of energy and new products for world markets. Environment remains a low priority. With lessened efforts by Government in environmental research, industry also slackens in its committment.

As the delayed economic recovery begins to take_shape in the early 1980's, the deteriorated environment again comes to the forefront of public ocncern. Meanwhile, a turnover of staff has occurred at the Ministry of State for Science and Technology as a result of disillusionment described above. The "second generation" staff of the early 1980's sets in with renewed vigor to develop a cohesive science policy and sets of programmes which are appropriate to the societal requirements of the 1980's.

Government recognizes the need and approves the programmes for funding. Research builds on the work that exists as well as research findings that have come from other countries, including research done by NASA in the United States which became much more oriented to "earth problems" in the late 1970's.

The number of scientists employed for research increases as does their effectiveness. Government support of industry research is re-newed and industry efforts are increased proportionately.

THE SCIENTIFIC COMMUNITY - C

Government funding of external environmental research dropped from its all time high of $1.3 million in 1971 to .7 million in 1972. Corresponding drop occurred in internally funded research. With problems of energy, inflation, unemployment and housing of greatest concern to the Canadian public in the late 1970's, environmental research remains at minimal levels.

The science community remains fairly constant numerically but with diminishing public interest and government attention, their output also declines.

The growth of government increases problems of bureaucracy so that the ratio of "productive" scientists vis a vis "administrative" scientists becomes less favourable.

The lack of a well defined science policy with R & D components continues to frustrate scientists. Cooperative research efforts with industry through the CPARP grants generate negligible results and are discontinued.

Scientists withdraw into their "ivory towers" and work on basic research isolated from problems requiring scientific solution. The discoveries that are made are not easily transferrable into "real life" applications. Development and applied research activities necessary for the production of inventions and innovations required for the solution of environmental problems are neglected.

These trends continue to the min-1980's when environmental neglect begins to minifest itself. Public concern generates renewed Governmental attention and large scale funding of scientific research is generated.

While the funds are there, the scientific resources, i.e. manpower, knowledge base, facilities, etc., are not. The build up of these resources requires time. Scientific emphasis continues through the 1990's but it remains a "catch-up" situation and the implementation of applied research findings is only adequate to maintain the 1985 status quo.

THE SCIENTIFIC COMMUNITY - D

The same as C except the "environmental lag" has become so great that environmental deterioration continues.

C. SCIENTIFIC KNOWLEDGE - A

Motivational research determines how to inspire and manage research in a more creative manner. Significant increases in scientific data and knowledge occur. Major scientific breakthroughs take place as the inter-relatedness of new knowledge is demonstrated, such as the effects of atmospheric pollution on water pollution and the correlation of various land uses on water pollution.

"Ecological systems" knowledge "expoldes" in the 1980's as does knowledge of "urban systems", "industrial systems", "domestic systems". Former systems become sub-systems of larger systems as "total systems" understanding increases in the 1980's and 1990's.

Knowledge gained allows for an optimal balance in environmental management; social goals, economic goals and natural resource exploitation/conservation.

SCIENTIFIC KNOWLEDGE - B

Data continues to increase but the intellectual stamina and creative spark to translate it into knowledge remains absent. By 1985, the longitudinal tracking of data is such that the data itself becomes transformed into knowledge by indicating trends.

Persistent research on toxic substances, hydrologic systems and "brush fire" solutions to environmental problems leads eventually to a more coherent body of knowledge in the mid 1980's.

SCIENTIFIC KNOWLEDGE - C

Data regarding the environment continues to accumulate, but the complexity of environmental problems becomes greater and therefore more difficult to understand. Federal science policy in deed (if not in formal statements) becomes increasingly "trapped" into short range "brush fire" research to solve problems and /or the symptoms of problems. Research related to longer term solutions and understanding of hydrological and other systems is postponed.

SCIENTIFIC KNOWLEDGE - D

There continues to be an absence of social science research to determine how social trends effect water quality. Knowledge of how to more effectively manage environmental institutions becomes a major gap. Data collection and dissemination becomes less efficient and a "data lag" occurs, that is the data obtained lags the problem solving requirements. Also new problems develop for which no data exists, for example, medical data and knowledge regarding the effects of environmental pollution on human beings.

D. TECHNOLOGY - GENERAL - A

A profound technological revolution occurs and comes together with renewed thinking about the environment, population, natural resources and social considerations re-shaping a "Noo" Society (based on the term Noosphere, i.e., an evolving sphere of knowledge that creates an intellectual awareness around the world) by the period 2000-2020.

Laser beams are utilized to dispose of garbage and sewage; Great Lakes farming is developed to feed the world; fission nuclear power is in wide use but includes measures to protect the environment; sophisticated architectural engineering makes the far north (beyond Thunder Bay) a habitable and habitated environment; farming in the far north is made economically feasible.

TECHNOLOGY - GENERAL - B

Technological advances occur particularly in the energy field as all nations put emphasis into this area over the next ten years because of energy shortages. Also, as a result of economic constraints and higher priorities such as world hunger, housing, etc., environmental technology lags.

Nuclear power plants begin to proliferate; transportation improvements open recreation areas into previously remote areas; new and larger water tarnsportation systems emerge including even larger automated, nuclear powered, bulk cargo ships. There are new uses of the oceans and the Great Lakes for mining, mineral extraction, as a source of energy and controlled farming.

The lag in environmental technology as well as environmental control measures continues until the mid 1980's when a series of major "crises" occurs similar to the oil spills of 1969 but of a much greater magnitude. Public alarm throughout the world triggers large scale government intervention on a national and international scale to close the "environmental technology" gap.

TECHNOLOGY - GENERAL - C

Essentially the same as B but sufficient environmental safeguards are built in to technological advances to avoid crises. Rather, the result is a slow and gradual environmental deterioration of the environment which goes unperceived by the public and continues to the year 2000.

TECHNOLOGY - GENERAL - D

Nuclear and fossil-field power plants proliferate around the periphery of the upper Great Lakes because of the availability of cooling water. Disposal of the waste heat results in increasing quantities of warm water being discharged into the Lakes changing their ecology.

Process industries requiring large amounts of power locate in the vicinity of plants resulting in increased amounts of toxic substances being discharged into the Lakes. Further, the emergence of a hydrogen economy focuses attention on water as a raw material as does aqua-farming. These new industries draw more population to the North.

Worldwide food shortages result is a much more intensive type of farming which requires new fertilizers. Run-off of the new fertilizer into the Lakes alters the marine ecology.

The development of an oil shale industry in the western United States requires enormous quantities of water to be pumped from the Great Lakes for use in processing.

The "physical" pollution of Great Lakes waters intensifies as public and political pressures increasingly force ecologically degrading projects into the Lakes such as solid waste disposal, jet ports, etc. The economics of sea transportation dictates the use of larger and larger super-vessels which, in turn, require the dredging of tremendous shipping channels and/or the construction of major terminals far from the coast.

Off-shore platforms are situated in ever deeper waters and become steadily bigger. Schemes for offshore man-made islands, floating airports, offshore shipping terminals and eventually complete communities are designed, developed and implemented.

E. TECHNOLOGY - WATER RELATED - A

Material and energy shortages force a comprehensive approach to resources and environmental management. Major breakthroughs and innovations are made towards self-contained processes and recycling. To quote one expert panelist, "There has to be by 1985 or we'll be up to our ass in land fill sites."

Houses and apartment buildings will have self-contained, recycled water supplies; sugar will be made from pulp and paper industry by-products; waste is used for fertilizer and the production of methane gas. Clivus toilets are used to produce compost from human and kitchen wastes.

Industrial wastes are increasingly removed at the source and water recycled. A forerunner of such a facility was a chemical installation circulating 1.5 billion gallons of water per day and requiring only a 1% make-up in volume per day.

Re-evaluation of industrial processes and changes in equipment and raw material result in the production of less toxic effluent. Textile finishing mills substitute cellulosic sizing agents (which have little toxic effect in streams) for starch. Metal plating industries introduce beneficial changes in electroplating techniques subtituting acid-copper solutions for copper-cyanide plating solutions. The metal industry adopts mechanical methods of cleaning such as shot blasting in place of pickling with acid and substitutes hydrochloric acid for sulfuric acid.

The pulp and paper industry directs major efforts toward improving existing processes to cut down on both volumes and pollutant loadings of effluents. Some mills partially replace chlorine with oxygen to bleach kraft pulp thus reducing the BOD and dissolved salts in plant discharges. Specialty paper mills recover caustic soda from cooking liquors with the aid of multiple-effect evaporators. Sulfite waste liquor by-proudcts are used as raw material for other manufactured products.

The food industry revises its harvesting and processing. Wastes are recycled as fertilizer and others recovered to be processed as protein food supplements and other additive products.

Technology for complete biological purification and removal of oxidizable organic materials is made more efficient and economically usable.

Advanced processes are developed for large scale implementation including adsorption by activated carbon for removal of organic compounds; foam separation to remove surface-active organic impurities; electrodialysis to separate ionized materials

from water; and distillation to process waste containing certain volatile contaminants. These processes become economically feasible in the 1980's.

Research and development continue and they become operable in the 1990's and later. These include reverse osmosis, ion exchange, and adsorption with the use of bauxite, fly ash and modified coal. Additional methods studied are coagulation, emulsion freezing, hydration, oxidation and the use of recoverable algae which remove nutrients.

The Ontario Government builds a resource recovery centre incorporating a full scale experimental reclamation plant which is used to explore, develop and provide technology for complete recovery of resources from solid wastes. The first pilot project plant built in the late 1970's has a capacity of 200 tons per day. The success of the pilot project leads to the development of bigger and more efficient plants throughout the Province.

Waste re-conditioned as fertilizer is used in "spray irrigation" techniques for agricultural areas and entire forests. By the year 2000 sewage (sludge cake) containing micro-organisms is used to feed algae (which are 80% protein) which is then harvested and dried for consumption as a food product.

Toxic and hazardous wastes are buried in boxes rather than allowed to seep through the ground. They are located on maps for eventual re-claiming and re-processing as required.

TECHNOLOGY - WATER RELATED - B

Essentially the same scenario as A except that R & D results are more slowly attained and breakthroughs are not realized until the mid 1980's. Their implementation occurs on a gradual basis from 1985 on.

Funding for remedial programs begins to occur in the late 1980's as well. These include weed harvesting, pH adjustment, phosphorous removal, aeration of lakes approaching eutrophic conditions and land management to control the quality of run-off.

TECHNOLOGY - WATER RELATED - C

Material and energy shortages continue forcing prices up even further. Continued inflation leads to an extended recession. Rather than comprehensive, long term solutions, efforts are directed toward meeting current requirements with existing technology.

R & D on innovative technology continues, but no significant breakthroughs occur in the 1980's. New industrial plants are "fitted" with recycling systems and "state of the art" abatement technology in the 1980's, but, because of the major expenses of retrofitting existing plants, the majority of industry continues to function on pre-1975 technology out to the year 2000.

F. MONITORING - A

Existing monitoring programs by CCIW and the Ontario Government continue. By the mid 1980's a national monitoring system is in place utilizing fully the NAQUADAT computerized data bank. The system makes it possible to determine, assess and interpret water quality trends on a national and regional basis.

By the year 2000, monitoring is integrated vertically so that effects of human activities on water can be forecast before they occur and remedial action taken.

Automated monitoring is developed with greater precision, reliability and simplicity. The St. John's River Basin experiment provides the necessary knowledge to do so. Following the success of this experiment, more river basin systems are automatically monitored in the 1980's and a complete network is in place by 2000.

Remote sensing by satellite complements the in-situ automated monitoring in river basins. Large earth observatory satellites (3½ tons),using remote sensing techniques, monitor environmental quality, observe the weather, oceans and large lakes, survey earth resources and facilitate land use planning by 1990.

The satellites provide information regularly, repetitively and relatively inexpensively after launch. Repeated observations show slow changes which may reveal either danger or opportunity. Information is obtained from remote and otherwise inaccessible locations.

MONITORING - B

While monitoring improves, relative to the need for monitoring it remains fairly constant.

MONITORING - C

With a movement towards a "Conservation Society", the need for monitoring is diminished. Recycling, pollution abatement at the source, etc. all lessen the need for more adequate monitoring.

Existing technology for monitoring is used more effectively. There is a more thorough understanding of the hydrological system and of the hydrological system as part of the total ecological system. The chemical and biological aspects of pollutants are more completely understood and the effects on receiving waters, marine life, etc.

Therefore, it becomes possible through the monitoring of a few indicators on a periodic basis to learn of the "health" of the total system.

G. THE PUBLIC AND THE MEDIA - A

With Watergate, the Indo-China War and Economic Recession no longer "front-page coverage", environmental issues regain attention by the media. Rather than peak coverage in a "crisis", "scare" copy approach to isolated events, as in much of the reporting of the 1969-71 period, coverage is more steady, comprehensive and in-depth. Environmental problems are given a national and even international perspective.

Trained, experienced environmental reporters are assigned full time to environment by major newspapers and television networks. Renowned environmental scientists lend their support to the media as do professionals in fields of law, planning, sociology, etc. Popular books on the environment are published.

Original investigative reporting makes possible critical articles and editorials about environmental problems and the effectiveness of solutions from physical, biological, social and management perspectives.

Environmental subjects are introduced into the educational system beginning in elementary grades on up as was done in Saskatchewan in 1972. Early exposure to environmental issues appropriate to the level of education creates an awareness of and a higher order environmental ethic in the population at large.

Environmental perspectives also begin to extend into courses in law, management, planning, etc. at the university levels.

The number of citizen's groups do not increase but their membership does. The trend is towards "umbrella groups" which move into the broad issues of resources, energy, food, etc. Environment takes on the broadest of definitions to include each of these topics as well as pollution.

As a result of their education in environmental matters and their attentiveness to the continued comprehensive and in-depth reporting by the media and articles by environmental scientists (and other professionals) in popular magazines, the groups are knowledgeable and well informed.

Governments increase formal opportunities and channels of communication to citizens groups through consultation, public meetings, advisory committees, etc., as well as by means of new communications technology as is made available through concepts such as the "wired city".

Governments become more comfortable with citizen participation and "bureaucratic barriers" and "walls of secrecy" are less prevalent. There are increases in advocacy planning, environmental impact studies for all major projects, green papers and white papers.

A significant segment of citizen group membership consists of professionals and technicians in various disciplines. As citizen groups take a larger role in the assessment of major projects, their capability to obtain and assess relevant data increases and their presentations become increasingly comprehensive, inter-disciplinary and sophisticated.

Citizens groups also encourage recycling, conservation, etc. through the day to day decisions and actions of their membership. Managers and professionals among the membership influence positively the decisions made by their relative corporations and institutions where matters of the environment are concerned.

THE PUBLIC AND THE MEDIA - B

A general feeling of, "We've done what we can; it's up to the government to do the job now. That's why we pay taxes and why civil servants are paid and politicians elected," pervades the public attitude.

The environment in effect becomes institutionalized and remains such. People generally are satisfied that the Government is doing all it can.

Periodic public surveys monitor the public attitude and "micro-adjustments" are made according to government priorities and programmes.

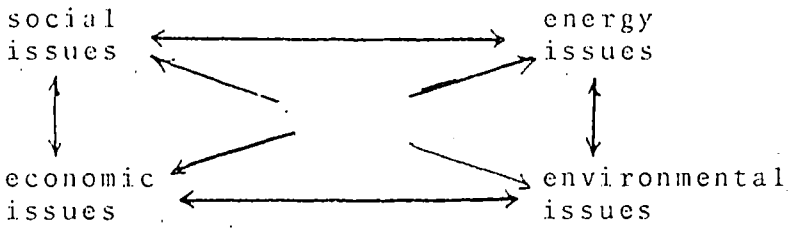
THE PUBLIC AND THE MEDIA - D

Same scenario as either B or C, however, by mid 1980's continued world population growth, economic development, resource depletion, energy requirements and un-checked pollution combine to result in a series of "macro-environmental crises" on a scale not now anticipated.

A flurry of media coverage and public response result in a manner comparable to 1969-71 but larger.

H. INSTITUTIONS - A

By the mid 1980's an emphasis is placed on obtaining a "balanced dynamic tension" on a global scale among



Optimal allocations of the world's resources of scientists, management, labour, capital, energy, clean air, clean water and other renewable and non-renewable resources are achieved by the year 2000.

Trade-offs are involved initially, but eventually environmental, social and economic values are stabilized. Combined forces for conservation, environmental protection and human relatedness result in changing life styles, consumption patterns, and industrial processes. Re-cycling, environmentally compatable products, etc. become commonplace.

Decision making between governments in a cooperative framework continues to improve. What each level of government can do best in its own jurisdiction and how it can complement other levels of government is recognized. The Great Lakes Agreement provides positive objectives and problems of water pollution are solved with the direction it provides. It in turn is linked to the Canada Water Act which provides a flexible joint definition of problems, strategy and plans between the Province of Ontario and the Federal Government.

Students graduating with environmental degrees in the 1970's begin to reach middle management positions in the mid 1980's. Also, graduates in planning, management and other desciplines have had courses regarding the environment or at least have been exposed to environmental issues. Inter-disciplinary approaches to comprehensive regional planning are consequently much more effective in the 1980's as are inter-departmental and inter-governmental task forces as jurisdictional barriers give way to a common purpose and direction.

Cooperation continues to grow in the mid 1980's. By the year 2000, there is a continental approach to management of the Great Lakes. The Canada-U.S. Agreement is the first step in this direction. It is developed further by the International Field Year which included scientists, operational people and managers at all levels. The IJC efforts bring it all together in terms of both water quantity and water quality.

Exchanges of scientific information also exist first with Europe and eventually with countries of the communist block.

Municipal-Provincial cooperation is also very positive. Goals set for municipal pollution abatement are achieved and an open atmosphere for citizen participation exists.

Consolidation of wastes from both industrial and municipal sources provides economic advantages of scale. Further, the industrial wastes containing excess organic carbon relative to other nutrients (nitrogen, phosphorous and potassium) required to activate sludge for secondary treatment balances the excess of nutrients in municipal wastes.

Advanced treatment processes are implemented which are able to accomplish water renovation, i.e. separating all pollutants from water to such a degree that the effluent is suitable for industrial, agricultural, recreational or domestic re-use. Renovation is accomplished to the degree required by the intended re-use.

Pollution control legislation is consolidated by 1985 and environmental legislation is consolidated in the 1990's. By the year 2000 legislation of water quality is captured in broad social legislation. Policies improve more rapidly than legislation and programmes achieve policy objectives and go even further than anticipated. Standards relative to assimilative capacities improve as scientific knowledge increases.

A fundamental shift in strategy that occurs in the 1980's is from the after-use pollution control measures of the 1970's to prevention of pollution at the source and pre-planning for recycling, self-contained systems and environmentally compatable manufacturing processes and products.

There is a much broader definition by Government in terms of what it will finance for waste processing. For example, Government finances transport trucks for a spray irrigation process.

INSTITUTIONS - B

The balance of economic-environment priorities is basically a function of the state of the economy. Therefore, with the economic recession of the mid 1970's, there is a shift away from environmental values. However, the economy begins to recover in 1976 and the environment gradually regains some emphasis in Government policies and programmes by 1980.

Local governments, feeling a critical revenue cost squeeze, lack funds for environmental programmes more than usual in the mid and late 1970's. "Bail-out" programmes by senior governments are curtailed until increased funding is available in the 1980's.

Economic considerations continue to dictate policy at all levels of government until the mid 1980's. Gradually at this time, the realities of a "global village" become manifest. Inherent capacities of the environment begin to dominate economic considerations. For example, the inherent capacity of the earth to produce food (with known technology) overrides economic mechanisms of price. There is a general shift in perception from economics to the inherent capacity of the earth to sustain human population in the long term.

Legislation, policies programmes and standards all improve. However, stresses on water quality are substantially greater and more complex. The adequacy of policies and programmes therefore remains behind and the environmental catch-up gap either remains constant or becomes larger.

INSTITUTIONS - C

The sharp decline in the importance of the environment as a social problem which took place in late 1971 continues in the mid and late 1970's. Societal concerns remain with issues of unemployment, inflation, energy, housing, etc. In fact, an environmental backlash occurs as some citizens place the blame for high food prices, energy shortages, etc. on environmentalists.

Therefore, the environment is relegated to lower priorities by governments at all levels. Few new initiatives occur in legislation, policy, programmes or enforcement of existing standards. Policies, structures, and programmes developed in the 1969-71 period become institutionalized. Few efforts are made to implement the river basin management provisions of the Canada Water Act. The few initiatives that occur to develop bilateral planning agreements between the Federal Government and the Province meet with little or no success.

The Department of the Environment curtails support for social science research, disbands its section on public participation, reduces liaison with citizens groups and stops support of attitude and value surveys.

Government intentions to achieve compliance of standards under the Fisheries Act in the pulp and paper industry by 1977 are not realized. Industries generally consider this a retreat by Government. Regulations which were to be developed for other industries under the Fisheries Act are in fact only developed for the petroleum industry. Other regulations are postponed indefinitely partially because of lack of scientific information on which to base regulations, partially because of the state of the economy and partially because of the effectiveness of industry lobby groups unchecked by a concerned public.

Policies, strategies and programmes in the 1980's continue to be incrementally designed, short term in perspective, fragmented and motivated by empire building.

By and large, attempts in universities at inter-disciplinary training are unsuccessful. Emphasis in education reverts back to specialization. Similarly, inter-disciplinary team efforts in regional planning, water resource management, etc. have not been successful. Inter-departmental and inter-governmental rivalries persist in the 1980's. Municipal-Provincial cooperation is hampered by tension between agencies and personalities involved.

Canada-U.S. cooperation which was high in the mid 1970's takes a downturn. There are an increasing number of diplomatic problems between Canada and the United States. There

1. INDUSTRY - A

Management development programs of the 1970's include efforts to teach managers (present and potential) how to look at "total systems", including environmental issues and social concerns. They are also taught how to maintain an awareness of the significant changes that are occurring in society and how to relate this awareness to responsible corporate plans and actions.

Efforts are made in the 1980's to balance corporate profit and growth objectives with efforts to serve broader societal goals. Internal standards are developed to measure effectiveness in the management of social concerns; guidelines are designed for deciding on the alternative uses of resources based not only on market priorities, but also environmental and social priorities; the social audit becomes a standardized implemented practice to develop information which is presented to the public as an index of a company's response to environmental and social goals.

Major emphasis is placed on recycling, self-contained water systems, recovery and utilization of waste products. Products are produced that are compatable with the environment. A built-in obsolescence marketing strategy gives way to repairable products and products with a long life. This is reinforced by a wave of consumerism which demands such changes and a new conservation ethic in society at large.

The Cooperative Pollution Abatement Research Programme is highly successful and extended beyond 1976 into broader R&D efforts which are environmentally related.

INDUSTRY - B

Private enterprise does not believe it has a moral obligation to the environment. It is up to government to establish the terms of reference for industry and industry's role is to meet consumer demands for its products at a profit to its shareholders. Furthermore, corrections to existing systems can only be made up to a certain point before a company becomes non-competitive in international markets.

Part of the reason offered for the lack of an environmental ethic is the abundance of land, water, air, energy and natural resources. Private enterprise has not had an environmental ethic in the past and it does not in the future.

Of the total industrial wastes loadings discharged to rivers and lakes, the pulp and paper industry continues to discharge the bulk of BOD (77%) and suspended solids (60%). The steel industry is responsible for three fourths of oily waste discharges and nearly 90% of the metal losses (mostly iron). Losses of other metals (zinc, copper, lead) continue to occur in the mining industry.

Pollution abatement in the pulp and paper industry progresses at a slow rate. Waste liquors from sulphite pulping facilities continue to create the greatest problem.

General areas of concern in the early 1980's continue to be thermal pollution, heavy metals, toxicity in pulp mill effluents, siting of major industrial developments with respect to environmental impact and surveillance of radioactive discharges from nuclear generating stations and other nuclear facilities.

Estimated costs to abate existing industrial water pollution in Ontario have inflated from 230 million in 1974 to 500 million in 1980.

Convictions with fines averaging $500 have not effected industry actions to take corrective measures.

The dilemma of retrofitting old plants persists. Stringent environmental controls on industry require large capital expenditures for treatment facilities and modernization. Some plants would be forced to close (leading to unemployment) while others would pass increased costs on to consumers (contributing to inflation).