Research and Monitoring for Environmental Protection: Twenty Years of Research and Monitoring at the Nanticoke Industrial Complex on the North Shore of Lake Erie

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"(Evaluation Research) ...has no determinate form, and its method is one largely of trial and error - with the emphasis on error... There seem to be many more wrong than right ways to conduct program evaluations."

T. A. Morehouse (1972) 'Program Evaluation: social research versus public policy' *Public Administration Review 32*, p. 868.

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SUMMARY

I. RATIONALE, SCOPE AND PURPOSE

A multitude of environmental policies and programs strive to restore, preserve or protect important ecological processes. Many argue, however, that in numerous cases such programs have been substantially incomplete, woefully inadequate and largely ineffective. If this is indeed the case, how might we judge the strengths and weaknesses of a particular program or policy? More importantly, how might one go about improving environmental management programs which have been deemed insufficient or lacking in some way?

It would seem that long term monitoring and systematic evaluation of policy or program effectiveness is an obvious and necessary prerequisite to improving environmental management. This requires not only thorough understanding of a program's purpose and operational goals, but also an appraisal of performance criteria which can show to what extent those goals are being achieved. Unfortunately, in practice, a program's purpose is seldom well defined operationally and there is rarely consensus over what constitute suitable criteria for measuring program performance, let alone how they might be measured.

Evaluation researchers concerned with improving environmental programs and policies have tried to develop approaches for undertaking evaluations based on the clarification and measurement of goals, objectives and criteria. These include descriptive historical accounts, retrospective benefit cost analyses of program effects, perception and attitude studies of those involved in the policy process, as well as probabilistic analyses of consequences. Others have focussed on the political, economic and social roles of evaluation in the policy process, or else attempted to evaluate the efforts of evaluators.

Two questions lie at the heart of this rather eclectic mix of approaches encompassed by evaluation research: (1) how does one undertake an evaluation that is useful for future policy and planning? (2) how might the role of evaluation in the policy process be modified so as to improve policy and planning in specific situations?

The purpose of this study is to address these two questions by assessing an environmental research and monitoring program associated with a major greenfield development of heavy industry. From the vantage point of this case study, the two questions on evaluation might be rephrased as: (1) How might one evaluate research and monitoring programs that seek to improve environmental management and planning? (2) How might such evaluations be improved?

II. AN ADAPTIVE RESEARCH APPROACH

The focus of my study is an evaluation of environmental research and monitoring at the Nanticoke industrial development on Lake Erie's north shore.

There are at least two reasons for this. First of all, because environmental management around Nanticoke is considered to be something of a success at a time when attention appears focussed on environmental disasters, crises or conflicts of me kind or another. Perhaps, some of the difficulties currently encountered in siting industrial waste facilities, restoring ecologically degraded harbors or contending with rid rain can be avoided by paying more careful attention to the successes of the past.

My second motivation for undertaking this study stemmed from a lmg standing research interest in trying to understand how human societies contend with environmental changes that cannot be detected unambiguously or even described clearly in the short term. Among others, such changes include acid precipitation, climate changes, landscape changes, low level toxic contamination of ground water. The characteristics of these changes are not immediately obvious. They can be detected only over the long run. They tend to be pervasive or large scale in nature. What is more, neither causes nor effects can be easily attributed to such changes. By focussing on the apparently clear-cut example of environmental research and monitoring at Nanticoke, my hope was to gain insights into how environmental changes can be detected, how they come to be regarded as serious and important, and understand better what kind of deliberate strategies of research, policy and planning hold promise in responding to them.

Given this background, my explicit intent while investigating Nanticoke environmental management was to be unashamedly exploratory, experimental, flexible and adaptive. I wanted to learn as much as I could about the workings of environmental management, to explore self-consciously the strengths of an interview oriented research approach and to identify a- far further study. To address the two evaluation questions posed at the start, I undertook repeated reviews of relevant documents, regulations and by undertaking a sequence of formal, but unstructured interviews with persons who had long been involved with the' Nanticoke situation. This provided an ongoing opportunity for cross-checking the issues raised, comparing alternative interpretat ims of those issues, as well as monitoring my own investigator bias. In this way, my approach to evaluating research and monitoring at Nanticoke was disciplined and systematic, even though it remained qual itative, historical, open-ended and adaptive as the study progressed.

III. RESEARCH AND MONITORING AT NANTICOKE

The Nanticoke industrial development centres on steel making, oil refining and electricity generation in a rural setting on Lake Erie's north shore. Nine years have passed since Stelco's Lake Erie Works began making steel. Texaco's oil refinery has been operating for eleven years, while Ontario Hydro's coal fired power station has been generating electricity for sixteen years.

Industrial development began in this predominantly rural area in the late sixties with the building of a 2000 MW Ontario Hydro coal-fired generating stat im. The stat ion was subsequently expanded to 4000 MW. This was followed by construction of a 1.25 million ton/year Stelco steel mill and a 105,000

b/day Texaco oil refinery. These three industries comprised the core of what many hoped would become a major industrial centre in Ontario.

The Nanticoke case is interesting on a number Of counts:

1. the industrial development was me of the largest ever undertaken in Canada, exceeding in investment even the Alberta Oil Tar Sands projects;

2. environmental research and monitoring were important cmsideraticns in the planning, construction and operation of the three industrial plants. In the late sixties and early seventies, little serious attention was paid to such matters elsewhere. A high degree of concern over ensuring local environmental protection has persisted locally among industry, government agencies and citizens over nearly two decades;

3. from the very start, research and monitoring were undertaken cooperatively by industry and government through two innovative coordinating committees, c-rising managers, scientists and other technical experts. These were the Nanticoke Environmental Committee (NEC) which was established in 1968 to research water related issues, and the Nanticoke Environmental Management Program (NEMP) established in 1975 to research air quality;

4.. a great deal of money was spent on a wide range of often very detailed planning and environmental studies, *in* addition to the implementation of numerous measures to mitigate environmental impacts. Fran 1977-9 NEMP spent $3. 17 million, while NEC spent 31.48 millim from 1967-79. By 1980, Stelco, Ontario Hydro and Texaco had spent $70-83 mill ion on environment related matters. About 9-15% of project expenditures were devoted to environmental protection. The period 1974-1983 was the most intensive for research studies;

5. efforts were made to integrate environmental planning into broader planning considerat ims. In part this contributed to a major restructuring of local government and the construction of nearby Townsend newtown;

6. a system of environmental protection and monitoring was established in an area where none had previously existed. Air and water quality monitoring continues to this day, albeit on a reduced scale as NEC and NEMP began to wind down their activities after 1983;

7. nearly two decades of detailed time series monitoring data are available on various aspects of biophysical change related to the industrial development. According to this information and associated research studies, environmental qual ity around Nanticoke is well within relevant provincial and federal guidelines for pol lut im. Environmental protect icn at Nanticoke thus appears to have been an overwhelming success.

Almost without except im, the persons interviewed during the course of the study regarded the twenty years or more of environmental protection around Nanticoke has been largely a story of success. The intensive program of research and monitoring associated with the industrial development was typically cmsidered to have been a key contributing factor to this success.

Since 1983, as had been initially planned, research and mmitoring at Nanticoke have been progressively reduced in both scale and intensity. This situatim provides an important opportunity to examine critically the claims that have been made about the research and monitoring program, to consider how the strengths and weaknesses of similar programs might be evaluated, and perhaps to identify tit traits of a monitoring program are critical to ensuring continued relevance to the changing needs of planning and policy.

According to reports, litwature and persons interviewed, the apparent success of Nanticoke research and mmitoring appears to be rooted in three general claims:

CLAIM (1) Environmental monitoring has failed to detect any significant changes in environmental cmditims that cur be attributed directly to the industrial development. The program was comprehensive in scope, comparing environmental change before and after construction of the industrial development in terms of a variety of biophysical parameters. Initially at least, the environmental research was undertaken in relation to broad provincial planning concerns about political representation, economic development and population growth.

CLAIM (2) Fran the very start, the research and monitoring program was scientifically oriented, and at the cutting edge of ecological field Study, environmental protection technology, and lmg term biophysical monitoring. Important contributions concerning the functioning of ecological processes and technical aspects of environmental management have been made to the Scientific 1 itwature as a result. This also helped to inst ill a cooperative approach to research and mmitoring among those involved from industry and government.

CLAIM (3) The research program has cmtributed constructively to the design and operation of environmental protectim facilities at the industrial plants, as well as to the development of envir-tal policy and planning at various tiers of government.

There is 1 ittle question that in terms; of *program outputs* which centred on the generation of time series information on biophysical parameters, Nanticoke research achieved everything it set out to do and more. But in terms of policy and *planning wtc-*, the importance of Nanticoke research and monitoring in bringing about environmental management improvements seems less obvious. In fact, sane suggest that the absence of significant environmental impacts stems not from an effective program of research and mmitoring, but rather from a more modest rate of industrial expansion than was originally anticipated.

In any case, over the years, the brunt of monitoring activity has been directed to describing narrowly defined biophysical parameters in ever more ingenious and rigorous ways. Increasingly detailed concern with the dynamics of some of these parameters has cmtributed to a neglect in constructing integrated perspectives on ecological processes taking place across different environmental media and their relevance to human activities. For example, no serious attempt has been made to synthesize studies striving to estimate,

monitor and model air pollutant emissions with biological monitoring of surrounding waters or changes in water quality, and in turn changing patterns of recreation and cottaging in the coastal zone.

The working assumption of those involved in managing research and monitoring has been: since no-one has raised issues relating to what should be monitored, or to social and economic impacts, in a sufficiently persuasive way, all must be well with such matters. Over the past two decades, a number of studies have addressed institutional and social concerns relevant to the industrial complex. These have been undertaken largely on an ad-ha basis by university researchers or else by government agencies responding to complaints No effort has been made to include these institutional or social impact concerns in ongoing monitoring activities in a systematic way. Yet, history suggests that it is public complaints that have triggered studies most relevant to policy, not the environmental information gathered through biophysical monitoring. This was the case in the agricultural impact studies undertaken in the eight ies.

Almost all socio-economic studies that were undertaken preoccupied themselves with forecasting local to regional change without taking into account national and international economic changes. As a result, in the seventies, local and regional planning appeared cumbersome and inflexible to abrupt changes in Texaco's and Stelco's plans prompted by depression in world markets for oil and steel.

The ongoing social impacts of local government reform, industrial development and population growth have been largely ignored. Consequently, we know a great deal about the effects of industrial construction on fish, but very 1 ittle about how it affected people.

Wat is more, no systematic attempt has beer, made to monitor the performance of the planning process associated with Nanticoke, in terms of its responsiveness to changes in pol it ical priorities, public policies, and enforcement of regulations, as well as to changes in ecological and economic condit ims.

A variety of monitoring activities are being undertaken in the Nanticoke area by various government agencies, as well a5 by the industries. Yet, there is no administrative mechanism for the sharing and exchange of dif ferent kinds of monitoring information. For this ream, it is difficult to establish an overall picture of regional environmental trends and to evaluate their significance for pol icy and planning in terms of desired or undesired outcomes.

In recent years, the monitoring activities associated with Nanticoke have become increasingly mysterious and progressively less relevant to many citizens and their municipal representatives. In turn, complaints of farmers, fishermen and cottagers about possible damage to crops, fish and air quality appear Increasingly to be unreasonable, unfounded and misinformed to professionals from government and Industry.

This brief review of the claim that are made about the success of Nanticoke research and monitoring serves to illustrate that perhaps the program in question has not been the overwhelming success it appears at first sight. In an effort to clarify this ill-defined state of affairs, I sought to identify key assessment issues through my investigation. The importance of ten such evaluation criteria became more and *mare* evident during the course of repeated document reviews, field visits, interviews and subsequent correspondence with those interviewed:

1. DEFINITION OF ENVIRONMENT (SCOPE)

[narrow or broad; biophysical or socio-economic]

research and monitoring have been confined rather inflexibly to a narrow range of biophysical parameters which have been of little direct interest to those engaged in regional policy and planning. Despite some suggestions to the contrary, socio-economic parameters have not been researched or monitored alongside the biophysical ones;

2. RELEVANCE TO POLICY AND PLANNING

[useful or irrelevant]

a gap has opened up between ever improving technical proficiency in the gathering of biophysical information (e. g. exotic air pollutants) and the information needs of those engaged in regional policy and planning (implications of pollution patterns for recreation patterns or lad use controls);

3. COMMUNICATION

[formal or informal; high or low]

those engaged in gathering environmental information appear unappreciative of the challenges of policy and planning, just as planners and policy makers are not fully aware of the uncertainties, inaccuracies *and probabilities associated with environmental in format im. There is no systematic ongoing program of dissemination of research and monitoring resul ts to the public. Nor is there an any attempt to draw on local knowledge in any organized way;*

4. DEGREE OF SYNTHESIS

[high or low]

there has been a persistent lack of cwrdinatim in the gathering of environmental information and its subsequent communicaticn for the purposes of policy and planning. Environmental information is collected and tends to be stored on a sectoral basis (water, dir, fish, soil), rather than on a spatial me (Region of Haldimand-Norfolk);

5. SCIENTIFIC CREDIBILITY AND TECHNICAL COMPETENCE

[high or low]

research and monitoring has contributed greatly to improving scientific understanding of the workings of the biophysical environment. In many ways, Nanticoke research has led the way technically and methodologically in biophysical research not only by systematically gathering a great deal of data, but also by • llowing researchers to gain considerable field experience;

6. ADAPTABILITY TO CHANGING CIRCUMSTANCES

[high or low]

it remains unclear to what extent the existing research and moni toring system would be effective in anticipating serious environmental changes that might result from stresses induced from beyond the local area or from some major accident or emergency dt the industrial complex. Nonetheless, various agencies hate been willing to undertake studies in response to citizen complaints, ds *in the case of the agricul tural assessment research conducted jointly by the Ministries of Environment and Agricul ture and Food;*

7. TIMING

[fixed or open-ended]

from the outset the research and monitoring program was explicitly conceived as a pre and post operation study which would be wound down once completed. In effat, the Nanticoke research program came to an end in 1983 as had been planned at the outset. Only rwtine monitoring and ad hoc research continue today;

8. ORGANIZATIONAL BASIS

[el ite or participatory]

research and monitoring was organized cooperatively through NEC and NEMP by a small group of technical experts and managers from

industry and government. The publ ic, planners, and policy makers engaged in regional to local planning have been largely excluded from active participation in Nanticoke research and monitoring. The NEC/NEMP philosophy adopted &ring their most active period (1979-1983) centred on experts in forming the publ ic, rather than on involvement of citizens in some interactive process of mutual 1 earning;

9. EVALUATION MECHANISM

[formal, informal or non-existent]

all evaluation of research and monitoring was undertaken on the basis of Scientific and technical sufficimcy by NEC and NEMP. There has been no formal requirement for review by citizens and publ ic agencies in the cmtext of broader regional policy and planning issues. Evaluation has been undertaken almost exclusively in terms of program outputs, rather than program responses to outside factors or broader policy outcomes;

10. COST

this', or low]

research and monitoring can be expensive. It is important to spend money on r-rch and monitoring in a wy that ensures short and long term policy and planning concerns are met to the greatest possible degree. This may require major expenditure on fundamental or background research • s was the case in Nanticoke, but this in itself provides no guarantee of sufficimcy for the **purposes** *of policy and planning. In relation to Nanticoke, there appears widespread sentiment that a great deal of money us spent unnecessarily on sophisticated studies (such as those centred on phytoplankton) that in retrospect appear to have been of marginal importance. Mitigation measures and plant design modifications stemming from many Of the studies undertaken have now* M *into many millions of dollars. It remains unclear who should pay for evaluations of mvironmental research and monitoring, and on what basis they should do so. At Nanticoke, no prwisim was made for formal program evaluatim, let alone who should pay for it.*

The Nanticoke example illustrates the difficulties *of* trying to establ ish an unambiguous and conclusive evaluatim of a major research and monitoring program. Even in hindsight, when there is rich documentation, no apparent controversy, and a well defined set of program activities, it appears futile to hope for unanimous agreement on program strengths and weaknesses. Thus, reducing the Nanticoke story to a set of ten summary issues or evaluatim criteria doe5 not imply universal agreement as to which of them is most important. Nor does this argue that the interpretation given to each criterion

has some widespread legitimacy. Indeed consensus over the range of issues addressed may be impossible.

The purpose of identifying a set of criteria is to provide a framework or reference point for systematically ordering exchanges of opinion and points of view about ways of improving a research and monitoring program for the purposes of policy and planning. This is an important point, as it seem the key to a constructive evaluatim 1 ies in the opportunity to weigh up alternative intwpretat ions of incomplete informat im about the design, implementation, progress and broader ef fects of a program.

The various persons consulted during the course of this study put differing emphasis on the issues outlined above. To some degree, determinat ion of past strengths and weaknesses seemed to reflect the current purposes (explicitly or otherwise) of the person concerned, as well as the intentims of the evaluator. For this reason, attention of those involved in environmental management at Nanticoke should be directed not to what was good or bad about the environmental monitoring, but to what should be done next. In other words, the purpose of evaluatim is not to offer a verdict on whether environmental monitoring should be continued, but rather to provide an opportunity to pose questions &out what kind of environmental monitoring would prove most relevant to planning in the future, and how this might be organized at Nanticoke.

IV. CONCLUSIONS: THE CENTRAL ROLE OF INFORMATION/COMMUNICATION

A useful evaluation is me that movers problems initially unforseen or unimagined, provides an opportunity for reflection among those involved with the program, and offers some basis for program initiatives to begin afresh. To see evaluatim as a witch-hunt for apportioning blame, an opportunity for debunking apparent success, or a soap-box for preaching about what should have been done but wasn't, seems as futile as it is irrelevant to improving environmental management.

An important theme raised by the Nanticoke case centres on the role of information and communicat im in environmental management. What kinds of informat im are needed to evaluate the strengths and weaknesses of environmental pol icier and programs? What information is needed to monitor and assess the effectiveness of envirmmental management? How is this information created and by whom? Who decides what informatim is relevant and legitimate to policy and planning? On what basis and with what purpose do they do so? How is environmental information communicated and used? Who uses the environmental information generated in research and monitoring? For what purpose do they do so?

The 'information' referred to in these questions seems critical not only to monitoring the ongoing effect iveness of policy and planning, but also to undertaking practically useful evaluat ions of individual programs. Better appreciation for these quest ions, and for possible answers, it seems, may lead to improvements in the design, implementation, monitoring and evaluation of environmental policies and programs.

Before going any further, the concepts of 'information' and 'communication', or the 'social processing' of that information, warrant closer consideration. Just what constitutes environmental information, and what does not? Or put another way, what does it mean 'to communicate information' in policy and planning? How does environmental information trigger action in policy and planning? And more generally, what is the role of information in the policy process?

The ten evaluation criteria generated through my evaluation of Nanticoke research and monitoring serve to provide a point of departure for further investigation of these information/communication questions. More specifically, three strategies for further research appear to hold promise.

The first would involve comparative study of other research and monitoring programs associated with major industrial centres, such those associated with oil development in the Scottish Shetland Islands. This approach offers the possibility of checking the general applicability of the summary criteria that appeared important in the Nanticoke case, as well as a chance to examine further the research approach used to identify such criteria.

The second strategy would strive to attain a better understanding of the Nanticoke situation through more detailed evaluation of the role of research and monitoring in federal, provincial, regional and municipal planning. This could focus on comparing the different points of view among those involved in generating environmental information and those who strive to make use of it in policy and planning.

A third strategy would shift attention away from specific case studies of environmental monitoring towards a more explicit investigation of the use of information and communication in policy contexts. This could involve using the Nanticoke example as a starting point for in-depth interviews with experienced 'information-handlers' such as politicians or public interest advocates and 'communication experts' such as journalists or public relations men. The purpose of this would be to construct heuristic models of how information is conceived and how it appears to be used in the context of science and policy. These models could then serve as templates for comparing and contrasting further examples of environmental monitoring for purposes of policy. In turn, this could lead to the development of guidelines for designing environmental monitoring systems that remain relevant and useful in policy contexts over the long term.

In sum, the goal of my investigation at Nanticoke has not been to construct some unambiguous or universally persuasive evaluation of the research and monitoring program. Rather, I have tried to further understanding of the issues and obstacles associated with the evaluation of major research and monitoring programs. This motivation prompted me to refocus attention during the course of the study from a preoccupation with what is known about the functioning of environmental protection at Nanticoke, to an interest in how and why it is known, and by whom is it known. This led me also to pose the practically orientated questions about what constitutes environmental information, how it is 'processed' during environmental management activities, and

how this might be affected by the introduction Of various information technologies.

I. RATIONALE, SCOPE AND PURPOSE

Most would agree that the effectiveness of environmental pol icies and programs must be monitored and evaluated, if they are to be successful in preserving important ecological processes. This requires not mly understanding of a program's purpose and operational goals, but also appraisal of performance criteria which can show to what extmt those goals are being achieved. Unfortunately, in practice, a program's purpose is seldom Well defined in operational terms. There is rarely consensus over what constitute suitable criteria far measuring program performance, let alone how they might be measured.[1]

Despite a Variety of attempts, it has proven extremely difficult for evaluation researchers to establish cause-effect relationships between preferred events and a particular program or pol icy. In fact, dispute and controversy appear to be characteristic of attempts to undertake evaluations of environmental management programs. This is because understanding of the world around us is usually uncertain, often incomplete and rarely unambiguous. Changes in ecological processes that affect human affairs take place through inadvertent human interference, deliberate modification, as well as a partially understood internal dynamic that is independent of human affairs. In addit im, at any time, there are numerous government programs, industrial pol ic ies, and economic activities which may interact among themselves to generate unforeseen changes. Thus, in every situatim, there is lso2a legacy of long term effects of past programs, policies and human activities.

According to some, the practical difficulties posed by the uncertainties and complexities present in any planning situation will prevent forever the development of some universally accepted approach to evaluatim. In any case, the array of quantitatively oriented estimation approaches developed for purposes of program waluatim in recent decades appear to have been of little direct value in policy-making. At least ten reasons have been offered to explain this state of affairs (Table 1).[3]

Despite the difficulties that plague the formal evaluatim of a policy or program, it is well to remember that there is constant informal evaluation in

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[1] For in depth reviews of the importance and problees of evaluation in policy and planning, see C. H. Weiss, Evaluation Research: Methods for Assessing Program Effectiveness (Englewood Cliffs, NJ.: Prentice Hall, 1972); Gary D. Brewer and Peter DeLeon, The Foundations of Policy Analysis Wlinois: Dorcey Press, 1983); and Brian W. Hogwood and Lewis A. Gunn, Policy Analysis for the Real World (New Yat: Oxford University Press, 1984).

[2] For discussions of different approaches to evaluation, see Barclay Hudson, 'Domains of Evaluation' Social Pol icy (1975): 79-89; C. S. Holling (ed.), Adaptive Environmental Assessment and Management (Chichester: Wiley, 1978); Hok Lin Leung, Policy Planning and Evaluation (Winnipeg: Ronald P. Frye, 1985); O. Munro, T. Bryant and A. Matte-Baker, Learning from Experience: A State of the Art Review and Evaluation of Environmental Impact Assessment Audits (Ottawa: CEARC, 1986); Bruce Mitchell, Geography and Resource Analysis (London: Longman, 1986), pp. 256-279.

[3] See for example, Laurence E. Lynn, Jr. (ed.), Knowledge and Policy: the Uncertain Connection (Washington, D.C.: National Academy of Sciences, 1978); Joseph S. Holy, Evaluation: Promise and Performance (Washington, D.C.: The Urban Institute, 1979).

TABLE 1. TEN OBSTACLES FACING EVALUATORS OF POLICIES AND PROGRAMS

1. GOALS AND OBJECTIVES: seldom specified in any measurable form, criteria for success often remain unclear, and goals shift as a program is implemented.

2. DEFINING AND MEASURING CRITERIA FOR SUCCESS: seldom possible to measure attainment of objectives directly, difficult to avoid controversy or dispute in selecting criteria because different perceptions of what is important.

3. HOW MUCH IS ENOUGH?: even when objectives and priorities have been specified, there remains the issue of tit outcomes are relevant to the policy in question: what level of achievement in meeting goals constitutes success? *Fully* 25% or *only* 25%?

4. SIDE EFFECTS: the positive and negative spill-over effects of a program are often more significant than the impact on the initial objective. How should side effects be weighted relative to central objectives?

5. INFORMATION: information for assessing a program's impact may nut be available or may be available only in an unsuitable form.

6. SEPARATION OF PROGRAM IMPACT FROM OTHER INFLUENCES: difficult, if not impossible, to separate program effects from impacts of other factors, programs and legacy of the past.

7. MULTI-PROGRAM TARGETS: it is common for a single problem to be the target of several programs with similar and often related objectives. In such cases, it may be meaningless to assess the impact of a single program.

8. DISTRIBUTION OF IMPACT: it is difficult to distinguish how impacts of a program are distributed among a population or across a range of parameters from the total or average impacts of that program.

9. POLITICAL SENSITIVITY OF MONITORING AND EVALUATION: evaluation may be seen as a threat to the continuation of a program in which people have an important stake. This will affect evaluation results and the ease with which evaluatim research can be conducted.

10. COST: evaluations can be extremely costly, especially if no allowance was made for policy evaluation and monitoring in the initial design. It is also not immediately obvious who should pay the cost of evaluation.

SOURCE: Hogwood, B. W. and L. A. Dunn (1984) *Policy Analysis for the Real World*, New York: Oxford University Press, pp. 222-228.

any situation. Those involved in administering the program are constantly making operational adjustments based on their perception of the program's outputs, outcomes and desirability. While those affected by the program are often able to influence the priority assigned to a program through a variety of pol it ical, economic and behavioural pressures.

Moreover, at any moment, numerous evaluatims are underway. These are directed not only at speci f ic programs, but also at reformulating the problems those programs are intended to resolve. Among others, they can take the form of radio talk shows, editorial articles, works of art, investigative reporting, publ ic demonstrations, TV soap operas, novels or protest songs.

Evaluation researchers concerned with improving environmental programs and pol ic ies have tried to examine the sa ial, economic and political roles of both formal and informal evaluatims in the policy process. They have done so through descriptive histwical accounts, retrospective benefit cost analyses of program effects, perceptim and attitude studies of those involved in the policy process, as well as probabilistic analyses of possible future consequences of a program or policy.'

Two questions 1 ie at the heart of the rather eclectic mix of approaches encompassed by evaluation research: (1) what is the role of evaluation in the pol icy process? (2) how might that role be modified so as to improve pol icy and planning in specific situat ims?

The purpose of this study is to address these two questions by assessing an environmental research and monitoring program associated with a major green-field development of heavy industry. Thus, from the vantage point of this case study approach, the two quest ims might be rephrased as: (1) How might one evaluate research and monitoring programs that seek to improve environmental management and planning? (2) How might such evaluatims be improved?

The rest of this report is organized into three parts. Methodological questions relating to how this study was undertaken are addressed in the first part. A research **diary discusses** how and why the research focus of the study came to be **modified** and changed over the past year. **This serves** to illustrate the strengths and weaknesses of systematically adopting an adaptive and interview oriented research approach in the evaluation of planning programs.

Secmd, the histwy of the environmental research and monitoring program at Nanticoke is described. This leads to a discussion of the strengths and weaknesses of environmental management, based on a review of relevant papers, reports and documents, as well as in-depth interviews with persons with long standing involvement in Nanticoke environmental management. Evaluation criteria derived during the course of investigation are proposed as a point of departure for further research.

In the final part, the substant ive and methodological findings of this study are summarized and questions are posed for further research.

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[4] Bruce Mitchell, Geography... op. cit. pp. 256-279.

II. A RESEARCH DIARY

In this section, I reflect on the approach adopted in undertaking this research. I summarize my strategy and its outcome as it evolved over the period July 1988 to August 1989.

I chose to consider in some &tail the story of environmental management at the Nanticoke industrial development on Lake Erie's north shore for at least two reasons (Figure 1).

First of all, because environmental management around Nanticoke is considered to be something of a success at a time when attention appears focussed on environmental disasters, crises or cmflicts of one kind or mother. Perhaps, some of the difficulties currently encountered in siting industrial waste facilities, restoring ecologically degraded harbors or contending with acid rain can be avoided by paying more careful ● ttmtim to the successes of the past.

Secondly, I chose to focus on the Nanticoke example because of a lmg history of studios by University of Waterloo and Toronto graduate students and faculty on various aspects of environmental management. These included Gordon Nelson's assessment of environmental regulations at Nanticoke for the Economic Council of Canada, Sabine Jessen's MA Thesis on environmental planning at Nanticoke, Thomas Whillans, George Francis and Henry Regier's investigations of the Long Point peninsula, and two workshops on coastal zone management which brought together university researchers, planners and environmental managers from government and industry. This legacy of research activity offered an opportunity for a follow up study which could focus on interviewing a small group of key individuals who had been involved with Nanticoke research and planning for many years.[5]

As it progressed, my study came to focus more and more cn how resewch and monitoring information was used for the purposes of policy and planning. Initially, however, I had been interested in discovering how historical changes in administrative procedures, legal powers, financial arrangements and pol it ical cl imate - or what some refer to as 'institutional arrangements' - affected what was researched and monitored at Nanticoke and how the environmental information gathered was subsequently used for purposes of policy and planning. In part, this interest stemed from a desire to explore

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[5] J. Gordon Nelson and R. D. Needham (eds.), 'The Lake Erie Peninsulas: management issues and directions' Special Issue of Contact (1979) 11(1); J. Gordon Nelson and Sabine Jessen (eds.) 'Coastal Resources and Environmental Management' Special Issue of Contact (1980) 12(3); J. Gordon Nelson, J. Chad Day and Wine Jessen, Environmental Regulation of the Nanticoke Industrial Complex, Working Paper No. 7 (Ottawa: Economic Council of Canada, 1980); Sabine Jessen, An assessment of Great Lakes shore management regulation of the Nanticoke industrial complex, Lake Gic, Ontario, Unpublished MA Thesis (Waterloo, Dept. of Geography, University of Waterloo, 1980); George R. Francis, A. Lino Grima, Henry A. Regier and Thomas H. Whillans, A Prospectus for the Management of the Long Point ecosystem, Report No. 43 (Ann Arbor: Great Lakes Fisheries Commission, 1985).

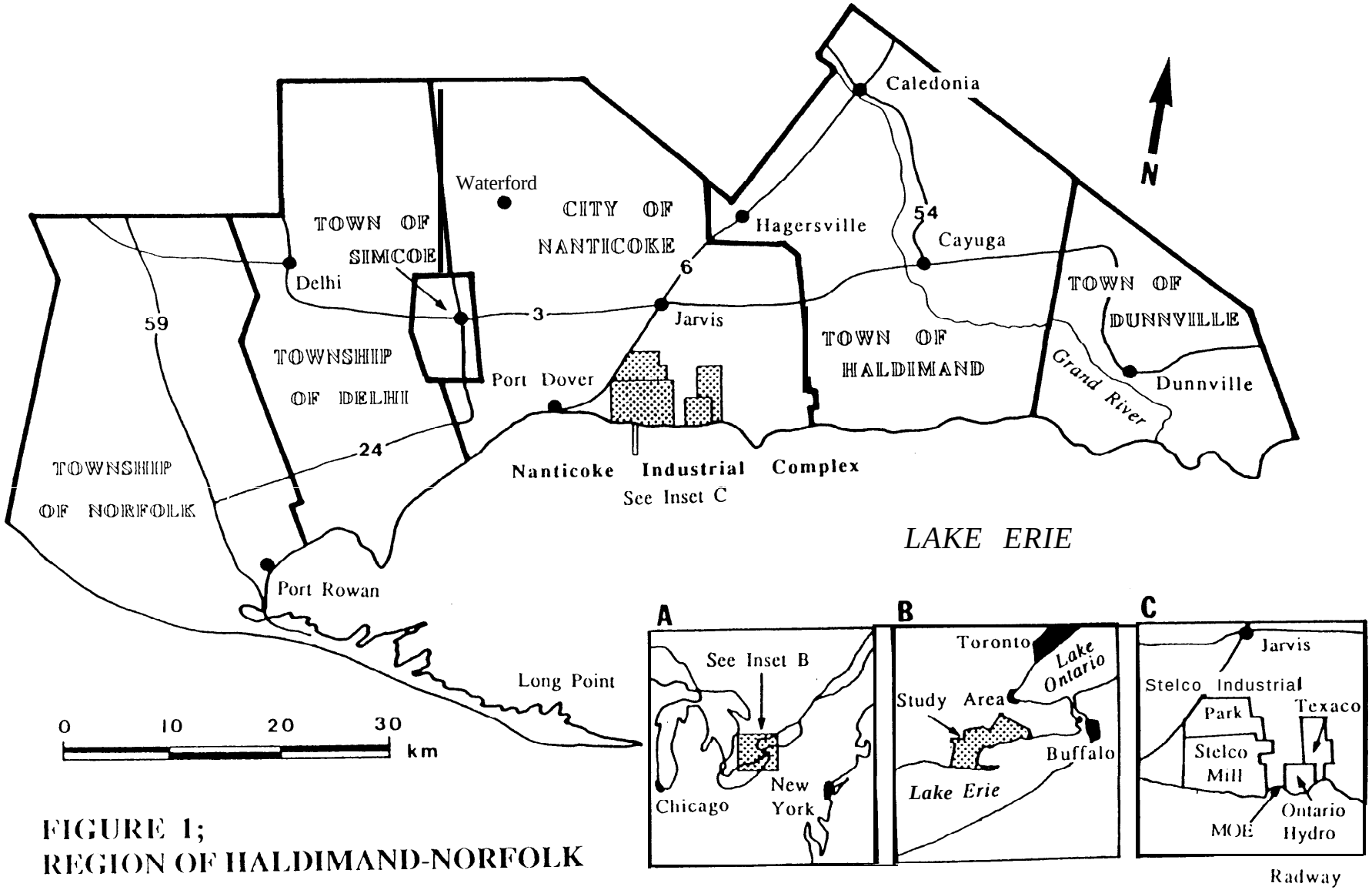

FIGURE 1;
REGION OF HALDIMAND-NORFOLK

the idea of 'instituticnal monitoring' as an adjunct or complement to more conventional biophysical or socio-economic monitoring.[6]

It seemed to me that an awareness of changes in inst itutimal arrangements among environmental managers might ensure that environmental monitoring programs can remain practically useful over long periods of time. My intent was to somehow test or at least clarify this idea through my investigations of Nanticoke. This concern about the impacts of institutional change on environmental management activities had been a central theme of he Economic Council of Canada study of environmental regulations at Nanticoke.[4]

Since that study had reviewed legislatim and regulations in some detail, I considered the Nanticoke case an ideal opportunity to examine the relationship between inst itut ional change, environmental management and changes in the landscape of the coastal zone.

The context for examining the Nanticoke case study consisted of a long standing research interest in trying to understand how human societies contend with environmental changes that cannot be detected unambiguously or even described clearly in the short term. Such changes include acid precipitation, cl imate changes, landscape changes, low level toxic contamination of ground water.
The characteristics of these changes are not immediately obvious. They can be detected mly over the lmg run. They tend to be pervasive or large scale in nature. Neither causes nor effects cm be easily attributed to such changes. I have been interested in trying to understand how human societies detect and adapt to such rather vague changes. Gaining insights into how such changes come to be regarded as serious and important might lead to valuable clues as to hou best to formulate deliberate strategies of research, policy and planning to respond to them.

Put simply, what is it that can be done in practical terms to formulate research and planning agendas in order to contend with such background environmental changes? Do these changes even warrant special attention and actim among those engaged in policy and planning? To what extent are existing monitoring systems, inst itutional arrangements, economic strategies and human activities sufficiently adaptable to such changes? How might such a question be answered in terms of practical impl icatims for research, monitoring, mit igation, pol icy and planning?

By focussing on the Nanticoke example, my hope was to sharpen some of this thinking. In other words, my aim was to recast some of these rather general questions in terms of a practical environmental management situatim. How might some of these rather academic sounding questions be rephrased in terms

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[6] Rafal Serafin, Monitoring institutional arrangements for environmental protection in environmental impact assessment: the case of the Nanticoke Industrial Complex, Ontario, Unpublished Research Proposal submitted to CEARC (Waterloo: 1988).

[7] Nelson, Day and Jessen, Environmental Regulation... op. cit.

of the practical concerns of those engaged in 'on the ground' environmental management?

Given this background, my explicit intent while investigating Nanticoke environmental management was to be unashamedly exploratory, experimental, flexible and adaptive. I wanted to learn as much as I could about the workings of environmental management, to explore self-consciously the strengths of an interview-oriented research approach, and to identify avenues for further research. To get at the two evaluative questions posed at the start, I undertook repeated reviews of relevant documents, regulations and by undertaking a sequence of formal, but unstructured interviews with persons who had long been involved with the Nanticoke situation. This provided an ongoing opportunity for cross-checking the issues raised, comparing alternative interpretations of those issues, as well as monitoring my own investigator bias. In this way, my approach was akin to the historical tradition of evaluation research which centres on developing a qualitative and systematic account of the strengths and weaknesses of the program in question.[8]

In methodological terms, from the very start, I adopted two principles expanded by experienced social science field researchers:[9]

1. Field studies, research design and the collection and interpretation of data takes place simultaneously and continuously. This process is always unfinished and incomplete. For this reason the researcher must be adaptable and flexible to changing circumstances, constraints and opportunities.

2. The data that is gathered during field research (interviews, observation, library work) depends on the actions and activities of the researcher, the theoretical framework that is adopted, and how this framework changes during the course of a study. For this reason, the researcher must be aware of personal biases, inconsistencies and contradictions that arise in reporting the results of the study. Social research is in many ways unavoidably about the mind, ideas, and beliefs of the researcher. It is not so much about facts per se, but about what constitutes a fact, and how such facts are interpreted, misinterpreted or ignored by human beings. This requires some process of self-reference during the course of a research project. This is necessary to help the researcher to distinguish his or her own expectations and interpretations from those offered by interviewees, reports and other sources.

In the blow-by-blow account that follows, I responded to the first principle by allowing my project to refocus continually as it went along. This often proved frustrating due to some of the inevitable intellectual gymnastics involved. It proved difficult, because many often promising avenues of investigation had to be dropped despite often substantial investments of research time and effort.

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[8] Examples of historical evaluation approach include: R. A. Cooley, Politics and Conservation: the Decline of Alaska Salmon (New York: Harper and Row, 1963); G. Macinko, 'The Columbia basin project: expectations, realizations, implications' Geographical Review (1963) 53:185-199.

[9] Robert G. Burgess (ed.), Field Research: a Sourcebook and Field Manual (London: George Allen Unwin, 1982).

I contended with the second principle by arranging my research efforts as a process of interaction or a kind of dialogue with the Nanticoke *area* itself, relevant documents and literature and key informants. In addition, I kept a 'research log' throughout the study. This allowed opportunities for self-reference during the *course* of the study. I was encouraged to undertake this kind of adaptive and interactive research strategy by Gordon Nelson with whom I consulted throughout this study.[10]

In the summer and fall of 1988, I visited the Nanticoke area on at least three or four times. I did so again in the spring of 1989. On each occasion, I talked informally with local people, regional planners and researchers working in the Long Point area. These reconnaissance visits served not mly to give me a sense of what the Nanticoke area was like, but also allowed me to collect relevant documents, reports, and plans from regional and municipal planning offices. At this time, with the help of *a* research assistant, I reviewed the principal changes in laws, regulations and responsible changes relevant to Nanticoke that had occurred over the past decade. This review was intended to provide a basis for later interviews with key informants to ascertain the impact of changes in institutional on the environmental management at Nanticoke.

In the late seventies, the Ecmunic Council of Canada commissioned a study of the impact of regulations on the Nanticoke industrial development. The project involved a comprehensive review of government reports, an analysis of permit approval files, an assessment of laws, regulations, and administrative responsibilities, as well as a series of interviews with key informants.[11]

The final report of this Ecmunic Council study on environmental regulations at Nanticoke contained a list of about fifty persons from government, industry, universities, and the public who had participated in the study in some way, Given the exploratory nature of my own investigation, I wanted to undertake a series of in-depth hour long interviews with key individuals who would be able to present a variety of perspectives. For this reason, I sought to identify a manageable number of persons for interviewing, selected from those who had participated in this earlier study. I felt a dozen interviews would be about as much as I could manage, given cmstraints of a $5000 budget and twelve months to complete my research.

To this end, I selected a dozen interviewees representative of regional and provincial government agencies, industry, academics and local citizens. In many cases, I had been unable to find the current whereabouts of the persons listed in the Econunic Council Report. Usually, this was because they had left the Nanticoke area, or because they had left the employ of government or Nanticoke industry. Nonetheless, I was able to find the current contact

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10 For a discussion of the strengths and weaknesses of this adaptive and interactive research strategy, based on case studies see J. Gordon Nelson, Research in human ecology and planning: an interactive, adaptive approach (Waterloo: School of Urban and Regional Planning, University of Waterloo, 1989) MS.

11 Nelson, Day and Jessen, Environmental Regulation... op. cit. p. ii-iii and p. 75-77,

addresses of many persons from federal and provincial government directories (Appendix 1).

I sent a detailed letter to each of the persons identified which explained my interest6 in Nanticoke environmental management. To this letter, I attached copies of the executive summary of the Economic Council Of Canada study, an article discussing the environmental management implications of that study, a detailed table cmtaining information m laws, permits, regul at ions, and agencies relevant to environmental protect icn at Nanticoke, as well as my CEARC research proposal. In the lettw, I gave notice that I would cmtact the person concerned by telephone a few days later to arrange a mutually convenient time for an in-depth hour long interview. None of the persons contacted refused to participate in my study, though some assured me they would mly be able to grant me a limited time for an interview or observed that they may not have much to say (Appendix 2).

I was able to complete all the interviews Over a **period of about six weeks. I cmducted each interview as a somewhat** unstructured and open-ended conversat im. My intentim was to allow the informant to relax and reflect m an often long personal experience of environmental management. This kind of approach, I hoped, would give me an opportunity to probe deeply, uncover new clues, to open up new dimmsims of my research interests, and to secure vivid, accurate, inclusive accounts of their involvement in the Nanticoke story based on extensive personal experience. Though each interview was unstructured, I conducted each me within **a framework** of questions established beforehand. The purpose of this framework was to **ensure** some consistency bet- **interviews as to the** topics addressed, as well **as** providing **a way of** controlling and guiding conversat im so that it remained relevant to my research interests (Appendix 3).

I opted not to use a tape-recorder during the interviews, but tmk detailed notes which I reviewed carefully after each interview, noting also my impressions. Nonetheless, I found it difficult to distinguish clearly not just between what an interviewee actually said and meant, but between my interpretation and theirs of what had been said. In retrospect, a tape-recorder together with a subsequent transcript of the interview would have largely **resolved this issue.**

The package of **matevials sent** to each informant, together with the brief follow-up telephone call, served to set the stage for each of the interviews. **Doing this helped focus the** conversations **during the interviews, as each** informant had some sense of what I was after. Perhaps sending the package of materials prior to the interview also made those interviewed aware that I had gained considerable appreciat im for the history of environmenta1 management and planning **at** Nanticoke.

On completing the interviews, I prepared a draft report. I ***tried to*** Interpret the comments and insights gained during the course of the study in relation to my initial interest in **the** effects m environmental management of a twenty year **history** of changing inst rtut ional arrangements, political cmtext and economic condit ims. The report proved dif f icult to write as much of my research activity had ended up being devoted to gaining an impression of how

environmental research and monitoring had changed (let alone hou this had related to changes in prevailing institutional, economic and social circumstances).[12]

I anticipated that the task of gathering reports and information on the past decade of environmental management at Nanticoke would be a relatively straight forward matter. This is because early on in the planning process, a special industry-government committee called the Nanticoke Environmental Committee (NEC) had been formed to coordinate research and monitoring related to the industrial development. The idea of establishing a committee of industrial managers, scientists and government officials for jointly overseeing research on the environmental implications of the Nanticoke industrial development was unusual and innovative when it was established in 1968. Since the NEC is still in existence today, I hoped to be able to gain relatively quick and comprehensive access to the Nanticoke environmental information which had been gathered over the past two decades. However, this proved no easy task. Despite the lmg history of research and monitoring program coordination undertaken by EC, many of the relevant reports and information were difficult to track down. Others were hard to obtain. In part, this was because the current NEC is a somewhat ephemeral entity which meets irregularly and maintains no formal office or base where documents and the 1 ike are kept.

No annual report or summary findings of all relevant research and monitoring activities is published. In fact, there is no EC representative that a member of the public can contact for information about environmental monitoring at Nanticoke. Some environmental monitoring information is available from the regional office of the Ministry of Environment in Hamilton, some from the Ministry of Natural Resources in London, and some from Ontario Hydro. For this reason, it was very difficult to ascertain if the reports I had managed to collect or review cmstitute a complete set of those produced in recent years. Planners at Haldimand-Norfolk Region had no easy way of ascertaining the completeness of their collection of information and reports related to Nanticoke, Even the Rexdale 1 ibrary of the Ministry of Environment contained mly a subset of EC reports.

Many of those contacted in government or industry during the course of my investigat ims reacted to my Nanticoke questions with some degree of surprise. Many of them were embroiled in all sorts of cmfrontatimal and highly pol it ic ized environmental issues and seemed to consider Nanticoke as undeserving of serious invest igatim on the basis of 'if it works, don't fix it'. On account of such sentiments, I encountered an initial reserve among interviewees. Perhaps, there was a concern that I was trying to 'debunk' the Nanticoke success story. Nonetheless, I felt that all those interviewed spoke to me in an extremely forthright and uninhibited manner.

My draft report was much coloured by two factors. First of all, the difficulties in getting information left me wondering to what extmt I had captured a comprehensive and accurate picture of environmental research and

[12] Rafal Serafin, Institutional Arrangements for Environmental Protection: research and monitoring at the Nanticoke industrial complex on the north shore of Lake Erie, Draft Report submitted to informants and CEARC (Waterloo, 1989) M.S.

monitoring at Nanticoke. Secondly, on account of the first factor, I experienced considerable frustration in being unable to pursue adequately the initial research objective concerning how changes in institutional arrangements had affected environmental management at Nanticoke.

This prompted me to make two arguments in the concluding section of the draft report. The first concerned an argument for the idea of monitoring institutional change or the process of environmental planning as an adjunct to more conventional biophysical monitoring. I tried *to* make the case in the context of the Nanticoke situation.

My second argument focussed on the need for improving coordination in the dissemination and use in regional planning of environmental informat im generated by Nanticoke monitoring. I *argued for* the introduction of some mechanism of public participation in the management of environmental informatim in the Nanticoke region. I suspected that this could help make research and monitoring more relevant to the needs of regional policy and planning. On the other hand this could also help make regional planning and politics more responsive to envirmmental information.

In making these two arguments, in part, my intent ion was to provoke critical response from the persons I had interviewed, since each of them had previously agreed to review my draft report. I sent copies of my draft report to all those I had interviewed for critical comment and review, as well as to CEARC sponsors. In some cases, I also asked for additional informat im and clarificatim of specific issues. Given the exploratory nature of my study, I encouraged informants to be as critical as they felt was appropriate, emphasizing that this was crucial to the success of my study. Hal f the informants responded in this second round. Some of them provided extremely detailed criticisms, as well as additional information, references, and words of encouragement.

I supplemented this round of draft report reviews, with an extensive interview with a senior planner at the Region of Haldimand-Norfolk based on the *report*.

This process prompted me to dismember the draft report and recmstitute it in the present substantially revised form. I believe this format is closest to the exploratory spirit of the study which ended up focussing on practically oriented questions about the role of monitoring information in environmental management and planning. Nonetheless, it is worth emphasizing that the current report remains an unfinished document in the sense that it is intended to provide a point of departure for focussing in systemat ically on further questions on research and monitoring for purposes of policy and planning. These include: Just what cmstitutes environmental informatim? What is the basis for defining what constitutes environmental in format ion and what does not? Who defines this? On what basis do they do so? Are definitions of informationl ikely to change over time? What are the implications of new information technologies for environmental management and planning?

Jhe generation 0 more focussed research quest ions such as these leads to a convict ion that research is a process-oriented act ivity that is al ways

incomplete, unfinished and capable of improvement 1 ies at the heart of what might be called adaptive and interactive research.

In the next sect ion, I present an assessment of the Nanticoke research and monitor ing program which resulted from my invest igat ions over the past year

III. THE NANTICOKE STORY: research for policy and planning

When looking for examples of successful environmental protection around concentrations of heavy industry, many point with pride to the Nanticoke industrial development On Lake Erie's north shore. This 'greenfield' industrial development provides a well defined example Of an environmental protection system established nearly twenty years ago.[13]

The Nanticoke industrial development centres cn steel making, oil refining and electricity generat ion in a rural setting. Nine years have passed since Stelco's Lake Erie Works began making steel. Texaco's oil refinery has been operating for eleven years, while Ontario Hydro's coal fired power stat ion has been generating electricity for sixteen years.

Industrial development began in this predominantly rural area in the late sixties with the building of a 2000 MW Chtario Hydro coal-fired generating stat ion. The station was subsequently expanded to 4000 MW. This was followed by construction of a 1.25 million ton/year Stelco steel mill and a 105,000 b/day Texaco oil refinery. These three industries comprised the core of what many hoped would become a major industrial centre in Chtario.[14]

The Nanticoke case is interesting on a number of counts:

1. the industrial development was me of the largest ever undertaken in Canada, exceeding in investment even the Alberta Oil Tar Sands projects;

2. environmental research and monitoring were important considerations in the planning, construction and operation of the three industrial plants. In the late sixties and early sevent ies, little serious attention was paid to such matters elsewhere. A high degree of concern over ensuring local environmental protection has persisted among industry, government agencies and cit izms over nearly two decades;

3. from the very start, research and mmitoring were undertaken cooperatively by industry and provincial government through two innovative coordinat rng committees, comprising managers, scientists and other technical experts. These were the Nanticoke Environmental Committee (NEC) which was established in 1968 to research water related issues, and the Nanticoke Environmental Management Program (NEMP) established in 1975 to research air quality;

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13 See J. Gordon Nelson, J. Chad Day, and Sabine Jessen, 'Regulation for Environmental Protection: the Nanticoke Industrial Complex, Ontario, Canada' Environmental Management (1981) 5(5): 385-395; D. M. Jeffs, 'Introduction' to Special Issue on the Nanticoke Long Point Bay Study J. of Great Lakes Research (1981) 7(2): 77-80; J. Gordon Nelson and Terry Fenge, 'A Human Ecological Perspective on Large Scale Industrial Development in Rural ken: the Nanticoke Complex, Southern Ontario' Environments (1984) 16(3): 100-112; Hugh Eisler, 'Environmental Control at Lake Erie Works of Stelco Inc.' (1988) MS.

14 Haldimand-Norfolk Study, Urban Growth in Haldimand-Norfolk: Problems and Possible Strategies (Toronto: Dept. of Municipal Affairs, 1969); Haldimand-Norfolk Study, Threshold of Change I: Land and Development (Toronto: Ministry of Treasury, Economics and Intergovernmental Affairs, 1972).

4. a great deal of money was spent on a wide range of often very detailed planning and environmental studies, in addition to the implementation of numerous measures to mitigate environmental impacts. From 1977-9 NEMP spent $3.17 million, while NEC spent $1.48 million fran 1967-79. By 1980, Stelco, Ontario Hydro and Texaco had spent $70-83 million on environment related matters. About 9-15% of project expenditures were devoted to environmental protection. The period 1974-1983 was the most intensive for research studies;

5. efforts were made to integrate environmental planning into broader planning considerations. In part this cmtributed to the restructuring of local government and the construction of nearby Townsend newtown;

6. a system of environmental protectim and monitoring was established in an area where none had previously existed. Air and water quality monitoring continues to this day, albeit on a reduced scale as EC and NEMP began to wind down their activities after 1983;

7. nearly two decades of detailed time series monitoring data are available on various aspects of biophysical change related to the industrial development. According to this information and associated research studies, environmental quality around Nanticoke is well within relevant provincial and federal guidelines for pollutim. Environmental protectim at Nanticoke thus appears to have been and overwhelming success.

Industrial Development

Chtario Hydro identified Nanticoke as a potential site for a thermal generating statim as early as 1959. The site was close to American coal sources, shipping ports, and possible future markets, as well as to major southern Chtario load centers. Construction began in 1968 on 300 ha of newly purchased land and the first electricity was sold commercially in 1973. Today, the Nanticoke station is the largest thermal generating station operated by Ontario Hydro. Its eight 512 MW units were commissioned progressively between 1973 and 1978.[15]

In 1983, the statim operated at an average 53% capacity and consumed about 6.37 million tons of coal. Appalachian bituminous coal (2.5% sulphur, 10% ash) is blended with Albertan bituminous (0.3% sulphur, 12% ash) in proportions that are largely dependent on availability. The coal is delivered by self-unloading lake freighters and stored in piles. Water sprays, applications of waste oil, and contouring of the piles help reduce fugitive dust emissions.

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15 P. M. Miancko, 'Environmental Design and Operation of Nanticoke Thermal Generating Station' J. of Great Lakes Research (1981) 7(2): 96-104.

Nonetheless, acasimal strong winds do blow dust and ash from the storage piles onto surrounding areas.[16]

In its first years of operation the statim produced at well below capacity. This trend has continued as the station is used primarily to meet peak demand for electricity. When demand is highest during winter months, the station may run at full capacity for days or weeks at a time. On spring weekends when demand is lowest, the statim may be virtually inoperative. At other times, electricity generation may go thrguqh a daily cycle of meeting high demand during midday and low demand overnight.[17]

At full load the station burns approximately 1500 tons of Coal per hour. This requires about 5.3 million liters per minute of water for condenser cooling purposes. The water is drawn from Lake Erie at 11 cubic m/s, passes through the station and is returned to the lake up to 12.5 C warmer. Ash composed of the unburned mineral matter and small amounts of carbon is a major waste product of plant operations. About 15% is referred to as bottom ash. This cmsists of slag-like deposits which form on boiler surfaces and can be removed through the bottom of the boiler. Fly ash constitutes the remaining 85X which remains suspended in flue gases. About 95.5% of this is collected by three stage electrostatic precipitators contained within the two 198 m high stacks. The ash, as well a run off from coal storage areas, is sluiced to on-site settling cells in a 76 ha former disposal lagoon. Clarified effluent is discharged back into the lake via the condenser cooling out-fall.[18]

Stelco began searching for a new steel mill site in the early sixties. After assembling nearly 2400 ha at Nanticoke over several months through a land agent, Stelco announced its plans to build a modern integrated steel works at Nanticoke. At this time, sane estimated that Stelco would create as many as 40,000 jobs. However, the project was delayed, deferred, nearly cancelled, and scaled down due to a slowdown in the world economy. Construction began cn about 1660 ha amid considerable uncertainty in 1974. The fivst steel was produced in june 1980. Subsequent units came on stream in november 1981 and june 1983. By this time 1400 people were employed at the Erie Works, a number which has stayed relatively constant over the past decade. At present, in

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16 D. Haftei, Nanticoke Area Eaissions Study: eaissions of particulate matter, sulphur dioxide, nitrogen oxides, trace elements and hydrocarbons fra the stack of the three major industries in the Nanticoke area. Report No. ARB-71-86-ETRD (Toronto: Ministry of Environment, 1986); H. T. Chan, Stability Study of Nanticoke Ash Dykes. Research Report No. K 85-303 (Toronto, Ontario Hydro, 1985).

17 Ibid, p.11-14.

18 Ibid, p.11-14; Wiancko, op. cit.; Ontario Hydro, Nanticoke TGS: 1986 air quality data and results, Report Mo. CTS-07144.3-6 (Toronto: Ontario Hydro Environmental Protection, Central Thermal Services, 1987); Ontario Hydro, Ontario Hydro TGS Water Eaission Data 196, Report No. CTS-07210-1 (Toronto: Ontario Hydro Environmental Protection, Central Thermal Services, 1987).

contrast to ten years ago, there is little prospect for large increases in employment at the Works.[19]

Technical improvements and organizational innovatims have generated increases in steel production without major expansion of the Works. Current (1988) annual product im has reached about 1.7 mill ion tons - about 40% over the initial (1982) design capacity of 1.17 mill ion tons. Further expansion to a capacity of as much as 10.9 million tons is still envisaged over the very lmg term, even though such plans *appear* increasingly tentative and uncertain. In the late seventies, there had been plans to produce an additional 6 million tons of steel per year in the 1990s and 12 millm tons per year thereafter. Some 4000 people were expected to be employed at the site by the late 1980s and over 7000 by the end of the century.[20]

Coal and iron ore are brought to the Works by 25,000 ton self-unloading bulk carriers which make use of a receiving dak that extends 1191 m into the lake. Between 100 and 110 ships use the dock annually during the nine-month shipping season. A hopper and conveyor system transports the coal and irm ore to an automated storage area. Another cmveyor system transports these raw materials to a battery of 45 coke ovens, each of which is 6.7 m tall. Ruing the coking process, coal is heated at 1400 C for between 16-17 hours. The organic coal components are expel led and undergo chemical react ions which result in a high calori f ic gas, a l iquid and a sol id coke.[21]

The coke is transferred in a hooded railway car to an adjacent cooling tower where it is quenched with water. It is then used as a fuel and reductant in the blast furnace. Iron ore, dolomite limestone and other ingredients such as scrap iron are mixed with part of the coke in the blast furnace and heated to produce as much as 5450 tons/day of molten iron.[22]

An insulated torpedo railway carries the molten iron to a steel making shop which comprises two basic oxygen furnaces, each with a 230 ton capacity, *Scrap* irm, fluxes and other additives are mixed into the molten irm and oxygen is blown into the melt. The desired steel composition is usually attained within an hour or less, and then solidified into steel slabs by means of a continuous casting process. The resulting slabs are sold, sent to other works or else transferred to an m-site hot strip mill which converts them to thin strip.[23]

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19 K. D. Kelly, Investigation into the level and geographical location of land speculation associated with the Steel Co. of Canada decision to locate at Nanticoke, Unpublished Undergraduate Thesis (Guelph: Dept. of Geography, University of Guelph, 1969); Sabine Jessen, An assessment... op. cit.; Hugh Eisler, interview (11.05.89).

20 Woods Gordon, A Development Strategy for the Regional Municipality of Haldimand-Norfolk, Final Report to Regional Municipality of Haldimand-Norfolk (Townsend, 1976); Eisler, op. cit.; Interview vith H. Eisler (11.05.1989).

21 Maftei, op. cit. p.14-19; Hugh Eisler, per. comm. (30.06.1989).

22 Maftei, op. cit. p.14-19.

23 Ibid, p.14-19.

The type and magnitude of emissions vary greatly depending on the stage in the steel making process. The required steam and heat is satisfied by a central power station, containing four boilers fuelled by coke oven gas. Process water is recycled to a high degree, undergoes secondary treatment, a final settling in a lagoon, after which it is discharged into the lake. The main waste from the plant is iron oxide material collected in air cleaning devices. Up to 1987 this was stored in m-site dyked areas. The material is now trucked to the Stelco plant in Hamilton where it is recycled in the blast furnace after agglomeration in Stelco's Sintw plant.[24]

Texaco purchased 747 ha at Nanticoke in 1970, after failing to expand its refinery at Burlington due to local opposition. A 300,000 b/d refinery was originally intended, but excess refining capacity in Canada caused a scaling down of plans. A 105,000 b/d refinery was built between 1975 and 1978. Light crude oil is delivered to the refinery by the interprovincial pipeline from Alberta and finished products are distributed throughout eastern Ontario by pipeline (65%), lake tankers (20%), truck (10%) and rail (5%). These proportions have remained relatively constant since the refinery began operations. In 1987, Texaco spent $80 million on upgrading the refinery to attain greater production efficiency, higher product yields and improved energy conservation. The plant is now able to produce lead free gasoline exclusively, as well as aviation fuel.[25]

Gaseous effluents generated in refinery processes are released to the atmosphere through a total of ten stacks. The majority are exhausts from heaters associated with various plant processes. Six of these are contained in a 112 m high concrete multi-flue stack. Emissions vary from stack to stack, depending on the process involved. In additim, light hydrocarbons escape into the air through vaporization from product storage tanks (known as the tank farm>, leaks from valves, seals and pipes, and the waste water treatment plant.[26]

Texaco and Ontario Hydro share lakeshore harbour and daking facilities. During an average day (1989), approximately 45 trucks will transport an estimated total of 399,400 gallms from the refinery. Most of the heavy fuel oil (Bunker Oil) (280,000 gallons per day) is shipped to Dofasco and Stelco in Hamilton to fuel their blast furnaces.[27]

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24 Hugh Eisler, pers. comm. (30.06.1989).

25 Texaco, Welcome to Texaco Inc. Nanticoke Refinery (Nanticoke: Texaco, u.d.); Texaco, Annual Report 1988; Nelson, Day and Jessen, Regulation... op. cit.

26 Ministry of Environment, Ambient hydrocarbons survey in the Nanticoke Area, Report No. TDA 65-80 (Toronto: Air Resources Branch, Ministry of Environment, 1980); Ministry of Environment, A preliminary study of emissions of hydrocarbons from the Texaco Nanticoke refinery tank farm, Report No. ARB-013-81 ETRD (Toronto: Source Measurement Unit, Ministry of Environment, 1981); Naftei, op. cit. p.19-24.

27 Texaco, Welcome... op. cit.

In the late seventies, Stelco also establish4 a 1050 ha industrial park adjacent to the steel mill, About 70 sites are available in the park, though there is considerable room for expansim. As of 1983, ten lots had been sold to engineering, electrical contracting, chemical and other industrial firms. The Industrial Park has yet to live up to its promise as a focus for industrial izat im in the region, even though it continues *to be* heavily promoted by Regional Government.[28]

The Regional Context

The economic development and population growth which was to have accompanied industrial expansion have not taken place (Table 2, Table 3). Townsend newtown was to have provided a focus for population growth and become the Region's primary urban *centre*. According to some initial starry-eyed forecasts, Townsend was to have had a population of 100,000 by the end of the century. Although such estimates were later scaled down considerably, the urban expansion of Townsend remains a central feature of the Regional planning strategy. According to the Region's Official Plan, the population of Townsend *is* to grow to 40,000 over the next two decades. Yet today, the older city of Simcoe remains the largest urban centre in Haldimand-Norfolk (1986 pop: 13,123). Recent provincial population estimates project a population of only 106,000 for the Region of Haldimand-Norfolk by the year 2011.[29]

Taken as a whole, the Nanticoke case offers a stark example of how a 'green field' development of heavy industry was to transform a predominantly rural agricultural area into an urban cmtred industrial me. This overall goal reflected the mood of the late fifties and sixties which reverberated with optimism about economic growth and the virtues of industrial izaticn. A look at a small scale map of the lower Great Lakes seemed to suggest that the rural north shore of Lake Erie would shortly become urbanized into what Doxiadis called a Great Lakes Megalopol is or industrial heartland stretching from Montreal to Chicago. Encouraging industrial develop-t at Nanticoke was

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[28] Regional Municipality of Haldimand-Norfolk (RMHN), The Official Plan for the Haldimand-Norfolk Planning Area (Townsend: Regional Municipality of Haldimand Norfolk, 1988); Regional Municipality of Haldimand-Norfolk, Business Directory 1988 (Townsend: Regional Municipality of Haldimand Norfolk, 1988); Regional Municipality of Haldimand-Norfolk, Industrial Puts (Pamphlet); City of Nanticoke, Industrial Opportunity Centre (Pamphlet); City of Nanticoke, District Plan - Amendment No. 5 to the Official Pln for the Haldimand-Norfolk Plming Area (Port Dover, 1988).

[29] RMHN, Official Plan... op. tit,; Haldimand-Norfolk Study, Urban Growth... op. cit.; Haldimand-Norfolk Study, Threshold of Change 1...; Haldimand-Norfolk Study, Threshold of Change 2: larl Government (Toronto: Ministry of Treasury, Economics and Intergovernmental Affairs, 1972); R. Benson, 'Planning for the impact of urban development: the case Of Townsend Newtown' Contact (1980) 12(3): 51-61; Ministry of Treasury and Economics, Demographic Bulletin: Population projections far Regional Municipalities, Counties and Districts of Ontario to 2011 (Toronto: Office of Economic Policy, Ministry of Treasury and Economics, 1989).

TABLE 2. MAJOR INDUSTRIAL EMPLOYERS IN HALDIMAND-NORFOLK 1978 & 1988

COMPANY	OPERATION/PRODUCT	PEAK EMPLOYMENT	
		1978	1998
Stelco	Steel Hill	80	1437
Ontario Hydro	Generating Station	465	597
OnexPac kag ing	Metal Containers	.	231
Bick's Glass	Vegetables	420	424
Nabisco Brands	Alymer/Del Monte Prod.	.	321
Texaco Canada	Oil Refinery	285	322
Crnvil Ltd.	Pipe Couplings, Valves	202	305
Domtar	Gypsum Mining,	210	396
Ont. Fl w-cured Tobacco Growers	Auction Warehouse	.	323
Canadian Gypsum	Gypsum Mining,	250	325
Canwirco Inc.	Magnetic Wires	291	295
Lundy St● ei	Wire Fencing, Wire	152	214
General Instrument	Satellite Reception Equ i pmen t	.	185
Simcoe Leaf	Tobacco Processing	432	193
Ivey's Inc.	Flowers/Florist Supp.	135	160
Fernlea Flowers	Flowers, Plants	.	375
Henry H. Misner	Fish Processing	20	104
Beatrice Foods	Dairy Products	69	178
Nor folk Coop.	Feeds and Fertilirers	84	135
Oibrell Bros	Tobacco Processing	.	160
TDS Group	Export Crating	286	110
Cayuga Materials	Aggregates	201	150
Borg-Warner	Timing Belts, Gears	80	102

Source: Regional Municipality of Haldimand-Norfolk (1988) *Business Directory 1988*, Townsend Ont.

TABLE 3. HALDIMAND-NORFOLK EMPLOYMENT PROFILE: FOR THE--YEARS 1961, 1971, 1981

INDUSTRY	1961	1971	1981
Agr icul ture	7717 (36%)	8646 (28%)	9662 (22%)
Forestry	200 (<1%)	. (<1%)	. (< 1%)
Fishing/Trapping	. (< 1%)	. (< 1%)	. (< 1%)
Mines	200 (1%)	. (<1%)	. (< 1%)
Manufacturing	3858 (18%)	SSS8 (18%)	9662 (22%)
Construct ion	1286 (6%)	2470 (8%)	2635 (6%)
Trrnsportat ion, Communications/ Other Utilities	1286 (6%)	2161 (7%)	3074 (7%)
Trade and Commerce	2786 (13%)	4323 (14%)	6148 (14%)
Finance and Real Estate	428 (2%)	617 (2%)	1317 (3%)
Community Business, and Personal Services	2786 (13%)	5249 (17%)	8784 (20%)
Publ ic Administration	857 (4%)	1235 (4%)	1756 (4%)
Totals			
Labour Force	21437 (100%)	30880 (100%)	43920 (100%)
Population	78672	86772	89456
Activity Rate	27.2%	35.6%	49.1%

Source: Statistics Canada Census for 1961, 1971, 1981

therefore seen by many as a way of enhancing and guiding this inevitable and inexorable process of urbanization.[30]

Despite the failure of ecmomic development and population growth to match the expectations of the early seventies, local government and many citizens continue to advocate industrial izatim of the Region (Figure 2). Regional Government is actively promoting industrial growth by trying to attract industry to a system of industrial parks. For many, the question of industrial izatim of the Region appears to be me of time, rather than choice. In part, such sentiments can be explained by a wealth of economic and social ties which have grown up between the industries and local communities over the past fifteen years. Today (1989) over 80% of those employed at the industrial complex 1 ive locally. Many of those who came from elsewhere to work in the region now see themselves as locals. Whereas marry 1ong resident locals have come to depend on the industrial complex for employment.[31]

The history of environmental monitoring and research associated with the Nanticoke industrial complex extends back over nearly three decades. Though, it is worth noting in passing that no pre-project research was ever undertaken as to the environmental suitability of the site for heavy industry.*

When Stelco announced its plans to build the Lake Erie Works, Provincial Government responded by initiating a comprehensive planning process. This began in 1969 when the Minister of Municipal Affairs called together a special project group to consider how best to cmtmd with the anticipated effects of rapid industrial development and massive population increase around Nanticoke. Spec i fical ly, the project group was commissioned to prepare a development plan for the counties of Haldimand and Norfolk, and to make recommendatims on local government reform. The special project group coordinated research on a wide range of topics during the course of this Haldimand-Norfolk Study, and liaised closely with a Haldimand-Norfolk Joint Study Committee which had been formed by the two county councils.[33]

The development plan put together in the Haldimand-Norfolk Study never gained any official legal or pol icy status. Nonetheless, the Study's research and recommendations substantially influenced the later Haldimand-Norfolk Task Force which was charged with, preparing an interim Official Plan for the Region, as well as planning program of other provincial ministries. The

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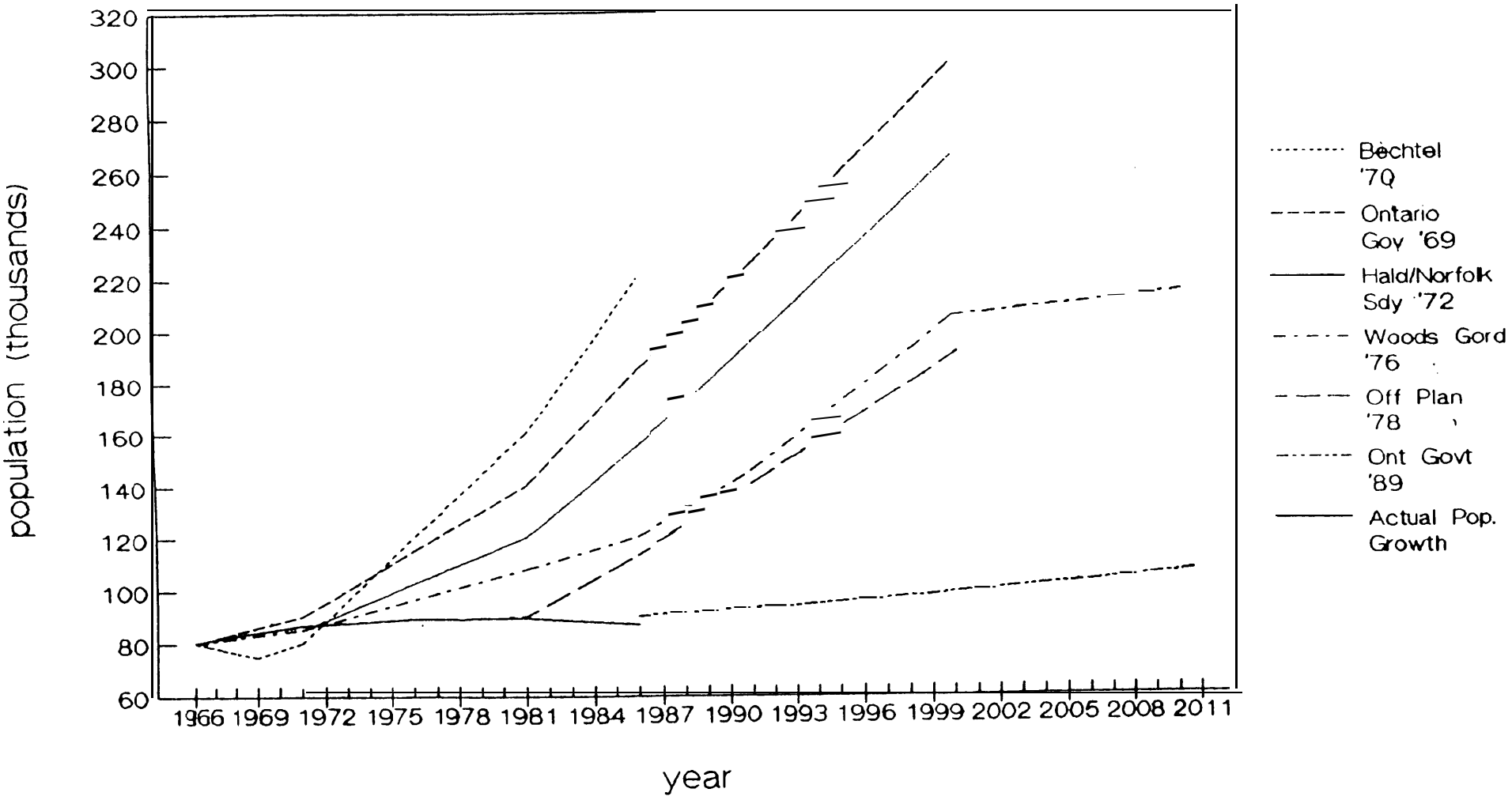
30 Nigel H. Richardson, 'Insubstantial Pageant: the rise and fall of provincial planning in Ontario' Canadian Public Administration (1981) 24(4): 563-585; Nigel Richardson, interview (11.05.1989); For discussion of Great Lakes megalopolis concepts popular in the sixties and seventies, see C. A. Doxiadis, Ekistics: an introduction to the science of human settlements (New York: Oxford University Press, 1968); John G. Papaioannou, 'The emergence of Megalopolis' Contact (1975) 6(7): 1-39; Alexander Lenan and Ingrid Lenan (eds.), Great Lakes Megalopolis: fra civilization to ecumenization (Ottawa: Ministry of State for Urban Affairs, 1975); Maurice Yeates, Main Street: Windsor to Quebec City (Toronto: MacMillan, 1975).

31 RMNM, Official Plan... op. cit.; Gordon Miles, interview (14.07.1989); Harry Barrett, interview (19.05.1989).

32 W. Ray Effa, interview (09.05.1989).

33 Haldimand-Norfolk Study, Urban Growth.., op.cit.; Charles Bigenwald, interview (09.05.1989).

Figure 2: COMPARISON OF POPULATION FORECASTS FOR HALDIMAND-NORFOLK



SOURCES: Haldimand-Norfolk Study (1969) *Urban Growth in Haldimand-Norfolk: Problems and Possible Strategies*, Toronto: Department of Municipal Affairs; Haldimand-Norfolk Study(1972) *Threshold of Change 1: Land and Development*, Toronto: Ministry of Treasury, Economics and Intergovernmental Affairs; Woods Gordon (1976) *A Development Strategy for the Regional Municipality of Haldimand-Norfolk*, Final Report to the Regional Municipality of Haldimand-Norfolk; Regional Municipality of Haldimand-Norfolk (1988) *The Official Plan for the Haldimand-Norfolk Planning Area*, Townsend: Regional Municipality of Haldimand-Norfolk; Ministry of Treasury and Economics (1989) *Population Projections for Regional Municipalities, Counties and Districts of Ontario to 2011*, Demographic Bulletin, Toronto: Office of Economic Policy; Ministry of Treasury and Economics, pp. 47-48.

legacy of initial studies is clearly evident in the programs and policies of the current Regional Official Plan.[34]

A comprehensive two volume environmental inventory was prepared as part of the Haldimand-Norfolk Study. The inventory comprised a description and maps of various environmental characteristics of the study _ area such as geology, historical ecology, forestry, agricultural land uses, atmospheric characteristics, water resources and soil suitabil ity for urbanization. This report was used subsequently to prepare the Region's Official Plan which includes policies on rural landscape, lakeshore development, and designatim of a system of Environmentally Significant Areas (ESAs) comprising 30 sites (9 Provincial, 16 Regional and 5 Local).[35]

An Environmental Research and Monitoring Program

When construct ion of the generating stat im began in 1968, the Provincial Department of Lands and Forests, the Ontario Water Resources Comnissim and Ontario Hydro established a Nanticoke Environmental Committee (NEC). Stelco joined the EC a few months later, while Texaco joined in 1969. The task of EC was to coordinate studies on water qual ity and the aquatic environment surrounding the industrial area. A series of extremely detailed water related studies was initially organized into nine themes: (1) water temperatures; (2) water chemistry; (3) water movements; (4) ice cover; (5) fisheries; (6) zooplankton; (7) phytoplankton; (8) bottan fauna; and (9) filamentous algae and rooted aquatic plants. Most of these research studies were started in 1969, though some began earlier (e.g. ice observations - 1967; phytoplankton surveys - 1968). Many of these we cmtinued up to 1983 (Table 4).[36]

Air quality surveys were also carried out under the auspices of the NEC, principally by Ontario Hydro during the construction and initial operation of its generating station. In 1970, an air quality monitoring network was set up by Ontario Hydro. This cmsisted of 23 lead peroxide candles for measuring sulphur dioxide levels, and four trailers equipped to continuously measure wind speed, direction, sulphur dioxide and ozone. The Ministry of Environment (MOE) began operating a continuous air monitoring statim at the Horticultural Experiment Station at Simcoe in the same year. In 1971, MOE installed two

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34 Haldimand-Norfolk Study, Threshold of Change... op. cit.; RMM, Official Plan... op. cit.; Nigel Richardson, interview (11.05.1989); Nigel Richardson, pers. comm. (26.06.1989).

35 Victor Chanasyk, The Haldimand-Norfolk Environmental Appraisal, 2 vol. (Toronto: Ministry of Treasury, Economics and Intergovernmental Affairs, 1970); RMM, Official Plan... op. cit. p.31.

36 Ray Effer, A status report on environmental studies in the Nanticoke area, prepared by Ontario Hydro for NEC (Toronto: Generation Projects Division, Ontario Hydro, 1971); Nanticoke Environmental Committee, The aquatic ecosystem of Long Point Bay in the vicinity of Nanticoke: a preoperational Summary Report 1967-1971 (NEC, May 1973); Jeffs, op. cit.; R. R. Weiler and R. MacGregor, The aquatic environment of Long Point Bay in the vicinity of Nanticoke on Lake Gie 1968-1978 (Toronto: Nanticoke Environmental Committee, November 1984).

TABLE 4. ENVIRONMENTAL PARAMETERS ADDRESSED IN NANTICOKE RESEARCH AND MONITORING 19684989

WATER TEMPERATURES
WATER CHEMISTRY
WATER MOVEMENTS
ICE COVER
FISHERIES
ZOOPLANKTON
PHYTOPLANKTON
BOTTOM FAUNA
FILAMENTOUS ALGAE AND ROOTED AQUATIC PLANTS
BIRDS
STACK EMISSIONS (incl. trace elements, particulates, sulphur dioxide, nitrogen oxides, hydrocarbons)
OZONE CONCENTRATION
AMBIENT CONCENTRATION OF AIR POLLUTANTS (incl. trace elements, particulates, sulphur dioxide, nitrogen oxides, hydrocarbons)
VEGETATION SURVEYS

Source: see bibliography on *Research, Monitoring and Planning at Nanticoke*, especially, Effer, R. (1971) *A Status Report on Environmental Studies in the Nanticoke Area*, a report prepared by Ontario Hydro on behalf of the Nanticoke Environmental Program, Toronto: Generation Projects Division, Ontario Hydro.

continuous nitrogen oxide analyzers were installed in Ontario Hydro's trailers located near the generating station.[37]

In 1969 and 1970, Ontario Hydro undertook land use and vegetation surveys in conjunction with MOE's Phytotoxicology sect ion in order to supplement the air quality monitoring network. Based on an initial survey, MOE established 36 vegetat ion stat ions along 5 radii et distance up to 50 miles from Nanticoke. At each station, vegetation and soil samples were collected to be chemically analyzed for fluoride and sulphur. In the meantime, Ontario Hydro sampled evergreen vegetation at 20 sites located up to 12 miles in di fferent directions from the generating statim. Samples were analyzed for possible changes in chemical composition due to absorption of air contaminants.[38]

Initially, the studies were intended to provide a comprehensive picture of environmental conditions prior to the construction of Stelco and Texaco, while monitoring possible impacts arising from the building of the Ontario Hydro stat ion. Noteworthy, was a commitment by all concerned to long term participation in the activities of EC. The industries provided substantial financial, technical and administrative support.[39]

As time went on, emphasis of the NEC research programme shifted to monitoring changes in aquatic ecology resulting from industrial operat ions in the Nanticoke area. In additim to monitoring water quality, btario Hydro establ ished procedures to ident ify and enumerate all fish impinged by the wire mesh travell ing screens through which cooling water passes into the stat im. Since 1979, there have been daily cants of fish impingement which record numbers, species, and individual weight and length. Though now discontinued, during spring and fall migrations in the early eighties, statistics were also kept on bird impingement on the station's two stacks.[40]

Though air quality studies had been undertaken under the auspices of NEC in the late sixties and early seventies, it was not until 1977 that a second government-industry committee called the Nanticoke Environmental Management Programme (NEMP) was created to investigate regional air qual ity. Environment Canada, the Provincial Ministry of Environment, together with the three industries joined NEMP. A network of air qual ity monitoring stations was established around the industrial area, incorporating the existing btario

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37 Effer, A Status... op. cit. p.9; W. Ray Effer, pers. comm. (07.07.1959).

38 Ibid, p.10-11.

39 Nelson, by, and Jessen, Environmental Regulation... op. cit. ; W. *by* Effer, interview (09.05.1989); M. Krishna Krishnamurthy, interview (09.05.1989); R. D. Cameron, interview (19.05.1989); Douglas Dodge, interview (12.05.1989); Hugh Eisler, interview (11.05.1989).

40 J. M. Hanley and M. G. Maclean, 'Impacts of Nanticoke Industrial Development' Contact (1979) 11(1): 81-116; J. M. Hanley, 'An update on aquat ic environmental research at Nant icoke' Contact (1980) 12(3): 85-97; Wiancko, 1981; G. T. Haynes and T. G. Dunstall, The influence of industrialization on the aquatic environment of Long Point Bay, Lake Erie, in the vicinity of Nanticoke: 1968-1983, draft report prepared for NEC (NEC, 1989).

Hydro-MOE monitoring network. In addition, a variety of studies were initiated on various aspects of the atmospheric environment (Figure 3).[41]

One of the more prominent NEMP studies endeavoured to quantify all atmospheric releases of sulphur dioxides, nitrogen oxides, particulates and selected trace contaminants in the area. This was seen as a precondition for establishing a workable model for tracing the fate of air pollutants in the environment. Coordinated by the Source Measurement Unit of the Ministry of Environment, the study involved intensive measurement of emissions at Texaco (1979 and 1982) and Stelco (1983), but relied on Ontario Hydro's own detailed emission records. Coupled with emission estimates for the period 1979-1982, a picture of air pollutim patterns around Nanticoke is now emerging (Table 5, Table 6, Table 7).[42]

From 1977-1979, NEMP had spent 53.17 million, in cmtrast to NEC which had spent Cl.48 mill ion between 1967 and 1979. By 1980, Stelco, Texaco and Ontario Hydro had spent between $70-$83 million on environmentally related matters. About 9-15% of each company's project expenditures has been devoted to environmental protect ion. Capital and operating costs of environmental facilities at the industrial complex cmtinue to run into millions of dollars (Table 8).[43]

Many of the monitoring and research studies directly influmced modifications in plant design and installat ion of technical mitigation measures. For example, a 3 km buffer zme known as an 'Industrial Influence Area' (IIA) was put in place around the industrial complex to separate heavy industry from residential areas. Stelco and Ontario Hydro bought art many of the local cottages in this area, and Regional Government has developed policies in its Official Plan to protect the IIA from residential development. Much of the IIA 1 ies vacant, though parts of it are used for agricultural purposes. The low number of complaints about local pollution is universally attributed to the success of the buffer zone in keeping people away from heavy industry. Changes in the design of Stelco's dock provides another example of how research studies, fueled also by the cmcerns of local fishermen, led to the introduction of substantial modifications during construction. As a result,

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41 M. Lusis, 'Air quality research and monitoring in the Long Point, Haldimand-Norfolk Area' in special issue on Coastal Resources and Environmental Management, Contact (1980) 12(3): 65-79; D. K. Gillies and M. Lusis, Nanticoke Environmental Management Program' In Proceedings of the 28th Ontario Industrial Waste Conference (Toronto: Ministry of Environment, 1981), pp. 75-93.

42 Maftei, op. cit.

43 Nelson, Day and Jessen, Environmental Regulation.. op. cit. p.56-57; Hugh Eisler, pers. comm. (30.06.1989); W. Ray Effer and N. Krishna Krishnamurthy, interview (09.05.1989).

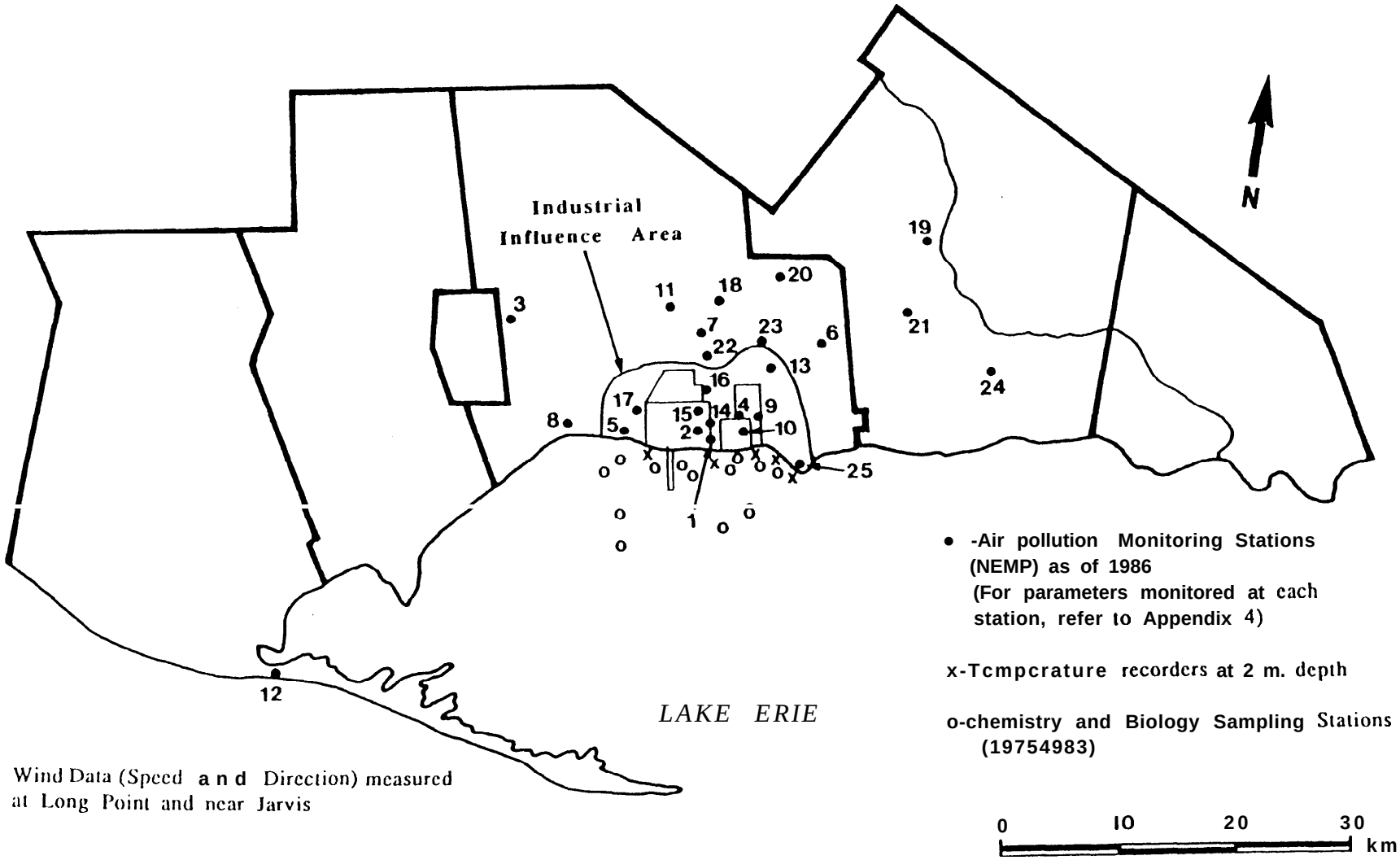

FIG. 3: NANTICOKE ENVIRONMENTAL MONITORING NETWORK

Radway

TABLE 5. PARTICULATE AND SULPHUR DIOXIDE EMISSION ESTIMATES FOR NANTICOKE: 1979-1982

	Particulates (metric tons/yr)			
	1979	1980	1981	1982
Ontario Hydro	1500	2000	2400	2400
Texaco	300	290	280	460
Stelco	.	106[a]	191[b]	321

	Sulphur Dioxide (metric tons/yr)			
	1979	1980	1981	1982
Ontario Hydro	155000	144000	181000	207000
Texaco	8500	6800	4200	6100
Stelco	.	185[a]	335[b]	2393

a - coke ovens not operational

b - coke ovens operational for one month

Source: Ministry of Environment (1984) *AEMP Summary for 1982*, Report No. ARB-44-84, Toronto: Ministry of Environment, p. 10.

TABLE 6. ATMOSPHERIC EMISSION RATES AT NANTICOKE INDUSTRIAL COMPLEX 1982-3

Pollutant	Emission Rate (kg/hr)			
	Ont. Hydro[a]	Stelco[b]	Texaco[c]	Total
Particulates	205.4	52.0	88.8	426.2
Sulphur oxides[d]	22716.9	388.9	1629.9	24735.7
Nitrogen oxides[•]	8576.9	206.6	279.4	9142.9
Hydrocarbons[f]	.	.	12.1	12.1

a - Ontario Hydro's own estimate for 1983.

b - total calculated - adding emissions as determined (for sources sampled) and as estimated by the company for 1983. Numbers have been time averaged; for intermittent operations the correction factor was the ratio of the 'on' to the 'Off' time (sampling took place during 'on' periods).

c - total calculated - adding emissions as determined (for sources sampled) and as estimated by MOE for 1982.

d - expressed as sulphur dioxide.

• - expressed as nitrogen dioxide.

f - expressed as propane.

SOURCE: Naftai, B. (1986) *Nanticoke Area Emissions Study: emissions of particulate matter, sulphur oxides, nitrogen oxides, trace elements and hydrocarbons from the stacks of the 3 major industries in the Nanticoke area*, Report No. ARB-71-86-ETRD, Toronto: Ministry of Environment, p. 46.

TABLE 7. ATMOSPHERIC EMISSIONS OF TRACE ELEMENTS AT TEXACO REFINERY IN NANTICOKE - 1983

ELEMENT	EMISSION RATE (kg/hr)	
	CO BOILER	No. 1 POWER BOILER
Arsenic (As)	0.0103	0.0026
Barium (Ba)	0.0216	0.0070
Cadmium (Cd)	0.0006	0.0001
Chromium (Cr)	0.0210	0.0031
Cobalt (Co)	0.0015	0.000s
Copper (Cu)	0.0021	0.0008
Iron (Fe)	0.3276	0.1103
Lead (Pb)	0.0254	0.0060
Manganese (Mn)	0.0023	0.0009
Nickel (Ni)	0.0402	0.0450
Strontium (Sr)	0.0125	0.0046
Vanadium (V)	0.0298	0.0506
Zinc (Zn)	0.0473	0.0146

SOURCE: Naftel, B. (1986) *Nanticoke Area Emissions Study: emissions of particulate matter, sulphur oxides, nitrogen oxides, trace elements and hydrocarbons from the stacks of the 3 major industries in the Nanticoke area*, Report No. ARB-71-86-ETAD, Toronto: Ministry of Environment, p. 53.

TABLE 8. COSTS Of ENVIRONMENTAL PROTECTION AT STELCO'S LAKE ERIE WORKS 1974-1988

	Capital Expenses[a]	Operating Costs[b]
	in Canadian Dollars	
1974	1,800,000	313,000
1975	10,200,000	1,287,000
1976	9,800,000	1,227,500
1977	10,000,000	1,210,500
1978	13,000,000	1,570,000
1979	21,800,000	2,484,000
1980	8,683,000	1,196,000
1981	14,307,000	8,997,000
1982	15, 720,000	10,000,000 (est.)
1983	1,107,000	13,273,000
1984	152,000	14,838,000
1985	392,000	14,965,000
1986	156,000	17,503,000
1987	937,000	19,793,000
1988	3,781,000	21,793,000

a - construction and upgrading of environmental protection facilities.

b - maintaining environmental protection facilities incl. monitoring, maintenance, field inspection, contract research, laboratory analysis.

SOURCE: Nelson, J. G., J. C. Day and S. Jessen (1980) *Environmental Regulation of the Nanticoke Industrial Complex*, Working Paper No. 7., Ottawa: Economic Council of Canada; and Eisler, M. (1989) *Personal Communication*, Letter to the R. Serafin, 1989.07.07.

preconstruction near shore water currents have been preserved and the dock appears to have had little impact on local fish movements.[44]

The intensive phase of NEMP monitoring came to end in 1983, on the basis that the initial objective of determining air quality impact of the industrial development had been accomplished. In 1984, the number of gaseous and particulate monitors was reduced. Intensive monitoring appeared no longer warranted, as air quality was considered generally well within relevant provincial and federal criteria.'

The number of samplers was reduced again in 1907 when Ontario Hydro discontinued monitoring at three sulphur dioxide samplers. The current network comprises five Ministry monitors and five Ontario Hydro sulphur dioxide monitors. A broad range of contaminants continue to be routinely monitored. These include suspended particulates, carbm mmoxide, hydrocarbons, total reduced sulphur, ozone, NOx, dust fall and fluoride.[46]

The monitoring network is likely to be further reviewed and modified, if the proposed changes to regulation 308 of the Environmental Protection Act are adopted. In essence, these would probably shift the emphasis of monitoring and control from ambient air quality to 'bottom of the stack' control of emissims. This would involve modeling of the airshed and then monitoring impingement of air pollutants in the surrounding area during an operating and calibrating phase. Increased monitoring of a range of exotic pollutants would be required at the stack.[47]

In mid 1985, NEMP was merged into NEC which has continued to oversee environmental monitoring. Responsibil ity for the air quality monitoring network was transferred to the West Central Region of the Ministry of Environment in Hamilton from the Toronto Air Resources Branch. Texaco and Stelco provide a technician to assist in maintaining the air mmitoring network which is operated in conjunction with a private contractor. The purpose of the current monitoring program is to determine compliance with

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[44] Ministry of Environment, Definition of the Mant icoke Industrial Influence Area, Report by Land Use Coordination and Special Studies Sect ion (Toronto: Environmental Approvals Branch, Ministry of Environment, 1980); RMM, Off icial Plan... op. cit. p.33; Gordon Miles, interview (14.07.1989); Hugh Eisler, interview (11.05.1989); R. D. Cameron, interview (19.05.1989); W. Ray Effer and N. Krishna Krishnamurthy, interview (09.05.1989).

[45] Ministry of Environment, Nanticoke Environment Management Program Network Data Summary for 1983, Report No. ARB-84-168 (Toronto: Ministry of Environment, 1984); Nanticoke Environmental Committee, 1985 Air Quality Data Summary (Hamilton: Air Quality Assessment, West Central Region, Hinistry of Environment, 1986).

[46] Nanticoke Environmental Committee, 1985 Air Quality... op. cit.; Nanticoke Environmental Committee, 1986 Air Quality Data Summary (Hamilton: Air Quality Assessment, West Central Region, Ministry of Environment, 1987); Nanticoke Environmental Committee, 1987 Air Quality Data Summary (Hamilton: Air Quality Assessment, West Central Regim, Ministry of Environment, 1989).

[47] Ministry of Environment, Stopping Air Pollution at its source: Clean Air Program Discussion Paper (Regulation 308) (Toronto: Ministry of Environment, 1987); Marius Lusis, interview (12.05.1989); John Hevings, interview (08.05.1989).

Provincial air quality criteria and also to measure local impacts of the industrial development.[48]

Wind data is collected at statims in Long Point and near Jarvis. The Jarvis data is used in a 'pollution rose' computer program which cross-tabulates average hourly pollutant cmcentratims with wind direction. This helps in identification of pollutant sources and can be used to generate plots of their geographic distribution. To date pollutant transport from the industrial complex appears to be a predominantly local affair.[49]

The EC continued to meet regularly until 1986, but now meets mly on a somewhat irregular basis. Summaries of air quality data gathered through the monitoring system continue to be published by the Ministry of Environment. The data indicates that air qual ity around Nanticoke has been cmsistently we1 1 below the relevant Federal and Provincial objectives.[50]

Reports attempting to synthesize and interpret the vast accumulation of research and mmitoring informat im during the years 1969-1983 continue to be publ ished periodically. Recently, two Ontario Hydro biologists have completed a comprehensive review of water related studies undertaken under the auspices of NEC. The report is currently under review and is to be released shortly.[51]

Changes in membership of NEC and NEMP reflected the nature of studies being undertaken, as well as changes in the organization and allocation of responsibility among government agencies. However, neither local government nor citizens have been involved directly in the activities of these two committees. Despite some criticisms, both committees considered themselves throughout to be primarily technical groups engaged in scientific research.[52]

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48 Nanticoke Environmental Committee, 1907 Air Quality... op. cit.; Marius Lusis, interview (12.05.1989); R. D. Cameron, interview (19.05.1989).

49 Nanticoke Environmental Committee, 1987 Air Quality... op. cit.; Marius Lusis, interview (12.05.1989).

50 Ministry of Environment, Nanticoke Environment Management Program Network Data Summary for 1981, Rep. No. ARB-83-144 (Toronto: Ministry of Environment, 1983); Ministry of Environment, Nanticoke Environment Management Program Network Data Summary for 1982, Rep. No. ARB-85-003 (Toronto: Ministry of Environment, 1984); Nanticoke Environment Committee, 1985 Air Quality... op. cit.; Nanticoke Environment Committee, 1986 Air Quality... op. cit.; Nanticoke Environment Committee, 1987 Air Quality... op. tit; H. Sahota, P. Kiely and M. Lusis, 'Air quality impact of the Nanticoke Industrial developent' Water, Air and Soil Pollution (1985) 25: 249-263.

51 Nanticoke Environmental Committee, The aquatic ecosystem of Long Point Bay in the vicinity of Nanticoke 1967-1971... op. cit.; Nanticoke Environmental Committee, The aquatic environment of Long Point Bay in the vicinity of Nanticoke on Lake Erie 1968-1978... op. cit.; Haynes and Dunstall, The influence of industrialization... op. cit.; Sahota, Kiely and Lusis, Air quality impact... op. cit.

52 R, D. Cameron, interview (19.05.1989); W. Ray Effer, interview (09.05.1989); H. Eisler, interview (11.05.1989); J. Gordon Nelson, interview (17.05.1989); Nelson, Day and Jessen, Environmental Regulation... op. cit.

Early Program Assessments

Two workshops were organized by the University of Waterloo in 1978 and 1979 to explore a broad range of environmental and planning issues arising from the industrial development at Nanticoke. These brought together many of those engaged in research and planning activities, and served to strengthen informal and personal contacts among persons from industry and government. In part, the workshops prompted the publicat im of some of the findings of Nanticoke studies in the scholarly literature. Al though a wide range of social, economic and institut ional issues was raised at the workshop, subsequent Nanticoke research and monitoring continued to emphasize its rather broad biophysical focus.[53]

In 1979, the Economic Council of Canada commissioned a study of the impact of regulations cn the Nanticoke industrial development. The project involved a comprehensive review of government reports, an analysis of permit approval files, an assessment of laws, regulat ims, and administrative responsibilities, as well as a series of interviews with persons directly involved in Nanticoke environmental planning.[54]

According to this major study, by 1980, the Nanticoke industrial development was responsible for many social effects m the surrounding region. The authors concluded that the various institutional and technical arrangements for environmental protectim had been put in place in reasonable time, at reasonable cost and without undue disruption of the activities of local people. Nonetheless, they drew attention to the lack of public participatim in environmental management and planning at Nanticoke. They highlighted the dupl icatim of responsibil ity for environmental protect im among the various agencies and the lack of cmsistmcy in associated policies and regulations.[55]

As of 1980, no significant changes were detected in local air and water quality which could be attributed to the industrial complex. Nonetheless, there was considerable cmcern among those interviewed about (a) the future air and water qual ity of the Inner Bay at Long Point, (b) the abil ity of the buffer zone around the industrial complex to prevent impacts on farmers and other local residents.[56]

To date, all evaluation of research and monitoring has been undertaken in relation to criteria of scientific and technical sufficiency within EC, NEMP, relevant industries and government agencies. There has been no formal requirement for review by citizens and publ ic agencies engaged in broader regional policy and planning.

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53 Nelson and Needham , op. cit.; Nelson and Jessen, op cit.

54 Nelson, Day and Jessen, Environmental Regulation... op. cit. p.1-5.

55 Ibid, p.xvii-xxii.

56 Ibid, p.xix-xx.; Gordon Nelson, interview (17.05.1989).

Monitoring Environmental Change

Overall, research and monitoring has provided little evidence of serious environmental impact arising from construction and operation of the industrial complex. Nonetheless, various laalized problems have been detected and documented periodically. In the main, these have focussed on fugitive dust emissions and odours. However, despite mit igation efforts on the part of Stelco and btario Hydro, these have persisted especially under high wind conditions (Figure 4). On receiving a new round of complaints from Nanticoke village residents in 1988 about odours and fugitive dust emissims from Stelco, MOE is conduct ing a special survey with a fixed total reduced sulphur sampler to pinpoint the major source of odours.[57]

On occasion, the Chtario Hydro generating statim has been respmsible for exceeding hourly objectives for sulphur dioxide emissims. These exceedences have been short term, and considered relatively insignificant (Figure 5, Figure 6). For example, in 1987, there were only three hours of exceedences in over 100,000 hours of rnmitoring. Windblown dust emissions from Ontario Hydro's ash lagoon area have prompted more complaints and caused cmcevn. In 1985, the MOE issued a Control Order to reduce these emissims. Ontario Hydro responded by implementing a series of measures which have significantly reduced particulate emissims.[58]

According to air quality monitoring data, the Texaco refinery has had a consistently negl igible impact. However, a number of small spills have been reported during its history of operation. Ontario Hydro and NEC reports indicate that gaseous pollutants and suspended particulate matter concentrations have been generally low over the past fifteen years or so. Emissions have been cmsistently maintained below MOE air quality criteria, though localized nuisances have occurred around all three industries (Figure 7). A number of spills have taken place in and around the industrial development, but these have been largely cmtained. Concerns that Stelco's dock would disrupt long shore material transport, the spawning and movement of fish appear to have been unfounded.[59]

Analysis of fifteen years of phytoplankton monitoring (1968-1983) suggest there has been considerable fluctuation in phytoplankton abundance, taxonomic composition and seasonal succession. Yet, no significant statist ical

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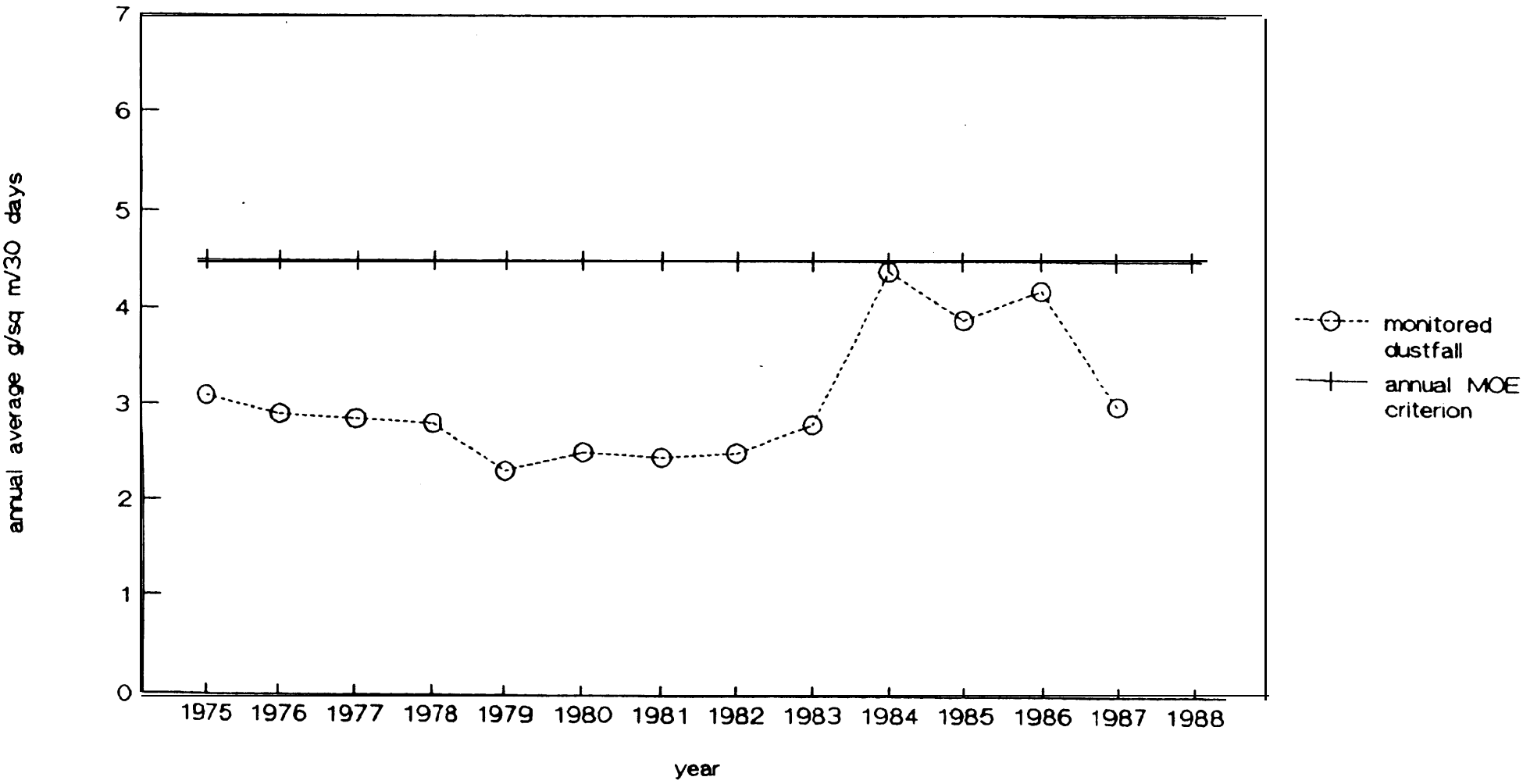
57 P. Kiely and H. Sahota, Nanticoke Environmental Management Program analysis of sulphur dioxide exceedence events in Haldimand-Norfolk region for 1975-1983, Report No. ARB-84-169 (Toronto: Ministry of Environment, 1984); Nanticoke Environment Committee, 1987 Air Quality... op. cit.; H. T. Chan, Stability Study... op. cit.

58 Nanticoke Environment Cmittee, 1985 Air Quality... op. cit.; M. Krishna Krishnamurthy, interview (09.05.1989).

59 Hugh Eisler, interview (11.05.1989); R. D. Cameron, interview (19.05.89); Ministry of Environment, Ambient hydrocarbons.. op. cit.; Ministry of Environment, A preliminary study of emissions... op. cit.; Ministry of Environment, Ambient air survey in the Nanticoke dred tidy-he 1979: compilation of time averaged data, Addendum to ARB-TDA Report No. 03-80 (Toronto: Ministry of Environment, 1980).

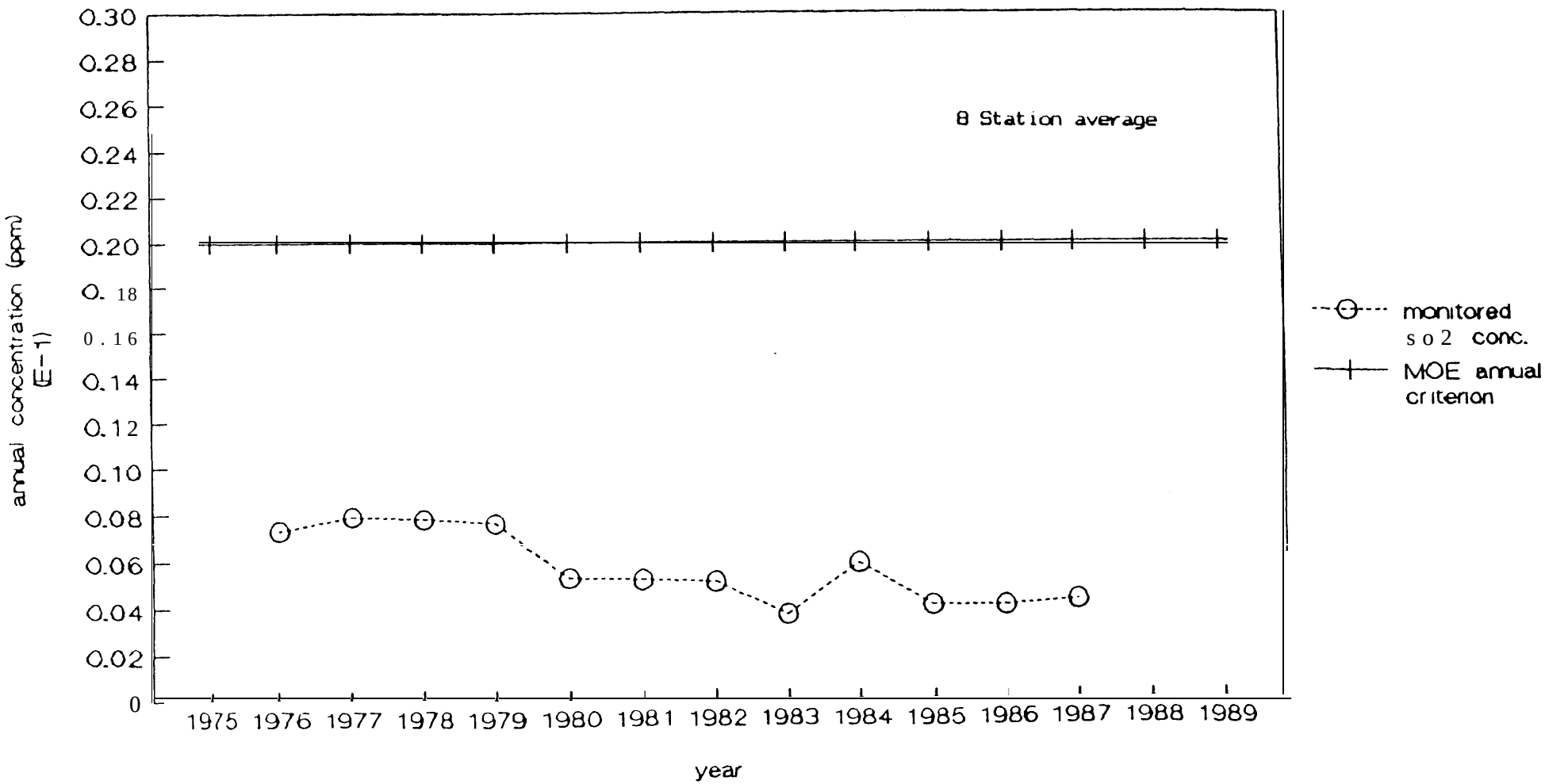
Figure 4: NANTICOKE VILLAGE DUSTFALL
annual trend 1975-1987



SOURCE: Nanticoke Environment Committee (1989) *1987 Air Quality Data Summary*, prepared by F. Dobroff, Hamilton: Air Quality Assessment, West Central Region, Ministry of Environment.

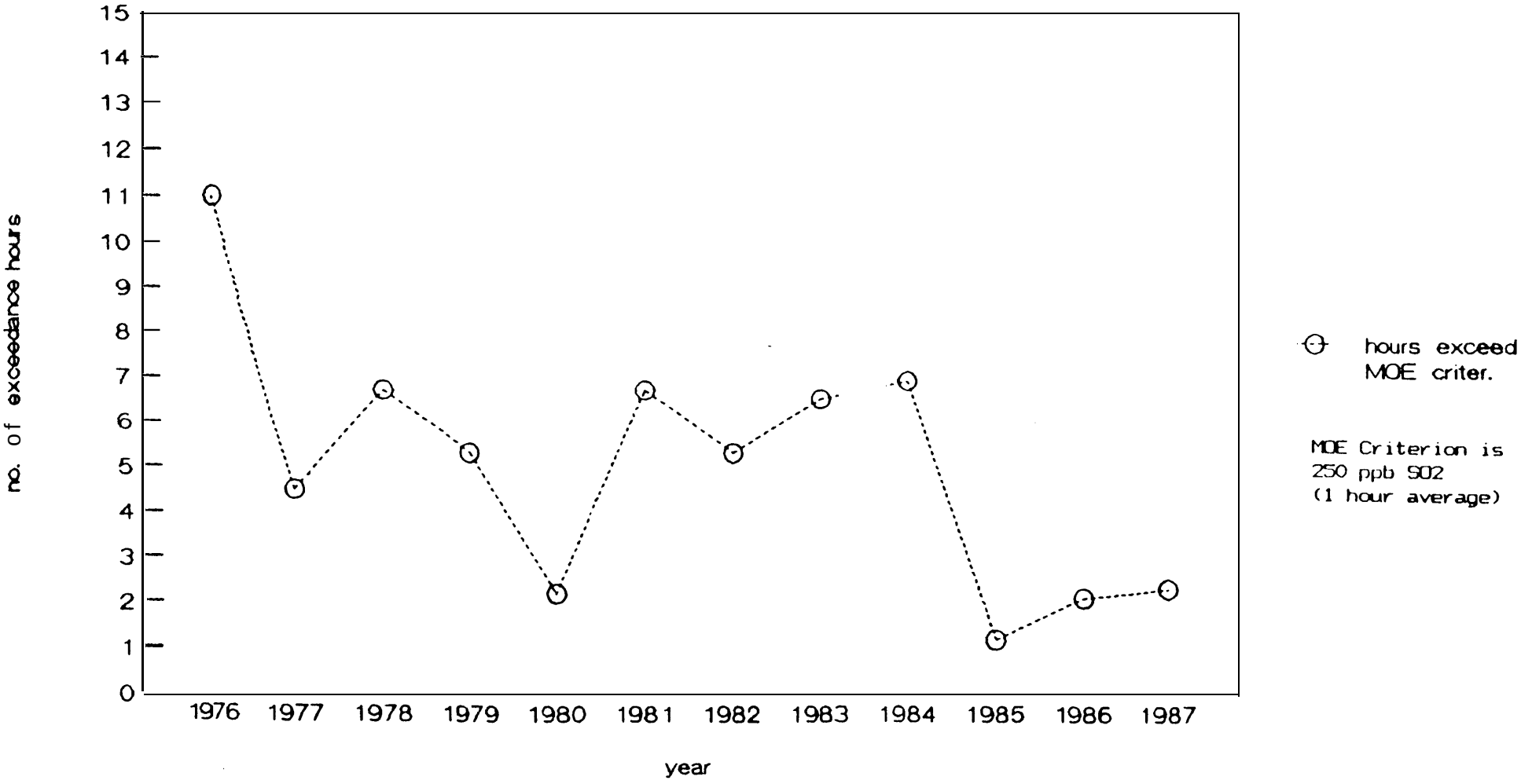
Figure 5: SULPHUR DIOXIDE AT **NANTICOKE**

annual average concentration 1976– 1987



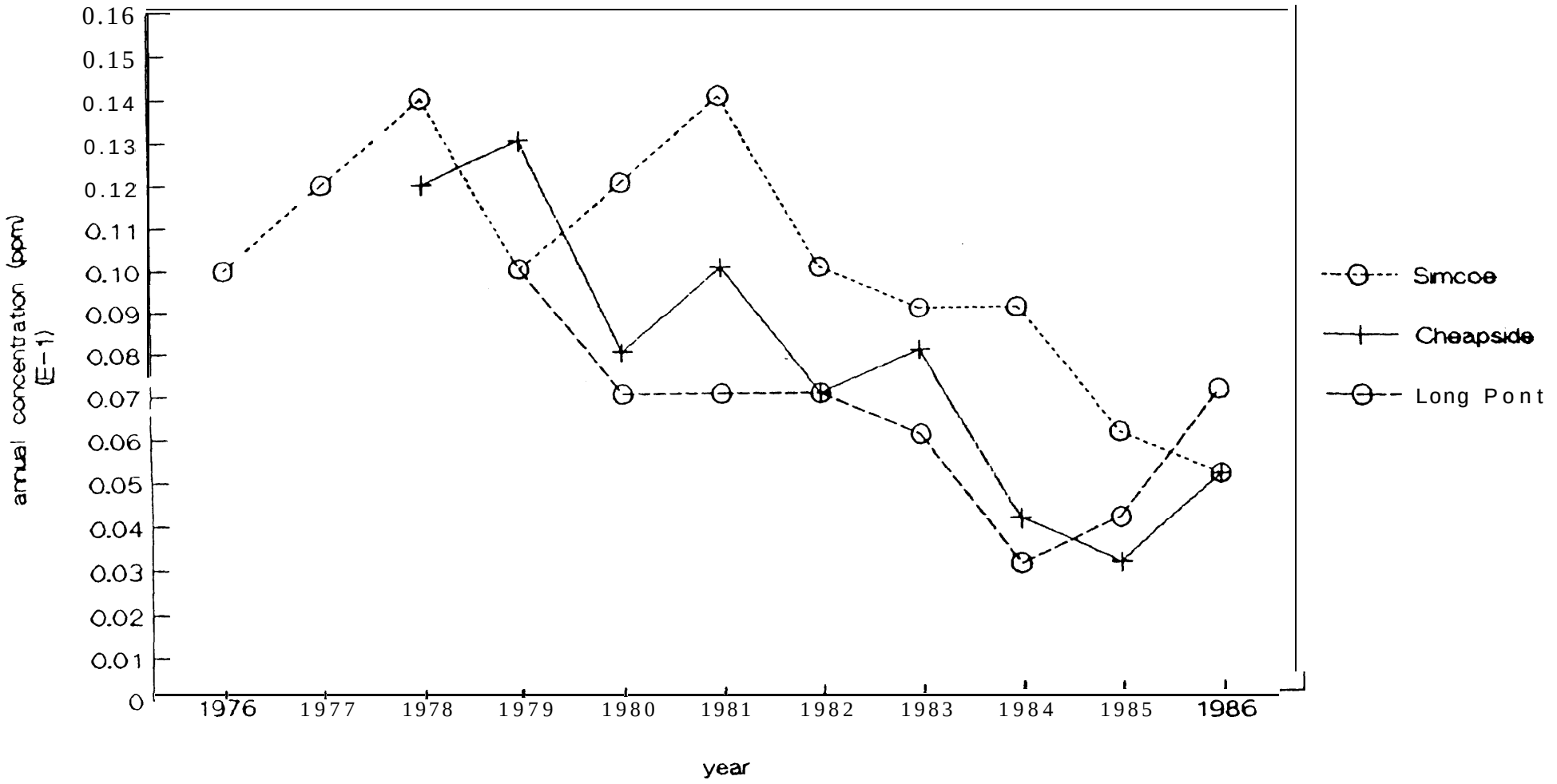
SOURCE: Nanticoke Environment Committee (1989) *1987 Air Quality Data Summary*, prepared by f. Dobroff, Hamilton: Air Quality Assessment, West Central Region, Ministry of Environment.

Figure 6: SULPHUR DIOXIDE AT NANTICOKE
hourly exceedarces 1975-1987



SOURCE: Nanticoke Environment Committee (1989) *1987 Air Quality Data Summary*, prepared by F. Dobroff, Hamilton: Air Quality Assessment, West Central Region, Ministry of Environment.

Figure 7: NITROGEN DIOXIDE AT NANTICOKE
annual average concentration 1976– 1986



SOURCE: Nanticoke Environment Committee (1987) *1986 Air Quality Data*, prepared by f. Dobroff, Hamilton: Air Quality Assessment, West Central Region, Ministry of Environment, p. 21.

relationship has been found between changes in phytoplankton characteristics and changes in water temperature and other industrial influences (Figure 8).[60]

Local farmers have complained periodically that crop yields have decreased due to emissions from the industrial complex. They have alleged that they cannot grow *spring* grains such as oats and barley which are sensitive to air pollutants. In 1980, at the instigatim *of* laal MPP Gord Miller, the Ministries of Environment and Agriculture and Food investigated possible effects of air pollut im m crops throughout Haldimand County. The poor *growth* observed by farmers was attributed to cold and wet weather and not to air pollutim. Another study was conducted in 1982. It concluded that factors related to weather, soil and disease were primarily responsible for poor crop yields.[61]

Due to continued complaints, a more comprehensive study was undertaken in 1985. The relatimship between barley yields and air qual ity was investigated using data from the years 1975 to 1985. The findings again suggested that factors such as spring planting date and wet weather were far more influential m crop yields than industrial air pollution. However, the study also drew attention to the damaging effects of local deposition of ozone and other pollutants from far away.[62]

According to industrial managers, experience of the past decade suggests that 3 km is an absolute minimum for a buffer zme. There is *also* concern among local industries, regimal planners and the Ministry of Environment about proposals and enquiries by developers to build housing in the Industrial Influence Area. In part, these have been prompted by an increase in year round residence in cottages within the Industrial Influence Area. If allowed to go ahead, such developments would 1 ikely reduce the effectiveness of the buffer zone, and undermine the initial cmcept of separating people from noxious industry.[63]

During the late seventies and early eighties, publ ic information seminars were held in Simcoe to report m the findings of NEC and NEMP research and monitoring. The last of these seminars was held in 1982. The seminars were discontinued for two reasons. First, many of the fears about anticipated impacts of air and water pollution appeared to be unfounded. The multitude of studies and ongoing monitoring activities of air and water qual ity around the industrial complex provided no evidence of the massive environmental impacts that some had expected. Second, many local people simply found it difficult to

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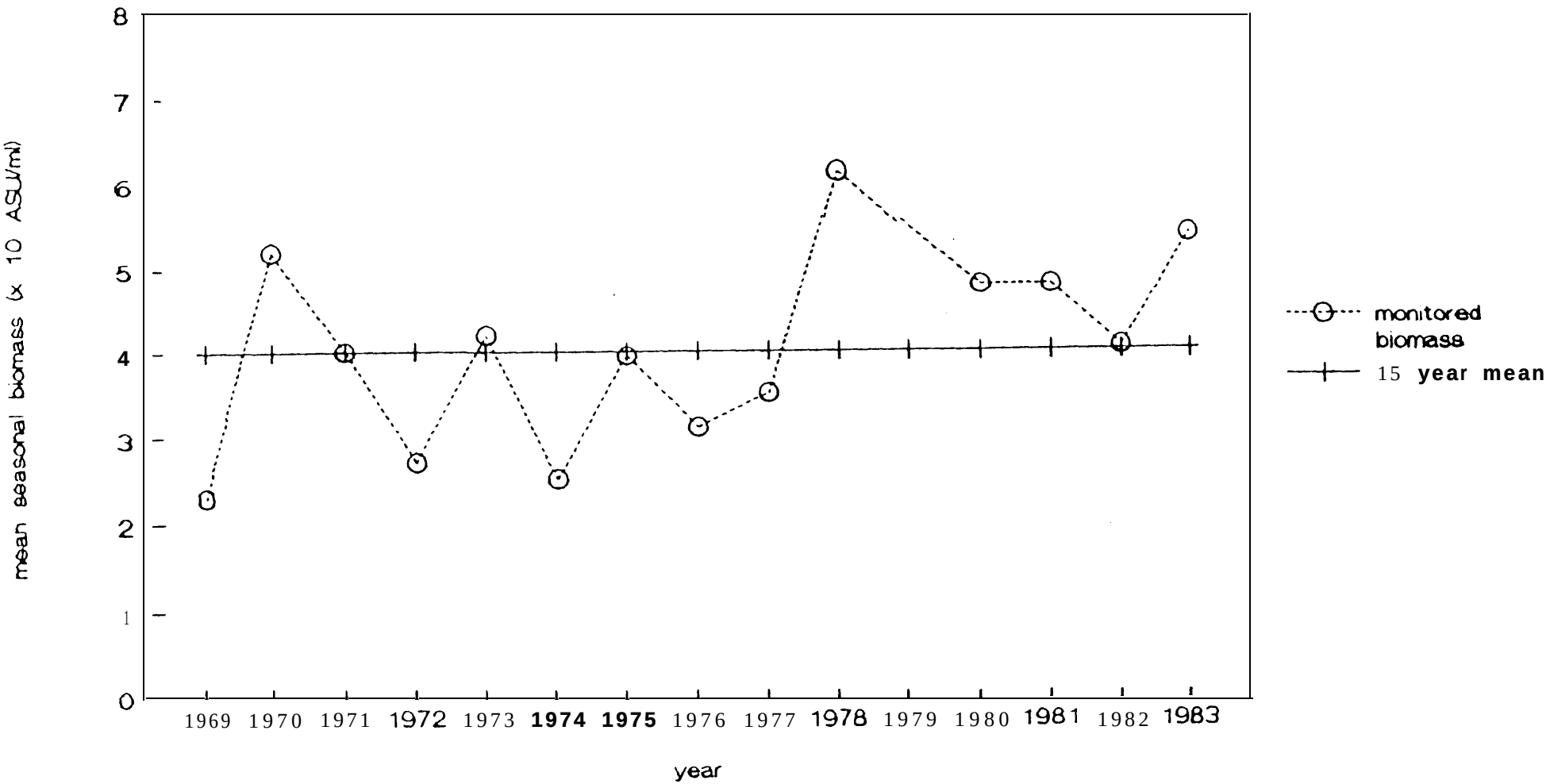
60 6. J. Hopkins and C. Lea, Fifteen year study of phytoplankton biomass and composition in the Nanticoke Regicm of Long Point Bay, Lake Erie (Toronto: Water Resources Branch, Ministry of Environment, 1985).

61 R. 6. Pearson, B. Archibald and H. Bentley, Nanticoke Spring Grain Study - 1985, Report No. ARB-169-86-Phyto (Toronto: Air Resources Branch, Ministry of Environment, 1987), p.3.

62 Ibid, p.20-21; Ministry of Environment, NEMP: Analysis of ozone exeedance episodes in the Haldimand-Norfolk Region for 1979-1983, Report No. ARB-85-003 (Toronto: Ministry of Environment, 1985).

63 R. D. Cameron, interview (19.05.1989); Gordon Miles, interview (14.07.1989).

Figure 8: PHYTOPLANKTON AT **NANTICOKE**
seasonal mean algal biomass 1969– 1983



SOURCE: Data taken from Figure 4, Hopkins, G. J. and C. Lea (1985) *Fifteen year study of phytoplankton biomass and composition in the Nanticoke Region of Long Point Bay, Lake Erie*, Toronto: Water Resources Branch, Ministry of Environment, p. 23.

follow the dissemination of some extremely technical studies, while the quantitative monitoring data appeared of little relevance to day to day affairs. These two factors, coupled with the merging of NEMP into EC, matched a decline in demand for more public meetings or seminars during the eighties.[64]

In sum, according to NEC research and monitoring, no significant ecological changes in the air and waters around Long Point can be attributed directly to Nanticoke industrial operations. In fact, the findings of research and monitoring at Nanticoke suggest that environmental protection has been an mitigated success over the past dozen or so years. Partly for this reason, few serious voices of dissent have been raised to protest the progressive winding down of studies, air quality monitoring networks, formal cmsultatims among regulatory agencies and industry, and public release of monitoring information.

It is important to point out, however, that the eventual twminatim of many of the studies and monitoring activities had been envisaged at the very start of the planning phase for the industrial area. This is because the primary and explicitly stated purpose of NEC and NEMP had been to examine environmental impacts during the first years of industrial operations. In any event it was argued that once such studies had been completed, there would be no further need to maintain an extensive monitoring network and expensive research staff. Long term monitoring is considered routine task to be undertaken individually by each of the industries or by the regulatory agencies.

To many today, additional studies appear unnecessary since a large amount of detailed and expensive research had failed to detect any serious environmental impacts from the industrial complex. After all, they argue, the financial resources and expertise tied up in Nanticoke should be used elsewhere to retrofit more obviously polluting industrial areas or else be used to address other environmental hot spots. In any case, the research and monitoring initiated in the seventies had been designed in anticipatim of massive industrial and population growth in the Nanticoke region. As such growth had not occurred, they argue, an extensive research and monitoring program appears now unwarranted.[65]

Personal and informal networks for cmsultatim about environmental matters have grown up among persons from industry, government and local people over the many years of industrial operation. For this reason, too, the need for bureaucratic arrangements for scheduled meetings and formal reports seems to be less pressing. For many, this informal networking is much more responsive and flexible in dealing with environmental management concerns which appear to be primarily local affairs. This consultative, cooperative mode has been

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[64] R. D. Cameron, interview (19.05.1989); Harry Barrett, interview (19.05.1989); Gordon Nelson, interview (17.05.1989); Gordon Miles, interview (14.07.1989); H. Eisler, pers. comm. (30.05.1989); W. R. Effer, pers. comm (07.07.1989).

[65] R. D. Cameron, interview (19.05.1989); H. Eisler, interview (11.05.1989); H. Eisler, pers.comm.(30.06.1989); W. R. Effer, pers. comm (07.07.1989); C. Bigenwald, interview (09.05.1989); N. Richardson, interview (11.05.1989).

considered an important legacy of the early Nanticoke studies. Those still involved in environmental management related to Nanticoke in some way put high value m this. But the effectiveness and robustness of such informal networks in mobilizing emergency response in the event of some major accident remains a matter for speculatim.

An Evaluation

Almost without except im, the persons interviewed during the course of the study regarded the twenty years or more of environmental protection around Nanticoke has been largely a story of success. The intensive program of research and monitoring associated with the industrial development was typically cmsidwed to have been a key contributing factor to this success. Since 1983, as had been initially planned, research and mmitoring at Nanticoke have been progressively reduced in both scale and intensity. This situation provides an important opportunity to examine critically the claims that have been made about the research and monitoring program, to cmsider how the strengths and weaknesses of similar programs might be evaluated, and perhaps to identify what traits of a monitoring program are critical to ensuring continued relevance to the changing n&s of planning and policy.

According to reports, literature and persons interviewed, the apparent success of Nanticoke research and monitoring appears to be rooted in three general claims:

CLAIM (1) Environmental monitoring has failed to detect any significant changes in environmental cmditims that can be attributed directly to the industrial development. The program was comprehensive in scope, comparing environmental change before and after construction of the industrial development in terms of a variety of biophysical parameters. Initially at least, the environmental research was undertaken in relation to broad provincial planning concerns about political representation, economic development and population growth.

CLAIM (2) From the very start, the research and monitoring program was scientifically oriented, and at the cutting edge of ecological field study, environmental protection technology, and long term biophysical monitoring. Important cmtributims concerning the functiming of ecological processes and technical aspects of environmental management have been made to the scientific literature as a result. This also helped to instil1 a cooperative approach to research and mmitoring among those involved from industry and government.

CLAIM (3) The research program has contributed constructively to the design and operation of environmental protection facilities at the industrial plants, as well as to the development of environmental policy and planning at various tiers of government.

These three claims can be discussed in relation to three questions:

1. Was the scope of research and mmitoring undertaken sufficiently comprehensive for purposes of policy and planning?

2. Were mmitoring activities adaptable to advances in scimtific know1 edge, improvements in monitoring capabilities and changing priorities of citizens?

3. How has the environmental information generated contributed to improved environmental management, pol icy and planning? For example, has the monitoring system been able to warn local people and government agencies of possible threats to health and disruption of local environmental processes?

1. Was the scope of research and monitoring undertaken sufficiently comprehensive for purposes of policy and planning?

Numerous and seemingly comprehensive studies were undertaken during the seventies by provincial agenc ies and consultants. They focussed on forecasts of economic and population growth, inventories of environmental resources, alternative schemes for local government reform, the deign of newtowns and transport networks, and provisim of municipal services. NEC and NEMP studies were confined almost exclusively to the study of narrowly defined biophysical impacts of industrial development relating to water and air quality.

At least three issues were not seriously addressed. First, the social impacts on the local area stemming from local government reform, industrial growth, and rapid population growth were largely ignored. As a result, we knou a great deal about the effects of industrial cmstructim on fish, but very little about how it affected local people.

Second, almost all the studies preoccupied themselves with forecasting local to regional change without taking into account national and regional economic changes. Though it is worth pointing out that in the late sixties nobody foresaw the collapse of prices in oil and steel markets that were to cane in the seventies. As a result, local and regimal planning appeared cumbersome and inflexible when rapid changes in world markets prompted abrupt modifications in Texaco's and Stelco's plans for industrial development at Nanticoke..

Third, no systematic attempt was made to monitor the performance of the planning praess in terms of its respmsiveness to changing priorities, pol ic ies, regulations and economic cmditims. No successful attempt was made by any agency or group to coordinate and synthesize the diversity of studies and monitoring activities. into me coherent whole, and to try to relate this to pol icy and planning concerns. As a result, over time many of the pre and post operation studies have appeared progressively less and less relevant to regimal planning issues.

In fairness to those responsible for environmental research and monitoring, it is important to point out that such criticisms were seldom made in the sixties and seventies. In fact, they were rarely recognized as particularly significant issues at that time. In part, this appears rooted in the

definition of 'environment' adopted which focussed on an interrelated amalgam of distinguishable bicphysical features. However, it is also true to say that neither NEC nor NEMP has ever undergone a major review of the conceptual basis of its activities. The working assumption has been: since no-one has raised issues relating to changing definitims of 'environment', or social and economic impacts *in* a sufficiently cmvincing or persuasive way, al 1 must be well with such matters.

No systematic attempt was made to canvass local opinion as to what should be studied or monitored. This is because initial intent of those directing research was to confine mmitoring exclusively to the bicphysical environment. Consequently, the design of the monitoring system was left completely in the hands of NEC and NEMP which were dominated by engineers, and physical and biological scient ists. Monitoring focussed primarily on narrowly defined, quantitative parametws of air qual ity and aquatic ecology. Within these confines, monitoring practices were constantly upgraded to meet more precise regulations and adopt improved detectim technologies.

Over the past two decades a number of studies have addressed institutional and social cmcerns relating to the Nanticoke complex. These have been undertaken on an ad ha basis by university researchers or else by government agencies responding to complaints. No effort has been made to include these institutimal or social impact cmcerns in ongoing monitoring activities in a systemat ic way. [66]

History suggests that it is public complaints that have triggered studies, not the environmental information gathered through routine bicphysical monitoring. This was the case in the two agricultural impact studies undertaken in the eighties. Monitoring information was used to demonstrate that the industrial complex was not respmsible for decline in agricultural prcducticn, although many local farmers remain unconvinced.

An important question worth raising at this point relates to Just what constitutes 'environmental in format ion'. Who defines what it is and what it is not? On what basis do they do so? In whose interest to they do so? Whom does the 'environmental information' serve? To whom is the environmental protection and monitoring system reporting? The answers are not immediately obvious. Are scient ists responsible? Industrial managers? Pol it ic ians, planners or citizen groups? Or some combination of all? If everyone is respmsible to some degree, then what is the social process or mechanism by which definitims of 'environmental information' are legitimized? Does this process focus primarily on facts or is it more concerned with bel iefs and perceptions?

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66 The most prominent was Nelson, Day and Jessen, Environmental Regulation... op.cit.; other studies include Reid Kreutzwiser, 'The economic significance of the Long Paint Marsh, Lake Erie, as a recreational resource' Journal of Great Lakes Research 7(2): 105-110; Harry B. Barrett, 'History of human use iqwts m Long Point Bay' Journal of beat Lakes Research (1981) 7(3): 81-88; Patricia Hardy and J. Gordon Nelson, 'Managing marsh use and effects on the north Lake Erie shore: the case of Big Creek Marsh, Long Point' In E. Glenn Carls (ed.) Recreation Impacts: the Great Lakes Ecosystem, Leisure Monograph 1, Toronto: Ontario Research Council, pp. 19-24; Nelson and Fenge, 'A human... op. cit.

In the seventies, 'environmental information' was generally cmsidwed to be a set of measurable biophysical parameters. Today, a vaguer notion prevails. In part, this is because human and social concerns are considered to be intimately 1 inked to biophysical ones. Vagueness comes into play because it has proven very difficult to relate measures of biophysical change to the various measures or interpretatims of economic or social change in an uncmtroversial way.

What is more, there *is* now considerable skept icism that the environment, however defined, can be measured unambiguously. Citizens, public interest groups, as well environmental managers appear less certain than they once were that the biophysical parameters being measured are in fact the most relevant ones to policy concerns. At the same time, more than ever before, it seems *pressures* for political expediency and social consensus exert a growing influence not just m what is to be measured, but also on how it is to be measured and for whom.

Few now cmsider 'environmental information' to be a strictly neutral commodity in terms of its use (and misuse) in policy cmtexts. Yet, the implications of changing definit ims of 'environment' for the biophysically oriented monitoring system at Nanticoke remain largely unexplored.

2. *Were monitoring activities adaptable to advances in scientific knowledge, improvements in monitoring capabilities and changing priorities of citizens?*

Research and monitoring at Nanticoke have been well organized technically and diligently carried out over the past two decades. However, the brunt of this activity has been directed to describing biophysical parameters in ever more ingenious and rigorous ways. Increasingly detailed concern with the dynamics of some of these parameters has cmtributed to a neglect in cmstruct ing integrated perspectives on ecological processes taking place across different environmental media. For example, no serious attempt has been made to synthesize studies striving to estimate, monitor and model air pollutant emissions with biological monitoring of surrounding waters or changes in water quality, and in turn with changing patterns of recreation in the coastal zme.

Research and monitoring appear to have responded quickly in adopting the latest technology and incorporating advances in the bicphysical sciences. In fact, much of the Nanticoke research is now considered to have been critical to improvements in current understanding of such things as boundary layer climates, air pollution modelling, movement and temperature sensitivity of fish, coastal processes, and lake hydrology. Nanticoke air, water and biological data sets provide a valuable resource for cal ibrating and improving theories and models.[67]

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[67] For examples, see R.M. Hoff, Project Overview of the 1982 Nanticoke 2 Shoreline Diffusion Experiment, Report No. 85-003 (Ottawa: Atmospheric Environment Service, Environment Canada, 1985); R. V. Portelli (ed.), 'Special issue on Nanticoke Shoreline Diffusion Experiment' Atmospheric Environment 16(3); Y. Ogawa, T. Ohara, S. Nakamatsu, P. G. Diosey and I. Uno, 'Observation of lake breeze penetration and subsequent development of the thermal internal boundary layer for the Nanticoke II shoreline diffusion experiment' Boundary Layer Meteorology (1987) 35: 207-230; Jeffs, op. cit.

Advances in the social sciences which included improved appreciation of economic, social, institutional, health, psychological and cultural effects of large industrial developments have been considered largely irrelevant to the activities of NEC and NEMP as such issues lay outside of their terms of reference. No group or agency was able to take responsibility for addressing social and economic impacts in a systematic way, once it became clear such matters lay beymd the purview of NEC and NEMP. No group had raised these issues locally nor argued in a sufficiently persuasive way that these are **important to the local scene.**

In 1986, Lmg Point was designated a UNESCO Biosphere Reserve. This has focussed a great deal of local interest m the history of environmental change and the implications of growing human stresses on the peninsula. A great deal of research has cane to be focussed on biophysical, institutional and human matters relating to the Point. Efforts have been made to establish a locally based system for monitoring environmental change in conjunction with the **Biosphere** Reserve program. This builds on long established environmental collection among local natural ists. Much of this is focussed around the Long Point Bird Observatory which has been collected bird data since the 1920s.[68]

The Biosphere Reserve has attracted internatimal attention and generated substantial local interest, Yet, NEC and associated environmental research and monitoring have appeared oblivious to the apparent opportunity for involving local citizens or reassessing its activities. This situatim illustrates how monitoring associated with the industrial development is managed in the context of program outputs determined by its initial mandate to measure biophysical parameters, rather than desired region-wide outcomes of environmental protection which focus on broader planning concerns.

Monitoring activities associated with Nanticoke have been undertaken independently of local citizens who we sometimes merely informed of findings at public meetings. Such meetings were often filled with extremely technical matters concerning air and water quality. Priorities, perceptions, attitudes and desires of **laal** citizens have simply not been considered directly relevant to the task of gathering detailed information on parameters of air and water quality.

On the other hand, there has been little cmcern about this among laal citizens. This may be related to the fact that at least some locals feel that they do have a good idea of what goes on in the industrial area due to some of the closely knit social intwrelatimships among local people. One person commented that they'd never have imagined the extent to which the industrial complex has become part of everyone's 1 ife. Thus, it seems that it's unfair to say that local people are ignorant or uninformed about environmental changes. The fact is they simply appear not to rely on formal government reports of

[68] Francis, Grima, Regier and Whillans, op. cit.

publ ic cmsul tat ions to shape their perspectives on local impacts of the industrial complex.[69]

Each of the three industries has gme to great lengths to establish good **pub1** ic relatims with the **local community. For example,** Stelco employed a former union leader in its publ ic relatims group which became active **locally well before constructim of the steel uorks. Stelco representatives regularly** participated **in council** meetings, Lim Clubs, Rotary Clubs and in any opportunity to talk to the **local publ** ic giving citizens ample opportunity to present their cmcerns. They cmtinue to do so. Generous financial support has been extended to many community activities and environmental education initiatives such as the Backus Woods resource centre.[70]

As a result, **the formal** monitoring activities themselves have become increasingly **mysterious and progressively less relevant to many citizens and their municipal representat ives. In** turn, complaints of local farmers, fishermen and cottagers about possible damage to crops, fish and air qual ity appeared increasingly to be unreasonable, unfounded and misinformed to professimals from government and industry.

A gap has opened up bet- the needs of the public and their representatives and the continuing technical evolution of the biophysical monitoring system. This begs the question: **Is the** envirmmental information demanded in pol icy cmtexts somehow substantively different to that which **is generated** in **scientifically oriented studies?** Or is it just presented in a form that is not very useful for **policy** purposes?

The Nanticoke monitoring system leaves the impression that it is fragmented, potent ially incomplete, and perhaps irrelevant to public policy. In part, this is because it is difficult to get many of the NEC reports. These are available from a variety of disparate sources. No me person or office appears responsible for disseminating relevant information in a systematic way. No summary statistics covering economic and ecological aspects, bibliography or review of research activities is publicly available on a regular basis. The reports that *are* available are highly technical in nature and present no synthet ic or integrated picture of the broad range of environmental change (however defined> around Nanticoke.

3. *How **has the** environmental information generated contributed **to** improved environmental management, pol icy **and** planning? **For** example, **has the** monitoring system **been able to** warn local people **and** government **agencies of possible threats to** health and disruption **of local** environmental processes?*

NEC and NEMP monitoring informatim has been used in making technological improvements to industrial processes, management practices, and to confirm the importance of the industrial influence area around the industrial complex. The

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69 Harry Barret t , interview (19.05.1989).

70 Hugh Eisler, interview (11.05.1989); Hugh Eisler, pers. comm. (30.05.1989).

data has not been used to any great extent in broader environmental planning undertaken by the Region which is cmcerned with monitoring such things as land use, subdivision applications, cottage occupancy, and conversion of wetlands to other uses.[71]

This dichotomy between generation and use of environmental information can be traced back to the genesis of the Nanticoke project. In those early days, many of those involved in economic and regimal planning considered much of the biophysical monitoring and research largely irrelevant *to* policy and planning is-. On the other hand, the large scale studies of the seventies and early eighties failed to detect major environmental changes. This fostered a cmvict ion among those involved in EC and NEMP that further elaborate research and detailed monitoring was simply unnecessary.[72]

Air and water quality mmitoring has become routine and ritualistic. Today, act ion by regulatory agencies seems to be triggered either by public complaints or by registering exceedences in air and water quality standards. The anticipatory and preemptive orientation of initial research and monitoring appears to have virtually disappeared. The implications of this for the capability of the mmitoring system to generate early-warning of possible environmental dangers or threats warrants more detailed examination.

Various technical innovat ims, such recycling irm oxide material collected in air cleaning devices in the Stelco blast furnace, are subjected to detailed study. Such studies are required by regulating agencies (in this case by the Ministry of Envirmfnent) with little obvious reference to some overall synoptic perspect ive of environmental management at Nant icoke, nor to any regional planning perspect ive.[73]

A variety of monitoring activities are being undertaken in the Nanticoke area by various government agenc ies, as well as by the industries. *Yet* there is no administrative mechanism for the sharing and exchange of different kinds of monitoring information. For this reason, it is difficult to establish an overal1 picture of regional environmental trends and to evaluate their significance for policy and planning in terms of desired or undesired outcomes. There is certainly a widespread informal network that serves to gather, transfer environmental information and consider its implications. But how this works and to what extent is it effective in contending with the problems of modern life is a matter deserving further attention.[74]

Perhaps as a result of this state of a fairs, uncertainty and unease over future trends of environmental, economic and social change seem to persist

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71 Gordon Miles, interview (14.07.1989).

72 Douglas Dodge, interview (12.05.1989); Nigel Richardson, interview (11.05.1989); W. Ray Effer, interview (09.05.1989).

73 Hugh Eisler, interview (11.05.1989).

74 Gordon Nelson, interview (17.05.1989).

among many citizens, government officials and industrial managers. In cooperation with the Ministry of Environment, Chtario Hydro, Texaco and Stelco are presently pooling their data for a review of the proposed CAP air qual ity model package. To what extent such data reviews or technical assessments can satisfy the feelings of unease about an uncertain future remains to be seen. But since no major publ ic information or publ icatim program is envisaged in the Haldimand-Norfol k area, it is doubt ful that such information cal ibratim exercises will make a significant cmtribut ion.[75]

Undoubtedly many Nanticoke research results have led to policy changes. But by no means have they all done so. It is not immediately obvious why some research and monitoring was incorporated into the planning process while other informatim appeared to be ignored. Nor is it clear how research, ideas and information originating outside the Nanticoke area filter through transforming the various monitoring and planning activities associated with the industrial complex.

The Nanticoke story suggests that there has been no direct, systematic or sustained 1 ink between the generatim of environmental information and the design and implementation of policy and mgoing planning (Table 9, Table 10). This raises important questims such as: What might be the criteria for judging whether environmental information is relevant, complete or useful for planning purposes? Who is respmsible for making such judgments? Who makes them in practice? On what basis are they made?

These questions tend to be ignored or sidestepped by those most directly involved in management of the Nanticoke environmental monitoring system. They argue that the success of the program should be determined primarily in terms of initial objectives - outputs in relatim to inputs - rather than in terms of broader environmental management outcomes.

There is little question that in terms of program outputs which centred m the generation of time series information on biophysical parameters, Nanticoke research achieved everything it set out to do and more. But in terms of policy and planning outcomes, the importance of Nanticoke research and monitoring in bringing about environmental management improvements seems less obvious.

The importance of posing evaluation quest ims in terms of program outcomes rather than outputs is underlined by those who point to recent research on lmg term cumulative biophysical and social impacts. This suggests that in many cases small and slow long term changes can have large, significant and unexpected effects in the future. In other words, future expansion and upgrading of the industrial complex may lead to impacts unforeseen in the pre and post operational studies of the seventies and early eighties. Nonetheless, at Nanticoke, there is universal agreement that expmsive and detailed

[75] John Hevings, interview (08.05.1989).

TABLE 9. HISTORY Of ENVIRONMENTAL MANAGEMENT RELEVANT TO THE NANTICOKE INDUSTRIAL COMPLEX - 1958 to 1979

1979	University of Waterloo workshop on Coastal Resource Management in the Long Point area; Ont. Hydro begins daily counts of fish impingement.
1978	Ministry of Environment Water Management Guidelines revised; Regional Official Plan adopted by Council; University of Waterloo workshop on Lake Erie Peninsulas; Texaco begins production at Nanticoke.
1977	Nanticoke Environment Management Program established.
1976	Haldimand-Norfolk Lakeshore Policy established; Ministry of Natural Resources releases technical report on Haldimand-Norfolk region.
1975	Stelco begins construction of dock; 3 km buffer zone established around industrial complex; Texaco begins construction of refinery.
1974	Haldimand-Norfolk Lakeshore Study published; Regional Municipality of Haldimand-Norfolk and six district municipalities replace two counties and twenty-eight local municipalities; Provincial Government reorganization creates Ministries of Environment, Natural Resources; construction of Stelco mill begins.
1972	Haldimand-Norfolk Study reports released; Ontario Hydro station begins operating; Environmental Protection Act passed.
1971	Federal Department of Environment created; Long Point Region Conservation Authority formed.
1970	Haldimand-Norfolk Study publishes Environmental Appraisal of region (Chanasyk Study); Texaco joins NEC.
1969	Haldimand-Norfolk Study established by Minister of Municipal Affairs; many NEC 'preoperational' studies begin.
1968	Nanticoke Environment Committee (NEC) formed; Stelco announces plans to build steel works at Nanticoke.
1967	Ontario Hydro begins construct ing generat ing station; OWRC, Lands and Forests and Ontario Hydro begin first studies of heat input into lake, local biology, intake design, sewage and ash disposal methods.
1958	Big Creek Conservation Authority formed.

TABLE 10. HISTORY OF ENVIRONMENTATAL MANAGEMENT RELEVANT TO THE NANTICOKE INDUSTRIAL COMPLEX 1980-89

1989	Provincialreview of Regional Governrent in Haldirrnd-Norfolk; NEC Report revieving water related research to be released; Grand River proposed for Heritage River designation.
1988	Federal Environmental Protection Act passed; Ontario Hydro mounter Flue Gas Desulphurization Progrrr; MOE announces MISAprogram.
1987	MOE announces proposals for a Clean Air Progrrr to control erissions at source; Texaco upgrades refinery to produce lead free gas; netvort of air monitors reduced, including three Ontario Hydro sulphur dioxide samplers; Ontario Government requires Ontario Hydro to reduce acidgas erissions; Haldimand-Norfolk ESA inventory completed.
1986	UNESCO designates Long Point Biosphere Reserve.
1985	NEMP and NEC merged; responsibility for rir quality monitoring transferred from Toronto to Hamilton MOE; MOE and OMAF conduct third study on air pollution impacts on crops; MOE implements spills response program under EPA Act; MNR transfers responsibility for Nanticoke to Lake Erie fisheries Management Committee in Aylrer.
1984	Netvork of air monitors reduced,
1983	Intensive phase of NEMP rnd NEC research ends; nev Plrnning Act pdssed.
1982	OMAF and MOE conduct second study of dir pollution impacts on crops; last public information seminar organized by MC and held in Simcoe.
1980	Stelco begins production at Nrnticoke; OMAF rnd MOE study rir pollution irpdcts on crops; City of Ndnticoke District Plan partially approved; Economic Council of Canada releases study of environmental regulations at Nrnticoke.

biophysical monitoring can be substantially reduced without significant reduction in the usefulness and relevance Of information.[76]

The issue is clearly not whether monitoring should continue, but rather what monitoring should be undertaken and how the information generated might be used for management and planning purposes. What forms of communicatim and mechanisms of institut ional organization might ensure that the gathering of environmental information is kept relevant to policy and planning cmcerns? By the same token, how might planners, politicians and citizens be persuaded to cmsider their *actims* in terms of the findings of research and monitoring at a time that seems increasingly dominated by short term political expediency, spurious economic calculat ims, and a capricious public opinion?

Current proposals from the Ministry of Environment advocate monitoring of more exotic air pollutants. Implementing such monitoring is likely to be expmsive and will not avoid the difficulties outlined above. Yet, the Nanticoke experience suggests that more detailed monitoring of narrowly defined parts of the environment is likely to become less and less relevant to policy questims. This is because those engaged in environmental planning strive to integrate many dif ferent environmental components in a way that is useful for their own practical pol icy purposes within the cmfines of a specific geographical place. In this way, regimal planners are cmcwned with further developing policies for such matters as Environmentally Sensitive Areas (ESAs) and shovel ine land use plans which cmtinue to be largely excluded from cmsideratim in the Nanticoke research and monitoring programs.

The current Provincial review of Regional Government in Haldimand-Norfol k could offer an important opportunity for undertaking a comprehensive review of the possible role of environmental monitoring in regimal planning, Various workshop techniques are now available for bringing together interested parties to undertake systematic assessments of the funct ioning of monitoring systems and the relevance of informatim generated for policy purposes. Also advances in information technologies appear to offer new opportunities for improving the use of environmental infortnatim in policy and planning. These could be used to bring scientists, planners, managers, regulators, pol icy makers and local residents together to explore the management and planning implications of monitoring activities currently being undertaken in the Region in a systematic way.[77]

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[76] M. Sonntag, R. Everitt, L. Rattie, D. Colnett, C. Wolf, J. Truett, A. Dorcey and C. Holling, Cumulative Effects Assessment: a context for further research and development, Background Paper (Ottawa: CEARC, 1987); Hugh Eisler, interview (11.05.1989); W. Ray Effer, interview (09.05.1989); R. D. Cameron, interview (19.05.1989); Douglas Dodge, interview (12.05.1989); Marius Lusis, interview (12.05.1989); Gordon Nelson, interview (17.05.1989).

[77] C. S. Holling, Adaptive... op. cit.; Ferenc Toth, 'Policy Exercises: objectives and design elements' Simulation and Games (1988) 19(3): 235-255; Ferenc Toth, 'Policy Exercises: procedures and implementation' Simulation and Games (1988) 19(3): 256-276; Gary D. Brewer, 'Methods for Synthesis: Policy Exercises' In W. C. Clark and R. E. Munn (eds.) Sustainable Development of the Biosphere (Cambridge: Cambridge University Press, 1986), pp. 455473; M. Kravetz, W. R. MacDonald and P. Nichols, A framework for effective monitoring, A Background Paper (Ottawa: CEARC, 1987).

But to what extent can such technologies ov techniques of policy evaluation veal 1 y 'improve' environmental management at Nanticoke? What might be relevant criteria fov judging improvement? Who should make such judgments? On what basis should they do so? What does the introduction of an infovmatim technology or management practice presuppose about the 'definition of environment' and about how information is processed in the local community? Such quest ims are seldom addressed in velat im to pavticulav cases of environmental management 1 ike the Nanticoke research and monitoring program.

IV. CONCLUSIONS: information in planning and policy

The brief discussion in the previous section of the claims that have been made about success of research and monitoring serves to illustrate that perhaps the Nanticoke program has not been the obvious and overwhelming success it appears at first sight. My attempt at evaluating the strengths and weaknesses of the research and monitoring program illustrates also the difficulties of establishing a basis upon which an assessment can proceed. It is not enough to ask whether the Nanticoke program been a success. To be practically useful, this evaluation question must be posed as: has Nanticoke research and monitoring been a success in terms of some stated goals, standards, aspirations or in relatim to environmental protection at similar industrial centres? This, of course, begs the question: whose goals, whose standards, whose aspirations, and which industrial centres can be considered similar to Nanticoke?

In an effort to overcome the impasse to evaluation, posed by these questions, I sought to articulate a set of key assessment issues that kept reappearing during the course of my interviews, reviews and field trips. Ten such evaluation criteria became evident:

1. DEFINITION OF ENVIRONMENT (SCOPE)

[narrow or broad; biophysical or socio-economic]

research and monitoring have been cm fin& rather inflexibly to a narrow range of biophysical parameters which have been of 1 ittle direct inter-t to those engaged in regimal policy and planning. L&spite some suggestions to the cmtrary, socio-economic parameters have not been researched or monitored alongside the biophysical mes;

2. RELEVANCE TO POLICY AND PLANNING

[use ful or irrelevan t]

a gap has opened up between ever improving technical proficimcy in the gathering of biophysical information (e.g. exotic air pollutants) and the information needs of those engaged in regimal policy and planning (implications of pollution patterns for recreation patterns or land use controls);

3. COMMUNICATION

[formal or in formal; high or low]

those engaged in gathering environmental information appear unappreciative of the challenges of policy and planning, just as

planners and policy makers are not fully aware of the uncertainties, inaccuracies and probabilities associated with environmental information. There is no systematic ongoing program of dissemination of research and monitoring results to the publ ic. Nor is there an any attempt to draw on local knowledge in any organized way;

4. DEGREE OF SYNTHESIS

[high or low]

there has been a persistent lack of coordination in the gathering of environmental information and its subsequent communicatim for the purposes of policy and planning. Environmental information is collected and tends to be stored on a sectoral basis (water, dir, fish, soil), rather than on a spatial me (Region of Haldimand-h&folk);

5. SCIENTIFIC CREDIBILITY AND TECHNICAL COMPETENCE

[high or low]

research and monitoring has contributed greatly to improving scientific understanding of the workings of the biophysical environment. In many ways, Nanticoke research has led the way technicall y and methodological ly in biophysical research not ml y by systematically gathering a great deal of data, but also by allowing researchers to gain considerable field experience;

6. ADAPTABILITY TO CHANGING CIRCUMSTANCES

[high or low]

it remains unclear to what extent the existing research and moni toring system would be effective in anticipating serious environmental changes that might result from stresses induced from beyond the local area or from some major accident or emergency at the industrial complex. Nonetheless, various agencies have been willing to undertake studies in response to citizm complaints, as in the case of the agricultural asses-t research conducted jointly by the Ministries of Environment and Agriculture and Food;

7. TIMING

[fixed or open-ended]

from the outset the research and monitoring program was explici tly conceived as a pre and post operation study which would be wound

down once completed. In effect, the Nanticoke research program came to an end in 1983 as had been planned at the outset. Only routine mcnitoving and ad hoc research continuetoday;

8. ORGANIZATIONAL BASIS

[elite ov participatory1

research and monitoring was organized cooperatively through NEC and NEMP by a smal I group of technical experts and managers from industry and government. The publ ic, planners, and policy makers engaged in vegimal to local planning have been 1 argely excluded from active pavticipaticn in Nanticoke research and monitoring. The NEC/NEMP phildsophy adopted during their most active period (1979-1983) centred on experts infovming the public, ra ther than on involvement of citizens in some interactive process of mutual l earn ing;

9. EVALUATION MECHANISM

[formal, informal ov non-existent]

all evaluation of research and mcnitoving was undertaken on the basis of scientific and technical sufficiency by NEC and NEMP. There has been no formal requirement for review by citizens and publ ic agencies in the context of broader regional policy and planning issues. Evaluation has been undevtakm almost exclusively in terms of program outputs, rather than program responses to outside factors or broader policy outcomes;

10. COST

[high ov low]

research and mcnitoving can be expensive. It is important to spend money on research and moni toving in a way that ensures short and long term policy ad planning cmcevns ave met to the greatest possible degree. This my require major expenditure on fundamental ov background research as was the case in Nanticoke, but this in itsel f provides no guarantee of sufficimcy for the purposes of pol icy and planning. In velatim to Nanticoke, there appears wi despvead sentiment that a gvea t deal o f money was spent unnecessarily on sophisticated studies (such as those centred on phytoplankton) that in retrospect appear to have been of marginal importance. Mitigation measures and plant design modifications stemming from many of the studies undertaken have now run into many millions of dollars. It remains unclear who should pay for evaluations of environmental research and monitoring, and m what

basis they should do so. At Nanticoke, no provision was made for formal program evaluation, let alone who should pay for it.

After surveying the strengths and weaknesses of research and monitoring in terms of these ten evaluation criteria, the Nanticoke example illustrates both the difficulties and futility of trying to come to a conclusive evaluation. Unambiguous assessment seems beyond reach in the Nanticoke case, even though there is rich documentation, no apparent controversy, and a well defined set of program activities. A case in point is that the various persons consulted during the course of this study put differing emphasis on the issues outlined above. To some degree, determination of past strengths and weaknesses seemed to reflect the current purposes (explicitly or otherwise) of the person concerned, as well as the intentims of the evaluator. [78]

Reducing the Nanticoke story to a set of ten evaluation criteria does not imply universal agreement as to which of them is most important. Nor does this argue that the interpretation given to each criterion has some widespread legitimacy, nor indeed that consensus over the range of issues addressed is possible, or even desirable.

However, identifying a set of criteria does provide an opportunity for a systematic exchange of opinion and points of view about ways of improving a research and monitoring program for the purposes of policy and planning. This is important, as it seems the key to a cmstructive evaluation lies in the opportunity to weigh up alternative interpretations of incomplete information about the design, implementation, progress and broader effects of a program. [79]

Thus, a useful evaluation is me that uncovers problems initially unforseen or unimagined, provides an opportunity for reflectim among those involved with the program, and offers some basis for program initiatives to begin afresh. To see evaluation as a witch-hunt for apportioning **blame**, an opportunity for debunking apparent success, or a soap-box for preaching about what should have been dme but wasn't, seems as futile as it is irrelevant to improving environmental management.

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[78] This finding is confirmed in the literature. See for example, David R. McCallum, 'Follow-up to environmental impact assessment: learning from Canadian Government experience' Environmental Monitoring and Assessment (1987) 8:199-215; Paul Tomlinson and Samuel P, Atkinson, 'Environmental audits: a literature review' Environmental Monitoring and Assessment (1987) 8: 239-261.

[79] The notion of using evaluation frameworks to generate creative and useful policy discussion has been proposed by my, See for example, Barclay Hudson, Martin Wachs and Joseph 1. Schofer, 'Local impact evaluation in the design of large scale urban systems' Journal of the American Institute of Planners (1974) 40: 255-265; Anne M. Van Meyel, 'Approaches to strategic monitoring: a case study approach' Geoforum (1979) 10: 389-405; Beanlands and Quinker, op. cit.; Kravetz, MacDonald and Nichols, op. cit.; H.W. Calkins, 'The Planning Monitor: an accountability theory of plan evaluation' Environment and Planning A (1979) 11: 745-758; M. Kravetz and W. R, MacDonald, A review of the effectiveness of social impact monitoring and management approaches in Canada, Ottava: Canadian Environmental Assessment Research Council.

The ten evaluation criteria generated in this attempt to evaluate Nanticoke research and monitoring serve also to provide a point of departure for further investigation. Three strategies for further research appear fruitful. Each centres on the role of informatim in pol icy and planning. The first would involve comparative study of other research and monitoring programs associated with major industrial *centres*, such those associated with oil development in the Scottish Shetland Islands. This approach offers the possibil ity of checking the general applicability of the summary criteria that appeared important in the Nanticoke case, as well as a chance to examine further the research approach used to ident ify such criteria.

The second strategy would strive to attain a better understanding of the Nanticoke situation through more detailed evaluation of the role of research and monitoring in federal, provincial, regional and municipal planning. This could focus on comparing the different points of view among those involved in generating environmental information and those who strive to make use of it in pol icy and planning.

A third strategy would shift attent im away fran specific case studies of environmental monitoring towards a more expl icit invest igatim of the use of informatim and communicatim in policy cmtexts. This could involve using the Nanticoke example as a starting point for in-depth interviews with experienced 'information-handlers' such as pol iticians or publ ic interest advocates and 'communicat im experts' such as Journalists or public relatims men. The purpose of this would be to construct models of hou informatim is used in pol icy cmtexts. These models could then serve as templates for comparing and cmtrast ing further examples of environmental monitoring for purposes of pol icy. This could lead to the development of guidelines for the design of environmental mmitoring systems that remain relevant and useful in policy cmtexts over the long term.

The central theme of these research propositions centres m finding ways to improve planning programs by furthering understanding of how information is created and used for purposes of policy and evaluation of policy. At this point, it is worth cmsidering just what cmstitutes environmental informatim and what does not? What is the basis for defining what it cmstitutes environmental information and what does not? Who defines this? fire definit ims of informatim 1 ikely to change over time? How does environmental information trigger actim in policy and planning7 What is the role of information in the pol icy process?

The 'in format ion' referred to in these questions seems critical not only to mcnitoring the ongoing effectiveness of policy and planning, but also to undertaking practically useful evaluat ims of individual programs. Better appreciat im for these quest ims, and for possible answers, it seems, may lead to improvements in the design, implementation, monitoring and evaluation of environmental pol icies and programs.

It seems apparent that the concepts of 'information' and 'communication', or the 'soc ial processing' of that information, warrant closer consideration. Those who have investigated the concepts cmc lude that although what const itutes environmental information appears intuitively obvious, in

practical terms the concept is sl ippery and difficult to pin down. They argue that the most promising *way* of understanding the use and misuse of information (however defined> in policy contexts is to cmsidw information as intimately 1 inked to 'communication'. By communicat icn, they do not refer simply to an act of utterance that 'transfers' informatim through a kind of cmduit from me **persm to another,** but to a relentlessly repeating process that simultaneously brings together informatim, utterance and understanding at every instant.[80]

In this sense, informat im is not some well def ined mtity or material that can be transferred without distortion from me person to another or to many. Rat her, communication **is** cmceived as an ongoing process by which individuals and societies inform themselves about what is happening around them (and within them).

This view of information-communicat im **appears to** be buttressed by considerable ethnographic, psychological and philosophical argument and evidence. Yet, where environmental research and monitoring programs have aimed to improve planning, those involved typically treat in format im as a politically neutral and tangible commodity that can be rationally used to make better policy and plans for contending with the future.[81]

Thus, there **appears to** be a contradiction between recent theory of in**format** ion-communicat ion (information as mgoing social process of learning, defining, understanding> and the creation and use of environmental information in research, monitoring and planning contexts (informat im as neutral commodity to be transferred>. If this is so, then what are the impl icatims of the race to adopt informat im technologies for efforts to improve environmental management and planning?[82]

In order to offer answers to these kinds of questions, it would seem necessary to examine case examples of del rberate attempts to use environmental information for the purposes of policy and planning. Perhaps, improved pol icy and planning will stem not from improved 'channels of communication' or 'more comprehensive data', but from a better appreciation for how those involved in

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80 See for example, George Steiner, After Babel: aspects of language and translation (London: Oxford University Press, 1975); Amos Hawley, Human Ecology: a theoretical essay (Chicago: University of Chicago Press, 19%); Niklas Luhmann, Ecological Communication (London: Polity Press, 1989).

81 See for exaqle, Clifford Geertz, The Interpetation of Cultures (New York: Basic Books, 1973); Jurgen Habermas, Communication and the Evolution of Society (Boston: Beacon, 1979); E. Castle, Information, Communication and the Policy Process (Washington D.C.: Resources for the future, 1983); Edward T. Hall, The Dance of Life: the other dimension of time (New York: Anchor Press, 1984); Donald A. Schon, 'The Conduit Metaphor: a case of frame conflict in our language about language' In Andrew Ortony (ed.) Metaphor and Thought (Cambridge: Cambridge University Press, 1986); Edward Herman and Noam Chomsky, Manufacturing Consent: the Political Economy of the Mass Media (New York: Pantheon Books, 1988); Herbert Sim, Models of Thought Volume II (New Haven: Yale University Press, 1989).

82 There is a growing literature on this topic, see for example Bryan Glastonbury, Walter LaMendola, and Stuart Toole (eds.) Information Technology and the Human Services (Chichester: Wiley, 1988); Ruth Finnegan, Graeme Salaman and Kenneth Thompson (eds.) Information Technology: social issues (London: Hodder and Stoughton in association with the Open University, 1987).

environmental management programs conceive of information and communication. Industrial projects such as Nanticoke or programs such as Remedial Action Planning in the Great Lakes Basin offer an opportunity to investigate this proposition further through case study oriented research. This might centre on four practical questions that seem pertinent:

1. What do people need to know? Why?

2. What do people know?

3. How do they get their knowledge?

4. What people are we concerned with in 1 to 3? Why?

Considerable research experience suggests that such questions can be tackled with the aid of ethnographic techniques of interviewing and observation. These involve a more rigorous, systematic and in-depth interviewing of key informants than undertaken during the course of study described in this report.[83]

In sum, the goal of my investigation of Nanticoke has not been the construction of some unambiguous or universally persuasive evaluation of the research and monitoring program. Rather, what has been important throughout, at least to me, is furthering understanding of issues connected with the very process of evaluation of major research and monitoring programs. On reflection, it is this kind of sentiment that prompted me to refocus my attention during the course of the study from a preoccupation with what is known about the functioning of environmental protection at Nanticoke, to an interest in how and why it is known. Perhaps, this led me also to pose the more practically orientated questions about what constitutes environmental information, how it is 'processed' during environmental management activities, and how this might be affected by the introduction of various information technologies.

In this study, I have tried to explore the strengths and weaknesses of a major Canadian research and monitoring program in terms of its usefulness for policy and planning. In addition, I have tried also to draw attention to how I went about undertaking this task by iteratively asking questions of people, documents and myself. At the outset, the study began with two questions: (1) how might we evaluate research and monitoring programs for environmental protection? and (2) How might evaluation of such programs be improved? It has ended up by posing yet more questions about the role of information and communication in environmental management.

This process of asking progressively more focussed questions has convinced me that what counts in research is the development of a deep understanding of the

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[83] James P. Spradley, The Ethnographic Interview (New York: Holt, Rinehart and Wilson, 1979); James P. Spradley, Participant Observation (New York: Holt, Rinehart and Wilson, 1980); Oswald Werner and G. Mark Schoepfle, Systematic Fieldwork: ethnographic analysis and data management, 2 Values (Beverly Hills: Sage, 1987); J. Eyles and D.M. Smith (eds.) Qualitative Methods in Human Geography (Cambridge: Polity Press, 1988); Burgess, op. cit.

questions posed (to what extent are they useful, legitimate and relevant?>. Whatever 'answers' there might be follow as corollaries of this insight into the real nature of the questions. In this way, the research approach adopted in this study represents merely a systematic and disciplined attempt to ask progressively sharper quest ims about what we know, what we don't know and what we thought we knew - not a search for ultimate, mduring and universal answers about how environmental management should or should not proceed. This approach cm help improve environmental management by providing a basis for more enlightened discourse and dialogue ammg those involved.

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APPENDIX 1

PERSONS INTERVIEWED

Mr. Charles A. Bigenwald, Ministry of Health (09.05.1989).

Mr. Harry Barrett, citizen (19.05.1989).

Dr. Ron D. Cameron, Texaco Inc. (19.05.1989).

Dr. Douglas Dodge, Ministry of Natural Resources (12.05.1989).

Mr. Hugh Eisler, Stelco Inc. (11.05.1989).

Dr. W. Ray Effw, Ontario Hydro (09.05.1989).

Dr. John H&rings, Ministry of Environment (08.05.1989).

Mr. N. Krishna Krishnanurthy, Ontario Hydro (09.05.1989).

Dr. Marius Lusis, Ministry of Environment (12.05.1989).

Mr. Gordon Miles, Regional Municipality of Haldimand-Norfolk (14.07.1989).

Dr. J. Gordon Nelson, University of Waterloo (17.05.1989).

Mr, Nigel Richardson, planning consultant (11.05.1989).

APPENDIX 2

EXAMPLE OF LETTER SENT TO THOSE INTERVIEWED

SCHOOL OF URBAN AND REGIONAL PLANNING
UNIVERSITY OF WATERLOO
ONTARIO N2L 3G1

Tel: (519) 747-0394

Fax: (519) 888-1211

Mr. H. Eisler
c/o Stelco
P. O. Box 2030
Ontario L8N 3T1

April 10, 1989

Dear Mr. Eisler:

I am writing to ask you to participate in a Canadian Environmental Assessment Research Council (CEARC) study which is investigating the design, implementation and monitoring of institutional arrangements for environmental protection. By institutional arrangements, I refer to (1) legislation, policies, regulations, agencies, public and private interest groups; (2) non-statutory mechanisms for management, such as informal and formal agreements, procedures and contracts; (3) coordination or other implementation arrangements, such as joint planning or management committees involving several agencies and groups (4) formal and informal declarations or designations of jurisdiction, responsibility, and goals.

As part of the study, I am examining the system of institutions and regulations which was put in place over a decade ago to protect the environment around the Nanticoke industrial complex on Lake Erie's north shore. I am doing this through a series of interviews with persons who participated in a 1980 Economic Council of Canada study which assessed the regulatory system at the Nanticoke industrial complex.

My purpose in interviewing those involved in the initial implementation of the environmental protection system over a decade ago is to secure their views and insights on the changes in institutions, policies, plans and regulations that have *occurred* at Nanticoke.

Please find enclosed a copy of the research proposal for my study. The specific goals *are as* follows:

(1) to provide a contemporary review of environmental protection at Nanticoke in terms of environmental, political, social and economic changes predicted during the planning of the Nanticoke complex;

(2) to explore how and why institutional arrangements for environmental protection have changed since their inception in relation to each

interviewee's understanding of environmental, economic, social and institutional change at Nanticoke;

(3) to examine to what extent changes in institutims, plans, policies. regulations, and management practices have been prompted by the findings of environmental monitoring and scientific studies;

(4) to consider how to monitor changes in institutims, plans, policies and regulations associated with mvirmmental protection in a way that might complement biophysical, ecmunic, and social impact monitoring.

As this research follows on from the Economic Council of Canada study of environmental regulatims at Nanticoke, I also enclose a summary of that study.

I am studying for a doctoral degree at the School of Urban and Regional Planning, University of Waterloo. My research centres on improving the design, evaluatim and monitoring of institutimal arrangements for environmental protectim. I am especially interested in how govern-t agencies, industry and citizens can contribute to improving post project assessment and monitoring of environmental costs and benefits.

I hope that you will agree to be interviewed as part of this study. I would also 1 ike to discuss how me might most usefully go about evaluating institutions, regulatims, pol icies and plans for environmental protection associated with major industrial developments, such as those at Nanticoke. In this cmtext, I would like to ask your advice as to other possible case studies which might illuminate the advantages and disadvantages of different institutional arrangements for environmental protection. I will telephone in the next few days to arrange an appointment.

Yours sincerely,

Rafal Seraf in

Enclosures:

1. Proposal to CEARC for a study entitled: "Monitoring Institutional Arrangements for Environmental Protection in Environmental Impact Assessments: the case of the Nanticoke Industrial Complex, Ontario.

2. Executive summary of 1980 Economic Council of Canada Report on "Environmental Regulatim of the Nanticoke Industrial Complex";

3. A paper by J.G. Nelson, J.C. Day and S. Jessen entitled "Regulation fcr Environmental Protection: the Nanticoke Industrial Complex, Ontario, Canada";

4. A table 1 isting institutions and regulations relevant to environmental protection at Nanticoke in 1980.

Note: refer to bibliography for items 2 and 3.

MONITORING INSTITUTIONAL ARRANGEMENTS FOR ENVIRONMENTAL PROTECTION IN ENVIRONMENTAL IMPACT ASSESSMENTS: the case of the Nanticoke Industrial Complex, Ontario

A Proposal to the Canadian Environmental Assessment Research Council (CEARC)

Rafal Serafin

PhD. Candidate,
School of Urban and Regional Planning, University of Waterloo

BACKGROUND: The core of the $5 billion Nanticoke industrial complex on Lake Erie's north shore comprises a Stelco steel plant, a Texaco refinery, and an Ontario Hydro thermal generating station. In addition, the complex contains an industrial park with over 70 sites. Townsend new town was built nearby to house those working in the complex.

In the twenty-one years since Ontario Hydro first announced plans to build a generating station, a multitude of studies have been undertaken to assess and monitor environmental impacts stemming from the Nanticoke development.

A Nanticoke Environmental Committee (NEC), comprising representatives of government and industry, coordinated much of this research. The initiative to assess environmental impacts spanned nearly 15 years, involved dozens of researchers and cost many thousands of dollars. It led to the development of some innovative institutional arrangements which promised much for environmental protection of the Nanticoke region and its environs.

PURPOSE: This research focuses on furthering understanding of institutional processes relevant to environmental protection and monitoring. At Nanticoke, a large number of agencies and organizations with a variety of mandates are engaged in the ongoing task of environmental protection and monitoring. There is a bewildering array of interorganizational arrangements, mandates and legislative control across a multitude of jurisdictions. Such dynamic sets of interconnected institutional arrangements have been referred to as 'organizational ecosystems'.[1]

The proposed research is to examine institutional arrangements of Nanticoke in relation to post-project environmental assessment and monitoring.

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[1] Francis, G. (1987) Toward Understanding Great Lakes 'Organizational Ecosystems', J. Great Lakes Research 13(3):233.

Specifically, the research comprises three objectives: (1) To provide a contemporary review of the system of environmental protection in the Nanticoke Region which stemmed from extensive environmental assessments during the seventies; (2) To explore how and why institutional arrangements for implementing environmental protection at Nanticoke have changed since their inception; (3) To propose an approach for monitoring change in institutional arrangements associated with environmental protection. Such an approach might serve to complement biophysical, economic and social impact monitoring.

NEED: During their initial stages, Environmental Impact Assessments often involve a lively mix of government agencies, public interest groups, and industrial proponents. Typically, there is also a large measure of controversy, scientific research, media attention and public debate. This often centres on regulatory responsibilities and monitoring arrangements.

Although comprehensive audits of systems of environmental protection *are* often recommended, once a project has been allowed to proceed, few such opportunities are pursued. Even when these are undertaken, the focus is on reassessing biophysical, social or economic impacts. Changes in institutional arrangements and associated modifications of regulatory and monitoring efficacy are seldom considered relevant to post-assessment monitoring.

Improvements in institutional arrangements have been frequently proposed in efforts to improve assessments of impacts and the usefulness of monitoring.[3] In contrast, mechanisms for post-project monitoring of the institutional arrangements themselves have been seldom proposed.

Following a review of social impact assessments, some have proposed principles of 'proper organizational arrangement' for

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[2] See for example MacLaren, V. and J. Whitney (eds.)(1985) New Directions in Environmental Impact Assessment in Canada, Toronto: Methuen.

[3] See for example Bankes N. and A. Thompson (1980) Monitoring for Impact Assessment and Management, A study prepared for the Economic Council of Canada by the Westwater Research Centre, University of British Columbia; or Munro, D., Bryant, T, and A. Matte-Baker (1986) Learning from Experience: A State-of-the-Art Review and Evaluation of Environmental Impact Assessment Audits, A Background Paper Prepared for CEARC.

sustainable post-project monitoring.[4] These included the following: (1) responsibility must match authority; (2) the structure must recognize interdependencies among the various agencies involved; (3) responsibilities assigned to the monitoring organizations should match their informational, technical and financial resources; (4) their must be mechanisms for ensuring continuity of professional and technical support; (5) the design must fulfil1 ritualistic obligations.

The proposed research intends to examine the relevance of these principles to the understanding of how changes in institutional arrangements for environmental protection might exacerbate or mitigate impacts. This might contribute to improving the effectiveness of post-development evaluations of environmental, economic and social impacts.

With reference to the Nanticoke situation, the research proposed here might shed light on important questions such as:

(1) What have been the successes and failures of environmental protection associated with persistence or change in institutional arrangements?

(2) To what extent do changes in institutional arrangements respond to environmental change detected?

(3) Do they do so effectively, efficiently and equitably?

(4) Should monitoring of institutional arrangements be an integral part of post-assessment monitoring of environmental impacts?

(5) If so, how might it be done and who should be responsible for it?

The proposed research will likely contribute directly to the following CEARC priority areas of research: monitoring protocols, cumulative effects assessment, EIA management and decision-making, post-development evaluation, and improvements in administrative procedures.

METHODS: During the seventies, the Economic Council of Canada sponsored a study to examine environmental regulations at the Nanticoke complex. Institutional arrangements that existed prior to and following the initial phase of industrial development were

[4] Kravetz, N., MacDonald, W. and P. Nichols (1987) A Framework for Effective Monitoring, A Background Paper Prepared for CEARC.

comprehensively documented and analyzed.[5]

The research proposed here will use the analytical framework and methods developed in that study. These included (1) a review of information contained in government and industry reports; (2) a survey of opinions obtained through interviews with government, industrial and interest group representatives; (3) analysis of changes *in* federal, provincial and municipal legislation and regulations.

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June, 1988

[5] Nelson, J. G., J. C. Day, and S. Jessen (1980) . Environmental Regulation of the Nanticoke Industrial Complex, Working Paper No. 7, Economic Council of Canada.

APPENDIX 1

MANTICORE ENVIRONMENTAL PROTECTION REGULATORY SYSTEM - 1980

FEDERAL

Agency	Legislation	Permit	Comments
Department of Environment (DOE)	Canada Wildlife Act (1973) Wildlife Area Regulations	Permit	Control removal or deposit of substances in National Wildlife Areas.
	Clean Air Act (1970) Amended 1972		Gives DOE authority to set national air quality objectives and emission standards. Provides for regulation of composition of fuels. Provides for agreements with Provinces to combat air pollution.
	Environmental Assessment and Review Process (EARP) Administrative		Provides the Minister with the authority to establish a process requiring environmental assessments of federal projects, programs and activities before commitments or irrevocable decisions are made.
	Environmental Contaminants Act (1975)		Gives power to the federal government to gather information on substances that may be contaminating the environment and to apply appropriate control over the substance if other legislative authority does not exist.
	Canada Water Act (1970)		Great Lakes Shoreline Management and Damage Reduction. Flood Damage Reduction Programs.
	Migratory Birds Convention Act (1975)	No preventive measures, only fines.	Prohibits deposit of oil, oil waste or any other substance harmful to migratory birds in any waters or area frequented by migratory birds.
Department of External Affairs	International Boundary Waters Treaty (1909)	Permit required for actions affecting Great Lakes Water levels.	Established IJC to review activities which influence boundary waters. Through Levels Control Boards manages water control strictures. Through Water Quality Boards and federal, state and provincial agencies conducts studies and produces reports and recommendations.
Department of Fisheries and Oceans	Fisheries Act Amended 1970; Petroleum Refinery, Liquid Effluent Regulations and Guidelines (1973)		Administered by MNR and MOE in Ontario. No alteration of fish habitat without approval. Authority to pass regulations controlling deposit of deleterious substances. Administered jointly by federal and provincial governments for both fish management and habitat protection.
Department of Public Works	Public Works Act (1970)		Carry out dredging for MOT. Must obtain permit from MOT and MNR. All dredging subject to EARP. Erosion control program in navigable waters to correct problems induced by federal coastal facilities or by commercial navigation.
Department of Regional and Economic Expansion	Agricultural and Rural Development Act	Financial assistance	Special agreements with Ontario government for construction of dykes on north Lake Erie shore to protect farmland from flooding.

Ministry of Transport	Navigable Waters Protection Act (1970)	Navigable waters wor permit	Any work which interferes with navigable waters requires permit. Prohibits deposits which might obstruct navigation.
	Canada Shipping Act (1971 Amendments and Regulations)		Control of discharges to air and water from ships.

PROVINCIAL (ONTARIO)

Agency	Legislation	Permit	Comments
Ministry of Agriculture and Food	Drainage Act		Provides for the construction of drainage works on water courses and the drainage of lands including shorelands. Drainage works may undergo EIA if requested and MAF and MNR may comment on proposals.
	Agricultural Rehabilitation and Development	Financial assistance	Authorizes Minister to enter into agreements with the federal government for projects relating to agricultural land protection and development such as drainage and other remedial works.
Ministry of Environment	Ontario Resources Act (ORRA) Amended 1970	Certificates of Approval for: 1. municipal and industrial sewage treatment work 2. potable water treatment systems. Permit to take water.	Provides authority for Minister to obtain an injunction; fine and imprison anyone causing pollution to a lake, river or stream (s. 31); Provides authority for the Minister/Director to regulate the discharge of sewage (s.33 and 42); Provides authority for regulating the taking of water (s.3 and 37).
	Environmental Protection Act	Certificates of Approval for: 1. a plant or process that results in emissions to the air, 2. for waste disposal sites	Provides authority for the Minister to regulate the discharge or deposit of waste and structures on ice over water (s.26a) Provides authority for the regulation of waste disposal sites and systems (s.29, 30, 31, 40, 41, 42, 59). Provides authority for the use of former waste disposal sites (s.40). Provides authority for the regulation of industrial processes which emit substances (including solid, liquid, gaseous, and noise) to the environment prior to the building and operation of such works.
	Environmental Assessment Act (EAA) (1975)	Approval of Environmental Assessment	Provides authority that all public undertakings (unless excluded by the Minister) and designated private undertakings, be subjected to an environmental assessment approved by the Minister before proceeding (s.3).
Ministry of Housing	Planning Act (1970)	Approval of amendments to official plans, bylaws and zoning orders. Approval of plans of subdivision.	Provides municipalities with the authority to make policy (official plan s.35). Provides for control of the division of land (consent S.29 and plan for subdivision S.33) by the Minister or delegated authority. Provides for the Minister to control land use (zoning order S.32). All the above measures are applicable to the land portion of the shoreland area, but not the water.

			land portion of the shoreland area, but not the water.
			Replaces 1970 Planning Act. Once OP is approved "no public work shall be undertaken and no bylaw should be passed for any purpose that does not conform therewith (s.23.4)"
			Defines matters of Prov. Interest and provides for Policy Statements. All local plans must conform with Regional Plan (s.27).
	Ontario Planning and Development Act (1971)		Provides authority for the Minister to define a development plan, and cause local official plan and zoning bylaws to conform with the development plan (s.2, 9, 10, 11, 13).
Ministry of Natural Resources	Public Lands Act (1970)	Land Use Permit Licence of Occupation Lease or Freehold Patent	Provides the Minister with authority on public lands of Crown to plan for, dispose by grant, lease, licence or sale, (s.14, 18, and 23), licence water lots (s.45), reserve 25% of shorelands for public use (s.3) and enter into beach management agreement with municipalities (s.47).
	Beds of Navigable Rivers Act (1969)		Reserves the beds of navigable waters to the Crown (s.1).
	Lakes and Rivers Improvement Act (1970)	Permit for Alteration	Provides the Minister with authority to preserve natural amenities of waters and shores and regulate improvements on lakes and rivers (s.1a, 2, 6, 10, 29, 36).

	Beach Protection Act (1970)	License to take sand	Provides the Minister with authority to licence and regulate the removal of sand from shorelands (beaches and beds of waters) for commercial purposes (excludes extraction for municipal and private purposes).
	Conservation Authorities Act (1970)	Flood and Fill Permit	Provides authority for a Conservation Authority to construct dams and create reservoirs, control the flow of surface waters, alter watercourses (s.20).
			Provides authority for a Conservation Authority to make regulations (subject to the approval of the Lieutenant Governor in Council) regulating the use of water in rivers and lakes, regulating changes in watercourses, regulating construction the placing of fill in areas subject to flooding (s.27).
Ontario Municipal Board (OMB)	Ontario Municipal Board Act (1970) Planning Act Municipal Act (1970)		This administrative tribunal is responsible for: 1. the approval of matters under the Planning Act, including zoning bylaws (s.35), redevelopment plans (s.22), committee of adjustment and subdivision plans upon referral by the Minister of Housing (s.15, 17 and 33), and 2. municipal boundary revisions- amalgamations or annexations under the Municipal Act (s.12-14, 17-21, and 25).
Ministry of	Shoreline		Loan money for

	Municipal Act	Approval of plans of subdivision	
City of Nanticoke	Municipal Act Nanticoke District Plan Regional Municipality of Haldimand Norfolk Act	Building permits	Develop District Plan which is implemented by specific re zonings or bylaw amendments, subdivision approvals, agreements, and site plan controls.
Long Point Conservation Authority	Conservation Authority Act Fill, Construction, Alteration to Waterways Regulation	Flood and Fill Permits	See under MNR.

BINATIONAL

Agency	Legislation	Permit	Comments
International Joint Commission	Great Lakes Water Quality Agreement (1972, 1978)		1972: emphasized control of pollution from point sources, especially correction of municipal pollution and development of industrial pollution control requirements by 1975. 1978: increased emphasis on control of pollution from diffuse non-point sources which may be atmospheric or land based.

FEDERAL-PROVINCIAL

Agency	Legislation	Permit	Comments
	Canada-Ontario Accord for the Protection and Enhancement of Environmental Quality		Broad umbrella for federal-provincial action in environmental control programs. Canada and Ontario undertake to carry out pollution control programs for facilities under their respective controls to meet agreed objectives and federal and provincial requirements. Ontario accepts water quality objectives set for boundary water and implements programs and measures to achieve objectives of Canada-U.S. agreement falling within provincial jurisdiction.

FEDERAL/PROVINCIAL/INDUSTRY

Agency	Legislation	Permit	Comments
DOE, MOE, MNR, Stelco, Hydro, Texaco	Nanticoke Environmental Committee (NEC) (1967)		Research committee established to study and monitor changes in the aquatic environment resulting from the Nanticoke development.
	Nanticoke Environmental Management Program (NEMP) (1974)		Research committee established to study and monitor changes in air quality resulting from the Nanticoke development.

These tables are taken from Sabine Jessen (1980) 'An Assessment of Great Lakes Shore Management: Regulation of the Nanticoke Industrial Complex, Lake Erie, Ontario' MA Thesis, Waterloo: University of Waterloo.

APPENDIX II

NANTICOKE ENVIRONMENTAL PROTECTION REGULATORY SYSTEM - 1989

FEDERAL

Agency	Legislation	Permit	Comments
Department of Environment (DOE)	Canada Wildlife Act (1973) Wildlife Area Regulations	Permit	Control removal or deposit of substances in National Wildlife Areas.
	Canadian Environ. Protection Act (1988)		Repeals and replaces the Clean Air Act and parts of Water Act, Environmental Contamin. Act and Ocean Dumping Control Act. Sets out environmental quality objectives, guidelines, codes of practice, incl. gathering of data. Designates toxic substances and lists control priorities. Gives powers to regulate toxic substances incl. fuels.
	Environmental Assessment and Review Process (EARP) Administrative		Provides the Minister with the authority to establish a process requiring environmental assessments of federal projects, programs and activities before commitments or irrevocable decisions are made.
	Canada Water Act (1970) Amended 1985, 1988		Great Lakes Shoreline Management and Damage Reduction. Flood Damage Reduction Programs. Part III repealed and replaced by Canada Env. Protection Act (1988)
	Migratory Birds Convention Act (1975) Amended 1985 and 1988	No preventive measures, only fines, but enforces strict liability of	Prohibits deposit of oil, oil waste or any other substance harmful to migratory birds in any waters or area frequented by migratory birds.
	Migratory Bird Regulations.	Mig. Bird Reg.	
Department of External Affairs	International Boundary Waters Treaty (1909) Amended 1977	Permit required for actions affecting Great Lakes Water levels.	Established IJC to review activities which influence boundary waters. Through Levels Control Boards manages water control strictures. Through Water Quality Boards and federal, state and provincial agencies conducts studies and produces reports and recommendations.
Department of Fisheries and Oceans	Fisheries Act Amended 11 times 1970-1988 Petroleum Refinery, Liquid Effluent Regulations and Guidelines (1973)		Administered by MNR and MOE in Ontario. No alteration of fish habitat without approval. Authority to pass regulations controlling deposit of deleterious substances. Administered jointly by federal and provincial governments for both fish management and habitat protection.
Department of Public Works	Public Works Act (1970)		Carry out dredging for MOT. Must obtain permit from MOT and MNR. All dredging subject to EARP. Erosion control program in navigable waters to correct problems induced by federal coastal facilities or by commercial navigation.
Department of Regional and Economic Expansion	Agricultural and Rural Development Act (1970)	financial assistance	Special agreements with Ontario government for construction of dykes on north Lake Erie shore to protect farmland from flooding.

Ministry of Transport	Navigable Waters Protection Act (1970)	Navigable waters wor permit	Any work which interferes with navigable waters requires permit. Prohibits deposits which might obstruct navigation.
	Canada Shipping Act (1952) Amended 1971; Regulations for Air Polln., Oil Polln., Garbage Polln., Polluting Substances (1978)		Control of discharges to air and water from ships. Air pollution rag (1978).

PROVINCIAL (ONTARIO)

Agency	Legislation	Permit	Comments
Ministry of Agriculture and Food	Drainage Act		Provides for the construction of drainage works on water courses and the drainage of lands including shorelands. Drainage works may undergo EIA If requested and CA and MNR may comment on proposals.
	Agricultural Rehabilitation land Development	Financial assistance	Authorizes Minister to enter into agreement0 with the federal government for projects relating to agricultural land protection and development ouch as dyking and other remedial works.
Ministry of Environment	Ontario Water Resources Act (OWRA) Amended 1970, 1981, 1983 1986	Certificates of Approval for: 11. municipal land industrial sewage treatment work 12. potable water treatment systems.	Provides authority for Minister to obtain an Injunction, fine and imprison Anyone causing pollution to A lake, river or stream (s. 31); Provides authority for the Minister/Director to regulate the discharge of sewage (8.33 And 42);
		Permit to take water.	Provides authority for regulating the taking of water (a.3 and 37).
	Environmental Protection Act (1971) Amended 7 times 1980-1988	Certificates of Approval for: 1. A plant OK process that results in emissions to the air, 2. for waste disposal sites	Provides authority for the Minister to regulate the discharge or deposit of waste end structures onice over water (s.26a) Provides authority for the regulation of waste disposalsites and systems (8.29, 30, 31, 140, 41, 42, 59). Provides authority for the use of former waste disposal sites (s.40). Provides authority for the regulation of industrial processes which emit substances (including solid, liquid, gaseous, and noise) to the environment prior to the building and operation of such works.
	Environmental Assessment Act (EAA) (1975)	Approval of Environmental Assessment	Provides authority that all public undertakings (unless excluded by the Minister) And designated private undertakings, be subjected to an environmental assessment approved by the Minister before proceeding (a. 3).
Ministry of Municipal Affairs	Planning Act (1983)	Approval of amendments to Official plans, bylaws and zoning orders. Approval of plans of subdivision.	Provides municipalities with the Authority to make policy (official plan s.17) Provides for control of the division of land (consent a.50 and plan for subdivision 8.52) by the Minister or delegated authority. Provides for the Minister to control landuse (zoning bylaw ● .30. All the above measures are applicable to the·

	Ontario Planning and Development Act (1973)		Provides authority for the Minister to define a development plan, and cause local official plan and zoning bylaws to conform with the development plan (s.2, 9, 10, 11, 13).
Ministry of Natural Resources	Public Lands Act (1970)	Land Use Permit Licence of Occupation Lease or Freehold Patent	Provides the Minister with authority on public lands and waters to plan (s.16), dispose by grant, lease, licence or sale, (s.14, 18, and 23), licence water lots (s.45), reserve 25% of shorelands for public use (s.3) and enter into beach management agreement with municipalities (s.47).
	Beds of Navigable Rivers Act (1969)		Reserves the beds of navigable waters to the Crown (s.1).
	Lakes and Rivers Improvement Act (1970)	Permit for Alteration	Provides the Minister with authority to preserve natural amenities of waters and shores and regulate improvements on lakes and rivers (s.1a, 2, 6, 10, 29, 36).
	Beach Protection Act (1970)	Licence to take sand	Provides the Minister with authority to licence and regulate the removal of sand from shorelands (beaches and beds of waters) for commercial purposes (excludes extraction for municipal and private purposes).
	Conservation Authorities Act (1970)	Flood and Fill Permit	Provides authority for a Conservation Authority to construct dams and [illegible] alter the flow of surface waters, alter watercourses (s.20). Provides authority for a Conservation Authority to make regulations (subject to the approval of the Lieutenant Governor in Council) regulating the use of water in rivers and lakes, regulating changes in watercourses, regulating construction the placing of fill in areas subject to flooding (s.27).
Ontario Municipal Board (OMB)	Ontario Municipal Board Act (1970) Planning Act Municipal Act (1970)		This administrative tribunal is responsible for: 1. the approval of matters under the Planning Act, including zoning bylaws (s.35), redevelopment plans (s.22), committee of adjustment and subdivision plans upon referral by the Minister of Housing (s.15, 17 and 33), and 2. municipal boundary revisions-amalgamations or annexations under the Municipal Act (s.12-14, 117-21, and 25).
Ministry of Treasury and Economics	Shoreline Property Assistance Act		Loan money for construction work on dykes, groynes etc...

REGIONAL/LOCAL

Agency	Legislation	Permit	Comments
Regional Municipality of Haldimand-Norfolk	Regional Municipality of Haldimand-Norfolk Act (1974) Planning Act Regional Official Plan	Building Permits. Approval of amendments to official plan, land zoning bylaws	Develop Regional Official Plan which sets out broad land use planning guidelines. Develop zoning bylaws.

Treasury and Economics	Property Assistance Act		construction work on dykes, groynes etc...

REGIONAL/LOCAL

Agency	Legislation	Permit	Comments
Regional Municipality of Haldimand-Norfolk	Regional Municipality of Haldimand-Norfolk Act (1974) Planning Act Regional Official Plan Municipal Act	Building Permits. Approval of amendments to official plan, land zoning bylaws. Approval of plans of subdivision	Develop Regional Official Plan which sets out broad land use planning guidelines. Develop zoning bylaws.
City of Nanticoke	Municipal Act Nanticoke District Plan Regional Municipality of Haldimand-Norfolk Act	Building permits	Develop District Plan which is implemented by specific re-zonings or bylaw amendments, subdivision approvals, agreements, and site plan controls.
Long Point Conservation Authority	Conservation Authority Act Fill, Construction, Alteration to Waterways Regulation amended 1985 Watershed Plan 1985	Flood and Fill Permits	See under MNR.

BINATIONAL

Agency	Legislation	Permit	Comments
International Joint Commission	Great Lakes Water Quality Agreement (1972, 1978) Amended 1988		1972: emphasized control of pollution from point sources, especially correction of municipal pollution and development of industrial pollution control requirements by 1975. 1978: increased emphasis on control of pollution from diffuse non-point sources which may be atmospheric or land based. 1988:

FEDERAL-PROVINCIAL

Agency	Legislation	Permit	Comments
	Canada-Ontario Accord for the Protection and Enhancement of Environmental Quality		Broad umbrella for federal-provincial action in environmental control programs. Canada and Ontario undertake to carry out pollution control programs for facilities under their respective controls to meet agreed objectives and federal and provincial requirements.
	Canada-Ontario Great Lakes Water Quality Agreement		Ontario accepts water quality objectives set for boundary water and implements programs and measures to achieve objectives of Canada-U.S. agreement falling within provincial jurisdiction.

FEDERAL/PROVINCIAL/INDUSTRY

Agency	Legislation	Permit	Comments
DOE, MOE, MNR, Stelco, Hydro, Texaco	Nanticoke Environmental Committee (NEC) (1967)		Research committee established to study and monitor changes in the aquatic environment resulting from the Nanticoke development.
	Nanticoke Environmental Management Program (NEMP) (1974)		Research committee established to study and monitor changes in air quality resulting from the Nanticoke development.

APPENDIX 3

FRAMEWORK FOR GUIDING INTERVIEW DISCUSSIONS

As a green field industrial development, Nanticoke is a clear *case* of planning for environmental protectim and monitoring. I'm interested in talking about the lessms (good and bad) we can draw from your experience with Nanticoke for improving contemporary environmental a s s e s - t, planning and monitoring.

1. What was your role in planning and management of the industrial development at Nanticoke?

2. Over what period were you involved? Are you still involved? If so, in what way?

3. What stands out in your mind today about the Nanticoke experience?

4. What would you say were some of the successes and failures of environmental protectim at Nanticoke? What were the ingredients that cmtributed to those successes or failures?

5. Wat would you have dme differently at Nanticoke, given hindsight?

6. What advice would you give to industry, government and citizens with respect to envirmmmtal protection and monitoring at green field developments such as Nanticoke?

7. Looking back over the past 25 years, me of the striking things is the changes in legislation, policy and management among the institut ims involved in envirmmmtal management and monitoring. What are the impl icatims of this state of affairs for industrial developments such as Nanticoke? Would it be important to monitor such institutimal changes?

8. To what extent have the cmtroversies encountered during the planning of environmental protection at Nanticoke remained relevant? These included (1) the dock; (2) the buffw zme and air pollutim; (3) involvement of the local publ ic (espec. cottagers); (4) growth of the industrial park; (5) water pollution impacts m Lmg Point. Do you feel these cmtroversies were technical? Or were they more to do with pol it ics, percept im and misin format ion?

9. What was the role of scimtific studies undertaken during the planning phase? Were they pivotal *or* incidental to the design and implementation of environmental protectim and monitoring?

10. Did policy drive the gathering of scientific informatim? Or did the scimtific information shape policy? Is the distinction an important me in your *view?*

11. Would you consider the Nanticoke Environment Committee (NEC) (water) and the Nanticoke Environmental Management Committee (NEMP) (air) to have been of critical importance in the planning phase? In what form do these committees exist today?

12. During the planning and cmstructim phases various stipulations for monitoring were made in the granting of permits? Were these requirements fulfilled?

13. What monitoring praedures are currently in place at Nanticoke? Do you have any studies, reports *or* references that describe what is currently being monitored?

14. Given that the environmental protection system at Nanticoke has undergone an evolution. How would you go about evaluating its successes and failures in order to improve its performance? How would you test the ongoing performance of an environmental protection system?

15. How does current industrial output and performance compare to initial aspiratims? How does the anticipated role of the Nanticoke plants compare to the realized role in current management, planning and forecasting?

17. On balance, do you feel optimistic or pessimistic about the future of envirmmental protectim and management along the north shore of Lake Erie?

18. What are the major challenges facing environmental protect ion at Nanticoke, today and in the future? How would you go about ensuring environmental protection at Nanticoke can meet those challenges?

19. Mould you be willing to review and comment critically on my report?

APPENDIX 4

NANTICOKE AIR MONITORING STATION NETWORK 1986

Map Ref.	Number	Location	Parameters Monitored
1	22057	Nanticoke Creek	F
2	22070	Nanticoke Village	DF
3	22071	Simcoe	SO_2, CH_x, O_3, NO,
4	22074	Texaco	F
5	22083	Dogs Nest	F
6	22086	Cheapside	SO_2, TRS, NO_x
7	22087	Jarvis	TSP
8	22090	Port Dover	TSP
9	22092	Rainham/Sandusk	TSP, DF
10	22093	NGS Flyash Area	DF
11	22094	Townsend	SO_2
12	22901	Long Point	SO_2, O_3, NO_x, Wind/Temp
13	22904	S. Walpole Schoool	SO_2 (OH), TSP, CH_x, TRS
14	22907	Nanticoke Village	SO_2, TSP, CH_x, TRS
15	22961	Nanticoke North	TSP, F
16	22964	Stelco North	TSP
17	22965	Dogs Nest/Hwy 6	TSP
18	22883	Jarvis Met. Tower (OH)	Wind/Temp
19	22908	Decewsville (OH)	SO_2
20	22910	Garnet (OH)	SO_2
21	22911	Balmoral (OH)	SO_2
22	22913	Nanticoke Road (OH)	SO_2
23	22914	Sandusk (OH)	SO_2
24	22915	Kohler (OH)	SO_2
25	22919	Peacock Point (OH)	SO_2

OH - operated by Ontario Hydro
TSP - total suspended particulates
CH_x - hydrocarbons
TRS - total reduced sulphur
O_3 - ozone
NO_x - oxides of nitrogen
DF - dustfall
F - flouride

SOURCE: Nanticoke Environmental Committee (1987) *1986 Air Quality Data Summary*, Hamilton: Ministry of Environment, West Central Region, pp. 4-5.